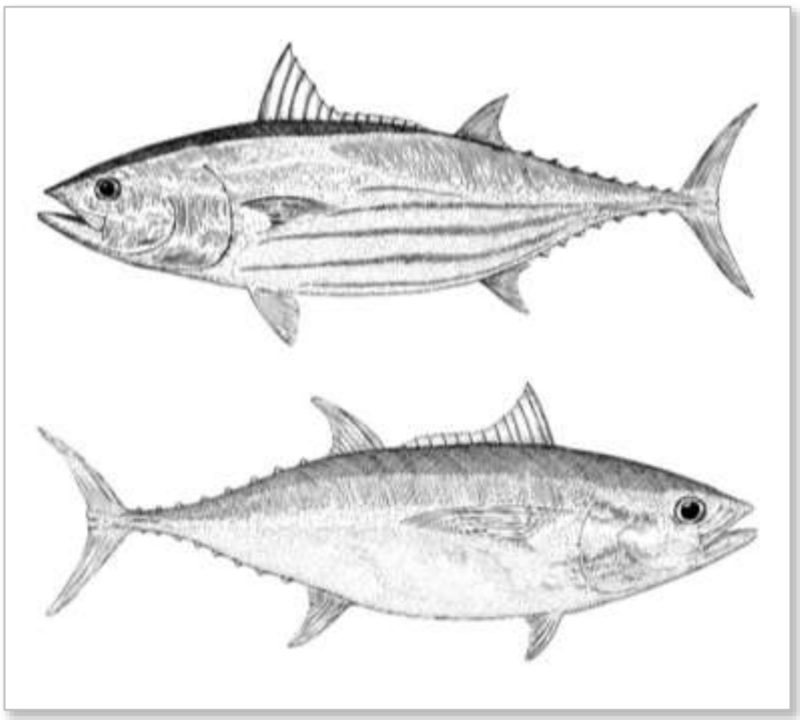
Annual Stock Assessment and Fishery Evaluation Report for U.S. Pacific Island Pelagic Fisheries Ecosystem Plan

2019



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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 bottomfishing.
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.
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 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).
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 Area
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). 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) 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 available information (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 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 essential fish habitat (EFH) provisions, and assessing the relative success of existing relevant state and Federal fishery management programs. The SAFE report is intended to serve as a source document for developing the FEP, amendments, and other analytical documents needed for management decisions.

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

Table ES-1. Fulfillment of National Standard 2 requirements within the 2019 annual SAFE report Pacific Island Pelagic Fishery 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 (ACL)	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 (BSIA)[2] on biological condition of stocks		NA
Condition of ecosystems	BSIA to assess success of FEP		3.3 + Ch. 4
Condition of EFH	Report on Review of available information; full review every 5 years	600.815(a)(10)	3.4
Socioeconomic conditions of fishery	BSIA to assess success of FEP		3.1
Socioeconomic conditions of fishing communities	BSIA to assess success of FEP		3.1
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 Federal Register 43067).

SUMMARY OF SAFE STOCK ASSESSMENT REQUIREMENTS

Many of the fish managed under the 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 Pacific Pelagic FEP. For the purposes of stock status determinations, NMFS will determine stock status of Pelagic MUS using the Status Determination Criteria (SDC) described in the Pelagic FEP.

For all pelagic management unit species (MUS), 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 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 EPO 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 2019, stock assessments were completed for the Western and Central Pacific Ocean skipjack tuna (Vincent et al., 2019), the Western and Central Pacific Ocean Oceanic Whitetip Shark (Tremblay-Boyer et al., 2019), and the Western and Central North Pacific Ocean striped marlin (ISC, 2019). Additionally, an indicator report was prepared for Eastern Pacific Ocean bigeye tuna (Xu et al., 2019) and a stock assessment update was produced for Eastern Pacific Ocean yellowfin tuna (Minte-Vera et al., 2019) prior to the benchmark stock assessment to be completed in 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 Pacific Pelagic Fishery Ecosystem Plan (Pelagic FEP).

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

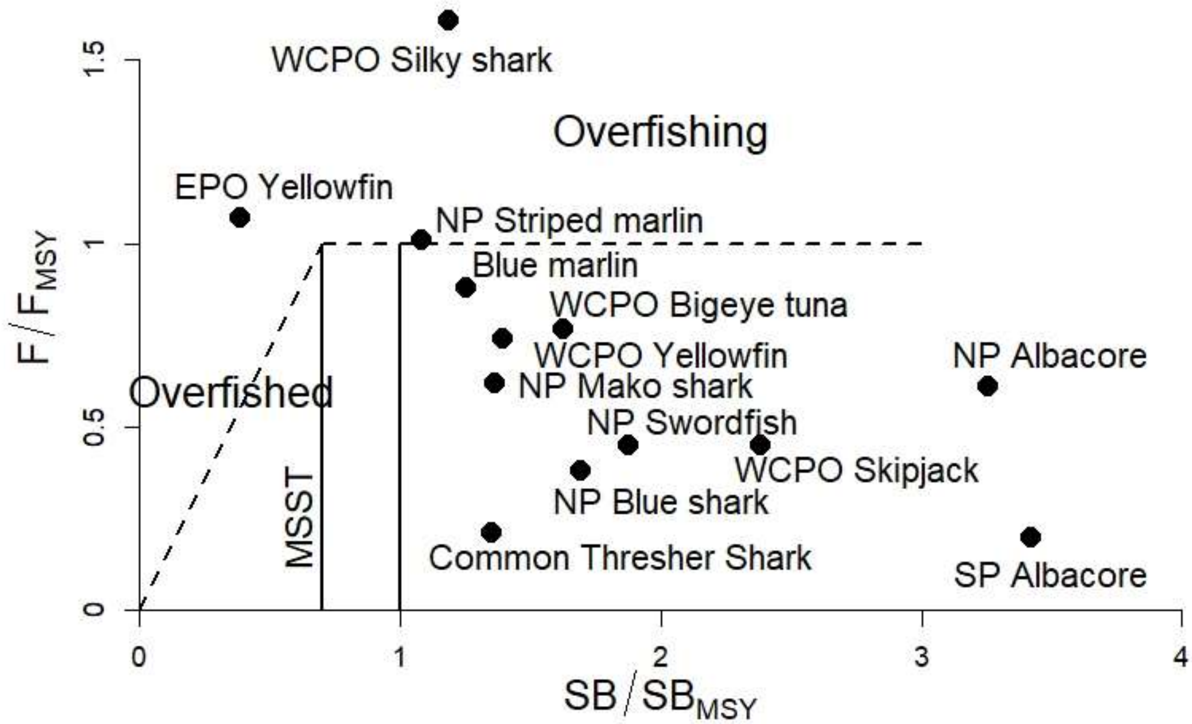


Figure ES-1. Specification of fishing mortality and biomass reference points in the Pelegic FEP and current stock status in the WCPO and EPO. Oceanic whitetip shark is not illustrated and overfishing is occurring and the stock is overfished. As of this publication, NMFS has not yet determined the stock assessment for WCPO silky shark to be the best scientific information available for the purpose of stock status determination

SUMMARY OF FISHERY DATA IN THE PACIFIC ISLAND REGION

Table ES-2. Summary of the total pelagic landings during 2019 in the Western Pacific and the percentage change between 2018 and 2019

Species	American Samoa		CNMI		Guam		Hawaii	
	Lbs.	% Change	Lbs.	% Change	Lbs.	% Change	Lbs.	% Change
Swordfish	8,128	-40.1	-	-	-	-	1,624,656	-30.3
Blue marlin	63,739	-11.0	3,855	+43.4	56,020	+129	2,334,992	+29.2
Striped marlin	3,509	8.50	-	-	-	-	1,237,575	+17.7
Other billfish*	8,263	89.7	0	-	1,459	-66.6	502,430	-7.43
Mahimahi	4,040	-63.1	71,791	+10.0	162,541	+83.0	1,000,348	-7.10
Wahoo	39,156	-43.0	2,448	-61.8	32,600	-66.1	1,590,729	+35.3
Opah (moonfish)	1,185	-57.2	-	-	-	-	2,255,204	-26.6
Sharks (whole wt.)	1,447	-84.9	0	-	0	0	114,745	-17.4
Albacore	2,232,098	-34.4	-	-	-	-	255,099	+6.93
Bigeye tuna	66,547	-43.4	-	-	-	-	17,758,157	+3.89
Bluefin tuna	476	-66.7	-	-	-	-	3,765	+221
Skipjack tuna	162,875	-7.91	345,172	-7.8	479,966	-21.4	828,335	+56.2
Yellowfin tuna	402,438	-31.3	36,473	+209	84,825	+61.4	5,952,433	-21.3
Other pelagics**	3,374	-9.01	6,530	+373	22,921	+55.9	1,070,353	-11.9
Total	2,997,275	-32.9	466,269	+0.3	840,332	-5.77	36,528,820	-3.46

Note: Total Pelagic Landings based on commercial reports or creel surveys; % change based on 2018 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 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.

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 ft., are required to fish beyond 50 nautical miles (nmi) from shore, and sell the majority of their catch, primarily albacore, to the Pago Pago canneries. In 2019, there were 17 active longline vessels, with nine vessels greater than 70 ft., five vessels between 50 and 70 ft., and three vessels shorter than 40 ft. Smaller longline vessels called alias (locally built, twin-hulled vessels about 30 ft. long, powered by 40HP gasoline outboard engines) can fish within 50 nmi 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 five boats that landed pelagic species in 2019. Recreational pelagic fisheries in American Samoa are less common.

Landings. The estimated annual pelagic landings have varied widely, from 2.9 to over 11 million lbs. since 2010. The total estimated 2019 landings were approximately 2.9 million lbs., the lowest in the past decade, which contributes to the declining trend since recent peak landings in 2010 (Figure 4). Pelagic landings consist mainly of five tuna species including albacore, yellowfin, skipjack, mackerel, and bigeye, which made up approximately 98% of the total estimated landings when combined with other tuna species. Albacore made up 77% 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 2019 (Table 13). In the longline fishery, 1.2% of the tuna caught were released. Bigeye and yellowfin were the most released bycatch tuna species, while sharks and oilfish had the highest numbers of non-tuna released fish accounting for 63% release of non-tuna species. In total, only 7% of all pelagic species caught were released in 2019. 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 Pelagic Management Unit Species (PMUS) and releases of some tuna.

Effort. There are currently 28 vessels known to be fishing in the waters of American Samoa according to federal logbooks collected. The 17 longline vessels that fished in 2019 made 114 trips (average 6 trips/vessel), deployed 1,695 sets, (99 sets/vessel) using nearly 4.8 million hooks (Table 5). The troll fishery conducted 170 trips that landed pelagic species.

Catch Rate. The total pelagic catch rate by all longline vessels decreased by 1.2 fish per 1,000 hooks in 2019 from the previous year. Non-tuna pelagic species also had a decrease in catch rate of 0.5 fish per 1,000 hooks. The longline catch rates for tuna species have fluctuated during the past decade ranging from 15 to nearly 22 fish per 1,000 hooks. Albacore catch rates also decreased this year by 1.9 to 11.6 fish per 1,000 hooks. Troll trips decreased by 13% and troll hours decreased by over 24% from their 2018 values. The average catch per troll hour for all pelagic species slightly increased from the previous year to 24 lbs./hour.

Revenue. In 2019, the total longline fleet revenue (estimated landed value) was $3.9 million, and albacore composed of over 89% of the total landed value. Other main species included yellowfin, bigeye, skipjack, and wahoo. The estimated value of the species landed were 7%, 1%, 2%, and 1%, respectively. Albacore had an estimated price of $1.61 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, with coverage for 2019 at 15.7%. 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 2019, 49 boats reported landing pelagic species, a decrease of 12.5% from the 56 boats in 2018.

Landings. Skipjack tuna is the principal species landed, comprising over 74% of the total estimated pelagic landings in 2019 based on expanded creel survey data. Skipjack estimated landings decreased by 7.8% in 2019 to 345,172 lbs., while total estimated landings slightly increased by less than 0.3% to 466,269 lbs. Landings of mahimahi and yellowfin tuna ranked second and third by weight of pelagic species landings in 2019 at 71,791 lbs.(10% increase from 2018) and 36,473 lbs. (209% increase from 2018), respectively. The amount of wahoo landed in 2019 substantially decreased from 2018 levels by nearly 62% to 2,448 lbs.

Effort. In 2019, the number of trips catching pelagic species from commercial receipt invoices increased 11.5% from 2018 to 2,457 trips. The number of estimated trips from expanded creel survey data decreased 23.8% from 4,203 trips in 2018 to 3,202 trips in 2019. Total estimated trolling hours similarly decreased in 2019 by 21.9% to 16,841 hours. Average trip length has remained steady over the last decade, maintaining between 5.1 and 5.7 hours per trip and slightly increasing in 2019 to 5.3.

Catch Rate. Average trolling catch rates increased nearly 30% from 21.5 lbs. per trolling hour in 2018 to 27.9 in 2019. The catch rate for skipjack, the primary target species in CNMI, also increased by over 18% from 17.3 lbs. per hour fished in 2018 to 20.5 lbs. per hour in 2019. Pounds caught per trip for skipjack however, decreased from 78 to 52. Yellowfin catch rate also increased in 2019 from its decadal low of 0.5 lbs. per hour fished to 2.2 lbs. per hour. The mahimahi catch rate increased by 40% to 4.2 lbs. per hour fished in 2019, and there was also an increase in the pounds caught per trip from 7.6 in 2018 to 8.4 in 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 2010 to 2019.

Revenue. Commercial revenues, based on the commercial receipts, were $464,101 in 2019, which was a decrease of 13% from estimated revenue in 2018. It was estimated that 38% of all pounds caught were sold. The average price per pound for tuna slightly increased from 2018 to 2019 to 2.61, ranging from $2.50 for saba to $2.60 for skipjack and $2.77 for yellowfin. Non-tuna PMUS had an average price per pound of $2.72.

Protected Species Interactions. There have not been any reported or observed interactions with protected species in the CNMI 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 472 boats involved in Guam's pelagic fishery in 2019, an increase of 18.6% from 2018. 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 of the pelagic group (approximately 5-10%) is made up of marina-berthed charter boats that are operated primarily by full-time captains and crews.

Landings. Estimated annual pelagic landings have varied widely in the available 35-year time series, ranging between 383,000 and 958,000 lbs. The average total catch has shown a slowly increasing trend over the reporting period. The 2019 total expanded pelagic landings were 840,332 lbs., a slight decrease of 5.77% when compared to 2018. Tuna PMUS landings were 564,886 lbs., while non-tuna PMUS were 252,702 lbs. 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. Sharks were also caught during 2019, as they were noted in specific fishermen interviews 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. If caught, sharks are usually 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 2019 from 2018 levels: Blue marlin increased 129%, yellowfin tuna increased 61.4%, and mahimahi, which accounts for the largest percentage of non-tuna PMUS landed on Guam, increased 83.0%. Skipjack tuna landings decreased 21.4% and wahoo landings decreased 66.1% in 2019 from 2018 levels.

The amount of transshipped fish has ranged from 1,898 mt to 2,411 mt between 2010 and 2014. Transshipment data from 2015 to 2019 are confidential due to fewer than three transshipment reporting agents.

Effort. In 2019, the number of trolling trips increased by 9.7% from 2018 levels, and hours spent trolling increased 10.2%. 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 2019 was 27, equaling 65 closure days, down from 107 closure days in 2018.

Catch Rate. Trolling catch rates (lbs. per hour fished) decreased 14.7% from 2018 to 2019. Yellowfin tuna, blue marlin, and mahimahi catch per unit effort (CPUE) increased, while skipjack tuna and wahoo CPUE decreased. The fluctuations in CPUE can likely be attributed to variability in the year-to-year abundance and availability of the stocks.

Bycatch. There is very low bycatch in Guam's charter fishery, which has zero reported releases in 2019. In Guam's non-charter fisheries in 2019, there were 150 reported bycatch in 7,484 fish caught, for a 2% rate, most of which were skipjack tuna. Bycatch occasionally occurs in the troll fishery including sharks, shark-bitten and undersized fish.

In 2019, fishers were asked if they experienced a shark interaction. There was a total of 789 interviews for boat based fishing in 2019, with 335 of these inappropriate for determining shark interaction. Of the remaining 454 interviews, 218 reported interactions with sharks, 236 reported no interactions with sharks, a 48% positive rate for interviews where fishers were asked about shark interactions.

Revenue. Commercial revenues slightly increased in 2019 with total adjusted revenues equaling to $312,708. Average fish price per pound was $2.25. Most troll fishermen do not rely on the catch or selling of fish as their primary source of income, and only 17% of total estimated pounds caught were sold. 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 and may have contributed to the decrease in commercial sales seen following 2002.

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.

Participation. A total of 3,124 fishermen were licensed in 2019, including 1,929 (62%) who indicated that their primary fishing method and gear were intended to catch pelagic fish. This is a 6% decrease in fishing licenses from the previous year. Most licenses that indicated pelagic fishing as their primary method were issued to longline fishermen (46%) and trollers (40%). The remainder was issued to ika shibi and palu ahi (handline) (14%).

Landings. Hawaii commercial fisheries caught and landed 36.5 million pounds of pelagic species in 2019, a decrease of 3% 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 87% (32.0 million pounds) of all pelagic fisheries. The shallow-set longline fishery targeted swordfish and its catch was 837,000 pounds, or 2% of the total catch. The Main Hawaiian Islands troll fishery targeted tunas, marlins and other PMUS, and caught 2.5 million pounds or 7% of the total. The MHI handline fishery targeted yellowfin tuna while the offshore handline fishery targeted bigeye tuna. The MHI handline fishery accounted for 675,000 pounds (2% of the total). The offshore handline fishery was responsible for 477,000 pounds or 1% of the total catch.

The largest component of the pelagic catch was tunas, which comprised 68% of the total in 2019. Bigeye tuna alone accounted for 72% of the tunas and 49% of all the pelagic catch. Billfish catch made up 16% of the total catch in 2019. Blue marlin was the largest of these, at 41% of the billfish and 6% of the total catch. Catches of other PMUS represented 16% of the total catch in 2019 with moonfish being the largest component at 37% of the other PMUS and 6% of the total catch.

Bycatch. A total of 144,677 fish were released by the deep-set longline fishery in 2019. 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 3% for targeted and incidentally caught pelagic species in 2019. A total of 3,286 fish were released by the shallow-set longline fishery in 2019. Sharks accounted for 94% of the shallow-set longline bycatch. With the exception for mako shark, there is almost no demand for sharks in Hawaii. Of all shark species combined, 97% of the shallow-set longline shark catch was released. Conversely, bycatch rate for the shallow-set longline fishery was 4% for targeted and incidentally caught pelagic species in 2019. 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 150 active Hawaii-permitted deep-set longline vessels in 2019, seven more vessels than the previous year, with 140 or more deep-set vessels in the past 5 years. The number of deep-set trips (1,724) and sets (22,513) were both deep-set effort records. The number of hooks set by the deep-set longline fishery reached a record 63.2 million hooks in 2019. The Hawaii-permitted shallow-set longline fishery operates mainly in the first half of the year. In 2019, 14 vessels completed 25 trips and made 284 sets, which was significantly lower effort for this segment of the fishery due to the closure of the fishery in March as a result of reaching the loggerhead sea turtle interaction limit. The number of hooks set by this fishery also decreased to 400,000 in 2019, a record low since the reopening of the shallow-set fishery in 2004. The number of days fished by MHI troll fishers has been trending lower from its peak in 2012, with 1,291 fishers logging 20,359 days fished around the MHI in 2019. There were 438 MHI handline fishers that fished 3,629 days in 2019, both at their lowest levels in the ten-year period. The offshore handline fishery had 7 fishers and 261 days fished in 2019.

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 (1.0) and albacore (0.1). CPUE of blue marlin and striped marlin for the deep-set fishery were low (0.2 and 0.3 fish per 1,000 hooks, respectively), while the CPUE for blue shark, a bycatch species, is second only to bigeye at 1.8 fish per 1,000 hooks. The Hawaii-permitted shallow-set longline fishery targets swordfish and had a CPUE of 9.8 fish per 1,000 hooks in 2019 followed by blue shark, a bycatch species of this fishery, with a CPUE of 8.5 fish per 1,000 hooks. The 2019 MHI troll fishery CPUE for yellowfin tuna was above the long-term average with blue marlin at a 10-year high CPUE. Mahimahi and ono CPUE were both above their long-term average in 2019. MHI handline CPUE for yellowfin, albacore and bigeye tuna were all below their long-term mean weights in 2019. Bigeye tuna CPUE for the offshore handline fishery increased from 2017 while yellowfin tuna decreased during the same time period.

Fish Size. The average weight for most tuna species caught by the deep-set longline fishery were close to their respective long-term weights in 2019. Bigeye tuna caught in the deep-set fishery was 79 lbs. in 2019, close to the long-term average. The size of swordfish was much higher from 2017 while marlins were below their respective long-term average weights in 2019. The mean weight of other PMUS and PMUS sharks were close to their respective long-term average weights. Swordfish caught by the shallow-set longline fishery was 217 pounds, well above 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 close to their long-term average in 2019. Troll and handline caught blue marlin was below its long-term mean weight.

Revenue. The total revenue from Hawaii's pelagic fisheries was $105.6 million in 2019, a decrease of 11% from the previous year. Bigeye tuna and yellowfin tuna represented 60% and 20% of the total pelagic revenue, respectively in 2019. The deep-set longline revenue was $92.9 million in 2019. This fishery represented 88% of the total revenue for pelagic fish in Hawaii. The shallow-set longline fishery decreased to $2.0 million and accounted for 2% of the revenue. The MHI troll revenue was $7.2 million or 7% of the total in 2019 and was followed by the MHI handline fishery at $2.2 million (2%). The offshore handline fishery was worth $1.0 million in 2019. The trend for revenue from the deep-set longline was increasing although it dropped 11% in 2019. Revenue for the shallow-set longline fishery was decreasing. The revenue from the MHI troll, MHI handline, and offshore handline fishery showed some variability and had no clear trend over the past ten years.

Protected Species Interactions. Protected species interactions are monitored in the Hawai`i-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 2019, there were 312 sets and 374,487 hooks observed in the shallow-set fishery. The low effort is attributed to the fishery closure 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. The shallow-set fishery had no observed interactions with cetaceans and one observed interaction with an unidentified seal in 2019. The level of mortality and serious injury for all marine mammal species being 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 low compared to past years due to the early closure of the fishery.

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 2019, there were 4,697 sets and 12,948,007 hooks observed in the deep-set fishery at 20.5% annual observer coverage. Interaction levels for several of the sea turtle species in recent years had exceeded the ITS in the 2017 supplementary Biological Opinion, and ESA reconsultation for the deep-set fishery is ongoing. Interactions with olive ridley sea turtles have remained high since 2016 compared to years prior. Marine mammal interactions in 2019 included one interaction with a rough-toothed dolphin, one with a Risso’s dolphin, 15 with false killer whales and one with an unidentified cetacean. 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. Monitoring of false killer whale interactions in the MHI Insular and Hawaii pelagic stocks is ongoing under the False Killer Whale Take Reduction Plan. 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. ESA-consultations for oceanic whitetip shark and giant manta ray are ongoing.

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 2019 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 meters 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 3.3.2 provides a description of each of these indicators, a 2019 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 2019. Non-fishing and cumulative impact components were reviewed from 2016 through 2017 (Minton, 2017), and habitat review for crustaceans in Guam and Hawaii was completed in 2019.

MARINE PLANNING

The Council recently approved a new FEP objective to “consider the implications of spatial management arrangements in Council decision-making”. To monitor implementation of this objective, the 2019 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 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 Pacific Pelagic Fisheries 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 plan's objectives, past amendments, and other information, refer to the Pelagic FEP found on Council website and regulations at 50 CFR 665.

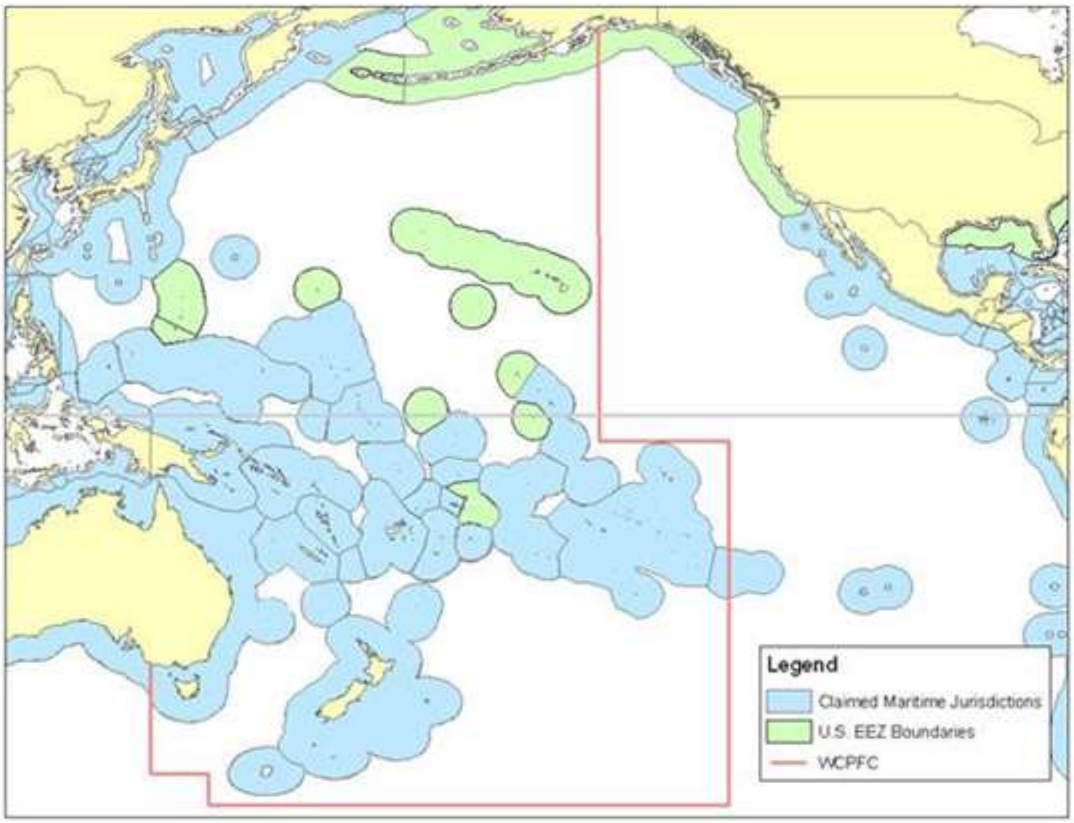
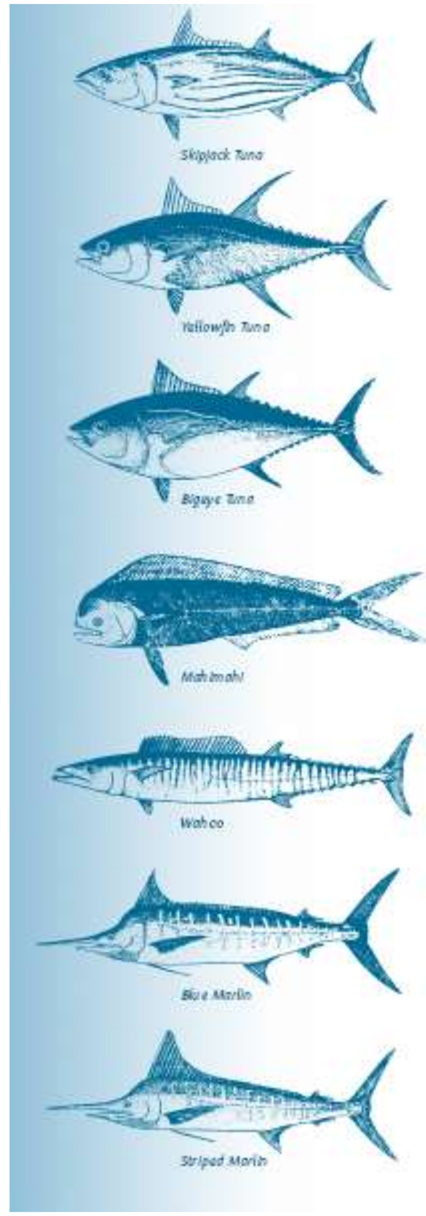


Figure 1. Map of the Western Pacific region

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 fourth 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

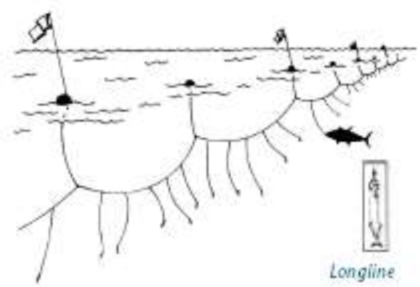
The Management Unit Species (MUS) managed under the Pelagic FEP include large pelagic species such as tunas (tribe Thunnini), billfishes (Istiophoridae and Xiphiidae), and other harvested species with distribution straddling domestic and international waters. The MUS excludes some scombrids found predominantly 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 Pacific Pelagic Management Unit Species

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

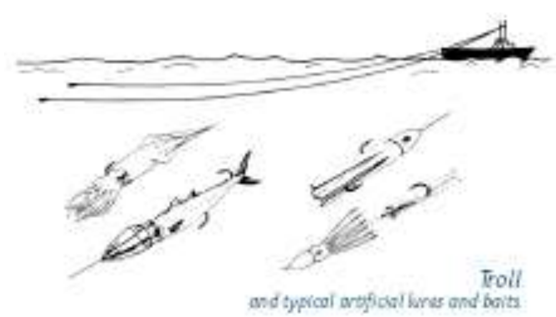
1.3 SUMMARY OF PELAGIC FISHERIES AND GEAR TYPES MANAGED UNDER THE FEP

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



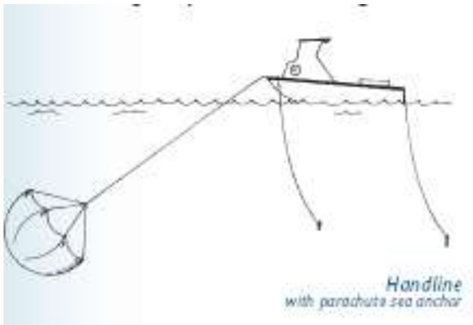
U.S. longline vessels in the Western Pacific Region are based primarily in Hawaii and American Samoa, although Hawaii-based vessels targeting swordfish and bigeye tuna have also fished seasonally out of California. The Hawaii fishery, with 150 active vessels, targets a range of species, with vessels 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 pelagics 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 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 pelagics 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 3.0 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, approx. 328 ft.) but the thermocline itself is diffuse (lower boundary at 300 m depth, approx. 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 Islands 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 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 40HP 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 nautical miles of Tutuila, Manu‘a, Swains Island and Rose Atoll (see Section 3.5 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 almost defunct with only three vessels still operating. 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 stimulus 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 2019, there were 17 active longline vessels. Poor economic conditions have plagued the large vessel feet for several years, as the lowest effort and catch was observed in 2019 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 on tournaments venture to the various outer banks which include the South Bank (35 miles), North East Bank (40 miles northeast), South East bank (37 miles southeast), 2% bank (40 miles), 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 now operates a full-time charter fishery.

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 the Western Pacific Fisheries Information Network (WPacFIN). While boat-based recreational catches were as high as over 46,000 lbs. in the 2000s, non-commercial catch was estimated to be over 97,000 lbs. in 2019.

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 both the CNMI and Guam is the North Equatorial Current, which flows westward through the Mariana 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 feet in length, which usually have a limited 20-mile travel radius from Saipan. There were an estimated 3,202 trolling trips in 2019, down from a decadal high of 4,293 in 2010.

The primary target and most marketable species for the pelagic fleet is skipjack tuna (approximately 74% of 2019 commercial landings). Schools of skipjack tuna have historically been common in near shore 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 species but are seasonal. 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 near shore 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 very difficult to market their catch and did not do well. By 2014, there were no active longliners in the CNMI, although a few of the original vessels were experimenting (unsuccessfully) with other types of fishing.

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 on 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 472 boats active in Guam's domestic pelagic fishery in 2019. 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 (upwelling) where the thermocline shoals and deep nutrients are pumped into surface waters enhancing phytoplankton production, and also regions of convergence (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 the 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 1980's 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 36.5 million lbs. of commercial landings with a total ex-vessel value of $105.6 million in 2019. The deep-set longline fishery was the largest of all commercial pelagic fisheries in Hawaii and represented 87% of the total commercial pelagic catch and 88% of the ex-vessel revenue. The MHI troll was the second largest fishery in Hawaii and accounted for 7% 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 68% of the total in 2019. Bigeye tuna alone accounted for 71% of the tunas and 49% of all pelagic catch. Billfish catch made up 15% of the total catch in 2019. Blue marlin was the largest of these at 41% of the billfish and 6% of the total catch. Catches of other pelagic management unit species (PMUS) represented 16% of the total catch in 2019 with moonfish being the largest component at 37% of the other PMUS and 6% of the total catch.

The Hawaii longline fishery is by far the most important economically, accounting for about 90% percent of the estimated ex-vessel value of the total commercial fish landings in the state in 2019. 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, 2014). 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 2019 was nearly 12.8 million lbs. 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 WPacFIN.

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, 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, 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, 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 (PRIAs), 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 management actions for the pelagic fisheries that NMFS implemented over the course of 2019.

On January 1, 2019 (83 FR 49495), NMFS issued a final rule that revised the annual number of allowable incidental interactions between the Hawaii shallow-set pelagic longline fishery and North Pacific loggerhead sea turtles from 34 to 17, in compliance with an order of the U.S. District Court, District of Hawaii.

On February 22, 2019 (84 FR 5356), NMFS issued a temporary rule closing the Southern Exclusion Zone (SEZ) to deep-set longline fishing for vessels registered under the Hawaii longline limited access program, because the fishery reached the established annual trigger of two observed false killer whale mortalities or serious injuries within the U.S. EEZ around Hawaii. The SEZ will remain closed until the area is reopened by the Assistant Administrator pursuant to established criteria. This action was necessary to comply with False Killer Whale Take Reduction Plan regulations that establish the SEZ closure trigger and procedures to limit mortalities or serious injuries of false killer whales in the Hawaii deep-set longline fishery.

On March 28, 2019 (84 FR 11654), NMFS issued a temporary rule closing the Hawaii shallow-set pelagic longline fishery north of the Equator for all vessels registered under the Hawaii longline limited access program. The shallow-set fishery had reached the annual limit of 17 physical interactions with North Pacific loggerhead sea turtles, so NOAA Fisheries closed the fishery for the remainder of the calendar year. This action was necessary to comply with regulations that establish maximum annual limits on the numbers of interactions that occur between longline fishing gear and sea turtles.

On July 18, 2019 (84 FR 34321), through December 31, 2019, NMFS specified a 2019 limit of 2,000 mt of longline-caught bigeye tuna for each U.S. participating territory (American Samoa, Guam, and CNMI). NMFS allowed each territory to allocate up to 1,000 mt each year to U.S. longline fishing vessels in a valid specified fishing agreement. As an accountability measure, NMFS monitored, attributed, and restricted (when necessary), catches of longline-caught bigeye tuna, including catches made under a specified fishing agreement. These catch limits and accountability measures support the long-term sustainability of fishery resources of the U.S. Pacific Islands and fisheries development in the U.S. territories.

On July 24, 2019 (84 FR 35568), NMFS issued a temporary rule closing the U.S. pelagic longline fishery for bigeye tuna in the western and central Pacific Ocean because the fishery had reached the 2019 catch limit. This action was necessary to ensure compliance with regulations that implement decisions of the Western and Central Pacific Fisheries Commission.

On July 31, 2019 (84 FR 37145), NMFS issued and interim final rule that established limits on fishing effort by U.S. purse seine vessels in the U.S. EEZ and on the high seas between the latitudes of 20° N. and 20° S. in the area of application of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (the Convention). The calendar year limit for 2019 was 1,616 fishing days. The calendar year limit for 2020 and subsequent years was 1,828 fishing days. This action was necessary for the U.S. to implement provisions of a conservation and management measure adopted by the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean and to satisfy the obligations of the United States under the Convention.

On August 1, 2019 (84 FR 37592), NMFS announced a valid specified fishing agreement that allocated up to 1,000 mt of the 2019 bigeye tuna limit for CNMI to identified U.S. longline fishing vessels. The agreement supported the long-term sustainability of fishery resources of the U.S. Pacific Islands, and fisheries development in the CNMI.

On October 1, 2019 (84 FR 52035), NMFS issued a temporary rule closing the U.S. purse seine fishery in the area known as the Effort Limit Area for Purse Seine (ELAPS) as a result of reaching the 2019 purse seine fishing effort limit in that area. The ELAPS consists of the areas of the U.S. EEZ and the high seas between the latitudes of 20° N. and 20° S. in the area of application of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the WCPO.

On October 28, 2019 (84 FR 57652), NMFS announced a valid specified fishing agreement that allocated up to 1,000 mt of the 2019 bigeye tuna limit for the Territory of American Samoa to identified U.S. longline fishing vessels. The agreement supported the long-term sustainability of fishery resources of the U.S. Pacific Islands, and fisheries development in American Samoa.

On November 4, 2019 (84 FR 57827), NMFS issued a final rule closing the U.S. pelagic longline fishery for bigeye tuna in the western and central Pacific Ocean because the fishery reached the 2019 allocation limit for the CNMI. This action is necessary to comply with regulations managing this fish stock.

On November 7, 2019 (84 FR 60040), NMFS issued a proposed rule that would revise the management regime for fishing vessels that target tunas and other highly migratory fish species in the area of overlapping jurisdiction in the Pacific Ocean between the Inter-American Tropical Tuna Commission (IATTC) and the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the WCPFC. If approved, the rule would apply all regulations implementing IATTC resolutions in the area of overlapping jurisdiction. Also, regulations implementing WCPFC decisions on catch and fishing effort limits, bycatch mitigation measures, and associated reporting requirements would no longer apply in the overlap area. However, regulations implementing WCPFC management measures related to monitoring, control, and surveillance would continue to apply in the overlap area.

On November 11, 2019 (84 FR 65690), NMFS issued a temporary rule reopening the U.S. purse seine fishery in the area known as the Effort Limit Area for Purse Seine (ELAPS, for ten calendar days because part of the fishing effort limit remains after the purse seine fishery closure on October 9, 2019. The ELAPS consists of the areas of the U.S. exclusive economic zone and the high seas between the latitudes of 20° N. and 20° S. in the area of application of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean.

On December 13, 2019 (84 FR 68057), NMFS issued a temporary rule reopening the 2019 U.S. pelagic longline fishery for bigeye tuna in the western and central Pacific Ocean for five days because the fishery did not catch the entire 3,554 mt limit. This action was intended to allow the fishery to access the remainder of the available limit.

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

A summary of the 2019 total pelagic landings in the Western Pacific and the change between 2018 and 2019 are shown in Table 2.

Table 2. Total pelagic landings (lbs.) in the Western Pacific Region in 2019 and percent change from the previous year

Species	American Samoa			CNMI			Guam			Hawaii		
	2018 lbs.	2019 lbs.	% Change	2018 lbs.	2019 lbs.	% Change	2018 lbs.	2019 lbs.	% Change	2018 lbs.	2019 lbs.	% Change
Swordfish	13,561	8,128	-40.1	-	-	-	-	-	-	2,329,211	1,624,656	-30.3
Blue marlin	71,643	63,739	-11.0	2,688	3,855	+43.4	24,516	56,020	+129	1,808,822	2,334,992	+29.2
Striped marlin	3,234	3,509	8.50	-	-	-	-	-	-	1,051,876	1,237,575	+17.7
Other billfish*	4,355	8,263	89.7	0	0	-	4,374	1,459	-66.6	542,778	502,430	-7.43
Mahimahi	10,961	4,040	-63.1	65,266	71,791	+10.0	88,817	162,541	+83.0	1,077,772	1,000,348	-7.10
Wahoo	68,664	39,156	-43.0	6,400	2,448	-61.8	96,035	32,600	-66.1	1,175,690	1,590,729	+35.3
Opah (moonfish)	2,766	1,185	-57.2	-	-	-	-	-	-	3,070,202	2,255,204	-26.6
Sharks (whole wt.)	9,573	1,447	-84.9	0	0	-	0	0	-	138,923	114,745	-17.4
Albacore	3,400,270	2,232,098	-34.4	-	-	-	-	-	-	238,564	255,099	+6.93
Bigeye tuna	117,481	66,547	-43.4	-	-	-	-	-	-	17,092,920	17,758,157	+3.89
Bluefin tuna	1,428	476	-66.7	-	-	-	-	-	-	1,174	3,765	+221
Skipjack tuna	176,871	162,875	-7.91	374,373	345,172	-7.8	610,751	479,966	-21.4	530,231	828,335	+56.2
Yellowfin tuna	586,052	402,438	-31.3	11,787	36,473	+209	52,555	84,825	+61.4	7,566,564	5,952,433	-21.3
Other pelagics**	3,708	3,374	-9.01	1,381	6,530	+373	14,700	22,921	+55.9	1,215,244	1,070,353	-11.9
Total	**4,468,447**	**2,997,275**	**-32.9**	**465,009**	**466,269**	**+0.3**	**891,748**	**840,332**	**-5.77**	**37,837,970**	**36,528,820**	**-3.46**

Note: Total Pelagic Landings based on commercial reports and/or creel surveys. % change based on 2018 landings relative to 2019 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. Regarding violin plots of fish size distributions in the Environmental and Climate Variables module, consider truncating the upper tail of the plots and add indicators of 20/80th percentiles. Also consider adding a line across a weight corresponding with a weight of 50% maturity (converted from L_{50}). The plan team noted regional differences in L_{50} estimates but suggested using a base case L_{50} from the official stock assessments.
2. Consider the addition of ecosystem indicators for American Samoa into the SAFE Report with a predefined area domain where the albacore fishery typically operates. If the ecosystem indicators presented in the Archipelagic SAFE report for American Samoa cover this area, then additional indicators do not need to be added to the Pelagic SAFE report.
3. Determine feasibility of incorporating ecosystem indicator data in the online portals of the annual SAFE reports and begin monitoring usage levels of the online portals. In the future, explore a data pipeline to automate data entry into the portal framework.
4. Consider closures associated with proposed small arms fire ranges in the Mariana Archipelago and to coordinate with DFW and DAWR staff to include relevant information in the Marine Planning module.
5. American Samoa DMWR and PIFSC representatives on the Plan Team to initiate coordination to investigate the American Samoa creel survey expansion data against commercial receipt book data, whereas pounds sold was relatively similar to total reported catch from trolling methods. The Plan Team noted cultural practices in American Samoa, whereby a significant portion of catch is given away, are not reflected in the presented data.
6. Coordinate with local agencies (DMWR, DFW, DAWR, and HDAR) to aggregate information on FAD location and changes from previous year and include this information in the Marine Planning module.
7. Initiate coordination between Council and PIRO SFD regarding implementing previous action items on requested updates to the Marine Planning and Data Integration modules, including the addition of cumulative impacts to the Marine Planning module and a guide for adaptive management to the data integration section.
8. Improve bycatch data summaries to include amount and type (species and condition) of bycatch, where data are available.
    1. Explore feasibility of including bycatch data from the observer programs for Hawaii and American Samoa longline fisheries.
    2. Present bycatch data including species and amount for Hawaii, American Samoa and CNMI small-boat fisheries. For the Hawaii data, also explore whether bycatch data for the charter vessels should be included in the Hawaii or non-commercial module.

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 Western Pacific Fishery Information Network (WPacFIN) 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.

Prior to 1985, only commercial landings were monitored. From October 1985 to the present, data have been collected through the Tutuila and Manu‘a boat-based creel survey 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 never been known to release fish. The Pago Pago Gamefishing Association, a recreational troll fishery, catches and releases blue marlin.

In September 1990, a Commercial Purchase System (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, the National Marine Fisheries Service (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 2019, except that the number of vendors participating in the Commercial Purchase System has increased.

Participation (number of boats) is determined through both logbook entries and creel interviews. Effort (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 (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 bottomfishing and/or trolling.

DMWR implemented a fuel subsidy program during from 2015 to 2018 which 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 change in fishing behavior and affected catch estimates to a certain extent. 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, WPacFIN 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 2019, which is from DMWR's boat-based 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 2018, but the information is not yet available. It 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, vs. 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, WPacFIN was 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 is not sold, proxy values from previous years were applied. The net result of using lower average weights (from boat-based creel) 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 the recreational/subsistence component of the fishery.

This module was prepared by DMWR and WPacFIN and was reviewed by the Pelagics Plan Team (PPT), Scientific and Statistical Committee (SSC), and the Council.

2.1.2 SUMMARY OF AMERICAN SAMOAN PELAGIC FISHERY

Landings. The estimated annual pelagic landings have varied from 2.9 to 11 million lbs. between 2009 to 2019. The 2019 landings were approximately 2.9 million pounds, the lowest recorded and a continuation of the decline from 11 million lbs. in 2010 (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 79% of the tuna species. Wahoo, blue marlin, and swordfish make up most of the non-tuna species landings.

Longline Effort. There were 17 vessels known to be fishing in the waters of American Samoa in 2019 according to the PIRO Sustainable Fisheries Division permit program. This was an increase from 13 in 2018. The following number of vessels were active in each class: 9 Class D vessels (> 70 foot), 5 Class C (50 - 60 foot), 0 Class B vessels (40 - 50 foot) and 3 Class A (< 40 foot). The number of active longline boats decreased to 15 in 2017 from 20 in 2016. The 17 vessels that fished in 2019 made 114 trips (averaging 7 trips/vessel), deployed 1,695 sets, (100 sets/vessel) using 4.8 million hooks (Table 5). While the number of boats increased in 2019 from 2018, the effort decreased (trips, sets and hooks), longline hooks set were an all-time low.

Longline CPUE. The total pelagic catch rate by all longline vessels decreased by 1.7 fish/1,000 hooks in 2019. The tuna catch rate by longliners also decreased by 1.2 fish/1,000 hooks in 2019 to 16.2 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 1.9 fish/1,000 hooks in 2019.

Lbs.-Per-Hour Trolling. Trolling catch rates increased slightly in 2019 (24 lbs./hr) from 2018 (23 lbs./hr) and have been increasing since 2017 (14 lbs./hr; Figure 19). Trolling catch rates have fluctuated with peaks in 2011 to 2012 (52 lbs./hr) and 2016 (43 lbs./hr). The catch rates for skipjack have been increasing since 2017 but decreased for yellowfin in 2019 relative to 2018 (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 lbs. from 2010 to 2015. However, boat-based creel survey recorded size range of 35 to 43 lbs. from 2013 to 2019. Yellowfin and big-eye tuna weight per fish from the cannery sampling program seemingly to decline from 2010 to 2015, at 59 to 38 lbs. and 54 to 38 lbs., respectively.

Revenues. In 2019, the total longline fleet revenue (estimated landed value) was $3.9 million, and albacore composed of over 89% of the total landed value. Other main species included yellowfin, bigeye, skipjack, and wahoo. The estimated value of the species landed were 7%, 1%, 2%, and 1%, respectively. Albacore had an estimated price of $1.61 per pound. See the Socioeconomics (Section 3.1) section for data on American Samoa pelagic fisheries.

Bycatch. There was no recorded bycatch for the troll fishery in 2019 (Table 13). In the longline fishery, around 1.2% of the tuna catch was released. Yellowfin and bigeye were the most released bycatch tuna species at 3.2 and 3.0%, 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% of all pelagic species caught were released. Fish are released for various reasons including quality, handling and storage difficulties, and marketing problems

2.1.3 PLAN TEAM RECOMMENDATIONS

Regarding the American Samoa data module in the 2019 annual SAFE report, Plan Team members agreed to carry out the following module improvements:

1. Improve bycatch data summaries to include amount and type (species and condition) of bycatch, where data are available.
    a. Explore feasibility of including bycatch data from the observer programs for Hawaii and American Samoa longline fisheries.
    b. Present bycatch data including species and amount for Hawaii, American Samoa and CNMI small-boat fisheries.

2.1.4 OVERVIEW OF PARTICIPATION – ALL FISHERIES

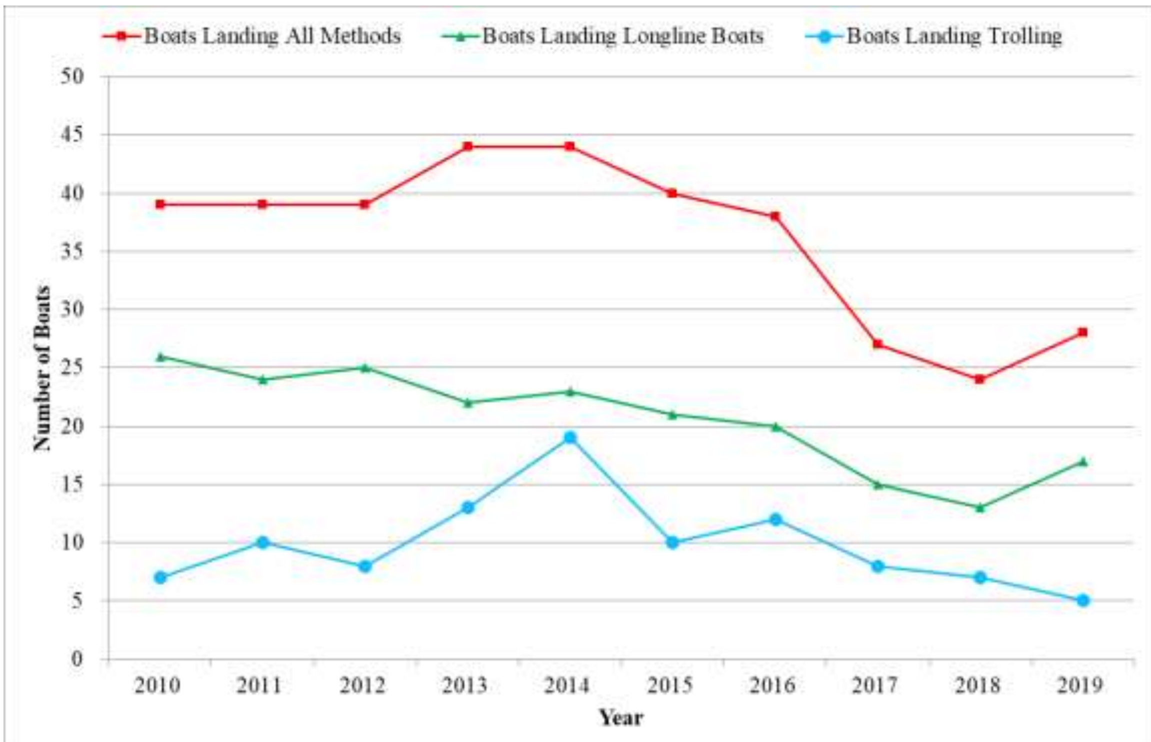


Figure 2. Number of American Samoa boats landing any pelagic species by longlining, trolling, and all methods from 2010-2019

Supporting data shown in Table A-2.

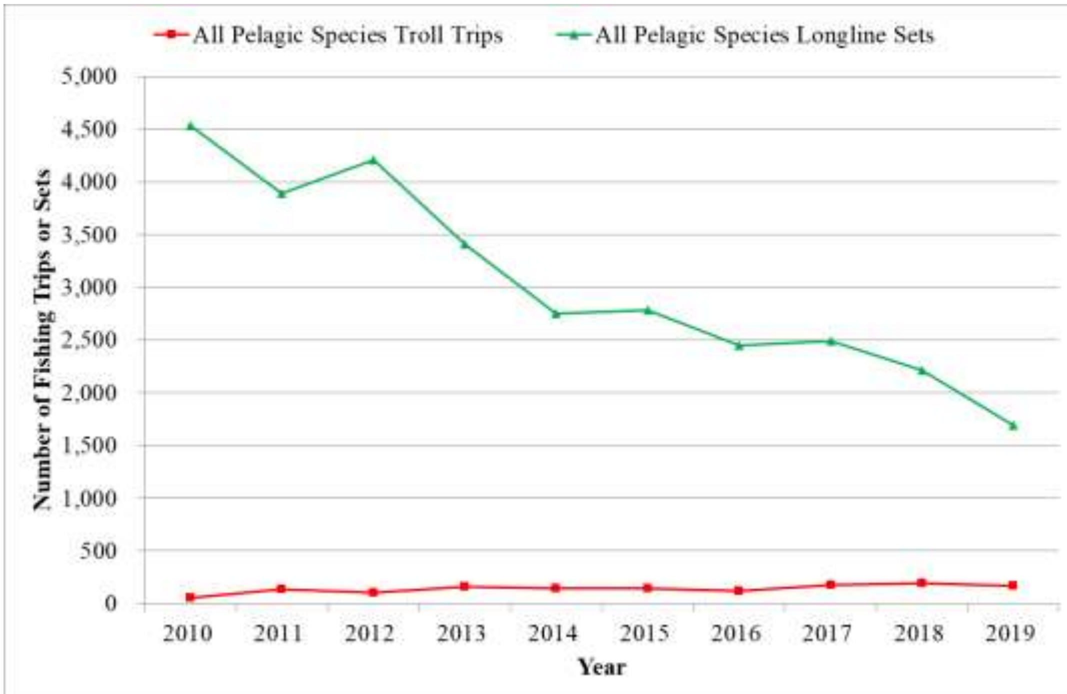


Figure 3. Number of American Samoa fishing trips and sets for pelagics from 2010-2019
Supporting data shown in Table A-3.

2.1.5 OVERVIEW OF LANDINGS – ALL FISHERIES

Table 3. 2019 estimated total landings (lbs.) of pelagic species by gear in American Samoa

Species	Longline Pounds	Troll Pounds	Other Pounds	Total Pounds
Skipjack tuna	149,917	12,958	0	162,875
Albacore tuna	2,232,098	0	0	2,232,098
Yellowfin tuna	399,298	3,140	0	402,438
Kawakawa	0	233	63	296
Bigeye tuna	66,547	0	0	66,547
Bluefin tuna	476	0	0	476
Tunas (unknown)	0	0	0	0
TUNAS TOTAL	**2,848,336**	**16,331**	**63**	**2,864,730**
Mahimahi	3,250	714	75	4,040
Black marlin	0	0	0	0
Blue marlin	62,905	834	0	63,739
Striped marlin	3,509	0	0	3,509
Wahoo	38,555	601	0	39,156
Swordfish	8,128	0	0	8,128
Sailfish	3,758	181	0	3,939
Spearfish	4,324	0	0	4,324

Species	Longline Pounds	Troll Pounds	Other Pounds	Total Pounds
Moonfish	1,185	0	0	1,185
Oilfish	19	0	143	162
Pomfret	554	0	151	706
Pelagic thresher shark	0	0	0	0
Thresher shark	1,357	0	0	1,357
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	**127,634**	**2,330**	**369**	**130,335**
Pelagic fishes (unknown)	40	0	0	40
Double-lined mackerel	0	0	0	0
Mackerel	0	9	0	9
Long-jawed Mackerel	0	0	0	0
Barracudas	784	0	10	795
Great barracuda	0	0	118	118
Small barracudas	0	0	0	0
Rainbow runner	0	24	57	81
Dogtooth tuna	0	336	832	1,167
OTHER PELAGICS TOTAL	**824**	**369**	**1,017**	**2,210**
TOTAL PELAGICS	**2,976,794**	**19,030**	**1,449**	**2,997,275**

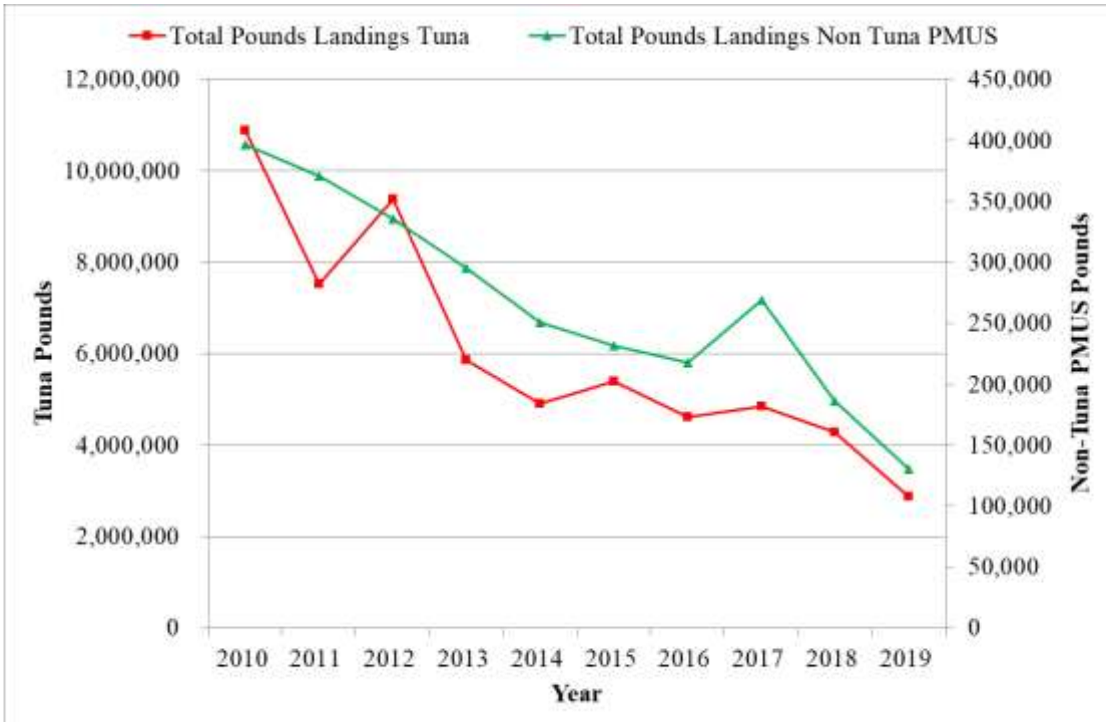


Figure 4. American Samoa estimated total landings of tuna and non-tuna PMUS from 2010-2019

Supporting data shown in Table A-4.

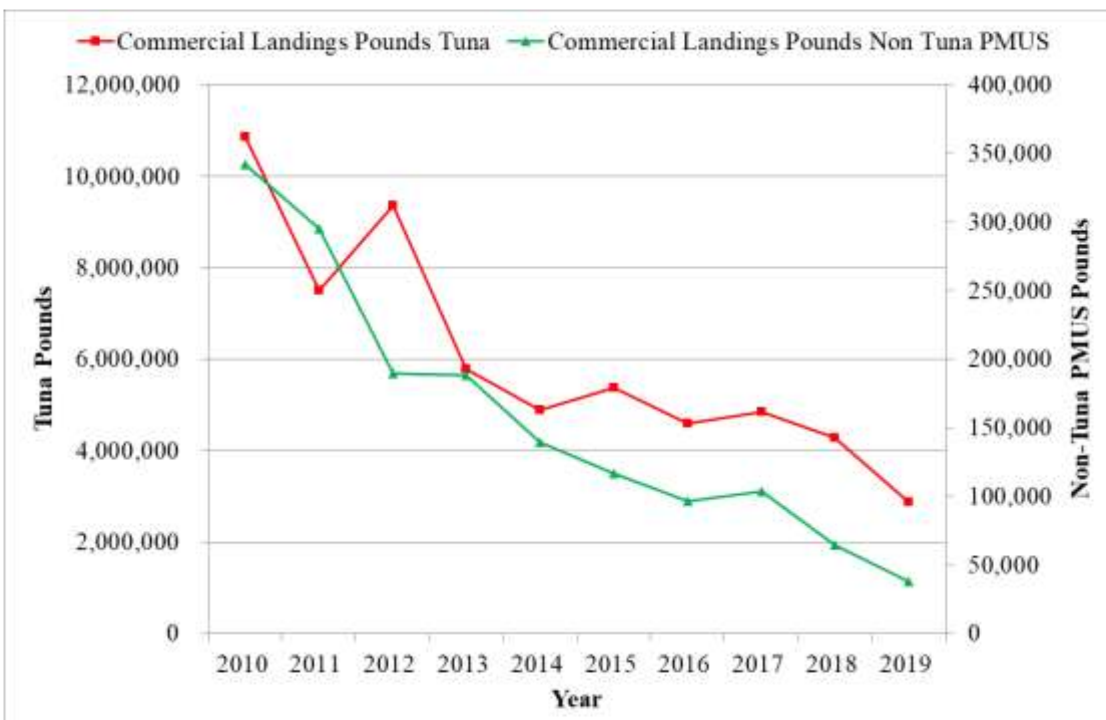


Figure 5. American Samoa commercial landings of tuna and non-tuna PMUS from 2010-2019

Supporting data shown in Table A-5.

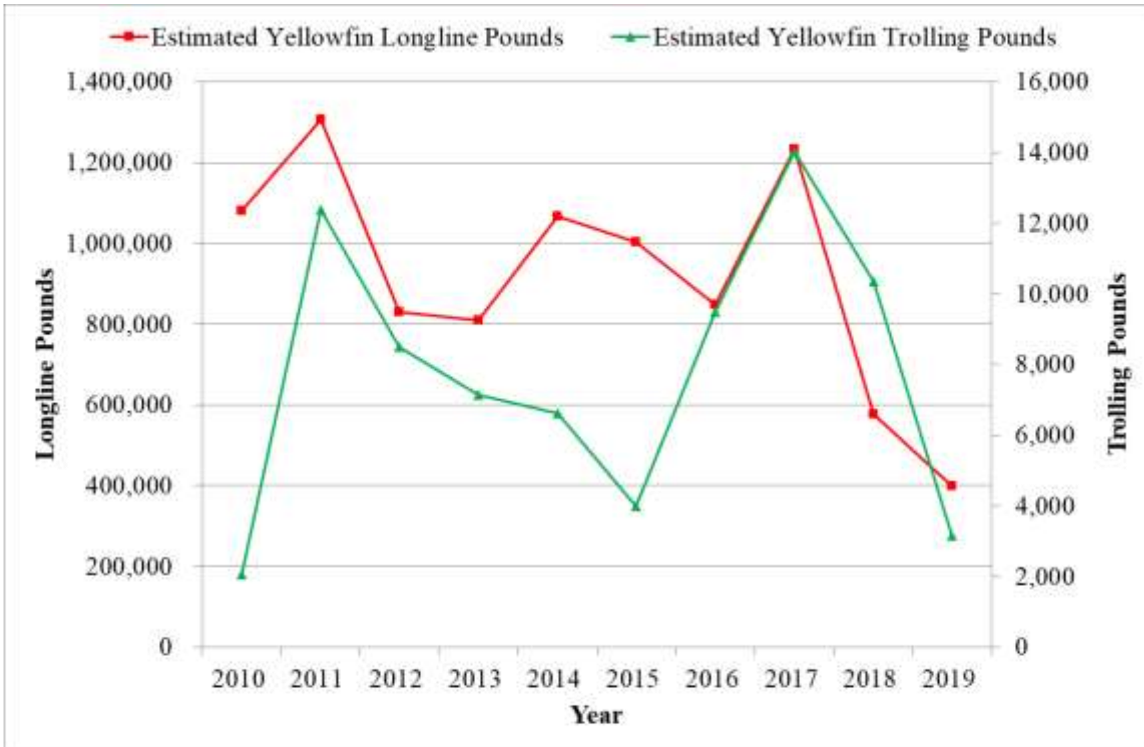


Figure 6. American Samoa annual estimated total landings of yellowfin tuna from 2010-2019
Supporting data shown in Table A-6.

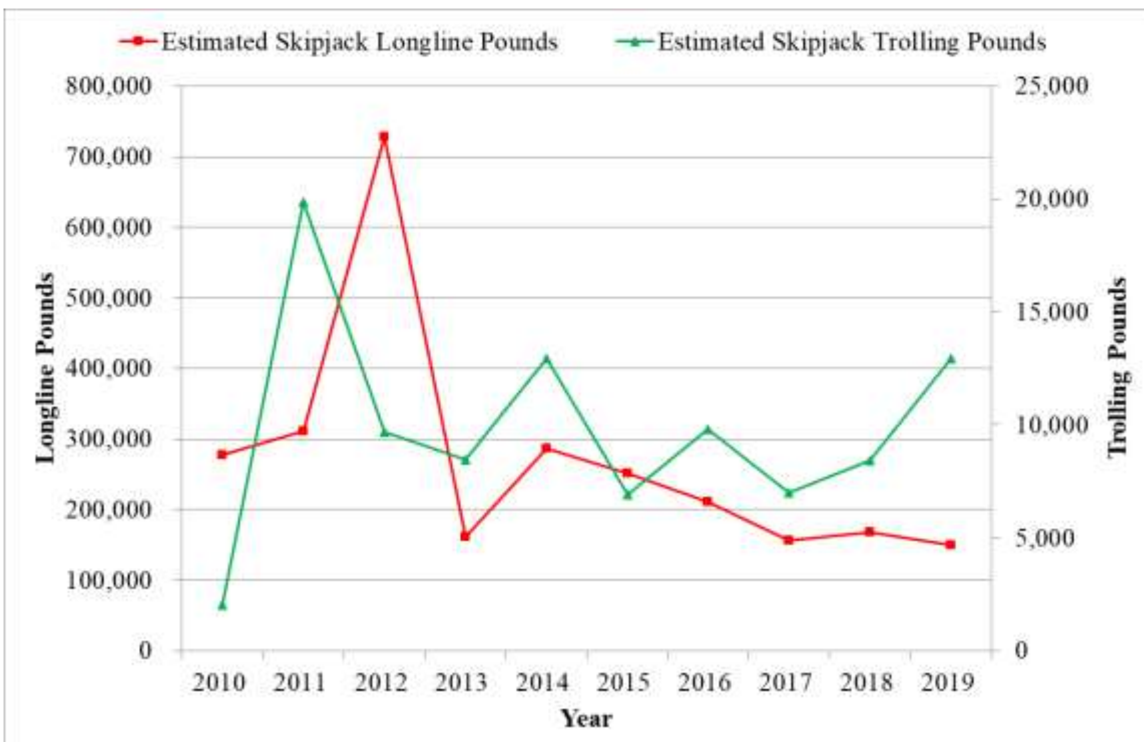


Figure 7. American Samoa annual estimated total landings of skipjack tuna from 2010-2019
Supporting data shown in Table A-7.

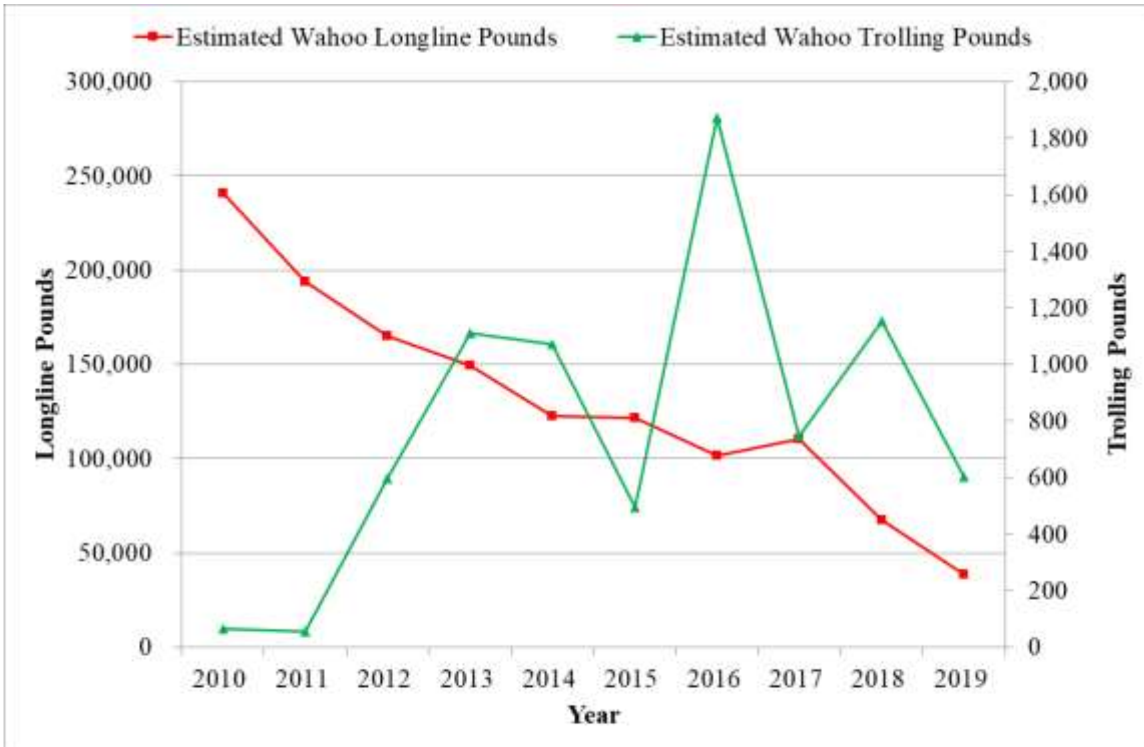


Figure 8. American Samoa annual estimated total landings of wahoo from 2010-2019

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

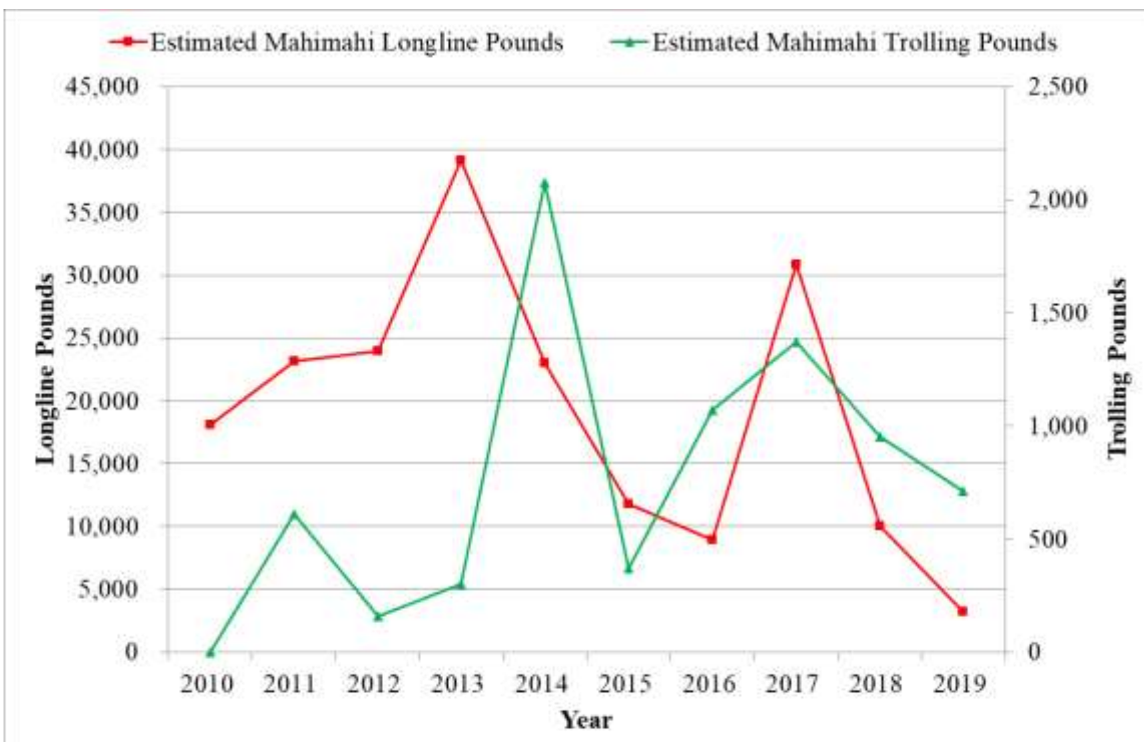


Figure 9. American Samoa annual estimated total landings of mahimahi from 2010-2019

Supporting data shown in Table A-9.

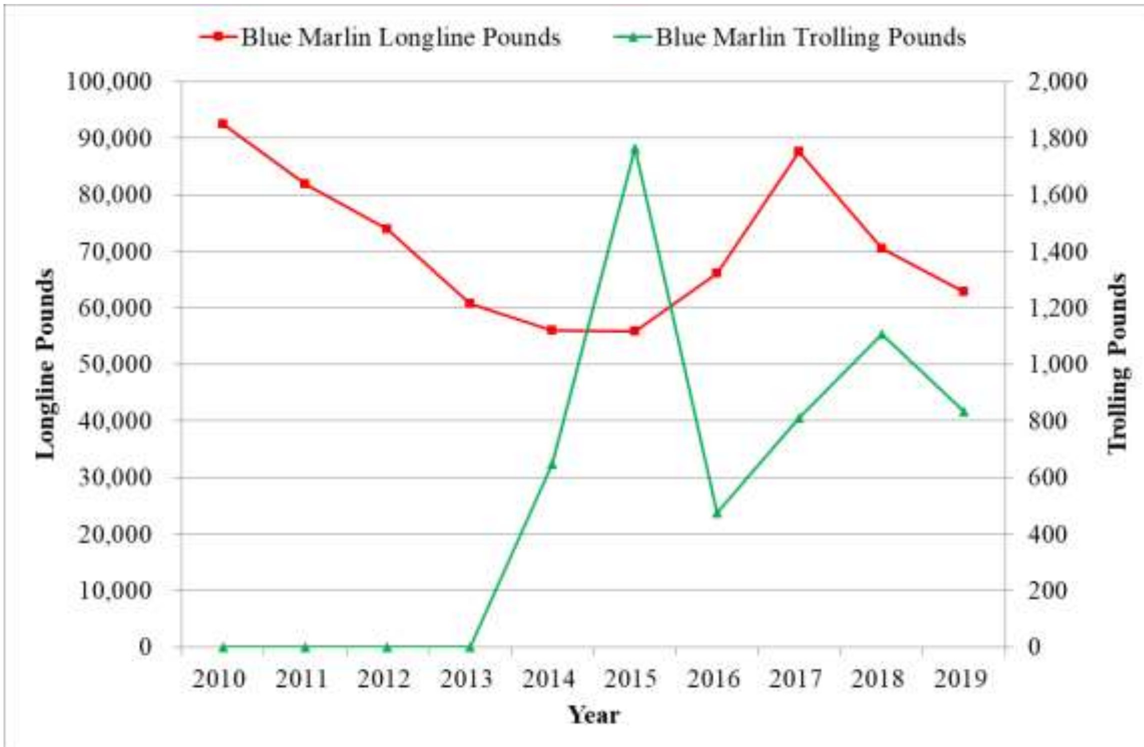


Figure 10. American Samoa annual estimated total landings of blue marlin from 2010-2019
Supporting data shown in Table A-10.

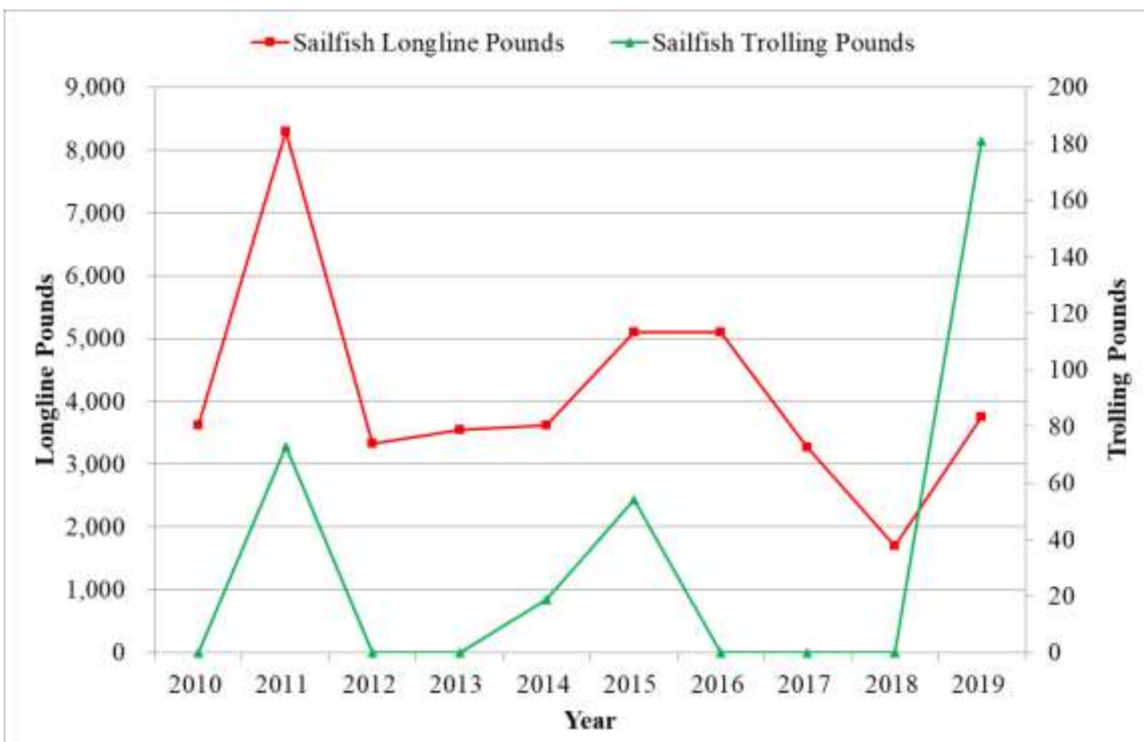


Figure 11. American Samoa annual estimated total landings of sailfish from 2010-2019
Supporting data shown in Table A-11.

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 from 2010-2019

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
2010	12	1	0	0	12	7	26	18
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	8
2019	4	3	4	0	13	5	29	9

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 size classes A (< 40 ft.), B (40-50 feet), C (51-70 feet) and D (> 70 ft.) from 2010-2019

Table 5. Longline effort by American Samoan vessels during 2019

Effort Type	All Vessels
Boats	17
Trips	114
Sets	1,695
1000 Hooks	4,769
Lightsticks	0

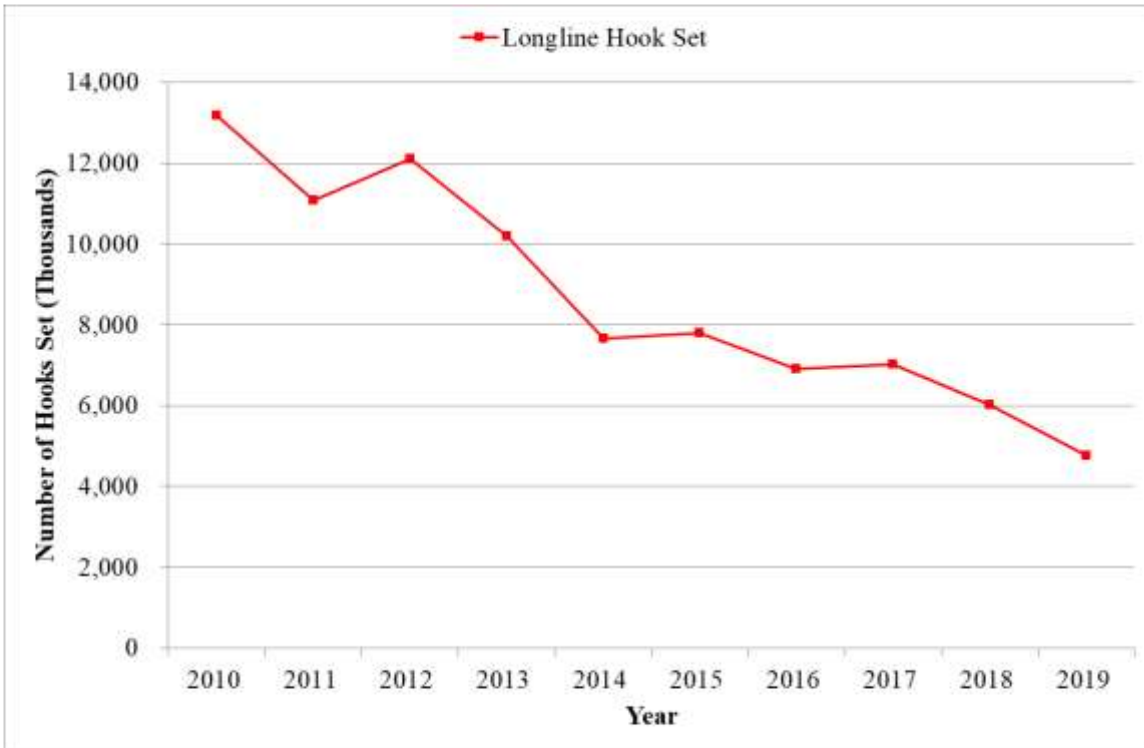


Figure 13. Thousands of American Samoa longline hooks set from federal logbook data from 2010-2019

Supporting data shown in Table A-12.

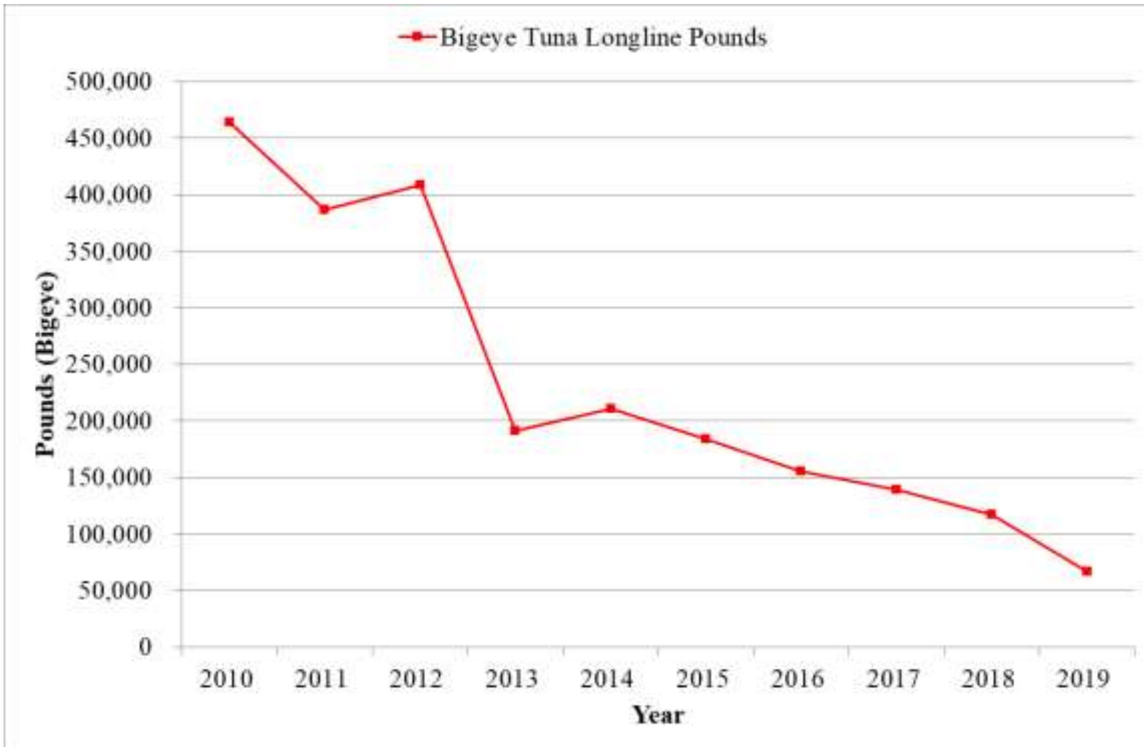


Figure 14. American Samoa estimated total landings of bigeye by longlining from 2010-2019

Supporting data shown in Table A-13.

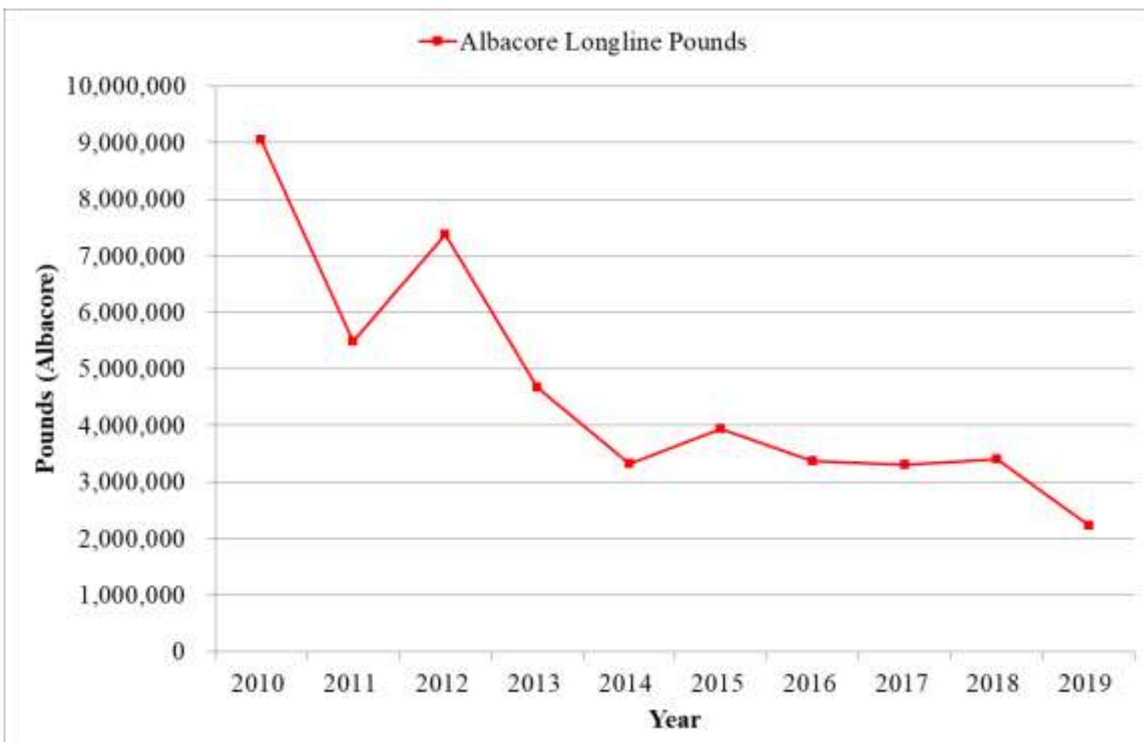


Figure 15. American Samoa estimated total landings of albacore by longlining from 2010-2019

Supporting data shown in Table A-14.

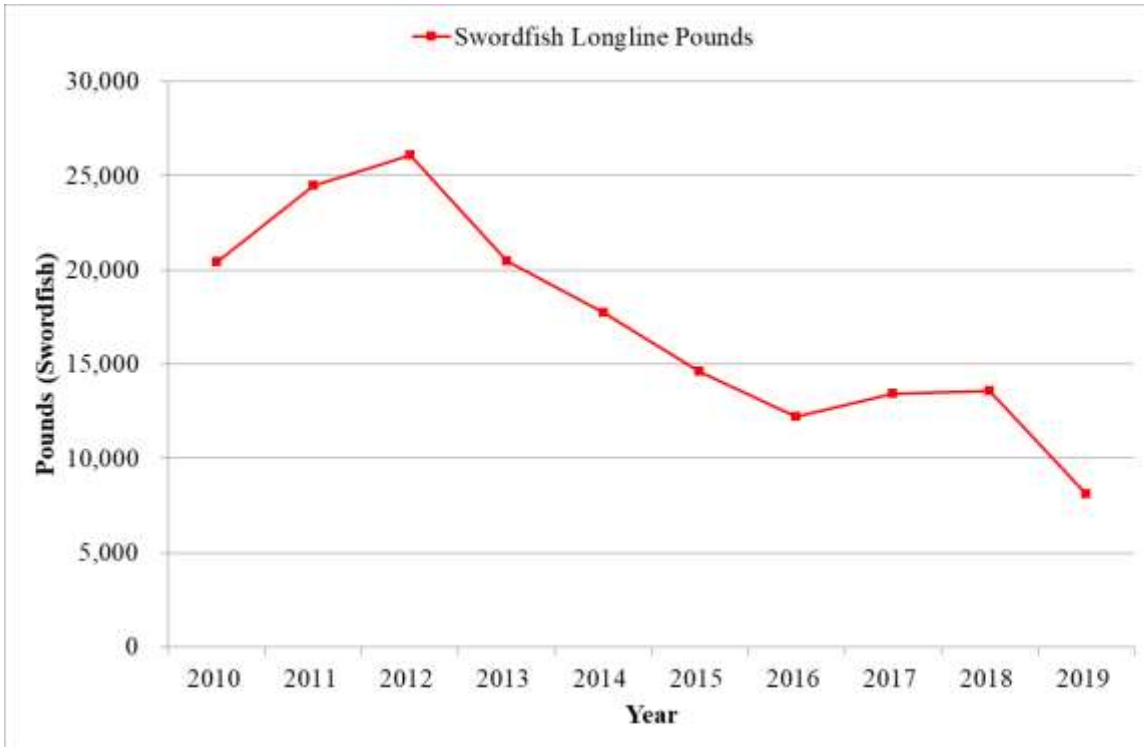


Figure 16. American Samoa estimated total landings of swordfish by longlining from 2010-2019

Supporting data shown in Table A-15.

Table 6. Number of fish kept, released, and percent released for all American Samoa longline vessels in 2019

Species	Number Kept	Number Released	Total Caught	Percent Released
Skipjack tuna	11,004	138	11,142	1.2
Albacore tuna	54,888	477	55,365	0.9
Yellowfin tuna	8,764	293	9,057	3.2
Kawakawa	0	0	0	0.0
Bigeye tuna	1,742	54	1,796	3.0
Bluefin tuna	2	0	2	0.0
Tunas (unknown)	0	0	0	0.0
TUNAS TOTAL	**76,400**	**962**	**77,362**	**1.2**
Mahimahi	150	2	152	1.3
Black marlin	0	0	0	0.0
Blue marlin	498	74	572	12.9
Striped marlin	51	4	55	7.3
Wahoo	1,935	30	1,965	1.5
Swordfish	80	114	194	58.8
Sailfish	53	27	80	33.8

Species	Number Kept	Number Released	Total Caught	Percent Released
Spearfish	94	119	213	55.9
Moonfish	24	21	45	46.7
Oilfish	1	1,071	1,072	99.9
Pomfret	63	371	434	85.5
Pelagic thresher shark	0	0	0	0.0
Thresher shark	7	179	186	96.2
Shark (unknown pelagic)	0	33	33	100.0
Snake mackerel	0	0	0	0.0
Bigeye thresher shark	0	0	0	0.0
Silky shark	0	714	714	100.0
White tip oceanic shark	0	505	505	100.0
Blue shark	0	1,626	1,626	100.0
Shortfin mako shark	1	151	152	99.3
Longfin mako shark	0	0	0	0.0
Billfishes (unknown)	1	1	2	50.0
NON-TUNA PMUS TOTAL	**2,958**	**5,042**	**8,000**	**63.0**
Pelagic fishes (unknown)	2	11	13	84.6
Double-lined mackerel	0	0	0	0.0
Mackerel	0	0	0	0.0
Long-jawed Mackerel	0	0	0	0.0
Barracudas	70	5	75	6.7
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	**72**	**16**	**88**	**18.2**
TOTAL PELAGICS	**79,430**	**6,020**	**85,450**	**7.0**

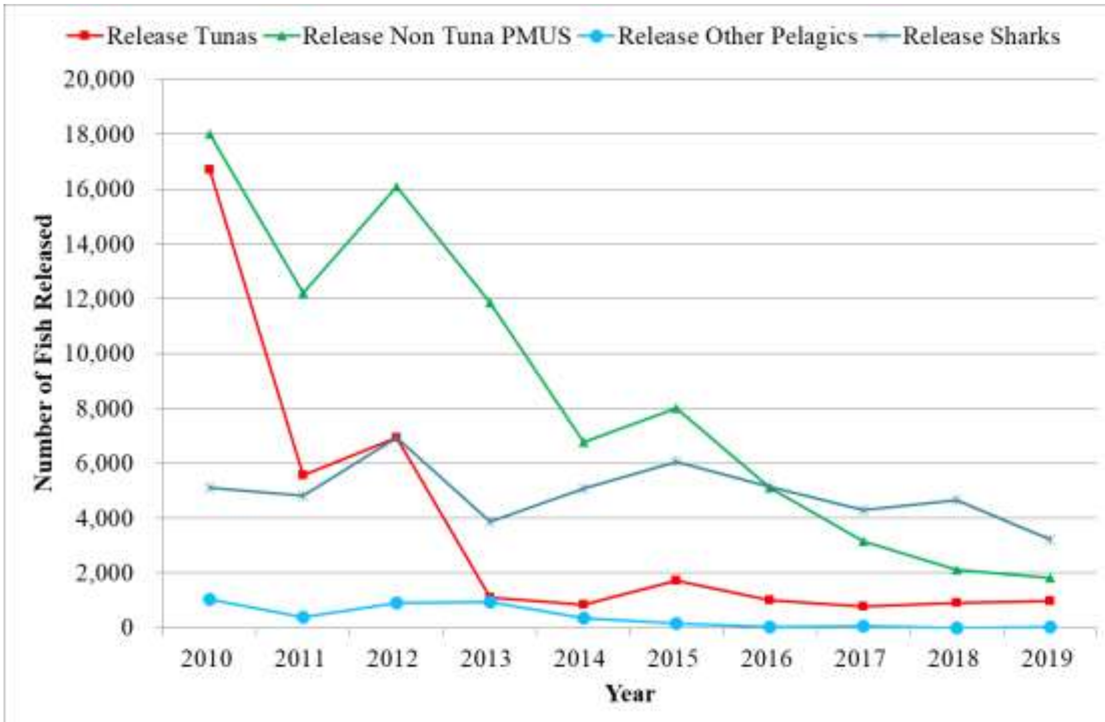


Figure 17. Number of fish released by American Samoa longline vessels from 2010-2019

Supporting data shown in Table A-16.

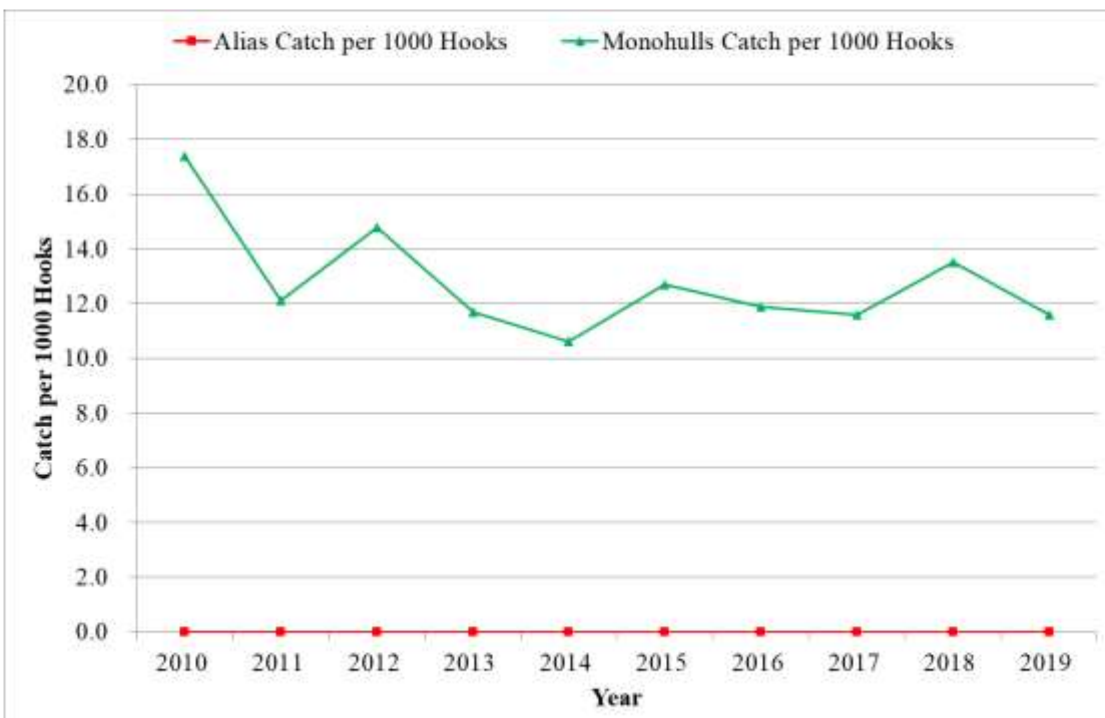


Figure 18. American Samoa albacore catch/1,000 hooks by monohull vessels from longline logbook data from 2010-2019

Note: There were fewer than three alias reporting, so alias are not included. Supporting data shown in Table A-17.

Table 7. American Samoa catch/1,000 hooks for alia vessels 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. American Samoa catch/1,000 hooks for two types of longline vessels 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. American Samoa catch/1,000 hooks for two types of longline vessels 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. American Samoa Catch/1,000 Hooks for all vessels 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. American Samoa 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	11.6
Yellowfin tuna	1.2	1.9	2.5	2.6	2.6	3.7
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**	**17.2**
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**	**19.3**

Table 12. American Samoa Catch/1,000 Hooks for all types of longline vessels from 2018-2019

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

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 the American Samoan trolling fishery are shown in Table 13.

Table 13. American Samoa 2019 trolling bycatch summary (released fish)

Year	Release Alive	Release Injured	Release Unknown	Total Bycatch	Total Catch	Percent Bycatch	Bycatch Interview	Total Interview	Percent Bycatch Interview
2019	0	0	0	0	648	0.0	0	49	0.0

Notes: "Catch" is the total number of fish counted and estimated in interviews (Tutuila & Manu'a islands) for trolling method. Bycatch information is calculated from raw interview data and represents the % of fish caught or % of interviews (trolling trips) with bycatch.

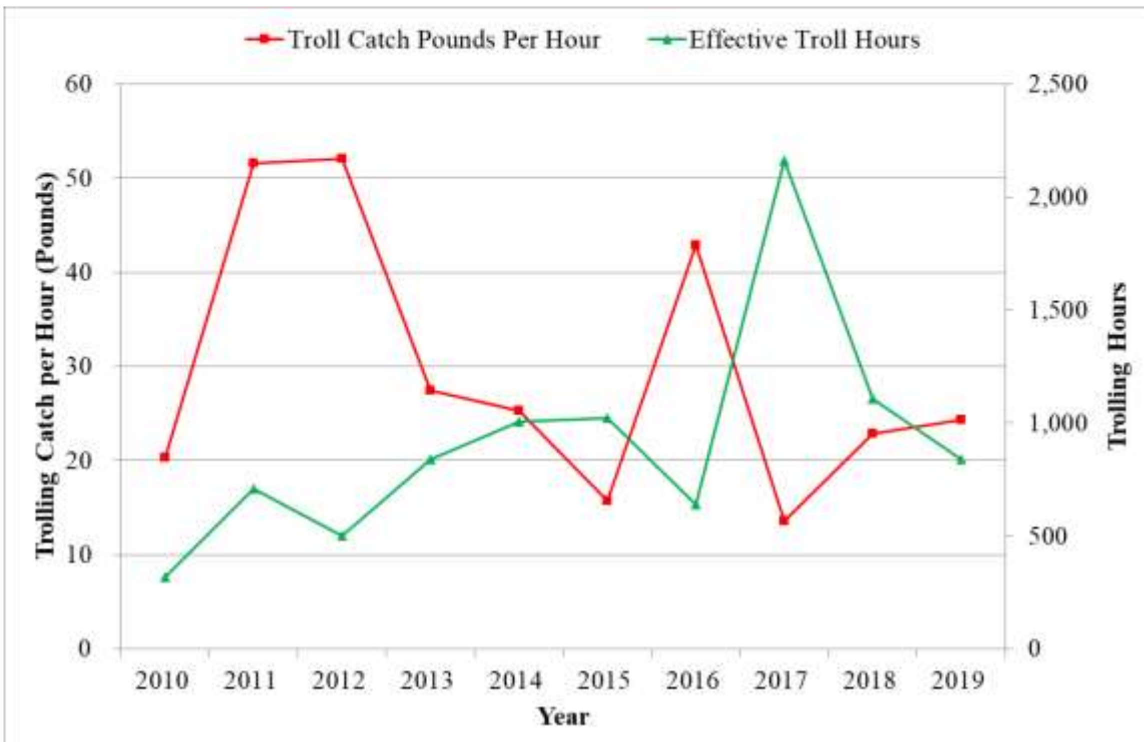


Figure 19. American Samoa pelagic catch-per-hour for trolling and number of trolling hours from 2010-2019

Supporting data shown in Table A-18.

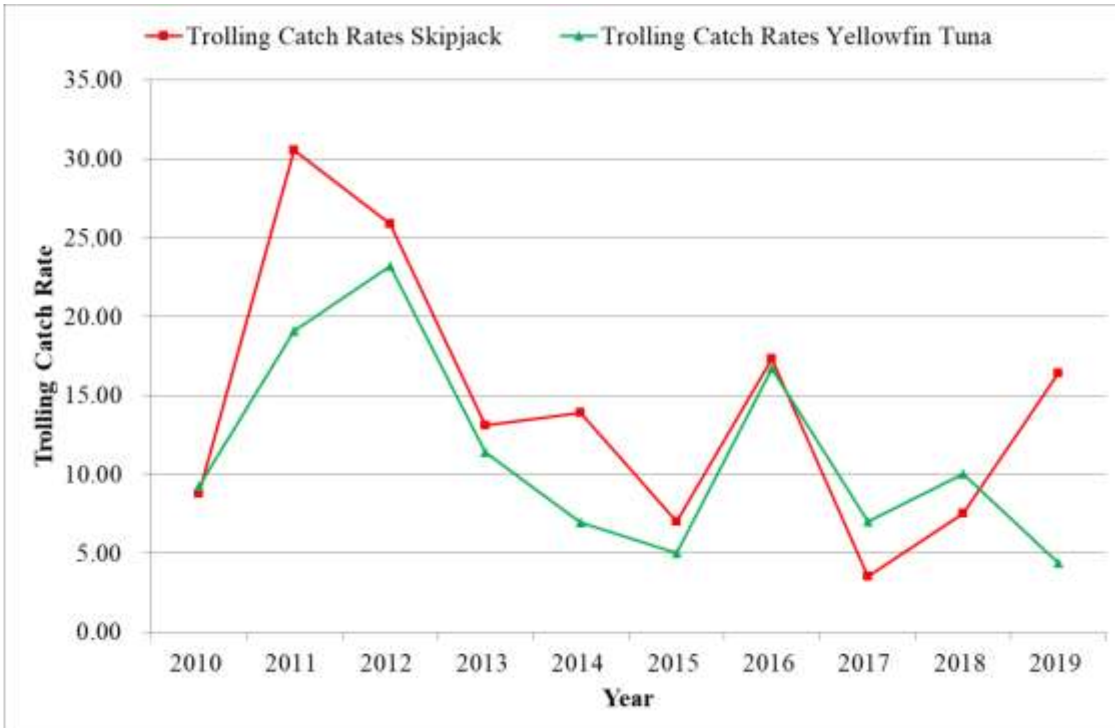


Figure 20. American Samoa trolling CPUE for skipjack and yellowfin tuna from 2010-2019

Supporting data shown in Table A-19.

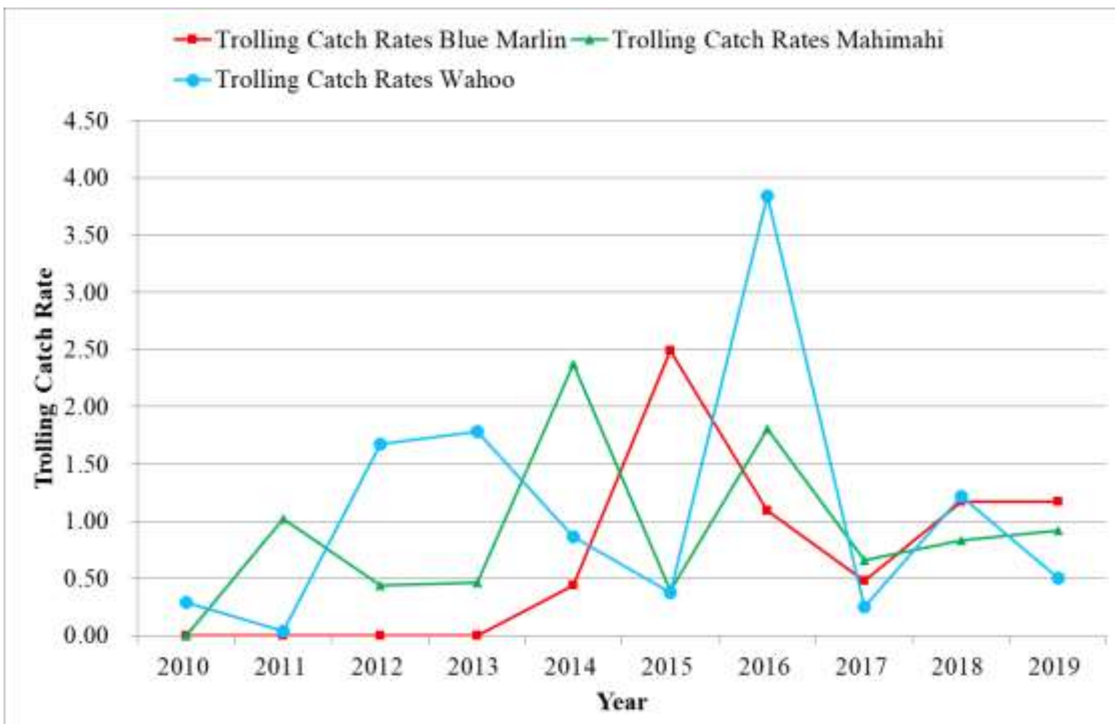


Figure 21. American Samoa trolling CPUE for blue marlin, mahimahi, and wahoo from 2010-2019

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 2015 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 (no forms returned, vendors missed, nonparticipation), an estimated 40-50% of total commercial sales are not included in the Commercial Purchase Data reported here 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 and 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 although these data are incomplete and not included in this analysis. These creel efforts were mainly focused on shore-based fisheries. The Rota pilot study during 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 37 survey days in 2019 (see Table A-21). Total trips in 2019 decreased by 37% and staff were only able to conduct 58 interviews, which was a 46% decrease in interview numbers from 2018. This decrease in surveys and interviews was due to the boat-based creel not being conducted for 3 months from July to September. The survey was not conducted during this time due to funding issues. Only 1 charter trip was intercepted in 2019, but 4 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.

Effort (number of fishermen) is determined by tallying unique fishermen as recorded on the Commercial Receipt Invoice, while 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 decreased in 2019 compared to the previous year due to a lack of surveys for three months. 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 74% of the entire pelagic landings in 2019 based on creel survey data. Skipjack landings decreased 8% (345,174 lbs.) and total landings remained roughly the same increasing 0.3% (466,269 lbs.) from landings in 2018.

Landings of mahimahi and yellowfin tuna ranked second and third by weight of landings during 2019. Creel data estimated 71,791 lbs. of mahimahi, a 10% increase from 2018. After three years (2014-2016) of high poundage of mahimahi landings and a moderate drop in 2017, landed pounds have increased the past two years. There were 36,473 lbs. of yellowfin landed in 2019, a large 209% increase from the 2018 landings. Skipjack tuna are easily caught in near shore waters throughout the year. mahimahi is seasonal with peak catch usually from February through April, whereas Yellowfin Tuna season usually runs from April to September. The lack of surveys for 3 months could have had an impact on tuna landings estimates because they are could more year round. The lack of survey likely had little effect on mahimahi estimates because the mahimahi season was captured in the surveys that were able to be conducted.

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 in fishermen to 73 reporting landings, but for the last 3 years numbers have remained more consistent. In 2019 the number decreased by 13% to 49. The number of trips, based on both the commercial data receipts and the creel survey, have been variable since the late 1990s, but has been increasing in the last year. In 2019, 2457 trips were recorded in the database (11% increase from 2018), and 3,202 trips estimated from the creel survey (24% decrease from 2018). The creel trip estimate may have been affected by missing surveys because of the missed Summer/Fall season. Estimated charter trips increased 128% to 41 trips. Total hours trolling in 2019 showed a decrease of 22% from 2018 to 16,841 hours, but charter trolling hours increased

108% to 175 hours. Average trip length increased slightly to 5.3 hours per trip. As noted above, charter fishing is a very small overall component of the trolling fishery, and minimal charter trips were reported. This is likely a sampling issue as there are known charter operators, but they infrequently operate and can be difficult to catch in normally scheduled surveys. The increases this year in charter numbers are more likely for an improved effort to sample charter trips.

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 trailerable boats is north of Garapan at Smiling Cove Mariana. The is a convenience and transient dock as well as slips that can be rented for long term boat storage. There are small boat ramps further north in 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 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 has to be dredged periodically. It is still frequently used when the ramp is covered in sand as it is an important launching site. Currently Sugar Dock has not been dredged in several years and is used less than in the past.

Weather. Weather and typhoon conditions followed traditional patterns. There were no major typhoons this year. January and February were affected by bad weather for 26 and 27 days, respectively. March, August, September, October, November, and December were moderately affected by bad weather for 7, 12, 7, 10, 8, and 18 days, respectively. April through July was unaffected by bad weather days.

Fish Aggregating Devices (FADs). FADs deployed in 2018 were lost to Super Typhoon Yutu. Materials were obtained and prepared for deployment. A contract was completed, and 11 FADs will be deployed in early 2020.

CPUE. In 2019, trolling catch rates increased to 27.9 lbs. per trolling hour, a level higher than the 10 year average (23.2 lbs./hr). The skipjack catch rate, the primary target species in CNMI, increased to 20.5 lbs. per hour fished. This catch rate is a 12% increase and is higher than the 10 year average (16.0 lbs./hr). Yellowfin catch rate in 2019 increased 4.4 times more than 2018 to 2.2 lbs. per hour. The mahimahi catch rate increased to 4.2 lbs./hr in 2019, which is above the long-term average of 3.9 lbs./hr.

Revenues. Commercial estimated inflation-adjusted revenues per trip, at ~$160.00, were down from 2018, and have been decreasing since 2016. The total value of the pelagic fishery was $464,101.30. The average price for all pelagics was up to $2.61 driven by the $2.60 price for skipjack.

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 2007-2019.

2.2.3 PLAN TEAM RECOMMENDATIONS

Regarding the CNMI data module in the 2019 annual SAFE report, Plan Team members agreed to carry out the following module improvements:

1. Improve bycatch data summaries to include amount and type (species and condition) of bycatch, where data are available.
   a. Explore feasibility of including bycatch data from the observer programs for Hawaii and American Samoa longline fisheries.
   b. Present bycatch data including species and amount for Hawaii, American Samoa and CNMI small-boat fisheries.

2.2.4 OVERVIEW OF PARTICIPATION AND EFFORT

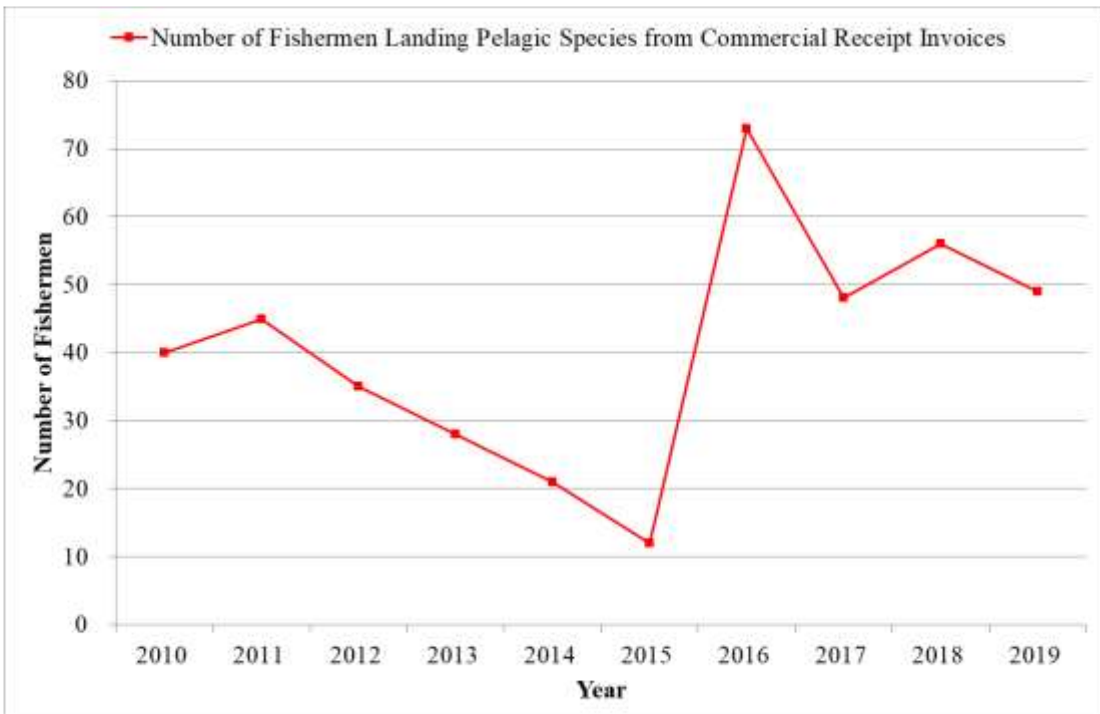


Figure 22. CNMI fishermen (boats) with commercial pelagic landings from 2010-2019

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

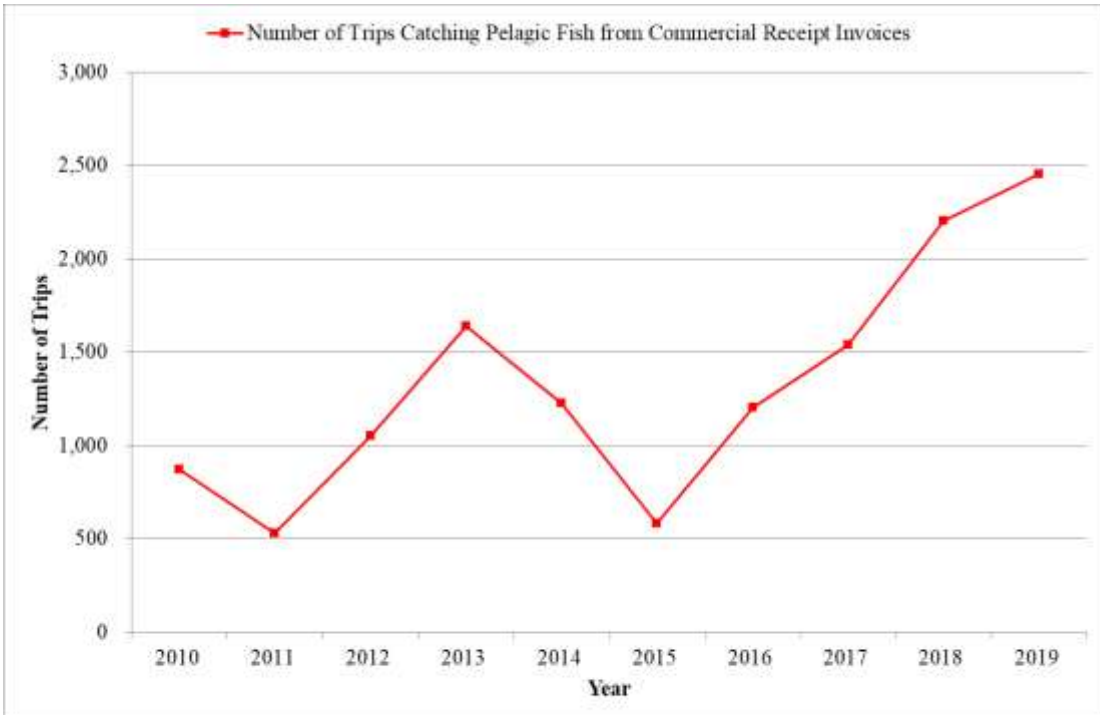


Figure 23. Number of trips catching pelagic fish from commercial receipt invoices from 2010-2019

Supporting data shown in Table A-23.

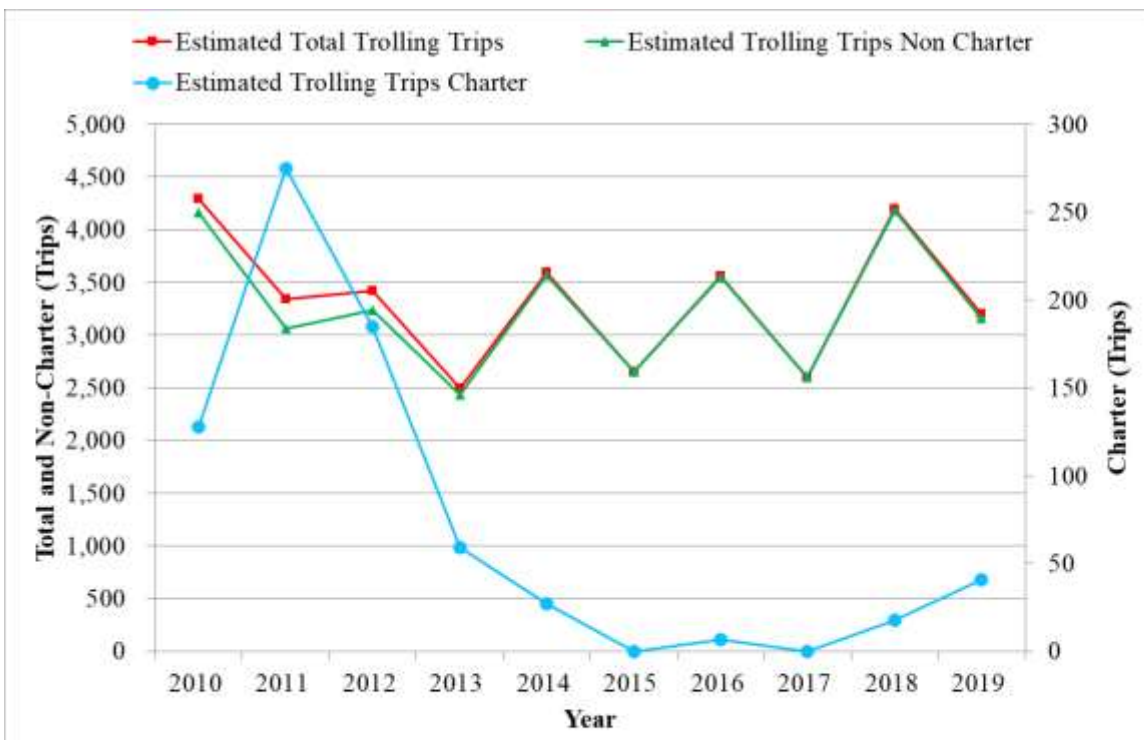


Figure 24. CNMI boat-based creel estimated number of trolling trips from 2010-2019

Supporting data shown in Table A-24.

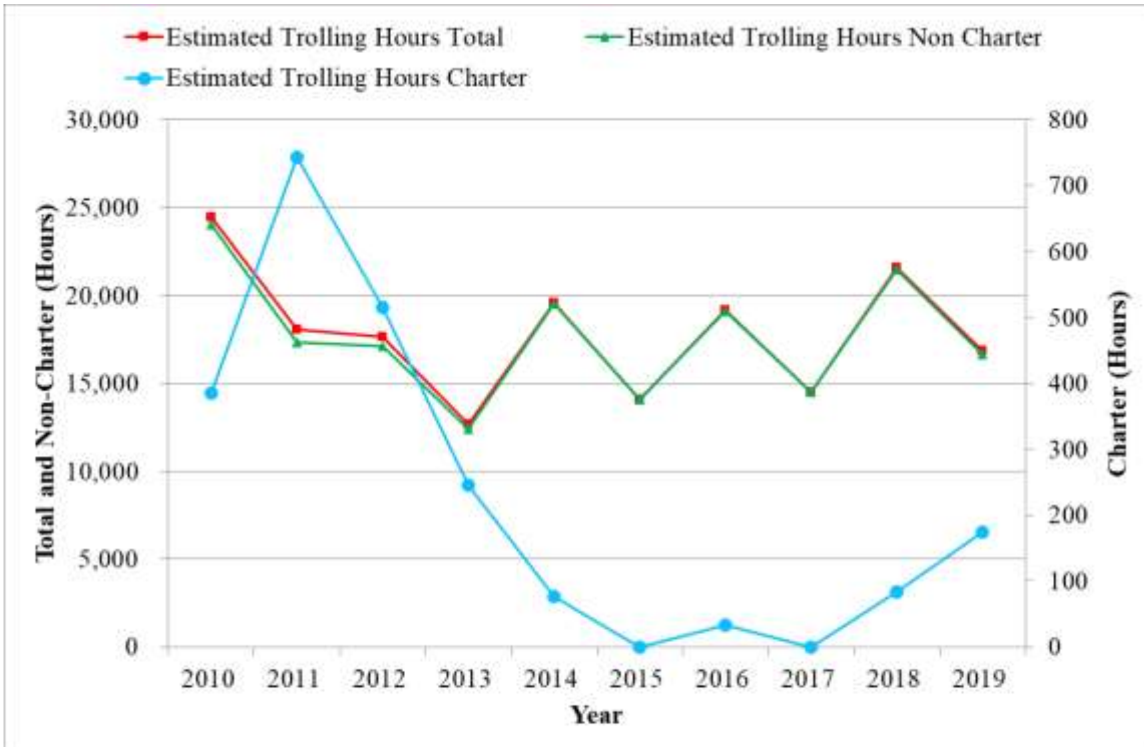


Figure 25. CNMI boat-based creel estimated number of trolling hours from 2010-2019
Supporting data shown in Table A-25.

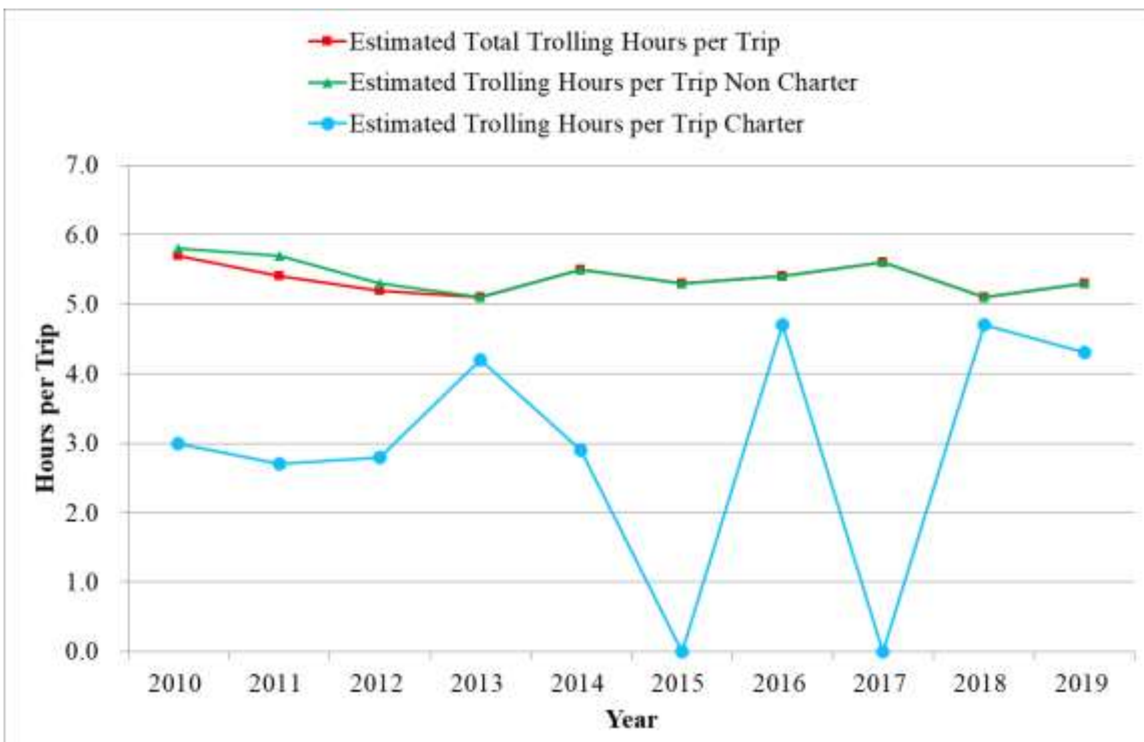


Figure 26. CNMI boat-based creel average trip length in hours per trip from 2010-2019
Supporting data shown in Table A-26.

2.2.5 OVERVIEW OF LANDINGS

Table 14. Pelagic species composition from creel surveys performed in the CNMI in 2019

Species	Total Landings	Non Charter	Charter
SKIPJACK TUNA	345,172	342,431	2,741
YELLOWFIN TUNA	36,473	36,473	0
SABA (KAWAKAWA)	0	0	0
TUNAS (MISC.)	0	0	0
TUNAS Total	**381,645**	**378,904**	**2,741**
MAHIMAHI	71,791	71,791	0
WAHOO	2,448	2,448	0
BLUE MARLIN	3,855	3,855	0
SAILFISH	0	0	0
SPEARFISH	0	0	0
SHARKS	0	0	0
SICKLE POMFRET (W/WOMAN)	124	124	0
NON-TUNA PMUS Total	**78,218**	**78,218**	**0**
DOGTOOTH TUNA	3,965	3,965	0
RAINBOW RUNNER	2,251	1,867	384
BARRACUDA	190	190	0
TROLL FISH (MISC.)	0	0	0
OTHER PELAGICS Total	**6,406**	**6,022**	**384**
TOTAL PELAGICS	**466,269**	**463,144**	**3,125**

Note: Total pelagic landings are 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 15. Commercial pelagic landings (lb.), revenues ($), and average prices ($) in the CNMI in 2019

Species	Pounds	Value	Average Price
SKIPJACK TUNA	127,688.9	331,435.4	2.60
YELLOWFIN TUNA	12,282.8	33,964.5	2.77
SABA (KAWAKAWA)	68.0	170.0	2.50
TUNAS (MISC.)	338.7	874.0	2.58
TUNAS TOTAL and AVERAGE PRICE	**140,378.4**	**366,443.8**	**2.61**
MAHIMAHI	20,724.3	56,058.9	2.70
WAHOO	336.0	1,045.3	3.11
BLUE MARLIN	604.0	1,488.0	2.46

Species	Pounds	Value	Average Price
SICKLE POMFRET (W/WOMAN)	379.3	1,262.0	3.33
NON-TUNA PMUS TOTAL and AVERAGE PRICE	**22,043.7**	**59,854.2**	**2.72**
DOGTOOTH TUNA	12,494.7	30,086.8	2.41
RAINBOW RUNNER	617.3	1,669.7	2.70
BARRACUDA	120.0	360.0	3.00
TROLL FISH (MISC.)	1,965.3	5,686.7	2.89
OTHER PELAGICS TOTAL and AVERAGE PRICE	**15,197.3**	**37,803.2**	**2.49**
PELAGICS TOTAL and AVERAGE PRICE	**177,619.4**	**464,101.3**	**2.61**

Note: Total pelagic landings are 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 of offshore daytime creel surveys in the CNMI from 2010-2019

Year	Total Trips	Total Bycatch	Bycatch Charter	Bycatch Non Charter
2010	115	0	0	0
2011	105	0	0	0
2012	126	0	0	0
2013	149	0	0	0
2014	144	0	0	0
2015	102	0	0	0
2016	100	0	0	0
2017	109	0	0	0
2018	108	0	0	0
2019	58	0	0	0

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

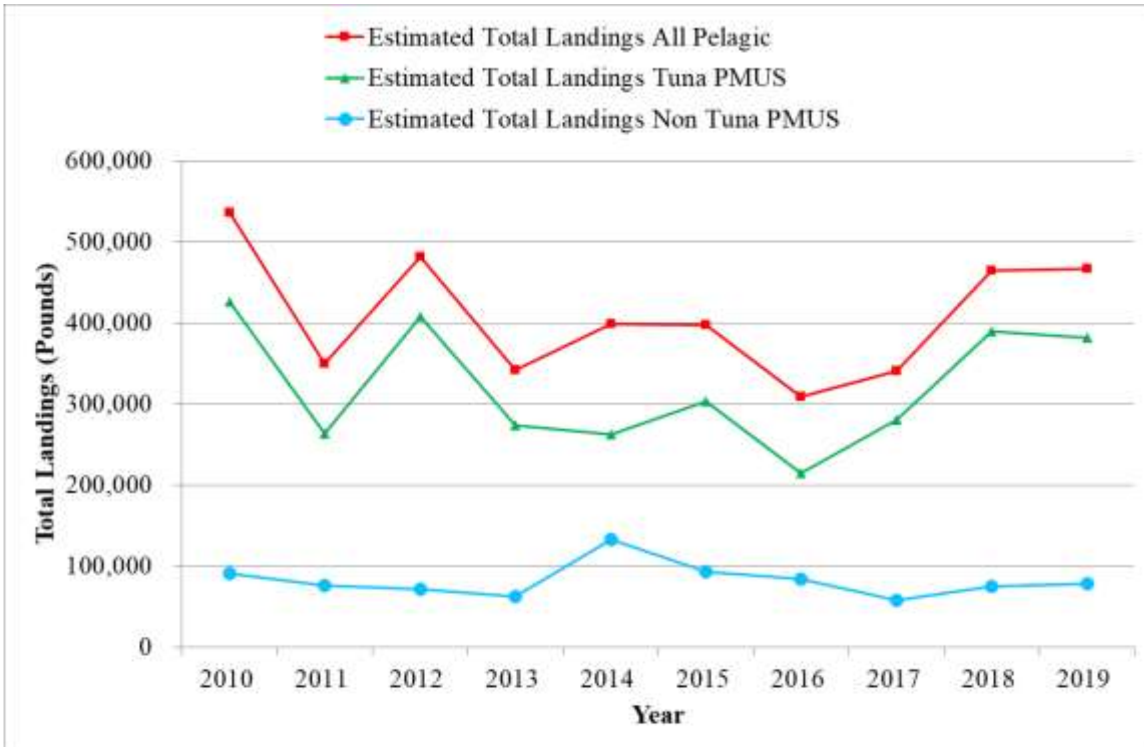


Figure 27. Total estimated annual catch for all pelagics, tuna PMUS, and non-tuna PMUS in the CNMI from 2010-2019

Supporting data shown in Table A-27.

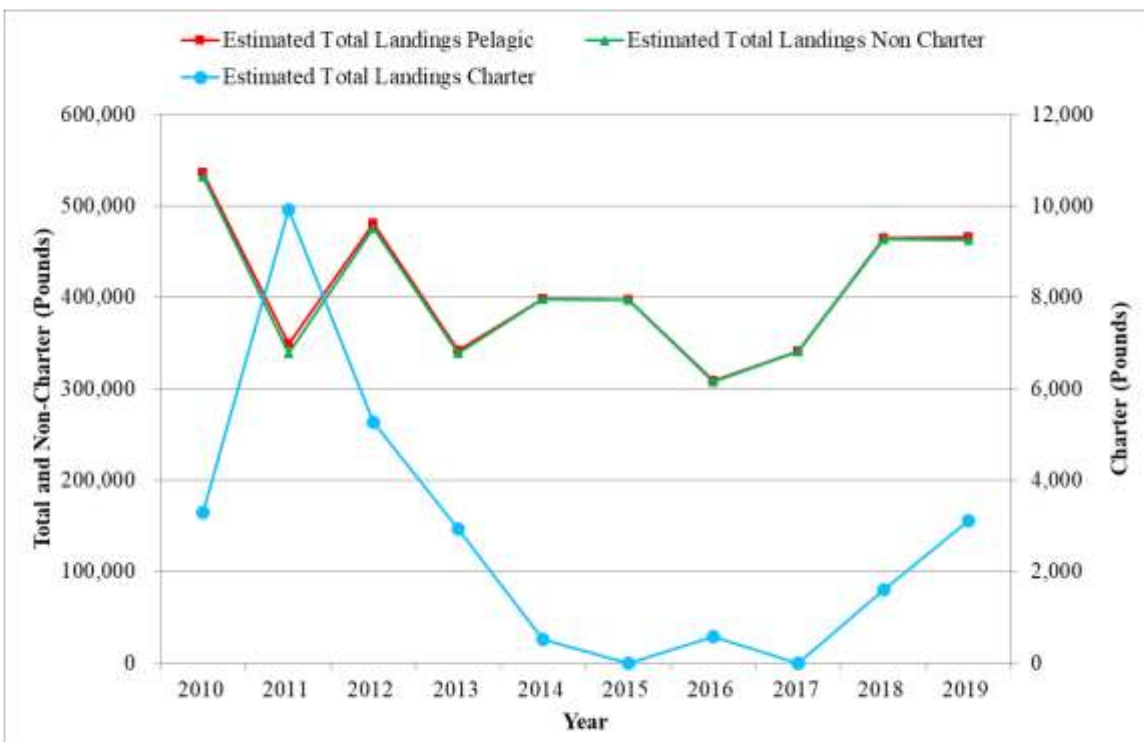


Figure 28. Total estimated annual catch for all pelagics in the CNMI from 2010-2019

Supporting data shown in Table A-28.

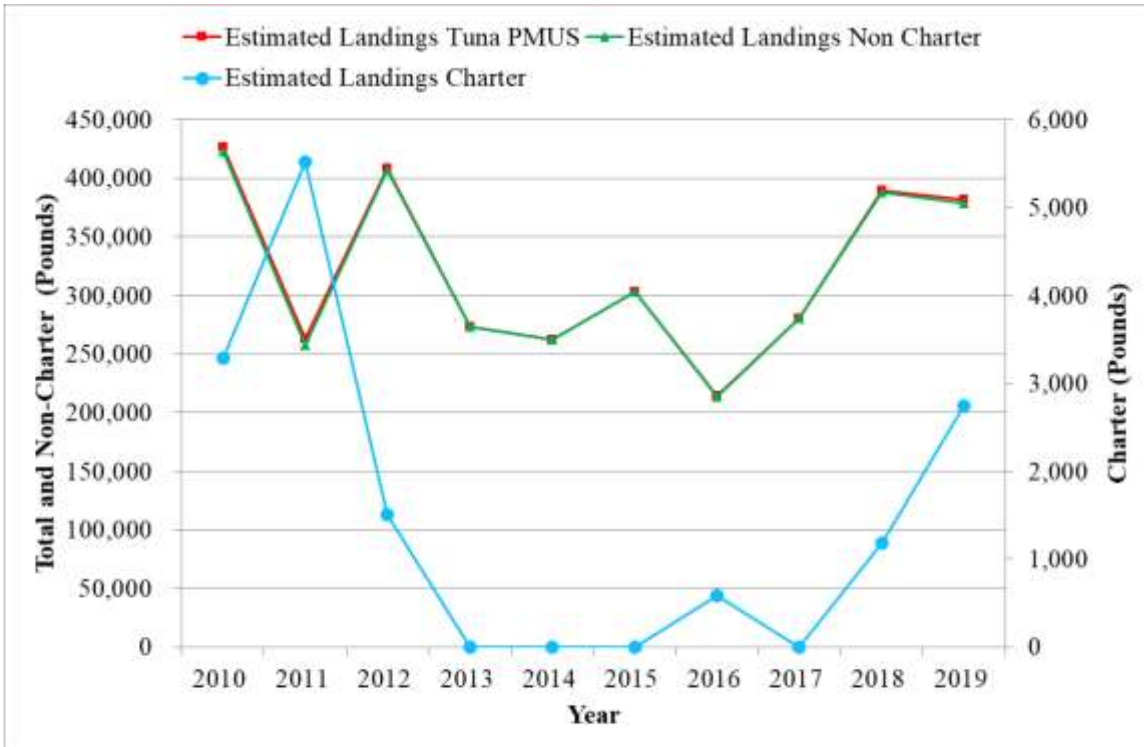


Figure 29. Total estimated annual catch for tuna PMUS in the CNMI from 2010-2019
Supporting data shown in Table A-29.

Figure 30. Total estimated annual catch for non-tuna PMUS in the CNMI from 2010-2019
Supporting data shown in Table A-30.

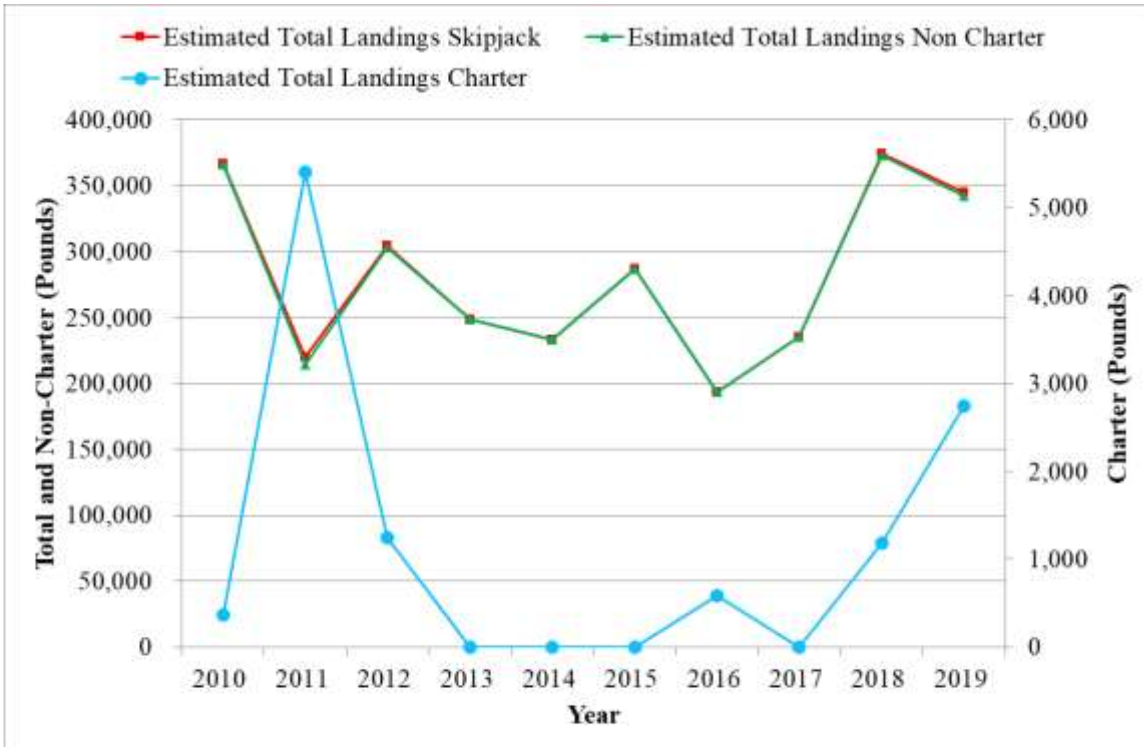


Figure 31. Total estimated annual catch for skipjack in the CNMI from 2010-2019

Supporting data shown in Table A-31.

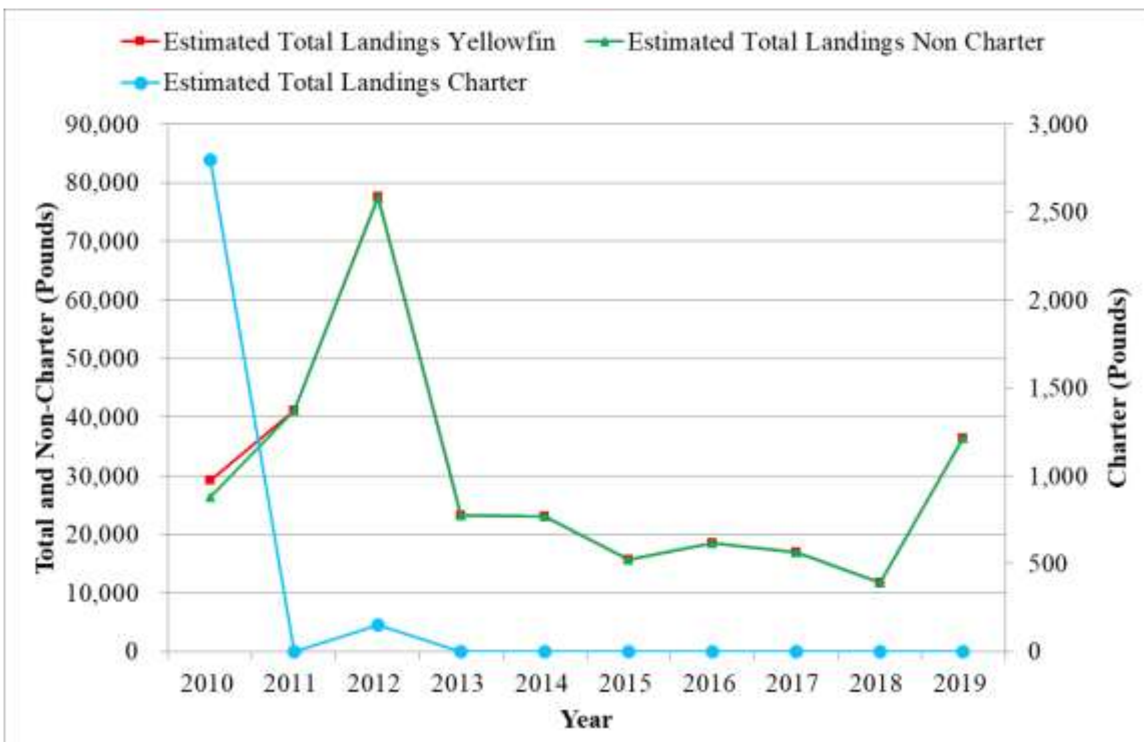


Figure 32. Total estimated annual catch for yellowfin in the CNMI from 2010-2019

Supporting data shown in Table A-32.

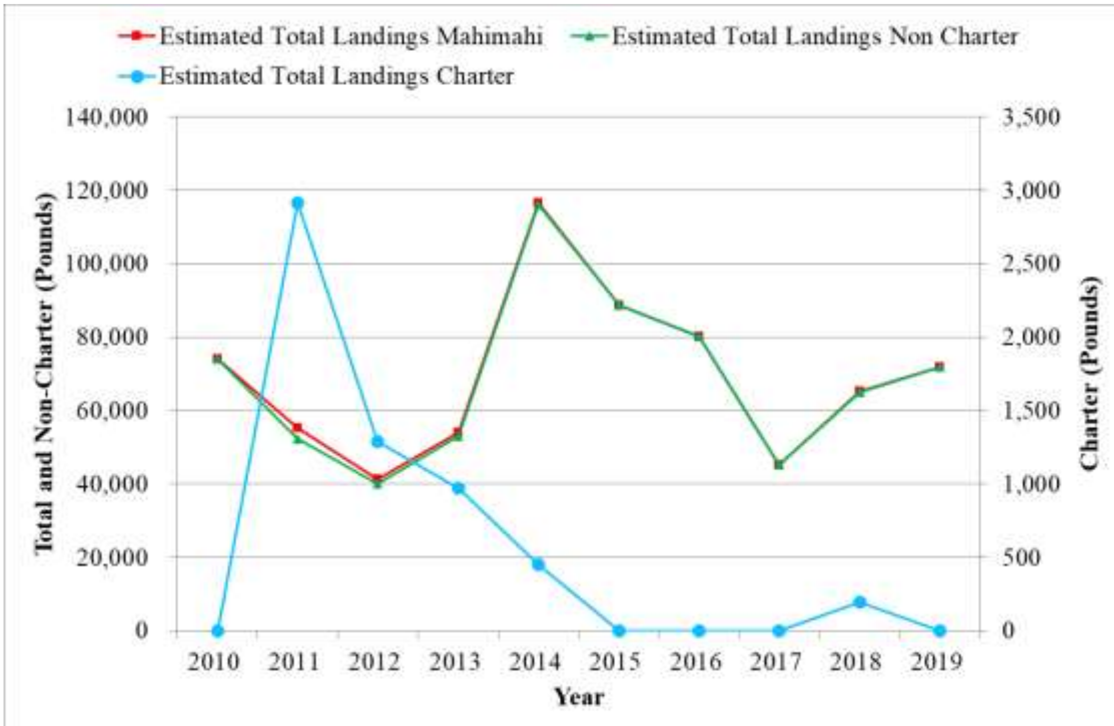


Figure 33. Total estimated annual catch for mahimahi in the CNMI from 2010-2019
Supporting data shown in Table A-33.

Figure 34. Total estimated annual catch for wahoo in the CNMI from 2010-2019
Supporting data shown in Table A-34.

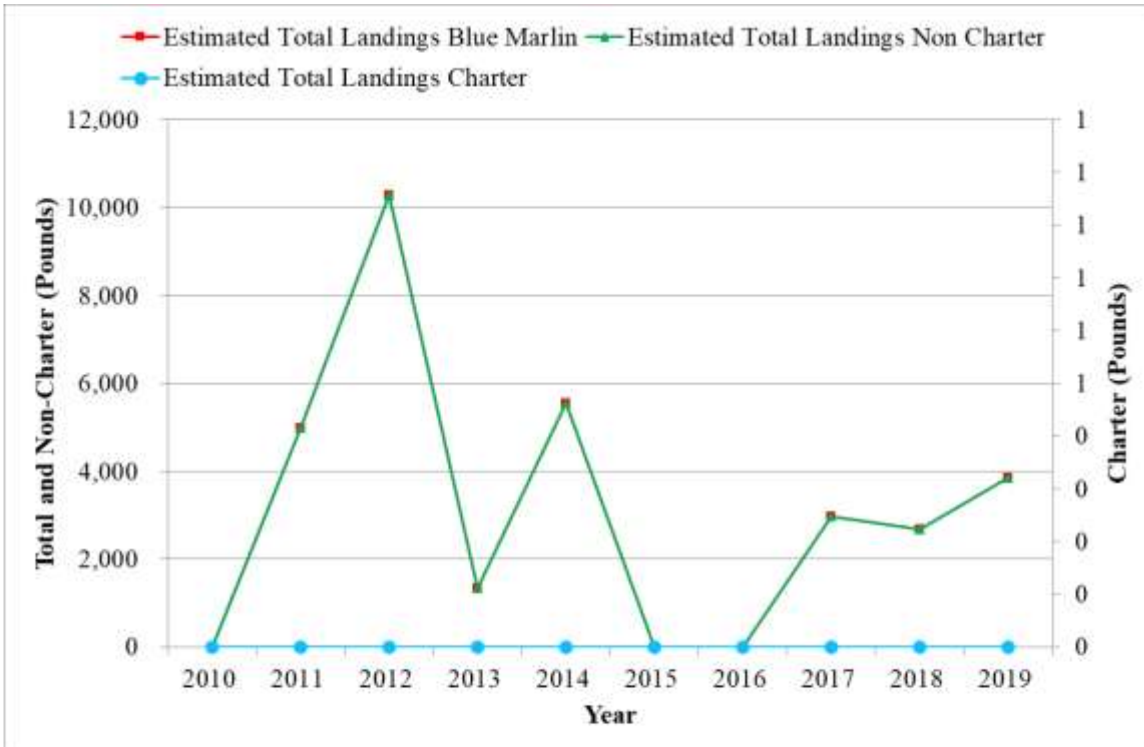


Figure 35. Total estimated annual catch for blue marlin in the CNMI from 2010-2019

Supporting data shown in Table A-35.

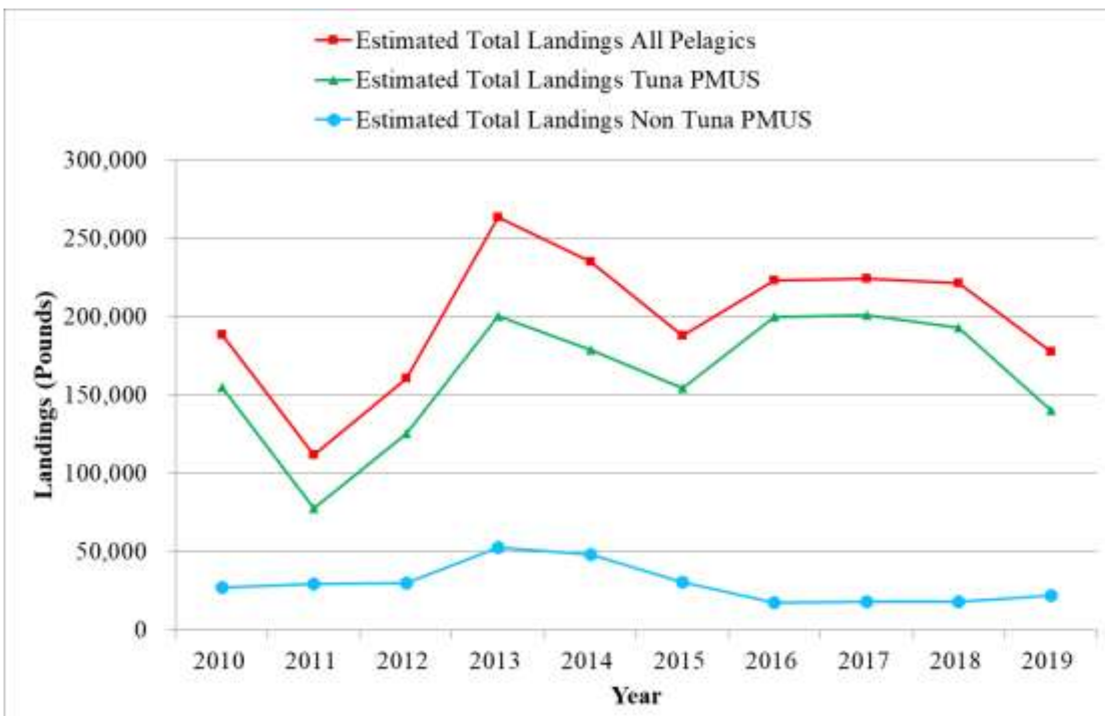


Figure 36. Annual commercial landings for all pelagics, tuna PMUS, and non-tuna PMUS in the CNMI from 2010-2019

Supporting data shown in Table A-36.

Figure 37. Annual commercial landings for skipjack and yellowfin in the CNMI from 2010-2019

Supporting data shown in Table A-37.

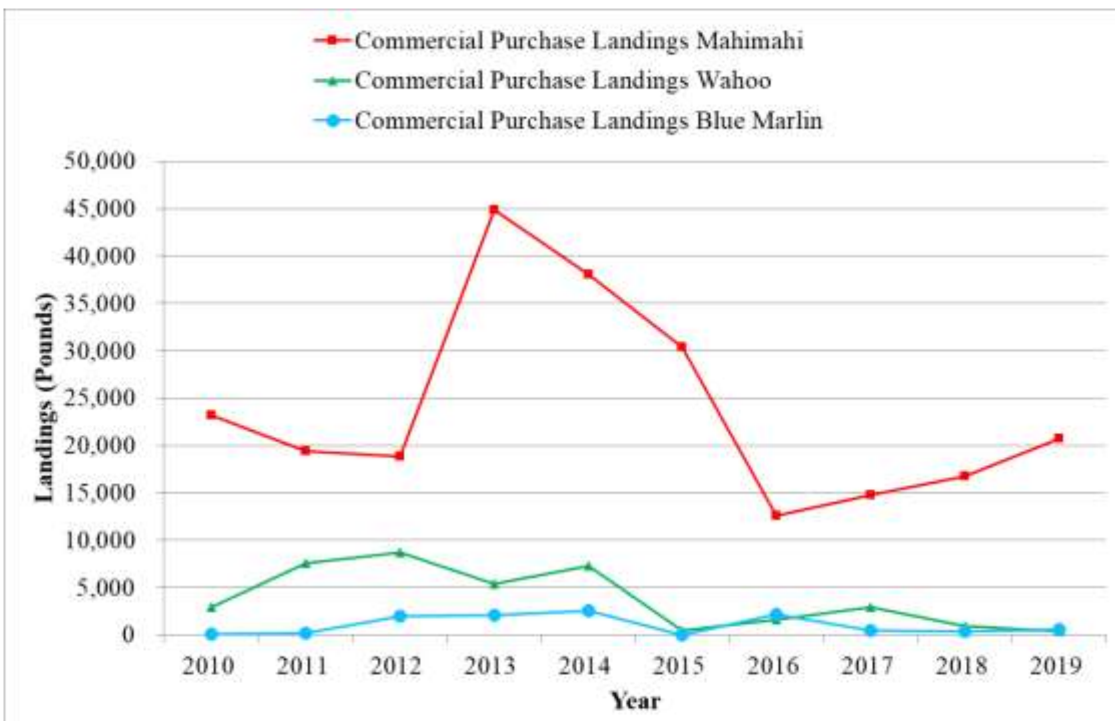


Figure 38. Annual commercial landings for mahimahi, wahoo, and blue marlin in the CNMI from 2010-2019

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.

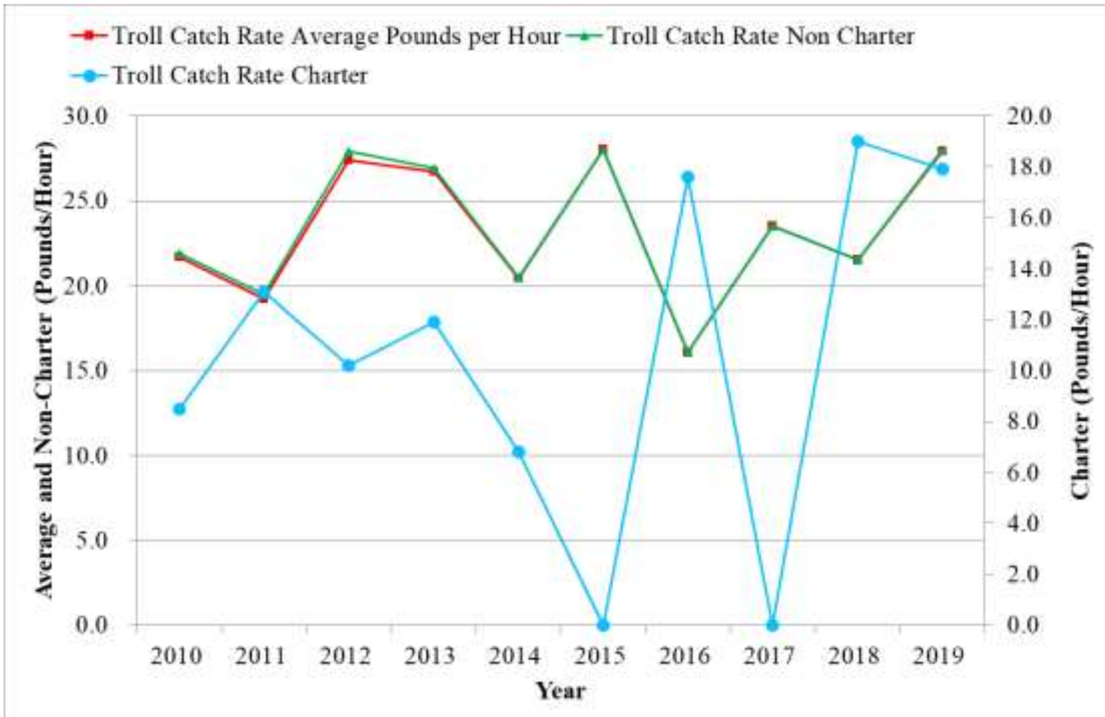


Figure 39. Estimated trolling catch rates (lbs./hr) from creel surveys in the CNMI from 2010-2019

Supporting data shown in Table A-39.

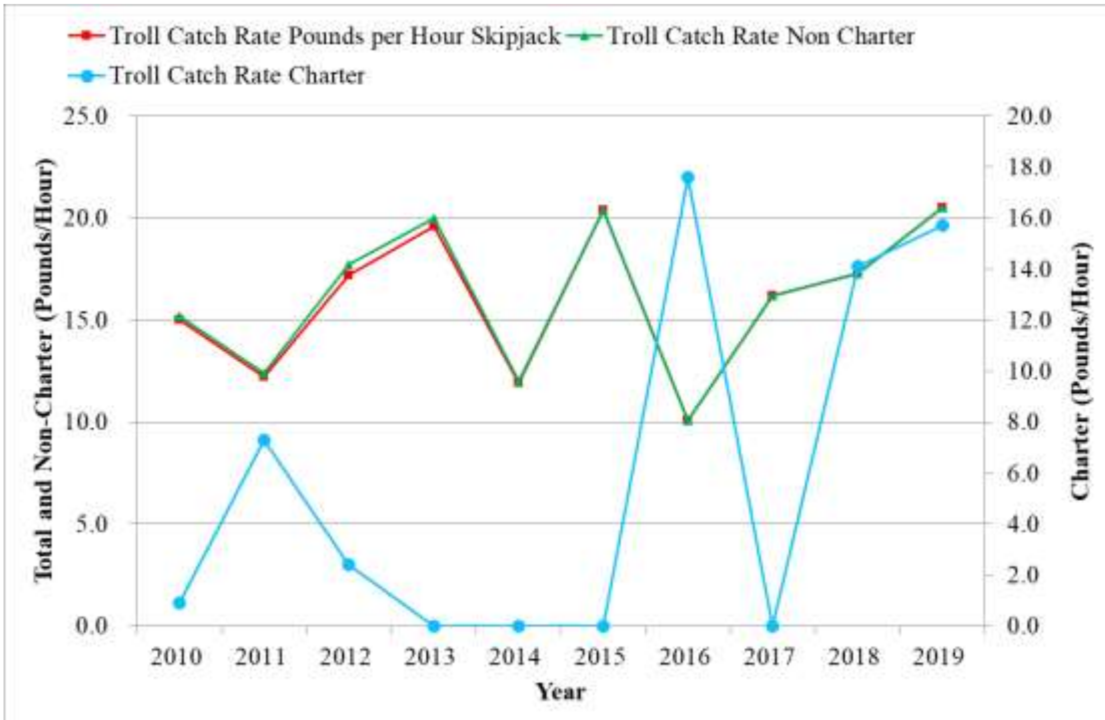


Figure 40. Estimated trolling catch rates (lbs./hr) for skipjack from creel surveys in the CNMI from 2010-2019

Supporting data shown in Table A-40.

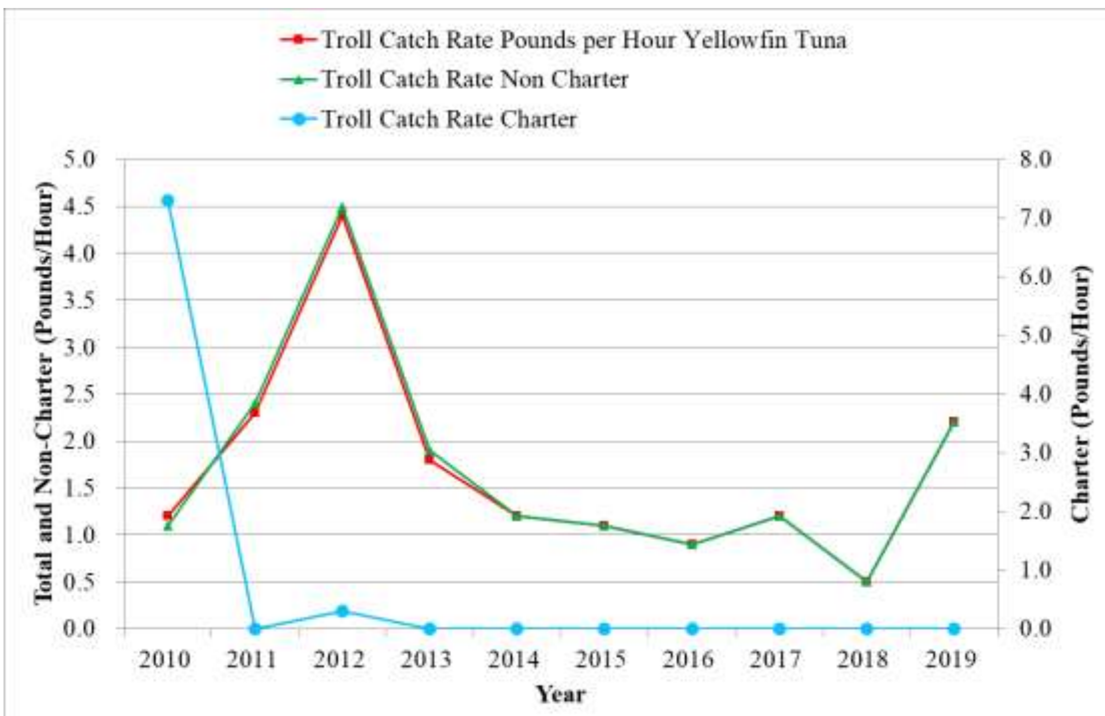


Figure 41. Estimated trolling catch rates (lbs./hr) for yellowfin from creel surveys in the CNMI from 2010-2019

Supporting data shown in Table A-41.

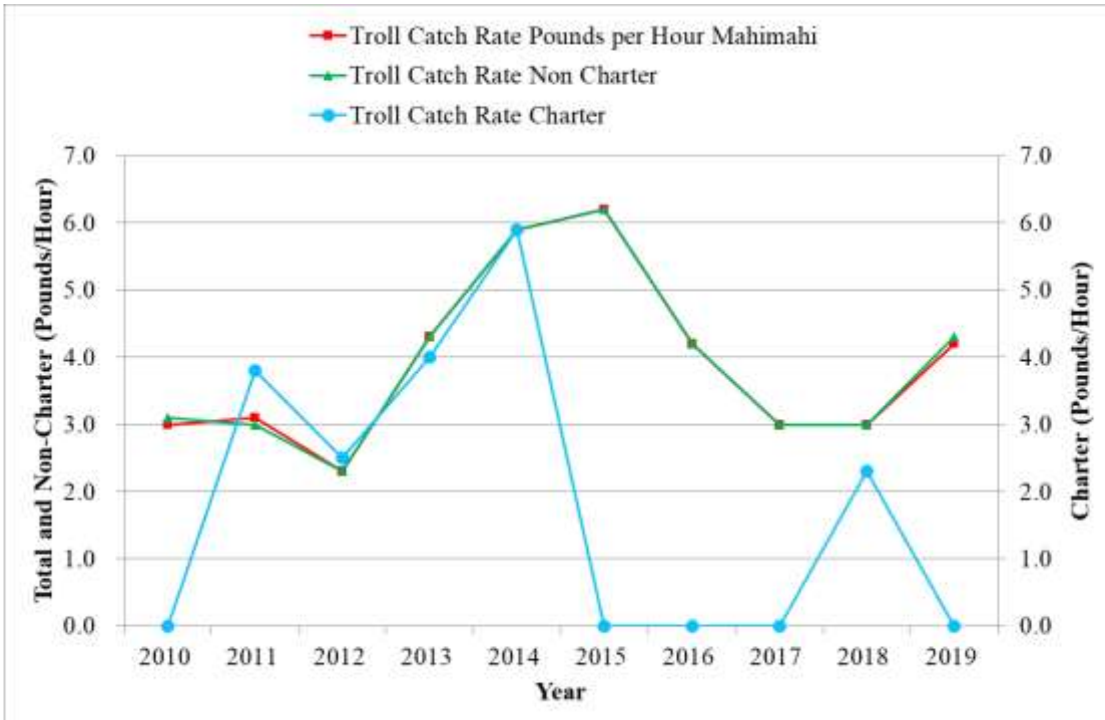


Figure 42. Estimated trolling catch rates (lbs./hr) for mahimahi from creel surveys in the CNMI from 2010-2019

Supporting data shown in Table A-42.

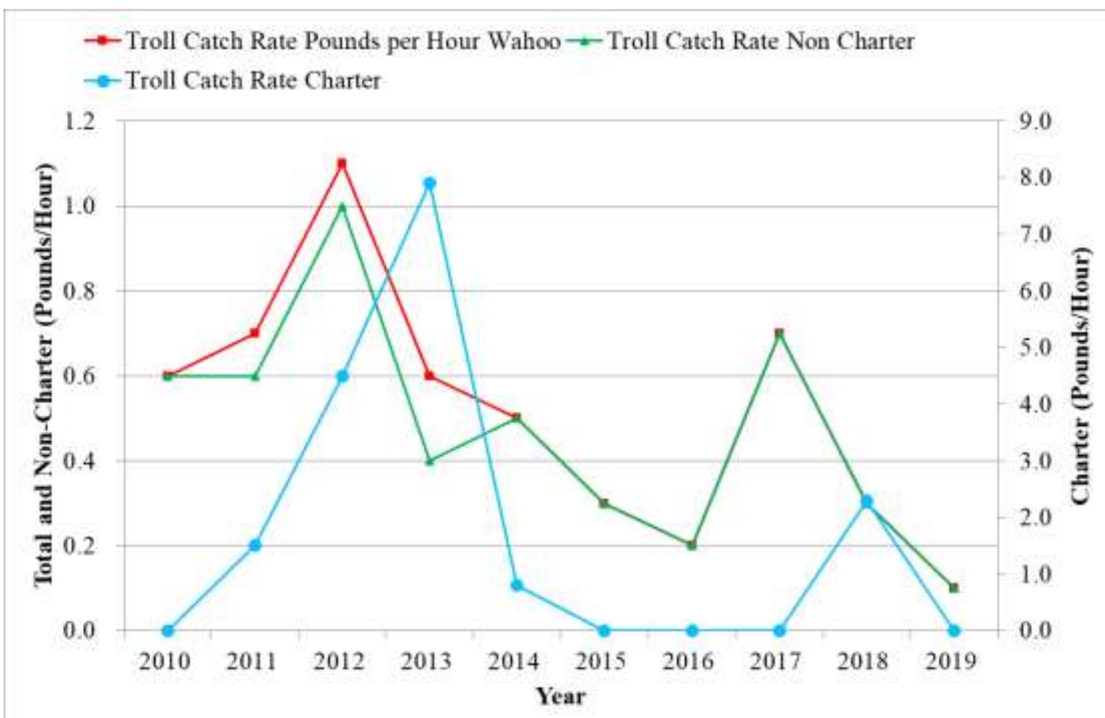


Figure 43. Estimated trolling catch rates (lbs./hr) for wahoo from creel surveys in the CNMI from 2010-2019

Supporting data shown in Table A-43.

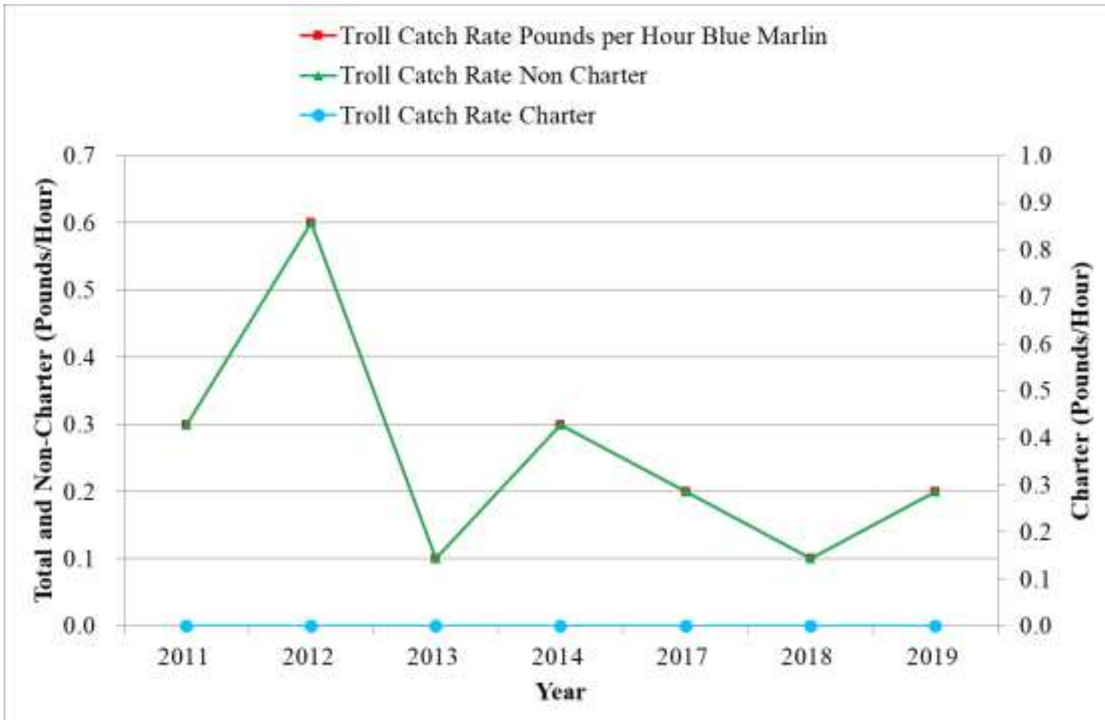


Figure 44. Estimated trolling catch rates (lbs./hr) for blue marlin from creel surveys in the CNMI from 2011-2019

Supporting data shown in Table A-44.

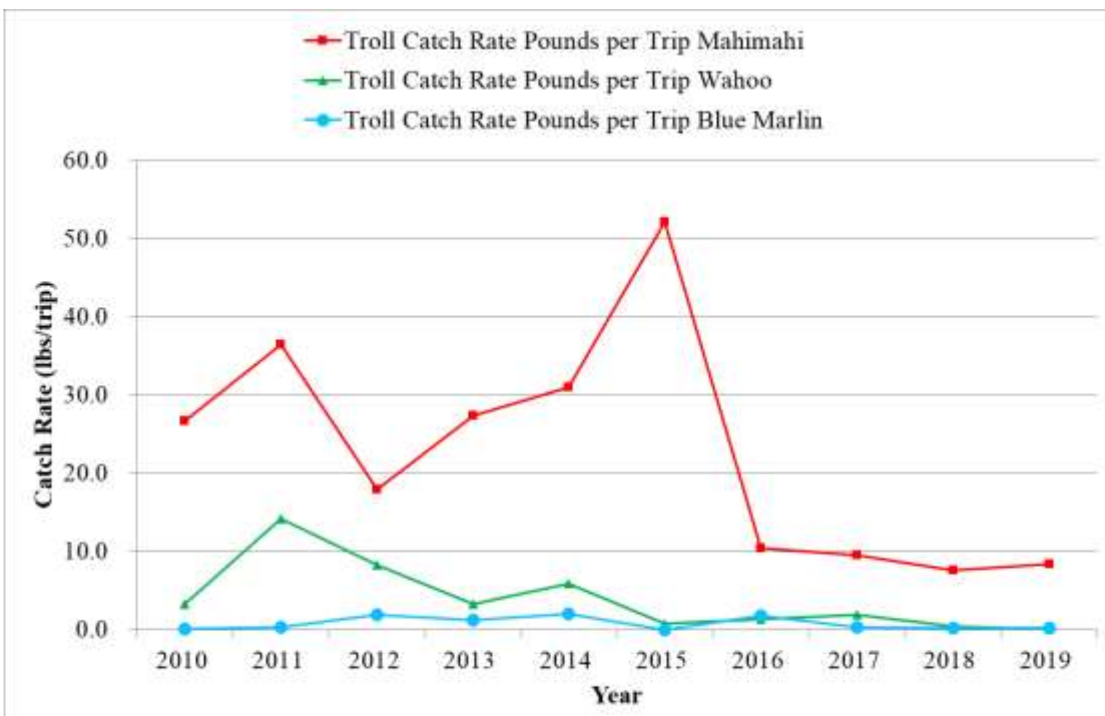


Figure 45. Estimated trolling catch rates (lbs./trip) for mahimahi, wahoo, and blue marlin in the CNMI from 2010-2019

Supporting data shown in Table A-45.

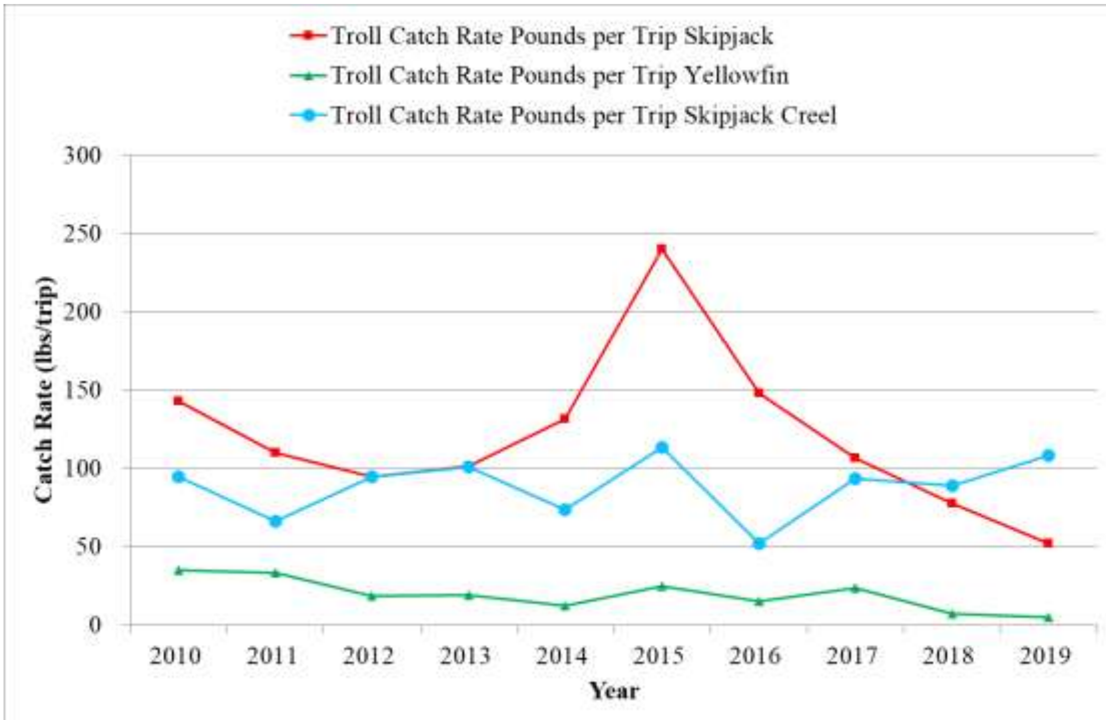


Figure 46. Estimated trolling catch rates (lbs./trip) for skipjack and yellowfin tuna in the CNMI from 2009-2018

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 WPacFIN and the WPRFMC. Data are gathered through the offshore creel survey data program. In the past 10 years, DAWR staff have logged between 90 and 97 survey days annually (see Table A-47). The number of trips logged in boat logs has varied from 498 to 1,147 during that period, with the number of interviews slightly greater than half of that year's total trips. In 2019, DAWR completed 96 survey days, logging 930 trips during that time, and conducted 620 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 WPacFIN-sponsored commercial landings system through the commercial receipt book. Transshipment landings data are obtained from the Bureau of Statistics and Plans. Some tables include landings of several species of barracuda and the double-lined mackerel 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 between tables.

The shortage of staff biologists has been significant in the past several years. DAWR staff biologists continue to oversee several projects simultaneously, while providing on-going training to ensure the high quality of data being collected by all staff. All fisheries staff are trained to identify the most commonly caught fish to the species level. New staff are mentored by biologists and senior technicians in the field before conducting creel surveys on their own.

Total commercial landings are estimated by summing the weight fields in the commercial landings database from the principal fish wholesalers on 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 varied widely in the 39-year time series, ranging between 383,000 and 958,000 lbs. The average total catch has shown a slowly increasing trend over the reporting period. The 2019 total expanded pelagic landings were 840,322 lbs., a decrease of 5.77 % when compared with 2018's total. Tuna PMUS decreased 14.9%, while non-tuna PMUS increased 18%. 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 2019, with sharks noted in specific fishermen interviews conducted in 2019 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 2019 from the previous year's levels. Skipjack decreased 21.4%, and wahoo decreased by 66.05%. Yellowfin tuna catch increased 61.4%, mahimahi catch increased 83%, and blue marlin, which accounts for the largest percentage of non-tuna PMUS landed on Guam, increased 128.5%. Both mahimahi and wahoo catches fluctuate erratically from year to year, although both appear to be experiencing a long-term downward trend.

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 2015-2019, transshipment data were confidential because there were less than three transshipment agents collecting the data.

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 472 boats involved in Guam's pelagic fishery in 2019, an increase of 16% from 2018 numbers. 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 (~5%), but economically significant, segment 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 2019 was 27, equaling 65 closure days, down from 87 closure days in 2018. This certainly impacted the number of fishing days south of Guam.

Weather can also affect the number of available fishing days. In 2019, 114 days were either high surf or small craft advisory in the waters around Guam. There were 0 days in April through July. As yellowfin tuna and blue marlin are traditionally caught in higher numbers during summer months, good weather conditions may have facilitated higher catches.

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 (lbs. per hour fished) showed a decrease from 2018. Total CPUE decreased 14.7%. Yellowfin tuna, blue marlin, and mahimahi CPUE increased, while skipjack tuna and wahoo CPUEs decreased slightly. The fluctuations in CPUE are possibly due to variability in the year-to-year abundance and availability of the stocks.

Revenues. Commercial revenues increased in 2019, with total adjusted revenues increasing 43.5%. Tuna PMUS decreased 4.6%, non-tuna PMUS increased 106.9%. Commercial landings have shown a decreasing trend over the past twenty years, but 2019 was the highest level in 6 years, and 3.3% over the time series average. 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 very low bycatch in the charter fishery. In 2019, there were 150 reported bycatch in 7,799 fish caught, for a 2% rate. Bycatch occasionally occurs in the troll fishery including sharks, shark-bitten and undersized fish.

In 2019, fishers were asked if they experienced a shark interaction. There was a total of 789 interviews for boat based fishing in 2019, with 335 of these inappropriate for determining shark interaction. Of the remaining 454 interviews, 218 reported interactions with sharks, 236 reported no interactions with sharks, a 48% positive rate for interviews where fishers were asked about shark interactions.

2.3.3 PLAN TEAM RECOMMENDATIONS

Regarding the Guam data module in the 2019 annual SAFE report, Plan Team members agreed to carry out the following module improvements:

1. Improve bycatch data summaries to include amount and type (species and condition) of bycatch, where data are available.

2.3.4 OVERVIEW OF PARTICIPATION

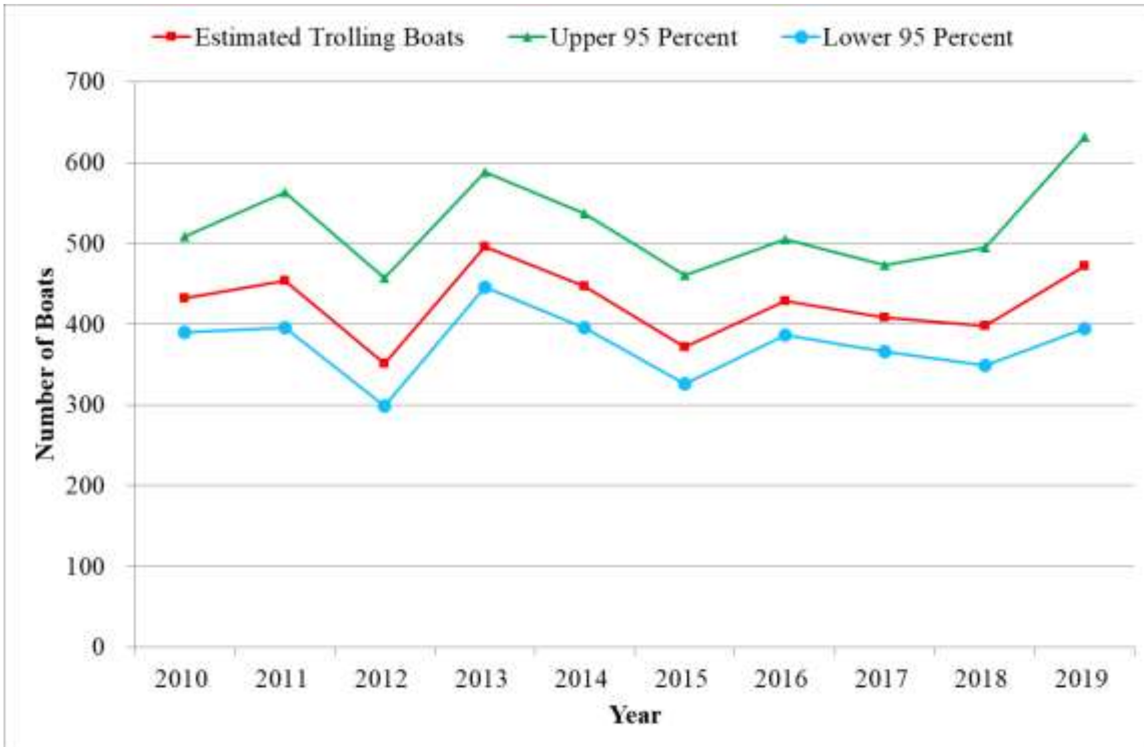


Figure 47. Total estimated vessels in Guam pelagic fisheries from 2010-2019

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 (lbs.) for Guam in 2019

Species	Total Landings	Non Charter	Charter
Skipjack Tuna	479,966	466,653	13,313
Yellowfin Tuna	84,825	82,705	2,120
Kawakawa	95	95	0
Albacore	0	0	0
Bigeye Tuna	0	0	0
Other Tuna PMUS	0	0	0
TUNAS Total	**564,886**	**549,453**	**15,433**
Mahimahi	162,541	136,431	26,109
Wahoo	32,600	29,094	3,506
Blue Marlin	56,020	47,995	8,025
Black Marlin	0	0	0
Striped Marlin	0	0	0
Sailfish	1,459	1,459	0

Shortbill Spearfish	0	0	0
Swordfish	0	0	0
Oceanic Sharks	0	0	0
Pomfrets	82	19	64
Oilfish	0	0	0
NON-TUNA PMUS Total	**252,702**	**214,998**	**37,704**
Dogtooth Tuna	6,922	6,922	0
Rainbow Runner	11,383	11,084	300
Barracudas	4,428	4,428	0
Double-lined Mackerel	11	11	0
Misc. Troll Fish	0	0	0
OTHER PELAGICS Total	**22,744**	**22,445**	**300**
TOTAL PELAGICS	**840,332**	**786,896**	**53,437**

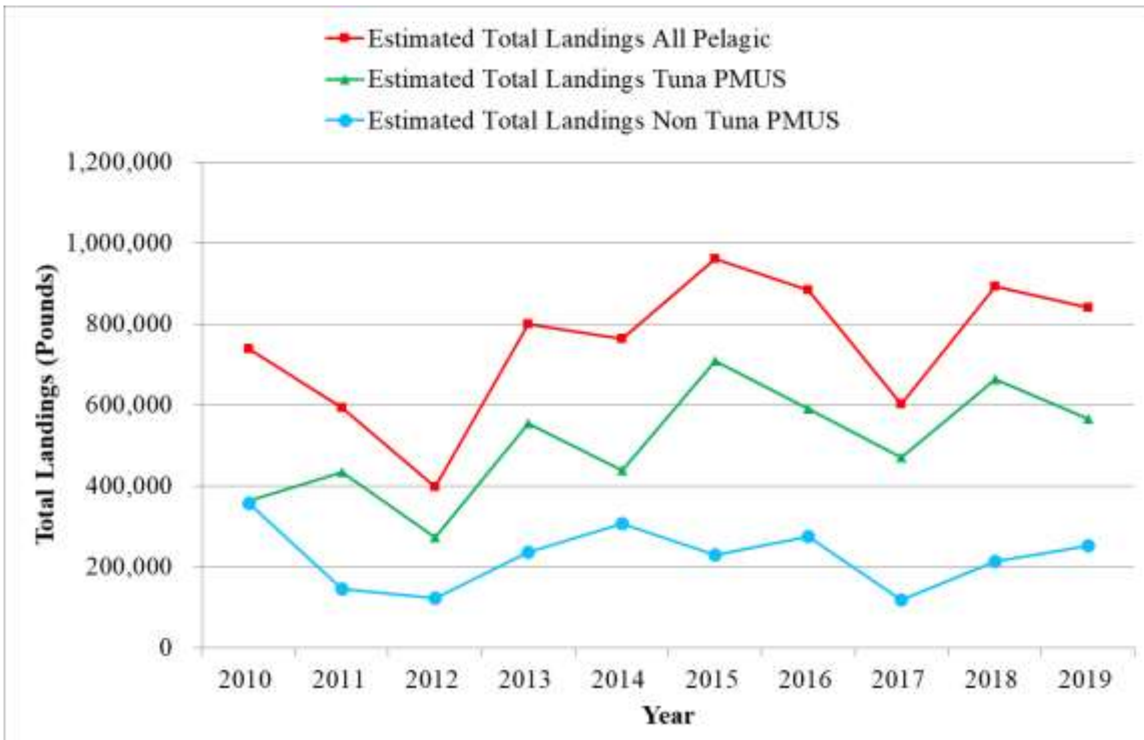


Figure 48. Total estimated annual landings in Guam for all pelagics, tuna PMUS, and non-tuna PMUS from 2010-2019

Supporting data shown in Table A-49.

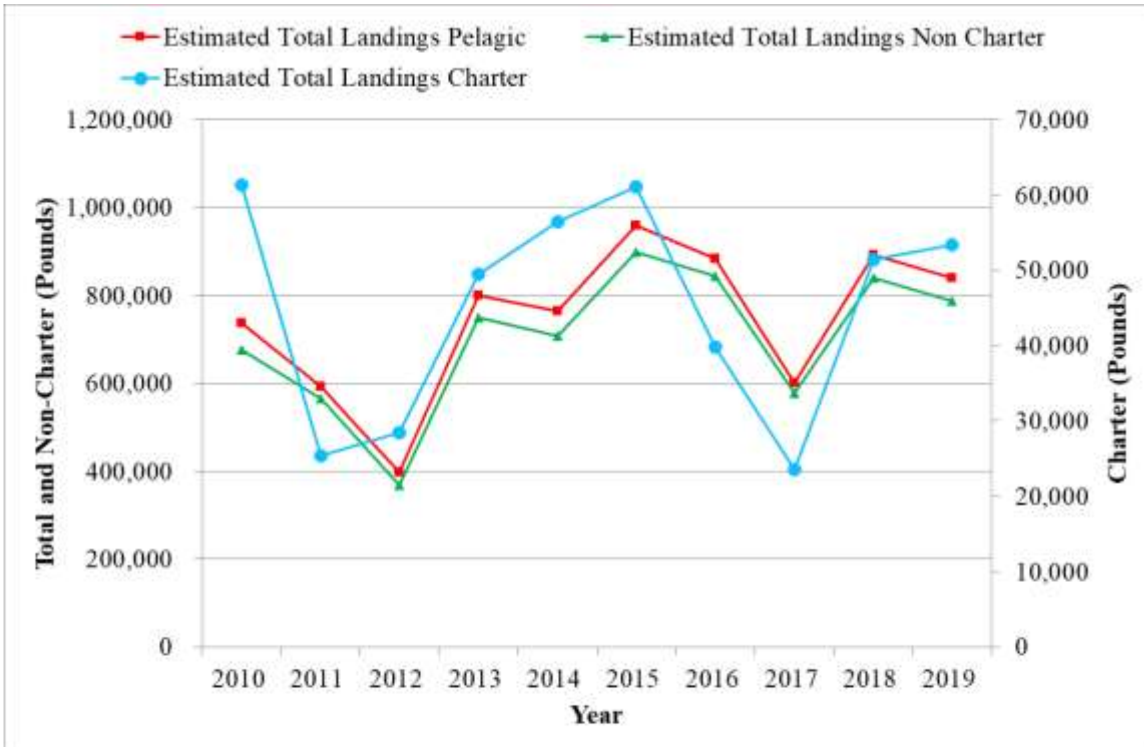


Figure 49. Total estimated annual pelagic landings in Guam from 2010-2019
Supporting data shown in Table A-50.

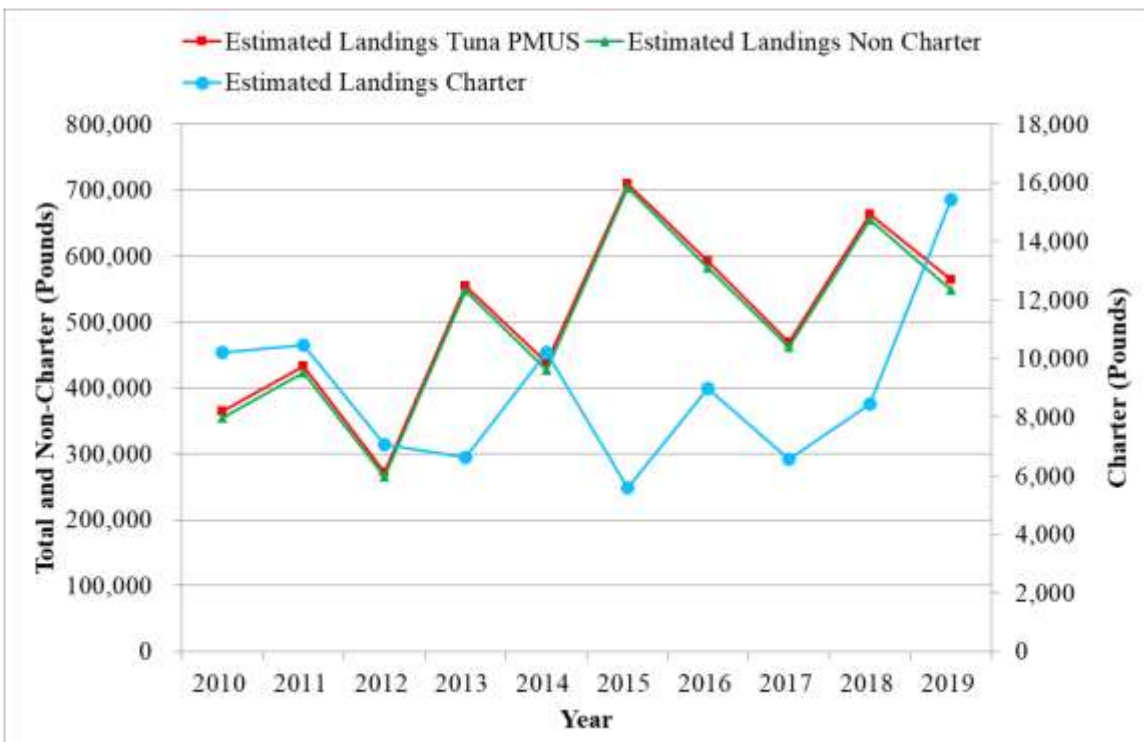


Figure 50. Total estimated annual tuna PMUS landings in Guam from 2010-2019
Supporting data shown in Table A-51.

Figure 51. Total estimated annual skipjack tuna landings in Guam from 2010-2019
Supporting data shown in Table A-52.

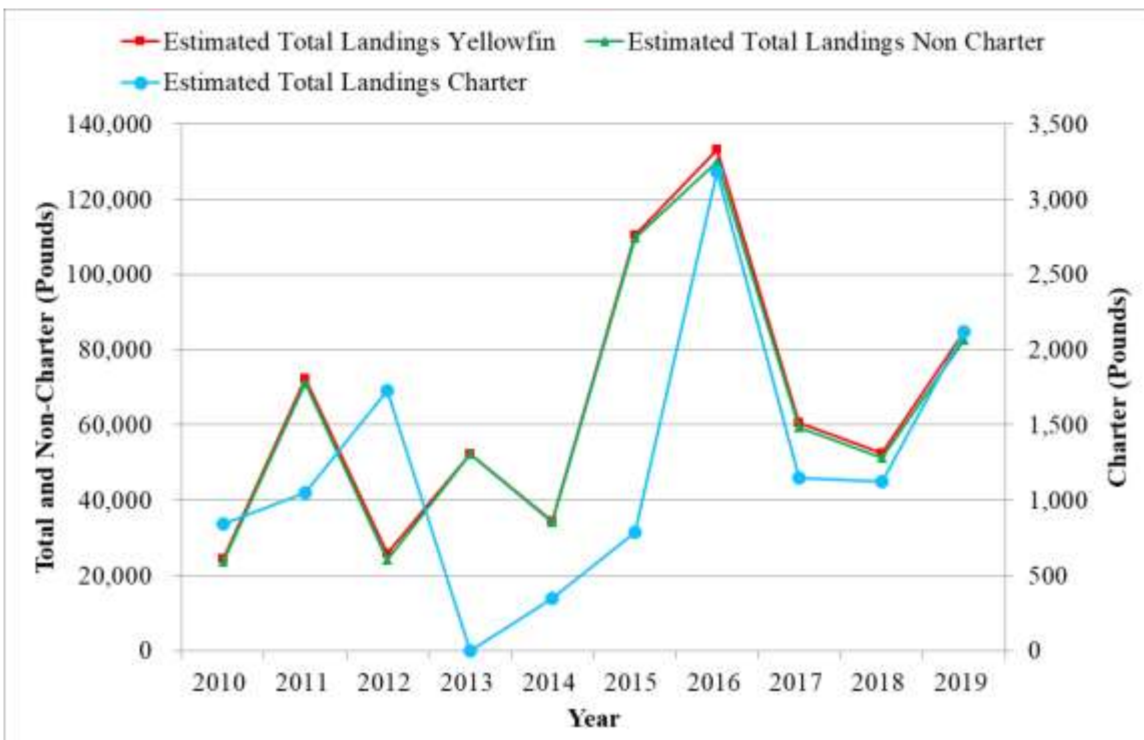


Figure 52. Total estimated annual yellowfin landings in Guam from 2010-2019
Supporting data shown in Table A-53.

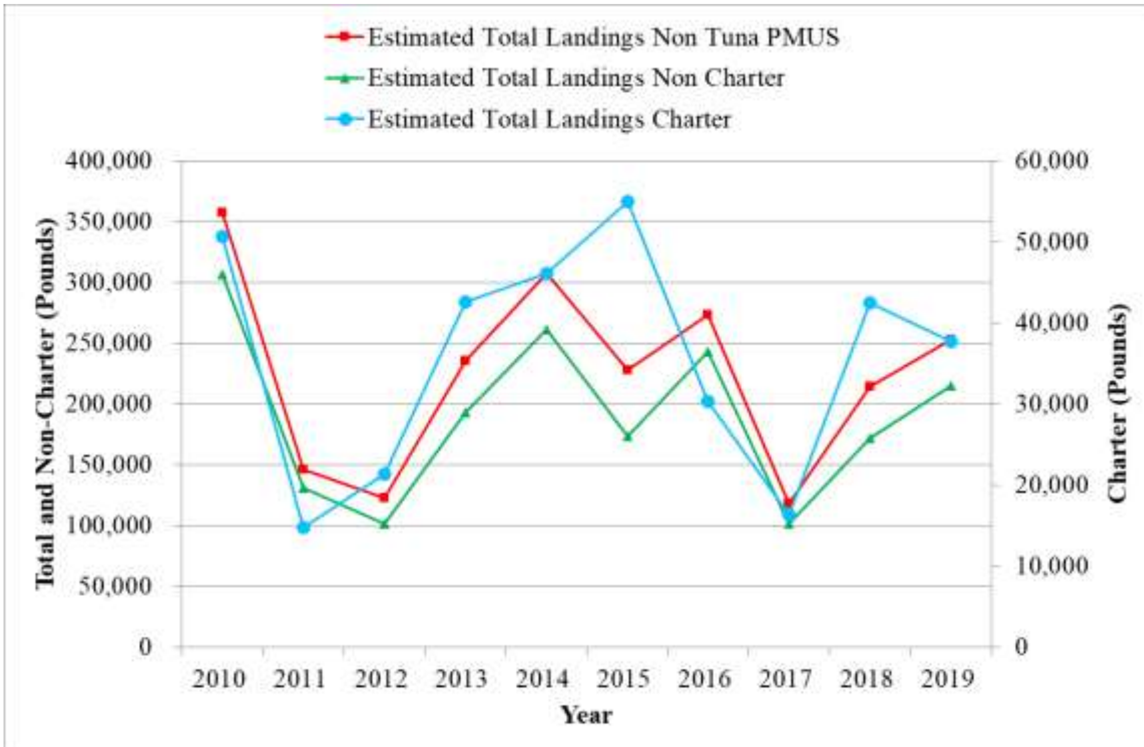


Figure 53. Total estimated annual non-tuna PMUS landings in Guam from 2010-2019
Supporting data shown in Table A-54.

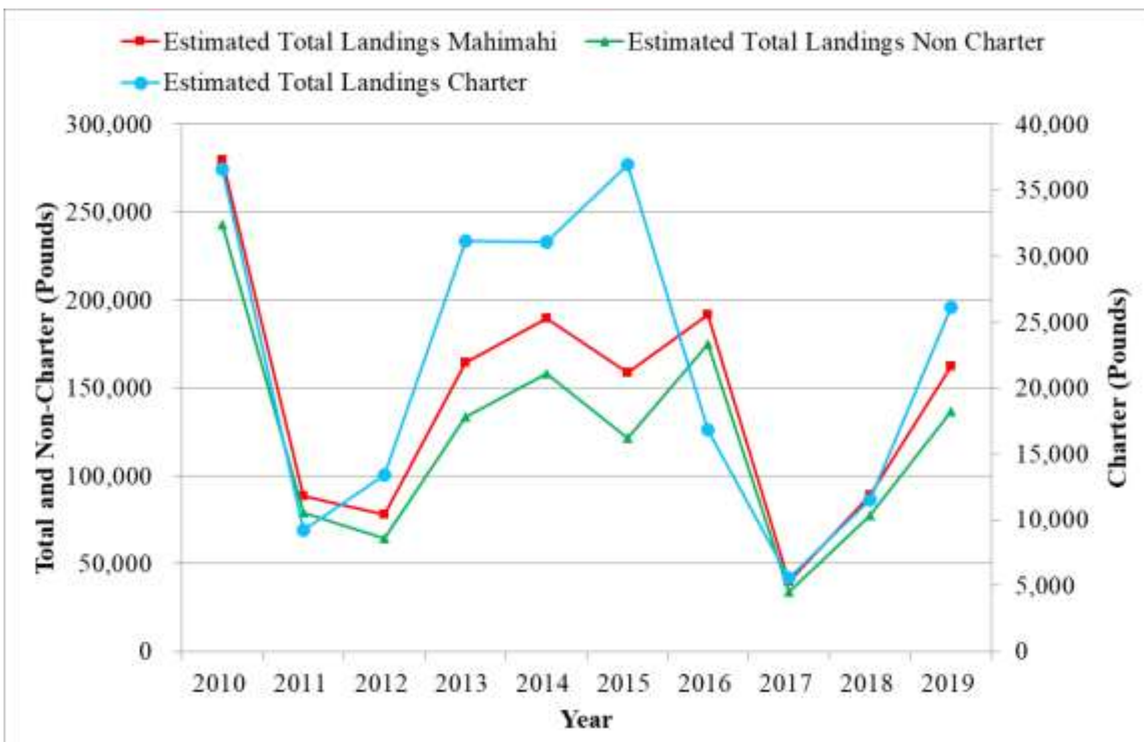


Figure 54. Total estimated annual mahimahi landings in Guam from 2010-2019
Supporting data shown in Table A-55.

Figure 55. Total estimated annual wahoo landings in Guam from 2010-2019
Supporting data shown in Table A-56.

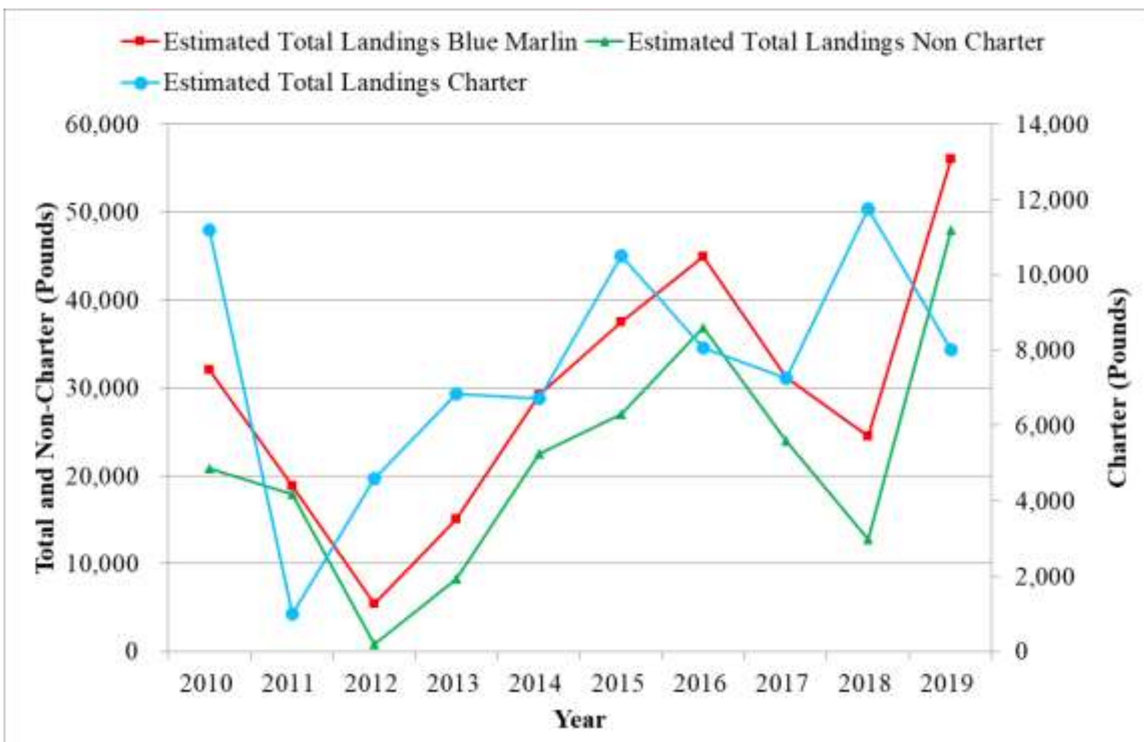


Figure 56. Total estimated annual blue marlin landings in Guam from 2010-2019
Supporting data shown in Table A-57.

Table 18. Bycatch summary for Guam trolling fisheries from 2010-2019

Year	Number Release	Percent Release	Number Kept	Number Caught	Charter
2010	0	0.0	6,269	6,269	F
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
2010	0	0.0	567	567	T
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
2017	0	0.0	231	231	T
2018	0	0.0	284	284	T
2019	0	0.0	315	315	T

Table 19. Bycatch species summary for Guam trolling fisheries from 2010-2019

Year	Species	Number Release	Percent Release	Number Kept	Number Caught	Charter
2011	Skipjack Tuna	1	0.0	7,272	7,273	F
2013	Yellowfin Tuna	6	1.6	373	379	F
2013	Skipjack Tuna	21	0.4	5,474	5,495	F
2013	Rainbow Runner	1	3.0	32	33	F
2014	Skipjack Tuna	19	0.5	3,914	3,933	F
2014	Barracudas	1	2.6	38	39	F
2014	Yellowfin Tuna	1	0.4	271	272	F
2018	Yellowfin Tuna	1	0.3	343	344	F
2018	Wahoo	1	0.2	568	569	F
2019	Yellowfin Tuna	2	0.4	531	533	F
2019	Skipjack Tuna	148	2.5	5,862	6,010	F
2016	Skipjack Tuna	3	2.4	124	127	T
2016	Mahimahi	3	2.2	133	136	T

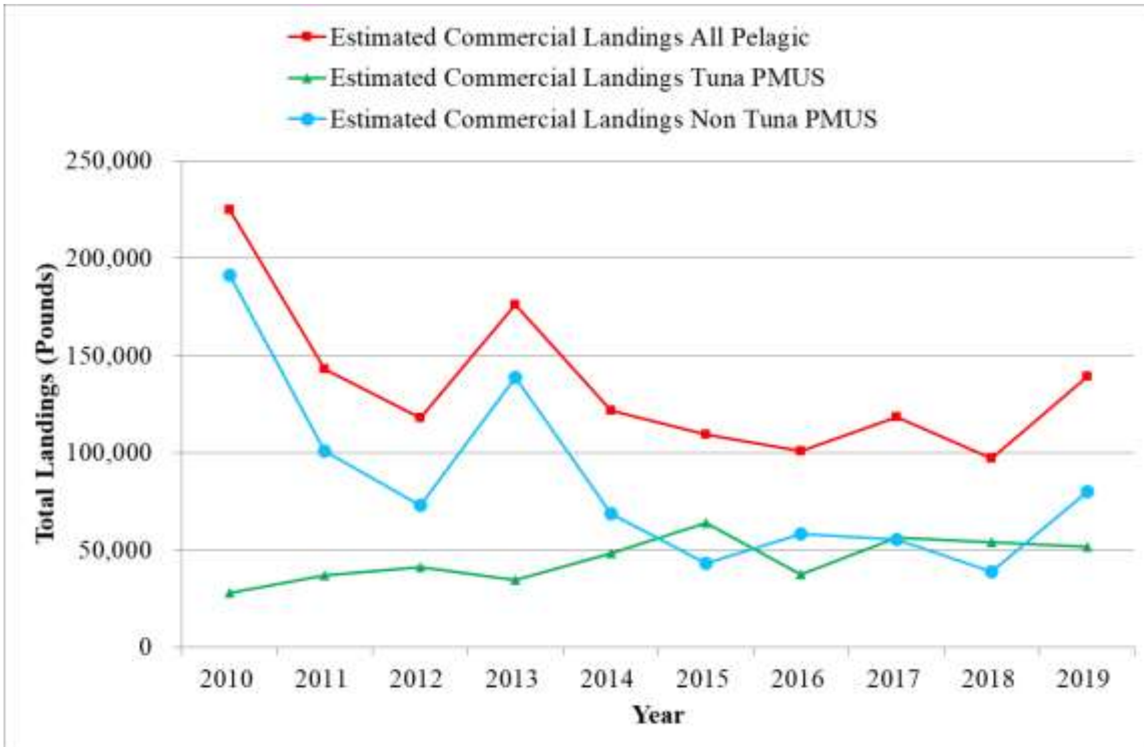


Figure 57. Annual estimated commercial landings for all pelagics, tuna PMUS, and non-tuna PMUS in Guam from 2010-2019

Supporting data shown in Table A-58.

2.3.6 OVERVIEW OF EFFORT AND CPUE

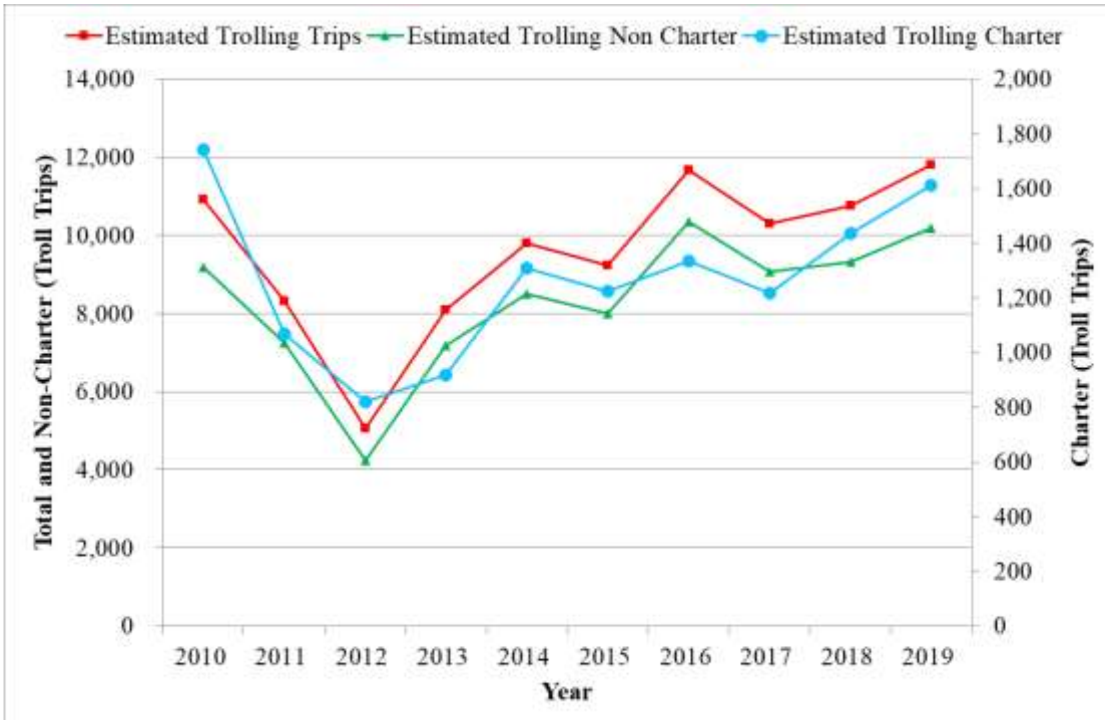


Figure 58. Total estimated number of trolling trips in Guam from 2010-2019

Supporting data shown in Table A-59.

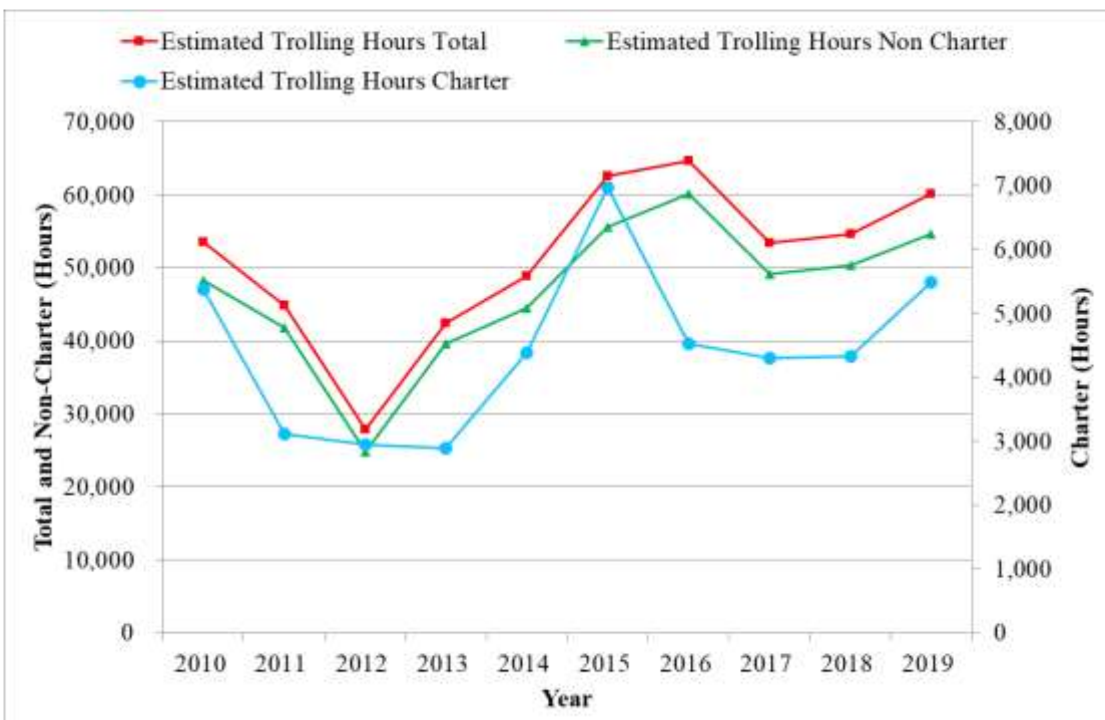


Figure 59. Total estimated number of trolling hours in Guam from 2010-2019

Supporting data shown in Table A-60.

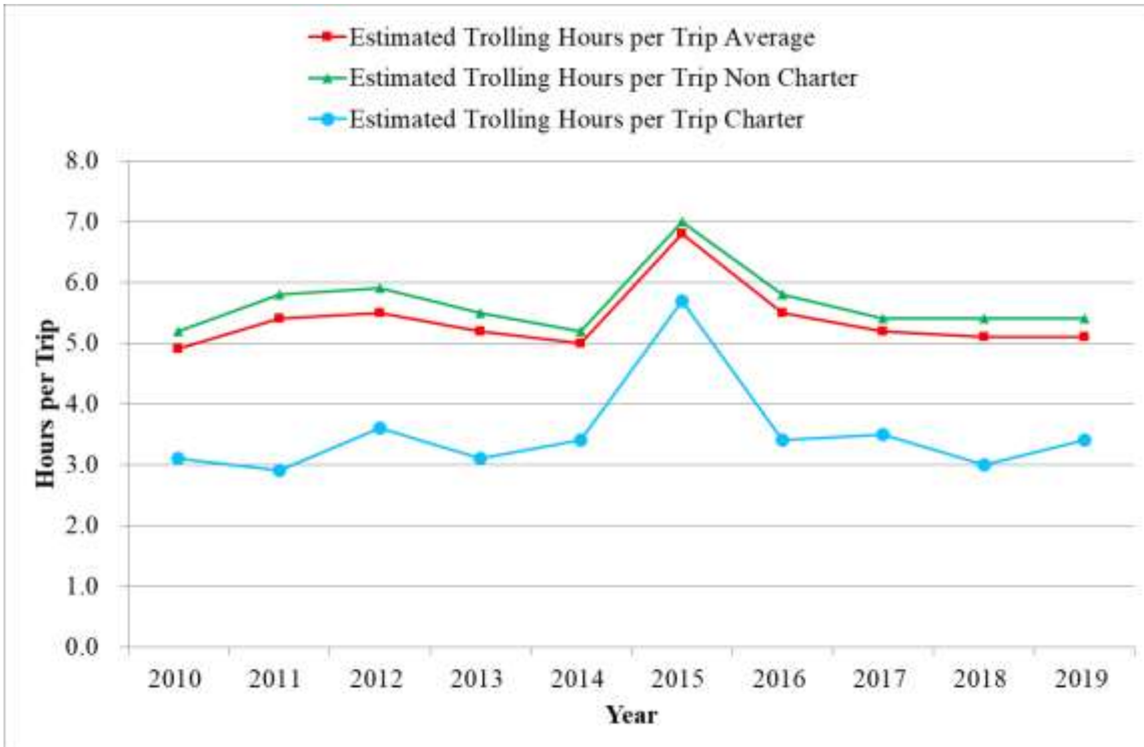


Figure 60. Estimated fishing trip length (hr./trip) in Guam from 2010-2019

Supporting data shown in Table A-61.

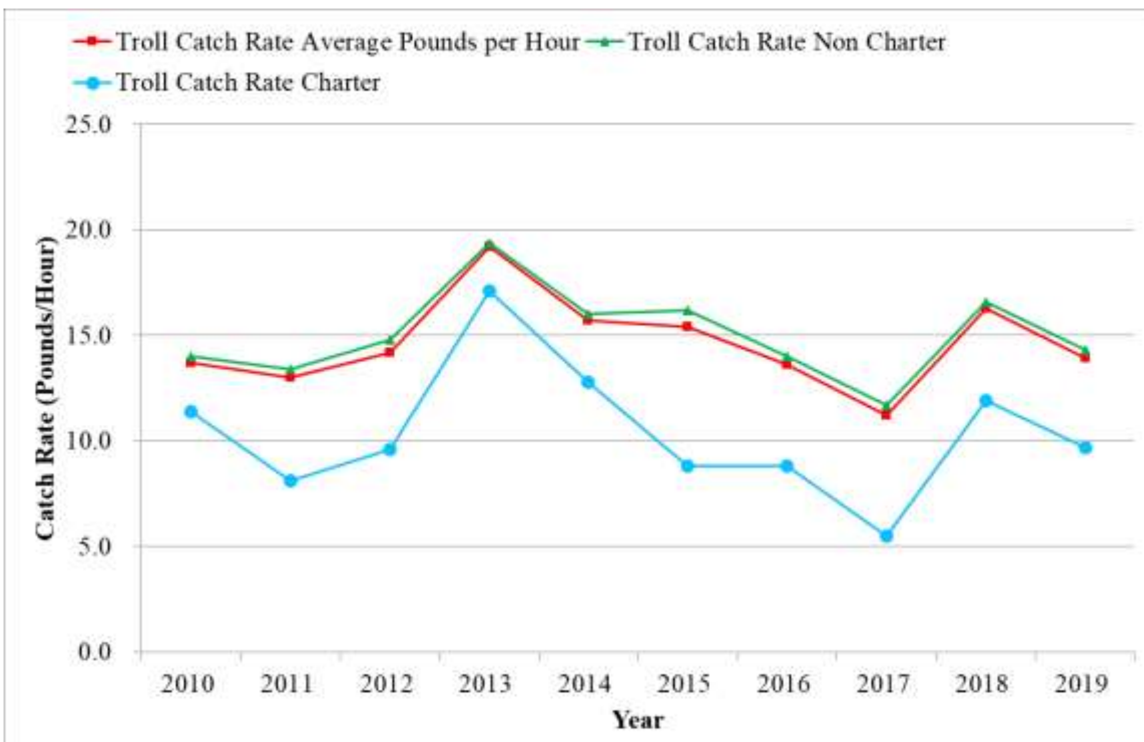


Figure 61. Trolling catch rates (lbs./hr.) in Guam from 2010-2019

Supporting data shown in Table A-62.

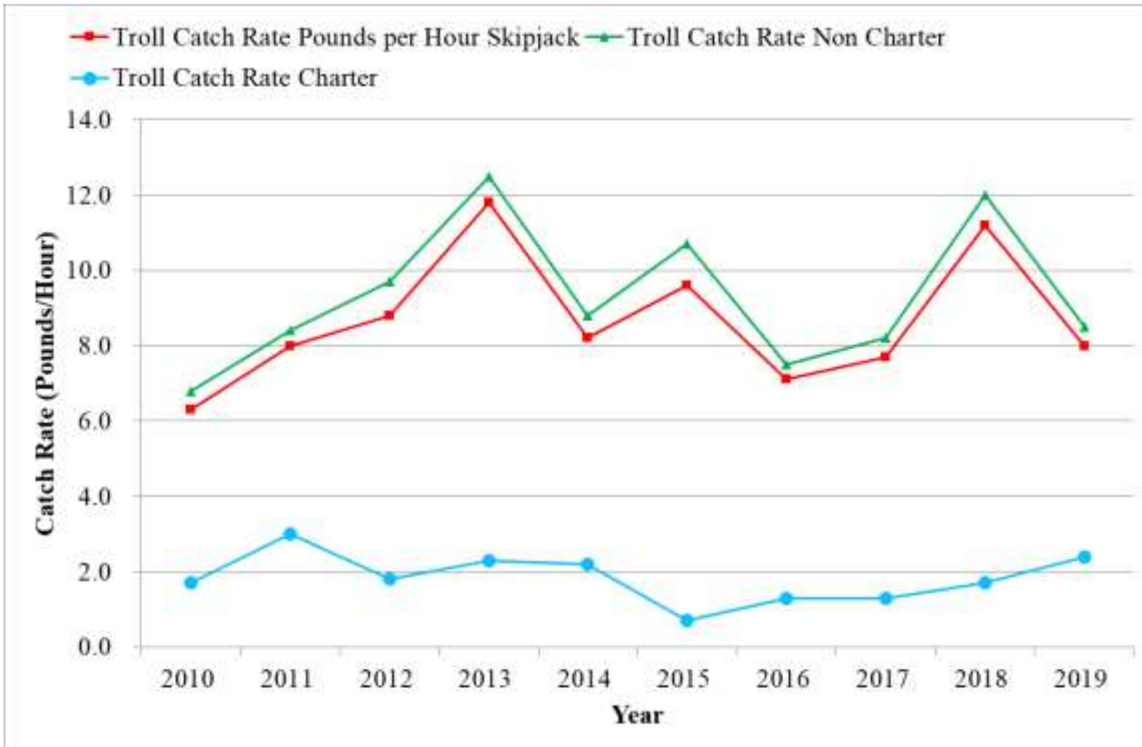


Figure 62. Trolling catch rates (lbs./hr.) for skipjack tuna in Guam from 2010-2019

Supporting data shown in Table A-63.

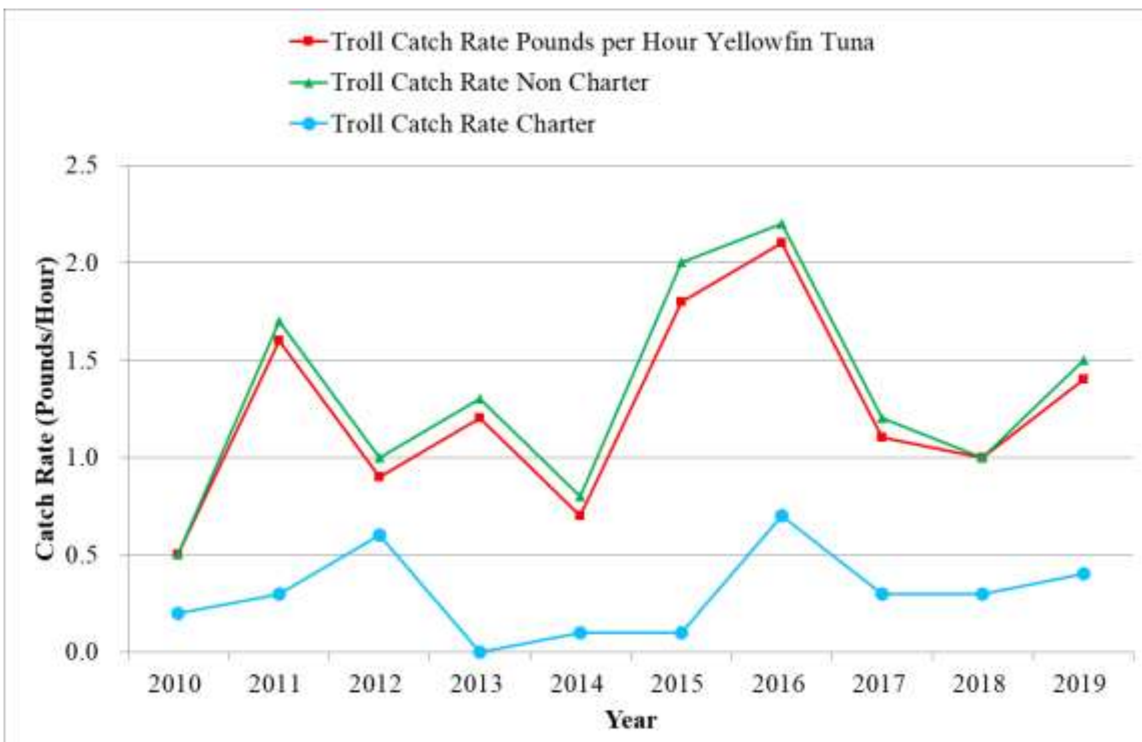


Figure 63. Trolling catch rates (lbs./hr.) for yellowfin tuna in Guam from 2010-2019

Supporting data shown in Table A-64.

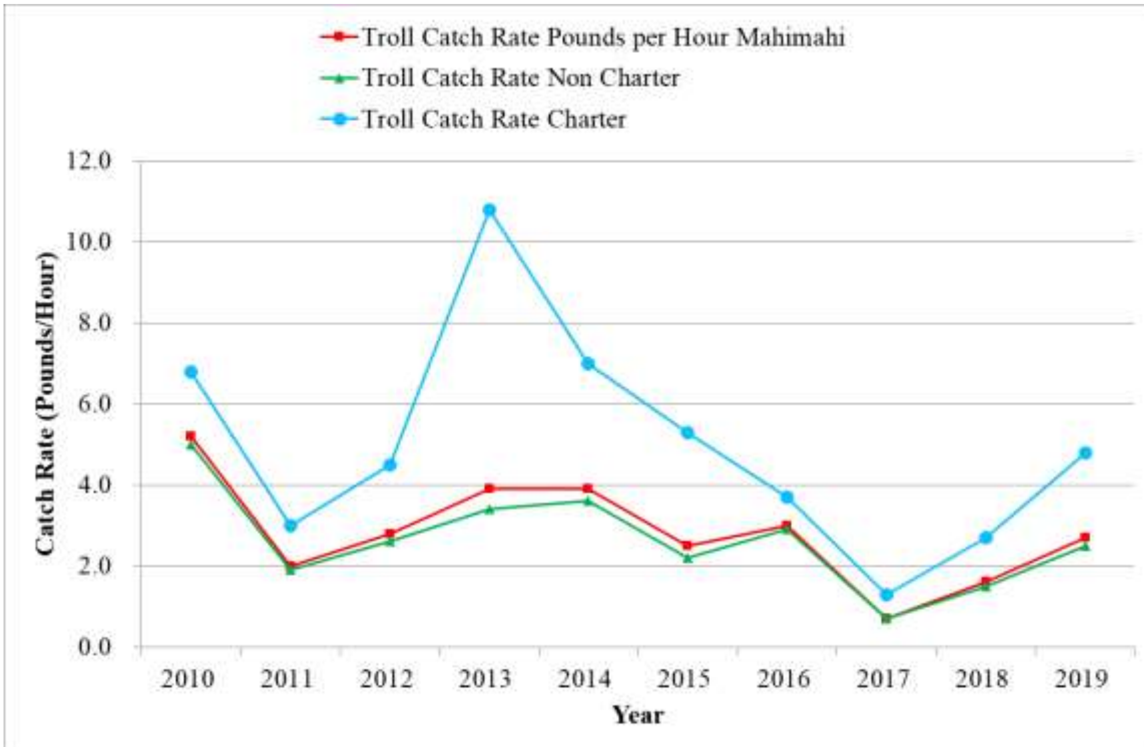


Figure 64. Trolling catch rates (lbs./hr.) for mahimahi in Guam from 2010-2019
Supporting data shown in Table A-65.

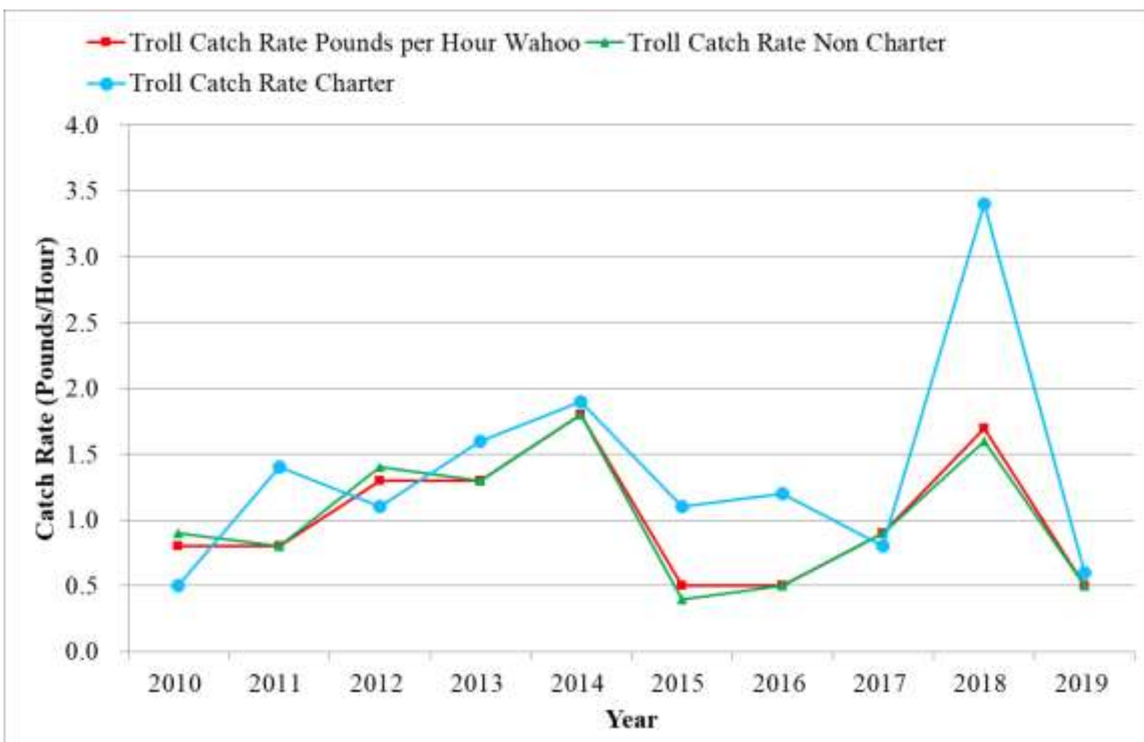


Figure 65. Trolling catch rates (lbs./hr.) for wahoo in Guam from 2010-2019
Supporting data shown in Table A-66.

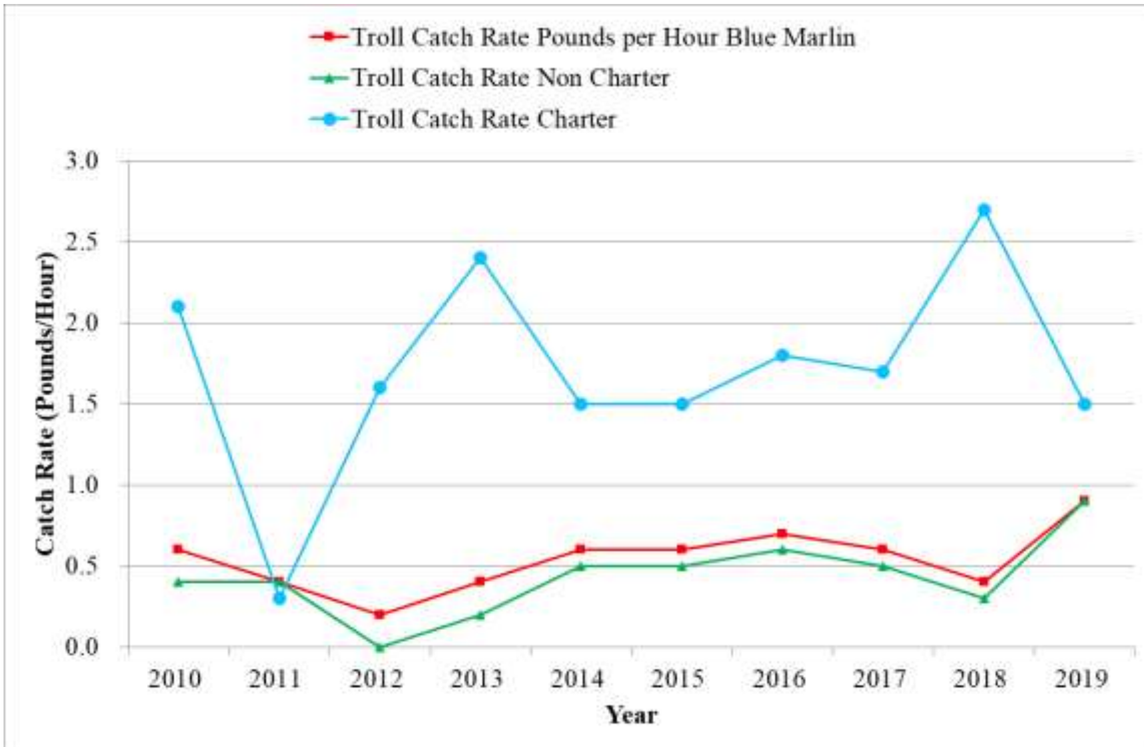


Figure 66. Trolling catch rates (lbs./hr.) for blue marlin in Guam from 2010-2019

Supporting data shown in Table A-67.

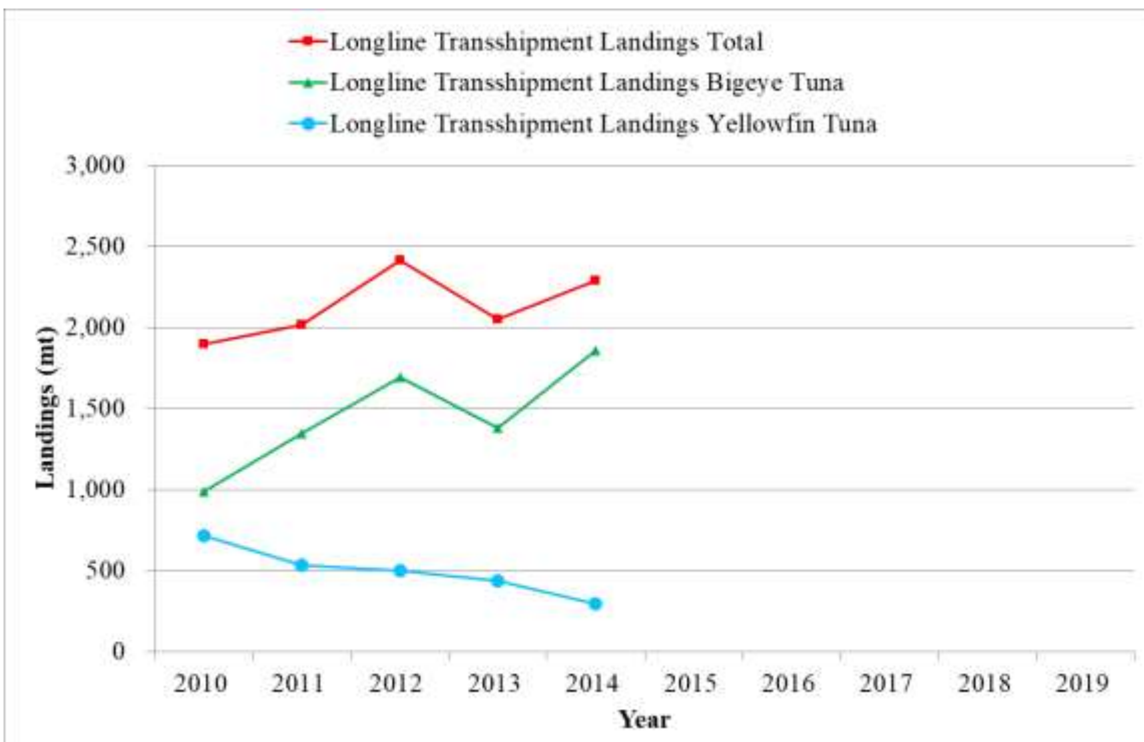


Figure 67. Guam foreign longline transshipment landings for longliners fishing outside the Guam EEZ from 2010-2019

Note: Data from 2015-2019 are confidential. 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 data (CML), Commercial Fishing Report data (Fishing Report), HDAR Commercial Marine Dealer's Report data (Dealer), 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 catch-per-unit-effort (CPUE). Logbook data have detailed operational information and catch in number of fish. Longline vessel operators are required to declare whether they will be making a deep-set or shallow-set trip prior to their departure. A deep-set is defined as a set with 15 or more hooks between floats as opposed to a shallow-set that is characterized by setting less than 15 hooks between floats.

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

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

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

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

2.4.2 SUMMARY OF HAWAII PELAGIC FISHERIES

The following is a summary of effort, catch, CPUE, size of fish, revenue, and bycatch for the main pelagic fisheries (deep set and shallow set longline, MHI troll, MHI handline, and offshore handline).

Participation. A total of 3,124 fishermen were licensed in 2019, including 1,929 (62%) who indicated that their primary fishing method and gear were intended to catch pelagic fish. This is a 6% decrease in fishing licenses from the previous year. Most licenses that indicated pelagic fishing as their primary method were issued to longline fishermen (46%) and trollers (40%). The remainder was issued to ika shibi and palu ahi (handline) (14%).

Catch. Hawaii commercial fisheries caught and landed 36.5 million pounds of pelagic species in 2019, a decrease of 3% 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 87% (32.0 million pounds) of all pelagic fisheries. The shallow-set longline fishery targeted swordfish and its catch was 837,000 pounds, or 2% of the total catch. The main Hawaii Islands troll fishery targeted tunas, marlins and other PMUS, and caught 2.5 million pounds or 7% of the total. The MHI handline fishery targeted yellowfin tuna while the offshore handline fishery targeted bigeye tuna. The MHI handline fishery accounted for 675,000 pounds (2% of the total). The offshore handline fishery was responsible for 477,000 pounds or 1% of the total catch.

The largest component of the pelagic catch was tunas, which comprised 68% of the total in 2019. Bigeye tuna alone accounted for 72% of the tunas and 49% of all the pelagic catch. Billfish catch made up 16% of the total catch in 2019. Blue marlin was the largest of these, at 41% of the billfish and 6% of the total catch. Catches of other PMUS represented 16% of the total catch in 2019 with moonfish being the largest component at 37% of the other PMUS and 6% of the total catch.

Effort. There were 150 active Hawaii-permitted deep-set longline vessels in 2019, seven more vessels than the previous year, with 140 or more deep-set vessels in the past 5 years. The number of deep-set trips (1,724) and sets (22,513) were both deep-set effort records. The number of hooks set by the deep-set longline fishery reached a record 63.2 million hooks in 2019. The Hawaii-permitted shallow-set longline fishery operates mainly in the first half of the year. In 2019, 14 vessels completed 25 trips and made 284 sets, which was significantly lower effort for this segment of the fishery due to the closure of the fishery in March as a result of reaching the loggerhead sea turtle interaction limit. The number of hooks set by this fishery also decreased to 400,000 in 2019, a record low since the reopening of the shallow-set fishery in 2004. The number of days fished by MHI troll fishers has been trending lower from its peak in 2012, with 1,291 fishers logging 20,359 days fished around the MHI in 2019. There were 438 MHI handline fishers that fished 3,629 days in 2019, both at their lowest levels in the ten-year period. The offshore handline fishery had 7 fishers and 261 days fished in 2019.

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 (1.0) and albacore (0.1). CPUE of blue marlin and striped marlin for the deep-set fishery were low (0.2 and 0.3 fish per 1,000 hooks, respectively), while the CPUE for blue shark, a bycatch species, is second only to bigeye at 1.8 fish per 1,000 hooks. The Hawaii-permitted shallow-set longline fishery targets swordfish and had a CPUE of 9.8 fish per 1,000 hooks in 2019 followed by blue shark, a bycatch species of this fishery, with a CPUE of 8.5 fish per 1,000 hooks. The 2019 MHI troll fishery CPUE for yellowfin tuna was above the long-term average with blue marlin at a 10-year high CPUE. Mahimahi and ono CPUE were both above their long-term average in 2019. MHI handline CPUE for yellowfin, albacore and bigeye tuna were all below their long-term mean weights in 2019. Bigeye tuna CPUE for the offshore handline fishery increased from 2017 while yellowfin tuna decreased during the same time period.

Fish Size. The average weight for most tuna species caught by the deep-set longline fishery were close to their respective long-term weights in 2019. Bigeye tuna caught in the deep-set fishery was 79 lbs. in 2019, close to the long-term average. The size of swordfish was much higher from 2017 while marlins were below their respective long-term average weights in 2019. The mean weight of other PMUS and PMUS sharks were close to their respective long-term average weights. Swordfish caught by the shallow-set longline fishery was 217 pounds, well above 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 close to their long-term average in 2019. Troll and handline caught blue marlin was below its long-term mean weight.

Revenue. The total revenue from Hawaii's pelagic fisheries was $105.6 million in 2019, a decrease of 11% from the previous year. Bigeye tuna and yellowfin tuna represented 60% and 20% of the total pelagic revenue, respectively in 2019. The deep-set longline revenue was $92.9 million in 2019. This fishery represented 88% of the total revenue for pelagic fish in Hawaii. The shallow-set longline fishery decreased to $2.0 million and accounted for 2% of the revenue. The MHI troll revenue was $7.2 million or 7% of the total in 2019 and was followed by the MHI handline fishery at $2.2 million (2%). The offshore handline fishery was worth $1.0 million in 2019. The trend for revenue from the deep-set longline was increasing although it dropped 11% in 2019. Revenue for the shallow-set longline fishery was decreasing. The revenue from the MHI troll, MHI handline and offshore handline fishery showed some variability and no clear trend over the past ten years.

Bycatch. A total of 144,677 fish were released by the deep-set longline fishery in 2019. 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 3% for targeted and incidentally caught pelagic species in 2019. A total of 3,286 fish were released by the shallow-set longline fishery in 2019. Sharks accounted for 94% of the shallow-set longline bycatch. With the exception for mako shark, there is almost no demand for sharks in Hawaii. Of all shark species combined, 97% of the shallow-set longline shark catch was released. Conversely, bycatch rate for the shallow-set longline fishery was 4% for targeted and incidentally caught pelagic species in 2019. 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 2019 annual SAFE report, Plan Team members agreed to carry out the following module improvements:

1. Improve bycatch data summaries to include amount and type (species and condition) of bycatch, where data are available.
    a. Explore feasibility of including bycatch data from the observer programs for Hawaii and American Samoa longline fisheries.
    b. Present bycatch data including species and amount for Hawaii, American Samoa and CNMI small-boat fisheries. For the Hawaii data, also explore whether bycatch data for the charter vessels should be included in the Hawaii or non-commercial module.

2.4.4 OVERVIEW OF PARTICIPATION – ALL FISHERIES

Table 20. Number of HDAR Commercial Marine Licenses, 2018-2019

	Number of licenses	
Primary Fishing Method	**2018**	**2019**
Trolling	826	775
Longline	887	894
Ika Shibi & Palu Ahi	267	258
Aku Boat (Pole and Line)	2	2
Total Pelagic	1,982	1,929
Total All Methods	3,308	3,124

2.4.5 OVERVIEW OF LANDINGS AND ECONOMIC DATA

Table 21. Hawaii commercial pelagic catch, revenue, and price by species, 2018-2019

	2018			2019		
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	239	$399	$1.82	255	$488	$1.82
Bigeye tuna	17,093	$67,520	$4.24	17,758	$63,508	$3.87
Bluefin tuna	1	$27	$8.53	4	$65	$5.78
Skipjack tuna	530	$658	$1.79	828	$815	$1.27
Yellowfin tuna	7,567	$26,821	$3.73	5,952	$20,565	$3.54
Other tunas	10	$18	$3.02	10	$17	$3.14
Tuna PMUS subtotal	**25,439**	**$95,443**	**$4.02**	**24,807**	**$85,457**	**$3.69**
Billfish PMUS						
Swordfish	2,329	$3,762	$2.16	1,625	$3,801	$2.55
Blue marlin	1,808	$1,633	$1.28	2,335	$1,328	$0.72
Spearfish (hebi)	504	$586	$1.21	452	$418	$0.91
Striped marlin	1,052	$1,725	$1.37	1,238	$1,229	$0.88
Other marlins	39	$56	$1.28	50	$61	$0.52
Billfish PMUS subtotal	**5,732**	**$7,763**	**$1.62**	**5,700**	**$6,836**	**$1.29**
Other PMUS						
Mahimahi	1,077	$3,560	$3.55	1,000	$3,453	$3.67
Ono (wahoo)	1,176	$3,061	$2.68	1,591	$3,635	$2.39
Opah (moonfish)	3,070	$3,356	$1.44	2,255	$3,120	$1.93
Oilfish	315	$238	$0.79	306	$252	$0.95
Pomfrets (monchong)	878	$2,899	$3.12	749	$2,733	$3.50
PMUS Sharks	139	$63	$0.68	115	$83	$1.14
Other PMUS subtotal	**6,654**	**$13,176**	**$2.27**	**6,017**	**$13,276**	**$2.56**
Other pelagics	**12**	**$13**	**$0.79**	**5**	**$8**	**$1.61**
Total pelagics	**37,838**	**$116,395**	**$3.39**	**36,529**	**$105,577**	**$3.14**

Table 22. Hawaii commercial pelagic catch, revenue, and price by fishery, 2018-2019

	2018			2019		
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	32,410	$102,981	$3.39	31,955	$92,861	$3.10
Shallow-set longline	1,438	$1,576	$2.13	837	$1,969	$2.82
MHI trolling	2,743	$8,121	$3.69	2,460	$7,229	$3.64
MHI handline	778	$2,427	$3.66	675	$2,152	$3.67
Offshore handline	366	$973	$3.23	470	$1,018	$2.72
Other gear	104	$316	$3.63	131	$349	$3.23
Total	**37,838**	**$116,395**	**$3.39**	**36,529**	**$105,577**	**$3.14**

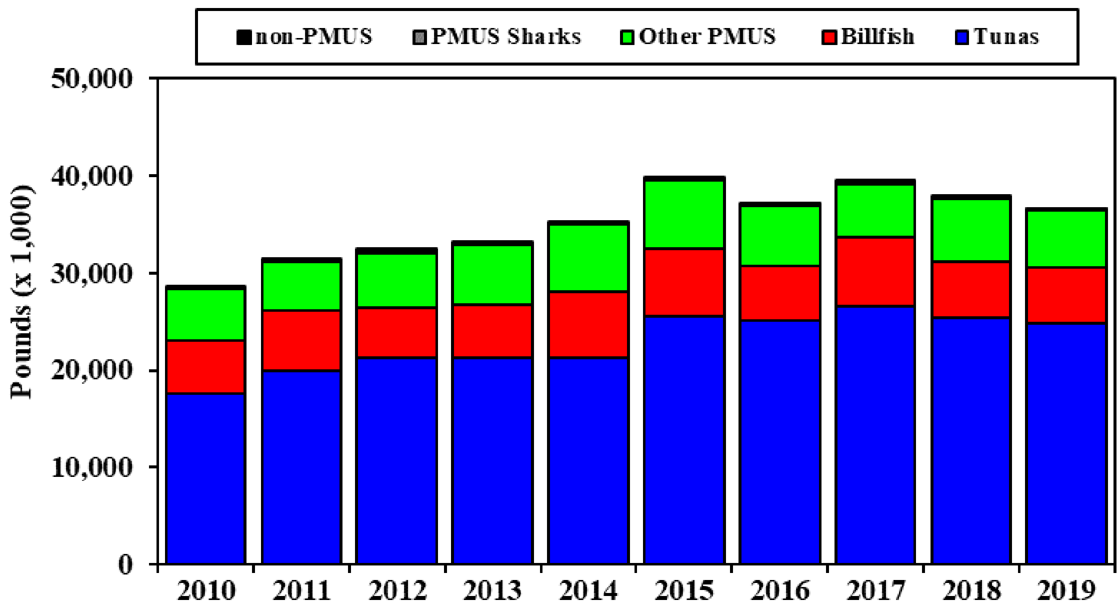


Figure 68. Hawaii commercial tuna, billfish, other PMUS and PMUS shark catch, 2010-2019
Supporting data shown in Table A-69.

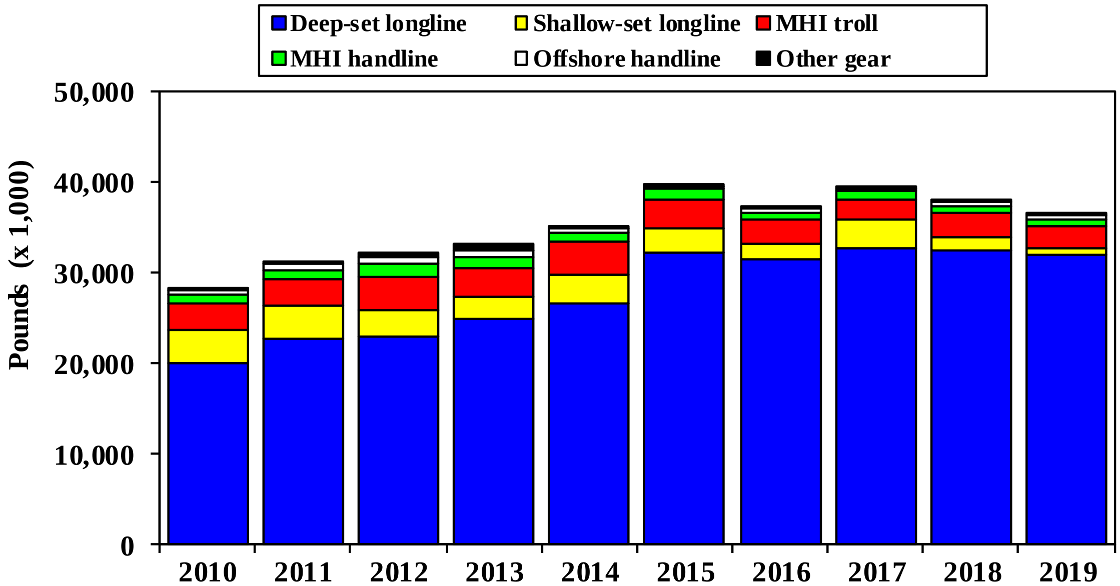


Figure 69. Total commercial pelagic catch by gear type, 2010-2019

Supporting data shown in Table A-70.

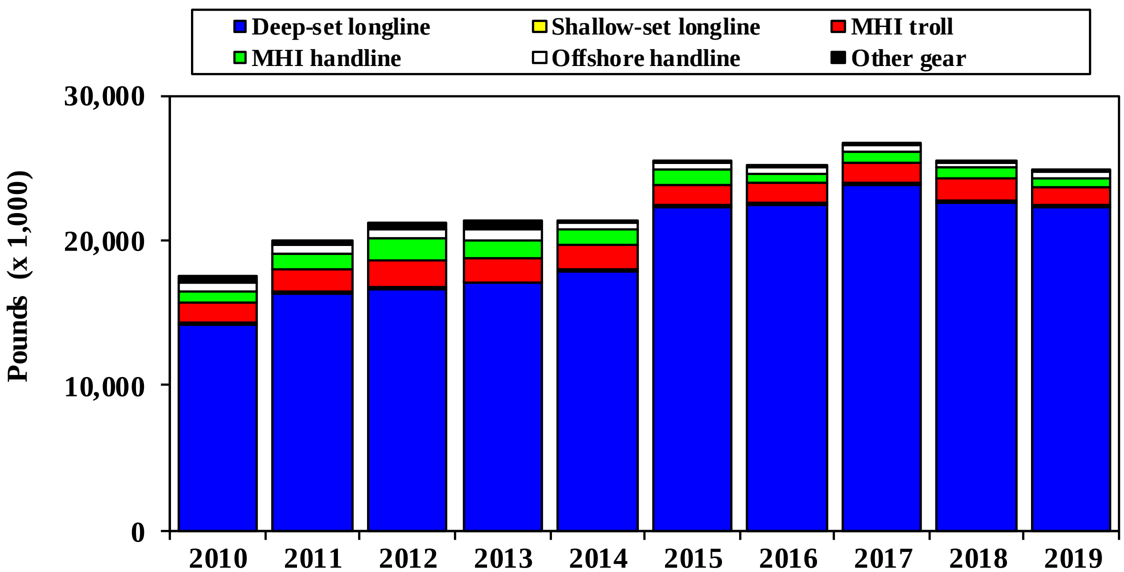


Figure 70. Hawaii commercial tuna catch by gear type, 2010-2019

Supporting data shown in Table A-71.

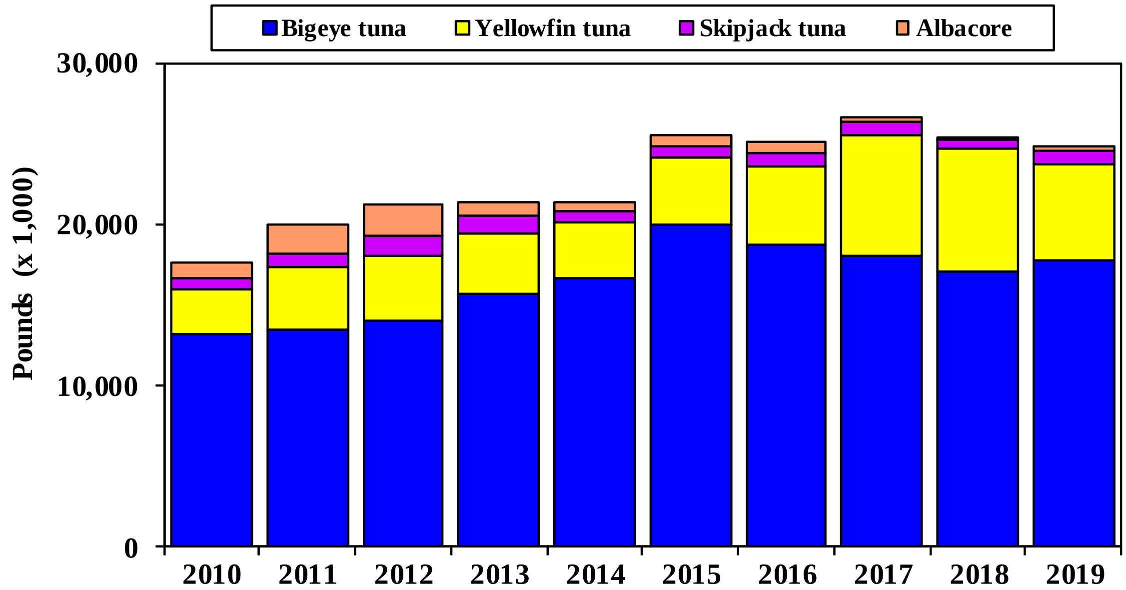


Figure 71. Species composition of tuna catch, 2010-2019

Supporting data shown in Table A-72.

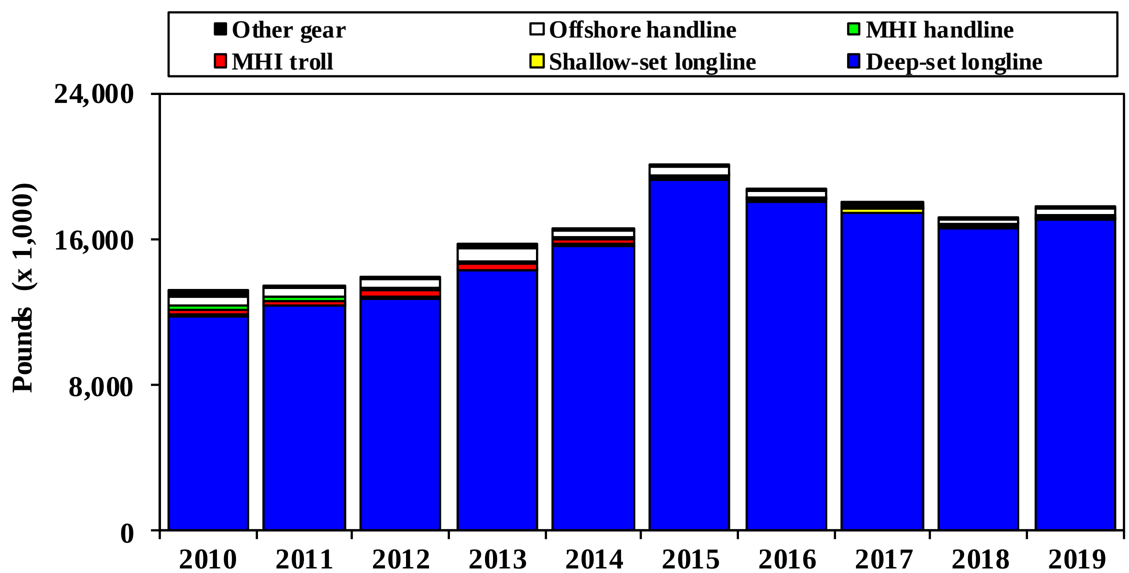


Figure 72. Hawaii bigeye tuna catch by gear type, 2010-2019

Supporting data shown in Table A-73.

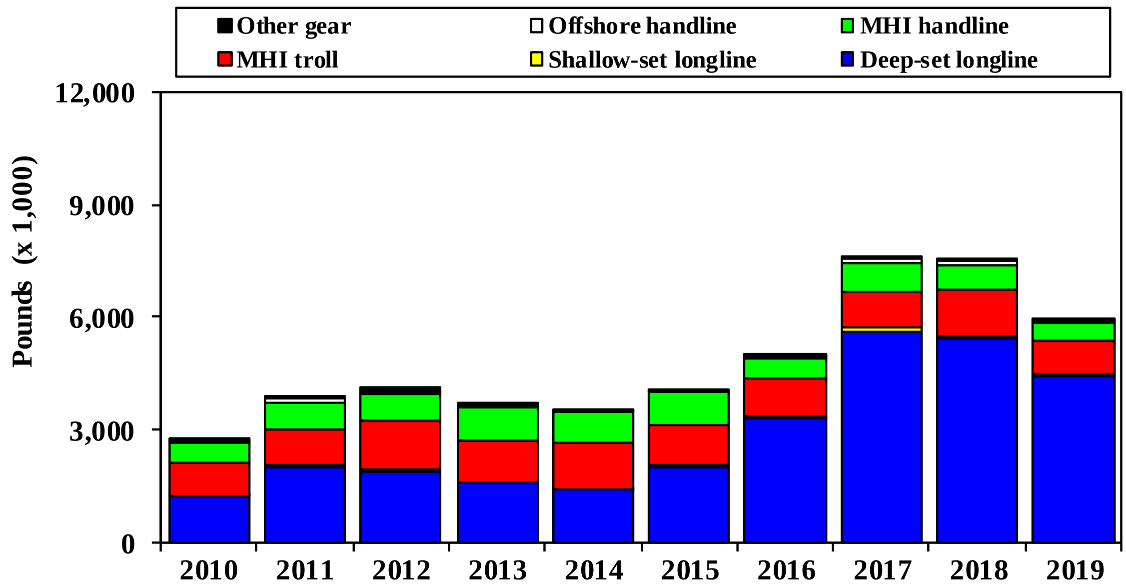


Figure 73. Hawaii yellowfin tuna catch by gear type, 2010-2019

Supporting data shown in Table A-74.

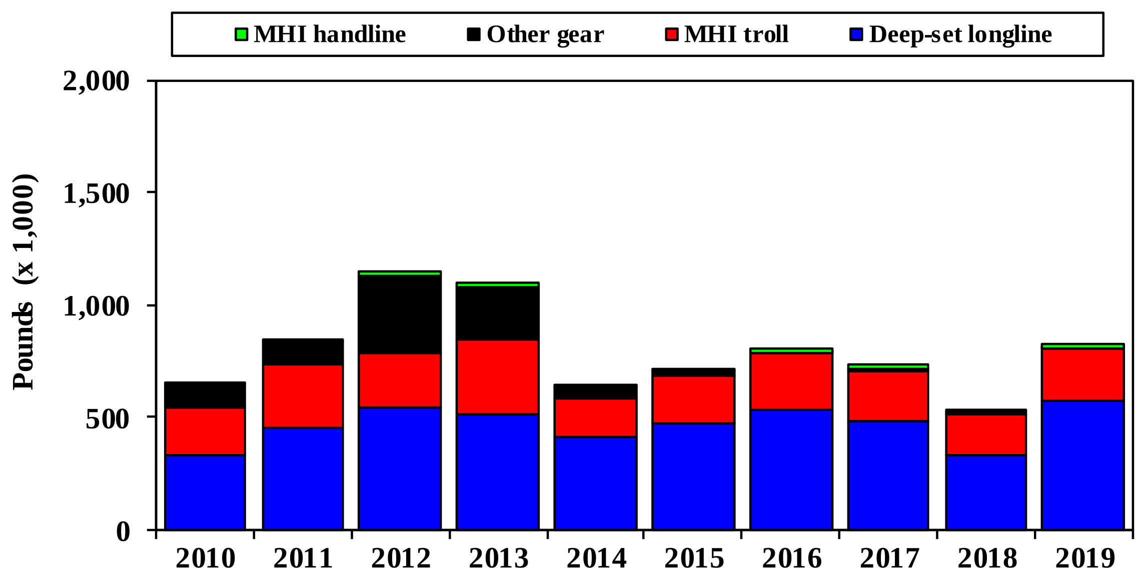


Figure 74. Hawaii skipjack tuna catch by gear type, 2010-2019

Supporting data shown in Table A-75.

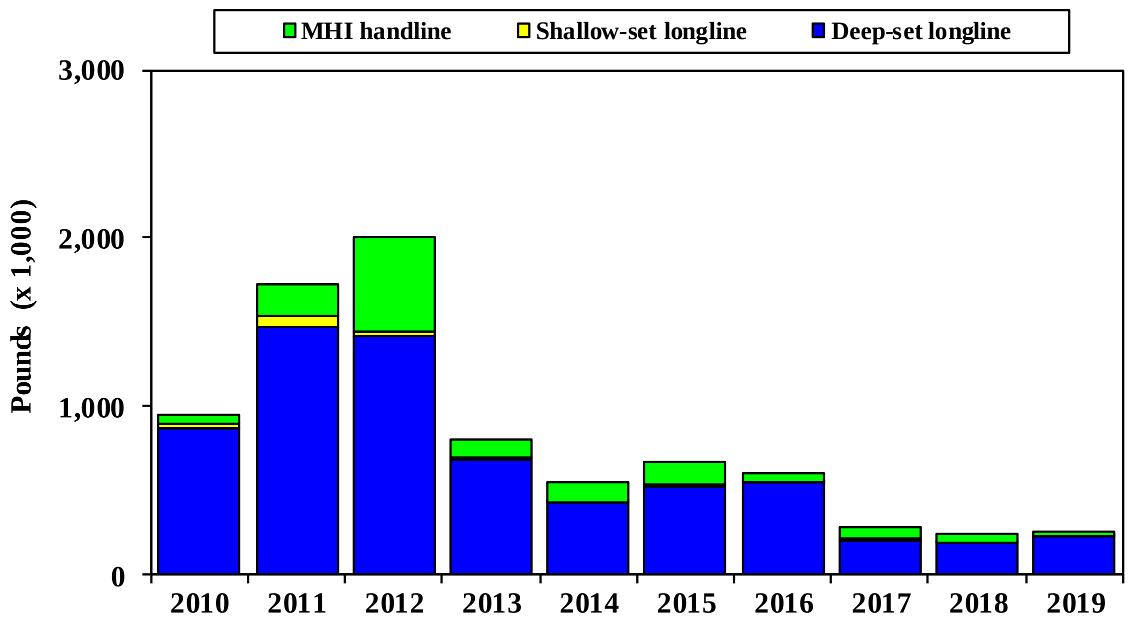


Figure 75. Hawaii albacore catch by gear type, 2010-2019

Supporting data shown in Table A-76.

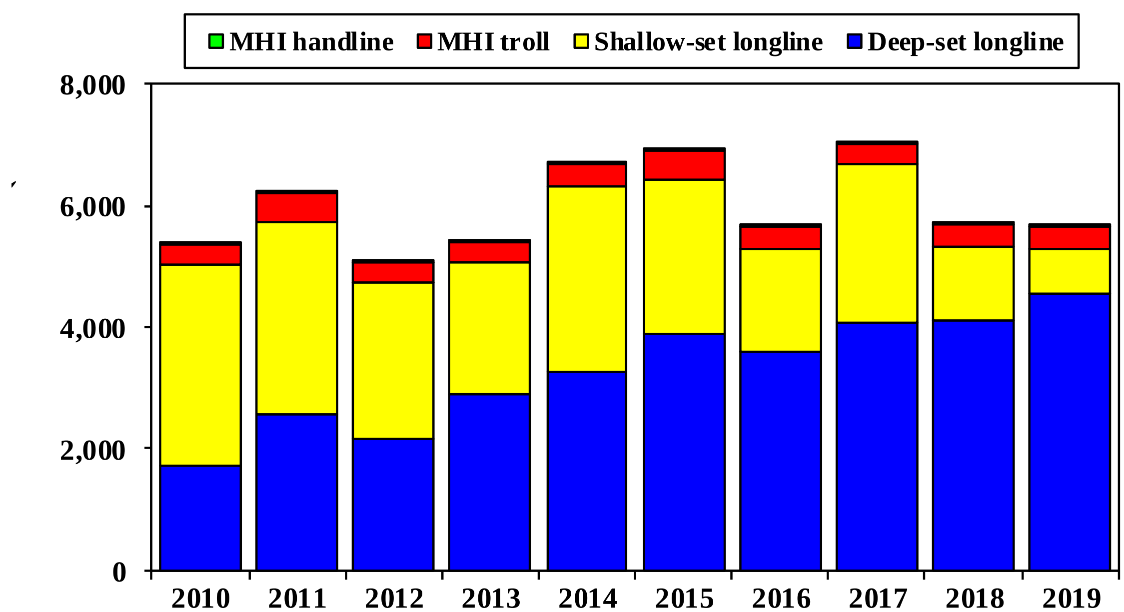


Figure 76. Hawaii commercial billfish catch by gear type, 2010-2019

Supporting data shown in Table A-77.

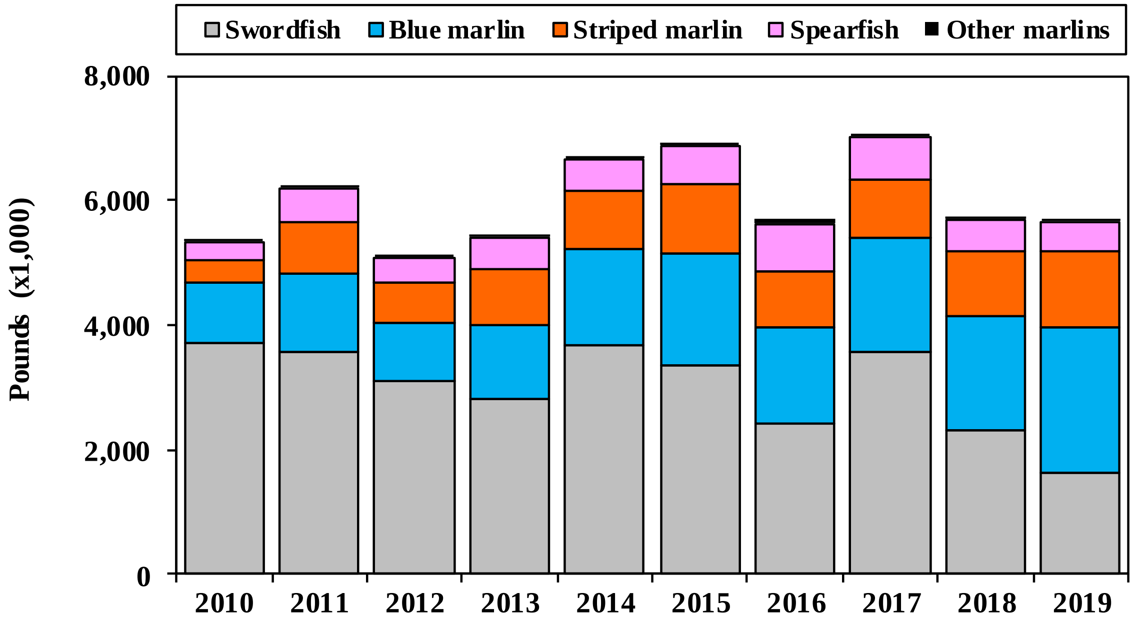


Figure 77. Species composition of billfish catch, 2010-2019

Supporting data shown in Table A-78.

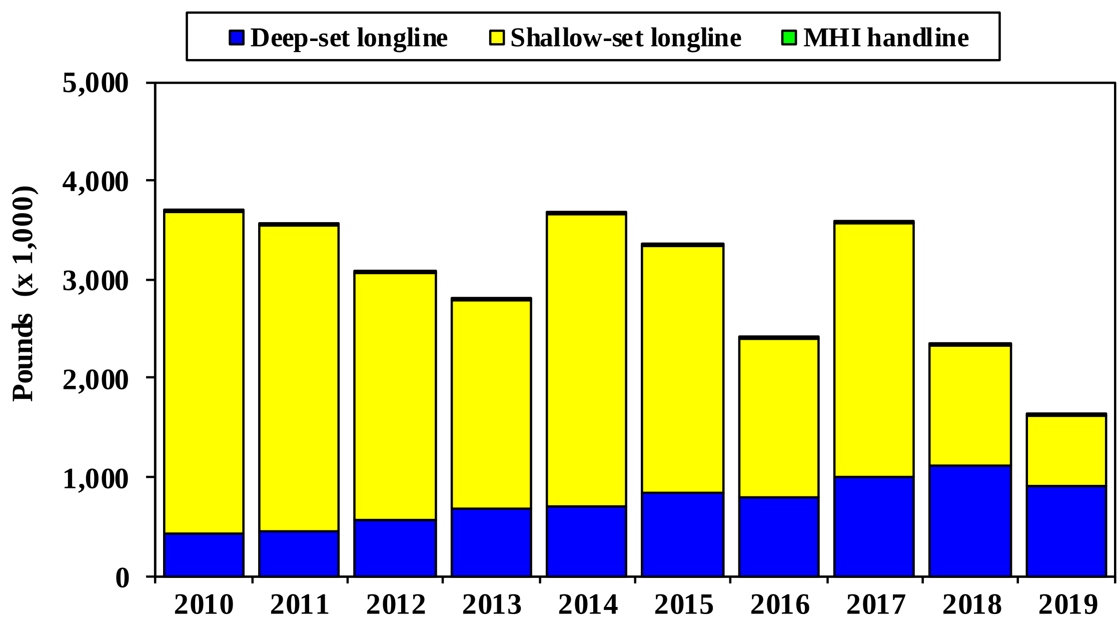


Figure 78. Hawaii swordfish catch by gear type, 2010-2019

Supporting data shown in Table A-79.

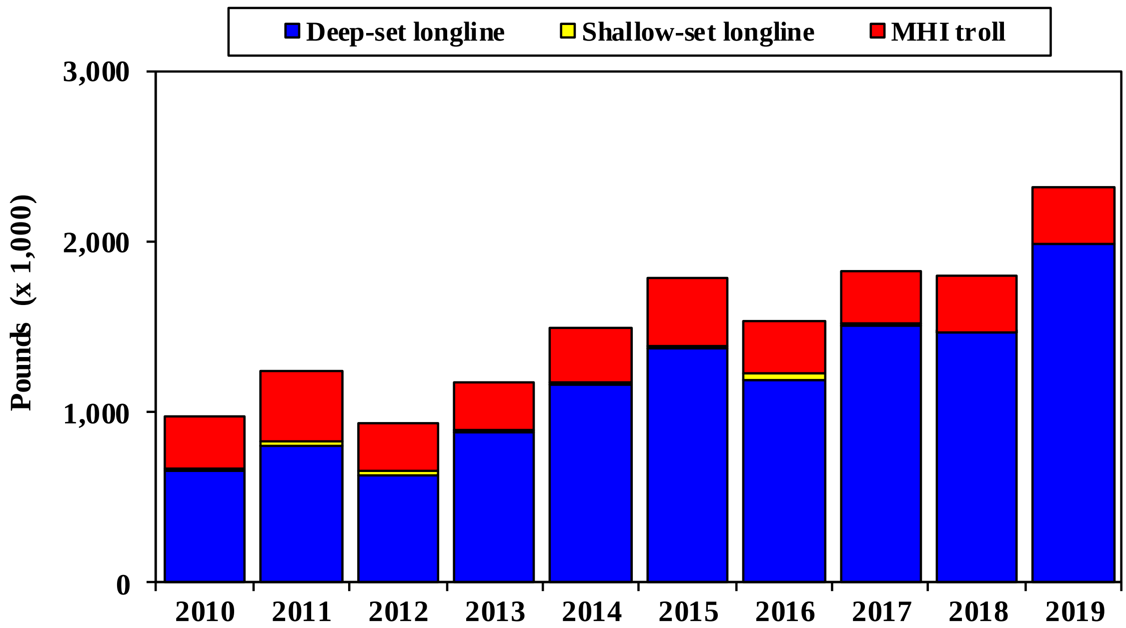


Figure 79. Hawaii blue marlin catch by gear type, 2010-2019

Supporting data shown in Table A-80.

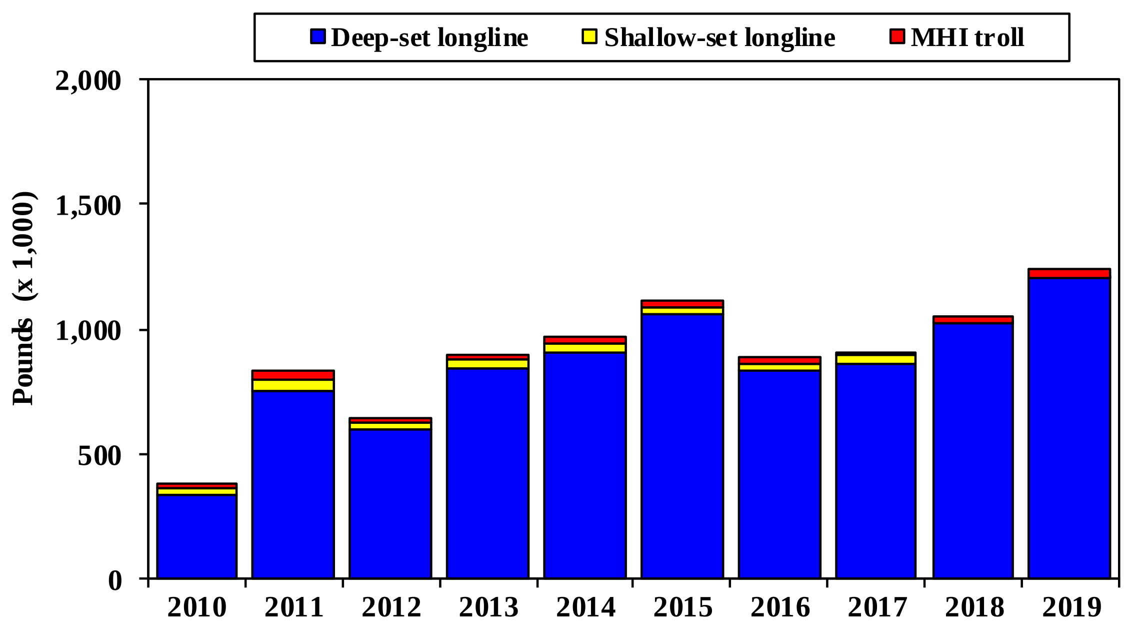


Figure 80. Hawaii striped marlin catch by gear type, 2010-2019

Supporting data shown in Table A-81.

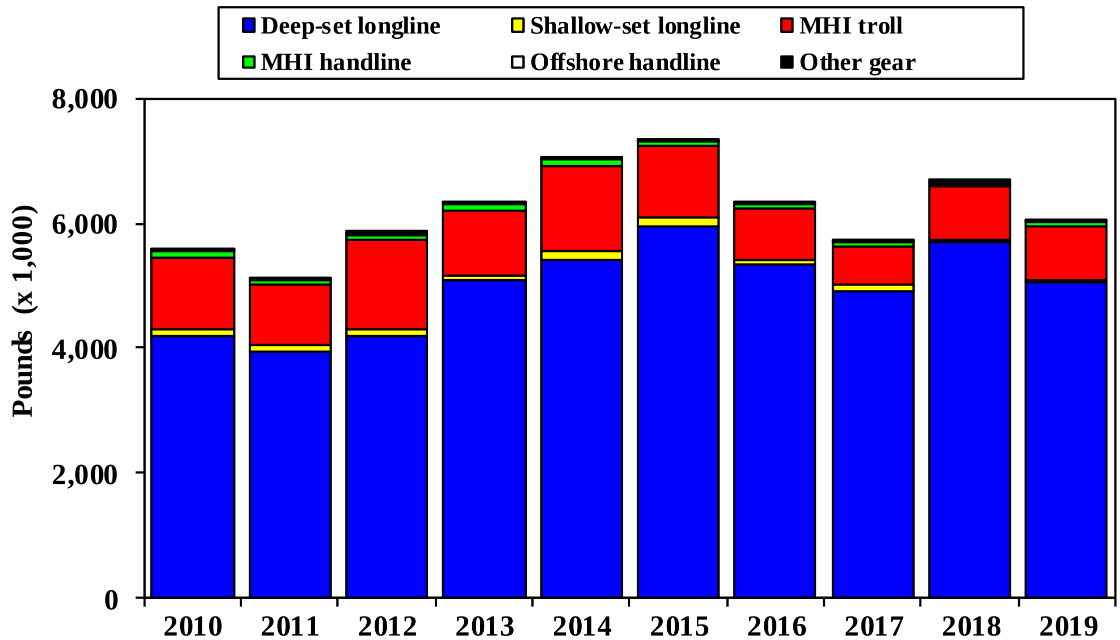


Figure 81. Hawaii commercial catch of other PMUS by gear type, 2010-2019

Supporting data shown in Table A-82.

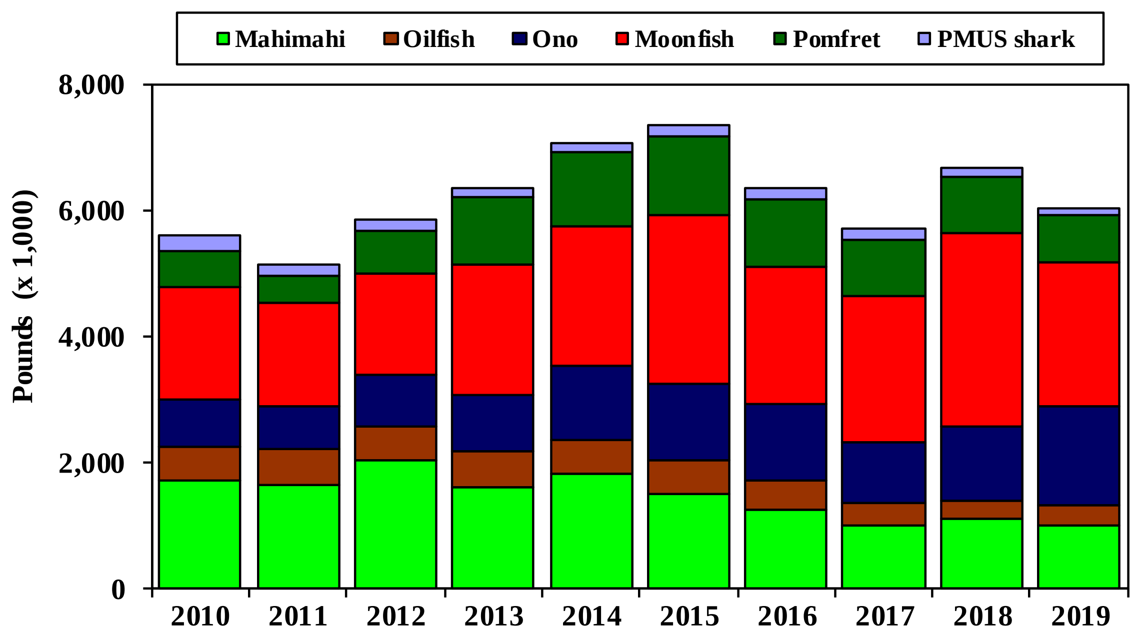


Figure 82. Species composition of other PMUS catch, 2010-2019

Supporting data shown in Table A-83.

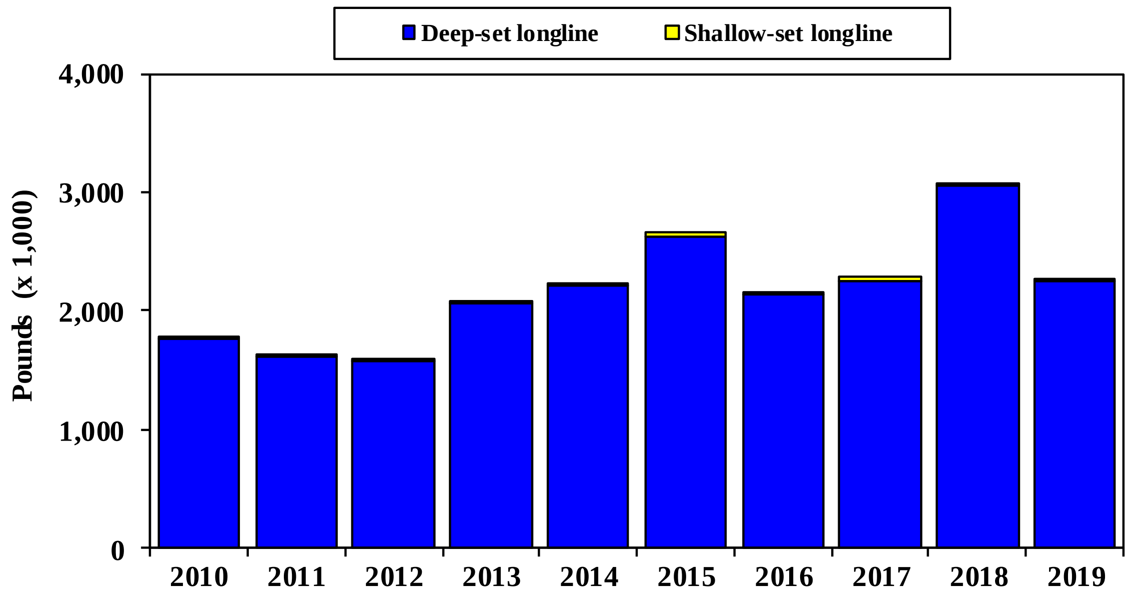


Figure 83. Hawaii moonfish catch by gear type, 2010-2019

Supporting data shown in Table A-84.

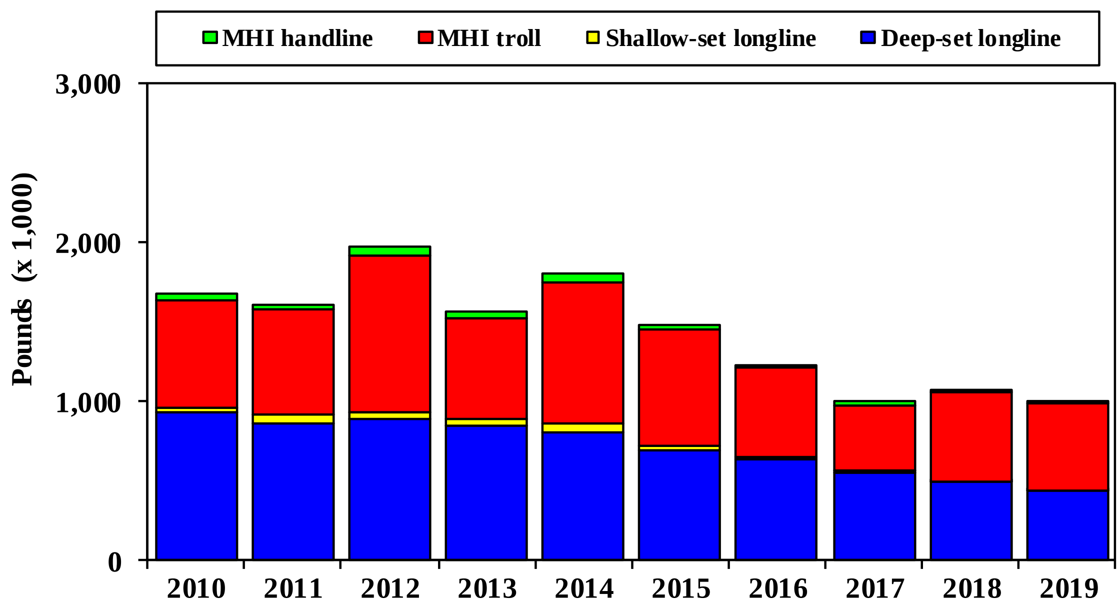


Figure 84. Hawaii mahimahi catch by gear type, 2010-2019

Supporting data shown in Table A-85.

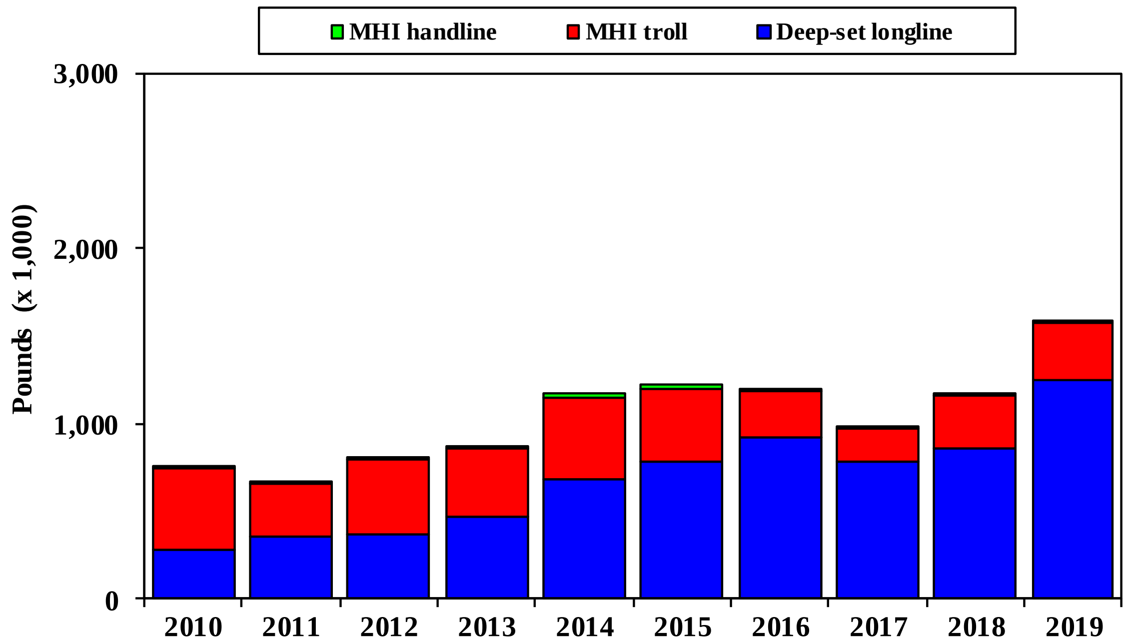


Figure 85. Hawaii ono (wahoo) catch by gear type, 2010-2019

Supporting data shown in Table A-86.

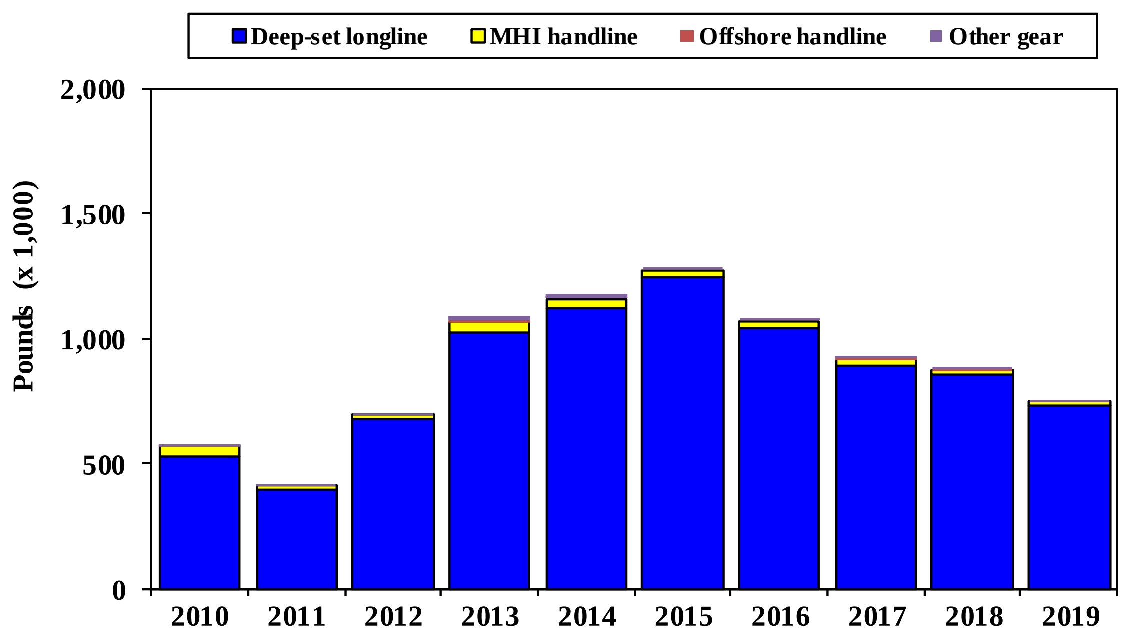


Figure 86. Hawaii pomfret catch by gear type, 2010-2019

Supporting data shown in Table A-87.

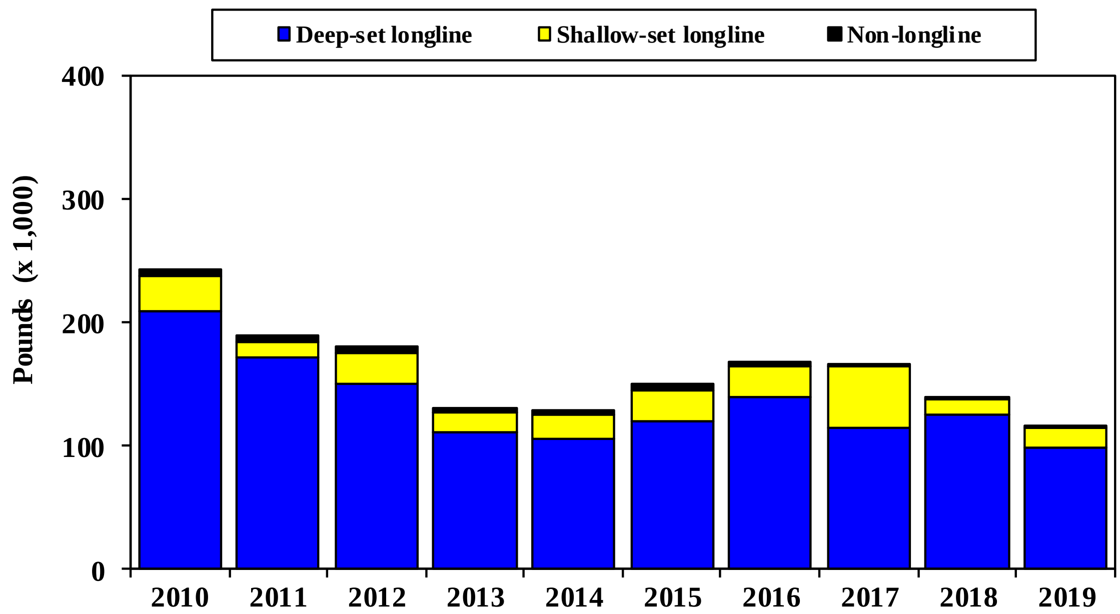


Figure 87. Hawaii PMUS shark catch by gear type, 2010-2019
Supporting data shown in Table A-88.

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

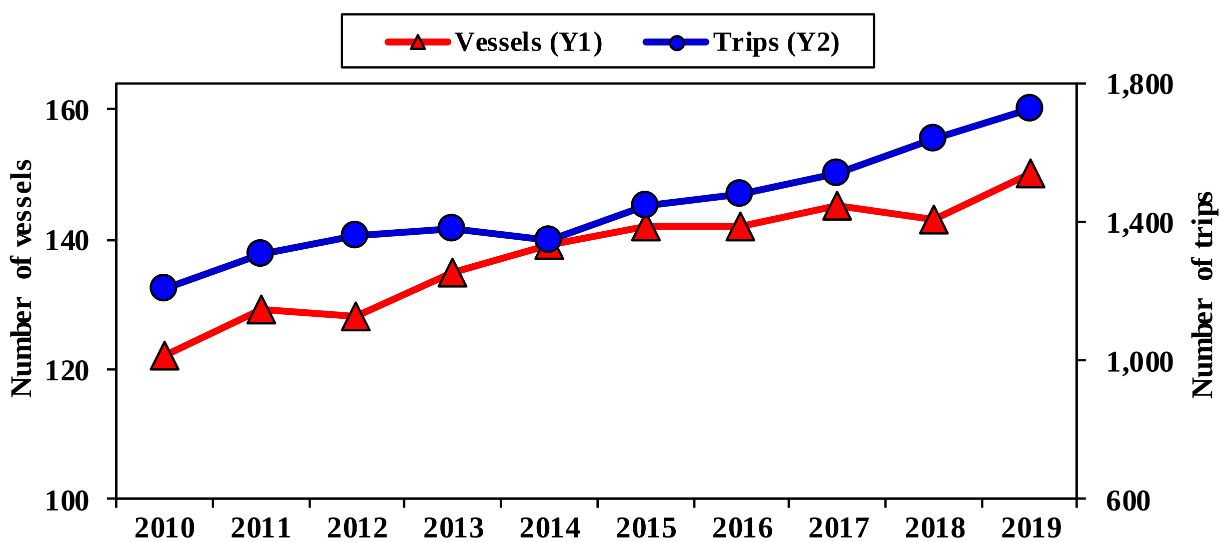


Figure 88. Number of Hawaii-permitted deep-set longline vessels and trips, 2010-2019
Supporting data shown in Table A-89.

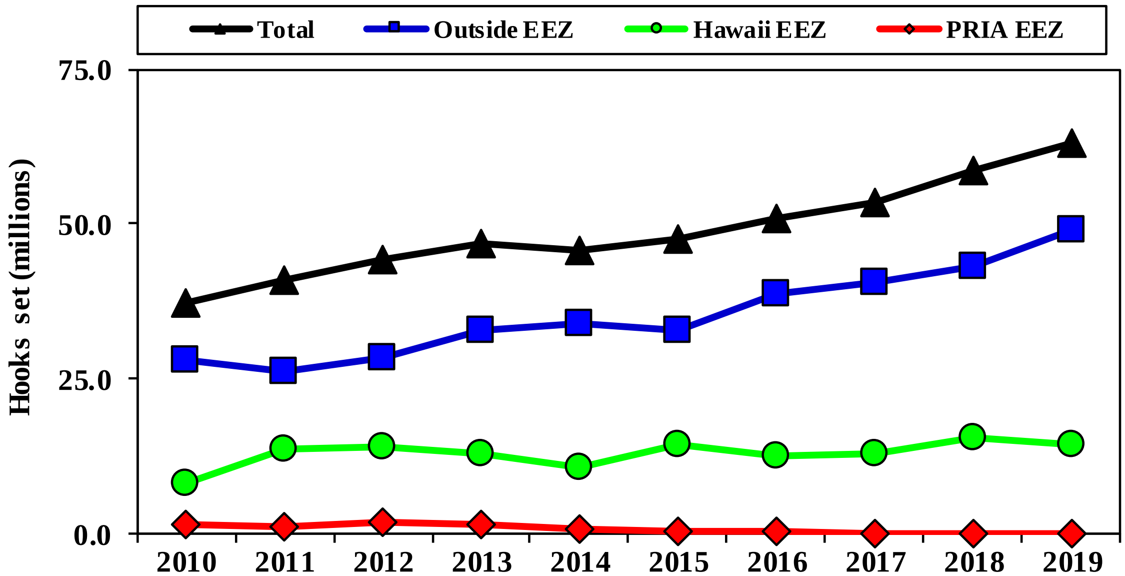


Figure 89. Number of hooks set by the Hawaii-permitted deep-set longline fishery, 2010-2019

Supporting data shown in Table A-90.

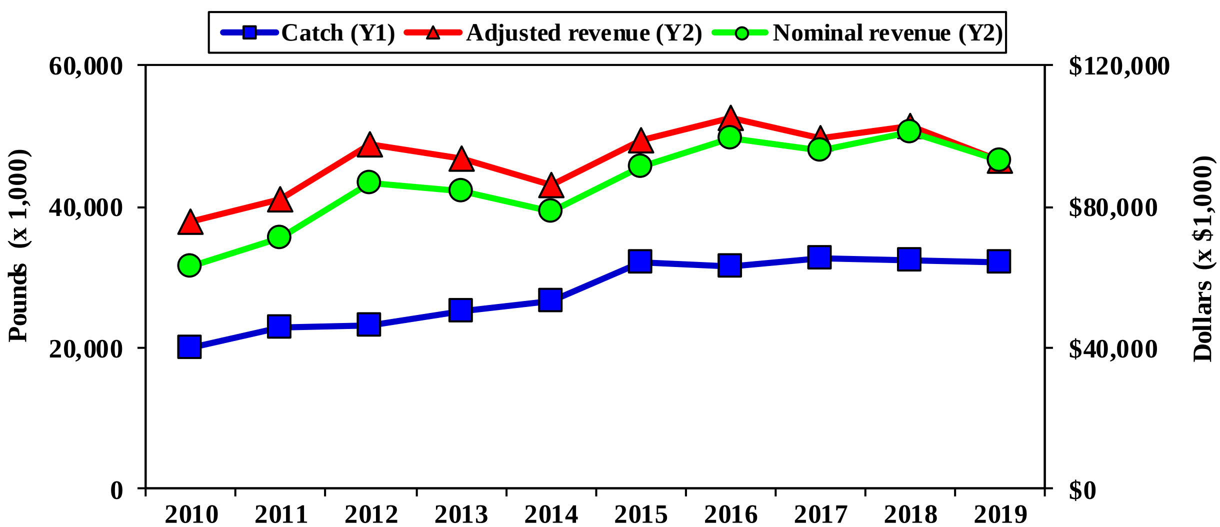


Figure 90. Catch and revenue for the Hawaii-permitted deep-set longline fishery, 2010-2019

Supporting data shown in Table A-91.

Table 23. Hawaii-permitted deep-set longline catch (number of fish) by area, 2010-2019

	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												
2010	22,868	4,383	3,835	643	548	1,032	1,749	7,162	1,429	2,412	4,988	11,595
2011	44,194	12,884	11,101	873	1,452	7,225	5,885	21,995	2,022	3,133	10,721	22,849
2012	48,995	10,616	6,524	945	768	4,055	3,624	16,298	2,192	3,077	12,128	21,053
2013	49,124	7,700	3,461	922	1,177	5,642	5,434	16,711	2,912	2,963	11,047	20,766
2014	43,433	5,199	1,764	866	1,036	5,020	4,248	8,898	4,090	2,172	10,920	20,527
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	44,674	13,428	1,656	1,233	1,772	3,880	7,176	9,088	5,718	2,319	15,728	23,506
2017	52,261	24,316	276	822	2,296	4,311	5,506	8,843	5,126	1,794	12,699	27,661
2018	46,391	19,622	292	1,619	2,915	5,387	5,034	10,219	7,203	2,637	13,072	26,587
2019	40,008	12,157	167	1,125	3,850	5,758	3,737	6,054	8,197	2,140	13,193	30,172
Outside EEZ												
2010	105,375	7,642	14,161	2,109	2,515	2,514	6,425	84,806	6,684	16,980	30,883	36,547
2011	107,094	15,931	19,474	2,170	2,793	8,653	9,392	52,293	7,812	14,471	21,706	31,488
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	138,604	10,299	9,620	3,215	2,563	6,717	8,959	58,991	10,526	20,092	64,928	34,083
2014	168,506	11,205	6,139	3,587	4,475	9,558	11,348	61,135	18,190	22,980	69,240	51,039
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	175,897	32,830	8,197	3,870	4,445	7,701	16,841	39,401	24,444	22,033	65,882	65,391
2017	172,053	55,300	3,832	4,751	5,720	8,705	15,162	37,297	20,279	22,999	55,005	71,287
2018	172,668	42,110	3,363	4,492	4,643	10,340	10,443	33,912	24,092	30,548	42,875	76,092
2019	183,133	49,847	4,177	3,768	9,075	14,782	12,558	31,445	36,102	22,460	39,805	95,578
All areas												
2010	135,636	13,597	18,766	2,916	3,396	3,674	8,375	92,294	8,736	19,523	37,713	51,144
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	223,047	62,006	4,344	4,893	12,926	20,535	16,296	37,505	44,331	24,600	53,000	125,808

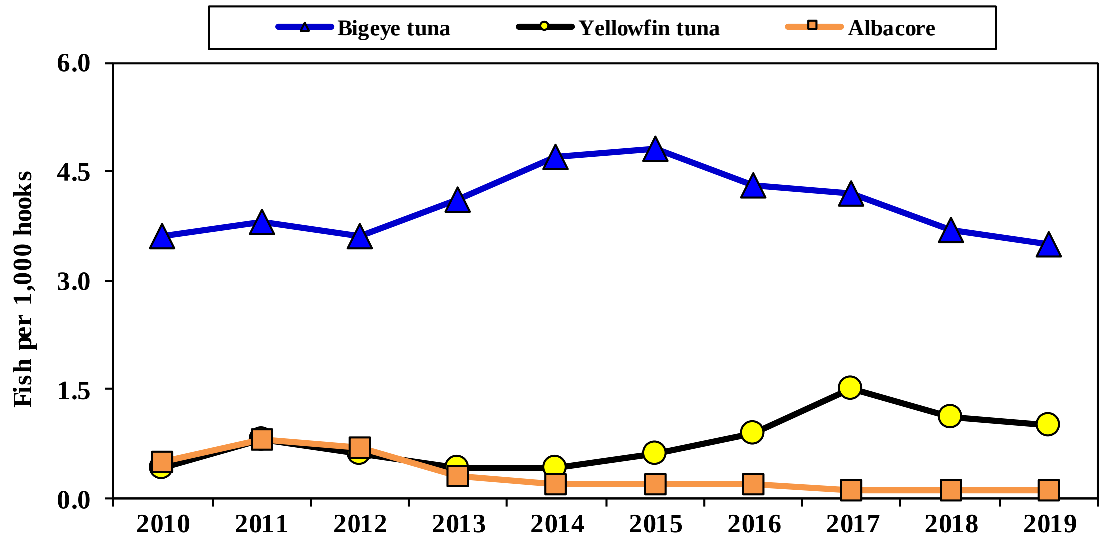


Figure 91. Tuna CPUE for the Hawaii-permitted deep-set longline fishery, 2010-2019
Supporting data shown in Table A-92.

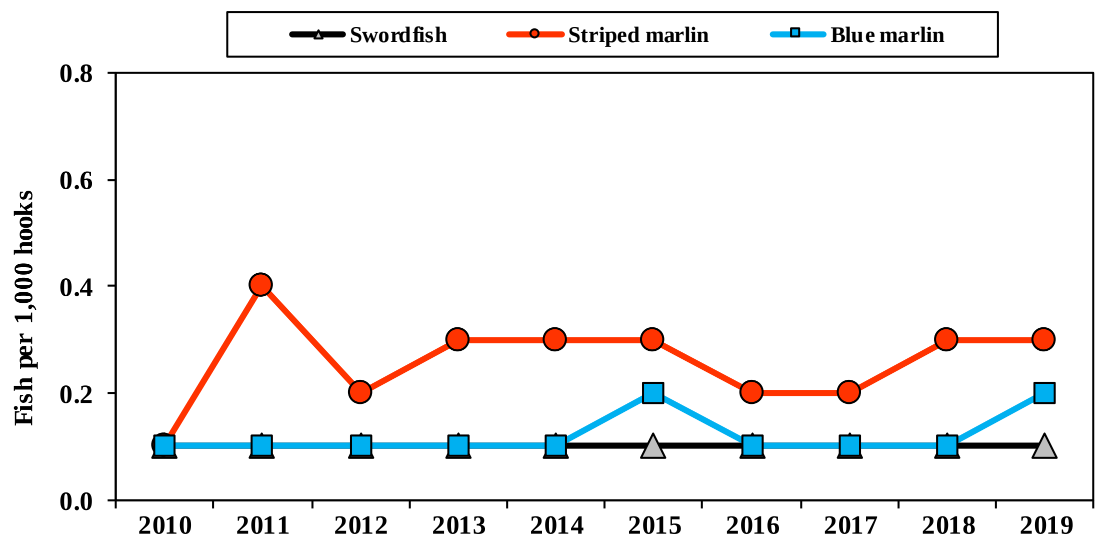


Figure 92. Billfish CPUE for the Hawaii-permitted deep-set longline fishery, 2010-2019
Supporting data shown in Table A-93.

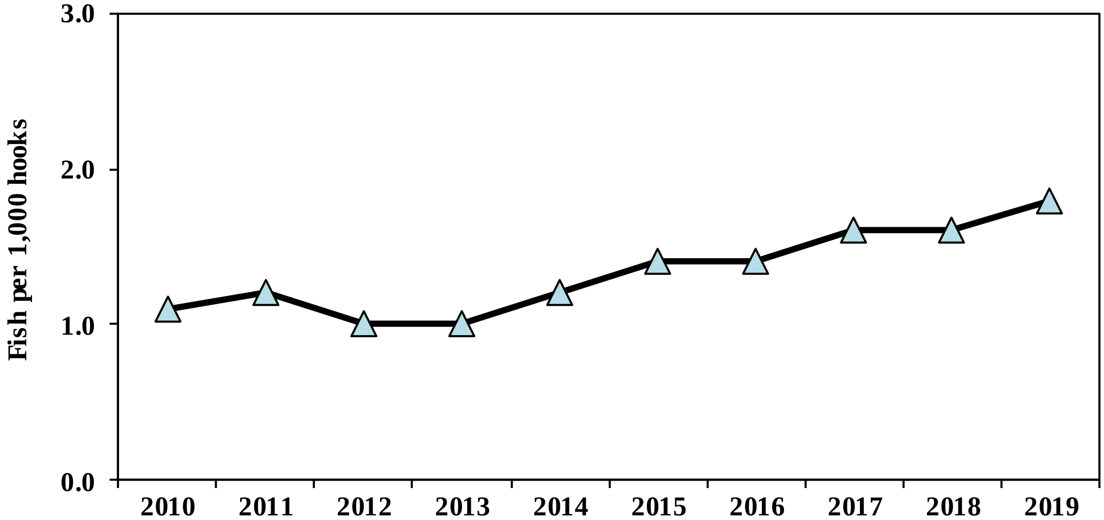


Figure 93. Blue shark CPUE for the Hawaii-permitted deep-set longline fishery, 2010-2019

Supporting data shown in Table A-94.

Table 24. Released catch, retained catch, and total catch for the Hawaii-permitted deep-set longline fishery, 2019

	Deep-set longline fishery			
	Released catch	**Percent released**	**Retained catch**	**Total Catch**
Tuna				
Albacore	91	2.1	4,253	4,344
Bigeye tuna	5,949	2.7	217,098	223,047
Bluefin tuna	0	0.0	14	14
Skipjack tuna	374	1.1	32,678	33,052
Yellowfin tuna	1,850	3.0	60,156	62,006
Other tuna	0	0.0	0	0
Total tunas	**8,264**	**2.6**	**314,199**	**322,463**
Billfish				
Swordfish	155	3.2	4,738	4,893
Blue marlin	153	1.2	12,773	12,926
Striped marlin	628	3.1	19,907	20,535
Spearfish	410	2.5	15,886	16,296
Other marlin	26	1.8	1,397	1,423
Total billfish	1,372	2.4	54,701	56,073
Other PMUS				
Mahimahi	425	1.1	37,080	37,505
Wahoo	222	0.5	44,109	44,331
Moonfish	237	1.0	24,363	24,600
Oilfish	2,597	15.7	13,934	16,531
Pomfret	439	0.8	52,561	53,000
Total other PMUS	**3,920**	**2.2**	**172,047**	**175,967**
Non-PMUS fish	**5,558**	**96.8**	**185**	**5,743**
Total non-shark	**19,114**	**3.4**	**541,132**	**560,246**
PMUS Sharks				
Blue shark	111,322	100.0	2	111,324
Mako shark	4,423	90.5	462	4,885
Thresher shark	8,690	99.4	53	8,743
Oceanic Whitetip shark	493	100.0	0	493
Silky shark	363	100.0	0	363
Total PMUS sharks	**125,291**	**99.6**	**517**	**125,808**
Non-PMUS sharks	**272**	**100.0**	**0**	**272**
Grand Total	**144,677**	**21.1**	**541,649**	**686,326**

Table 25. Average weight (lbs.) of the catch by the Hawaii-permitted deep-set longline fishery, 2010-2019

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
2010	88	90	47	19	235	172	93	202	31	56	189	10	32	91	14	15	203	182
2011	81	67	47	20	235	172	47	188	33	58	189	12	34	91	12	16	186	172
2012	82	71	48	16	276	172	66	200	32	57	186	12	32	92	14	16	198	196
2013	75	84	47	16	235	183	68	225	31	62	189	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	235	165	81	185	33	59	219	12	31	91	13	18	194	219
2016	83	73	55	17	250	165	73	196	31	51	242	13	31	88	13	19	179	183
2017	79	72	49	19	250	190	67	188	32	63	286	12	31	92	13	20	181	200
2018	78	89	52	19	276	189	66	197	32	64	185	11	28	93	15	22	182	184
2019	79	74	53	18	269	189	61	156	28	29	182	12	28	92	14	22	190	190
Average	**80.3**	**77.8**	**50.2**	**17.9**	**251.2**	**175.5**	**68.4**	**194.2**	**31.3**	**55.7**	**212.5**	**11.7**	**31.0**	**90.7**	**13.5**	**18.3**	**190.9**	**191.3**
SD	**4.5**	**8.2**	**3.0**	**1.4**	**18.0**	**11.5**	**12.3**	**17.6**	**1.5**	**10.1**	**37.2**	**0.8**	**1.9**	**1.8**	**0.8**	**2.5**	**8.6**	**16.0**

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

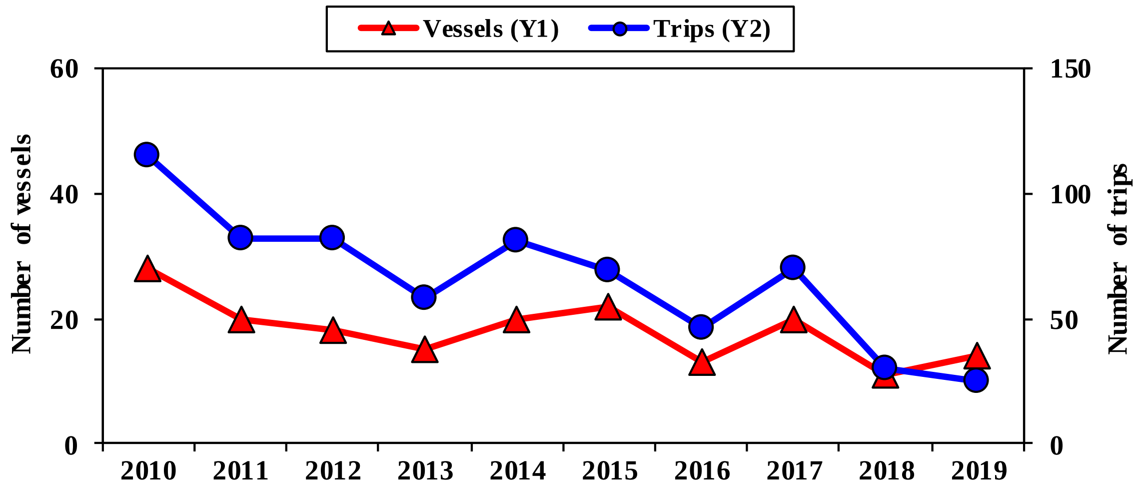


Figure 94. Number of Hawaii-permitted shallow-set longline vessels and trips, 2010-2019

Supporting data shown in Table A-95.

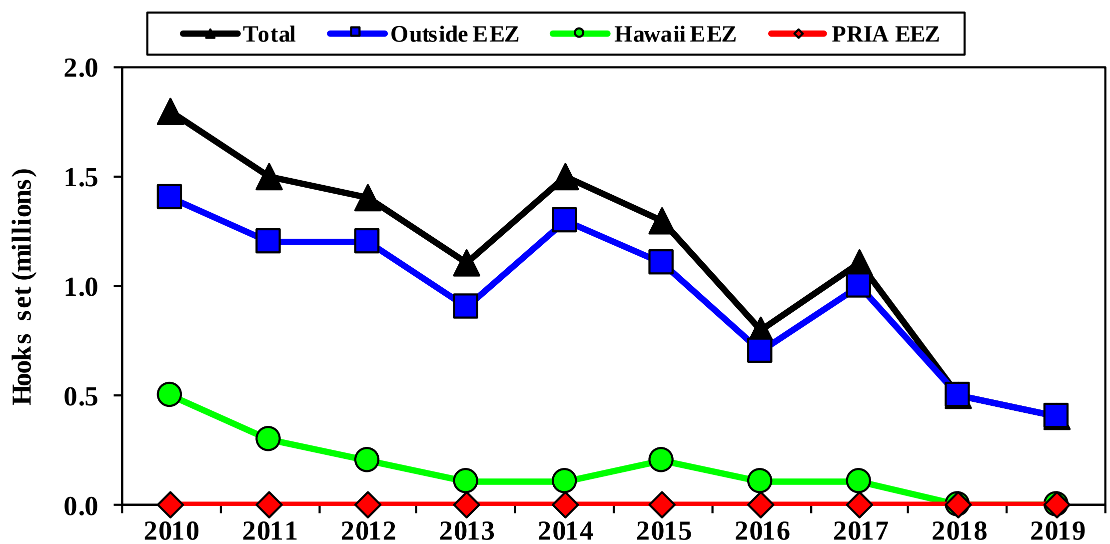


Figure 95. Number of hooks set by the Hawaii-permitted shallow-set longline fishery, 2010-2019

Supporting data shown in Table A-96.

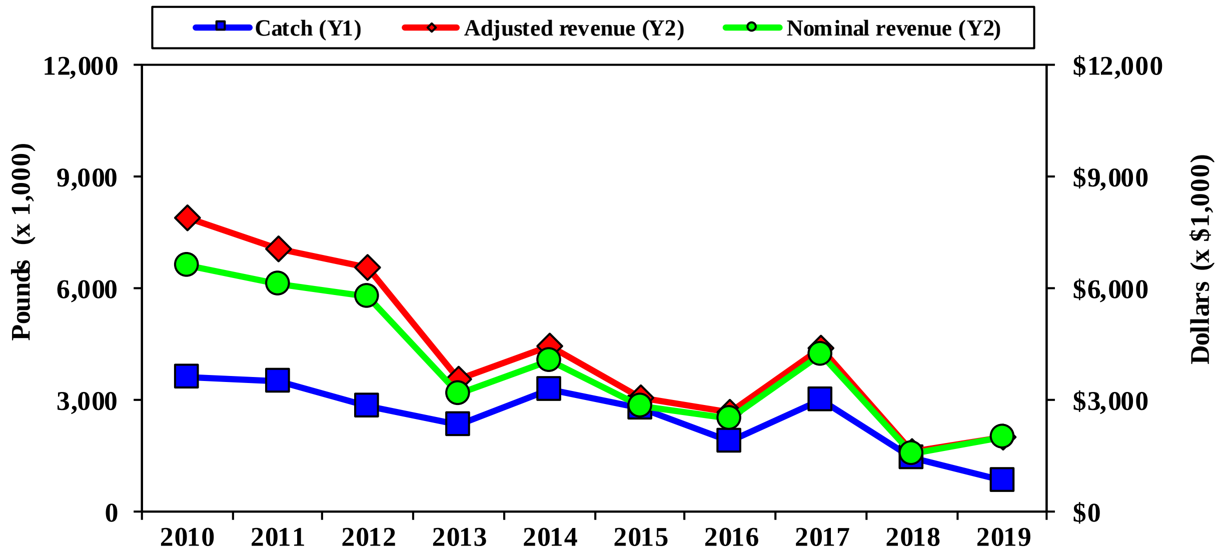


Figure 96. Catch and revenue for the Hawaii-permitted shallow-set longline fishery, 2010-2019

Supporting data shown in Table A-97.

Table 26. Hawaii-permitted shallow-set longline catch (number of fish) by area, 2010-2019

Year	Tunas			Billfish				Other PMUS				PMUS sharks
	Bigeye tuna	Yellowfin tuna	Albacore	Swordfish	Blue marlin	Striped marlin	Spearfish	Mahimahi	Ono (Wahoo)	Moonfish	Pomfrets	
Hawaii+PRIA EEZ												
2010	218	102	18	3,491	42	133	32	783	57	4	20	2,157
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												
Outside EEZ												
2010	1,367	103	1,902	13,636	22	122	38	1,819	15	213	57	16,800
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
All areas												
2010	1,585	205	1,920	17,127	64	255	70	2,602	72	217	77	18,957
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

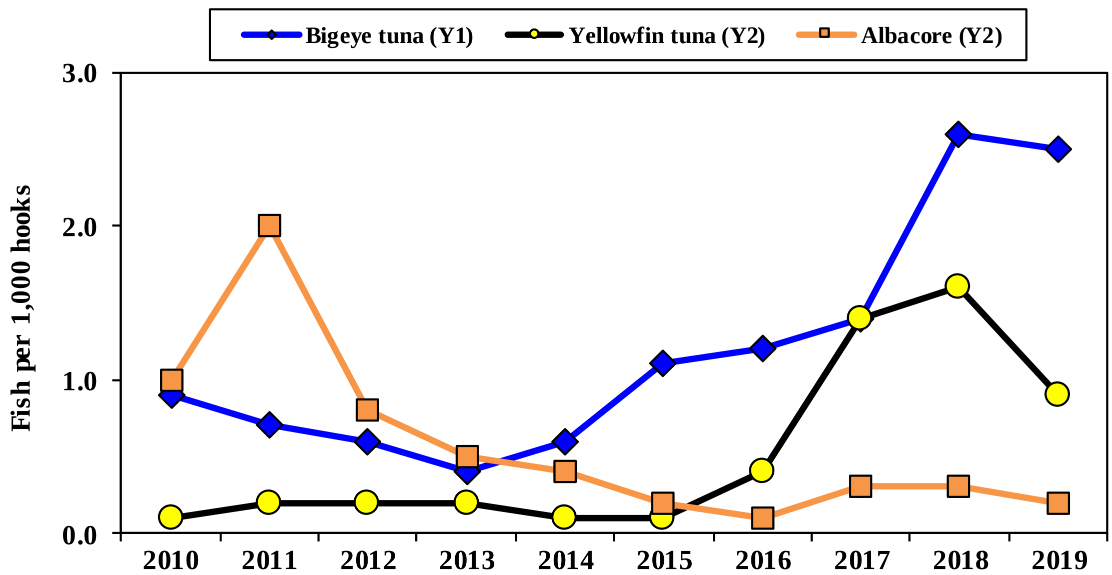


Figure 97. Tuna CPUE for the Hawaii-permitted shallow-set longline fishery, 2010-2019
Supporting data shown in Table A-98.

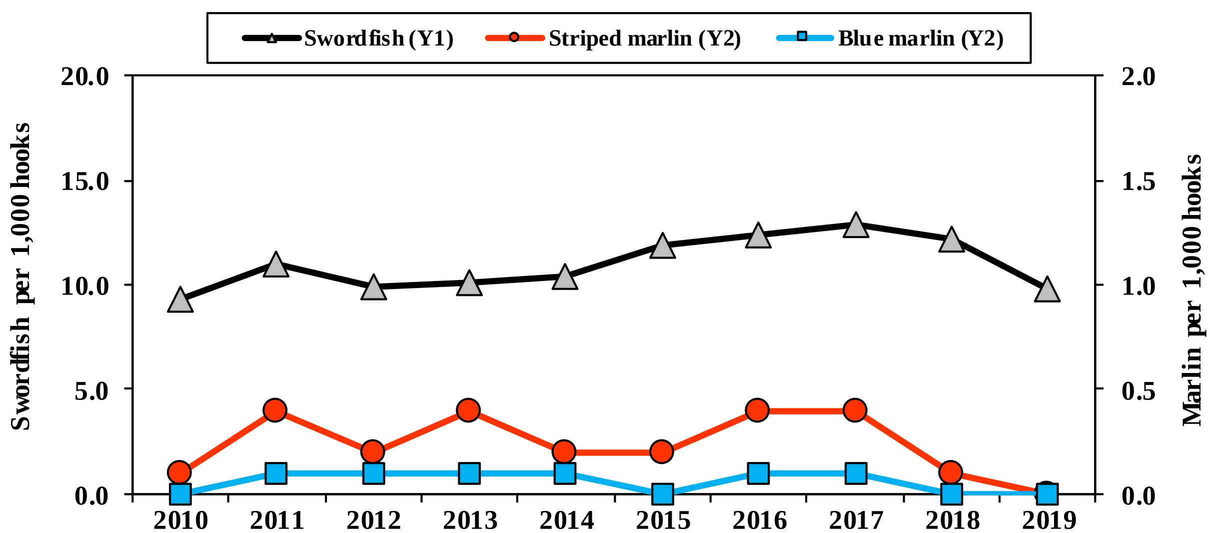


Figure 98. Billfish CPUE for the Hawaii-permitted shallow-set longline fishery, 2010-2019
Supporting data shown in Table A-99.

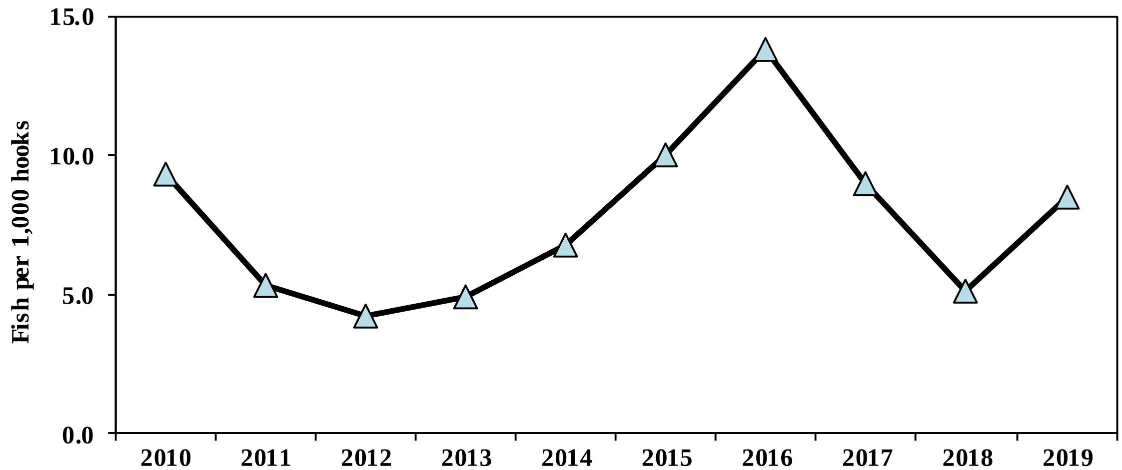


Figure 99. Blue shark CPUE for the Hawaii-permitted shallow-set longline fishery, 2010-2019

Supporting data shown in Table A-100.

Table 27. Released catch, retained catch, and total catch for the Hawaii-permitted shallow-set longline fishery, 2019

	Shallow-set longline fishery			
	Released catch	**Percent released**	**Retained catch**	**Total Catch**
Tuna				
Albacore	0	0.0	81	81
Bigeye tuna	36	4.1	838	874
Bluefin tuna	0	0.0	0	0
Skipjack tuna	4	20.0	16	20
Yellowfin tuna	4	1.2	327	331
Other tuna	0	0.0	0	0
Total tunas	**44**	**3.4**	**1,262**	**1,306**
Billfish				
Swordfish	118	3.4	3,317	3,435
Blue marlin	0	0.0	0	0
Striped marlin	3	25.0	9	12
Spearfish	5	27.8	13	18
Other marlin	0	0.0	3	3
Total billfish	**126**	**3.6**	**3,342**	**3,468**
Other PMUS				
Mahimahi	1	0.4	246	247
Wahoo	0	0.0	3	3
Moonfish	0	0.0	31	31
Oilfish	18	32.1	38	56
Pomfret	0	0.0	5	5
Total other PMUS	**19**	**5.6**	**323**	**342**
Non-PMUS fish	**0**	**0.0**	**0**	**0**
Total non-shark	**189**	**3.7**	**4,927**	**5,116**
PMUS Sharks				
Blue shark	2,993	100.0	0	2,993
Mako shark	99	50.3	98	197
Thresher shark	5	100.0	0	5
Oceanic Whitetip shark	0	0.0	0	0
Silky shark	0	0.0	0	0
Total PMUS sharks	**3,097**	**96.9**	**98**	**3,195**
Non-PMUS sharks	0	0.0	0	0
Grand Total	**3,286**	**39.5**	**5,025**	**8,311**

Table 28. Average weight (lbs.) of the catch by the Hawaii-permitted shallow-set longline fisheries, 2010-2019

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
2010	95	115	27	15	173	200	111	282	37	54		13	49	73	17	18	154	321
2011	110	121	30	18		211	91	246	37	52		11	38	57	17	17	185	200
2012	99	109	27	16	173	198	98	259	34			12	37	80	14	16	185	277
2013	107	111	27	17	173	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	173	200	102	259	39	52		12	36	83	14	20	179	243
2018	89	98	36	15	173	214	94	413	36			10	39	84	14	25	184	243
2019	72	92	35	17		217	126		36	52		9	39	83	16	21	165	
Average	**92.2**	**109.4**	**29.7**	**16.2**	**188.8**	**203.1**	**99.9**	**290.4**	**36.5**	**52.3**	**---**	**11.7**	**39.4**	**77.2**	**14.9**	**20.7**	**179.6**	**251.6**
SD	**11.9**	**12.7**	**5.0**	**1.3**	**38.8**	**13.4**	**11.0**	**49.3**	**1.7**	**0.8**	**---**	**1.4**	**4.3**	**8.5**	**1.5**	**3.0**	**20.0**	**34.8**

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

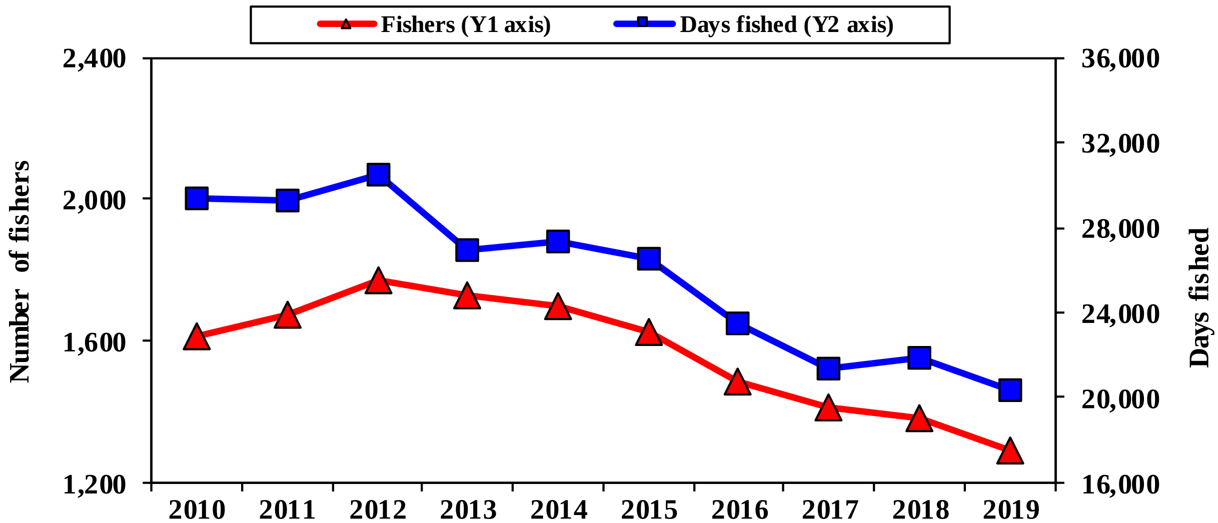


Figure 100. Number of MHI troll fishers and days fished, 2010-2019

Supporting data shown in Table A-101.

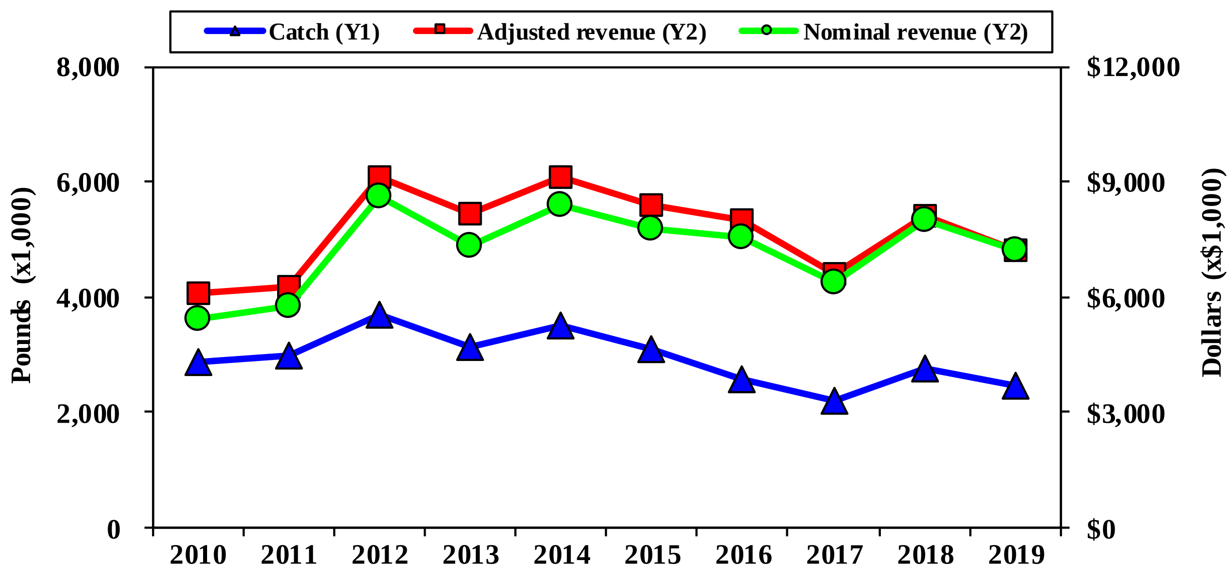


Figure 101. Catch and revenue for the MHI troll fishery, 2010-2019

Supporting data shown in Table A-102.

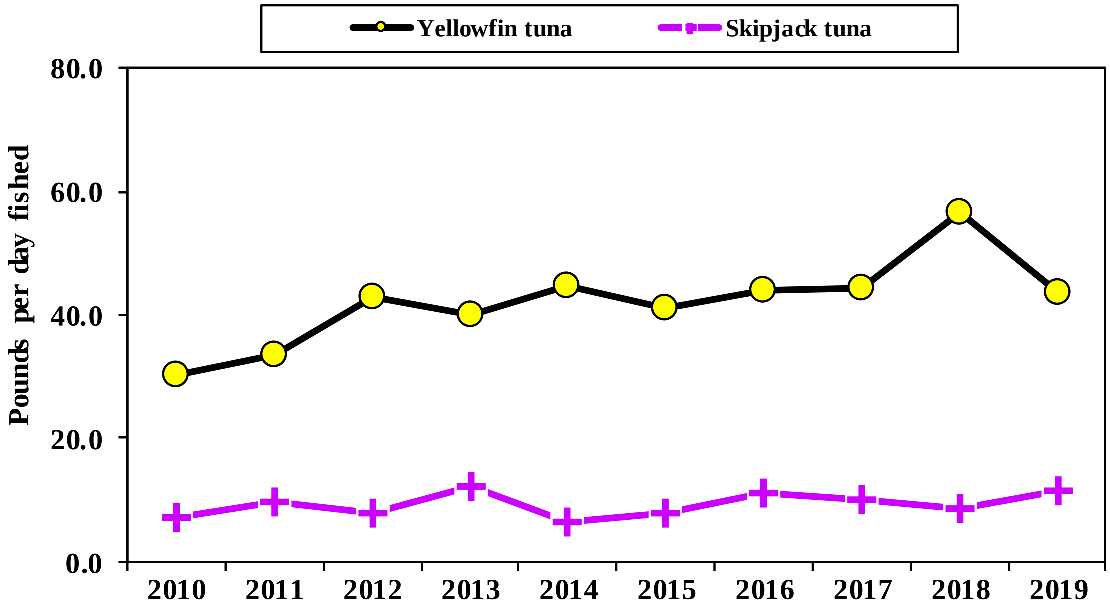


Figure 102. Tuna CPUE for the MHI troll fishery, 2010-2019

Supporting data shown in Table A-103.

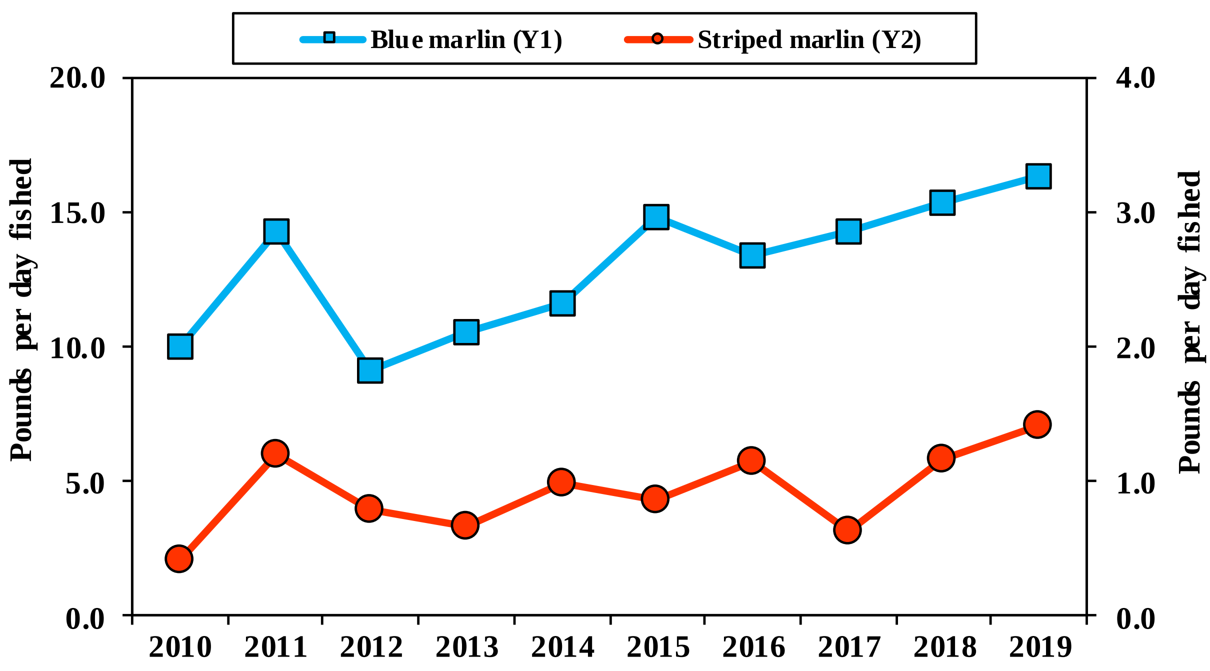


Figure 103. Marlin CPUE for the MHI troll fishery, 2010-2019

Supporting data shown in Table A-104.

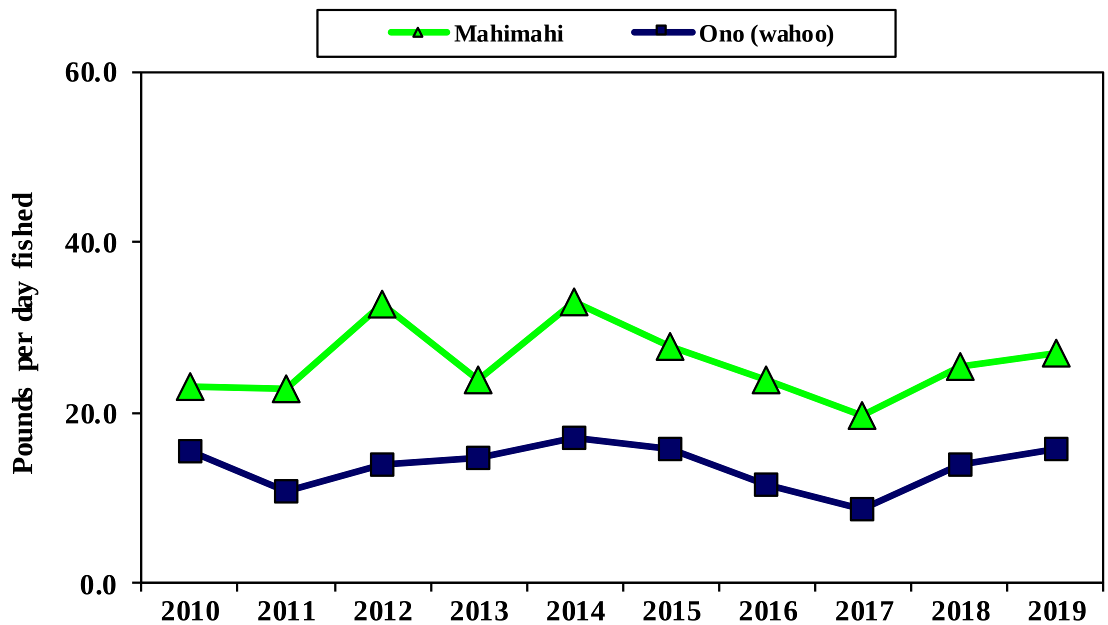


Figure 104. Mahimahi and Ono CPUE for the MHI troll fishery, 2010-2019
Supporting data shown in Table A-105.

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

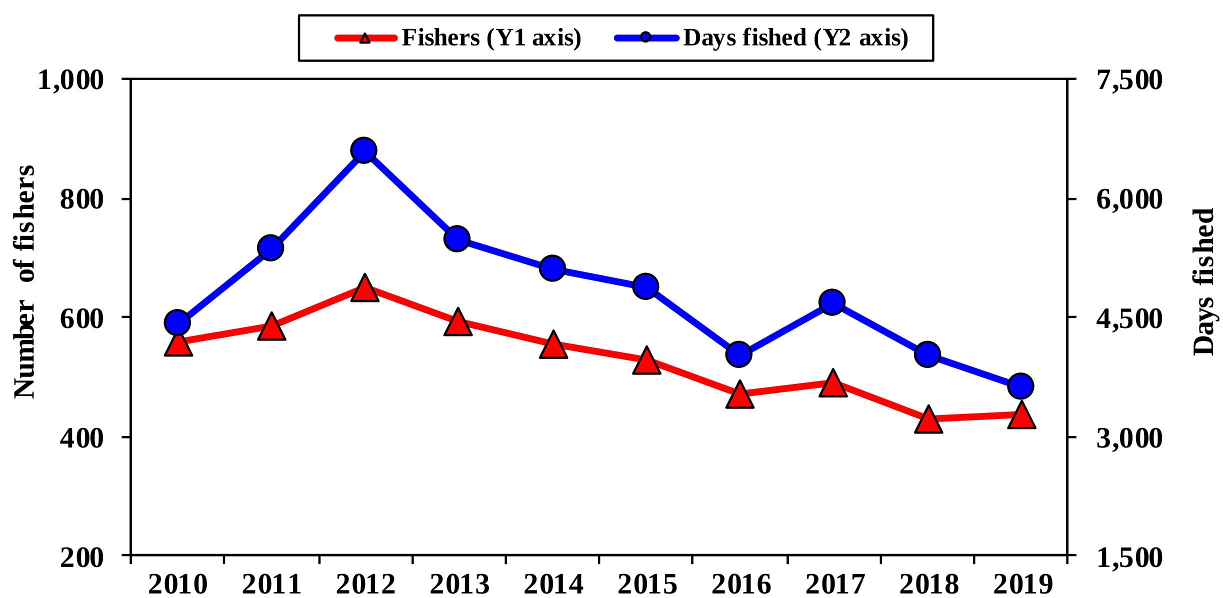


Figure 105. Number of MHI handline fishers and days fished, 2010-2019
Supporting data shown in Table A-106.

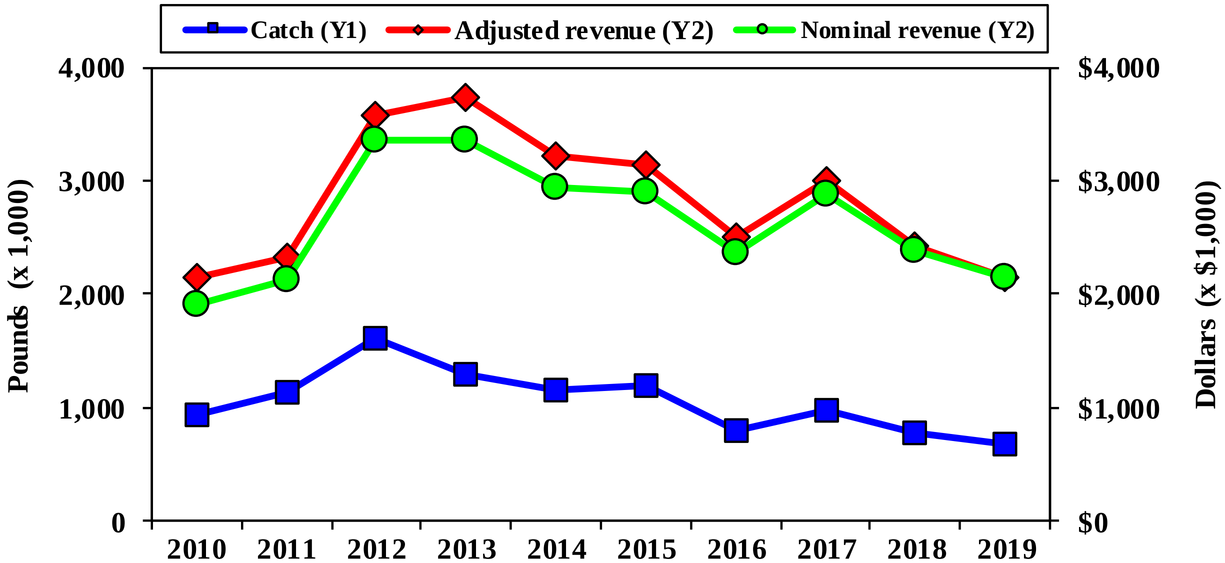


Figure 106. Catch and revenue for the MHI handline fishery, 2010-2019

Supporting data shown in Table A-107.

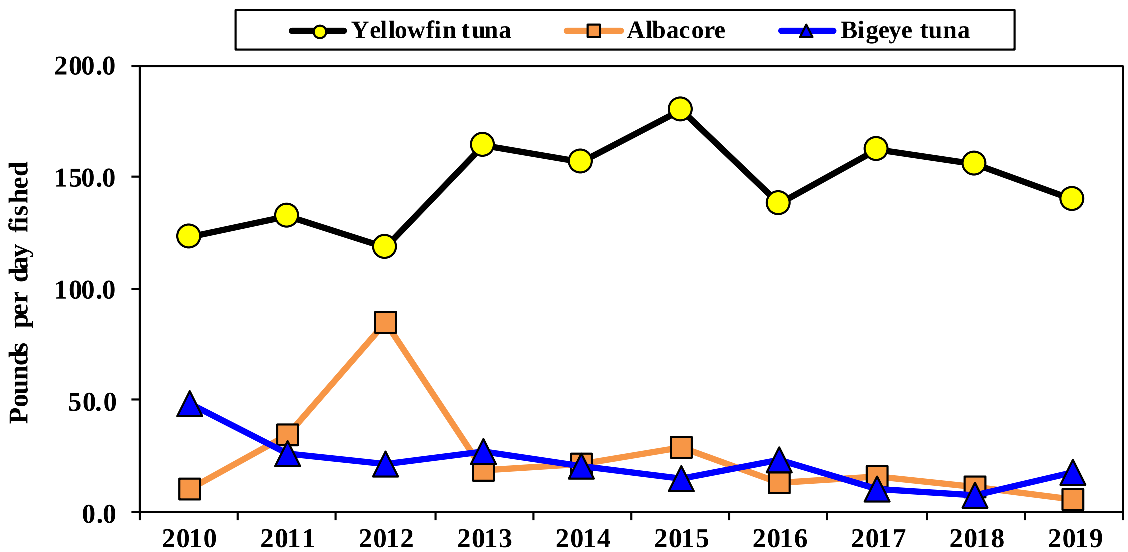


Figure 107. Tuna CPUE for the MHI handline fishery, 2010-2019

Supporting data shown in Table A-108.

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

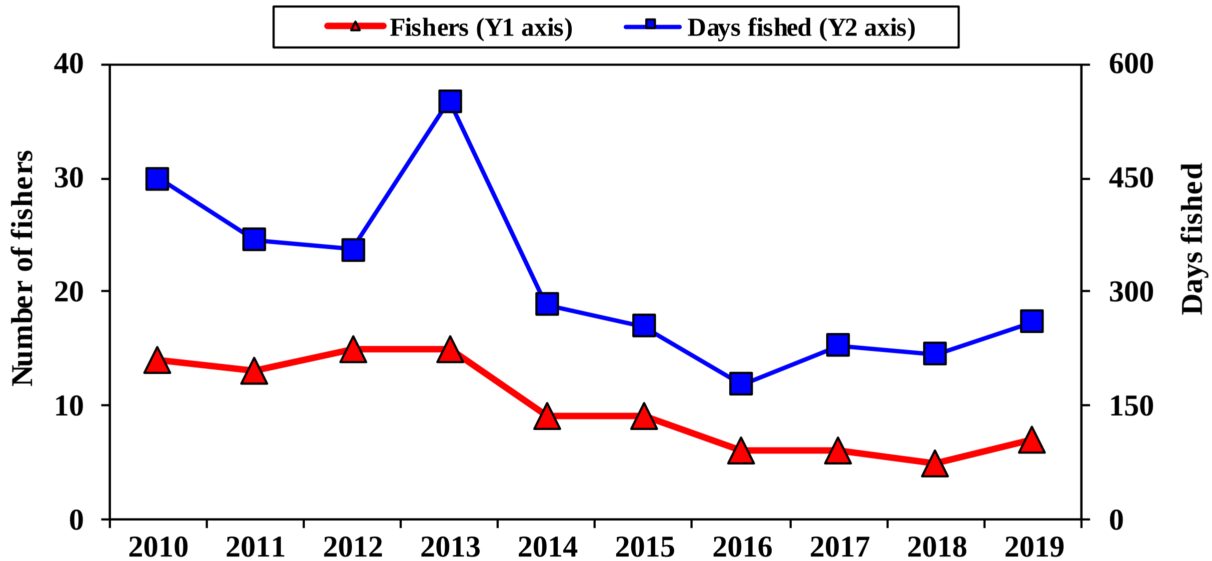


Figure 108. Number of offshore handline fishers and days fished, 2010-2019

Supporting data shown in Table A-109.

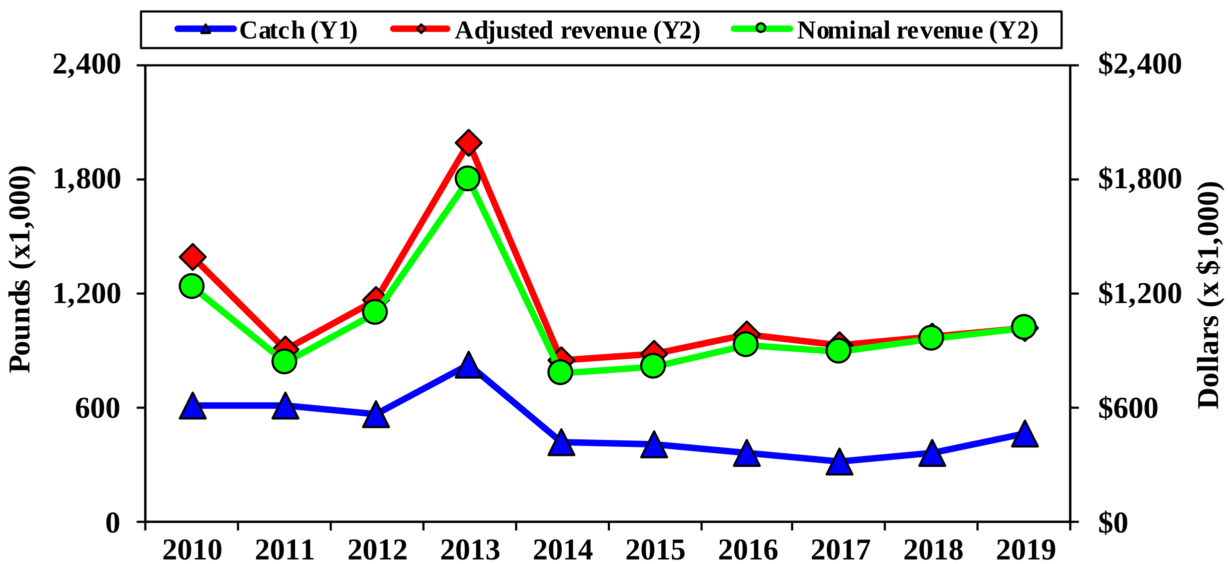


Figure 109. Catch and revenue for the offshore tuna handline fishery, 2010-2019

Supporting data shown in Table A-110.

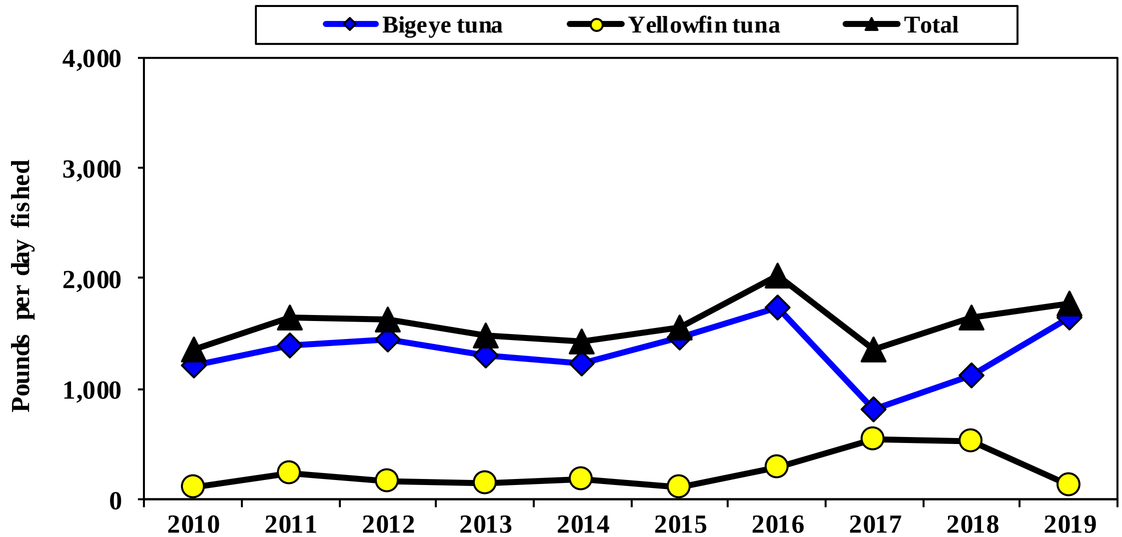


Figure 110. Tuna CPUE for the offshore tuna handline fishery, 2010-2019

Supporting data shown in Table A-111.

Table 29. Average weight (lbs.) of the catch by the Hawaii troll and handline fisheries, 2010-2019

	Tunas				Billfish			Other PMUS	
Year	**Albacore**	**Bigeye tuna**	**Skipjack tuna**	**Yellowfin tuna**	**Blue marlin**	**Striped marlin**	**Swordfish**	**Mahimahi**	**Ono (wahoo)**
2010	48.0	30.3	4.8	28.9	246.5	105.2	162.6	13.7	25.9
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	175.8	73.9	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
Average	**48.3**	**24.3**	**7.6**	**34.9**	**205.9**	**65.8**	**121.3**	**12.4**	**23.3**
SD	**3.8**	**2.7**	**1.5**	**5.2**	**44.5**	**16.5**	**18.6**	**0.7**	**2.1**

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 WWII through time and area restrictions, which effectively stopped commercial fishing and confined recreational 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 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 on Guam, including a fishing derby for children organized by the local Aquatic and Wildlife Resources Division.

Every summer on 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 (MASC), 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, 7 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 alias, 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 surplus to 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 during tournaments 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). 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 PRIAs, namely at Midway, Wake Island, and Palmyra Atoll. There are no resident populations at Howland

Island, Baker Island, Johnston Atoll, and 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, resulting in a non-commercial catch being relatively low. In comparison, CNMI and Guam both have a higher percentage of non-commercial fishing, where it is more than half of the total pelagic catch. This difference between island areas is to be expected, as both Hawaii and American Samoa have the larger markets to provide fish (i.e., hotels, restaurants, exports, and the cannery).

Non-commercial fishing trips for each island area, however, are a relatively smaller percentage of the total trips in everywhere but Hawaii, where the Hawaii Marine Recreational Fishing Survey estimates over 632,088 trips were taken in 2019.

Table 30. Summary of estimated non-commercial landings by island area in 2019

Island Area	Total Pelagic Catch (lbs.)	Total Trips	Non-Commercial Catch	Non-Commercial Fishing Trips	Non-Commercial % of Total Catch
American Samoa	2,997,275	1,865	97,801	102	3%
CNMI	466,269	3,336	288,650	879	62%
Guam	840,332	11,801	704,116	2,706	83%
Hawaii	49,314,507	658,061	12,785,507	632,088	26%

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 % of the total annual charter vessel catch by weight, but in 2019 only formed just over 28% of the charter vessel catch though yellowfin is very close with 25% of the kept catch. The reduction in catch may be attributed to an increasing catch and release effort of marlins in the industry that has grown since 2004 coupled with the lower price per pound received for marlins that may have been impacted by outside forces such as the Billfish Conservation Act which reduced the ability for fishermen to export marlin and marlin products outside of Hawaii. Guam's charter industry has slightly expanded but is subject to the availability of military and visitors, and thus has waxed and waned with the tourism industry. In CNMI, charter fishing is limited with less than a dozen boats operating on Saipan and Tinian.

Table 31. Summary of charter fishing in the Western Pacific region in 2019

Island Area	Catch (lbs.)	Effort (Trips)	CPUE (lbs./trip)	Principal Species
CNMI	3,125	74	42.23	skipjack tuna, mahimahi, wahoo, yellowfin tuna
Guam	53,437	1,613	34.37	mahimahi, skipjack tuna, blue marlin, wahoo, yellowfin tuna
Hawaii	515,104	7,744	66.51	Yellowfin tuna, blue marlin, mahimahi, ono, aku

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

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

Table 32 provides summaries of the non-commercial, boat-based catch between 2012 and 2019 for pelagic fish. Non-commercial catches of pelagic fish were considerably lower in 2018 than 2019 but just above the mean for the time series. The species composition of the catch in 2019 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 2019 had a similar species composition, and every species had a CPUE of less than 10 lbs./angler trip that year (Figure 112). The number of estimated boat-based angler trips was slightly down in 2019 from 2018 at 632,088 but remained well above the average for the time-series (Figure 113).

Table 32. Estimated non-commercial boat-based pelagic catch in Hawaii from 2012 to 2019

Year	Catch (lbs.)	Change from previous year
2012	12,330,638	-
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%)
Average	**12,127,271**	-

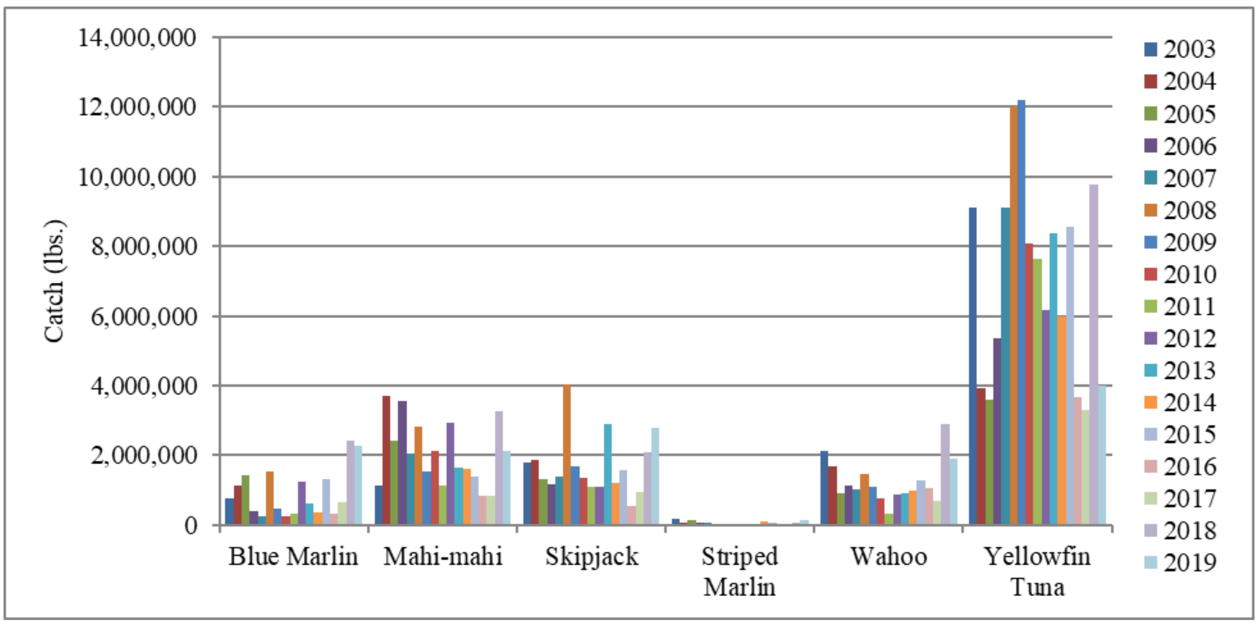


Figure 111. Non-commercial catch (lbs.) in Hawaii by species from 2003 to 2019

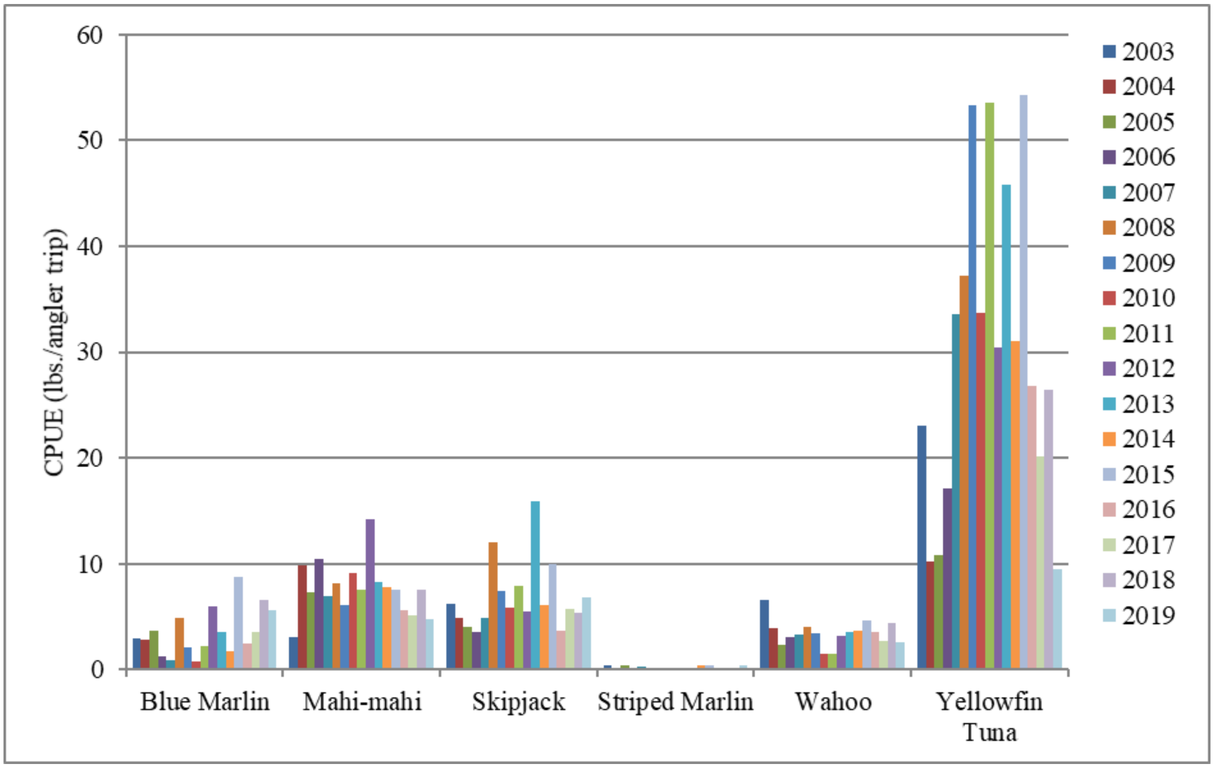


Figure 112. Non-commercial CPUE (lbs./angler trip) in Hawaii by species from 2003 to 2019

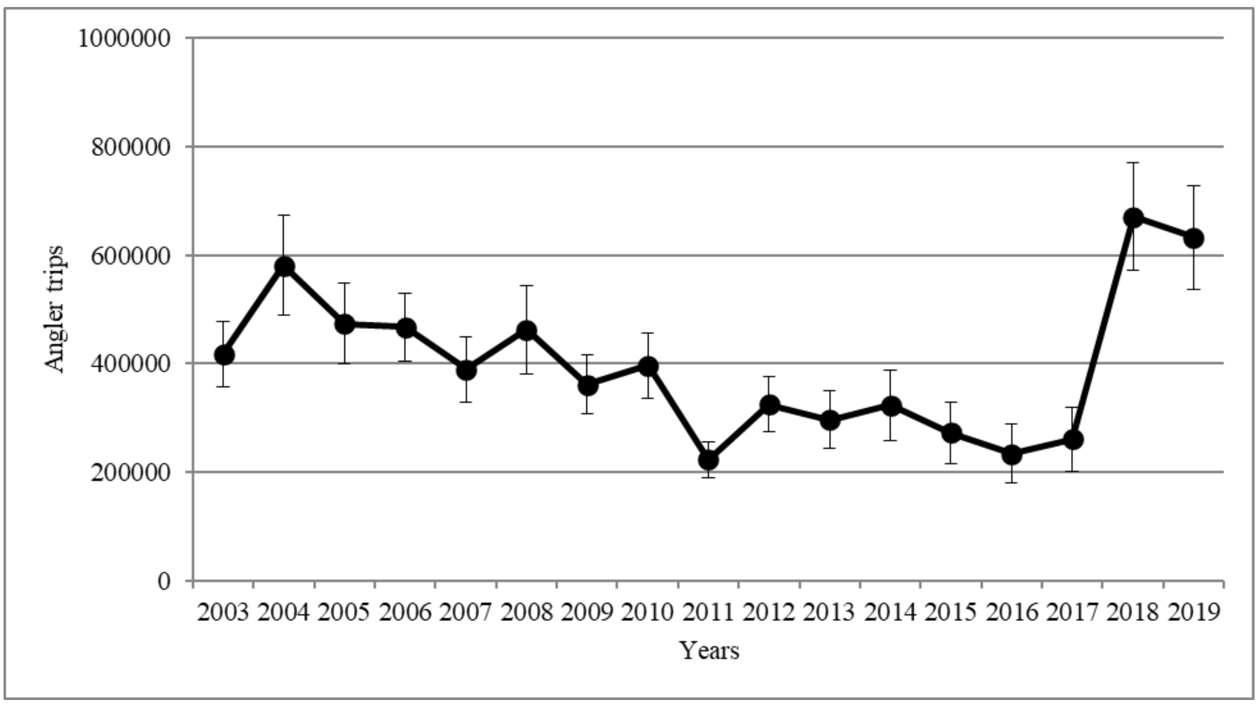


Figure 113. Estimated angler trips in the Hawaii non-commercial fishery from 2003-2019

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 2015-2019, as reported to the WCPFC (NMFS, 2020). The catches for 2019 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).

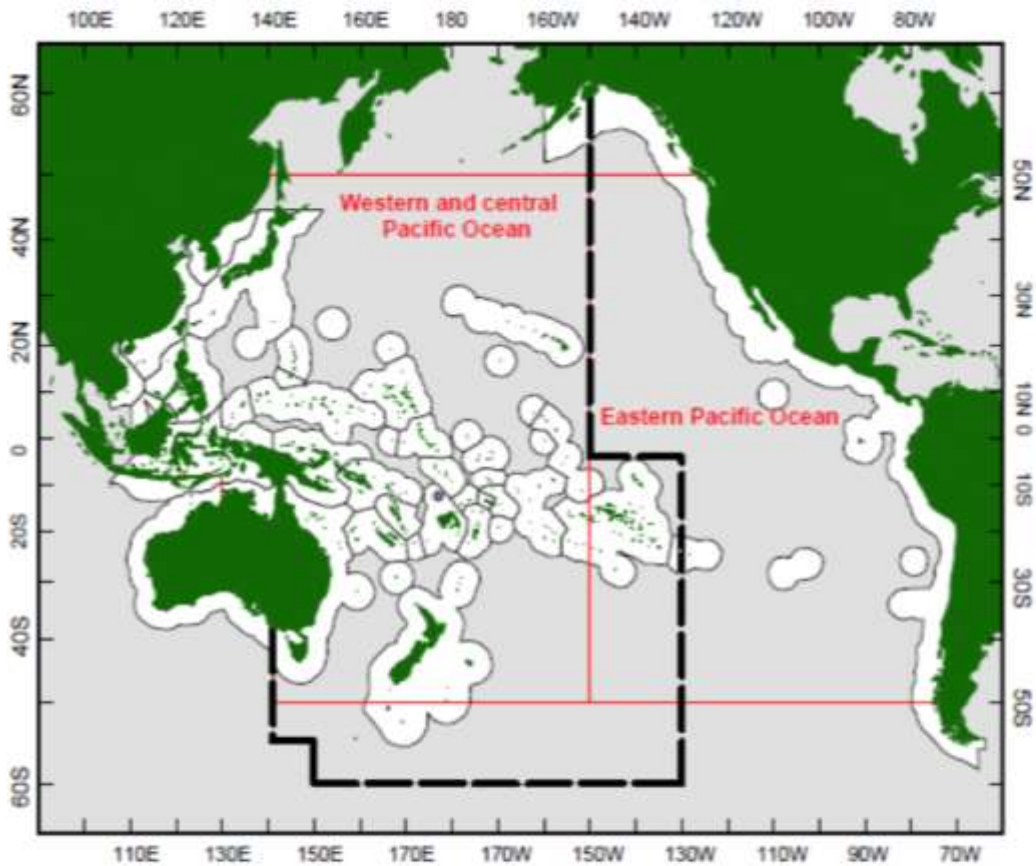


Figure 114. The Western and Central Pacific Ocean, Eastern Pacific Ocean and the WCPFC Convention Area (WCP–CA) [in dashed lines])

2.6.2 DATA SOURCES

The data sources for the international module of the 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 can be found in the bibliography for this module. Additional sources of data include the US data submissions to the WCPFC and IATTC documented in this module.

2.6.3 PLAN TEAM RECOMMENDATIONS

There were no International module recommendations by the Pelagics Plan Team for the 2019 annual SAFE report to be forwarded to the Council, only Action 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
2009	167,041	255,763	2,016,260	787,614	3,226,678
2010	155,879	227,291	1,839,282	820,488	3,042,940
2011	146,125	243,533	1,813,238	736,941	2,939,837
2012	179,943	257,896	2,028,327	815,581	3,281,747
2013	171,186	231,901	2,110,533	781,847	3,295,467
2014	162,827	246,875	2,269,240	839,782	3,518,724
2015	155,233	240,840	2,123,546	833,921	3,353,540
2016	125,071	236,697	2,133,882	888,963	3,384,613
2017	153,284	225,679	1,952,678	915,940	3,247,581
2018	138,851	235,782	2,129,676	937,504	3,441,813
Average	155,544	240,226	2,041,666	835,858	3,273,294
STD deviation	16,078	11,003	141,957	62,593	174,840

Source: SPC (2019).

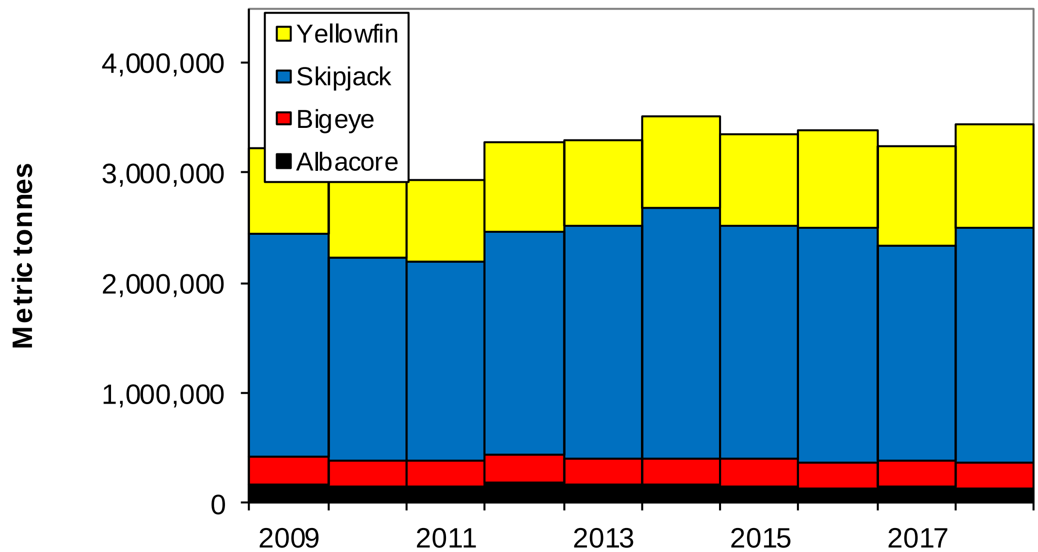


Figure 115. Estimated total annual catch of tuna species in the Pacific Ocean
Source: SPC (2019).

2.6.4.1 PURSE SEINE FISHERY IN THE WCPFC

Source: WCPFC-SC15-2019 GN-WP-01

Vessels: The majority of the historic WCP–CA purse seine catch has come from the four main Distant Water Fishing Nation (DWFN) fleets – Japan, Korea, Chinese-Taipei and USA, which combined numbered 163 vessels in 1992, but declined to a low of 111 vessels in 2006 (due to reductions in the US fleet), before some rebound in recent years (up to 129 vessels in 2017 and 122 vessels in 2018). The Pacific Islands fleets have gradually increased in numbers over the past two decades to a level of 130 vessels in 2017 and 126 vessels in 2018. The remainder of the purse seine fishery includes several fleets which entered the WCPFC tropical fishery during the 2000s (e.g. China, Ecuador, El Salvador, New Zealand, and Spain).

The total number of purse seine vessels was relatively stable over the period 1990-2006 (in the range of 180–220 vessels), but thence until 2014, the number of vessels gradually increased, attaining a record level of 308 vessels in 2015, before steadily declining since (to 271 vessels in 2018).

Catch: The provisional 2018 purse-seine catch of 1,910,725 mt was the second highest on record, at nearly 150,000 mt less than the record in 2014 (2,059,008 mt). The 2018 purse-seine skipjack catch (1,469,520 mt; 77% of total catch) was the second highest on record, only 12,000 mt lower than the record in 2014 (1,481,038 mt). The 2018 purse-seine catch for yellowfin tuna (374,062 mt; 20%) was over 100,000 mt lower than the record catch in 2017 (480,176 mt) but still amongst the highest annual catches for this fishery. The provisional catch estimate for bigeye tuna for 2018 (64,119 mt) was the highest since 2014 and slightly higher than the past ten-year average.

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 Nino conditions). The move to ENSO-neutral conditions, then weak La Nina 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 Nino 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.

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 WCP–CA. However, it appears that most of the yellowfin catch east of 160°E was from drifting FAD (associated) sets during 2018.

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

Year	Skipjack	Yellowfin	Bigeye	Total
2009	1,639,037	552,769	135,987	2,327,793
2010	1,449,457	595,204	114,093	2,158,754
2011	1,450,362	510,403	128,644	2,089,409
2012	1,666,433	573,793	129,910	2,370,136
2013	1,759,598	560,320	121,688	2,441,606
2014	1,901,260	585,755	125,964	2,612,979
2015	1,729,902	546,537	112,790	2,389,229
2016	1,720,726	627,125	117,860	2,465,711
2017	1,608,110	691,108	125,240	2,424,458
2018	1,746,918	606,878	129,141	2,482,937
Average	1,667,180	584,989	124,132	2,376,301
STD Deviation	139,519	49,927	7,444	154,257

Source: SPC (2019) and IATTC (2019).

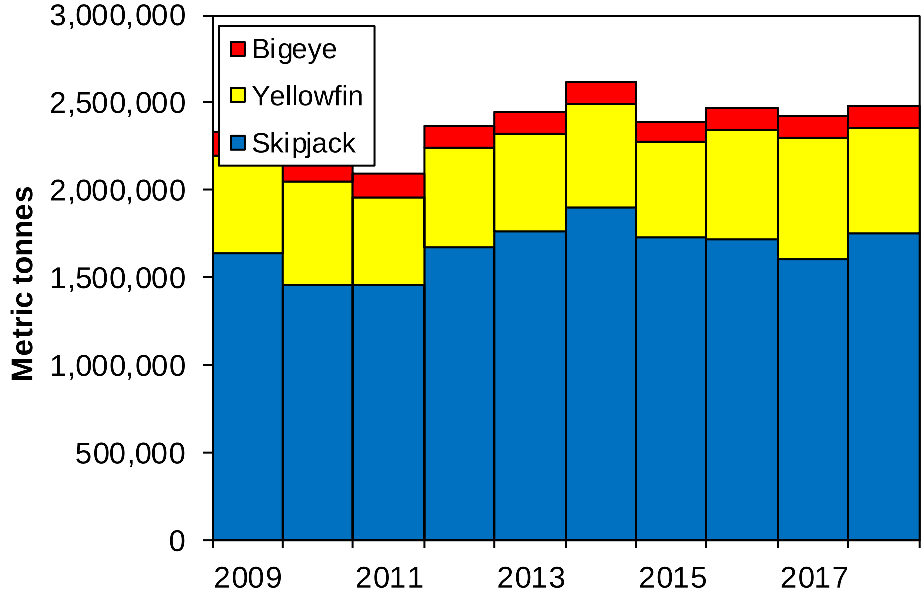


Figure 116. Total purse seine catch of skipjack, yellowfin, and bigeye tuna in the Pacific Ocean

Source: SPC (2019) and IATTC (2019).

2.6.4.2 LONGLINE FISHERIES IN THE WCPFC

Source: WCPFC-SC15-2019 GN-WP-01

Vessels: The total number of vessels involved in the fishery has generally fluctuated between 3,000 and 6,000 for the last 30 years. In recent years, total vessel numbers have dropped below 3,000 vessels for the first time since the 1960s with a provisional estimate of 2,781 vessels in 2018, a 17% drop on the vessels in 2015, 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, PNG, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu; these fleets mainly operate in subtropical waters, with albacore the main species taken. Two new entrants, Tuvalu and Wallis & Futuna, joined this category during 2011, although the latter fleet has not fished recently. Vessel numbers have stabilized in recent years, but they may also vary depending on charter arrangements.

Tropical offshore bigeye/yellowfin-target fishery includes "offshore" sashimi longliners from Chinese-Taipei, based in Micronesia, Guam, Philippines and Chinese-Taipei, mainland Chinese vessels based in Micronesia, and domestic fleets based in Indonesia, Micronesian countries, Philippines, PNG, the Solomon Islands and Vietnam.

Tropical distant-water bigeye/yellowfin-target fishery comprises "distant-water" vessels from Japan, Korea, Chinese-Taipei, mainland China and Vanuatu. These vessels primarily operate in the eastern tropical waters of the WCP–CA (and into the EPO), targeting bigeye and yellowfin tuna for the frozen sashimi market.

South Pacific distant-water albacore fishery comprises "distant-water" vessels from Chinese-Taipei, mainland China and Vanuatu operating in the south Pacific, generally below 20°S, targeting albacore tuna destined for canneries.

Domestic fisheries in the sub-tropical and temperate WCP–CA comprise vessels targeting different species within the same fleet depending on market, season and/or area. These fleets include the domestic fisheries of Australia, Japan, New Zealand, and Hawaii. For example, the Hawaiian longline fleet has a component that targets swordfish and another that targets bigeye tuna.

South Pacific distant-water swordfish fishery is a relatively new fishery and comprises "distant-water" vessels from Spain and Portugal (one vessel started fishing in 2011).

North Pacific distant-water albacore and swordfish fisheries mainly comprise "distant-water" vessels from Japan (swordfish and albacore), Chinese-Taipei (albacore only) and Vanuatu (albacore only).

Catch: The provisional WCP–CA longline catch (254,850 mt) for 2018 was at the average level for the past five years. The WCP–CA albacore longline catch (84,930 mt – 34%) for 2018 was amongst the lowest for ten years, and around 16,000 mt lower than the record of 101,820 mt attained in 2010. The provisional bigeye catch (71,305 mt – 28%) for 2018 was higher than the recent five-year average, but well down on the bigeye catch levels experienced in the 2000s (e.g., the 2004 longline bigeye catch was 99,705 mt). The yellowfin catch for 2018 (94,509 mt – 38%) was at the average level for the past five years and more than 30,000 mt less that the record for this fishery (1980: 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, but with variations in areas fished and target species.

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

Activity by the foreign-offshore fleets from Japan, mainland China and Chinese-Taipei is restricted to tropical waters, targeting bigeye and yellowfin for the fresh sashimi market; these fleets have limited overlap with the distant-water fleets. The substantial "offshore" effort in the west of the region is primarily by the Indonesian, Chinese-Taipei and Vietnamese domestic fleets targeting yellowfin and bigeye (the latter now predominantly using the handline gear). The growth in domestic fleets targeting albacore tuna in the South Pacific over the past decade has been noted; the most prominent fleets in this category are the Cook Islands, Samoan, Fijian, French Polynesian, Solomon Islands (when chartering arrangements are active) 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 (2019) and IATTC (2019).

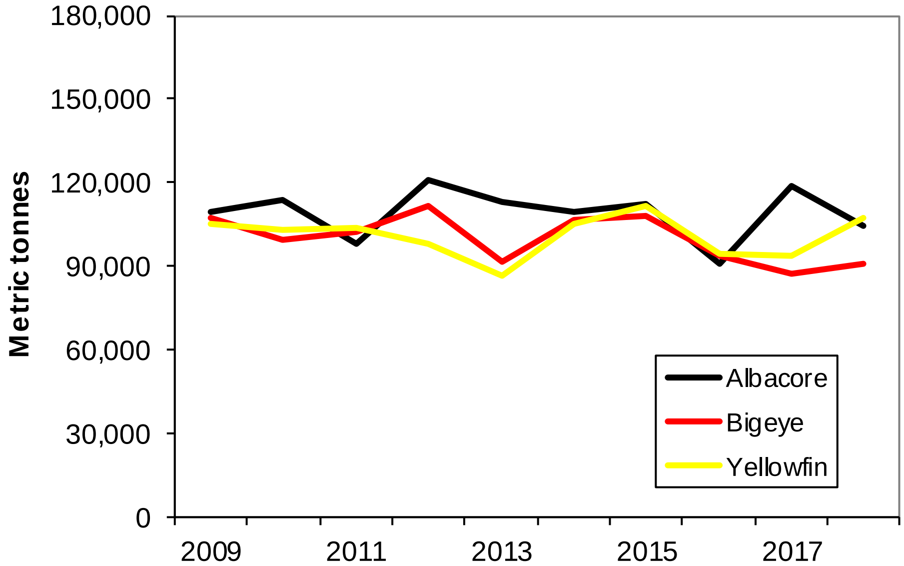


Figure 117. Reported longline tuna catches in the Pacific Ocean

Source: SPC (2019) and IATTC (2019).

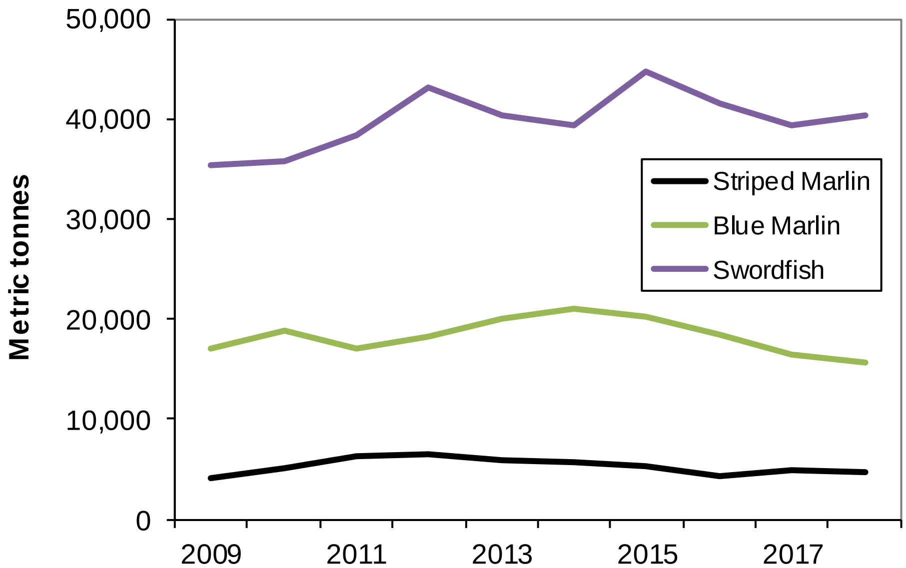


Figure 118. Reported longline billfish catches in the Pacific Ocean

Source: SPC (2019) and IATTC (2019).

2.6.4.3 POLE-AND-LINE FISHERY IN THE WCPFC

Source: WCPFC-SC15-2019 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 (36 vessels in 2018), 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 2018 pole-and-line catch (170,038 mt) was slightly higher than the 2017 catch which was the lowest annual catch 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 (70,533 mt in 2018), and the Indonesian fleets (79,759 mt in 2017; the 2018 catch estimate was being reviewed at the time of writing this paper), account for nearly all of the WCP–CA pole-and-line catch (99% in 2018). The catches by the Japanese distant-water and offshore fleets in recent years have been the lowest for several decades and this is no doubt related to the continued reduction in vessel numbers (although the vessel numbers have been stable at around 75-80 over the past 5 years). The Solomon Islands fleet recovered from low catch levels experienced in the early 2000s (only 2,773 mt in 2000 due to civil unrest) to reach a level of 10,448 mt in 2003. This fleet ceased operating in 2009 but resumed fishing in 2011 with catches generally around 1,000 mt (1,080 mt in 2018 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
2009	200,843
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	172,043
Average	172,114
STD deviation	30,322

Source: SPC (2019).

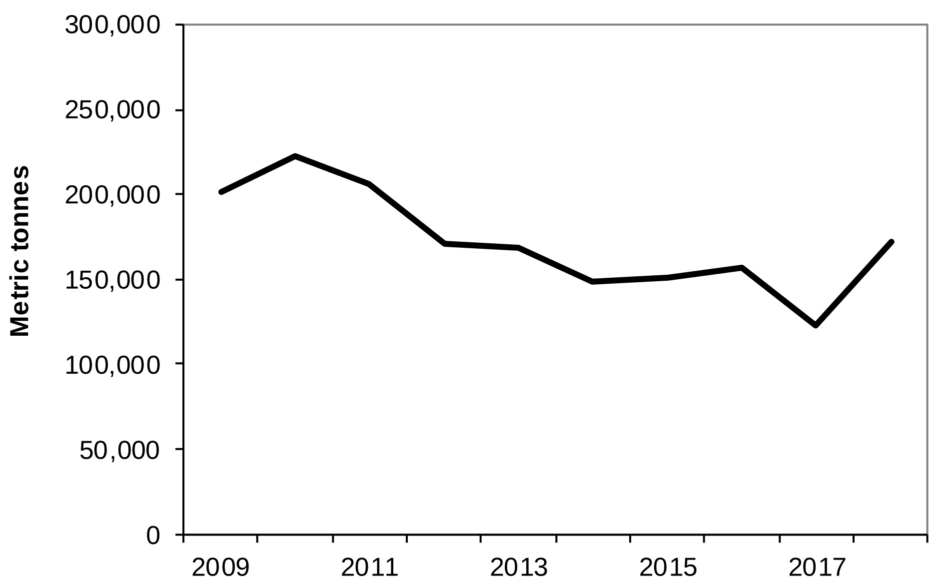


Figure 119. Reported pole-and-line catch (mt) in the Pacific Ocean
Source: SPC (2019).

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 pelagic MUS, 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.

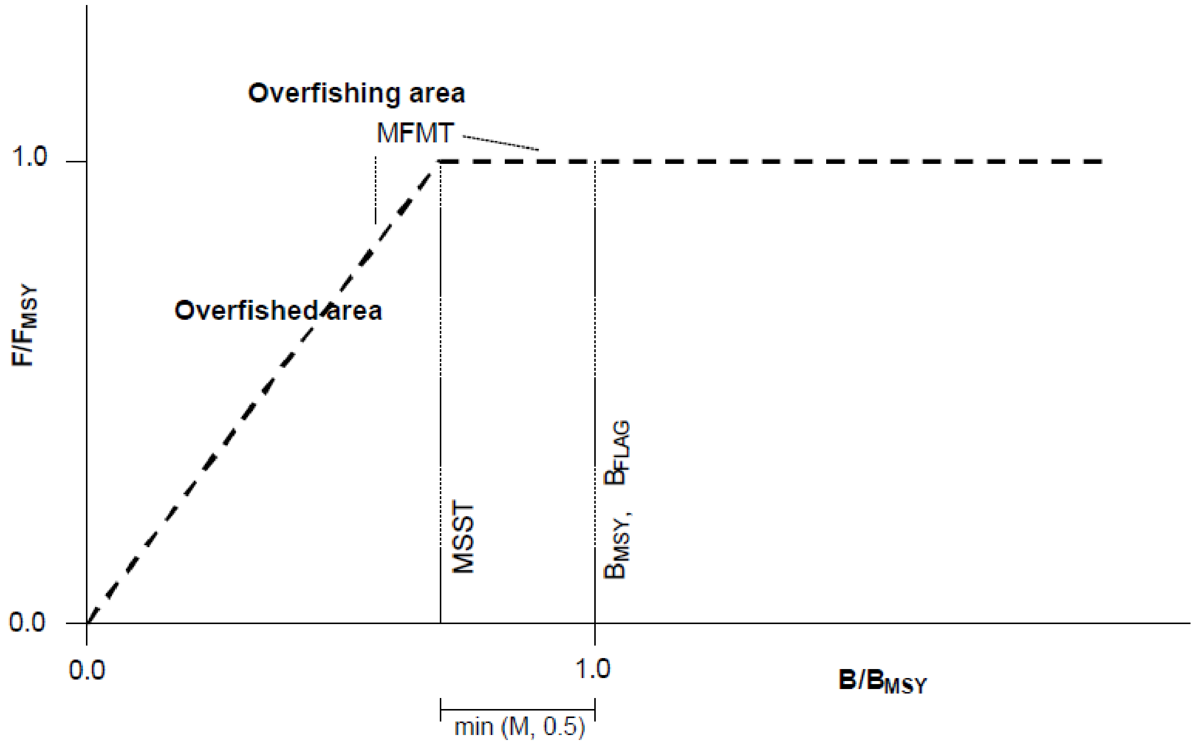


Figure 120. MSY control rule and reference points for pelagic MUS

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 2019.

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)	2014	Wahoo	
Other tuna relatives (*Auxis* sp.)		Yellowfin Tuna (WCPO)	2017
(*allothunnus* sp., *Scomber* sp.)		Kawakawa	
Bigeye Tuna (WCPO)	2018	Bluefin Tuna (Pacific)	2018
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 2019 based on the WCPFC SC15 Summary Report. For more information on stock assessments and assessment results completed prior to 2019, please see the past Annual Pelagic SAFE Reports.

2.6.7.1 WESTERN AND CENTRAL PACIFIC OCEAN SKIPJACK TUNA

Stock assessment: Vincent et al. (2019).

a. Stock status and trends

SC15 noted that the total provisional catch in 2018 was 1,795,048 mt, a 10% increase from 2017 and a 1% decrease from 2013-2017. Purse seine catch in 2018 (1,469,520 mt) was a 15% increase from 2017 and a 2% increase from the 2013-2017 average. Pole and line catch (138,534 mt) was a 4% increase from 2017 and a 9% decrease from the average 2013-2017 catch. Catch by other gear (182,888 mt) was a 16% decrease from 2017 and 19% decrease from the average catch in 2013-2017.

SC15 agreed to use the 8-region model to describe the stock status of skipjack tuna because SC15 considers that it better captures the biology of skipjack tuna than the existing 5 region structure. Stock status was determined over an uncertainty grid of 54 models with assumed weightings as illustrated in Table SKJ-01.

The median values of 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 54 models (Table SKJ-02) were used to define stock status. The values of the upper 90th and lower 10th percentile 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.

The spatial structure used in the assessment model is shown in Figure SKJ-01. Time series of total annual catch (1000's mt) by fishing gear for all regions is shown in Figure SKJ-02 and by region separately is shown in Figure SKJ-03. The annual average recruitment, spawning potential, and total biomass by model region for the diagnostic model are shown in Figure SKJ-04. The overall spawning potential summed across region for the diagnostic model is shown in Figure SKJ-05. The estimated annual average juvenile and adult fishing mortality for the diagnostic model is shown in Figure SKJ-06. The estimated impact of fishing ($1 – SB_{latest}/SB_{F=0}$) by region and overall regions for the diagnostic model is shown in Figure SKJ-07. The median and 80th percent quantile trajectories of fishing depletion for models in the weighted structural uncertainty grid in Table SKJ-01 is shown in Figure SKJ-08, where it can be seen that the median has been below the target since 2009. The Majuro plot shows the recent fishing mortality and spawning potential relative to the unfished spawning potential for all models in the structural uncertainty grid for (i) spawning potential in the recent time period (2015–2018) in Figure SKJ-09, and (ii) spawning potential in the latest time period (2018) in Figure SKJ-10. The Kobe plot shows the recent fishing mortality and spawning potential relative to spawning potential at MSY for all models in the structural uncertainty grid for (i) spawning potential in the recent time period (2015–2018) in Figure SKJ-11, and (ii) spawning potential in the latest time period (2018) in Figure SKJ-12.

SC15 noted that the median level of spawning potential depletion from the uncertainty grid was $SB_{recent}/SB_{F=0} = 0.44$ with a probable range of 0.37 to 0.53 (80% probability interval). There were no individual models where $SB_{recent}/SB_{F=0} < 0.2$, which indicated that the probability that recent spawning biomass was below the LRP was zero.

SC15 noted that the grid median F_{recent}/F_{MSY} was 0.45, with a range of 0.34 to 0.60 (80% probability interval) and that no values of F_{recent}/F_{MSY} in the grid exceed 1. Therefore, SC15 noted that there was a zero probability that the recent fishing mortality exceeds F_{MSY}.

SC15 noted that the largest uncertainty in the structural uncertainty grid was due to the assumed tag mixing period. In addition, SC15 acknowledges that further study is warranted to investigate the uncertainty surrounding the appropriate mixing period for the tagging data.

SC15 acknowledges that the spatial extent of the Japanese pole-and-line fishery has decreased over the time period and that the future use of this standardized CPUE index within future stock assessments is uncertain.

Therefore, SC15 acknowledges that further study of alternative indices of abundance is warranted, such as investigation of standardizing the purse seine fishery and evaluation of the feasibility of conducting fishery independent surveys.

Table SKJ-01. Description of the updated structural sensitivity grid used to characterize uncertainty in the assessment

Axis	Value	Relative weight
Steepness	0.65	0.8
	0.80	1.0
	0.95	0.8
Growth	Low	1.0
	Diagnostic	1.0
	High	1.0
Length composition scalar	50	0.8
	100	1.0
	200	1.0
Tag mix	1	1.0
	2	1.0

Table SKJ-02. Summary of reference points over the various models in the structural uncertainty grid. F_{mult} is the multiplier of recent (2014-2017) fishing mortality required to attain MSY, F_{recent} is the average fishing mortality of recent (2014-2017), SB_{recent} is the average spawning potential of recent years (2015-2018) and SB_{latest} is the spawning potential in 2018

	Mean	Median	Minimum	10th %ile	90th %ile	Maximum
C_{latest}	1,755,328	1,755,693	1,749,846	1,753,471	1,757,057	1,757,083
$Y_{Frecent}$	1,877,914	1,864,040	1,679,600	1,737,702	2,043,556	2,135,200
f_{mult}	2.282	2.258	1.472	1.757	2.957	3.705
F_{MSY}	0.223	0.222	0.180	0.189	0.264	0.270
MSY	2,296,566	2,294,024	1,953,600	1,995,987	2,767,083	2,825,600
F_{recent}/F_{MSY}	0.461	0.447	0.270	0.343	0.600	0.679
$SB_{F=0}$	6,220,675	6,299,363	5,247,095	5,580,942	6,913,431	7,349,557
SB_{MSY}	1,100,947	1,064,400	631,900	723,742	1,544,060	1,688,000
$SB_{MSY}/SB_{F=0}$	0.175	0.176	0.117	0.131	0.225	0.23
$SB_{latest}/SB_{F=0}$	0.414	0.415	0.325	0.36	0.487	0.525
SB_{latest}/SB_{MSY}	2.468	2.382	1.551	1.779	3.356	3.925
$SB_{recent}/SB_{F=0}$	0.440	0.440	0.336	0.372	0.530	0.551
SB_{recent}/SB_{MSY}	2.623	2.579	1.601	1.892	3.613	4.139

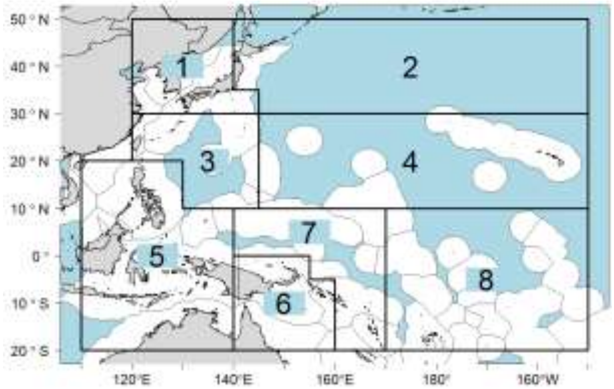


Figure SKJ-01. Eight region spatial structure used in the 2019 stock assessment model.

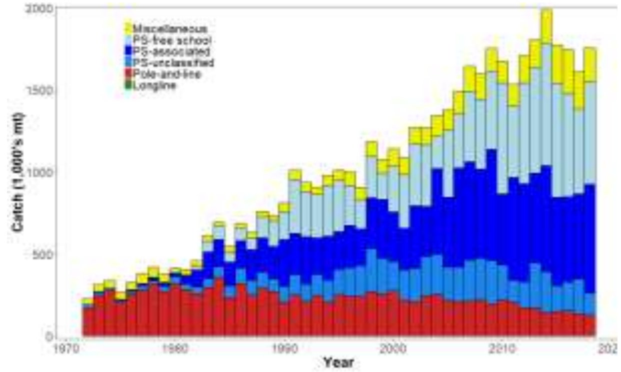


Figure SKJ-02. Time series of total annual catch (1000's mt) by fishing gear over the full assessment period.

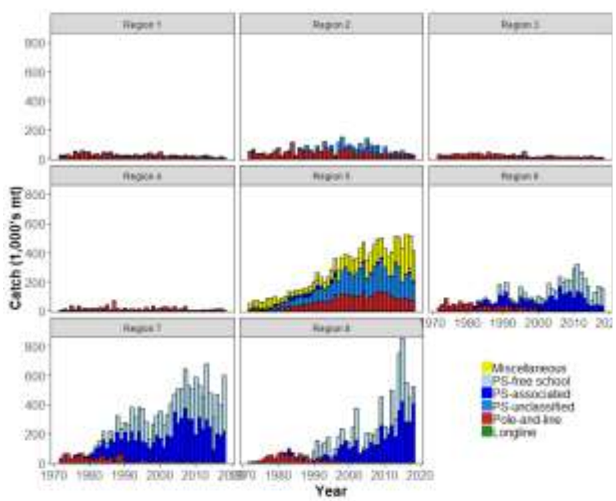


Figure SKJ-03. Time series of total annual catch (1000's mt) by fishing gear and assessment region over the full assessment period.

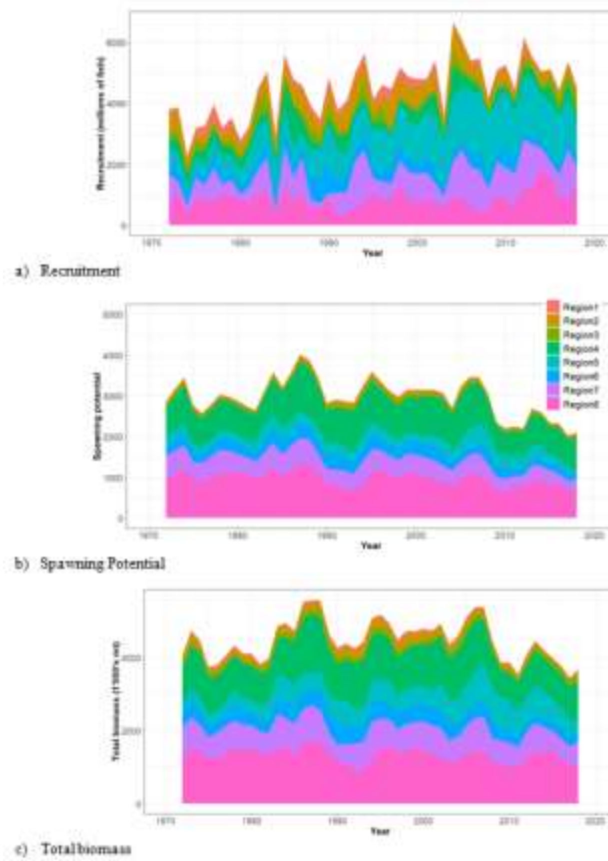


Figure SKJ-04. Estimated annual average recruitment, spawning potential and total biomass by model region for the diagnostic model, showing the relative sizes among regions.

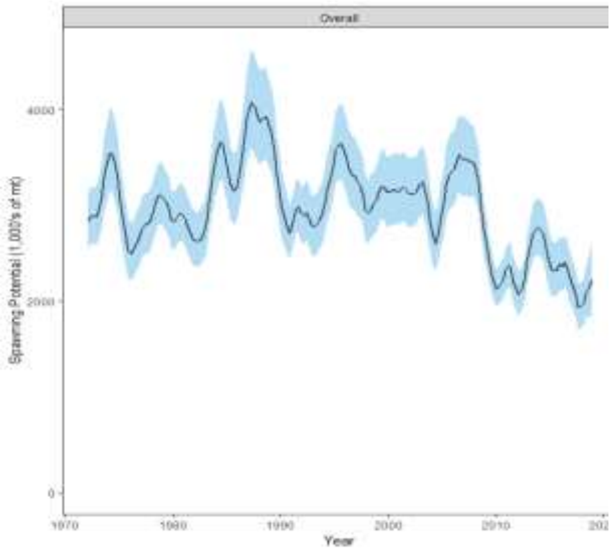


Figure SKJ-05. Estimated temporal overall spawning potential summed across regions from the diagnostic model, where the shaded region is ± 2 standard deviations (i.e., 95% CI).

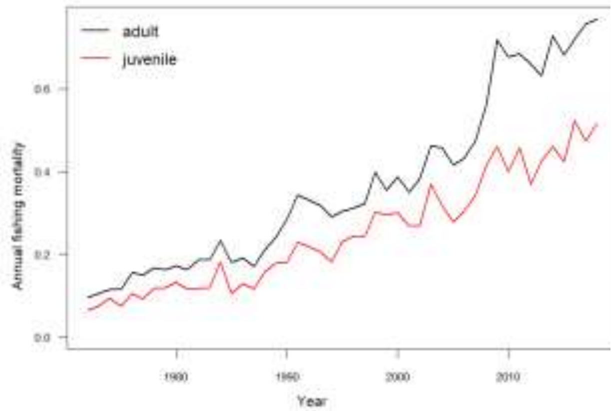


Figure SKJ-06. Estimated annual average juvenile and adult fishing mortality for the diagnostic model.

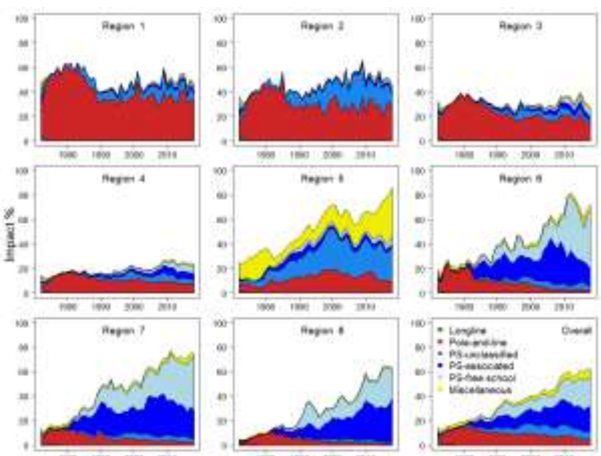


Figure SKJ-07. Estimates of reduction in spawning potential due to fishing (fishery impact = 1-SB_{latest}/$SB_{F=0}$) by region for the diagnostic model.

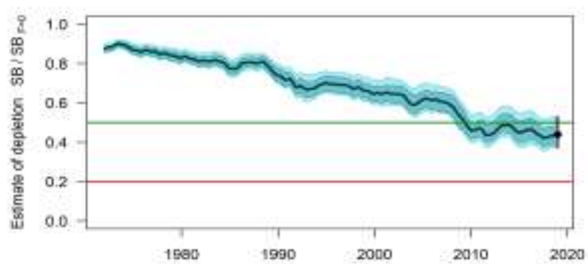


Figure SKJ-08. Plot showing the trajectories of spawning potential depletion for the model runs included in the structural uncertainty grid weighted by the values given in Table SKJ-01. Red horizontal line indicates the agreed limit reference point, the green horizontal line indicates the interim target reference point.

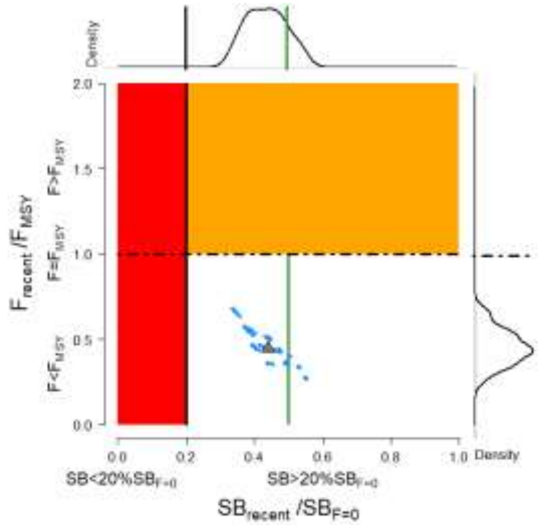


Figure SKJ-09. Majuro plot for the recent spawning potential (2015 – 2018) summarizing the results for each of the models in the structural uncertainty grid with weighting. The plots represent estimates of stock status in terms of spawning potential depletion and fishing mortality, and marginal distributions of each are presented. Vertical green line denotes the interim TRP. Brown triangle indicates the median of the estimates. The size of the circle relates to the weight of that particular model run.

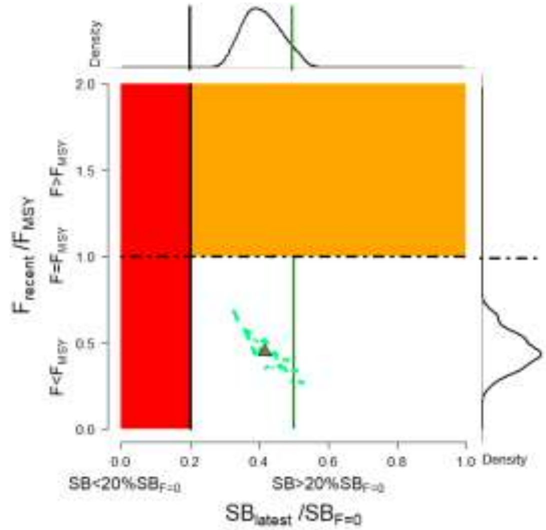


Figure SKJ-10. Majuro plot for the latest spawning potential (2018) summarizing the results for each of the models in the structural uncertainty grid with weighting. The plots represent estimates of stock status in terms of spawning potential depletion and fishing mortality, and marginal distributions of each are presented. Vertical green line denotes the interim TRP. Brown triangle indicates the median of the estimates. The size of the circle relates to the weight of that particular model run.

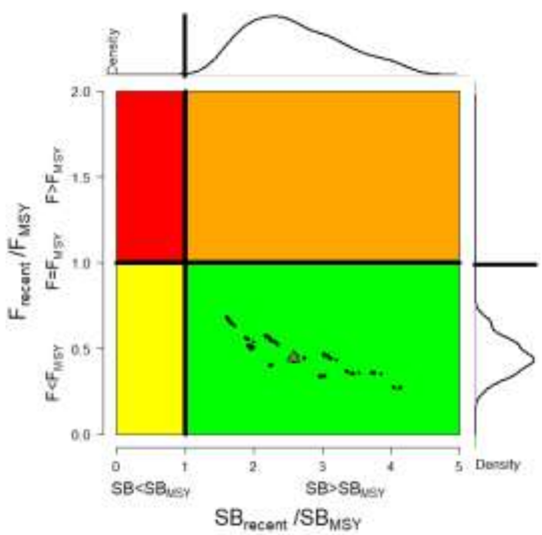


Figure SKJ-11. Kobe plot for the recent spawning potential (2015 – 2018) summarizing the results for each of the models in the structural uncertainty grid. The plots represent estimates of stock status in terms of spawning potential depletion and fishing mortality and marginal distributions of each are presented. Brown triangle indicates the median of the estimates. The size of the circle relates to the weight of that particular model run.

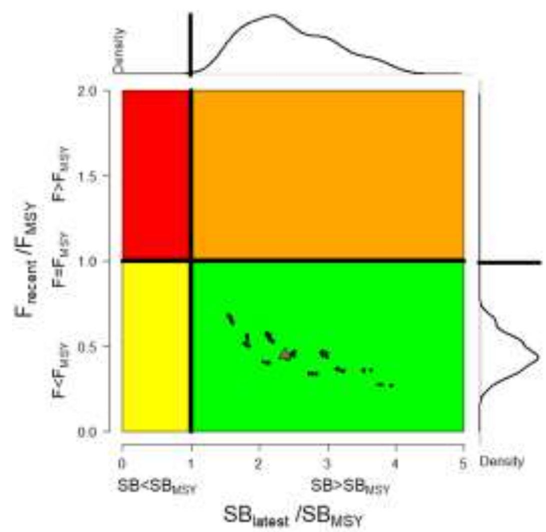


Figure SKJ-12. Kobe plot for the latest spawning potential (2018) summarizing the results for each of the models in the structural uncertainty grid. The plots represent estimates of stock status in terms of spawning potential depletion and fishing mortality and marginal distributions of each are presented. Brown triangle indicates the median of the estimates. The size of the circle relates to the weight of that particular model run.

b. Management advice and implications

SC15 noted that the skipjack assessment continues to show that the stock is currently moderately exploited and the level of fishing mortality is sustainable.

The 2019 stock assessment includes additional data and a range of model improvements such as a change to the maturity schedule used in this assessment, with length-at-maturity now larger than in the previous assessment, which has resulted in a reduction in the estimate of potential spawning biomass, relative to the 2016 assessment.

SC15 noted that the stock was assessed to be above the adopted Limit Reference Point and fished at rates below F_{MSY} with 100% probability. Therefore, the skipjack stock is not overfished, nor subject to overfishing. At the same time, it was also noted that fishing mortality is continuously increasing for both adult and juvenile while the spawning biomass reached the historical lowest level.

The skipjack interim Target Reference Point (TRP) is 50% of spawning biomass in the absence of fishing. The trajectory of the median spawning biomass depletion indicates a long-term trend and has been under the interim TRP since 2009 (i.e., for 10 years). Since the median spawning biomass has been consistently below the interim TRP, SC15 recommends that the Commission take appropriate management action to ensure that the biomass depletion level fluctuates around the TRP (e.g., through the adoption of a harvest control rule).

c. Research Recommendations

In order to maintain the quality of stock assessments for this important stock SC15 recommends:

- continuing work to develop an index of abundance based on purse seine data and from FAD acoustic sensors;
- evaluating the possibility of conducting fishery independent surveys to provide relative abundance indices;
- conducting regular large-scale tagging cruises and expanding the infrastructure for rapid return of recaptured tags in a manner that provides the best possible data for stock assessment purposes;
- investigating skipjack growth by validation studies of otolith readings and/or estimation of growth within MFCL from tag recapture data;
- attempting to provide finalized catch estimates to SPC no later than June 1st.

2.6.7.2 WESTERN AND CENTRAL PACIFIC OCEAN OCEANIC WHITETIP SHARK

Stock assessment: Tremblay-Boyer et al. (2019).

a. Stock status and trends

The median values of relative recent (2013-2015) spawning biomass ($SB_{recent}/SB_{F=0}$, SB_{recent}/SB_{MSY}) and relative recent fishing mortality (F_{recent}/F_{MSY}) over the structural uncertainty grid were used to measure the central tendency of stock status. The span of the recent time period was determined to only include years following the adoption of CMM-2011-04. 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.

Descriptions of the updated structural sensitivity grid used to characterize uncertainty in the assessment are provided in Table OCS-01. Historical catch data used for the diagnostic case is presented in Figure OCS-01. Estimated annual average total biomass, recruitment and spawning biomass are shown in Figure OCS-02, and fishing mortality in Figure OCS-03. The time series of depletion in spawning biomass over all runs in the structural uncertainty grid is shown in Figure OCS-04. Kobe and Majuro plots summarizing the results for each of the models in the structural uncertainty grid retained for management advice are represented in Figures OCS-05 and OCS-06. Table OCS-02 provides a summary of reference points used to determine stock status over the 648 models in the structural uncertainty grid using the grid weights agreed upon by SC and outlined in Table OCS-01.

SC15 noted that the median level of spawning biomass depletion from the uncertainty grid was $SB_{recent}/SB_{0} =$ 0.04 with a probable range of 0.03 to 0.05 (80% probability interval). While no limit reference point has been adopted, the depletion in spawning biomass is very high. The median level of recent spawning biomass relative to that leading to MSY was SB_{recent}/SB_{MSY} = 0.09 (range: 0.05–0.17).

SC15 noted that the recent relative fishing mortality was very high and the grid median F_{recent}/F_{MSY} was 3.94, with a range of 2.67 to 5.89 (80% probability interval), and that there were no model runs in the grid where F_{recent}/F_{MSY} was below 1.

The key conclusions are that overfishing is occurring and the stock is in an overfished state relative to MSY and depletion-based reference points (noting that depletion-based reference points have only been adopted for tunas) (Tables OCS-1 and OCS-2). This conclusion is robust to uncertainties in key model assumptions (Figure OCS-5).

SC noted that the inclusion of discard mortality (DM) scenarios in the historical catches was an improvement to the assessment and was necessary to account for the potential impacts of the no-retention measure (CMM-2011-04) for oceanic whitetip sharks.

SC noted that stock status improved relative to F-based reference points in the period since CMM 2011-04 became active, which covers the last 4 years of the assessment's time-span (2013–2016). Notably, F/F_{MSY} is predicted to have declined by more than half from 6.12 to 2.67 (n=432, unweighted grid median) (Figure OCS-2), for the last year of the assessment when the impact of CMM 2011-04 on survival is accounted for under 25% and 43.75% discard mortality scenarios (Figure OCS-6 and OCS-7). Relative fishing mortalities under two alternative reference points that have not been adopted by the WCPFC, specifically $F/F_{lim,AS}$ (the fishing mortality resulting in 0.5 of SB_{MSY}) and $F/F_{crash,AS}$ (the fishing mortality resulting in population extinction when sustained over the long-term, follow similar trends. Under the survival scenarios above, median SB/SB_{MSY} is predicted to have increased slightly from 2013 to 2016 (8.6% to 9.2%).

SC15 noted that there was some inconsistency between observed and estimated CPUEs for 2013-2016 in the diagnostic case, which is probably caused by the assumptions about the stock recruitment relationship in this stock assessment. Whether or not this inconsistency is present in all models across the included uncertainty grid remains unknown.

b. Management Advice and implications

Despite the data limitations going into the assessment and the wide range of uncertainties considered, all of the feasible grid model runs indicate that the WCPO oceanic whitetip shark stock continues to be overfished and overfishing is occurring relative to commonly used depletion and MSY-based reference points.

SC15 noted that while the assessment estimates that overfishing is still occurring (F_{recent}/F_{MSY} was 3.94) the stock assessment also estimates a slight recovery in stock biomass in recent years (2013-2016). It remains unclear whether the stock status will continue to improve or perhaps decline in the future. To help clarify this issue SC15 recommends that stock projections based on the assessment are undertaken and presented to SC16.

SC15 noted that there now appear to be few if any major fisheries targeting oceanic whitetip. The greatest impact on the stock is attributed to bycatch from the longline fisheries, with lesser impact from purse seining.

Noting that there are existing CMMs directed at oceanic whitetip, SC15 recommended that further efforts to mitigate catch and improve handling and release practices are required to further reduce fishing mortality and improve stock status.

SC15 noted that the assessment would be improved with better data collection for longline fisheries, such as improved observer coverage, as these fisheries are the major component of fishing mortality and would provide additional information on interaction rates, mitigation options and the fate and condition at release.

SC15 recommends that, as a minimum, CCM's meet the observer coverage specified in CMM 2018-05.

SC15 noted the need for improved estimates of age, growth and fecundity, as well as new length-length conversion factors that would allow for an improved assessment and the inclusion of a greater number of observed lengths.

SC15 noted that following the implementation of CMM 2011-04 and CMM 2014-05, the amount of scientific information available per year on oceanic whitetip sharks and other sharks species covered by a retention ban and the ban on shark lines or wire traces (e.g., bycatch estimates, length measurement, species and sex identification, and biological samples) has declined. SC15 also noted that the decline in information available for the oceanic whitetip shark assessment resulted in higher uncertainty in stock status, especially in more recent years since the introduction of these CMMs. This will also affect the capacity of SC to undertake future assessments if this decline in available information persists. SC15 recommends that WCPFC16 gives more consideration to the data needs for estimating reliable CPUE and other inputs into assessments when management measures are put in place, as these measures may have unintended consequences on continued availability and reliability of data. SC15 also recommended that WCPFC16 also take these considerations into account when reviewing the relevant sharks CMMs.

Noting that no limit reference points have been adopted for oceanic whitetip sharks, as well as other WCPO shark species, SC15 recommends that WCPFC16 consider identifying appropriate limit reference points for WCPO sharks.

Table OCS-01. Description of the axes for the structural uncertainty grid and assigned weight by level in the final resampling of stock status metrics. Settings used under the diagnostic case are highlighted with a star

Axis	Description	Weight
Growth and fecundity	Joung (⋆), Seki	0.5, 0.5
Catch	MedianDM100	0.1
	MedianDM44	0.25
	MedianDM25 (⋆)	0.15
	HighDM100	0.1
	HighDM44	0.25
	HighDM25	0.15
Initial F	0.1, 0.15 (⋆), 0.2	0.25, 0.5, 0.25
Steepness	0.34, 0.41 (⋆), 0.49	0.25, 0.5, 0.25
Natural mortality	0.1, 0.18 (⋆), 0.26	0.35, 0.5, 0.15
Recruitment σ_R	0.1 (⋆), 0.2	0.5, 0.5

Table OCS-02. Summary of reference points using SC15 adopted weights by axes over the 648 models in the structural uncertainty grid

	Mean	Median	Min	10%	90%	Max
C_{latest}	2464	2159	681	1002	4559	9233
C_{recent}	3007	2689	893	1311	5264	10348
MSY	7055	6052	1774	3036	11878	19122
SB_0	10387	8385	1510	3603	20148	34572
SB_{MSY}	4357	3433	523	1420	8524	15593
SB_{latest}	393	314	43	110	793	1217
SB_{recent}	404	324	36	106	795	1616
SB_{latest}/SB_0	0.04	0.04	0.02	0.03	0.05	0.07
SB_{recent}/SB_0	0.04	0.04	0.02	0.03	0.05	0.08
SB_{latest}/SB_{MSY}	0.09	0.09	0.05	0.06	0.13	0.16
SB_{recent}/SB_{MSY}	0.09	0.09	0.05	0.07	0.12	0.17
F_{MSY}	0.056	0.054	0.026	0.037	0.088	0.116
$F_{lim,AS}$	0.089	0.083	0.041	0.058	0.137	0.183
$F_{crash,AS}$	0.138	0.123	0.060	0.084	0.208	0.290
F_{latest}	0.194	0.171	0.096	0.116	0.335	0.473
F_{recent}	0.216	0.205	0.136	0.165	0.288	0.395
F_{latest}/F_{MSY}	3.78	3.30	1.09	1.96	6.55	12.07
F_{recent}/F_{MSY}	4.17	3.94	1.81	2.67	5.89	9.88
$F_{latest}/F_{lim,AS}$	2.40	2.10	0.69	1.23	4.10	7.73
$F_{recent}/F_{lim,AS}$	2.64	2.51	1.15	1.68	3.73	6.33
$F_{latest}/F_{crash,AS}$	1.57	1.38	0.44	0.76	2.70	5.26
$F_{recent}/F_{crash,AS}$	1.73	1.64	0.72	1.05	2.48	4.31

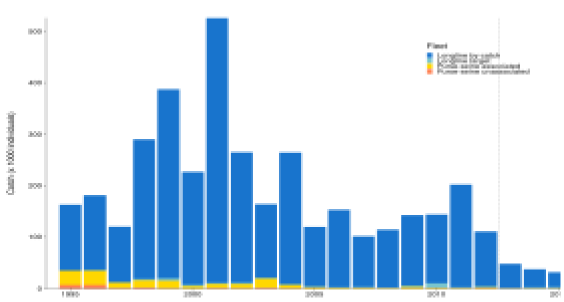


Figure OCS-01. Total reconstructed catches by fleet over time used for the diagnostic case.

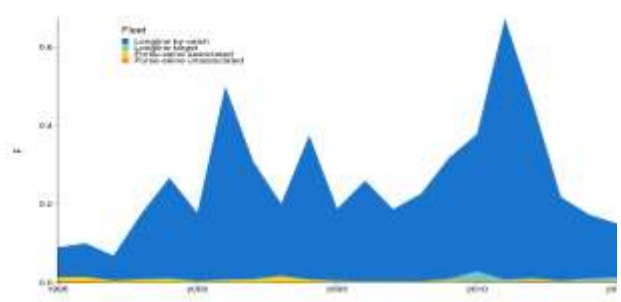


Figure OCS-02. Cumulative fishing mortality by fleet estimated for the diagnostic case over the time-span of the assessment (1995-2016).

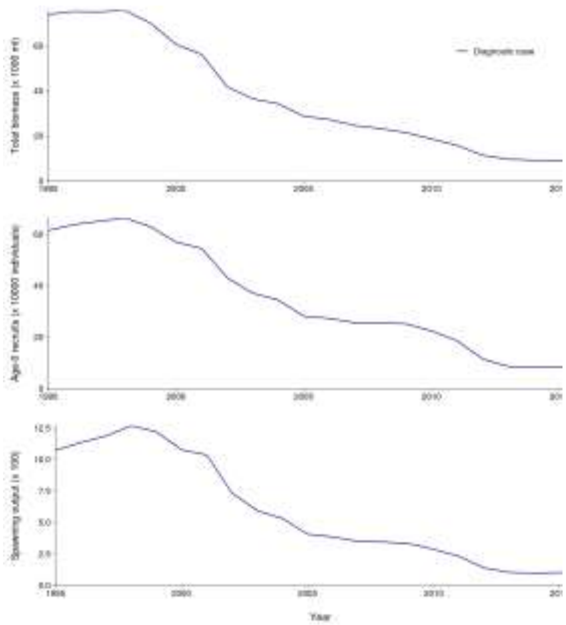


Figure OCS-03. Total biomass, recruitment and spawning biomass for the diagnostic case over the time-span of the assessment (1995-2016).

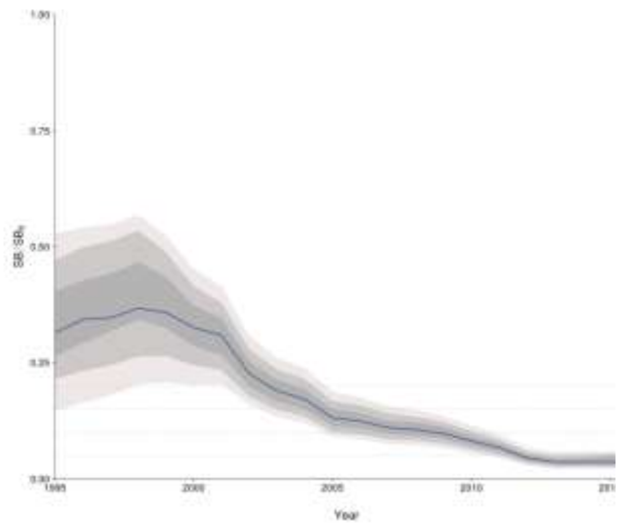


Figure OCS-04: Median estimates of depletion in spawning biomass over all (weighted) grid runs, with 2.5th -97.5th, 10th-90th and 25th -75th quantile intervals. Horizontal grey lines are placed at intervals of 5% in the lower part of the graph to aid visualization.

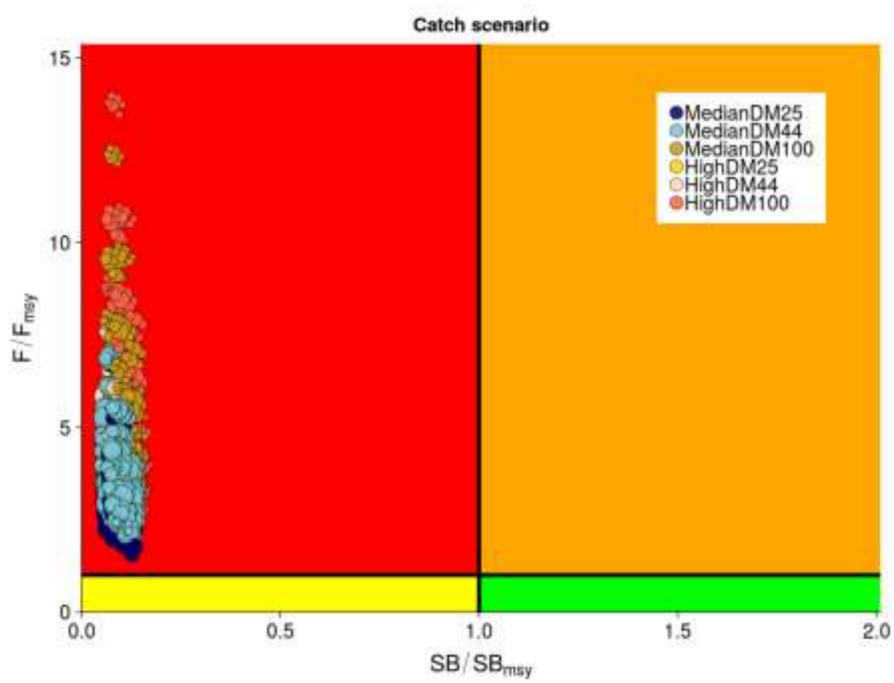


Figure OCS-05: Kobe plot summarizing recent status (2013-2015) for each of the (weighted) models in the structural uncertainty grid, based on SB/SB_{MSY} and F/F_{MSY}. The stock is considered to be overfished when $SB/SB_{MSY} > 1$ and undergoing overfishing when $F/F_{MSY} > 1$. The points are coloured according to the catch scenario that was used as input to the individual grid run. The size of the circle relates to the weight of that particular model run.

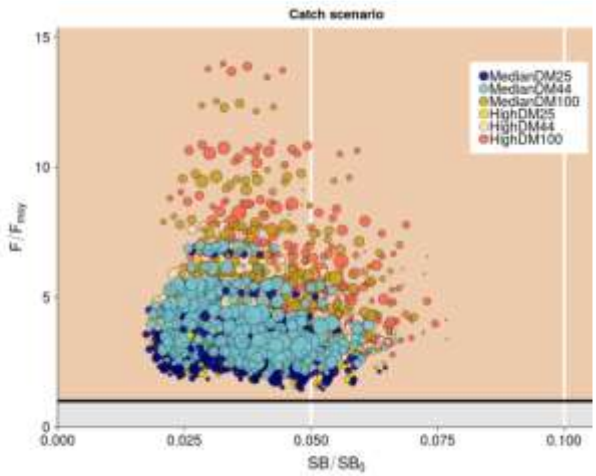


Figure OCS-06: Panel plot summarizing recent stock status (2013-2015) for each of the weighted models in the structural uncertainty grid for SB/SB_0 and F/F_{MSY}, noting no limit or target reference points have been adopted for oceanic whitetip shark. The stock is considered to be undergoing overfishing when $F/F_{MSY} > 1$ (beige zone). The SB/SB_0 axis was scaled to span the range of depletion values. Guidelines were added in white at $0.5SB/SB_0$ and $0.1SB/SB_0$. The points are coloured according to the catch scenario that was used as input to the individual grid run. The size of the circle relates to the weight of that particular model run.

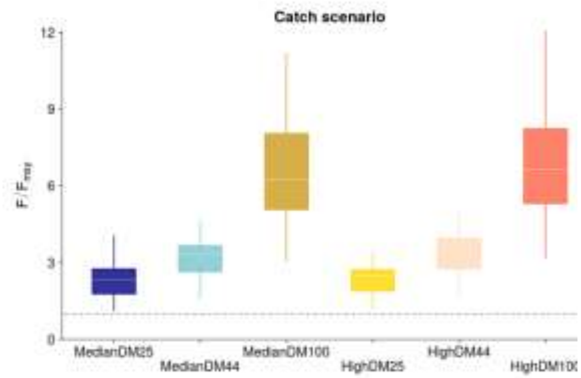


Figure OCS-07: Median (white bar) and inter-quartile bounds (box) for F/F_{MSY} in the final year of the assessment (2016) under the 6 catch scenarios used in the structural uncertainty axis. The catch scenarios included baseline and high levels of catches with 3 scenarios of discard mortality (25%, 43.75% and 100%). The whiskers extend to 1.5 times the interquartile range.

2.6.7.3 WESTERN AND CENTRAL NORTH PACIFIC OCEAN STRIPED MARLIN

Stock assessment: ISC (2019).

a. Stock status and trends

SC15 noted that ISC provided the following conclusions on the stock status of Western and Central North Pacific striped marlin:

> Estimates of population biomass of the Western and Central North Pacific Ocean (WCNPO) striped marlin fluctuated without trend between 1975 and 1993. The population deceased substantially in 1994 and fluctuated without trend until the present year. Population biomass (age-1 and older) averaged roughly 17,969 mt, or 54% below unfished biomass during the 1975-1993 period and declined to 4,508 mt, or 89% below unfished biomass by 2008. The minimum spawning stock biomass was estimated to be 618 t in 2011 (76% below SSB_{MSY}, the spawning stock biomass to produce MSY, Figure NMLS-1a). In 2017, SSB = 981 t and $SSB/SSB_{MSY} = 0.38$. Fishing mortality on the stock (average *F* on ages 3-12) has been around F_{MSY} since 2014 (Figure NMLS-1b). It averaged roughly 0.64 yr^{-1} during 2015-2017, or 7% above F_{MSY} and in 2017, $F=0.80\ yr^{-1}$ with a relative fishing mortality of $F/F_{MSY} = 1.33$ (Table NMLS-02). Fishing mortality has been above F_{MSY} in every year except 1984, 1992, and 2016. The predicted value of the spawning potential ratio (SPR, the predicted spawning output at current *F* as a fraction of unfished spawning output) is estimated to be SPR_{2015-}

2017 = 17% and is approximately equal to the SPR required to produce MSY. Recruitment averaged about 263,000 age-0 recruits between 1994 and 2017, which was 34% below the 1975-2017 average. No target or limit reference points have been established for the WCNPO striped marlin stock under the auspices of the WCPFC. Despite the relatively large L50/Linf ratio for WCNPO striped marlin, the stock is expected to be highly productive due to its rapid growth and high resilience to reductions in spawning potential. Recent recruitments have been lower than expected and have been below the long-term trend since 2005. Although fishing mortality has decreased since 2000, due to the prolonged low recruitment and landings of immature fish, the biomass of the stock has remained below MSY. When the status of WCNPO striped marlin is evaluated relative to MSY-based reference points, the 2017 spawning stock biomass of 981 mt is 62% below SSB_{MSY} (2,604 t) and the 2015-2017 fishing mortality exceeds F_{MSY} by 7%. Therefore, relative to MSY-based reference points, overfishing is occurring, and the WCNPO striped marlin stock is overfished (Figure NMLS-02).

Biological reference points were computed for the base case model with Stock Synthesis (Table NMLS-01 and Table NMLS-02). The point estimate of maximum sustainable yield (MSY) was 4,946 t. The point estimate of the spawning biomass to produce MSY (adult female biomass, SSB_{MSY}) was 2,604 t. The point estimate of F_{MSY}, the fishing mortality rate to produce MSY (average fishing mortality on ages 3 – 12) was 0.60 and the corresponding equilibrium value of spawning potential ratio at MSY was SPR_{MSY} = 18%.

Stock projections for WCNPO striped marlin were conducted using the age-structured projection model software AGEPRO. Stochastic projections were conducted using results from the base case model to evaluate the probable impacts of alternative fishing intensities or constant catch quotas on future spawning stock biomass and yield for striped marlin in the WCNPO. For fishing mortality projections, a standard set of F-based projections were conducted. For catch quota projections, the set of rebuilding projection analyses requested by NC14 were conducted. Two future recruitment scenarios were evaluated (Figure 3 and Figure 4): (1) a short-term recruitment scenario based on resampling the empirical cumulative distribution function of recruitment observed during 2012-2016 and (2) a long-term recruitment scenario based on resampling the empirical cumulative distribution function of recruitment observed during 1975- 2016. The short-term recruitment scenario had an average recruitment of 134,020 age-0 fish and the long-term recruitment mean was 306,989 age-0 fish. The stochastic projections employed model estimates of the multi-fleet, multi-season, size- and age-selectivity, and structural complexity in the assessment model to produce consistent results. Fishing mortality-based projections started in 2018 and continued through 2037 under five levels of fishing mortality and the two recruitment scenarios. The five fishing mortality stock projection scenarios were: 1) F status quo (average F during 2015-2017), 2) F_{MSY}, 3) F at $0.2 \cdot SSB_0$, 4) F_{High} at the highest 3-year average during 1975-2017, and 5) F_{Low} at $F_{30\%.}$ For the F-based scenarios, fishing mortality in 2018-2019 was set to be F status quo (0.64) and fishing mortality during 2020-2037 was set to the projected level of F. Catch-based projections also ran from 2018 to 2037 and included seven levels of constant catch for the long-term recruitment scenario and

10 levels of catch for the short-term recruitment scenario. For the catch-based scenarios, catch biomass in 2018-2019 was set to be the status quo catch during 2015-2017 (2,151 t) and annual catches during 2020-2037 were set to the projected catch quota. The ten constant catch stock projection scenarios were: 1) Quota based upon WCPFC CMM10-01, 2) 90% of the quota, 3) 80% of the quota, 4) 70% of the quota, 5) 60% of the quota, 6) 50% of the quota, 7) 40% of the quota, 8) 30% of the quota, 9) 20% of the quota, and 10) 10% of the quota. Results show the projected female spawning stock biomasses and the catch biomasses under each of the scenarios (Table NMLS-03, Figure NMLS-03 and Figure NMLS-04).

SC15 noted the following stock status from ISC:

Biomass (age 1 and older) for the WCNPO striped marlin stock decreased from 17,000 t in 1975 to 6,000 t in 2017. Estimated fishing mortality averaged F=0.97 yr^{-1} during the 1975-1994 period with a range of 0.60 to 1.59 yr^{-1}, peaked at F=1.71 $year^{-1}$ in 2001, and declined sharply to F=0.64 yr^{-1} in the most recent years (2015-2017). Fishing mortality has fluctuated around FMSY since 2013. Compared to MSY-based reference points, the current spawning biomass (average for 2015- 2017) was 76% below SSB_{MSY} and the current fishing mortality (average for ages 3 – 12 in 2015-2017) was 7% above F_{MSY}.

Based on these findings, the following information on the status of the WCNPO striped marlin stock is provided:

1. There are no established reference points for WCNPO striped marlin;
2. Results from the base case assessment model show that under current conditions the WCNPO striped marlin stock is overfished and is subject to overfishing relative to MSY- based reference points (Table NMLS-01, Table NMLS-02, and Figure NMLS-01).

SC15 noted that the assessment results are sensitive to the growth assumption and the ISC billfish working group (hereafter, WG) chair noted that the WG will attempt to revise the growth curve at the next stock assessment.

SC15 also highlighted the sharp decline in the stock biomass in the mid-1990s and recommends that ISC further investigate the reasons for this decline.

b. Management advice and implications

SC15 noted that some CCMs expressed concerns that based on the new assessment the WCNPO striped marlin stock was overfished and overfishing was occurring relative to MSY-based reference points.

SC15 noted that while fishing mortality has declined since 2000 fishing mortality has generally remained above F_{MSY} since the introduction of CMM 2010-01 and the stock biomass continues to remain well below SB_{MSY} and the NC target, while noting that the assessment model overestimate biomass in the terminal years. This is despite the phased reduction of the total catch to 80% of the levels caught in 2000-2003 as prescribed in the CMM. SC15 recommends that WCPFC16 note that further reduction in catch will be required to rebuild the stock to MSY levels and the NC target.

SC15 also noted that this stock does not have agreed upon limit reference points and measures on catch limits and reductions in fishing mortality to allow rebuilding of this stock.

SC15 recommends that WCPFC16 consider identifying appropriate limit reference points for WCNPO striped marlin.

SC15 recommends the WCPFC consider appropriate actions to ensure rebuilding this stock to the NC14 rebuilding target. SC15 noted that if lower than average recruitment persists over the near future the probability of rebuilding the stock would be low, noting that there has been a long-term decline in recruitment since the 1990s. Under the F_{MSY} scenario with short-term recruitment assumptions, the probability of achieving 20%SB_0 in 2027 is <0.5%.

SC15 noted the following conservation advice from ISC:

> The status of the WCNPO striped marlin stock shows evidence of substantial depletion of spawning potential (SSB_{2017} is 62% below SSB_{MSY}), however fishing mortality has fluctuated around F_{MSY} in the last four years. The WCNPO striped marlin stock has produced average annual yields of around 2,100 t per year since 2012, or about 40% of the MSY catch amount. However, the majority of the catch are likely immature fish. All of the projections show an increasing trend in spawning stock biomass during the 2018-2020 period, with the exception of the high F scenario under the short-term recruitment scenario. This increasing trend in SSB is due to the 2017 year class, which is estimated from the stock-recruitment curve and is more than twice as large as recent average recruitment.
>
> Based on these findings, the following conservation information is provided:
>
> 1. Projection results under the long-term recruitment scenario show that the stock has at least a 60% probability of rebuilding to 20%SSB_0, the rebuilding target specified by NC14, by 2022 for all harvest scenarios, with the exception of the highest F scenario (Average F 1975-1977);
> 2. However, if the stock continues to experience recruitment consistent with the short-term recruitment scenario (2012-2016), catches must be reduced to 60% of the WCPFC catch quota from CMM 2010-01 (3,397 t) to 1,359 t in order to achieve a 60% probability of rebuilding to 20%SSB_0=3,610 t[3] by 2022. This corresponds to a reduction of roughly 37% from the recent average yield of 2,151 t;
> 3. For the constant catch projection scenarios that were tested, it was notable that all of the projections under the long-term recruitment scenario would be expected to achieve the spawning biomass target by 2020 with probabilities ranging from 61% to 73% and corresponding catch quotas ranging from 3,397 to 1,359 t (Table NMLS-03).
>
> It was also noted that retrospective analyses show that the assessment model appears to overestimate spawning potential in recent years, which may mean the projection results are ecologically optimistic.

[3] The rebuilding target, 20% SSB_0, is estimated from the stock recruitment curve.

Special Comments

The WG achieved a base-case model using the best available data and biological information. However, the WG recognized uncertainty in some assessment inputs including drift gillnet catches and initial catch amounts, life history parameters such as maturation and growth, and stock structure.

Overall, the base case model diagnostics and sensitivity runs show that there are some conflicts in the data (ISC/19/ANNEX/11). When developing a conservation and management measure to rebuild the resource, it is recommended that these issues be recognized and carefully considered, because they affect the perceived stock status and the probabilities and time frame for rebuilding of the WCNPO striped marlin stock.

Research Needs

To improve the stock assessment, the WG recommends continuing model development work, to reduce data conflicts and modeling uncertainties, and reevaluating and improving input assessment data.

Existing genetic studies suggest regional spawning subgroups of striped marlin throughout the entire Pacific. More research is needed to improve upon knowledge of regional stock structure and regional mixing for incorporation into the stock assessment.

Table NMLS-01. Reported catch (t) used in the stock assessment along with annual estimates of population biomass (age-1 and older, t), female spawning biomass (t), relative female spawning biomass (SSB/SSB_{MSY}), recruitment (thousands of age-0 fish), fishing mortality (average F, ages-3 – 12), relative fishing mortality (F/F_{MSY}), and spawning potential ratio of WCNPO striped marlin.

Year	2011	2012	2013	2014	2015	2016	2017[2]	Mean[1]	Min[1]	Max[1]
Reported Catch	2,690	2,757	2,534	1,879	2,072	1,892	2,487	5,643	1,879	10,862
Population Biomass	5,874	6,057	4,937	6,241	5,745	5,832	6,196	12,153	4,509	22,303
Spawning Biomass	618	809	743	864	1,073	1,185	981	1,765	618	3,999
Relative Spawning Biomass	0.24	0.31	0.29	0.33	0.41	0.46	0.38	0.68	0.24	1.54
Recruitment (age 0)	196,590	87,956	330,550	77,274	185,438	195,069	354,391	396,218	77,274	1,049,460
Fishing Mortality	1.11	1.06	0.86	0.63	0.62	0.51	0.80	1.06	0.51	1.71
Relative Fishing Mortality	1.85	1.76	1.42	1.05	1.03	0.85	1.33	1.76	0.85	2.85
Spawning Potential Ratio	9%	11%	11%	16%	17%	20%	14%	12%	20%	6%

[1] During 1975-2017

[2] Recruitment in 2017 is estimated from the stock recruitment curve.

Table NMLS-02. Estimates of biological reference points along with estimates of fishing mortality (F), spawning stock biomass (SSB), recent average yield (C), and spawning potential ratio (SPR) of WCNPO MLS, derived from the base case model assessment model, where "MSY" indicates reference points based on maximum sustainable yield.

Reference Point	Estimate
F_{MSY} (age 3-12)	0.60
F_{2017} (age 3-12)	0.80
$F_{20\%SSB(F=0)}$	0.47
SSB_{MSY}	2,604 t
SSB_{2017}	981 t
$20\%SSB_0$	3,610 t
MSY	4,946 t
$C_{2015-2017}$	2,151 t
SPR_{MSY}	18%
SPR_{2017}	14%
$SPR_{20\%SSB(F=0)}$	23%

Table NMLS-03. Projected median values of WCNPO striped marlin spawning stock biomass (SSB, t), catch (t), and probability of reaching 20%SSB0 under five constant fishing mortality rate (F) and ten constant catch scenarios during 2018-2037. For scenarios which have a 60% probability of reaching the target of 20%$SSB_{F=0}$, the year in which this occurs is provided; NA indicates projections that did not meet this criterion. Note that 20%$SSB_{F=0}$ is 3,610 t and SSB_{MSY} is 2,604 t.

Year	2018	2019	2020	2021	2022	2027	2037	Year when target achieved with 60% probability
Scenario 1: $F_{status\ quo}$; Long-Term Recruitment								
SSB	1931.3	2605.3	3591	4288.3	4639.4	4893.4	4884.4	
Catch	2229.8	3089.8	3911.6	4412.8	4644.9	4797.2	4790.9	
Probability of reaching 20% SSB	0%	4%	44%	70%	79%	84%	84%	2021
Scenario 2: $F_{status\ quo}$; Short-Term Recruitment								
SSB	1932.4	2556.5	3080	2786.9	2422.3	2071.4	2072.1	
Catch	2224.6	2827	2871.7	2535.9	2260.7	2029.6	2030.4	
Probability of reaching 20% SSB	0%	4%	21%	9%	2%	<0.5%	<0.5%	NA
Scenario 3: FMSY; Long-Term Recruitment								
SSB	1935.1	2611.8	3650.5	4444	4860.6	5158.9	5203.5	
Catch	2228.1	3092.7	3705.2	4241.6	4498.9	4666.4	4711.5	
Probability of reaching 20% SSB	0%	4%	47%	75%	83%	89%	89%	2021
Scenario 4: FMSY; Short-Term Recruitment								
SSB	1932.9	2557.7	3126.3	2895.5	2552.2	2207	2197	
Catch	2230.8	2829.6	2724.6	2450.7	2209.9	1994.1	1984.9	
Probability of reaching 20% SSB	0%	4%	23%	12%	4%	<0.5%	<0.5%	NA
Scenario 5: F 20%$SSB_{F=0}$; Long-Term Recruitment								
SSB	1933.7	2611.9	3813.4	4943.7	5631	6358.1	6348.5	
Catch	2227.6	3091.3	2996.4	3588.7	3933.2	4271.7	4266.7	
Probability of reaching 20% SSB	0%	4%	55%	85%	93%	97%	98%	2021
Scenario 6: F 20%$SSB_{F=0}$; Short-Term Recruitment								
SSB	1934	2560.5	3276.3	3274.8	3030.2	2697	2690.2	
Catch	2224.9	2828.8	2211.6	2115.4	1969.7	1809.1	1804.7	
Probability of reaching 20% SSB	0%	4%	29%	28%	17%	6%	7%	NA
Scenario 7: Highest F (Average F 1975-1977); Long-Term Recruitment								
SSB	1932.8	2611.8	2739.8	2299.1	2102	2028.4	2036.2	
Catch	2226.4	3088.5	7520.7	6557.5	6184.4	6058	6084.1	

Table NMLS-03. (Continued)

Year	2018	2019	2020	2021	2022	2027	2037	Year when target achieved with 60% probability
Probability of reaching 20% SSB	0%	4%	9%	4%	2%	1%	1%	NA
Scenario 8: Highest F (Average F 1975-1977); Short-Term Recruitment								
SSB	1933.5	2559.4	2289.2	1330.7	968.3	858.7	859.2	
Catch	2225.9	2827.6	5362.9	3399.3	2751.6	2564.6	2570.9	
Probability of reaching 20% SSB	0%	3%	2%	<0.5%	0%	0%	0%	NA
Scenario 9: Low F ($F_{30\%}$); Long-Term Recruitment								
SSB	1933.6	2612.5	4009.5	5603.2	6742.4	8287.5	8353	
Catch	2228.6	3093.5	2117.6	2693.6	3075	3558.2	3577.8	
Probability of reaching 20% SSB	0%	4%	63%	93%	98%	>99.5%	>99.5%	2020
Scenario 10: Low F ($F_{30\%}$); Short-Term Recruitment								
SSB	1932.5	2555.6	3453.8	3788.4	3747.4	3537.4	3525.3	
Catch	2228.4	2832	1572.9	1623.8	1589	1515.8	1511.6	
Probability of reaching 20% SSB	0%	4%	37%	54%	54%	44%	42%	NA
Scenario 11: Current Quota; Long-Term Recruitment								
SSB	1946.7	2823	4141.1	5220.9	6074.7	8147.5	8715.3	
Catch	2150.6	2150.6	3396.8	3396.7	3396.3	3396.1	3396.8	
Probability of reaching 20% SSB	<0.5%	17%	61%	76%	83%	93%	95%	2020
Scenario 12: Current Quota; Short-Term Recruitment								
SSB	1948.8	2737.1	3279.8	2592.9	1781.9	524.2	436.7	
Catch	2150.6	2150.6	3393.7	3377.1	3319.7	2954.7	2903	
Probability of reaching 20% SSB	<0.5%	15%	36%	20%	7%	<0.5%	<0.5%	NA
Scenario 13: 10% Reduction; Long-Term Recruitment								
SSB	1947.9	2826.1	4225.3	5467.3	6492.5	9096.5	9798.7	
Catch	2150.6	2150.6	3057.1	3057.1	3056.8	3057.1	3057.1	
Probability of reaching 20% SSB	<0.5%	17%	63%	81%	87%	96%	97%	2020
Scenario 14: 10% Reduction; Short-Term Recruitment								
SSB	1948.6	2738	3390.9	2886.8	2162.9	763	587	
Catch	2150.6	2150.6	3054.6	3052.8	3032.5	2846.7	2780.1	
Probability of reaching 20% SSB	<0.5%	15%	40%	26%	12%	<0.5%	<0.5%	NA
Scenario 15: 20% Reduction; Long-Term Recruitment								
SSB	1949.9	2829.1	4317.7	5750.4	6954.1	9928.4	10806.2	
Catch	2150.6	2150.6	2717.4	2717.4	2717.4	2717.4	2717.4	
Probability of reaching 20% SSB	<0.5%	18%	65%	84%	90%	98%	99%	2020
Scenario 16: 20% Reduction; Short-Term Recruitment								
SSB	1949.3	2739.2	3495.1	3176.4	2570.8	1175.5	883.3	
Catch	2150.6	2150.6	2716.8	2714.3	2710.8	2648.8	2610.7	
Probability of reaching 20% SSB	<0.5%	15%	43%	34%	19%	1%	<0.5%	NA

Table NMLS-03. (Continued)

Year	2018	2019	2020	2021	2022	2027	2037	Year when target achieved with 60% probability
Scenario 17: 30% Reduction; Long-Term Recruitment								
SSB	1947.6	2824.5	4381.5	5981.7	7356.2	10856.1	11783.5	
Catch	2150.6	2150.6	2377.8	2377.8	2377.8	2377.8	2377.8	
Probability of reaching 20% SSB	<0.5%	17%	67%	87%	94%	99%	>99.5%	2020
Scenario 18: 30% Reduction; Short-Term Recruitment								
SSB	1947.4	2733.8	3594	3479.2	3018.1	1736.6	1383.5	
Catch	2150.6	2150.6	2377.8	2377.1	2377.1	2365.6	2355.3	
Probability of reaching 20% SSB	<0.5%	15%	45%	42%	29%	5%	2%	NA
Scenario 19: 40% Reduction; Long-Term Recruitment								
SSB	1949.2	2831.8	4486.8	6295.8	7868.9	11749.2	12851.3	
Catch	2150.6	2150.6	2038.1	2038.1	2038.1	2038.1	2038.1	
Probability of reaching 20% SSB	<0.5%	18%	70%	90%	95%	>99.5%	>99.5%	2020
Scenario 20: 40% Reduction; Short-Term Recruitment								
SSB	1949.9	2737.3	3689.5	3756	3445.9	2444.2	2124.2	
Catch	2150.6	2150.6	2038.1	2038.1	2037.9	2037.6	2036.4	
Probability of reaching 20% SSB	<0.5%	15%	48%	49%	41%	16%	10%	NA
Scenario 21: 50% Reduction; Long-Term Recruitment								
SSB	1950.4	2829.7	4548.9	6512.1	8259.1	12654	13799.3	
Catch	2150.6	2150.6	1698.4	1698.4	1698.4	1698.4	1698.4	
Probability of reaching 20% SSB	<0.5%	17%	71%	92%	97%	>99.5%	>99.5%	2020
Scenario 22: 50% Reduction; Short-Term Recruitment								
SSB	1949.1	2737.4	3791.4	4065.7	3916.3	3214.4	3021.3	
Catch	2150.6	2150.6	1698.4	1698.4	1698.4	1698.4	1698.4	
Probability of reaching 20% SSB	<0.5%	15%	51%	57%	53%	35%	29%	NA
Scenario 23: 60% Reduction; Long-Term Recruitment								
SSB	1949.9	2829.1	4631.3	6798.1	8741.1	13605.2	14857.1	
Catch	2150.6	2150.6	1358.7	1358.7	1358.7	1358.7	1358.7	
Probability of reaching 20% SSB	<0.5%	18%	73%	94%	98%	>99.5%	>99.5%	2020
Scenario 24: 60% Reduction; Short-Term Recruitment								
SSB	1948.6	2737.7	3888.1	4364.3	4396.6	4110.1	3970.5	
Catch	2150.6	2150.6	1358.7	1358.7	1358.7	1358.7	1358.7	
Probability of reaching 20% SSB	<0.5%	15%	53%	65%	67%	63%	59%	2021*
Scenario 25: 70% Reduction; Short-Term Recruitment								
SSB	1948.7	2736.4	3979.8	4667.7	4886	4960.9	4977	
Catch	2150.6	2150.6	1019	1019	1019	1019	1019	
Probability of reaching 20% SSB	<0.5%	15%	56%	72%	78%	85%	86%	2021

Table NMLS-03. (Continued)

Year	2018	2019	2020	2021	2022	2027	2037	Year when target achieved with 60% probability
Scenario 26: 80% Reduction; Short-Term Recruitment								
SSB	1948.7	2736.2	4071.1	4971.3	5380.3	5909.1	5977.5	
Catch	2150.6	2150.6	679.4	679.4	679.4	679.4	679.4	
Probability of reaching 20% SSB	<0.5%	15%	58%	79%	88%	97%	97%	2021
Scenario 27: 90% Reduction; Short-Term Recruitment								
SSB	1950.6	2740.5	4170.3	5284.1	5881.7	6836.7	7009.4	
Catch	2150.6	2150.6	339.7	339.7	339.7	339.7	339.7	
Probability of reaching 20% SSB	<0.5%	15%	61%	85%	94%	>99.5%	>99.5%	2020

* This scenario has a 60% probability of being at or above 20%$SSB_{F=0}$ in 2020 but drops slightly below 60% starting in 2035.

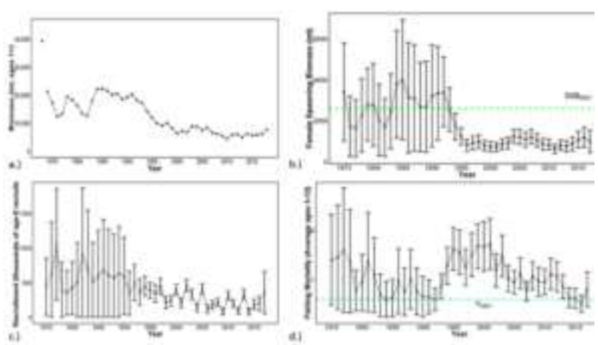


Figure NMLS-01. Time series of estimates of (a) population biomass (age 1+), (b) spawning biomass, (c) recruitment (age-0 fish), and (d) instantaneous fishing mortality (average for age 3-12, year^{-1}) for WCNPO striped marlin (derived from the 2019 stock assessment. The circles represent the maximum likelihood estimates by year for each quantity and the error bars represent the uncertainty of the estimates (95% confidence intervals), green dashed lines indicate SSB_{MSY} and F_{MSY}.

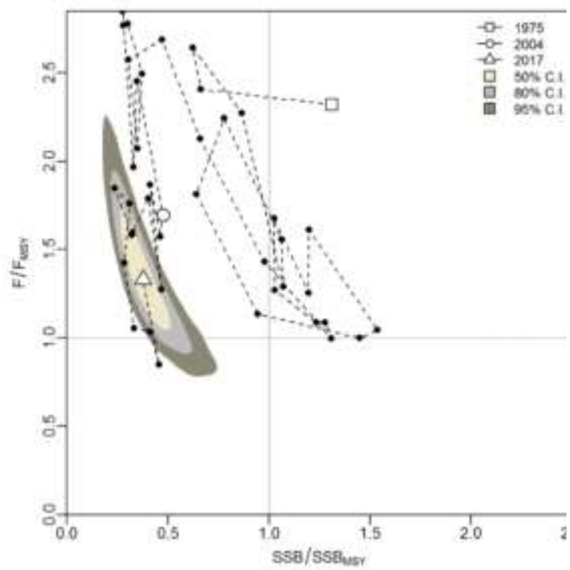


Figure NMLS-02. Kobe plot of the time series of estimates of relative fishing mortality (average of age 3-12) and relative spawning stock biomass of WCNPO striped marlin during 1975-2017. The white square denotes the first year (1975) of the assessment, the white circle denotes 2004, and the white triangle denotes the last year (2017) of the assessment.

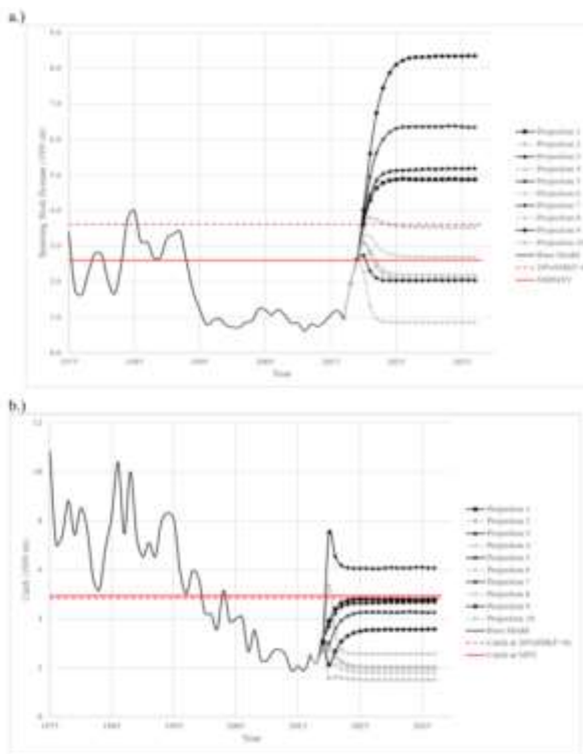


Figure NMLS-03. Historical and projected trajectories of spawning biomass and total catch from the WCNPO striped marlin base case model based upon F scenarios (projection 1-10): (a) projected spawning biomass and (b) projected catch.

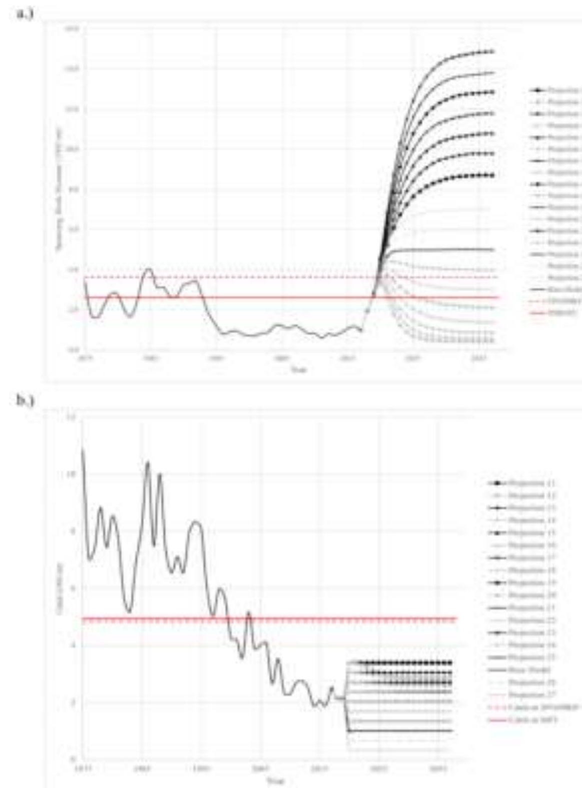


Figure NMLS-04. Historical and projected trajectories of spawning biomass and total catch from the WCNPO striped marlin base case model based upon constant catch scenarios (projections 11-15): (a) projected spawning biomass; and (b) projected catch.

Note on Figure NMLS-3 and Figure NMLS-4: Black lines are the long-term recruitment scenario results; grey lines show the short-term recruitment scenario results. The red dashed line shows the catch or spawning stock biomass at 20%$SSB_{F=0}$ and the solid red line is the catch or spawning stock biomass at SSB_{MSY}. The list of projection scenarios can be found in Table NMLS-03.

2.6.7.4 EASTERN PACIFIC OCEAN BIGEYE TUNA

Stock indicator report: Xu et al. (2019).

Stock status from Executive summary

Several uncertainties have been identified in the update assessment of bigeye tuna conducted in 2018, and its usefulness for management has been questioned. While the workplan to improve the bigeye stock assessment is being implemented (SAC-10-11), the staff will monitor a suite of stock status indicators (SSIs) for bigeye, which have been developed based on the methods used to compute stock status indicators for skipjack tuna. All bigeye indicators, except for catch, show strong trends over time indicating increasing fishing mortality and reduced abundance, and are at, or above, their reference levels. Additional analyses suggest that the method currently used to calculate the number of days fished on floating objects is biased towards an increasing trend in days fished, which also will bias the catch-per-day-fished (CPDF). Nonetheless, the increasing number of floating-object sets, particularly those on fish-aggregating devices (FADs), and the decreasing mean weight of the bigeye in the catch still indicate that the bigeye stock in the eastern Pacific Ocean (EPO) may be under increasing fishing pressure, and measures additional to the current seasonal closures, such as limits on the number of floating-object sets, are required. The staff has initiated research into the increase in the number of floating-object sets, per day and per vessel (SAC-10 INF-D), which is probably due to both the vessels' increased efficiency in finding FADs with tuna, due to the increased number of FADs and the increased use of satellite-linked fish-detecting sonar buoys, and the increased number of floating-object sets by vessels with Dolphin Mortality Limit (DMLs) that historically have made a mixture of floating object and dolphin-associated sets. However, further research is needed.

2.6.7.5 EASTERN PACIFIC OCEAN YELLOWFIN TUNA

Stock assessment: Minte-Vera et al. (2019).

Stock status from Executive summary

The model currently used for the stock assessment of yellowfin tuna in the eastern Pacific Ocean is unable to reconcile data that apparently carry contradictory signals about the status of the stock. The low values for recent years estimated for three CPUE-based indicators (CPUE for two dolphin-associated (DEL) fisheries, standardized using spatiotemporal methods, and for the southern longline (LL-S) fishery) suggest low abundance of the population, but this is inconsistent with the increased average size of the fish in the catch of these fisheries. It is therefore not clear from the indicators whether yellowfin abundance is in fact reduced, or changes have occurred in the fisheries.

Research is planned to revise the model and several of its assumptions in preparation for the benchmark assessment in 2020. Meanwhile, data-based indicators have been developed for the yellowfin stock, similar to those for the skipjack and bigeye tuna stocks.

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/F_{MSY}=0.74	No	No	SB_{2015}/SB_{MSY}=1.39, $SB_{2015}/SB_{F=0}$=0.34	No	No	Tremblay-Boyer et al. 2017, SC13 report	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/F_{MSY}=0.61	No	No	$SB_{2015}/SB_{F=0}$=0.40	No	No	ISC (2017b)	0.4 yr^{-1}	0.6 B_{MSY}
Bigeye Tuna (WCPO)	$F_{2011\text{-}2014}/F_{MSY}$=0.77	No	No	SB_{2015}/SB_{MSY}=1.62, $SB_{22015}/SB_{F=0}$=0.42	No, because SSB>MSST	No	Vincent et al. (2018), SC14 Report	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	$F20\%_{2015\text{-}2016}$ =1.15	Yes, because F>MFMT	Not applicable	$SB_{2016}/SB_{F=0}$=0.033	Yes, because SSB<MSST	Not applicable	ISC (2018a)	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 (2018b)	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}

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
Blue Shark (N. Pacific)	$F_{2012-2014}/F_{MSY}$=0.38	No	Unknown	SB_{2015}/SB_{MSY}=1.69	No	Unknown	ISC (2017a), BSIA	0.145-0.785 yr^{-1}	~0.8 SB_{MSY}
Oceanic white-tip shark (WCPO)[3]	F_{2016}/F_{MSY}=3.30	Yes	Not applicable	SB_{2016}/SB_{MSY}=0.11	Yes	Not applicable	Tremblay-Boyer et al. (2019), SC15 Report	0.18 yr^{-1}	0.82 B_{MSY}
Silky shark (WCPO)[3]	F_{2016}/F_{MSY}=1.61	Yes	Not applicable	SB_{2016}/SB_{MSY}=1.18	No	Unknown	Clarke et al. (2018), SC14 Report	0.18 yr^{-1}	0.82 B_{MSY}
Silky Shark (EPO)[3]	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Lennert-Cody et al. (2018)	Unknown	Unknown
Longfin mako shark (N. Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Shortfin mako shark (N. Pacific)	$F_{2013-2015}/F_{MSY}$=0.62	No	Unknown	SB_{2016}/SB_{MSY}=1.36	No	Unknown	ISC (2018c)	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

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
Pomfret (family Bramidae, W. Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Black marlin (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Shortbill spearfish (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Sailfish (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Kawakawa (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Oilfish (family Gempylidae, Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Other tuna relatives (*Auxis* spp., *Allothunnus* spp., and *Scomber* spp, Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Squids (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

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

2.6.8 U.S. LONGLINE LANDINGS REPORTED TO WCPFC AND IATTC FOR 2018

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 2015-2019, as reported by NMFS to the WCPFC. The catches for 2019 are preliminary.

Table 39. U.S. and Territorial longline catch (mt) by species in the WCPFC Statistical Area, 2015–2019

	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				
	2019	**2018**	**2017**	**2016**	**2015**	**2019**	**2018**	**2017**	**2016**	**2015**	**2019**	**2018**	**2017**	**2016**	**2015**	**2019**	**2018**	**2017**	**2016**	**2015**	**2019**	**2018**	**2017**	**2016**	**2015**	**2019**	**2018**	**2017**	**2016**	**2015**
Vessels	139	136	136	133	135	128	121	119	117	117				118	112	127	113	118	23	22	17	13	15	20	21	155	150	150	151	156
Species																														
Albacore, NPO	89	59	74	208	197											12	11	17	34	19						101	70	90	243	216
Albacore, SPO																					1,012	1,542	1,495	1,527	1,786	1,012	1,542	1,495	1,527	1,786
Bigeye tuna	3,531	3,393	2,948	3,747	3,427	1,000	993	999	879	999				932	856	1,505	798	1,346	586	441	30	53	63	71	83	6,066	5,236	5,356	6,216	5,788
Pacific bluefin tuna	1	0	1	0												0	0	0			0	1	2	0	6	2	1	2	1	6
Skipjack tuna	199	105	156	186	176											27	15	36	26	11	68	76	71	95	114	294	196	262	307	304
Yellowfin tuna	1,574	1,868	1,750	1,093	681											201	209	312	175	105	181	261	559	385	455	1,956	2,339	2,621	1,653	1,238
Other tuna				0	0														0							0	0	0	0	0
TOTAL TUNA	**5,395**	**5,424**	**4,928**	**5,234**	**4,482**	**1,000**	**993**	**999**	**879**	**1,000**				**932**	**856**	**1,744**	**1,034**	**1,710**	**821**	**577**	**1,292**	**1,933**	**2,190**	**2,079**	**2,444**	**9,431**	**9,384**	**9,827**	**9,947**	**9,337**
Black marlin	0	0	0	1	0													0		0			0			0	0	1	1	0
Blue marlin	754	529	485	419	445											77	38	87	57	55	29	32	40	30	25	860	598	612	514	523
Sailfish	12	9	9	15	11											2	1	2	2	2	2	1	1	2	2	16	11	12	19	15
Spearfish	156	171	205	251	188											15	15	27	28	15	2	1	2	2	1	173	187	234	281	204
Striped marlin, NPO	405	332	280	280	378											56	44	50	48	36						461	375	330	328	411
Striped marlin, SPO	0	0																			2	1	2	2	3	2	1	2	2	3
Other marlins	0	1	1	1	1											0		0		0						0	1	1	1	1
Swordfish, NPO	511	590	918	596	665											44	41	49	43	24						555	631	967	639	690
Swordfish, SPO	0	0																			4	6	6	6	7	4	6	6	6	7
TOTAL BILLFISH	**1,840**	**1,631**	**1,899**	**1,562**	**1,688**											**193**	**138**	**215**	**179**	**133**	**37**	**41**	**51**	**41**	**39**	**2,069**	**1,811**	**2,165**	**1,791**	**1,855**
Blue shark	0																		0			3	1	1	1	0	3	1	1	1
Mako shark	32	36	30	37	35											3	5	5	9	4	0	0	0	0	0	35	42	36	46	39
Thresher	4	2	2	3	5											1		0	0	1	1	1	2	0	0	5	2	5	4	6
Other sharks			0	0																			0	0	0			0	0	0
Oceanic whitetip shark																								0	0				0	0
Silky shark			0																			0					0	0		
Hammerhead shark				0																									0	
Tiger shark																														
Porbeagle																														
TOTAL SHARKS	**36**	**38**	**32**	**40**	**40**											**3**	**5**	**6**	**10**	**5**	**1**	**4**	**3**	**1**	**1**	**40**	**47**	**42**	**51**	**46**
Mahimahi	124	155	143	202	199											18	14	23	28	21	1	5	14	4	5	144	174	180	234	225
Moonfish	374	390	257	304	279											54	58	63	74	55	1	1	1	2	2	428	449	322	380	336
Oilfish	90	98	94	160	165											13	14	22	29	20	0	0	0	2	0	103	112	116	191	185
Pomfret	248	265	260	339	380											27	32	40	46	39	0	0	0	0	0	275	298	300	386	419
Wahoo	405	264	217	309	256											56	34	37	47	27	17	31	50	46	55	478	329	304	402	338
Other fish	1	4	2	7	7											1	0	0	1	1	0	0	1	1	1	2	5	3	9	9
TOTAL OTHER	**1,242**	**1,177**	**975**	**1,322**	**1,285**											**169**	**153**	**185**	**224**	**164**	**20**	**37**	**67**	**55**	**64**	**1,432**	**1,367**	**1,226**	**1,601**	**1,512**
GEAR TOTAL	**8,513**	**8,271**	**7,834**	**8,158**	**7,495**	**1,000**	**993**	**999**	**879**	**1,000**				**932**	**856**	**2,110**	**1,330**	**2,116**	**1,235**	**878**	**1,350**	**2,016**	**2,311**	**2,176**	**2,548**	**12,971**	**12,610**	**13,259**	**13,390**	**12,750**

Table 40. U.S. longline catch (mt) by species in the North Pacific Ocean, 2015-2019

	U.S. (ISC)				
	2019	**2018**	**2017**	**2016**	**2015**
Vessels	150	143	145	141	143
Species					
Albacore, North Pacific	104	87	95	248	227
Albacore, South Pacific					
Bigeye tuna	7,768	7,594	7,993	8,235	7,816
Pacific bluefin tuna	2	1	1	1	0
Skipjack tuna	261	149	221	240	211
Yellowfin tuna	2,025	2,500	2,594	1,515	893
Other tuna	0	0	0	0	0
TOTAL TUNA	**10,160**	**10,330**	**10,903**	**10,240**	**9,147**
Black marlin	0	0	1	1	0
Blue marlin	902	664	687	554	631
Sailfish	18	13	15	19	15
Spearfish	199	219	303	340	263
Striped marlin, North Pacific	548	465	406	390	493
Striped marlin, South Pacific					
Other marlins	1	1	1	1	2
Swordfish, North Pacific	733	1,052	1,618	1,092	1,515
Swordfish, South Pacific					
TOTAL BILLFISH	**2,401**	**2,414**	**3,032**	**2,397**	**2,918**
Blue shark			0		
Mako shark	47	60	71	70	58
Thresher	5	2	4	4	7
Other sharks			0		
Oceanic whitetip shark					
Silky shark					
Hammerhead shark					

Tiger shark					
Porbeagle					
TOTAL SHARKS	**52**	**62**	**75**	**74**	**65**
Mahimahi	178	213	256	295	330
Moonfish	969	1,334	1,040	982	1,189
Oilfish	125	129	153	218	238
Pomfret	304	357	403	471	563
Wahoo	512	356	357	418	348
Other fish	1	4	3	9	8
TOTAL OTHER	**2,090**	**2,393**	**2,211**	**2,393**	**2,676**
GEAR TOTAL	**13,982**	**15,351**	**16,221**	**15,104**	**14,806**

Table 41. U.S. longline catch (mt) by species in the Eastern Pacific Ocean, 2015-2019

	All U.S. vessels					**U.S. vessels ≥ 24 m**					**U.S. vessels ≤ 24 m**				
	2019	**2018**	**2017**	**2016**	**2015**	**2019**	**2018**	**2017**	**2016**	**2015**	**2019**	**2018**	**2017**	**2016**	**2015**
Vessels	125	128	131	123	131	30	30	29	24	30	96	91	102	99	101
Albacore, North Pacific	4	17	5	6	10	1	3	2	2	3	3	13	3	4	6
Albacore, South Pacific															
Bigeye tuna	1,732	2,410	2,700	2,090	2,948	510	524	491	312	463	1,222	1,886	2,209	1,778	2,485
Pacific bluefin tuna	0	0	0	0	0			0			0	0			0
Skipjack tuna	35	30	29	29	24	9	9	5	5	4	26	21	25	23	20
Yellowfin tuna	250	422	532	248	107	75	99	86	34	9	175	323	446	214	97
Other tuna															
TOTAL TUNA	**2,021**	**2,879**	**3,266**	**2,372**	**3,089**	**595**	**636**	**583**	**353**	**480**	**1,426**	**2,243**	**2,682**	**2,019**	**2,608**
Black marlin	0	0	0	0	0							0	0	0	0
Blue marlin	71	98	115	78	131	16	11	15	7	9	55	87	100	71	122
Sailfish	4	3	4	2	2	2	1	0	0	0	2	2	4	2	2
Spearfish	28	32	71	60	59	7	7	10	7	6	20	25	61	53	53
Striped marlin, North Pacific	87	90	76	62	79	23	15	10	11	8	64	74	66	52	70
Striped marlin, South Pacific															
Other marlins	1	0	0	0	1	1	0	0		0	0			0	1

	All U.S. vessels					U.S. vessels ≥ 24 m					U.S. vessels ≤ 24 m				
	2019	**2018**	**2017**	**2016**	**2015**	**2019**	**2018**	**2017**	**2016**	**2015**	**2019**	**2018**	**2017**	**2016**	**2015**
Swordfish, North Pacific	178	422	651	453	825	110	215	391	253	346	68	207	260	200	479
Swordfish, South Pacific															
TOTAL BILLFISH	**368**	**644**	**917**	**656**	**1,097**	**158**	**249**	**427**	**278**	**370**	**210**	**395**	**490**	**378**	**727**
Blue shark			0											0	
Mako shark	12	19	35	24	19	8	11	21	10	8	4	8	14	14	10
Thresher	0	0	1	0	2	0		0	0	0	0		1	0	1
Other sharks			0											0	
Oceanic whitetip shark															
Silky shark															
Hammerhead shark															
Tiger shark															
Porbeagle															
TOTAL SHARKS	**13**	**19**	**36**	**24**	**20**	**9**	**11**	**21**	**10**	**9**	**4**	**8**	**15**	**14**	**12**
Mahimahi	53	57	89	65	110	14	11	11	10	9	40	46	78	55	101
Moonfish	595	944	720	604	854	196	258	162	99	133	399	686	558	505	721
Oilfish	35	30	37	29	53	10	9	7	6	10	25	22	30	23	44
Pomfret	56	91	103	86	145	17	30	24	10	22	39	61	79	76	123
Wahoo	107	91	103	62	65	33	22	17	12	10	74	69	85	50	56
Other fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL OTHER	**848**	**1,215**	**1,052**	**847**	**1,228**	**270**	**331**	**221**	**137**	**184**	**578**	**884**	**831**	**710**	**1,044**
GEAR TOTAL	**3,250**	**4,757**	**5,272**	**3,899**	**5,434**	**1,032**	**1,226**	**1,253**	**778**	**1,042**	**2,218**	**3,531**	**4,019**	**3,121**	**4,391**

3 FISHERY ECOSYSTEMS

3.1 SOCIOECONOMICS

The socioeconomics section outlines the pertinent economic, social, and community information available for assessing the performance of Fishery Ecosystem Plan management measures for the Pelagic Fisheries (WPRFMC, 2009). 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 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(s). 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.

3.1.1 RESPONSE TO PREVIOUS COUNCIL RECOMMENDATIONS

At its 180th meeting held in Utulei, Tutuila, American Samoa, the Council requested NMFS continue to support future recreational summits or workshops on noncommercial fisheries data to continue the national exchange on noncommercial fishery reporting issues and initiatives. In 2019, PIFSC conducted a study to describe and characterize fishing activities in the region that do not clearly meet the MSA definition of recreational fishing. The study included national workshops with discussion of issues related to data and reporting issues (Leong et al., 2020).

At its 176th meeting held in Honolulu, Hawaii, related to the Charter Fishery Cost Earning Survey the Council encouraged PIFSC to maintain a regular schedule for the economic evaluations and monitoring of the fisheries in the Pacific Islands. To address this, in 2019, PIFSC has added a section titled *Ongoing Research and Information Collection*, which outlines planned economic data collections across the region, included in this and future SAFE reports.

Also at its 176th meeting held in Honolulu, Hawaii, the Council directed staff to work with industry NMFS, Pelagic Plan Team, and other expertise to examine alternative mitigation measures for seabird bycatch, including designs currently used voluntarily by Hawaii longline vessel operators. The Council also recommended that NMFS work with Council staff to develop and implement effective captain and crew training program to reduce the risk of false killer whale mortality or serious injury from gear interactions while also promoting crew safety in the Hawaii longline fishery. Related to these two recommendations, PIFSC initiated research with Hawaii longline captains and crew to learn more about interactions with protected species more broadly, especially to understand impacts from interactions with protected species, mitigation efforts taken by the longline fleet, and innovative ideas that could improve protected species handling. Interviews were conducted with captains or owner-operators and crew members in fall 2019, and analysis and reporting are expected to be completed in 2020.

Also at its 176th meeting held in Honolulu, Hawaii, the Council requested NMFS PIFSC Socioeconomics Program to evaluate the economic impacts on US Pacific Island fisheries from the 2018 amendment to the Billfish Conservation Act. PIFSC and JIMAR staff developed a preliminary analysis of market impacts related to the Billfish Conservation Act. This report was presented to Council staff in June 2019, and further developed as a PIFSC Internal Report (Chan, 2020).

3.1.2 SOCIAL AND CULTURAL ELEMENTS

3.1.2.1 AMERICAN SAMOA

3.1.2.1.1 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 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 (ASG, 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.

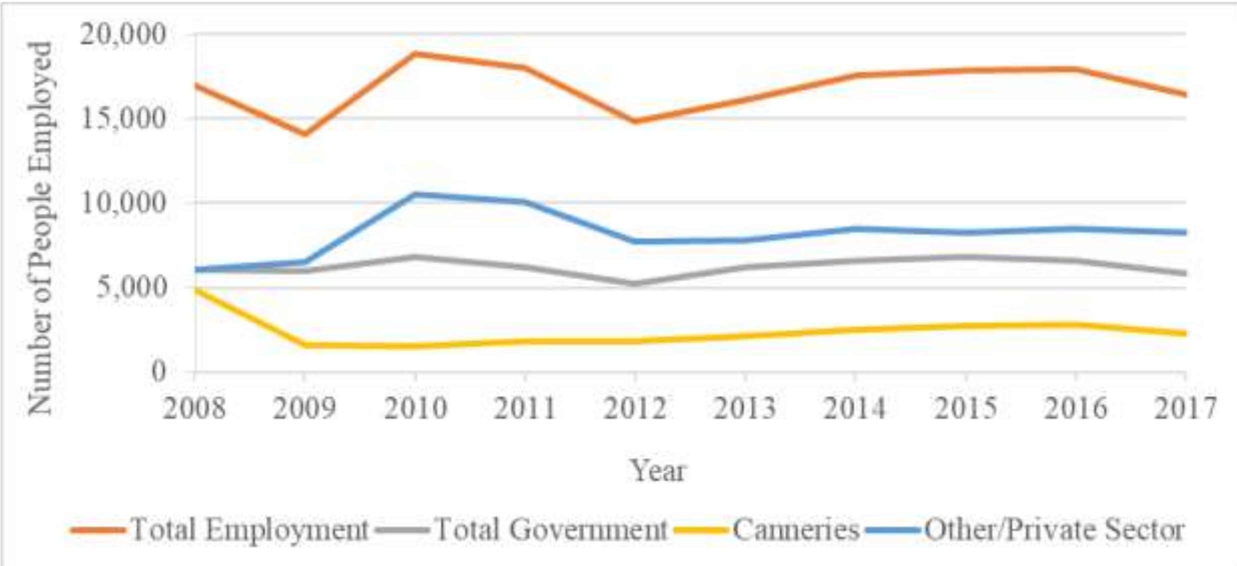


Figure 122. American Samoa Employment Estimates from 2008-2017[1]

[1] Source: American Samoa Statistical Yearbook 2017, 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 principle 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, SunKist 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, the National Marine Fisheries Service (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).

3.1.2.1.2 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).

3.1.2.1.3 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. 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 CPUE, 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.

3.1.2.1.4 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.

3.1.2.2 CNMI

3.1.2.2.1 Introduction

An overview of CNMI history, culture, geography, and relationship with the U.S. is described in Section 1.3 of the Fishery Ecosystem Plan for the Mariana Archipelago (Western Pacific Regional Fishery Management Council, 2009c). The Commonwealth of the Northern Mariana Islands (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 Marianas 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 WWII. During WWII, 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).

3.1.2.2.2 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

3.1.2.2.3 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 lbs. 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 then the general population and of comparable affluence. Pelagic trolling as the most popular gear type, followed by deepwater 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

3.1.2.3 GUAM

3.1.2.3.1 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 on 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 bottomfishing, 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 on 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 on 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 on Guam.

3.1.2.3.2 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 bottomfishing and reef fishing, the primary pelagic fishing method is trolling, thus, results of these studies will be reported in the Guam Troll section.

3.1.2.3.3 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 bottomfishing 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 then 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 on 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 the 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.

3.1.2.4 HAWAII

3.1.2.4.1 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 (Western Pacific Regional Fishery Management Council, 2016b). 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 (National Coral Reef Monitoring Program, 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 (National Coral Reef Monitoring Program, 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 fishers report selling their fish simply to recover these costs, not necessarily to make income (Hospital et al., 2011). Many describe the importance of sharing fish as a part of maintaining relationships within family or other networks as being more important than earning income from fishing (Calhoun et al., 2020).

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

3.1.2.4.2 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.

3.1.2.4.3 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

3.1.2.4.4 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 the Data Modules. 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).

3.1.2.4.5 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).

3.1.2.4.6 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).

3.1.2.4.7 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.

3.1.3 ECONOMIC PERFORMANCE OF MAIN COMMERCIAL FISHERIES

3.1.3.1 AMERICAN SAMOA

3.1.3.1.1 American Samoa Longline

3.1.3.1.1.1 Commercial Participation, Landings, Revenue, and Prices

The American Samoa longline fishery includes large longline vessels (> 50ft.) and small longline vessels (alia boats). There were 17 large longline active vessels (> 50 ft.) and three small (alia) vessels in 2019. 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 2019, the total fleet revenue (estimated landed value sold to cannery) was $3.9 million, and albacore composed of over 89% of the total landed value. Other main species included yellowfin, bigeye, skipjack, and wahoo. The estimated value of the species landed were 7%, 1%, 2%, and 1%, respectively. The five species sold to the local canneries composed of over 97% of the total landings by the longline fleet in 2019. Some wahoo landings might be sold in non-cannery markets, but no detailed data were available. Figure 123 presents the trends of commercial landings and revenue (for cannery only) from 2010-2019. Supporting data for Figure 123 are provided in Table A-113.

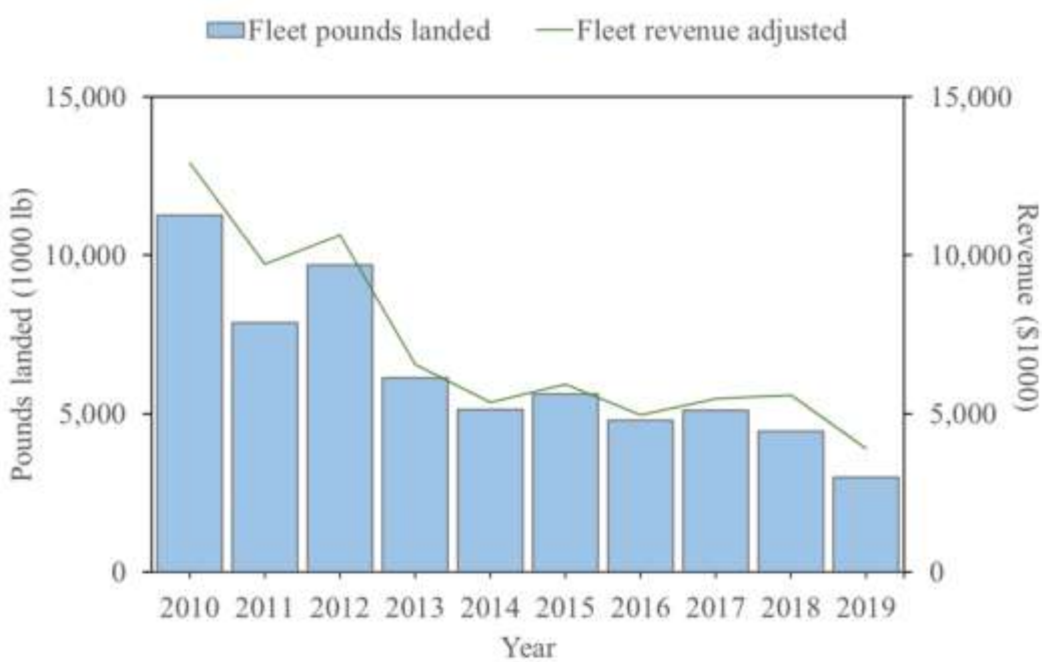


Figure 123. Commercial landings and revenues of the American Samoa longline fishery from 2010-2019 adjusted to 2019 dollars[1]

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

The 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. The trend of albacore price from 2012 to 2019 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 peak in 2012. The albacore price went up in recent years, and the average albacore price in 2019 was $1.61 per pound (whole weight), or $3,542 per metric ton, $0.21 per pound higher than that in the previous year. Table A-114 also shows the average fish price of all species sold to canneries.

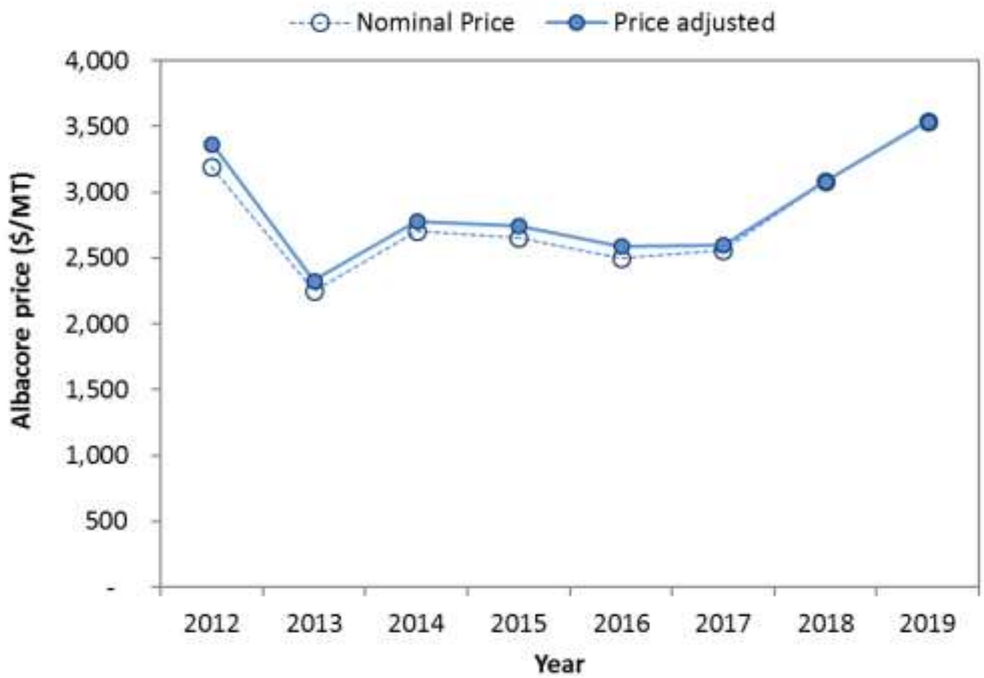


Figure 124. Albacore whole-weight price as reported by American Samoan fishers for 2012-2019 adjusted to 2019 dollars[1]

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

3.1.3.1.1.2 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. 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).

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.

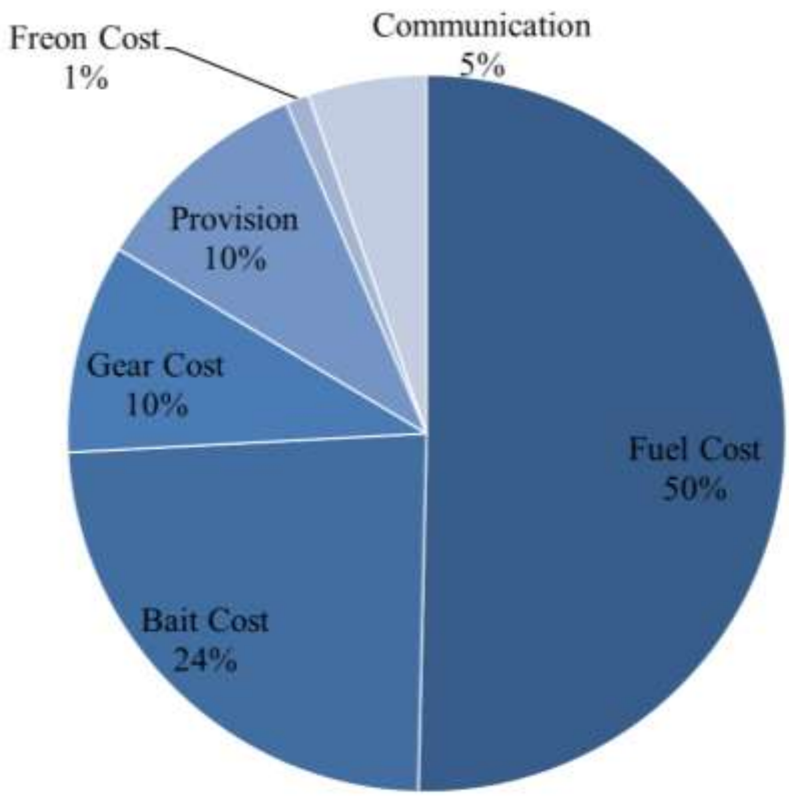


Figure 125. The cost structure for an average American Samoa longline trip in 2019[1]

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

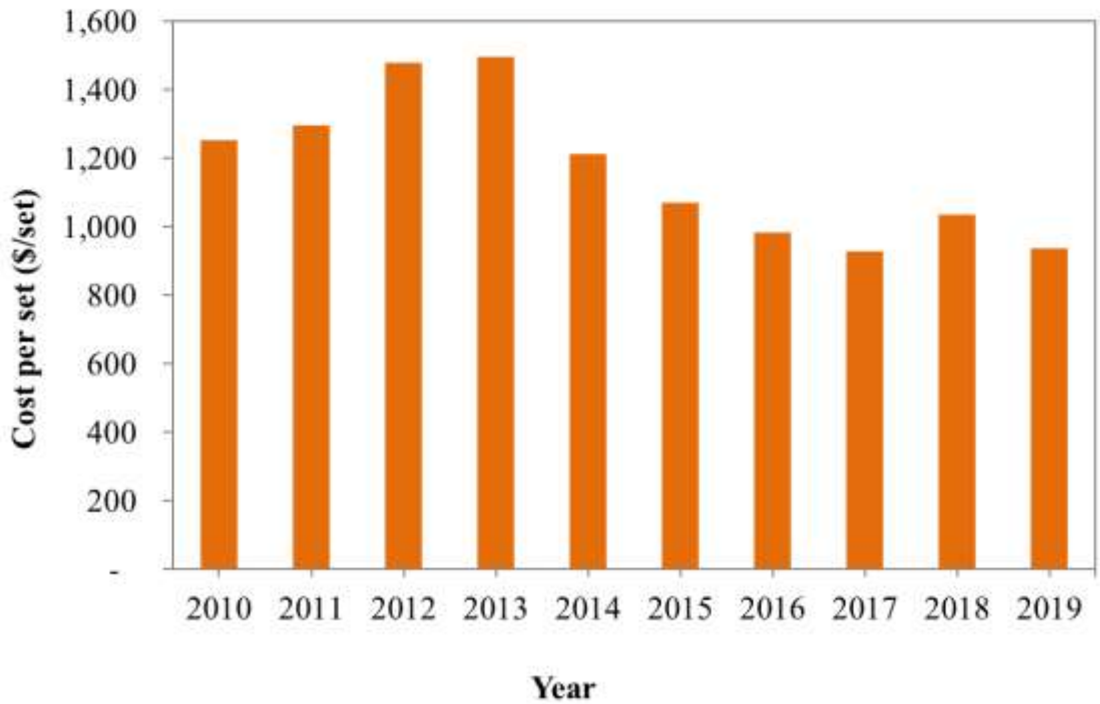


Figure 126. Costs per set[1] for the American Samoa Longline Fishery (not including labor cost and fixed costs) from 2010-2019 adjusted to 2019 dollars[2]

[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.

3.1.3.1.1.3 Economic Performance Indicators

The continuous economic data collection program allows for the monitoring of variation in the fishing cost over time. Compiling the revenue 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.

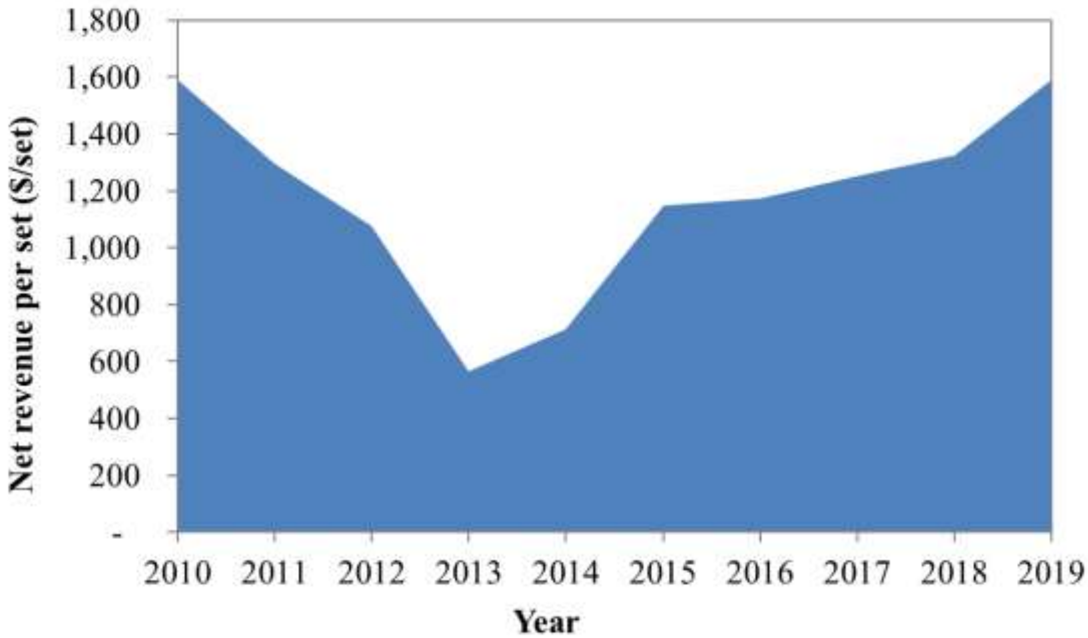


Figure 127. Net revenue per set for the American Samoa longline fishery from 2010-2019 (adjusted to 2019 dollars)[1]

[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) revenue per vessel, and (c) Gini coefficient (while b and c are both shown in the same figure).

The Gini coefficient measures the equality of the distribution of revenue among active vessels in the fishery. A value of zero represents a perfectly equal distribution of revenue amongst these vessels, whereas, a value of one represents a perfectly unequal distribution, in the case that a single vessel earns all of the revenue. Data on aggregate revenue from species in fishery per-day-at-sea and revenue per vessel calculation (for Gini coefficient) are 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 went down 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.

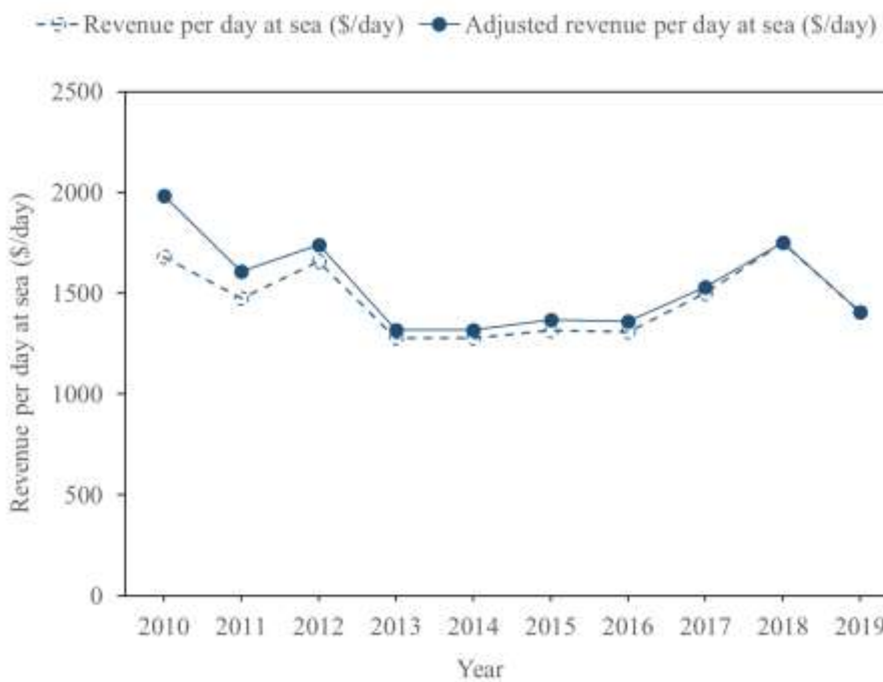


Figure 128. Revenue per-day-at-sea for the American Samoa longline fishery, 2010-2019[1]

[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.

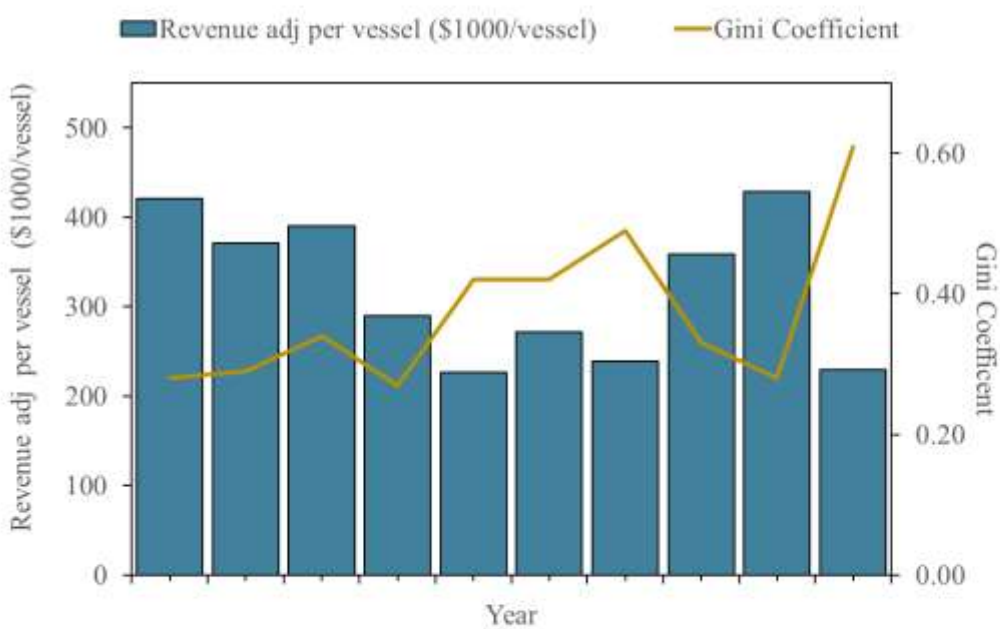


Figure 129. Revenue distribution (revenue per vessel and Gini coefficient) for the American Samoa longline fishery, 2010-2019[1]

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

3.1.3.1.2 American Samoa Trolling

3.1.3.1.2.1 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 has been included in the American Samoa longline section above. Thus, commercial landings and revenue are not included in this section. In addition, there were about 20% of the PMUS sold that were caught by neither longline fishery nor troll fishery. Figure 130 presents the trends of revenue and pounds sold of the troll fishery for American Samoa for 2010-2019 and Figure 131 presents the price trend of the pelagic price for the PMUS sold by the trollers during 2010-2019. Supporting data for Figure 130 and Figure 131 are presented in Table A-117. In 2019, PMUS pounds sold by trolling (including trolling from mixed gear trips) were 13,710 lbs. and valued at $37,710. On average, the pounds sold recorded were 39% of the total landings during 2010-2019. The annual pounds sold in 2019 were similar to the previous year. Fish price of pelagic fish was in an increasing trend since 2015 but went down slightly in 2019.

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 (https://www.pifsc.noaa.gov/wpacfin/as/Pages/as_crform3.htm), while the data of pounds caught were collected through "Boat-based Creel Survey" and "Shore-based Creel Survey" (https://www.pifsc.noaa.gov/wpacfin/as/Pages/as_coll_5.php). 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 (http://www.fpir.noaa.gov/ SFD/pdfs/feps/Pelagics_FEP.pdf) and the raw dataset frozen on March 15, 2019.

Figure 130. PMUS pounds sold and revenue trend by trolling gear from 2010-2019 adjusted to 2019 dollars[1]

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

Figure 131. The real and nominal price of PMUS for fish sold by trolling gear from 2010-2019 adjusted to 2019 dollars[1]

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

3.1.3.1.2.2 Fishing Costs

Since 2009, PIFSC economists have maintained a continuous small boat economic data collection program in American Samoa through collaboration with the PIFSC Western Pacific Fisheries Information Network (WPacFIN). 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 WPacFIN.

Figure 132 presents the average trip costs for American Samoa troll trips, 2011–2019 (adjusted to 2019 dollars). Supporting data for Figure 132 are presented in Table A-118. 2009 and 2010 data were not presented in the figure due to the number of respondents was fewer than three due to confidentiality concerns. 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 $129 in 2019.

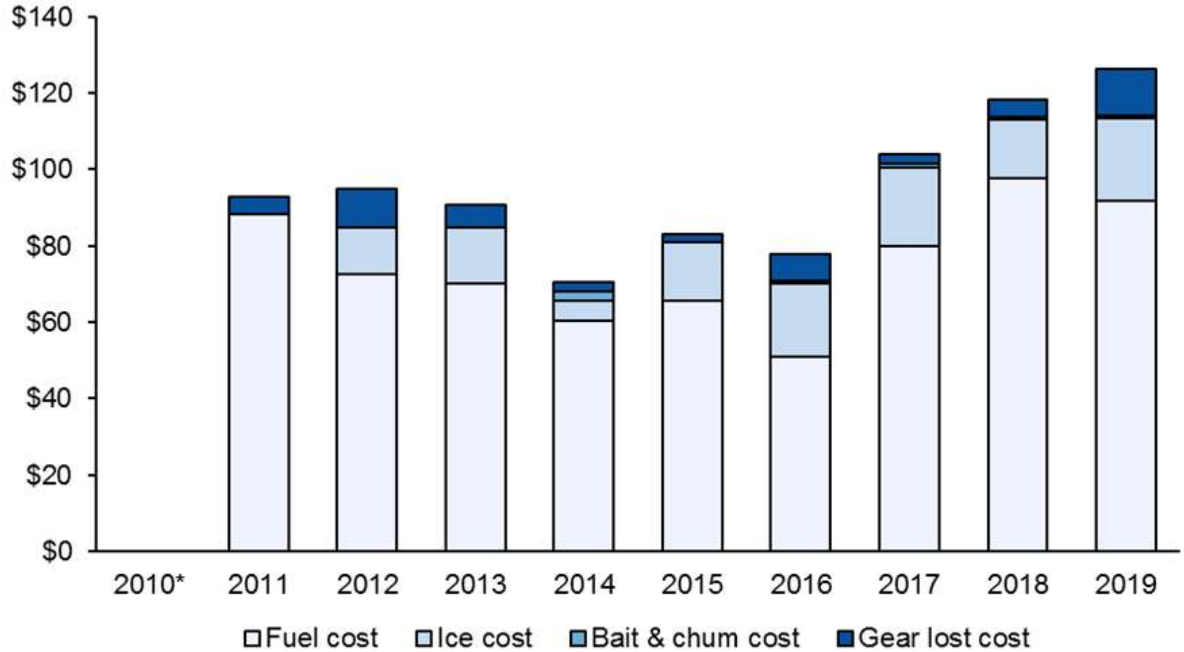


Figure 132. Average trip costs for American Samoa trolling trips from 2010–2019[1] adjusted to 2019 dollars[2]

[1] The number of boats (respondents) was fewer than 3 in 2010; due to confidentiality concerns, responses are not presented.
[2] Data sourced from Chan and Pan (2019a).

3.1.3.2 CNMI

3.1.3.2.1 CNMI Trolling

3.1.3.2.1.1 Commercial Participation, Landings, Revenue, and Prices

This section presents the pounds sold, revenue, and price for all PMUS in 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.

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 (https://www.pifsc.noaa.gov/wpacfin/cnmi/Pages/cnmi_cfrf.htm), while the data of pounds caught were collected through "Boat-based Creel Survey" and "Shore-based Creel Survey" (https://www.pifsc.noaa.gov/wpacfin/cnmi/Pages/cnmi_coll_3.php). 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.

Pelagic fishing is an important commercial fishery in CNMI, and the total pounds sold were 178 thousand pounds, 38% of the total pounds caught based on the data collected from the commercial receipt books. While the total pounds landed in 2019 was similar to the level of 2018, the pounds sold in 2019 was lower than 2018. The average pelagic fish price in 2019 continued to increase, $2.61 per pound, up $0.19 compared to 2018.

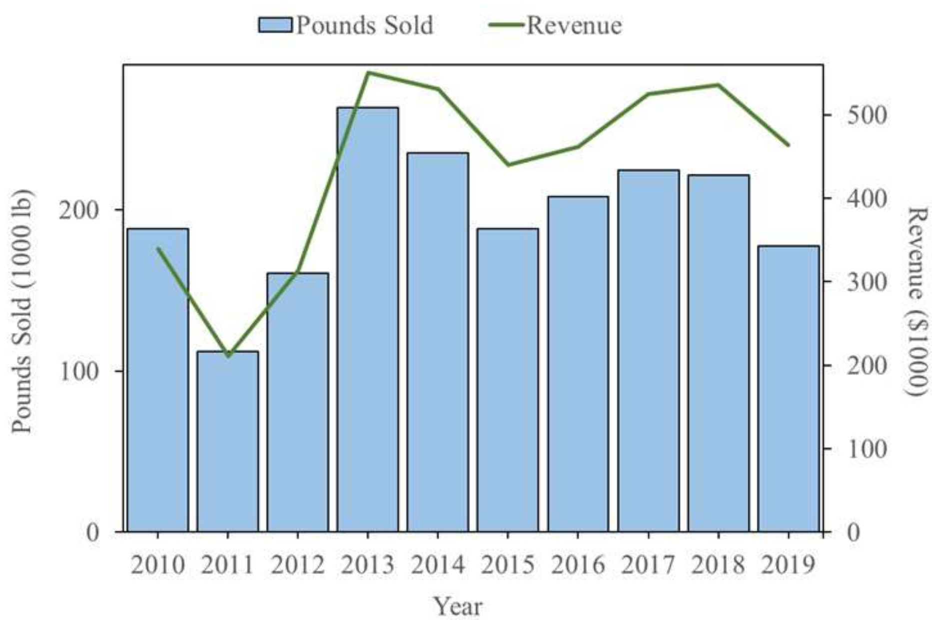


Figure 133. Total PMUS annual pounds sold and revenues in CNMI for all gears from 2010-2019 adjusted to 2019 dollars[1]

[1] CNMI CPI information was not available for the recent three years.

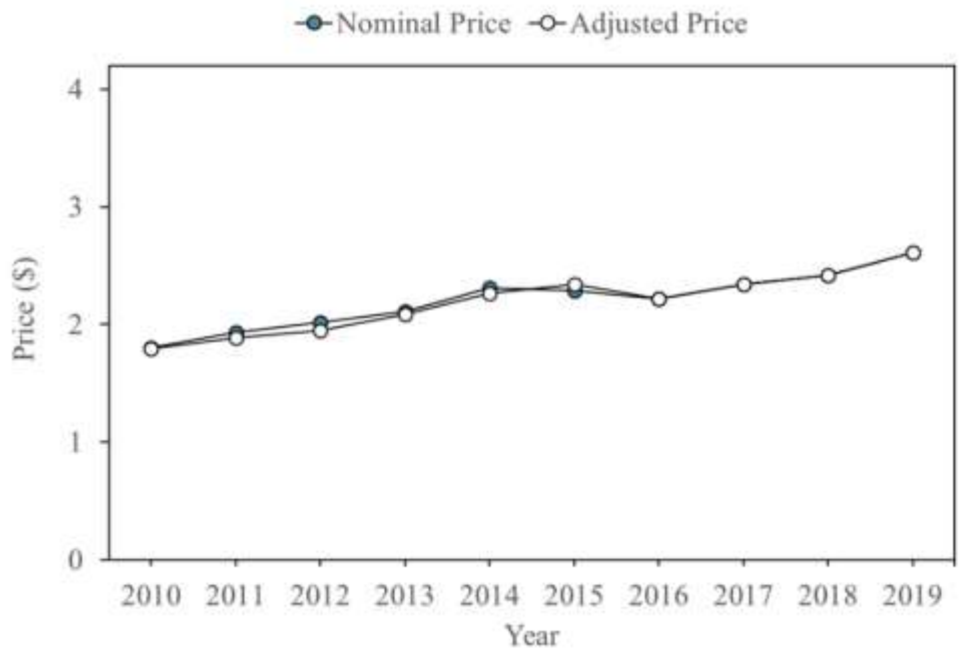


Figure 134. Real and nominal prices of PMUS for fish sold by all gears from 2010-2019[1]

1 Data sourced from the Pacific Islands Fisheries Science Center WPacFIN. CPI information of CNMI is not available for 2017, 2018, 2019, assuming no change for the three years.

3.1.3.2.1.2 Fishing Costs

Since 2009, the PIFSC Socioeconomics Program has maintained a continuous economic data collection program on Saipan through collaboration with the PIFSC Western Pacific Fisheries Information Network (WPacFIN). 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 WPacFIN.

Figure 135 presents the average trip costs for CNMI troll trips from 2009 through 2019 (adjusted to 2019 dollars). In general, the fishing costs of trolling trips showed small changes across years. It moved up and down mainly with the changes of fuel costs. In 2019, the average trip costs of trolling trips were around $76. Supporting data for Figure 135 is presented in Table A-120.

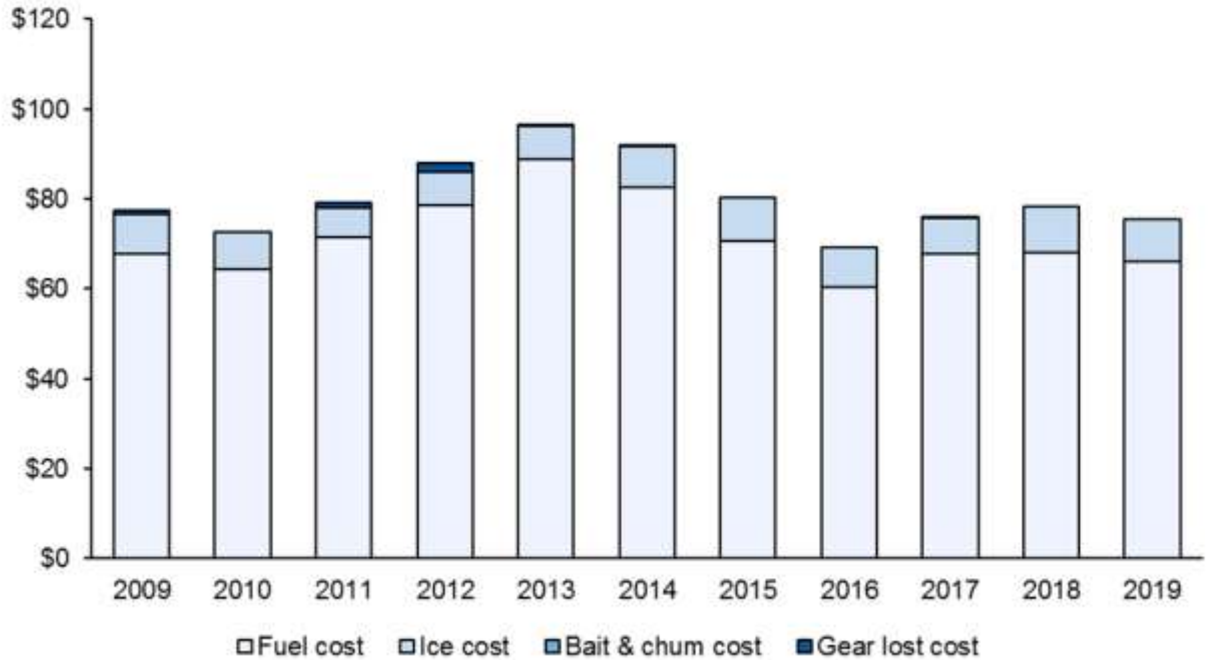


Figure 135. Average cost for CNMI trolling trips from 2009-2019 adjusted to 2019 dollars[1]

[1] Data sourced from PIFSC Continuous Cost Data Collection Program (Chan and Pan, 2019a).

3.1.3.3 GUAM

3.1.3.3.1 Guam Trolling

3.1.3.3.2 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 2010 to 2019. Supporting data of Figure 136 and Figure 137 are shown in Table A-121. Figure 136 shows a generally declining trend of PMUS pounds sold and revenue in Guam up to 2019, but both went up in 2019. The average price of all PMUS was relatively flat over the ten year period and has increased slightly since 2016. In 2019, the pelagic fish price was $2.25 per pounds.

Pelagic fishing is an important fishery in Guam, and the average annual total pounds landed in 2019 were near 840 thousand pounds. The pounds sold, estimated by commercial receipt books, was only a small percentage of pounds landed. In 2019, pounds sold was 17% of the total pounds landed. The total pounds caught (based on WPacFIN estimation) were five times higher than pounds sold in the years during the past 10 years, thus the average pounds sold over pounds caught ratio was 19%.

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 (https://www.pifsc.noaa.gov/wpacfin/guam/dawr/Pages/gdawr_cfrfc.htm), while the data of pounds caught were collected through "Boat-based Creel Survey" and "Shore-based Creel Survey" (https://www.pifsc.noaa.gov/wpacfin/guam/dawr/Pages/gdawr_coll_3.php). 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.

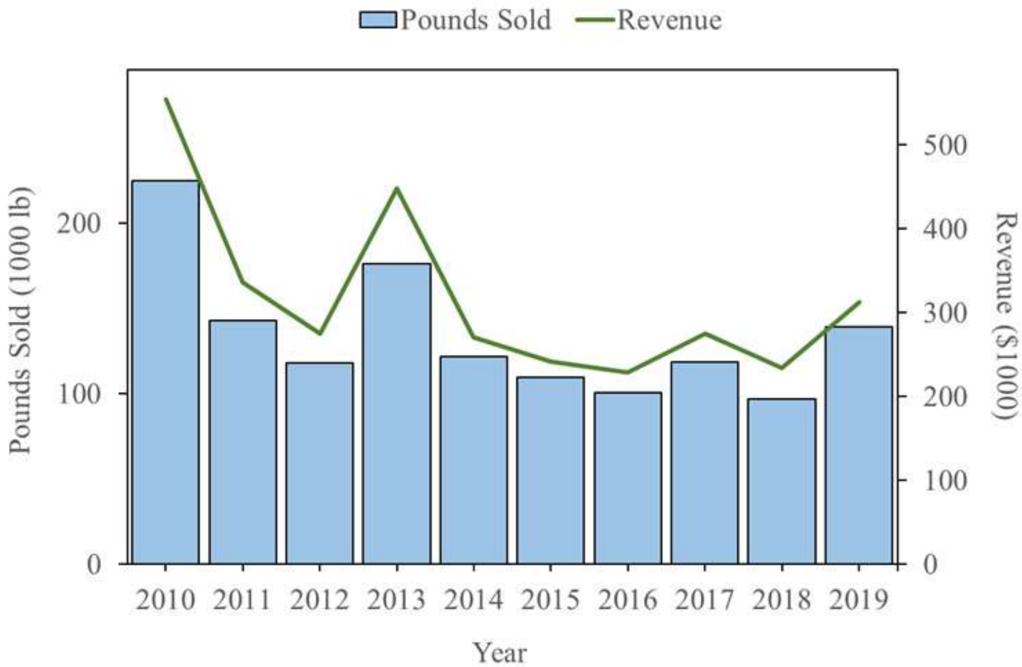


Figure 136. Total PMUS annual pounds sold and revenue in Guam from 2010-2019 adjusted to 2019 dollars[1]

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

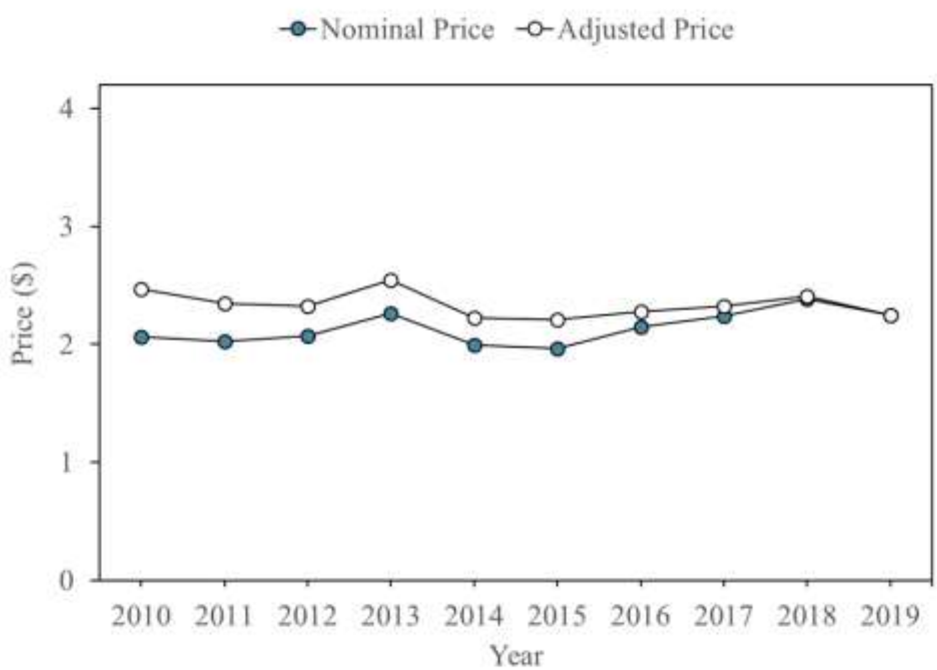


Figure 137. The real and nominal prices of PMUS sold by all gears in Guam from 2010-2019[1]

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

3.1.3.3.3 Fishing Costs

Since 2011, the PIFSC Socioeconomics Program has maintained a continuous economic data collection program on Guam through collaboration with the PIFSC Western Pacific Fisheries Information Network (WPacFIN). 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 WPacFIN.

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 costs of trolling trips in 2019 were $96 in Guam, which was lower than that in the previous year. Supporting data for Figure 138 are presented in Table A-122.

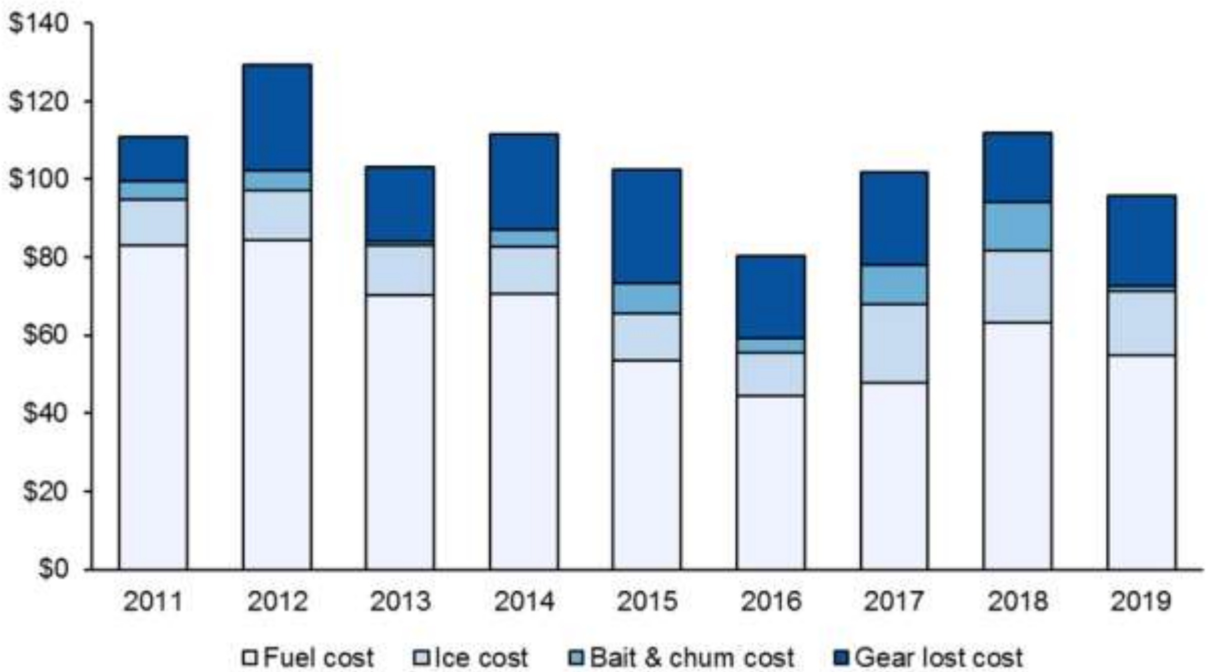


Figure 138. Average cost for Guam troll trips from 2011–2019 adjusted to 2019 dollars[1]

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

3.1.3.4 HAWAII

3.1.3.4.1 Hawaii Longline

3.1.3.4.1.1 Commercial Participation, Landings, Revenue, and Prices

The Hawaii permitted longline fishery conducts two types of fishing to target the pelagic species of bigeye tuna and swordfish 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 2010-2019, the fish landed and sold in the West Coast has increased gradually. However, the total revenue of the Hawaii longline presented in this report only included the fish landed and sold in Hawaii markets, due to data quality concerns on the commercial data of the West Coast landings.

The total active number of vessels landed fish in 2019 was 146. The fleet generated total revenue presented in Figure 139, which only included the revenue generated from pounds sold from the Hawaii markets (based on the Hawaii dealers' reports), not including the portion that landed and sold in the West Coast. The pounds sold in Hawaii accounted for 83% of the total estimated pelagic landings by the entire fleet in 2019. The data of fish landed and sold from West Coast are not presented in this year's report due to some data quality concerns. In general, the total revenue of the Hawaii permitted fleet shows an upward trend for the period of 2009-2017, and down in 2018 and 2019. Pounds sold in 2019 in Hawaii market were 26.8 million pounds, valued at $94 million and priced at $3.51/lb in average. Supporting data of Figure 139 are presented in Table A-123.

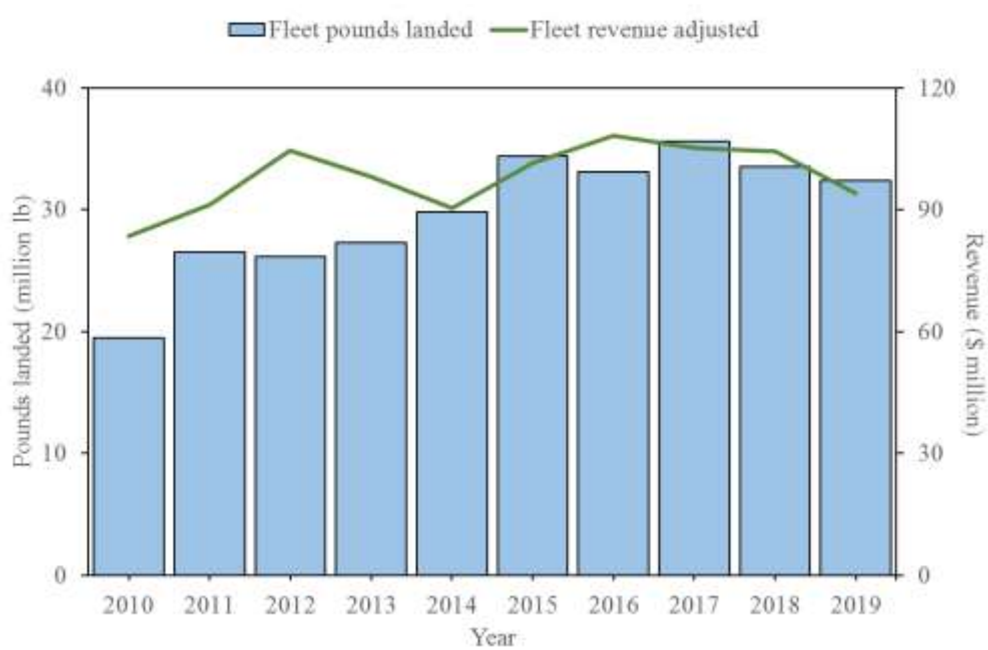


Figure 139. Commercial landings and revenue of Hawaii-permitted longline fleet 2010-2019 adjusted to 2019 dollars[1]

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

Since there was no detailed market information on the fish landed and sold in West Coast, 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. Figure 140 shows the trends of the revenue composition from the main species (bigeye, swordfish, yellowfin, and all others) during 2010-2019, 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. 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 2019, bigeye composed of 65.9% of revenue for Hawaii permitted longline vessels, followed by yellowfin, 15%, and swordfish 4%. Fish prices have fluctuated in general. Bigeye price peaked in 2012 and swordfish price peaked in 2013 before declining in recent years. Bigeye prices picked up slightly in 2019 compared to 2018 and swordfish fish price and yellowfin increased in 2019. Yellowfin price varied over time, and it also peaked in 2013 and declined after However, yellowfin price went up considerably in 2019, approaching bigeye prices.

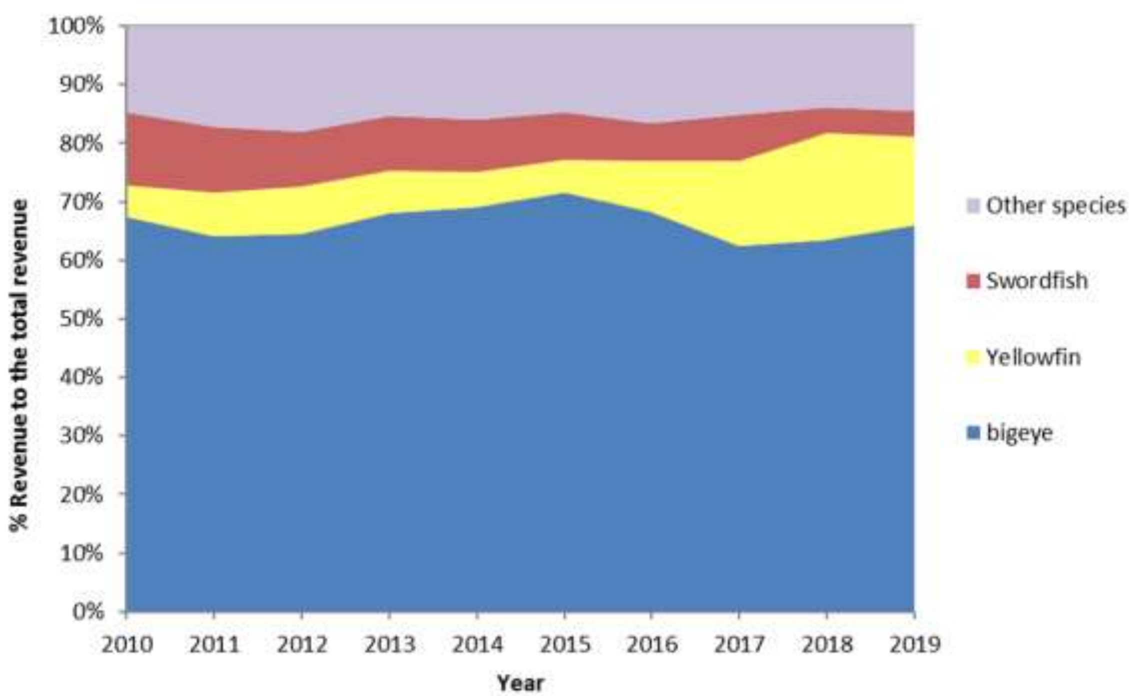


Figure 140. Trends in Hawaii longline revenue species composition from 2010-2019[1]

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

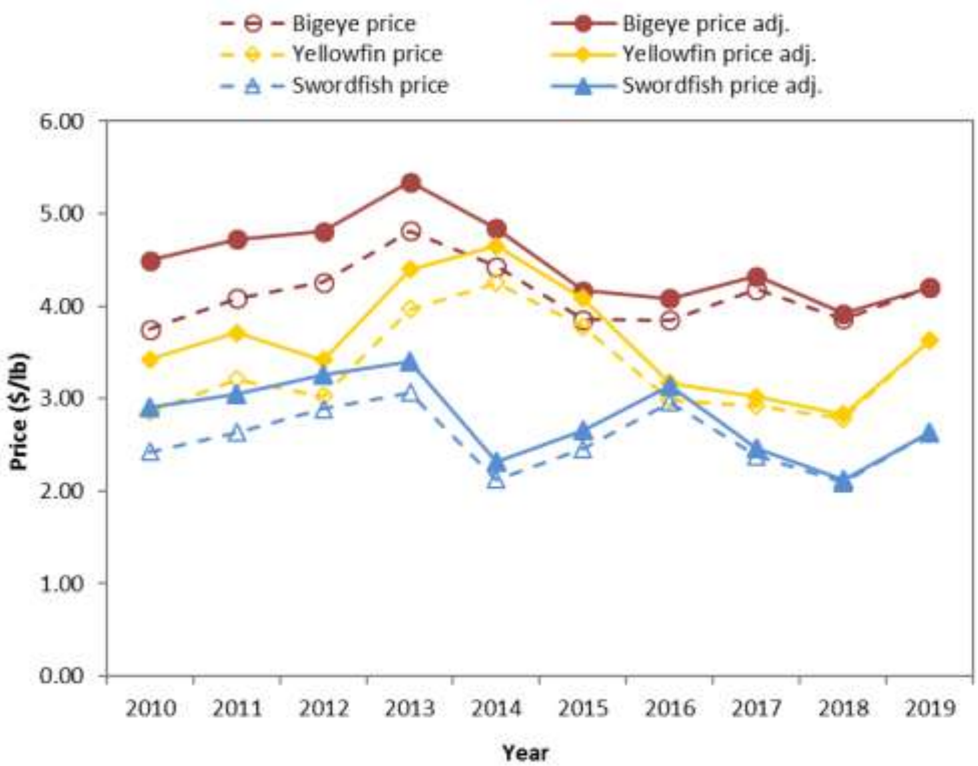


Figure 141. Price trends of nominal and adjusted of three main species (bigeye, yellowfin, and swordfish) from 2010-2019[1]

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

3.1.3.4.1.2 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. 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 data form is comprised of eight cost items commonly arising in Hawaii longline trips but excludes labor costs. Non-labor cost items 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 32 days per trip during the period of 2010-2019, while it was 22 days for tuna trips.

In terms of cost structure, fuel 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 2019, respectively. In 2019, fuel cost was the leading item of trip costs, comprising 52% of trip costs for tuna trip costs. Bait was the second largest item making up 22% of tuna trip costs. Fuel and bait costs together made up over 74% of the trip costs for tuna fishing. For swordfish trip, the cost of fuel made up 53% of swordfish trip costs, while bait cost made up 17% of swordfish trip costs. The cost of the lightstick gear is unique to swordfish fishing, and it made of 8% 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.

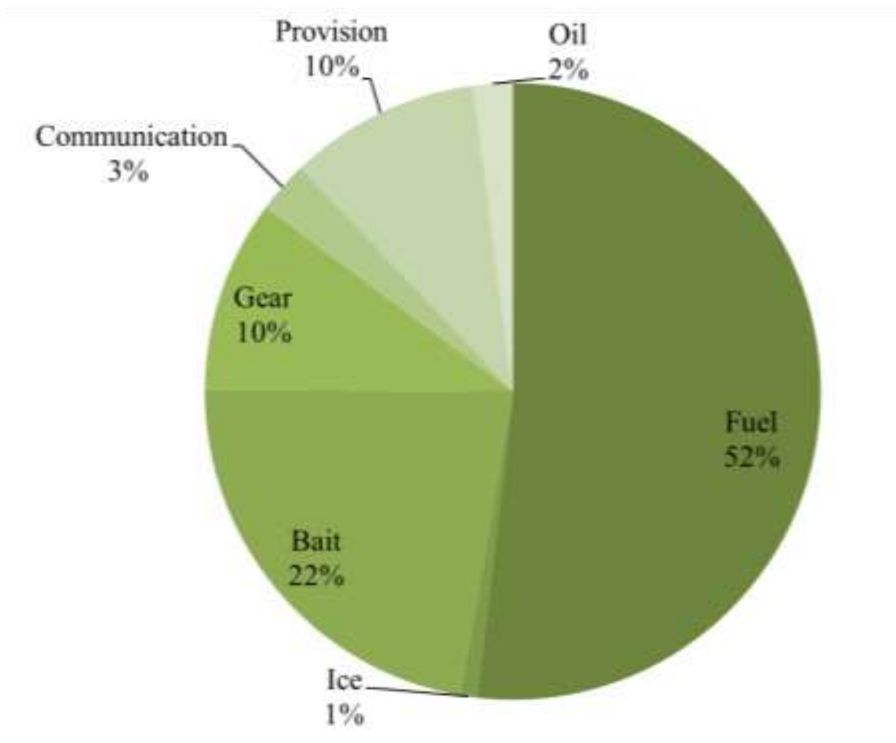


Figure 142. The cost structure of an average deep-set fishing trip in 2019[1]

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

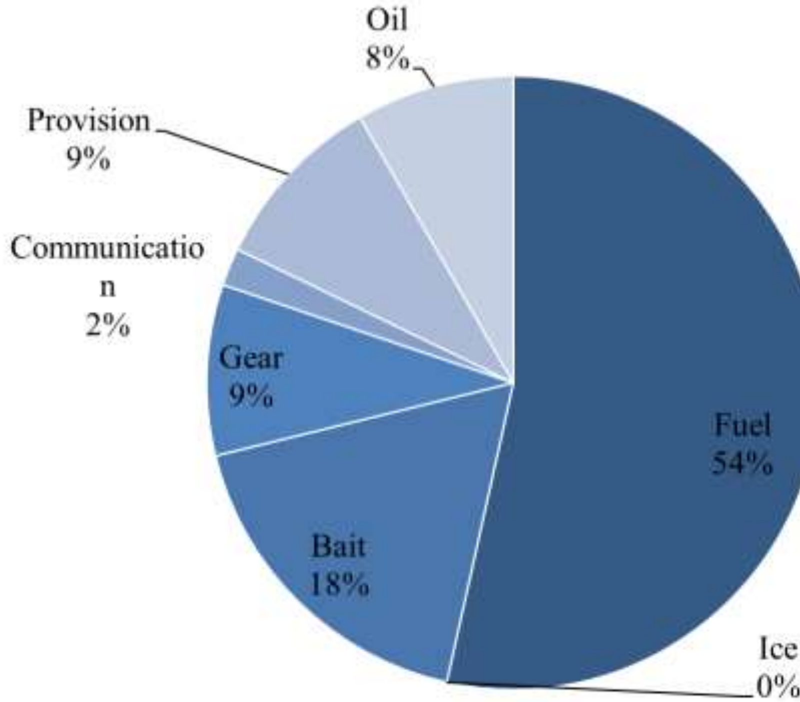


Figure 143. The cost structure of an average shallow-set fishing trip in 2019[1]

[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 2010-2019 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 2010 to 2019. Swordfish trip costs more than tuna trips. In 2019, the average trip costs for swordfish trips were $34,548 while it was $25,874 for tuna trips.

In considering trends, the costs of tuna trips peaked in 2012, while swordfish trip costs peaked in 2011. Since then, fishing costs have trended downward, until 2018 and 2019 where costs went up slightly. Swordfish trip costs were up 15% in 2018 compared to 2017 but went down substantially in 2019.

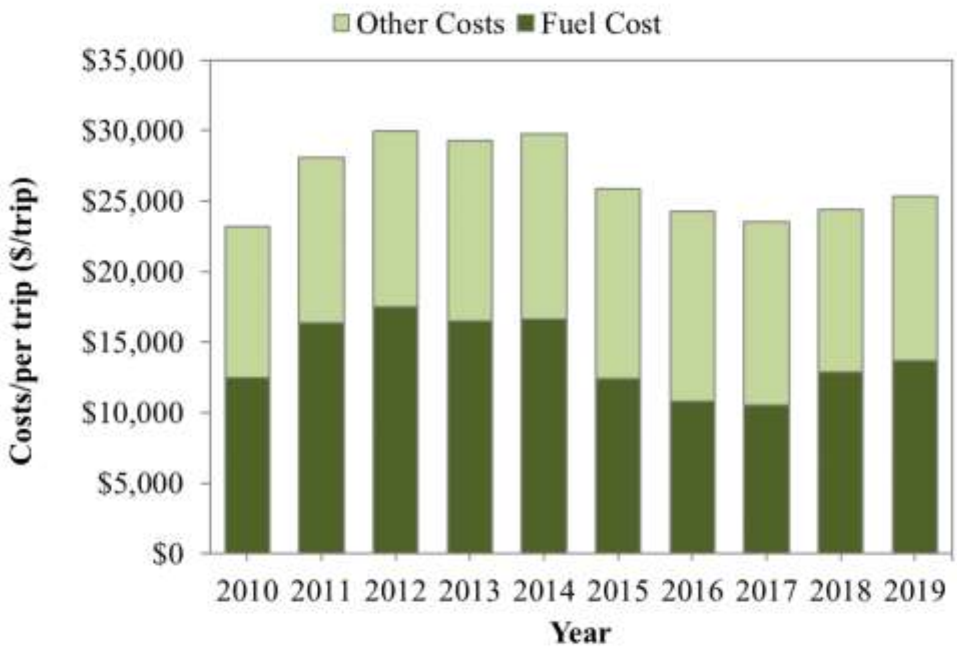


Figure 144. The trend of average trip costs with standard deviation for Hawaii longline deep-set fishing from 2010-2019 adjusted to 2019 dollars[1]

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

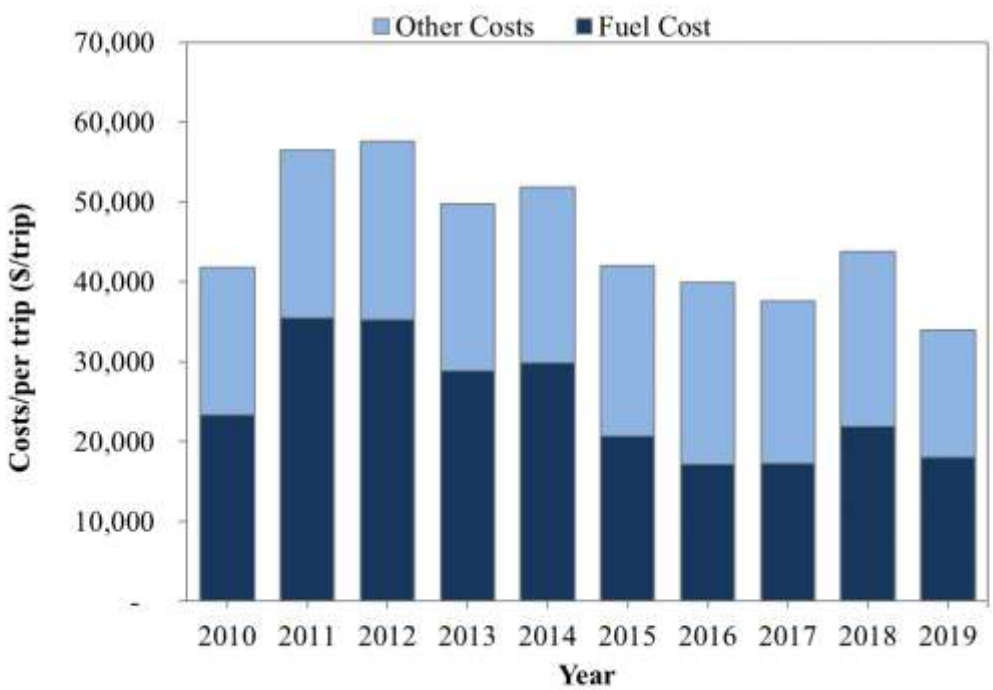


Figure 145. The trend of average trip costs with standard deviation for Hawaii longline shallow-set fishing from 2010-2019 adjusted to 2019 dollars[1]

Data source: PIFSC continuous economic data collection program (Pan, 2018).

3.1.3.4.1.3 Economic Performance Indicators

The continuous economic data collection program allows for the monitoring of movement in fishing cost over time. Compiling revenue 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 2010 to 2019 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 shows an upward trend during the period of 2010 to 2019 in general, while the net revenue of swordfish (deep-set) fishing shows fluctuations across years. The net trip revenue for both trip types peaked in 2016 and dropped in 2017 and 2018. In 2019, the net revenue per trip for tuna fishing continued declined while it went up for swordfish fishing.

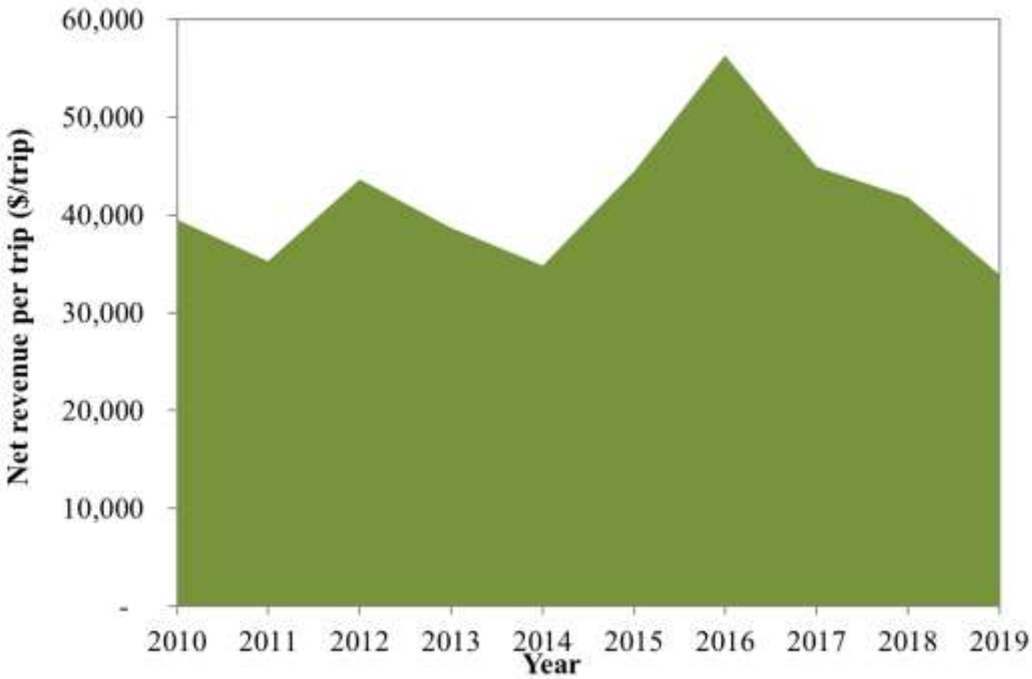


Figure 146. Average net revenue per trip for Hawaii longline deep-set trips from 2010-2019 adjusted to 2019 dollars[1]

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

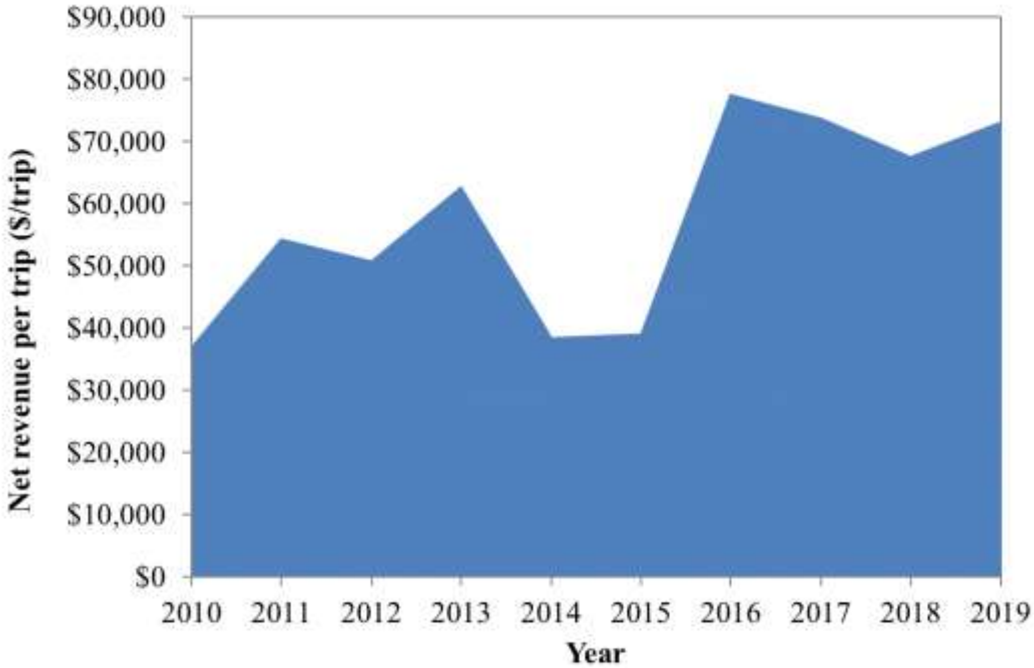


Figure 147. Average net revenue per trip for Hawaii longline shallow-set trips from 2010-2019 adjusted to 2019 dollars[2]

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) the Gini coefficient.

The Gini coefficient measures the equality of the distribution of revenue among active vessels in the fishery. A value of zero represents a perfectly equal distribution of revenue amongst these vessels, whereas, a value of one represents a perfectly unequal distribution, in the case that a single vessel earns all of the revenue. Data on aggregate revenue from species in fishery per-day-at-sea and revenue per vessel calculation (for Gini coefficient) are from Pacific Islands Fisheries Science Center, Fisheries Research and Monitoring Division. 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 2010 to 2019. 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 over the recent three years. Another economic performance indicator, the revenue per vessel also shows an upward trend in the beginning of the time period, held steady from 2014-2018, but was considerably lower in 2019. The income distribution (Gini coefficient in term of revenue per vessel) among vessels is relatively stable in the period.

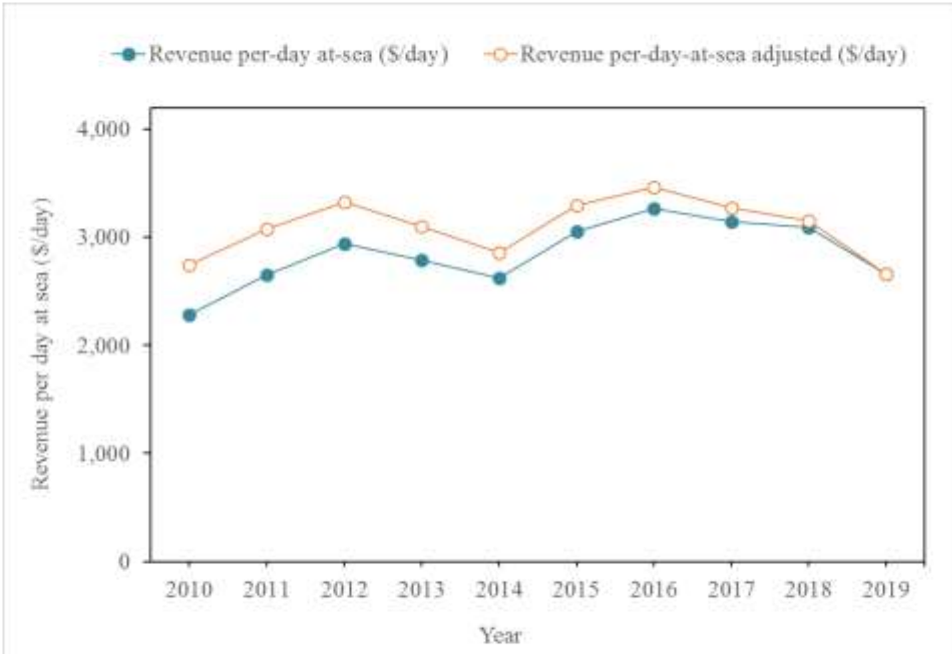


Figure 148. Revenue per-day-at-sea for Hawaii longline, 2010-2019, adjusted to 2019 dollars[1]
[1] Data Source: Pacific Islands Fisheries Science Center, Tier 1 indicators data request.

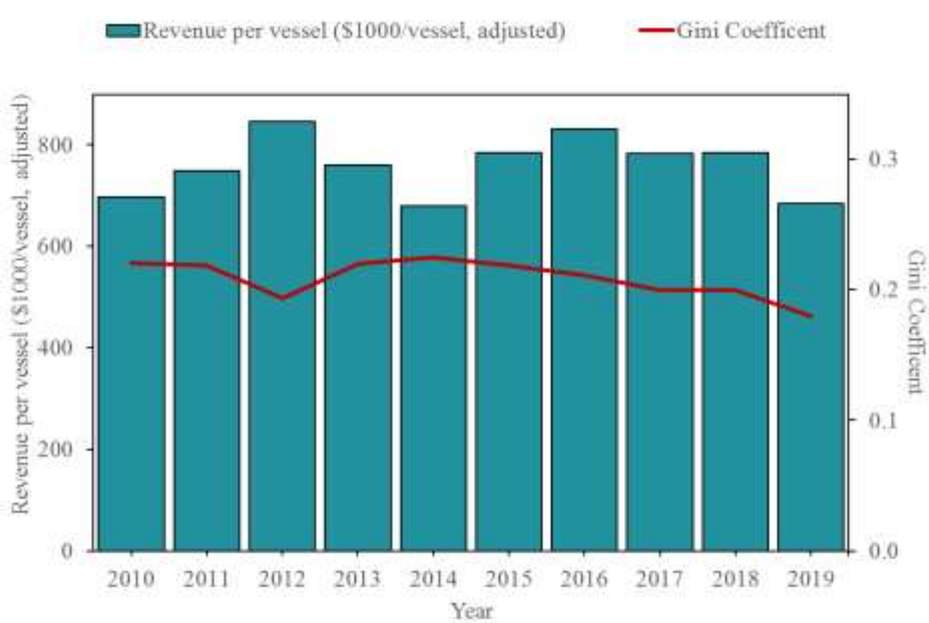


Figure 149. Revenue per vessel and Gini coefficient of the Hawaii longline fisheries[1] from 2010-2019 adjusted to 2019 dollars[2]
[1] Revenue per vessel includes the estimation of revenue landed in West Coast.
[2] Source: Pacific Islands Fisheries Science Center, Tier 1 indicators data request (https://inport.nmfs.noaa.gov/inport/item/46097).

3.1.3.4.2 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.

Considering pelagic fish landed and sold in the Hawaii markets from all gear types, the total revenue generated from Hawaii’s pelagic fisheries was $110.6 million in 2019. The Hawaii permitted longline fishery contributed 90% of the total revenue in 2019. 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 $7.2 million or 7% of the total in 2019 and was followed by the MHI handline fishery at $2.2 million (2%). The offshore handline fishery was worth $1.0 million in 2019. The sharp decline of the “other gears” reflected the decline of the aku boat fishing in the report period. Figure 150 presents the trend of commercial landings by different gears (not including longline), and Figure 151 presents the trend of commercial revenue by different gears (not including longline). Supporting data for the Figure 150 and Figure 151 are presented in Table A-131 and Table A-132, respectively. Both commercial landings and revenue peaked in 2012 and has declined since then (except a small lift in 2018). Total commercial landings in 2019 was at 65% of the 2012 level.

Figure 152 presents the price trends of PMUS harvested and sold by different gears, 2010-2019, (adjusted 2019 dollars). Supporting data for Figure 152 are presented in Table A-133. Figure 154 presents the fishing trip costs by the three main gears (small boats) for pelagic fishing.

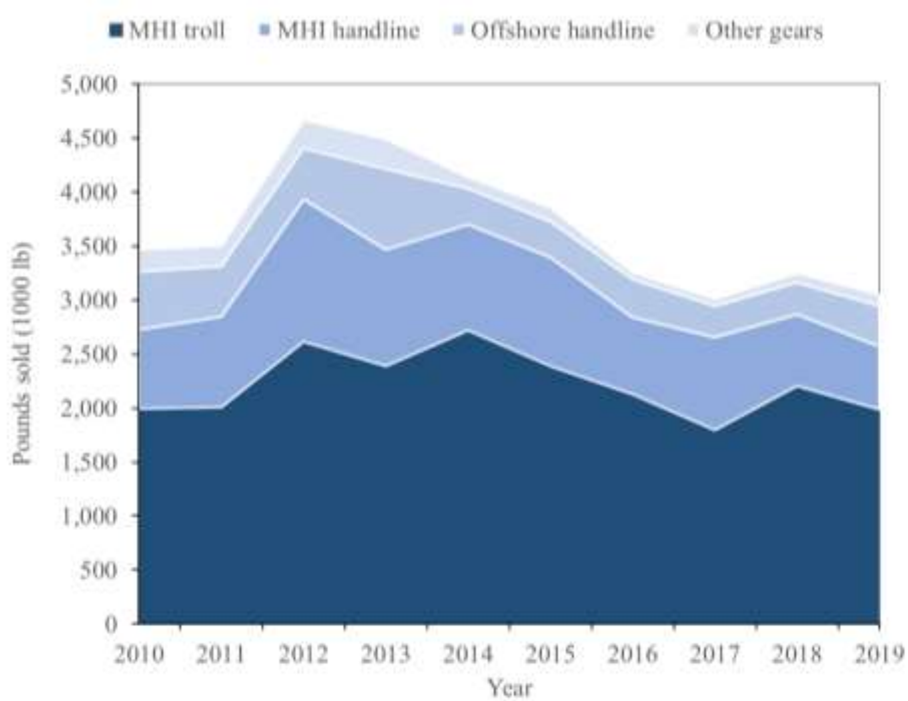


Figure 150. Total pounds sold of MHI commercial non-longline gears from 2010-2019[1]

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

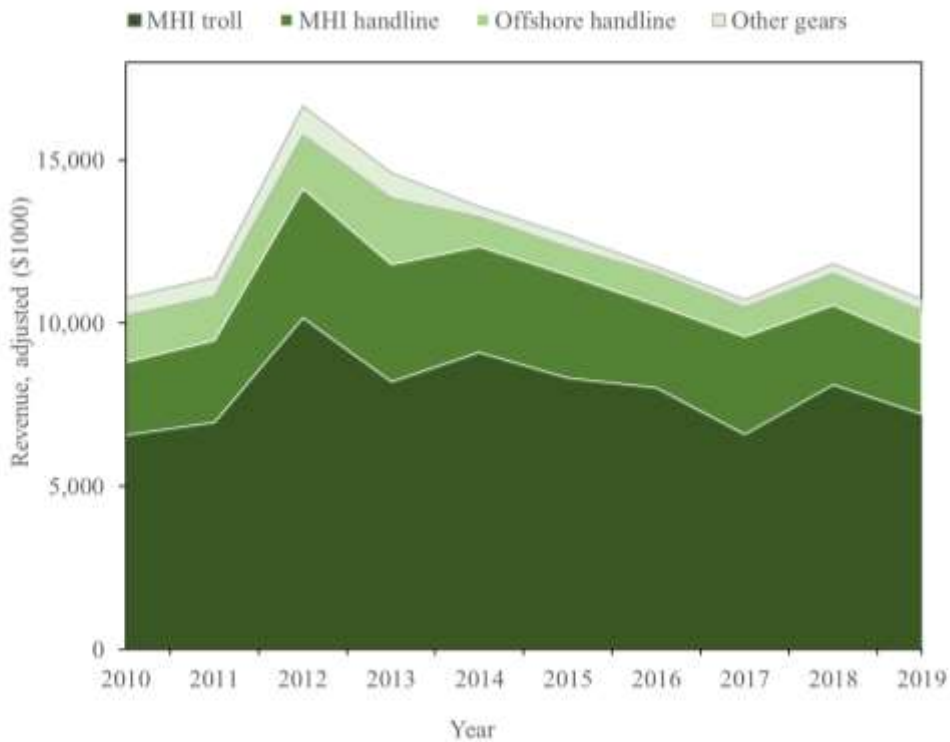


Figure 151. Revenue of non-longline gears from 2010-2019 adjusted to 2019 dollars[2]

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

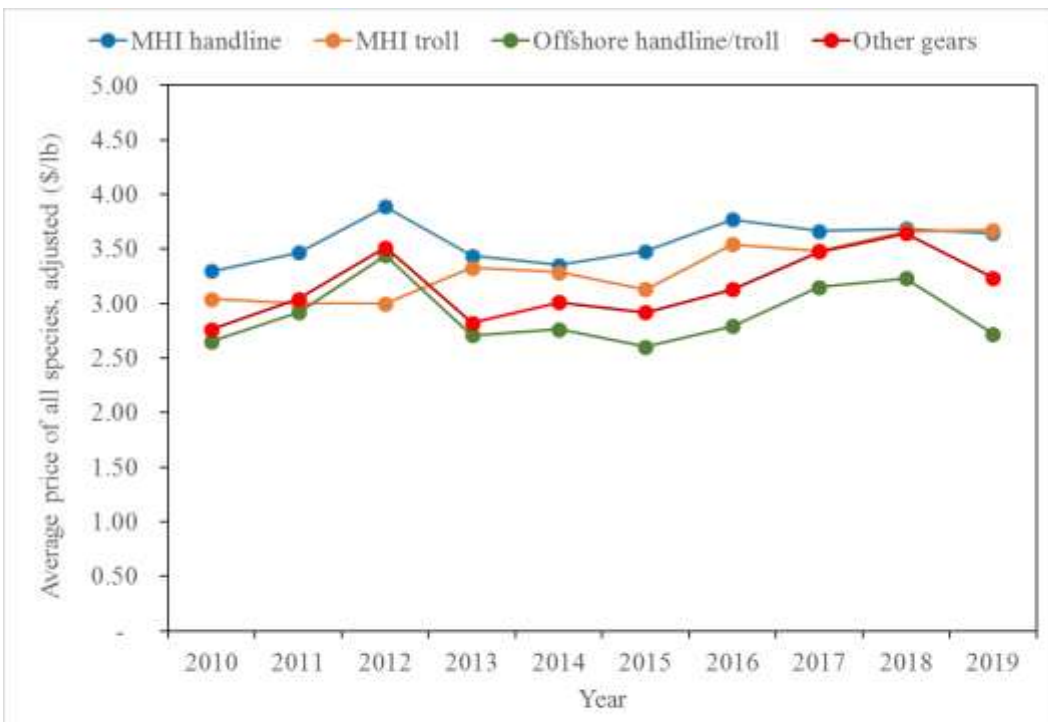


Figure 152. Price trends of PMUS by different gears, 2010-2019, adjusted to 2019 dollars[1]

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

3.1.3.4.3 Hawaii Trolling

3.1.3.4.3.1 Commercial Participation, Landings, Revenue, and Prices

This section will describe trends in commercial participation, landings, revenues, and prices for the Hawaii troll fishery. Figure 153 presents the pounds sold and revenue (adjusted to 2019 dollars) of the MHI troll, 2010-2019. Supporting data of Figure 153 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 (in 2019 dollars) from 2.6 million pounds sold in 2012. Pounds sold from trolling fishery peaked in 2014. Since then, both commercial landings and revenue were in a declining trend up to 2017. In 2018, both commercial landings and revenue was higher than 2018, but went down in 2019.

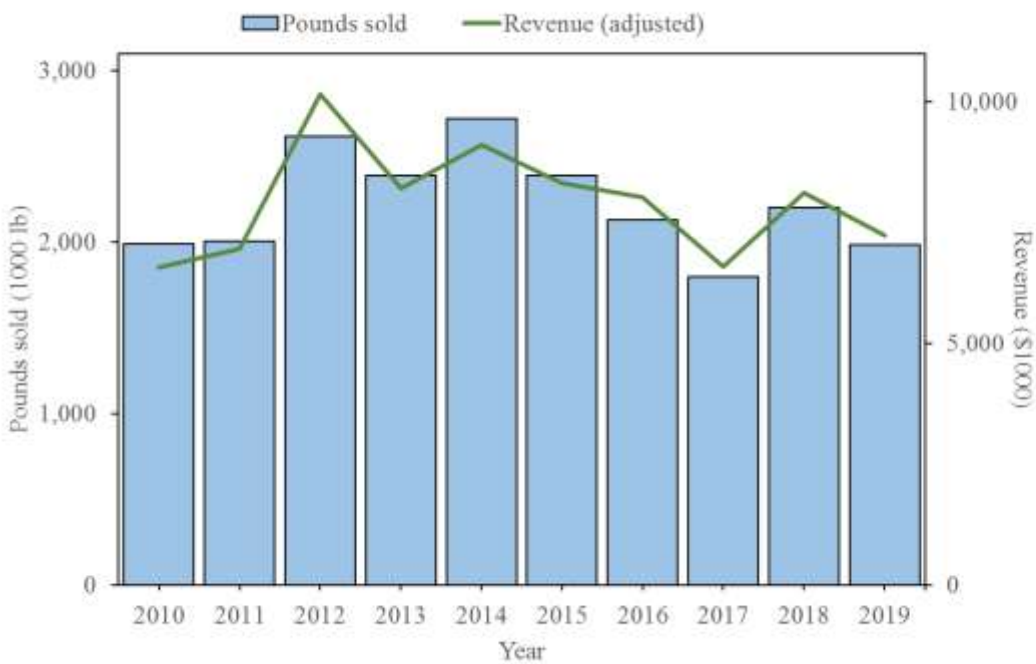


Figure 153. The pounds sold and revenue for the MHI troll from 2010-2019 adjusted to 2019 dollars [1]

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

3.1.3.4.3.2 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, 1998; Hospital et al., 2011; Chan and Pan, 2017). The most current cost data for a Hawaii trolling trip are presented in Figure 154.

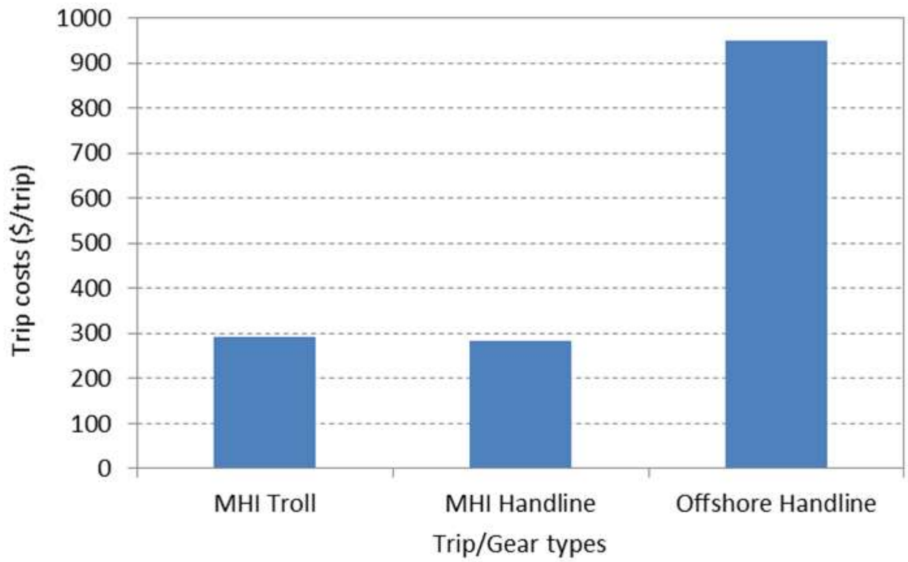


Figure 154. Fishing trip cost by gear type in 2014[1]

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

3.1.3.4.4 Hawaii Pelagic Handline

3.1.3.4.4.1 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in commercial participation, landings, revenues, and prices for the Hawaii pelagic handline fishery. Figure 155 presents the pounds sold and revenue (adjusted to 2019 dollars) of the MHI troll, 2010-2019. Supporting data for Figure 155 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 at $3.9 million (in 2019 dollars) respectively, then was in a declining trend since 2013. Both revenue and commercial landings of Hawaii handline continued declining in 2019.

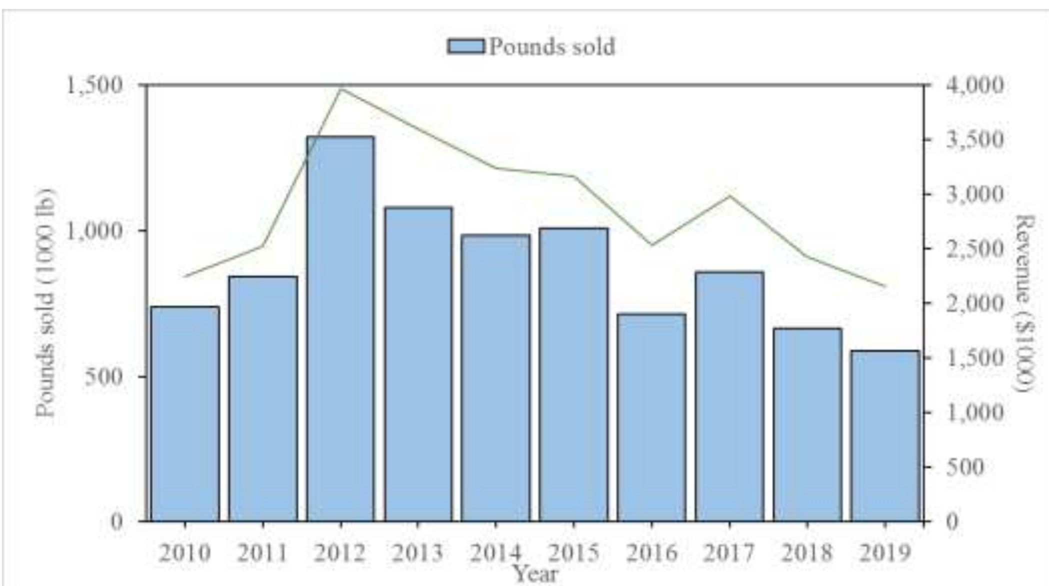


Figure 155. Pounds sold and revenue for MHI handline, 2010-2019, adjusted to 2019 dollars[1]

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

3.1.3.4.4.2 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 Figure 154.

3.1.3.4.5 Offshore Handline

3.1.3.4.5.1 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in pounds sold and revenues for the Hawaii offshore handline fishery. Figure 156 presents the pounds sold and revenue (adjusted to 2019 dollars) of the offshore handline, 2010-2019. Supporting data for Figure 156 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 2010-2019, except that the pounds sold and revenue jumped up considerably in 2010 and 2013, respectively.

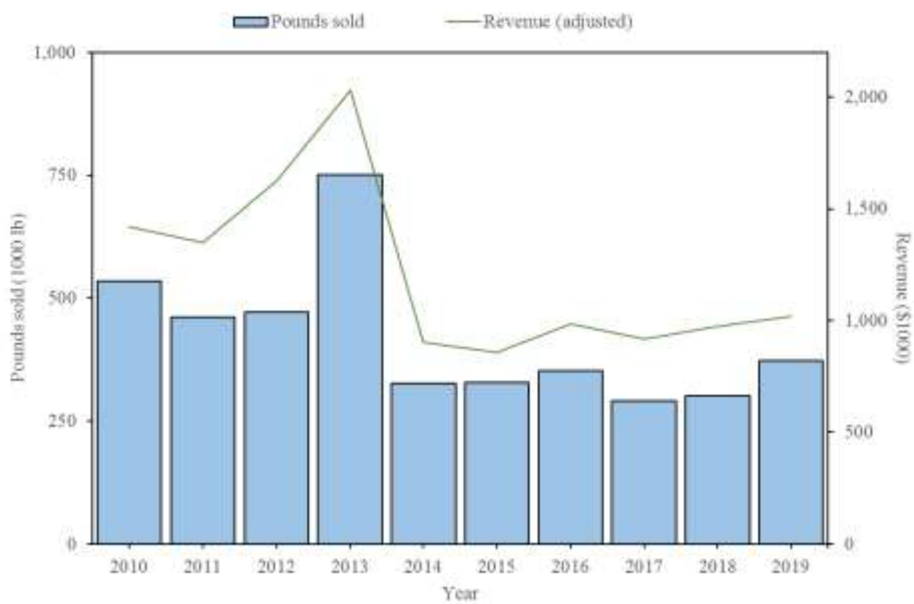


Figure 156. The pounds sold and revenue for the offshore handline from 2010-2019 adjusted to 2019 dollars[1]

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

3.1.3.4.5.2 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.

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

3.1.3.4.6.1 Commercial Participation, Landings, Revenue, and Prices

This section will describe trends in commercial pounds sold and revenues for the "other gears". Figure 157 presents the pounds sold and revenue (adjusted to 2018 dollars) of the other gears (including aku boats), 2009-2018. Supporting data for Figure 157 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" in 2019 composed less than 0.3% 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.

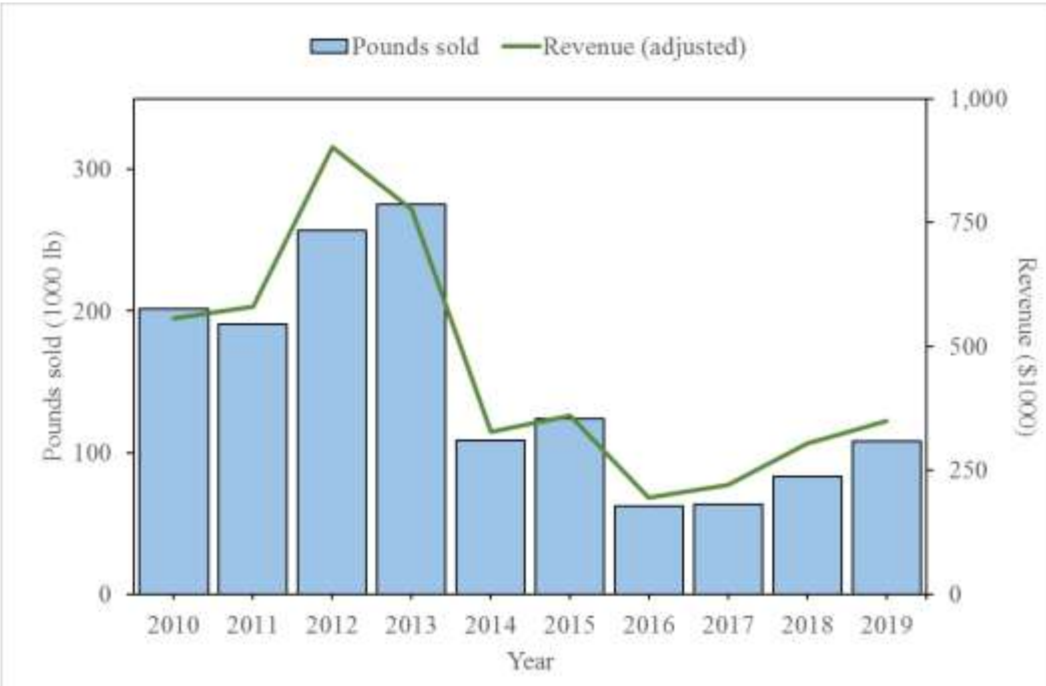


Figure 157. The pounds sold and revenue for all other gears from 2010-2019 adjusted to 2019 dollars[1]

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

3.1.3.4.6.2 Fishing Costs

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

3.1.4 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 2019. 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 2019 Commercial Fishing Economic Assessment Index

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

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 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.

PIFSC also generates projections for upcoming fiscal years, and the table below provides the projected CFEAI report for 2019 (*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. Additionally, PIFSC conducted a cost-earnings survey for the American Samoa longline fishery in 2017 and results, including a profit assessment have recently been published (Pan, 2019).

Table 44. Pacific Islands Region 2020 Commercial Fishing Economic Assessment Index

	2020 Projected 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**	**2019**	**2020**	**2016**
ASam Longline	**2020**	**2020**	**2016**	**2020**	**2019**
HI Offshore Handline	**2020**	**2020**	**2020**	**2019**	**2019**
HI Small Boat (pelagic)	**2020**	**2020**	**2020**	**2017**	**2019**
HI Small Boat (bottomfish)	**2020**	**2020**	**2020**	**2017**	**2019**
HI Small Boat (reef)	2020	2020	2020	2017	2019
Guam Small boat	**2020**	**2020**	**2019**	**2020**	
CNMI Small boat	**2020**	**2020**	**2019**	**2020**	
ASam Small boat	**2020**	**2020**	**2020**	**2020**	

Looking a bit further out, PIFSC intends for results of the 2018 Marianas cost-earnings survey, including a profit assessment, published by late 2020. Additionally, PIFSC intends to field updates to the Hawaii small boat (Chan and Pan, 2017; Hospital et al., 2011) and Hawaii longline cost-earnings surveys (Kolberg and Pan, 2016) during calendar year 2020 (*subject to OMB survey approval*). These surveys will provide updated information on operating costs and fixed costs for the Hawaii small boat troll, offshore handline, and longline fisheries, as well as numerous elements related to fishing behavior, market participation, and fishery demographics.

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 social, economic, and psychological welfare (https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-fishing-communities-0). 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.

PIFSC scientists conducted research in the Marianas during 2019-2020 with the goal to engage the Marianas fishing community to better understand the nature of shark interactions and explore mitigation techniques aligned with community needs and values. Interviews, focus groups, and participant observation were conducted across Guam, Saipan, Tinian, and Rota. Nearly 100 stakeholders were engaged. Data analysis and reporting will be conducted in 2020.

PIFSC scientists also conducted research with Hawaii longline captains and crew to understand impacts from interactions with protected species, mitigation efforts taken by the longline fleet, and innovative ideas that could improve protected species handling. In fall 2019, interviews were conducted with 30 captains or owner-operators and 8 crew members. Analysis and reporting will be conducted in 2020.

3.1.5 RELEVANT PIFSC ECONOMICS AND HUMAN DIMENSIONS PUBLICATIONS: 2019

Publication	MSRA Priority
Abrams KM, Leong K, Melena S, Teel T. 2019. Encouraging Safe Wildlife Viewing in National Parks: Effects of a Communication Campaign on Visitors' Behavior. Environmental Communication, 1-6. https://doi.org/10.1080/17524032.2019.1649291.	HC3.2.3
Chan HL, Pan M. 2019. Vessel level annual cost-earnings study of the Hawaii offshore handline fishery and the Hawaii small boat commercial fishery, 2014. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-80, 50 p. https://doi.org/10.25923/zffy-5a13.	HC1.1.1 HC1.1.8 HC1.1.9
Duncan C, Patyk K, Wild MA, Shury T, Leong KM, Stephen C. 2019. Perspectives on wildlife health in national parks: concurrence with recent definitions of health. Human Dimensions of Wildlife. https://doi.org/10.1080/10871209.2019.1650402.	HC3.2.4
Gove JM, Lecky J, Walsh WJ, Ingram RJ, Leong K, Williams I, Polovina J, Maynard J, Whittier R, Kramer L, et al. 2019. West Hawaii integrated ecosystem assessment ecosystem status report. Pacific Islands Fisheries Science Center, PIFSC Special Publication, SP-19-001, 46 p. https://doi.org/10.25923/t3cc-2361.	HC2.1.2
Hospital J, Schumacher B, Ayers A, Leong K, Severance C. 2019. A structure and process for considering social, economic, ecological, and management uncertainty information in setting of annual catch limits: SEEM* Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-19-011, 13 p.	IF5.1.2
Ingram RJ, Leong KM, Wongbusarakum S. 2019. Bringing human well-being into the West Hawaii Integrated Ecosystem Assessment program. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-19-005, 43 p.	HC2.1.1
Leong KM, Wongbusarakum S, Ingram RJ, Mawyer A, Poe MR. 2019. Improving representation of human well-being and cultural importance in conceptualizing the West Hawaii ecosystem. Frontiers in Marine Science. 6:231.https://doi.org/10.3389/fmars.2019.00231. https://doi.org/10.3389/fmars.2019.00231.	HC2.1.1
Pan M. 2019. Tracking Changes on Fishery Economic Performance. Pacific Islands Fisheries Science Center, PIFSC Special Publication, SP-19-004, 6 p. https://doi.org/10.25923/zv14-9m26.	HC1.1.1 HC1.1.9

3.2 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, sharks, 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.

3.2.1 HAWAII SHALLOW-SET LONGLINE FISHERY

3.2.1.1 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.

3.2.1.1.1 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 2019, the fishery operated under hard caps of 26 leatherback and 17 loggerhead turtles

3.2.1.1.2 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).

Due to the shallow-set fishery closure in March 2019 (see Section 3.2.1.3.2, this report), the fishery in 2019 operated under the 2012 Biological Opinion dated January 30, 2012, and modified on May 22, 2012 (NMFS, 2012).

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[a]

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

[a] Based on the 2019 BiOp dated June 26, 2019. The fishery operated under the 2012 BiOp for the duration that the fishery was open in 2019.

3.2.1.1.3 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 2020 List of Fisheries (LOF; 85 FR 21079, April 16, 2020), meaning that this fishery has occasional incidental mortality and serious injuries of marine mammals. The 2020 LOF lists the following marine mammal stocks that are incidentally killed or injured in this fishery:

- 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.

3.2.1.2 DATA SOURCE FOR MONITORING PROTECTED SPECIES INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Protected species interactions in the Hawaii longline fishery have been monitored through mandatory observer coverage since 1994. Observer coverage in the Hawaii longline fishery was between 3 and 5 percent from 1994 through 1999 and increased to 10 percent in 2000. Since 2004, the shallow-set component of the Hawaii longline fishery has had 100 percent observer coverage.

NMFS uses the date of the interaction for tracking interactions against the ITS and the shallow-set longline sea turtle hard caps, while the PIRO Observer Program Quarterly and Annual Reports 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 3.2.1.3.2, 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.

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

Table 47 summarizes the incidental take data of sea turtles from 2004 to 2019 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 2019 were released alive, with the exception of two loggerhead turtles released dead in 2018, 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. At the end of 2017, relatively higher numbers of interactions with loggerhead turtles were observed, with higher numbers continuing into 2018 and 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. Additional discussion regarding the higher number of loggerhead turtle interactions observed since 2017 is provided in Section 3.2.1.3.2.

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, 2004-2019[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

[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.

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, 2004-2019[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

[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: Unpublished observer data.

3.2.1.3.1 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 2019 Biological Opinion did not take effect until January 2020 when the fishery reopened.

Under the 2012 Biological Opinion, NMFS began monitoring the ITSs for the Hawaii shallow-set longline fishery in Quarter 1 of 2012 and used a rolling 2-year period 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 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 the post-hooking mortality criteria (Ryder et al., 2006) to estimate sea turtle mortality rates. As of June 26, 2019, the ITS from the 2019 Biological Opinion supersedes that of the ITS in the 2012 Biological Opinion.

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 2-year ITS in the 2012 Biological Opinion[a]

Species	2-year ITS Interactions (M)	2-year Monitoring Period Interactions (M)						
		2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
Green turtle	6(2)	0	1(0.25)	1(0.25)	0	2(0.10)	3(0.11)	1 (0)
Leatherback turtle	52(12)	18(3.05)	27(4.27)	21(4.07)	10(2.5)	9(2.35)	10(2.50)	6 (1.1)
Loggerhead turtle	68(14)	12(0.95)	21(2.31)	28(2.95)	28(3)	36(5.85)	54(9.42)	53 (8.4)
Olive ridley turtle	4(2)	0	1(0.05)	2(0.15)	1(0.1)	4(0.25)	5(0.75)	3 (1.1)

[a] Takes are counted based on interaction date.

3.2.1.3.2 Effectiveness of FEP Conservation Measures

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 will remain in place until NMFS completes a new Biological Opinion and a revised hard cap limit is implemented. In 2019, the fishery closed on March 19 due to reaching the loggerhead hard cap limit of 17, and the fishery reopened on January 1, 2020.

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). 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).

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) establish 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 final rule publication is pending as of May 2020. 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. This recommendation will be implemented in future reports after the final rule is published.

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

Table 50 through Table 54 summarize the incidental take data of marine mammals from 2004 to 2019 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 interactions and all mortalities during this time period involved small dolphin species (Table 50), although no interactions were observed in 2019. 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 51) and large whales (Table 52) 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 cetacean groups are shown in Table 53.

Interactions with pinnipeds, including Northern elephant seals, Guadalupe fur seals, and unidentified pinnipeds and sea lions have been occasionally observed since 2013 (Table 54). A total of five interactions with unidentified pinnipeds and sea lions were observed in 2015, all of which were taken outside of the EEZ offshore 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), and three were released injured in 2017. There were no interactions with pinnipeds documented in 2018, and one unidentified seal interaction was documented in 2019.

Table 50. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for dolphins in the Hawaii shallow-set longline fishery, 2004-2019[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

[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.

Table 51. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for small whales in the Hawaii shallow-set longline fishery, 2004-2019[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

[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.

Table 52. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for large whales in the Hawaii shallow-set longline fishery, 2004-2019[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

[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.

Table 53. 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, 2004-2019[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

[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.

Table 54. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for pinnipeds in the Hawaii shallow-set longline fishery, 2004-2019[a]

Year	Obs. Cov. (%)	Sets	Hooks	Northern elephant seal		Guadalupe fur seal		Unidentified pinniped		Unidentified sea lion		Unidentified 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
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	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
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	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
2013	100	912	1,000,084	1	0.001	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
2015	100	1,178	1,286,628	0	0.000	0	0.000	3[c]	0.002	2[c]	0.002	0	0.000
2016	100	778	849,681	0	0.000	1	0.001	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
2018	100	476	446,371	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	1	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.

3.2.1.4.1 Comparison of Interactions with ITS

As of June 26, 2019, the ITS from the 2019 Biological Opinion supersedes that of the ITS in the 2012 Biological Opinion. This includes a 1-year ITS of 11 interactions and 9 mortalities with the Guadalupe fur seal. The shallow-set fishery was closed in March 2019 before the new ITS went into effect. Future reports will include a comparison of the Guadalupe fur seal ITS and the observed interactions.

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 in the shallow-set longline fishery will continue to be monitored against the PBR in this report.

3.2.1.4.2 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 55. 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. The shallow-set longline fishery has not had an observed interaction with a short-finned pilot whale, but a mean annual M&SI is estimated for the Hawaii stock based on a proration of unidentified blackfish (*Globicephalinae* spp.) interactions.

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 55).

Table 55. 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 2018 SARs	Outside EEZ[a]	Inside EEZ	
		Mean Annual M&SI	Mean Annual M&SI	PBR (Inside EEZ only)[c]
Bottlenose dolphin, HI Pelagic	2011-2015	2	0	140
Risso's dolphin, HI	2011-2015	3.2	0	82
Rough-toothed dolphin, HI	2011-2015	0	1	423
Striped dolphin, HI	2011-2015	0.6	0	449
Blainville's beaked whale, HI	2011-2015	0	0	10
False killer whale, HI Pelagic	2011-2015	0.1	0.1	9.3
Short-finned pilot whale, HI	2011-2015	0.1	0	106
Kogia spp. whale (Pygmy or dwarf sperm whale), HI	2007-2011	Pygmy = 0 Dwarf = 0	Pygmy = 0 Dwarf = 0	undetermined
Humpback whale, Central North Pacific	2013-2017[d]	0[b]		83[b]
Fin whale, HI	2011-2015	0	0	0.1
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.

3.2.1.5 SEABIRD INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Table 56 summarizes the incidental take data of seabirds from 2004 to 2019 in the Hawaii shallow-set longline fishery. Since there is full observer coverage for this fishery, the interactions in Table 56 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 56 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.

3.2.1.5.1 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 2019.

Table 56. 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)	0.048	19(5)	0.051	0	0.000	0	0.000	0	0.000	0

[a] Take data are based on vessel arrival dates.
[b] Due to vessel confidentiality rules, data for the fourth quarter in 2007 are combined with data for 2008. Take data for 2007 reflect those from first, second and third quarters.
[c] These birds were later identified as sooty shearwaters in the NMFS Seabird Annual Report.
Source: 2004-2019 PIRO Observer Program Annual and Quarterly Status Reports.

3.2.1.6 ELASMOBRANCH INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Table 57 summarizes the incidental take data of ESA-listed elasmobranchs from 2004 to 2019 in the Hawaii shallow-set longline fishery. There were no observed interactions with ESA-listed elasmobranchs in 2019. 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 typically overlaps with oceanic whitetip shark distribution (south of 30°N) in the summer months. 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 57. Observed and estimated interactions with elasmobranchs in the Hawaii shallow-set longline fishery, 2004-2019[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

[a] Take data are based on vessel arrival dates.
[b] Mortality numbers include sharks that were released dead, finned, and kept.
Source: NMFS unpublished (2004-2018 data).

3.2.2 HAWAII DEEP-SET LONGLINE FISHERY

3.2.2.1 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

3.2.2.1.1 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.

3.2.2.1.2 ESA Consultations

The Hawaii deep-set longline fishery is covered under a NMFS Biological Opinion dated September 19, 2014 (NMFS 2014). 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 57). 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 59). 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). Until NMFS completes the Section 7 consultation and issues a new biological opinion, the 2014 Biological Opinion as supplemented (2017) remains valid for all species and critical habitat considered in the 2014 BiOp as supplemented.

Table 58. 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 59. Summary of ITSs for the Hawaii deep-set longline fishery

Species	ITS Time Period	Takes	Mortalities	Source BiOp
Loggerhead turtle, North Pacific DPS	3-year	18	13	NMFS 2017
Leatherback turtle	3-year	72	27	NMFS 2014
Olive ridley turtle, Endangered Mexico and threatened eastern Pacific populations	3-year	144	134	NMFS 2017
Olive ridley turtle, Threatened western pacific population	3-year	42	40	NMFS 2017
Green turtle, East Pacific DPS	3-year	12	12	NMFS 2017
Green turtle, Central North Pacific DPS	3-year	6	6	NMFS 2017
Green turtle, East Indian-West Pacific DPS	3-year	6	6	NMFS 2017
Green turtle, Southwest Pacific DPS	3-year	6	6	NMFS 2017
Green turtle, Central West Pacific DPS	3-year	3	3	NMFS 2017
Green turtle, Central South Pacific DPS	3-year	3	3	NMFS 2017
Sperm whale	3-year	9	6	NMFS 2014
False killer whale (MHI insular DPS)	3-year	1	0.74	NMFS 2014
Scalloped hammerhead shark (Indo-West Pacific DPS)[a]	3-year	6	3	NMFS 2014
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.

3.2.2.1.3 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 2020 LOF (85 FR 21079, April 16, 2020), meaning that NMFS has determined that this fishery has frequent incidental mortality and serious injuries of marine mammals. The 2020 LOF lists the following marine mammal stocks that are incidentally killed or injured in this fishery:

- 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
- 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.

3.2.2.2 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. 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).

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

Table 60 summarizes the incidental take data of sea turtles from 2002 to 2019 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. 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 60. 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, 2002-2019[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			Take s (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	10	-	3	0.0002	15	-	0	0.0000	0	-	29(28)	0.0022	141	-	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. 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.

3.2.2.3.1 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 61; Table 62). 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). Until NMFS completes the Section 7 consultation and issues a new biological opinion, the 2014 Biological Opinion as supplemented (2017) remains valid for all species and critical habitat considered in the 2014 Biological Opinion as supplemented.

Table 61. 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**
Leatherback turtle	72(27)	21.12(8.6)	25.51 (4.43)
2017 Supp. BiOp			
Species	**3-year ITS Interactions (M)**	**Estimated Total Interactions and Mortalities Interactions (M)**	
		Q3 2016-Q4 2018	**2017-2019**
Green turtle	-	-	-
East Pacific DPS	12(12)	20.38(18.67)	21.63 (20.28)
Central North Pacific DPS	6(6)	3.49(3.19)	7.75 (7.27)
East Indian-west Pacific DPS	6(6)	2.33(2.13)	3.29 (3.09)
Southwest Pacific DPS	6(6)	2.04(1.87)	2.83 (2.65)
Central West Pacific DPS	3(3)	0.29(0.27)	1.09 (1.02)
Central South Pacific DPS	3(3)	0.29(0.27)	1.94 (1.82)
Loggerhead turtle	18(13)	15(9.5)	20 (12.64)
Olive ridley turtle	-	-	
Endangered Mexico and threatened eastern Pacific populations	141(134)	179(168.09)	256.12 (244.31)
Threatened western Pacific populations	42(40)	53(49.77)	88.59 (84.5)

[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).

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

Table 62 through Table 67 summarize the incidental take data of marine mammals from 2002 to 2019 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. Observed interactions with false killer whales were more frequent, with the highest number of observed interactions occurring in 2019. False killer whales also had the highest interaction rate over the entire 2002-2019 period, followed by short-finned pilot whales, bottlenose dolphins and Risso's dolphins. Very few interactions were observed with striped dolphins, pantropical spotted dolphins, rough-toothed 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 64). Observed interactions with unidentified cetacean groups are shown in Table 65. In 2019, there were three observed unidentified cetacean interactions and one unidentified beaked whale interactions.

Table 62. 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, 2002-2019[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	5	-	1(1)	0.0001	5	-	0	0.0000	0	-

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

[b] One unidentified dolphin was later identified as a striped dolphin but is listed as an unidentified dolphin in the 2015 Annual Observer Report.

Source: Take data—2002-2019 PIRO Observer Program Annual and Quarterly Status Reports

ME—McCracken, 2005; McCracken, 2006; McCracken, 2011a; McCracken, 2016; McCracken, 2017b; McCracken 2019c.

Table 63. 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, 2002-2019[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	73	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-

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

Source: Take data—2002-2019 PIRO Observer Program Annual and Quarterly Status Reports

ME—McCracken, 2005; McCracken, 2006; McCracken, 2011a; McCracken, 2016; McCracken, 2017b; McCracken 2019c.

Table 64. 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, 2002-2019[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	-

[a] Take data are based on vessel arrival dates.
Source: Take data—2002-2019 PIRO Observer Program Annual and Quarterly Status Reports
ME—McCracken, 2005; McCracken, 2006; McCracken, 2011a; McCracken, 2016; McCracken, 2017b; McCracken 2019c.

Table 65. 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, 2002-2019[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

[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.

3.2.2.4.1 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 66). MHI Insular False killer whale interactions are an estimate and subject to change when 2018 effort data for the overlap zone becomes available. 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 66. 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
Sperm whale	9(3)	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.

[a] Takes are counted based on interaction date.

3.2.2.4.2 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 67. 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 67).

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 2011 to 2015 was 7.5, which is below this stock's PBR (Table 67). 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 will remain closed until one of the reopening criteria pursuant to the Take Reduction Plan implementing regulations is met.

Table 67. 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 2018 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	2011-2015	2.2	0	140
Pantropical spotted dolphin, HI Pelagic	2011-2015	0	0	403
Rough-toothed dolphin, HI	2011-2015	0	1.1	423
Risso's dolphin, HI	2011-2015	1.9	0	82
Striped dolphin, HI	2011-2015	1.1	0	449
Blainville's beaked whale, HI	2011-2015	0	0	10
False killer whale, MHI Insular	2013-2015	N/A	0.0	0.3
False killer whale, HI Pelagic	2011-2015	15.2	7.5	9.3
False killer whale, NWHI	2011-2015	N/A	0.4	2.3
False killer whale, Palmyra Atoll	2006-2010	N/A	0.3	6.4
Kogia spp. whale (Pygmy or dwarf sperm whale), HI	2007-2011	Pygmy = 0 Dwarf = 0	Pygmy = 0 Dwarf = 0	undetermined
Pygmy killer whale, HI	2011-2015	0	1.1	56
Short-finned pilot whale, HI	2011-2015	1.4	0.9	106
Humpback whale, Central North Pacific	2013-2017[d]	0.9		83[c]
Sperm whale, HI	2011-2015	0	0.7	14

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

3.2.2.5 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 68 and Table 69 summarize the incidental take data of seabirds from 2002 to 2019 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. 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 2019, a cooperative research project by the Council, NMFS and the Hawaii Longline Association was initiated to conduct 1) demonstration and trial of tori lines in the Hawaii longline fishery to inform minimum standards specific to this fishery, 2) field trials of tori lines to collect data on operational practicality and effectiveness in using tori lines under commercial fishing operations. Results of the project will be presented to the Council in 2020 to inform future modifications to seabird mitigation measure requirements.

3.2.2.5.1 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 2019.

Table 68. 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, 2002-2019[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	220	-	146(139)	0.0113	712	-	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.

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.

Table 69. 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, 2002-2019[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	5	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	0	-

[a] Take data are based on vessel arrival dates.
[b] This animal was identified as a brown booby on the 2005 PIRO Observer Program Annual and Quarterly Status reports.
[c] These were later identified as sooty shearwaters in NMFS Seabird Interactions and Mitigation Efforts in Hawaii Longline Fisheries (Seabird Annual Report).
[d] One *unidentified seabird* was released injured in the second quarter of 2008 (takes/1,000 hooks < 0.001, ME = 2).
[e] This animal was identified as a red-footed booby on the 2008 PIRO Observer Program Annual and Quarterly Status reports.
[f] These birds were identified as sooty shearwaters in the 2015 PIRO Observer Program Annual and Quarterly Status reports.
[g] These birds were identified as red-footed boobies in the 2015 and 2016 PIRO Observer Program Annual and Quarterly Status reports.
[h]One of the booby species was identified as a red-footed booby and one was identified as a brown booby on the 2018 PIRO Observer Program Annual and Quarterly Status reports.
[I] This animal was identified as a brown booby in the 2019 PIRO Observer Program Annual and Quarterly Status reports.
Source: Take data—2002-2019 PIRO Observer Program Annual and Quarterly Status Reports.
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.

3.2.2.6 ELASMOBRANCH INTERACTIONS IN THE HAWAII DEEP-SET LONGLINE FISHERY

Table 70 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 2019 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 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 2019.

Table 70. 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, 2004-2019[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	1,098		1	0.0001	5	
2019	20.5	4,697	12,948,077	0	0.0000	0		435(99)	0.0336	2,122		0	0.0000	0	

[a] Take data are based on vessel arrival dates.
[b] Mortality numbers include animals that were released dead, finned (prior to passage of the Shark Conservation Act of 2010), and kept.
Source: NMFS 2014 (2004-2013 data), NMFS unpublished (2014-2018 data), McCracken 2019b.

3.2.3 AMERICAN SAMOA LONGLINE FISHERY

3.2.3.1 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.

3.2.3.1.1 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, with coverage rate of approximately 20 percent or higher since 2010.

3.2.3.1.2 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 71). 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 72). 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, 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 consultation process and issues a new biological opinion, the 2015 BiOp remains valid for all species considered in the 2015 BiOp.

Table 71. 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 72. 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.

3.2.3.1.3 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 2020 LOF (85 FR 21079, April 16, 2020), meaning that this fishery has occasional incidental mortality and serious injuries of marine mammals. The 2020 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.

3.2.3.2 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 has been consistently about 20 percent since 2012. This report summarizes protected species interactions in the American Samoa longline fishery since 2006. 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 73). 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 74).

3.2.3.3 SEA TURTLE INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 73 summarizes the incidental take data of sea turtles from 2006 to 2019 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.

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 73. 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, 2006-2019[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	-	16	1(1)	0.0008	-	3	3(3)	0.0025	-	14	1(1)	0.0008	-	4
2017	20.0	447	1,271,803	4(4)	0.0031	-	20	1	0.0008	-	3	2(2)	0.0016	-	19	0	0.0000	-	5
2018	17.5	276	732,476	4(4)	0.0055	23	-	1	0.0014	6	-	2(2)	0.0027	11	-	2(2)	0.0027	11	-
2019	15.7	380	1,087,860	4(4)	0.0037	25	-	0	0.0000	0	-	3(3)	0.0028	19	-	1(1)	0.0009	6	-

[a] Take data are based on vessel arrival dates.
Source: Take data—2006-2019 PIRO Observer Program Annual and Quarterly Status Reports
ME—McCracken, 2015a; McCracken, 2017a, McCracken 2019a.

3.2.3.3.1 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 74). 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). Until NMFS completes the consultation process and issues a new biological opinion, the 2015 Biological Opinion remains valid for all species considered in the 2015 Biological Opinion.

Table 74. 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[d]
Green turtle [b]	60(54)	62.9(57.87)	68.2(68.2)
Central South Pacific DPS[b]	30(27)	31.9(29.35)[c]	35.1(35.1)[c]
Southwest Pacific DPS[b]	20(17.82)	21.1(19.41)[c]	19.2(19.2)[c]
East Pacific DPS[b]	7(6.48)	7.1(6.53)[c]	7.0(7.0)[c]
Central West Pacific DPS[b]	2(1.62)	1.7(1.56)[c]	5.7(5.7)[c]
East Indian-West Pacific DPS[b]	1(1.08)	1.2(1.1)[c]	1.2(1.2)[c]
Leatherback turtle	69(49)	10.6(7.21)	15(6.5)
Olive ridley turtle	33(10)	36.2(23.53)	36.7(36.7)
Loggerhead turtle	6(3)	0	0
Hawksbill turtle	6(3)	20.4(20.4)	16.6(16.4)

[a] Takes are counted based on interaction date.
[b] The green turtle DPS-specific ITSs became effective in May 2016 when the DPS listings were finalized.
[c] Estimated total interactions for the green turtle DPSs are prorated based on the estimated proportion of each green turtle DPS indicated in the 2015 BiOp (NMFS, 2015).
[d] Estimated total interactions for 2018 and 2019 were calculated using the number of observed interactions multiplied by the expansion factor.

3.2.3.4 MARINE MAMMAL INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 75 summarizes the incidental take data of marine mammals from 2006 to 2019 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).

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).

3.2.3.4.1 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 75. 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, 2006-2019[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.	Observed		EF Est.	Observed		EF Est.	Observed		EF Est.	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	9	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	5	1	0.0008	5	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	6	1(1)	0.0014	6	0	0.0000	0	0	0.0000	0	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	6	0	0.0000	0

[a] Take data are based on vessel arrival dates.
Source: 2006-2019 PIRO Observer Program Annual and Quarterly Status Reports.
Note: McCracken (2015a) produced annual estimates for cetaceans for 2010-2013, but they are not shown in this table. The ME did not include interactions classified as non-serious injury, thus do not correspond to the observed takes included in this table.

3.2.3.5 SEABIRD INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 76 summarizes the incidental take data of seabirds from 2006 to 2019 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).

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 76. 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, 2006-2019[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	6	-	0	0.0000	0	-

[a] Take data are based on vessel arrival dates.
[b] These seabird interactions occurred in the North Pacific by vessels departing American Samoa and landing in California.
Source: 2006-2019 PIRO Observer Program Annual and Quarterly Status Reports
ME—McCracken, 2015a; McCracken, 2017a.

3.2.3.6 ELASMOBRANCH INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 77 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).

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 77. Observed and estimated total elasmobranch interactions with the American Samoa longline fishery for 2006-2019[a]

Year	Obs. Cov. (%)	Sets	Hooks	Scalloped hammerhead				Oceanic whitetip				Giant manta ray			
				Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	ME
				Takes (M [b])	Takes/ 1,000 hooks			Takes (M [b])	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks		
2006	8.1	287	797,221	1(1)	0.0013	12	-	46(11)	0.0577	568	-	0	0.0000	0	-
2007	7.1	410	1,255,329	1	0.0008	14	-	62(18)	0.0494	873	-	0	0.0000	0	-
2008	6.4	379	1,194,096	0	0.0000	0	-	48(17)	0.0402	750	-	0	0.0000	0	-
2009	7.7	306	880,612	0	0.0000	0	-	45(13)	0.0511	584	-	1	0.0011	13	-
2010	25	798	2,301,396	4(1)	0.0017	-	17	130(37)	0.0565	-	1,176	3	0.0013	-	11
2011	33.3	1,257	3,605,897	2(1)	0.0006	-	7	116(44)	0.0322	-	319	3	0.0008	-	11
2012	19.8	662	1,880,525	0	0.0000	-	0	71(26)	0.0378	-	470	3	0.0016	-	29
2013	19.4	585	1,690,962	0	0.0000	-	0	88(15)	0.0520	-	407	2	0.0012	-	8
2014	19.4	565	1,490,416	1	0.0007	-	6	104(37)	0.0698	-	464	1	0.0007	-	2
2015	22.0	504	1,441,706	1(1)	0.0007	-	3	168(59)	0.1165	-	827	0	0.0000	-	3
2016	19.4	424	1,179,532	1	0.0008	-	6	197(70)	0.1670	-	899	0	0.0000	-	0
2017	20.0	447	1,271,803	1	0.0008	-	4	63(22)	0.0495	-	458	0	0.0000	-	0
2018	17.5	276	732,476	3	0.0041	17	-	108(39)	0.1474	617	-	0	0.0000	0	-
2019	15.7	380	1,087,860	0	0.0000	0	-	140(51)	0.1287	892	-	0	0.0000	0	-

[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.

Source: 2006-2019 PIRO Observer Program Annual and Quarterly Status Reports and unpublished observer data; McCracken 2015a; McCracken 2017a, McCracken 2019a.

3.2.4 HAWAII TROLL FISHERY

3.2.4.1 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.

3.2.4.1.1 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.

3.2.4.1.2 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.

3.2.4.1.3 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 2020 LOF (85 FR 21079, April 16, 2020), 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 2020 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).

3.2.4.2 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.

3.2.5 MHI HANDLINE FISHERY

3.2.5.1 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.

3.2.5.1.1 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.

3.2.5.1.2 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.

3.2.5.1.3 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 2020 LOF (85 FR 21079, April 16, 2020), 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).

3.2.5.2 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 Section 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.

3.2.6 HAWAII OFFSHORE HANDLINE FISHERY

3.2.6.1 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.

3.2.6.1.1 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.

3.2.6.1.2 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.

3.2.6.1.3 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 2020 LOF (85 FR 21079, April 16, 2020), 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).

3.2.6.2 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.

3.2.7 AMERICAN SAMOA, GUAM, AND CNMI TROLL FISHERY

3.2.7.1 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.

3.2.7.1.1 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.

3.2.7.1.2 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.

3.2.7.1.3 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 2020 LOF (85 FR 21079, April 16, 2020), 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).

3.2.7.2 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.

3.2.8 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, NMFS PIFSC 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 and Bigelow, 2019), PIFSC researchers have been working with observer programs and fishermen to quantify post release mortality rates of blue (BSH), bigeye thresher (BTH), oceanic whitetip (OCS), and silky sharks (FAL) that are incidentally captured in the Hawaii deep-set (HiDS) and 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 111 of these trips, 148 sharks were tagged by observers and fishers with pop-off archival tags (PAT). The handling and damage data recorded by trained observers indicated that most sharks (93.22%) were released by cutting the branchline. In the Hawaii deep-set tuna fishery this means that most sharks were released with an average of 9.02 meters of trailing gear, typically composed of a stainless-steel hook, 0.5 m of braided wire leader, a 45-gram weighted swivel, and monofilament branchline ranging in length from 1.0–25.0 m. Sharks released by cutting the line in American Samoa were released with an average of 3.038 m of trailing gear which is composed of a stainless-steel hook to an all monofilament line ranging in length from 1.0–9.0 m. The Kaplan-Meier (KM) survivorship function (Kaplan & Meier, 1958) was used to estimate the probability of survival over time, post release, and the Cox proportional hazards model (Cox, 1972) was used to assess the impact of different variables on the survivorship data. Results from the PAT deployments showed that survivorship to 30 days is relatively high (0.891 ± 0.03 S.E.) for sharks when captured in good condition. Survival rates are also higher for all species when they are left in the water and released by fishers cut the line versus removing the gear. Gear removal requires additional handling, and animals are sometimes brought on deck (sometimes using a gaff) and exposed to air which may impact release condition. The effects of the trailing gear were assessed in a subset (n=12) of BSH captured in the Hawaii deep-set fishery using tags programmed for longer deployments (180 and 360 days). Long term survival rates to 300 days were remarkably lower for this dataset (0.356 ± 0.18 S.E.). Additional details regarding the preliminary results of this study are available in Hutchinson and Bigelow (2019). Currently, tagging is ongoing to refine the post release survivorship estimates for BSH, BTH and OCS. Shortfin mako sharks (*Isurus oxyrhincus*) captured in the Hawaii deep-set fishery have recently been added to the study.

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 78 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 78. 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 planning workshops convened in 2019; draft plan anticipated in late 2020.
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.
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)	In development, proposed rule anticipated by July 2020	In development, expected TBA, interim recovery outline in place
Cauliflower coral	*Pocillopora meandrina*	Positive (83 FR 47592, 9/20/2018)	12-month finding anticipated by June 2020	TBA	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)	In development, draft plan and public comment period anticipated in 2020
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
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)	TBA (status review and 12-month finding anticipated in 2020)	TBA	N/A	N/A

Species		Listing/Petition Response Process			Post-Listing Activity	
Common Name	Scientific Name	90-day Finding	12-month Finding / Proposed Rule	Final Rule	Critical Habitat	Recovery Plan
Loggerhead sea turtle (North Pacific DPS)	*Caretta caretta*	Positive (72 FR 64585, 11/16/2007)	9 DPSs listed as endangered and threatened (76 FR 15932, 03/22/2011)	9 DPSs listed as endangered and threatened (76 FR 58867, 10/24/2011)	Designated for Atlantic Ocean and Gulf of Mexico DPSs (79 FR 39855, 08/11/2014)	In development; 5-year status review published on 4/7/2020

3.2.9 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:

- Research on at-sea foraging behavior of albatross species to improve understanding of interaction rates in the Hawaii longline fisheries;
- 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 tunas, albatrosses, leatherback, and olive ridley turtles) as they relate to environmental and ecological drivers of changing species distribution and aggregation;
- Evaluation of spatial and temporal representation of observer coverage compared to non-observed effort. While vessel behavior may be motivated by various factors, an assessment of sampling bias may be warranted;
- 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.

3.3 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 2019 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.

This year, information has been included in this section in order to make it more accessible to a broader audience. To this end, the section begins with a brief summary of the state of the ocean and climate in 2019. 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.

3.3.1 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 2019 were roughly average and long-term climate trends persisted. Modes of interannual climate variability (e.g., ENSO, PDO) were neutral. Hurricane activity was average. The atmospheric concentration of carbon dioxide continued to increase, ocean acidification intensified, and sea surface temperatures continued to rise. Chlorophyll concentrations at the ocean's surface and the median size of phytoplankton continued to decline. Temperatures at 200 – 300 m below the surface were average. Bigeye tuna and swordfish were slightly larger than average, though no long-term trend is evident. Neither the bigeye recruitment index nor the bigeye forecast suggest there will be a pulse of increased recruitment or catch rates in the next few years.

3.3.2 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.

3.3.2.1 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 158.

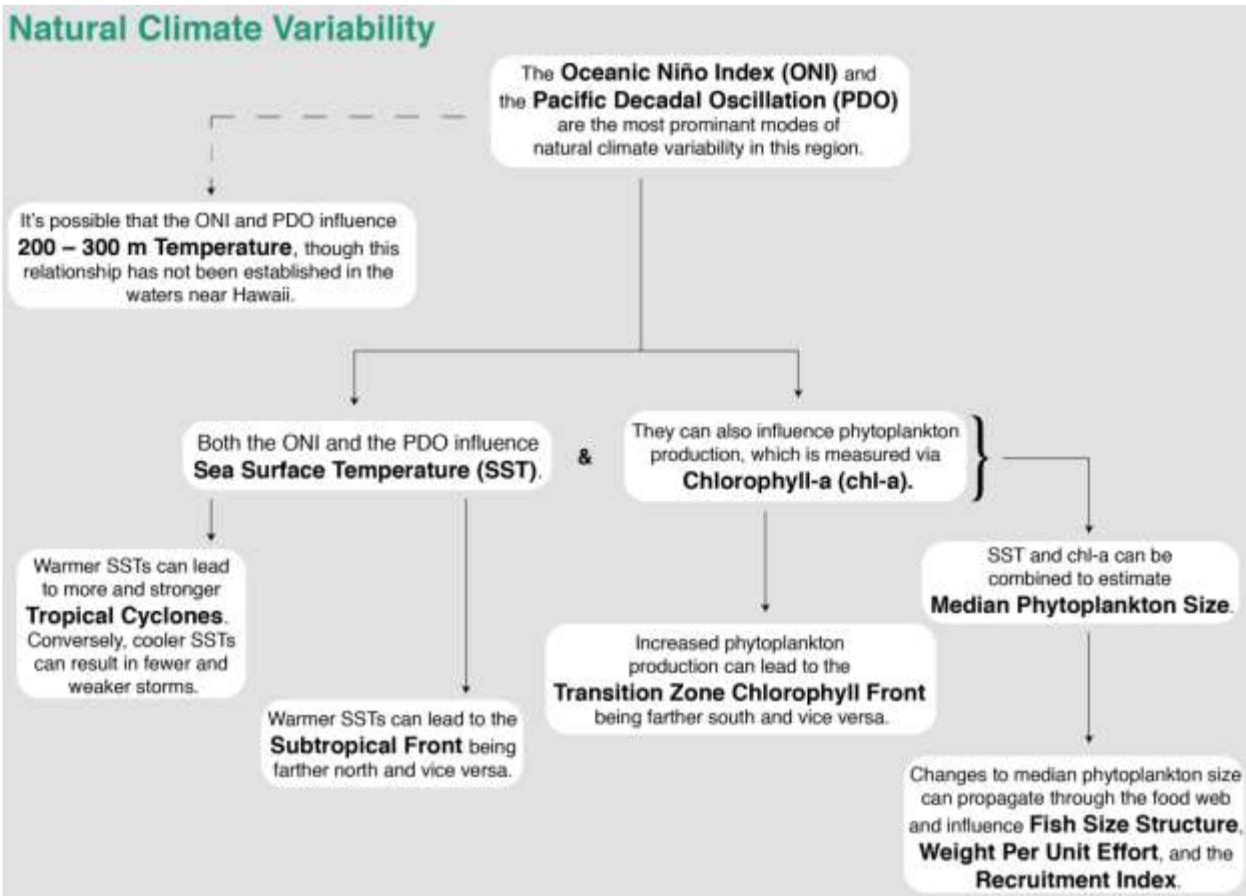


Figure 158. Schematic diagram illustrating the relationships between the ocean and climate indicators from the perspective of natural climate variability

The El Niño – Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) are the most prominent modes of natural climate variability in this region. 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 2019, ENSO phase transitioned from a weak El Niño to neutral conditions. 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 hovered around zero in 2019. The year was nearly evenly split between values that were slightly negative (seven months) and values that were slightly positive (5 months).

Both ENSO and the PDO influence 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 2019, SST was above the long-term average across Hawaii'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 close to its average latitude between 155 – 130°W and slightly north of average east and west of this area. The number of named storms and hurricanes/typhoons/cyclones, including major storms, was about average in all basins. The Accumulated Cyclone Energy (ACE) index, a measure of the intensity and duration of storms over the entire season, was below average in all basins.

ENSO and the PDO can also influence phytoplankton production, which is measured 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 production can lead to the transition zone chlorophyll front being farther south and vice versa, and changes in the location of this front particularly impact Hawaii's swordfish fishery. In 2019, surface chlorophyll was close to or just below average across much of the longline fishing grounds. The Transition Zone Chlorophyll Front (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 2019, average median phytoplankton size across the longline fishing grounds was below 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 median phytoplankton size to forecast bigeye tuna catch rates four years in advance. Overall, bigeye tuna and swordfish were slightly larger than average in 2019. Weight-per-unit-effort was below average in 2019. The recruitment index was similar to the previous few years and does not suggest an upcoming recruitment pulse. Similarly, the bigeye catch rate forecast suggest 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 Hawaii and in the southwestern portion of the bigeye tuna fishing grounds were up to 1 °C cooler than average in 2019. In the northeastern portion of the fishing grounds and between about 30 – 40°N, waters were slightly 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.

3.3.2.2 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 159.

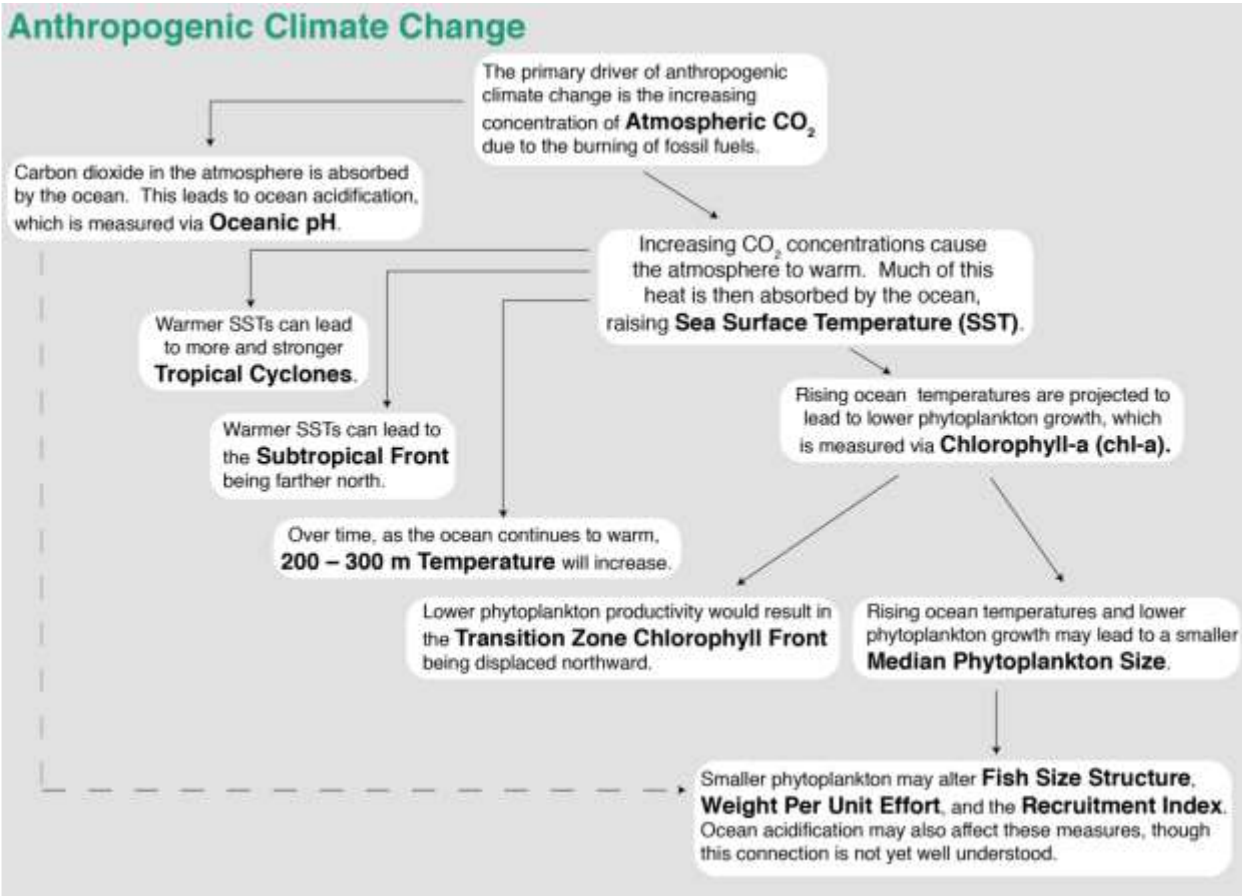


Figure 159. Schematic diagram illustrating the relationships between the ocean and climate indicators from the perspective of anthropogenic climate change

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 at a faster rate each year. In 2019, the annual mean concentration of CO_2 was 411 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 2018, the most recent year for which data are available, the average pH at Station ALOHA was 8.07. The ocean is now roughly 9.7% more acidic than it was nearly 30 years ago at the start of this time series. Over this time, pH has declined by 0.0401 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 35 years, SST in the Hawaii longline region has increased at a rate of 0.02 ºC yr^{-1}. In 2019, annual mean SST was 21.1 ºC. Monthly SST values in 2019 ranged from 18.2 – 24.7 ºC, exceeding the previous maximum of 24.6 ºC.

Rising sea surface temperatures may affect the number, strength, duration, 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 2019.

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 39 years, 200 – 300-meter temperatures have ranged from 10.87 – 11.58 ° C. There has been no meaningful trend in these temperatures over this period of record. In 2019, 200 – 300 m temperatures ranged from 10.96 – 11.22 °C with an average value of 11.09 °C. Temperatures in 2019 were 0.02 – 0.2 °C below average, though within the range of previously observed temperatures.

Rising ocean temperatures are projected to lead to lower phytoplankton growth, which is measured via chlorophyll-a (chl-a). Over the past 22 years, monthly chlorophyll-a has declined by 0.015 mg chl m^{-3} across the longline fishing grounds. Combined, rising ocean temperatures and lower phytoplankton growth may lead to smaller median phytoplankton sizes. Median phytoplankton size over the longline fishing grounds has steadily declined by 0.13µm over the period of record. 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 Hawaii's longline fishery or the recruitment index.

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

3.3.2.3 ATMOSPHERIC CONCENTRATION OF CARBON DIOXIDE (CO_2) AT MAUNA LOA

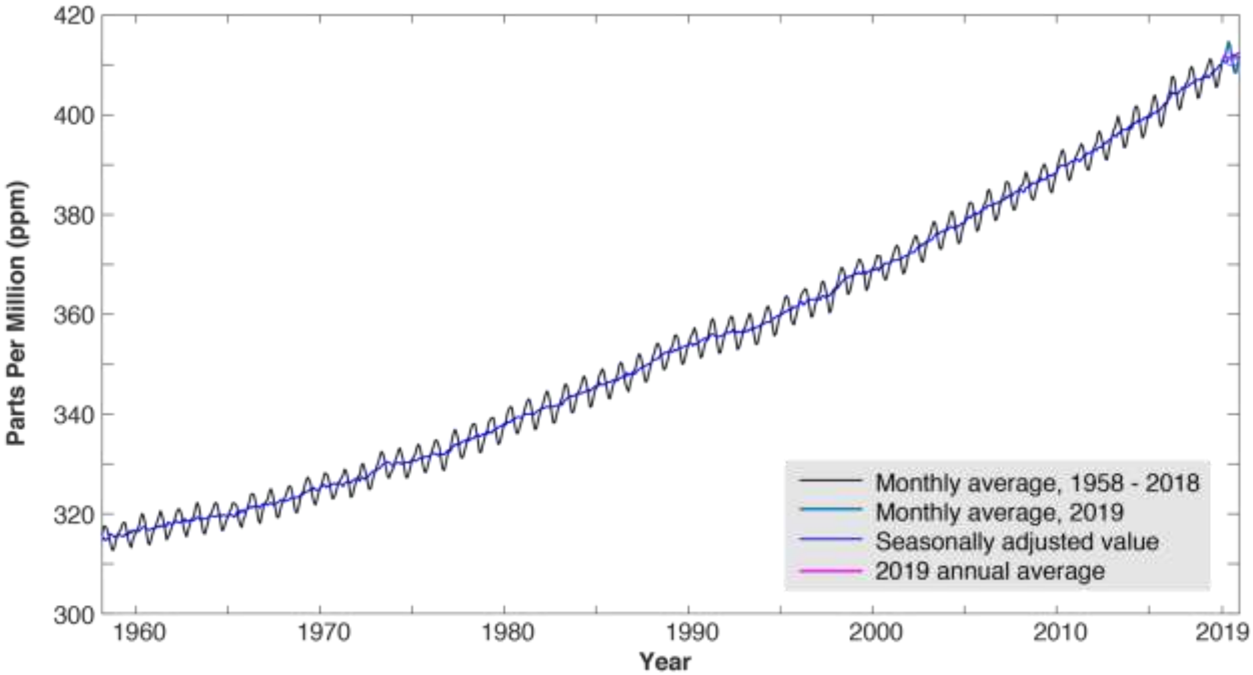


Figure 160. The concentration of atmospheric carbon dioxide at Mauna Loa Observatory on the island of Hawaii

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 at a faster rate each year. In 2019, the annual mean concentration of CO_2 was 411 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, Hawaii 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, Hawaii 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 (2020b).

3.3.2.4 OCEANIC PH

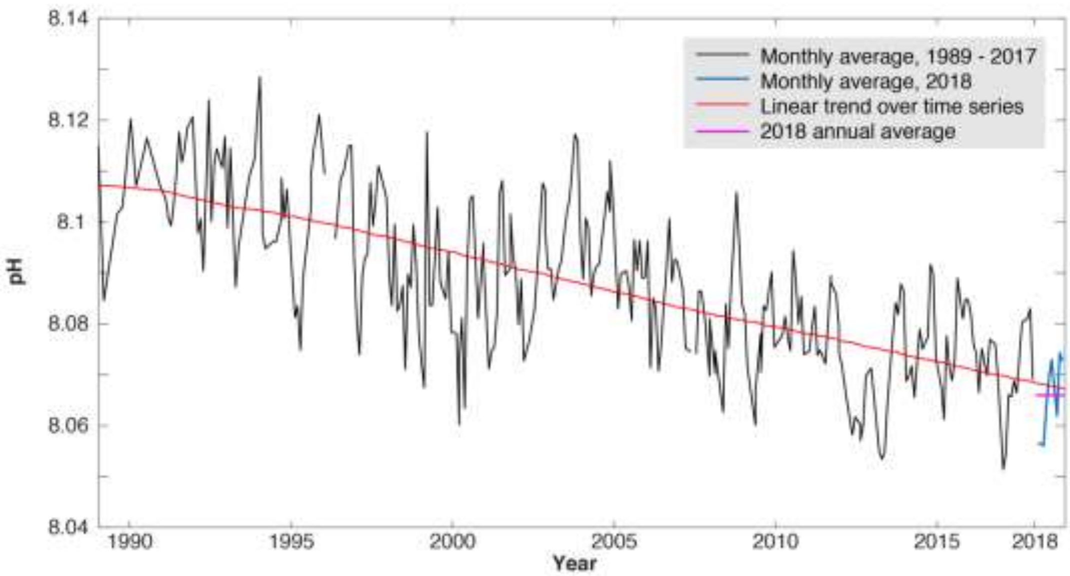


Figure 161. Time series and long-term trend of oceanic pH measured at Station ALOHA

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 9.7% more acidic than it was nearly 30 years ago at the start of this time series. Over this time, pH has declined by 0.0401 at a constant rate. In 2018, the most recent year for which data are available, the average pH was 8.07. 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 second year in a row. The highest pH value reported for the most recent year (8.0743, down from a high of 8.0830 in 2017) is lower than the lowest pH value reported in the first year of the time series (8.0845).

Description: Trends in surface (5 m) pH at Station ALOHA, north of Oahu (22.75°N, 158°W), collected by the Hawaii Ocean Time Series (HOT) from October 1988 to 2016 (2017 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 Hawaii Ocean Time Series as described in Karl et al. (1996) and on its website (HOT, 2020).

3.3.2.5 EL NIÑO – SOUTHERN OSCILLATION (ENSO)

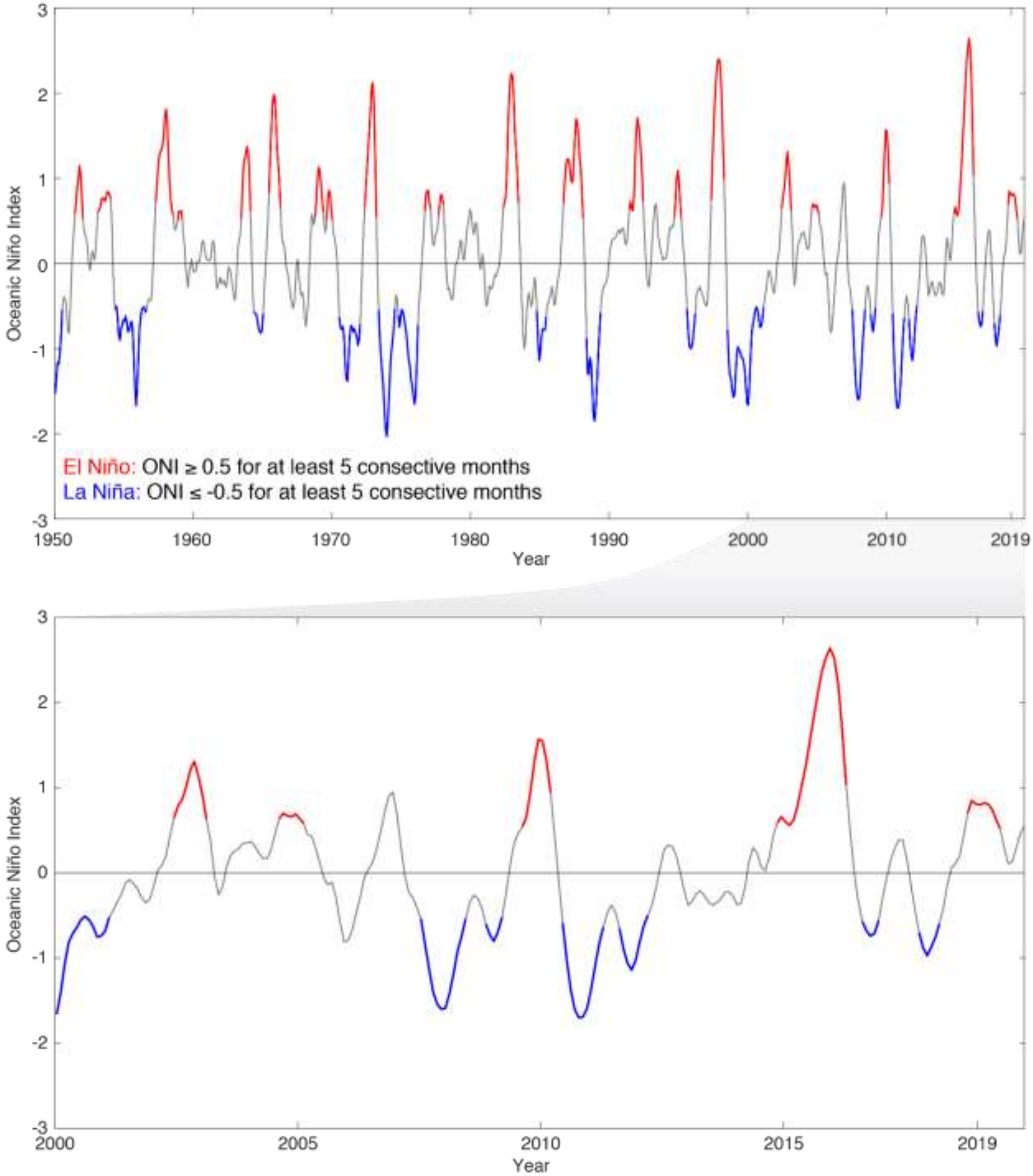


Figure 162. Oceanic Niño Index from 1950-2018 (top) and 2000–2018 (bottom) with El Niño periods in red and La Niña periods in blue

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 2019, the ONI transitioned from a weak El Niño to neutral conditions.

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 (2020).

3.3.2.6 PACIFIC DECADAL OSCILLATION (PDO)

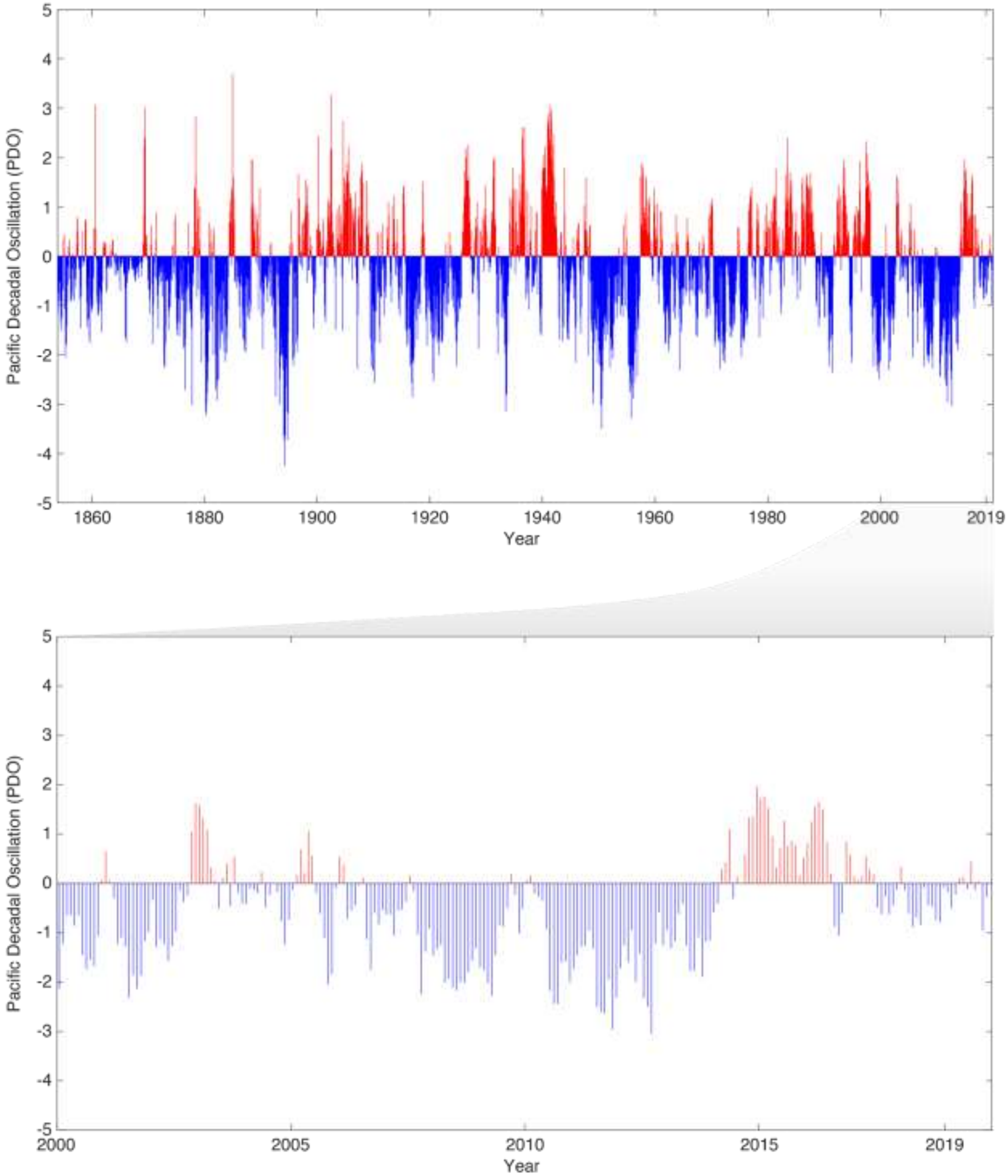


Figure 163. Pacific Decadal Oscillation from 1950–2018 (top) and 2000–2018 (bottom) with positive warm periods in red and negative cool periods in blue

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 hovered around zero in 2019. The year was nearly evenly split between values that were slightly negative (seven months) and values that were slightly positive (5 months).

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 interior 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. (https://www.ncdc.noaa.gov/teleconnections/pdo/).

Timeframe: Annual, monthly.

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

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

Sourced from: NOAA ESRL (2020a).

3.3.2.7 TROPICAL CYCLONES

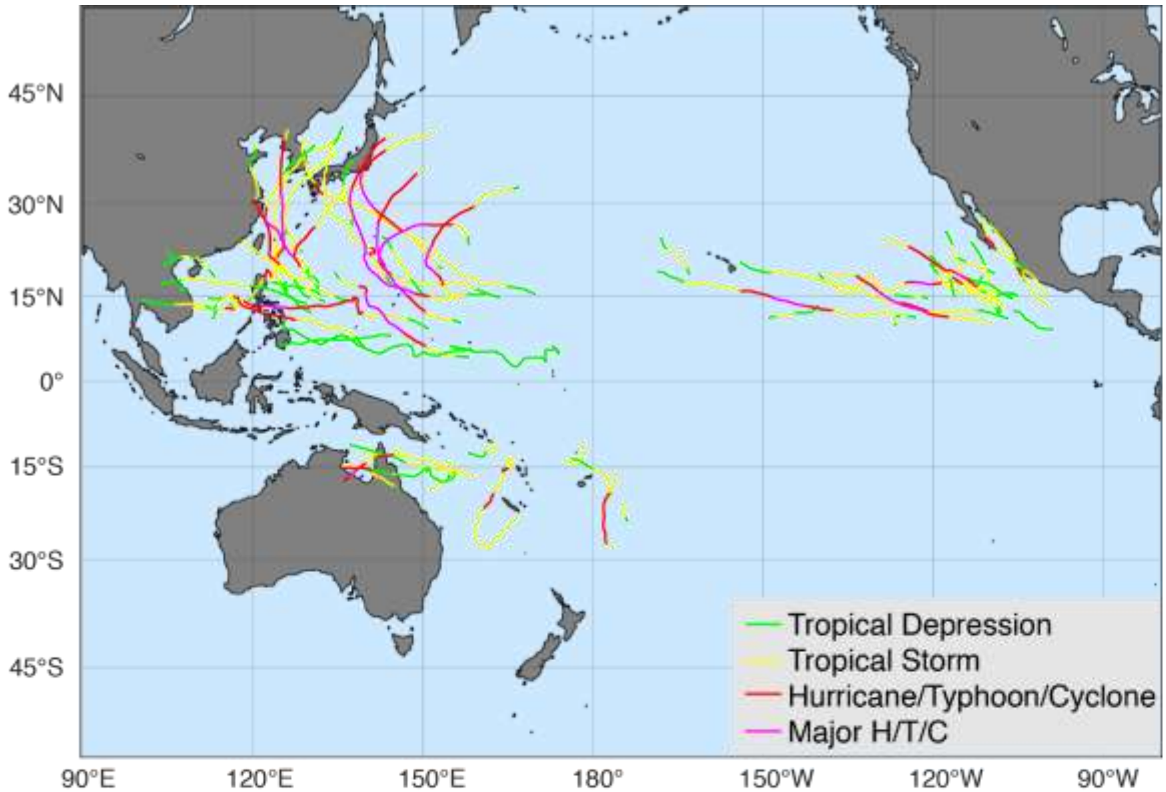


Figure 164. 2019 Pacific basin tropical cyclone tracks

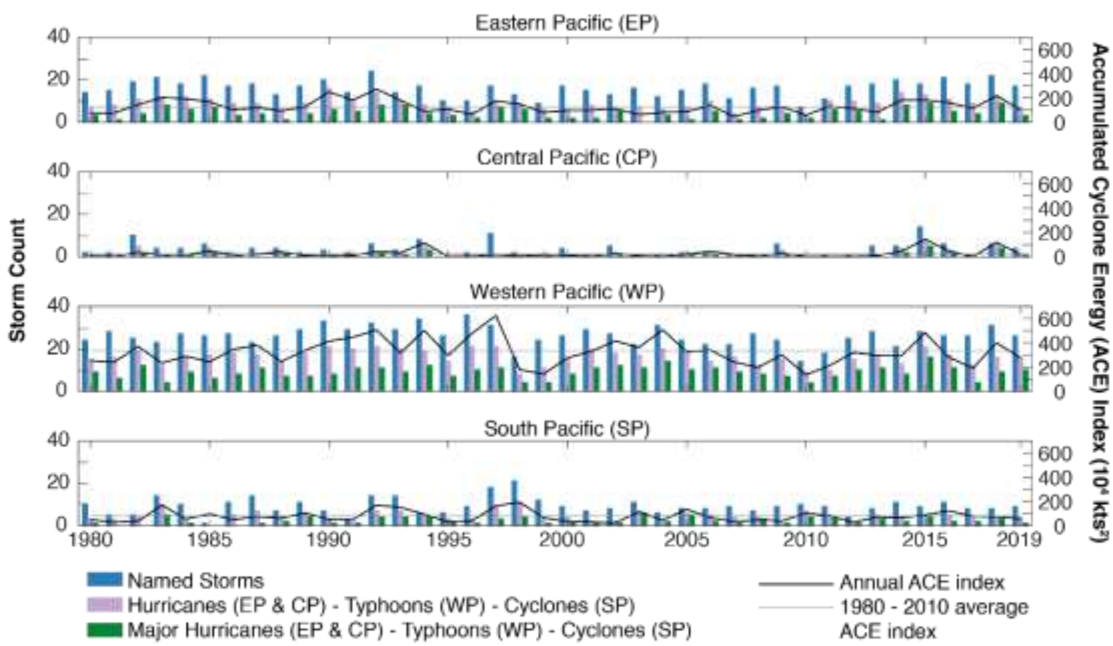


Figure 165. Storm counts (bars) and Accumulated Cyclone Energy (ACE) index values (lines) in each region of the Pacific. Both annual ACE index (black lines) and 1981 – 2010 average ACE index (grey lines) are shown

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 Hawaii 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 2019 eastern Pacific hurricane season featured near average activity. There were 17 named storms, of which seven 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 two tropical depressions that did not reach tropical storm strength. In terms of Accumulated Cyclone Energy (ACE), which measures the strength and duration of tropical storms and hurricanes, activity in the basin in 2019 was a little below the long-term mean. Summary inserted from https://www.nhc.noaa.gov/text/MIATWSEP.shtml.

Central North Pacific. Tropical cyclone activity in the central Pacific in 2019 was average. There were four named storms, of which one became a hurricane and one became a major hurricane. The ACE index was slightly below the 1981 – 2010 average of roughly 20 (x 10^4 knots^2).

Western North Pacific. Tropical cyclone activity was roughly average in the western Pacific in 2019. There were 26 named storms. Sixteen of these storms developed into typhoons, and ten of these typhoons were major. The ACE Index was below the 1981 – 2010 average. Of note was Super typhoon Hagibis. Hagibis was just the third category 5 tropical cyclone globally in 2019 (Super Typhoon Wutip and Hurricane Dorian were the others). Hagibis weakened to a category 2 storm before making landfall in Japan but was still one of the most damaging typhoons in history. The remnants of Hagibis transitioned to an extratropical cyclone that affected the Aleutian Islands and significantly altered the weather patterns over the North America in the subsequent days. Summary inserted from https://www.ncdc.noaa.gov/sotc/tropical-cyclones/201910.

South Pacific. Tropical cyclone activity was average in the south Pacific region in 2019. There were nine named storms, four of which developed into cyclones and one of which was a major cyclone. The ACE Index were below average in 2018.

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 a bar plots 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. This plot shows the historical 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).

3.3.2.8 SEA SURFACE TEMPERATURE (SST)

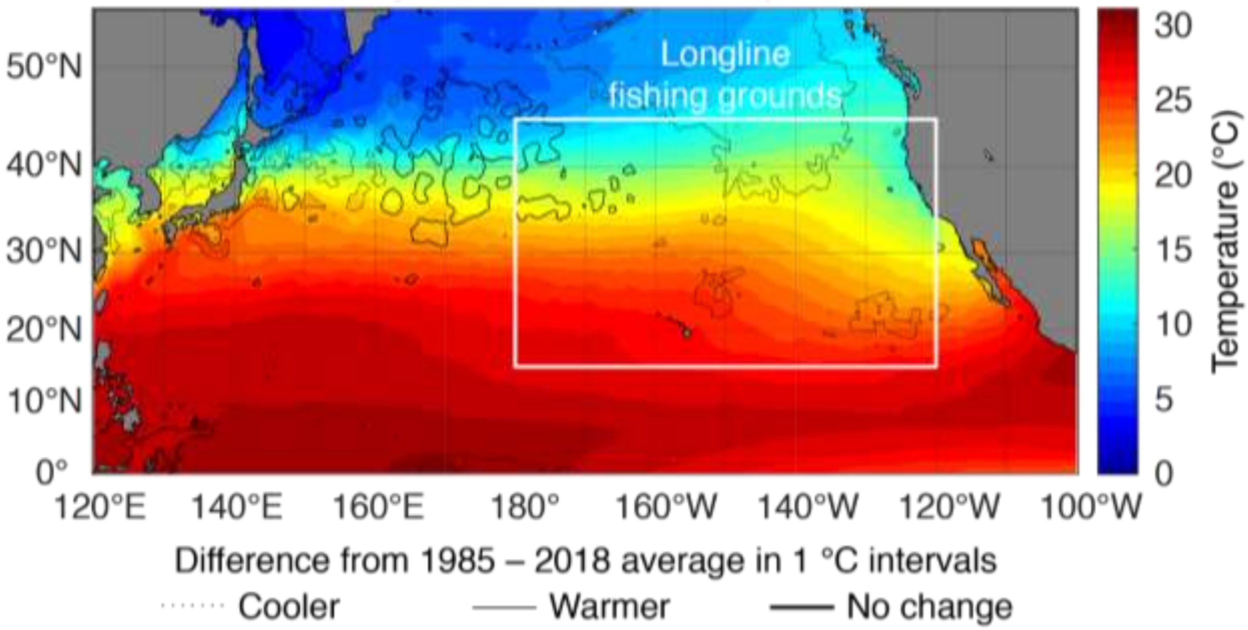


Figure 166. Average 2019 sea surface temperature (shaded) and the difference from the 1985 – 2018 average (contoured). The white rectangle identifies the area targeted by Hawaii's longline fisheries. SST is averaged over this area for the time series shown in Figure 167 and Figure 168

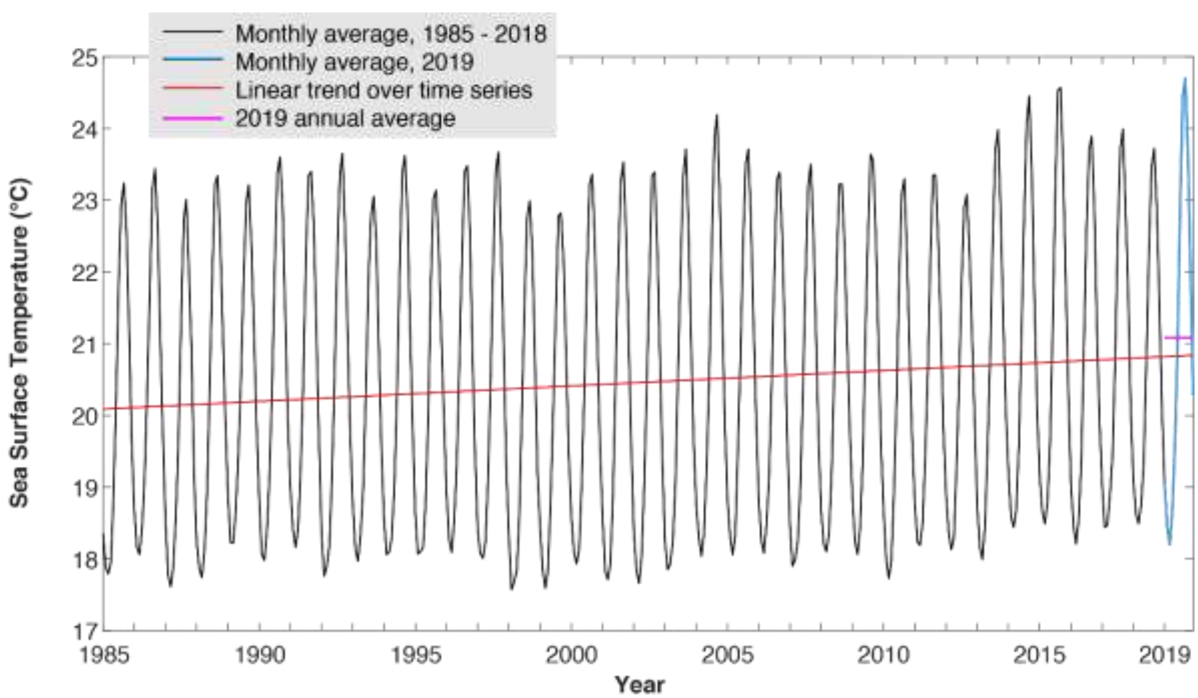


Figure 167. Time series of monthly average sea surface temperature over the longline fishing grounds outlined in Figure 166

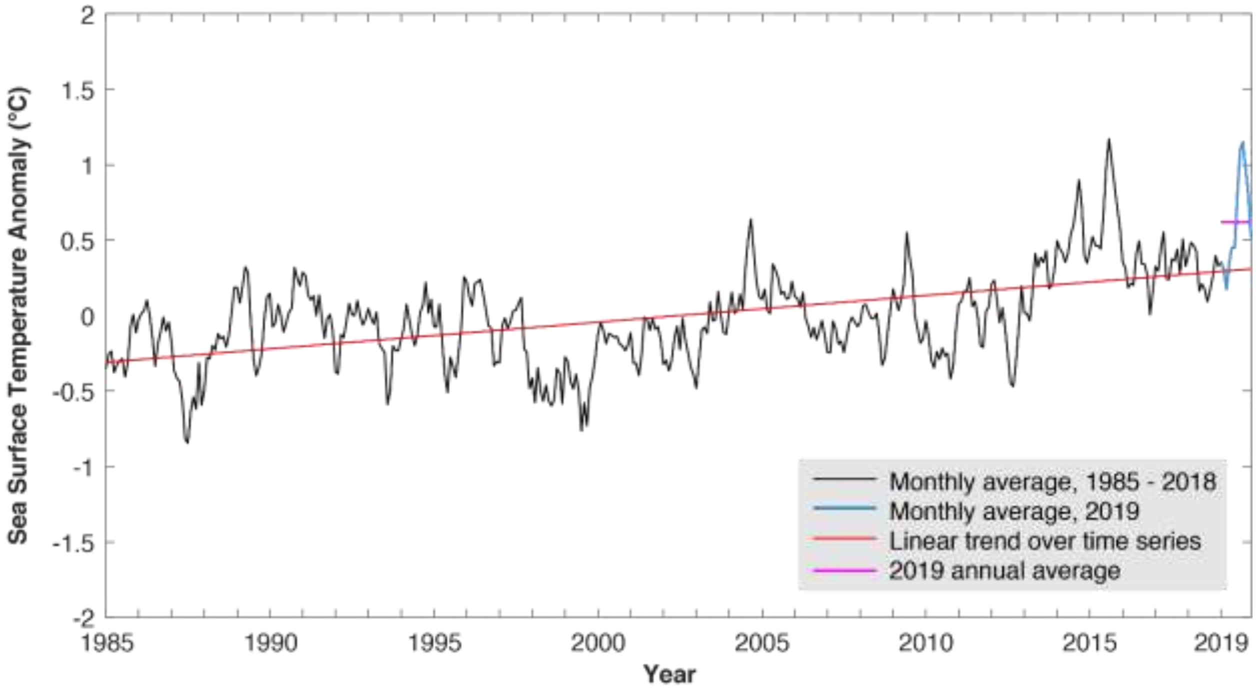


Figure 168. Time series of monthly average sea surface temperature anomaly over the longline fishing grounds outlined in Figure 166

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 projected to rise 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 2019. Over the period of record, annual SST has increased at a rate of 0.02 ºC yr^{-1}. Monthly SST values in 2019 ranged from 18.2 – 24.7 ºC, exceeding the previous maximum of 24.6 ºC. Overall, SST was above the long-term average across the Hawaii longline region in 2019.

Description: Satellite remotely-sensed monthly sea surface temperature (SST) is averaged across the Hawaii-based longline fishing grounds (15° – 45°N, 180° – 120°W). A time series of monthly mean SST averaged over the Hawaii 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 (2020).

3.3.2.9 TEMPERATURE AT 300 M DEPTH

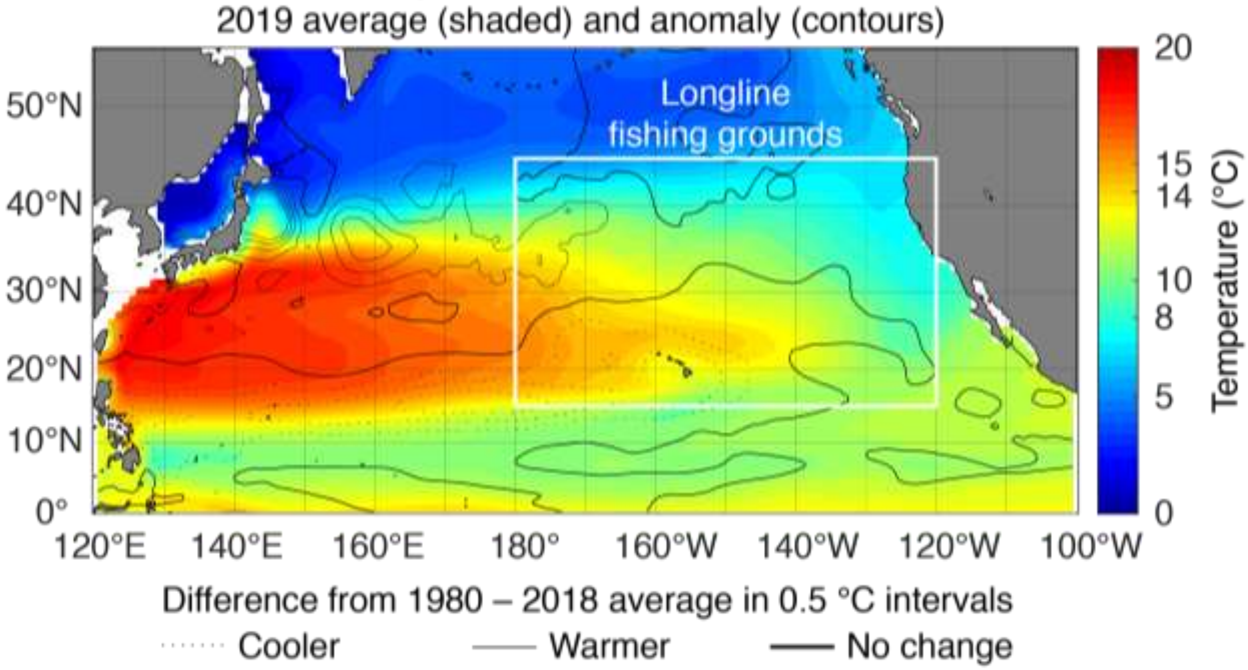


Figure 169. Average temperatures at 200 – 300 m depth in 2019 (shaded) and the difference from the 1980 – 2018 average (contoured). The white rectangle identifies the area targeted by Hawaii's longline fisheries. Temperatures is averaged over this area for the time series shown in Figure 170

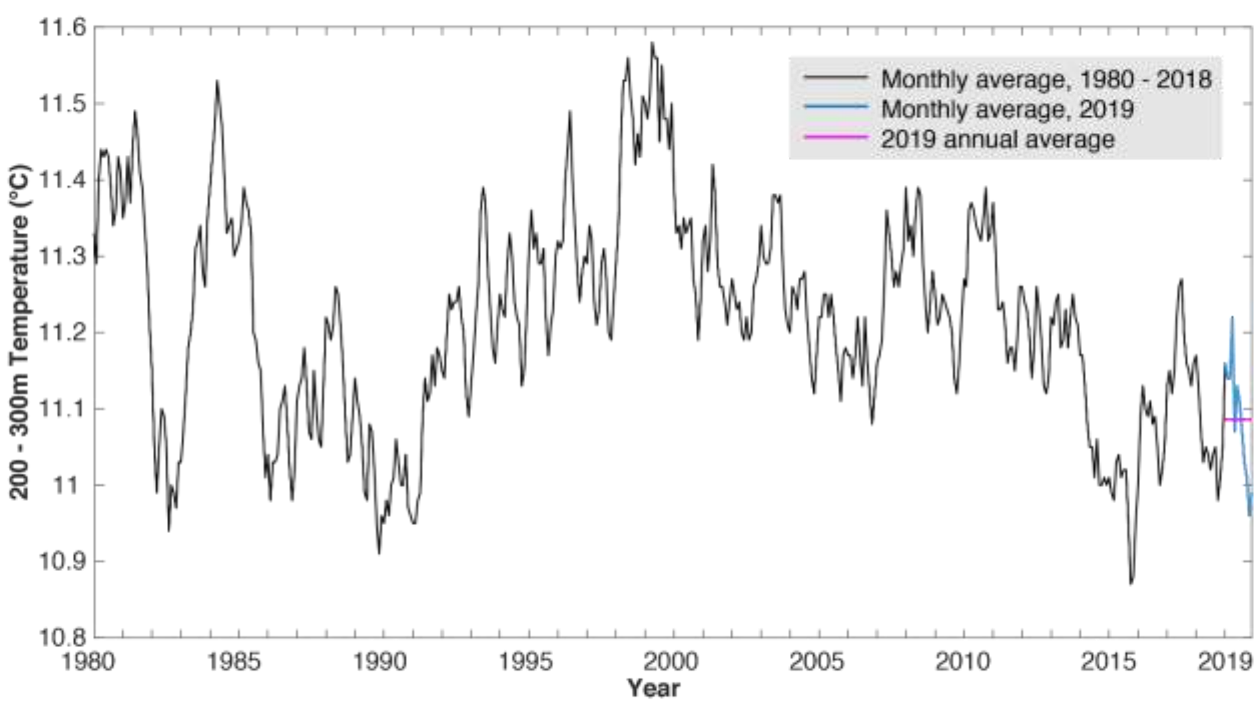


Figure 170. Time series of monthly 200 – 300 m temperatures over the longline fishing grounds outlined in Figure 169

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 2019, 200 – 300 m temperatures ranged from 10.96 – 11.22 °C with an average value of 11.09 °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 – 2019), 200 – 300 m temperatures have declined by 0.08 °C. The spatial pattern of temperature anomalies was mixed with cooler than average temperatures at depth in the southern portion of the fishing grounds and around the main Hawaiian Islands, and warmer than average temperatures in the mid-latitudes and the northeastern region of the fishing grounds.

Description: Ocean temperature at 200 – 300 m depth is averaged across the Hawaii-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 ESRL (2020c).

3.3.2.10 OCEAN COLOR

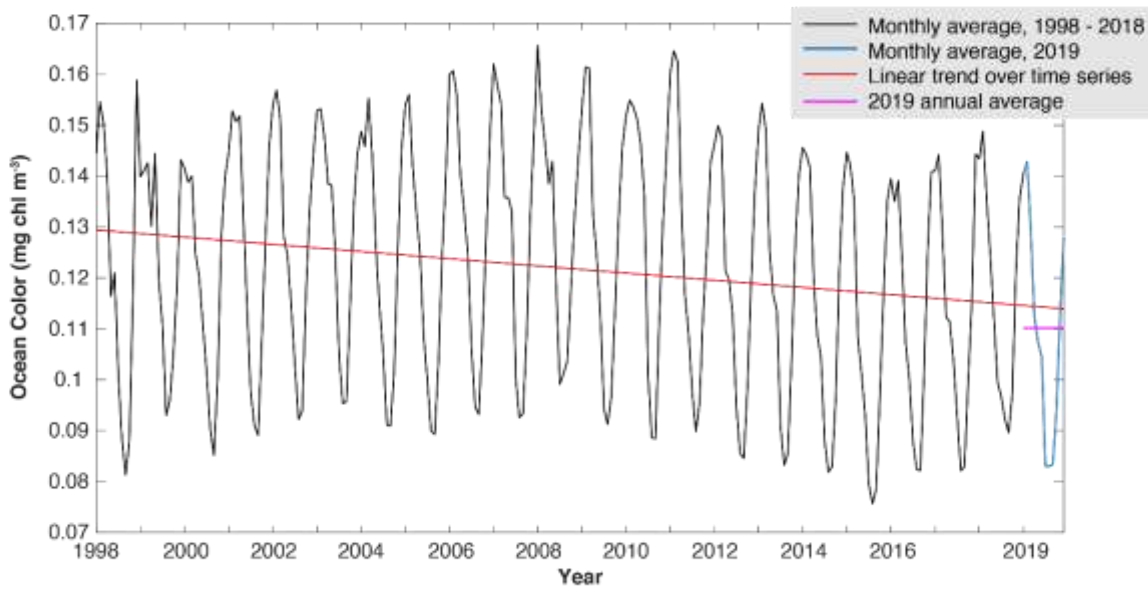


Figure 171. Time series of monthly average chlorophyll concentration over the longline fishing grounds outlined in Figure 172

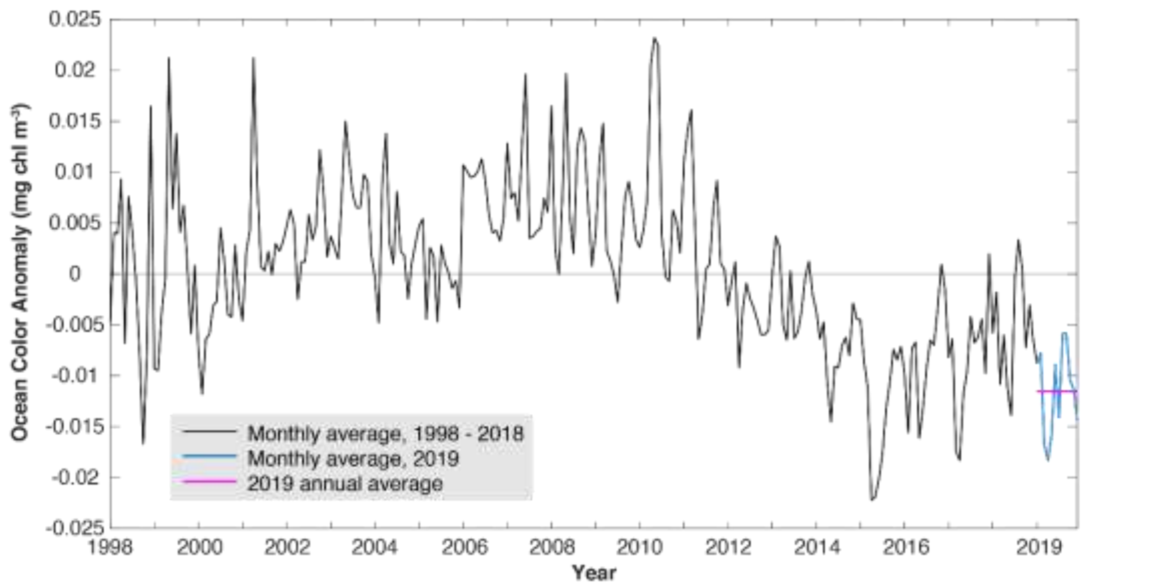


Figure 172. Time series of monthly average chlorophyll concentration anomaly over the longline fishing grounds outlined in Figure 171

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 0.11 mg chl m^{-3} in 2019. Monthly mean chlorophyll concentrations ranged from 0.08 – 0.14 mg chl m^{-3}, within the range of values observed over the period of record (0.0757 – 0.1657). Chlorophyll concentrations across the region were fairly close to the climatological average in 2017, though some anomalies were observed at the far northern and southern boundaries of the longline fishing ground.

Description: Satellite remotely-sensed ocean color is used to determine chlorophyll concentrations in the pelagic surface ocean. These data can be used as a proxy for phytoplankton abundance. A time series of median monthly chlorophyll-a concentrations averaged over the Hawaii 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 (2020).

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

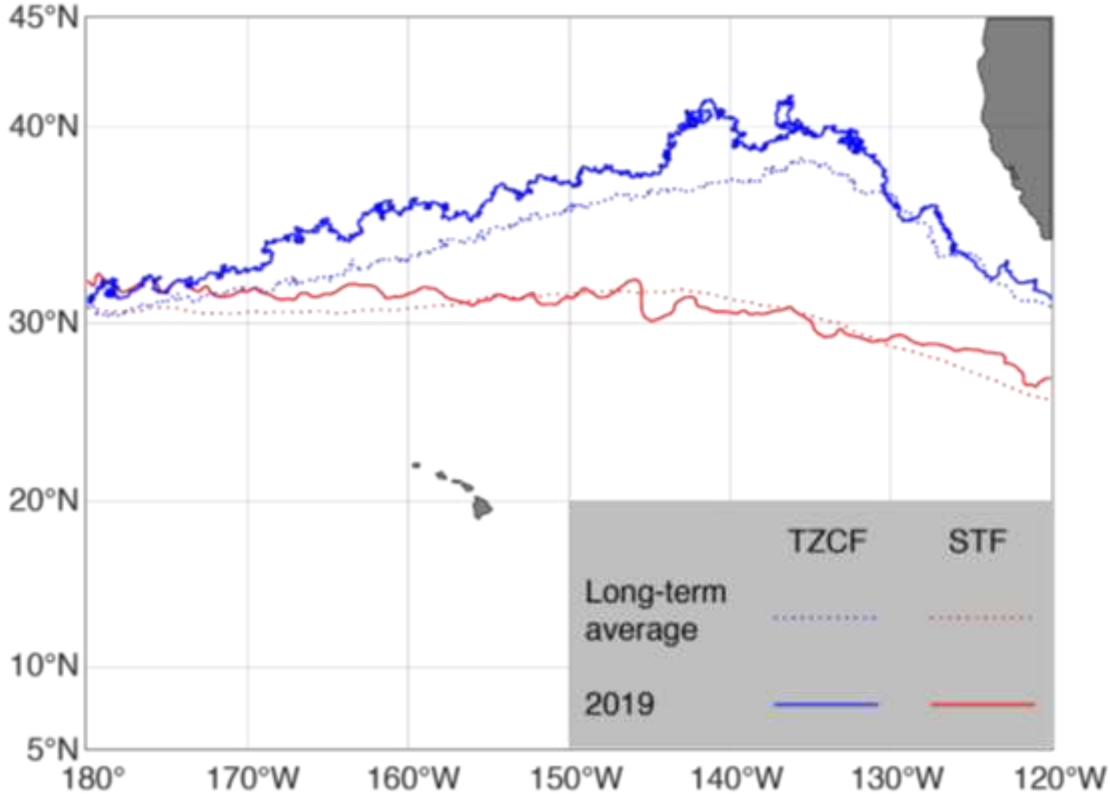


Figure 173. Average positions of the transition zone chlorophyll front (TZCF, blue lines) and subtropical front (STF, red lines) in 2019 (solid lines) and over a long-term average (dotted lines). The long-term average for the TZCF spans 1998 – 2018. The long-term average for the STF spans 1985 – 2018

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 2019, the STF was slightly north of average west of 160°W and east of 130°W, average from about 160 – 145°W, just south of average from 145 – 130°W. The TZCF was a few degrees north of average, particularly west of 130°W.

Description: The subtropical front (STF) is marked by the 18 °C sea surface temperature (SST) isotherm and the transition zone chlorophyll front (TZCF) by the 0.2 mg chl-a m^{-3} isopleth (Bograd et al., 2004; Polovina et al., 2001). They roughly mark the northern boundary of the North Pacific subtropical gyre as well as the northern extent of the Hawaii-based longline fishery. Both fronts migrate in a meridional direction 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 (2017) 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 (2020).

3.3.2.12 ESTIMATED MEDIAN PHYTOPLANKTON SIZE

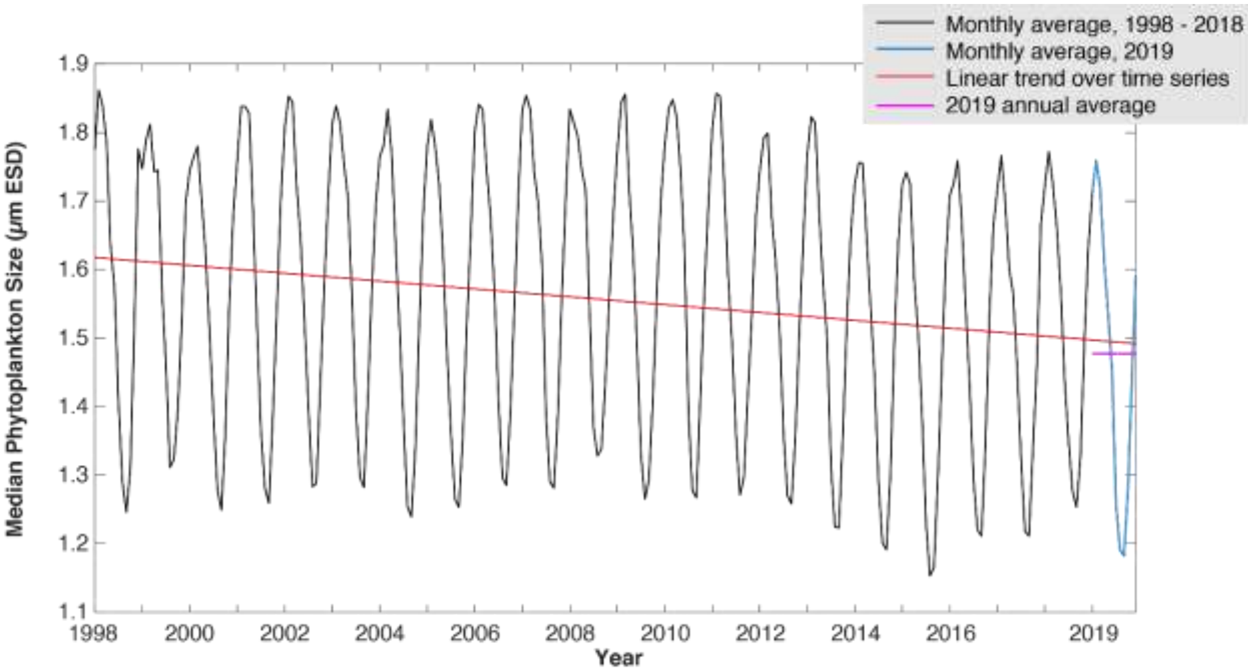


Figure 174. Time series of monthly median phytoplankton size over the longline fishing grounds outlined in Figure 175

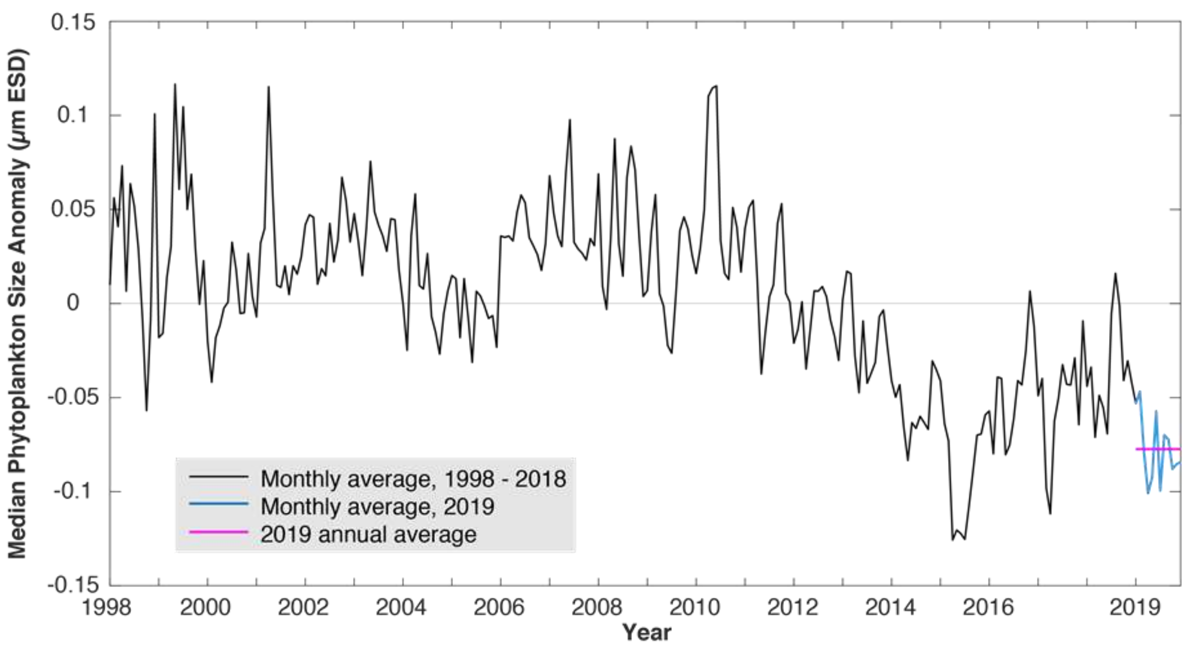


Figure 175. Time series of monthly median phytoplankton size anomaly over the longline fishing grounds outlined in Figure 174

Rationale: Phytoplankton are the base of the food web and their abundance influences the food available to all higher trophic levels from zooplankton through tunas. 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 tuna abundance and size structure are areas of active research.

Status: The mean monthly phytoplankton cell size was 1.48 μm Equivalent Spherical Diameter (ESD) in 2019. Monthly mean cell size ranged from 1.18 – 1.76 μm ESD during this period, within the range of values observed over the period of record (1.15 – 1.86 μm ESD). Over the period of record, median phytoplankton size has declined by 0.13 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 Hawaii longline region is presented. Additionally, spatial climatologies and anomalies are shown. 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 (2020) and Barnes et al. (2011).

3.3.2.13 FISH COMMUNITY SIZE STRUCTURE

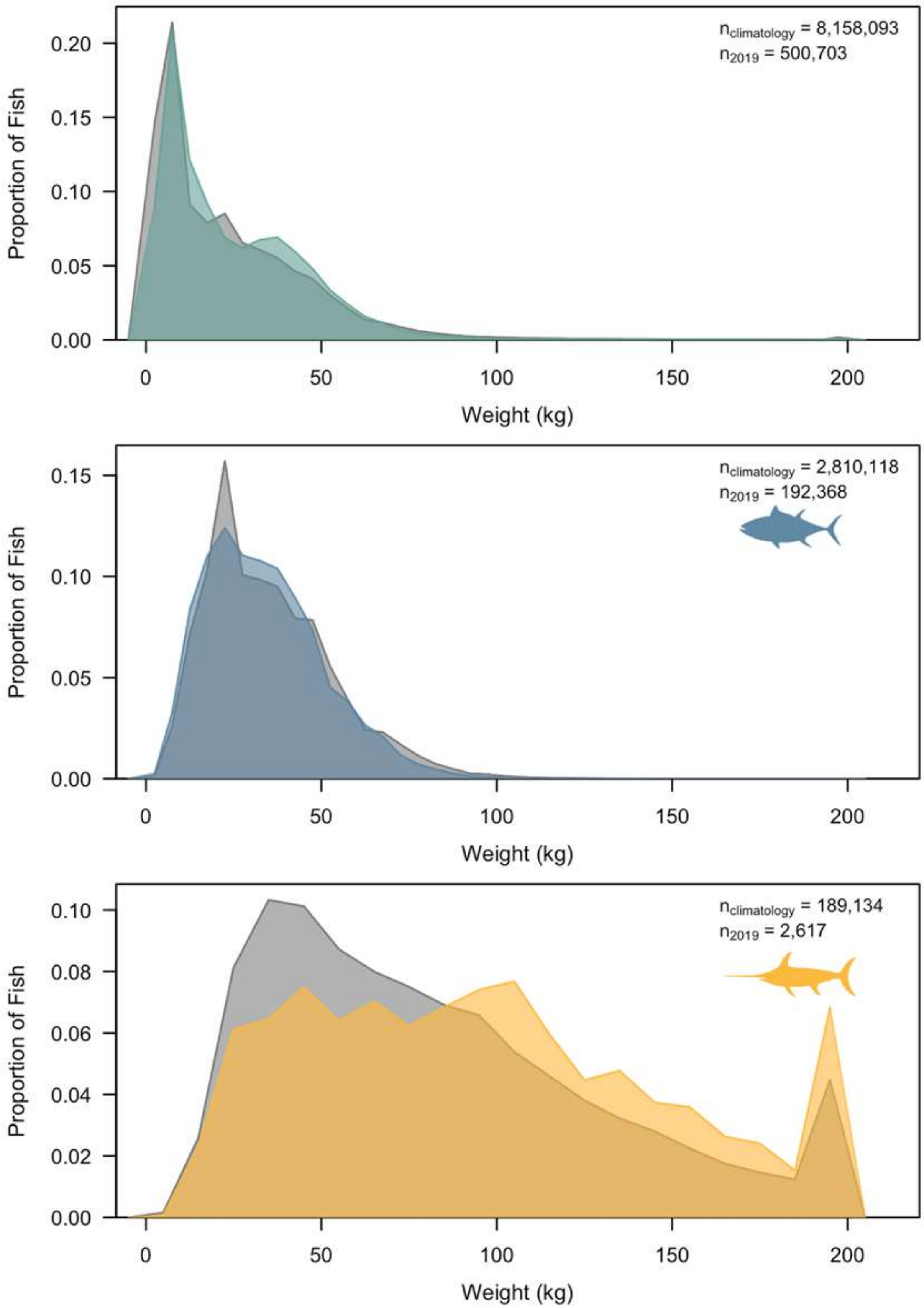


Figure 176. The climatological (2000 – 2018; grey) and 2019 (color) distribution of weights for all fish (top), bigeye tuna from deep sets (middle), and swordfish from shallow sets (bottom)

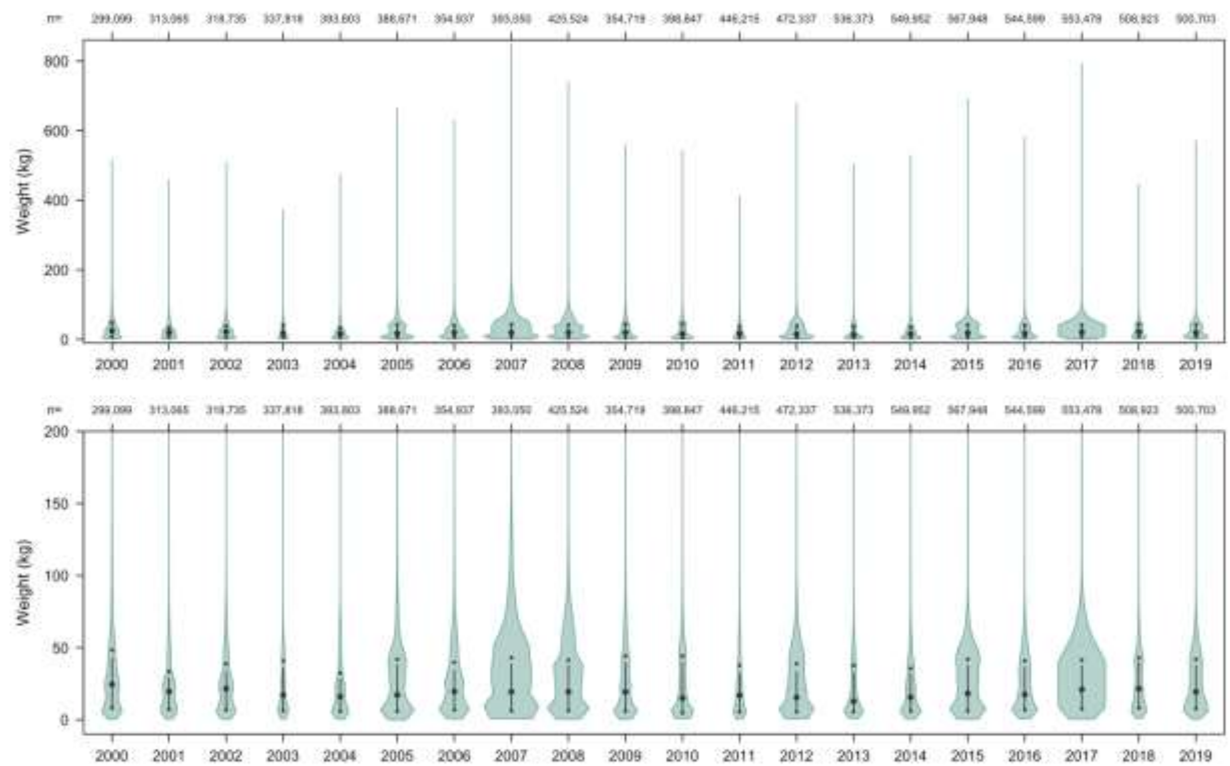


Figure 177. The annual distribution of weights of all fish, showing the full range of weights (top) and truncated to better demonstrate the distribution of the majority of weights (bottom) with large circles denoting median weight, black lines showing the range of the middle 50% of fish, small circles denoting the 20th and 80th percentiles of the weight distributions, and width of shading proportional to the number of fish of a given weight

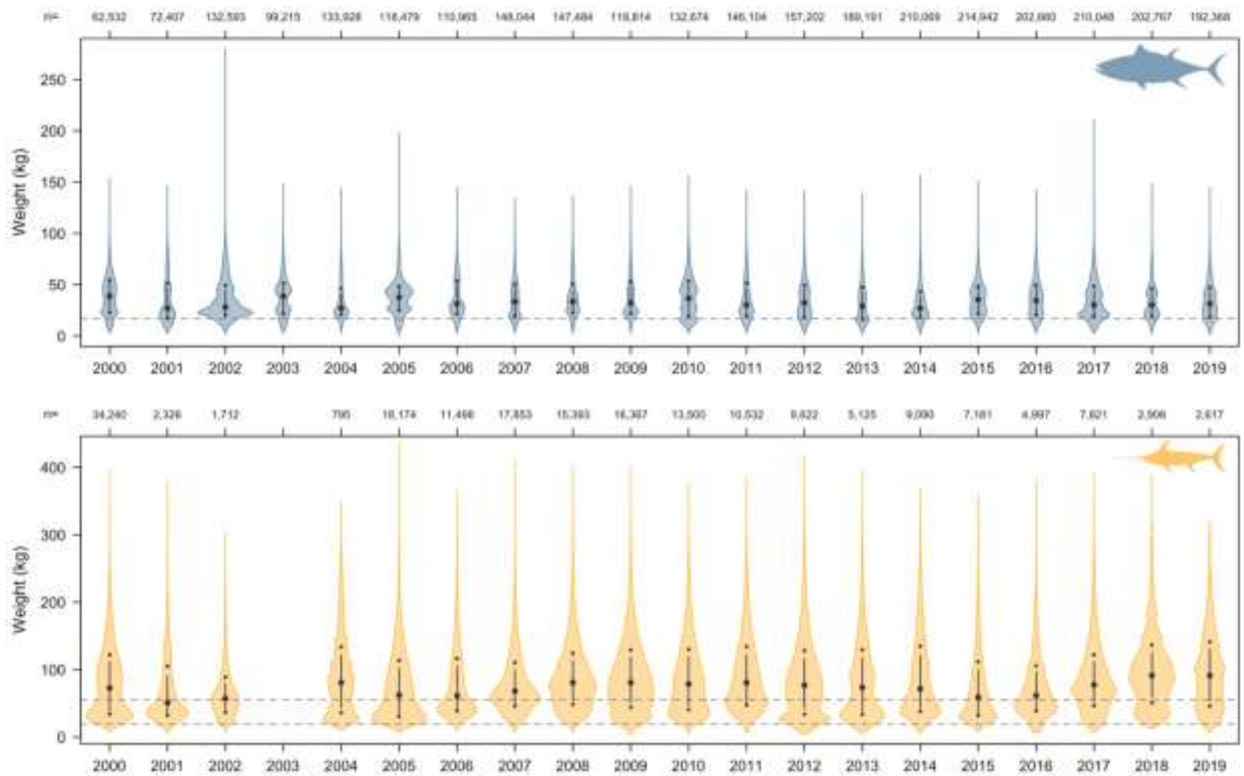


Figure 178. The annual distribution of weights of bigeye tuna from deep sets (top) and swordfish from shallow sets (bottom), with large circles denoting median weight, black lines showing the range of the middle 50% of fish, small circles denoting the 20th and 80th percentiles of the weight distributions, 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 2019 with a higher proportion of 40 – 50 kg fish. This peak may have been driven by an above average proportion of bigeye tuna in this size range. Swordfish also appeared larger than average in 2019, with an above average proportion of fish being 100 kg or larger.

In 2019, the median bigeye weight was 31.3 kg, and the median swordfish weight was 91.4 kg. The median fish weight for all species caught was 19.4 kg. The median weight of swordfish was at the maximum of the range of median weights seen across previous years, 50.9 – 91.4 kg. Median weights for all species and for bigeye were within the bounds observed over the time series from 2000 to 2018. There was no significant trend in bigeye, swordfish, or all species' median weight over the full time series. However, the median weight of swordfish has increased steadily since 2015.

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 2019 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: Hawaii Division of Aquatic Resources Measurement Platform and Langley et al. (2006).

3.3.2.14 BIGEYE WEIGHT-PER-UNIT-EFFORT

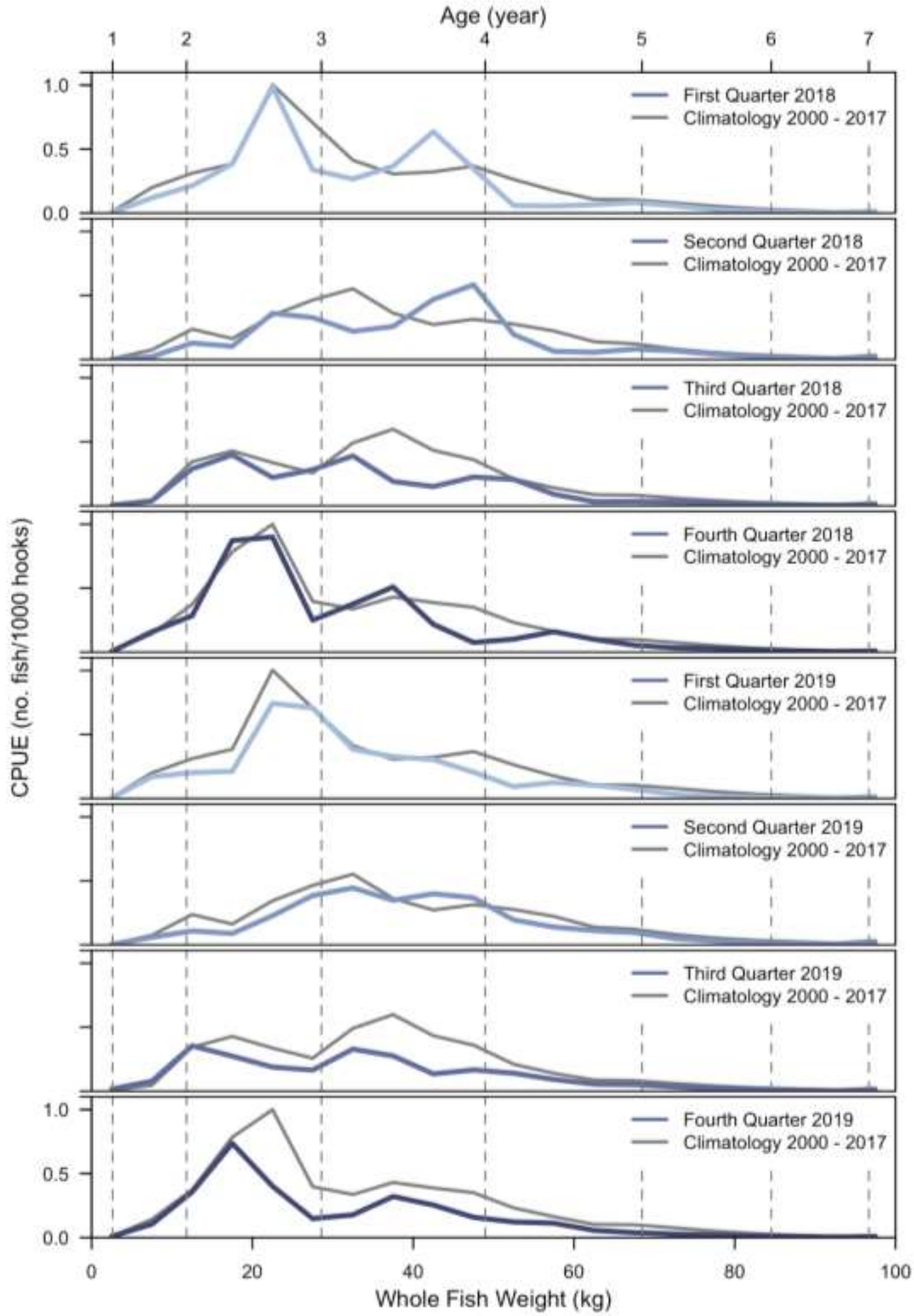


Figure 179. Quarterly deep-set bigeye tuna weight per unit effort for 2018 – 2019 (color) and the climatological average (2000 – 2017)

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 2018 or 2019, suggesting there will not be a peak in the CPUE of four- and five-year old bigeye in 2020 to 2021.

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 179. 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: Hawaii Division of Aquatic Resources.

3.3.2.15 BIGEYE RECRUITMENT INDEX

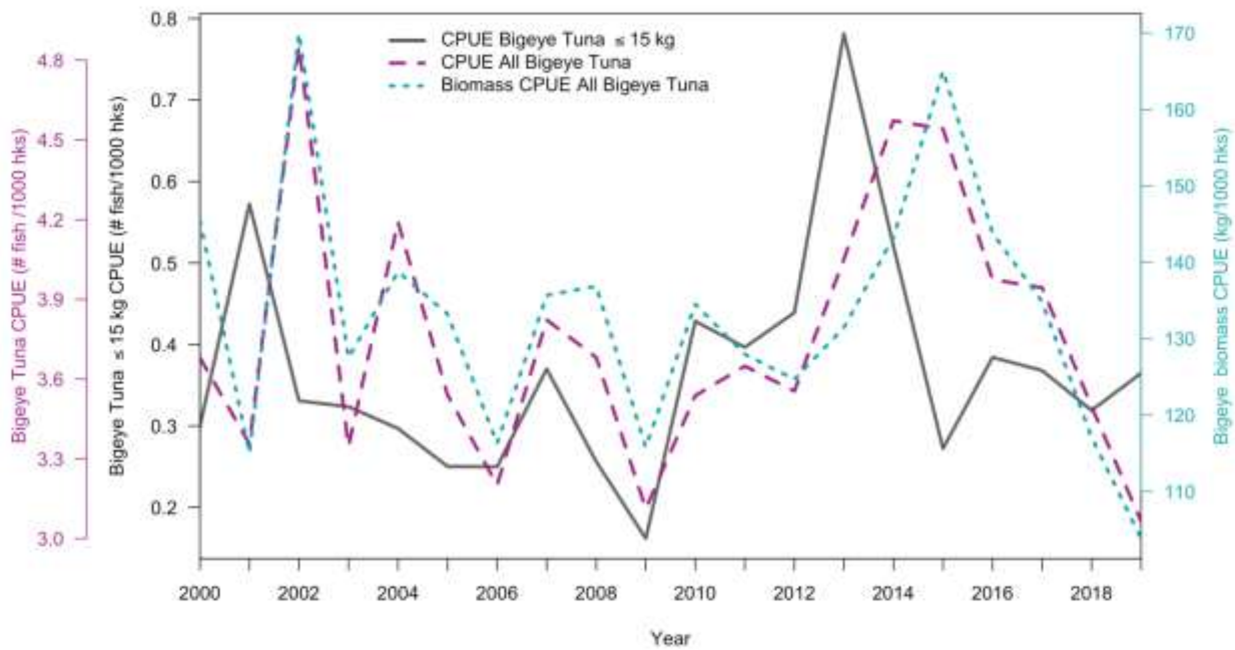


Figure 180. Annual CPUE of bigeye tuna ≤ 15 kg (grey solid line), CPUE of all bigeye tuna (pink dashed line), and biomass CPUE (blue dotted line) from 2000 – 2019, all from deep sets

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 2019, the CPUE of bigeye ≤ 15 kg was 0.37 fish per 1,000 hooks set. This is within the range observed over the previous 19 years (0.16 – 0.79 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: Hawaii Division of Aquatic Resources and Langley et al. (2006).

3.3.2.16 THE BIGEYE TUNA CATCH RATE FORECAST

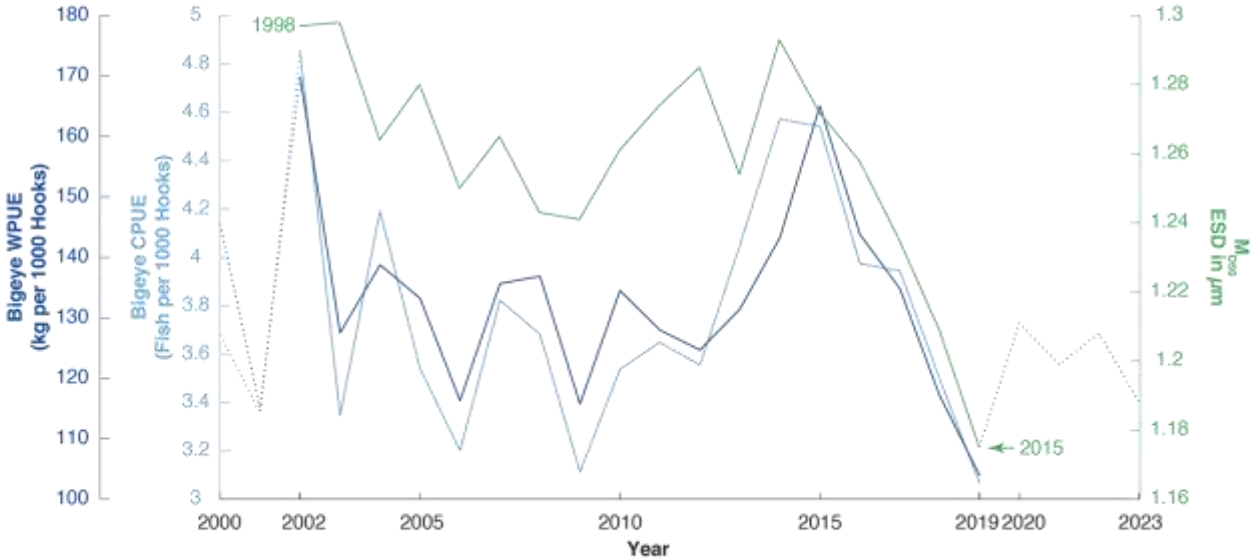


Figure 181. Annual WPUE (dark blue) and CPUE (light blue) of bigeye tuna from deep sets, as well as four-year lagged median phytoplankton size (M_{D50}, green). Dashed lines indicate years that are outside the forecast period described in the text

Rationale: Recent work has shown that average phytoplankton size can be used to predict bigeye tuna catch rates four years in advance (Woodworth-Jefcoats and Wren, In Review). 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 2019, the median size of phytoplankton across the Hawaii longline fishing grounds was 1.19 µm Equivalent Spherical Diameter (ESD). This is within the range observed over the previous 21 years (1.18 – 1.30 µm ESD). Median phytoplankton sizes from 2016 – 2019 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 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 (2020), Hawaii Division of Aquatic Resources, and Langley et al. (2006).

3.3.3 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.

3.3.4 RESPONSE TO PREVIOUS COUNCIL RECOMMENDATIONS

There were no Council recommendations relevant to the climate and oceanic indicators section of the annual SAFE report in 2019.

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.

3.3.5 CONCEPTUAL MODEL

In developing this chapter, the Council relied on a number of recent reports conducted in the context of the U.S. National Climate Assessment including, most notably, the 2012 Pacific Islands Regional Climate Assessment and the Ocean and Coasts chapter of the 2014 report on a Pilot Indicator System prepared by the National Climate Assessment and Development Advisory Committee (NCADAC).

The Advisory Committee Report presented a possible conceptual framework designed to illustrate how climate factors can connect to and interact with other ecosystem components to impact ocean and coastal ecosystems and human communities. The Council adapted this model with considerations relevant to the fishery resources of the Western Pacific Region:

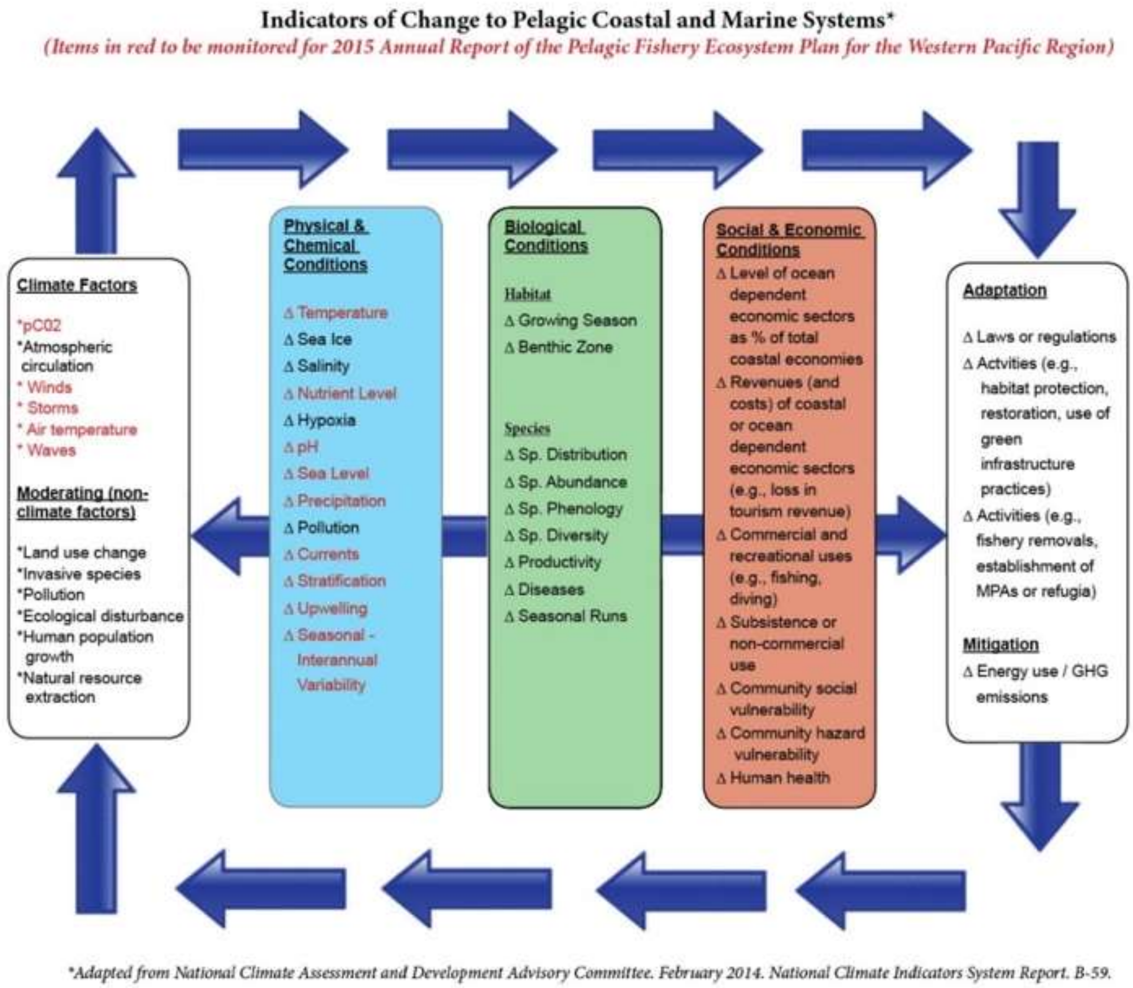


Figure 182. Indicators of change of pelagic coastal and marine systems; conceptual model

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.

3.3.6 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.

3.4 ESSENTIAL FISH HABITAT

3.4.1 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 Units 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 5 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 2019 SAFE report, except for the research and information needs. Non-fishing impacts to pelagic EFH were reviewed 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 report.

3.4.2 RESPONSE TO PREVIOUS COUNCIL RECOMMENDATIONS

At its 172nd meeting in March 2018, the Council recommended that staff develop an omnibus amendment updating the non-fishing impacts to EFH sections of the FEPs, incorporating the non-fishing impacts EFH review report by Minton (2017). An options paper has been developed.

The 2019 Pelagic Plan Team recommended that Council staff work appropriate Plan Team members to evaluate the EFH section of the Annual SAFE Report to see how it may be refined going forward, which was completed prior to the 2020 Pelagic Plan Team meeting.

3.4.3 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 3.3) 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.

3.4.4 REPORT ON REVIEW OF EFH INFORMATION

No pelagic EFH reviews were completed in 2019, though a review of crustacean EFH in Guam and Hawaii was finalized. This review can be found in the 2019 Archipelagic SAFE Reports for the Mariana and Hawaii Archipelagos. The non-fishing impacts and cumulative impacts components were reviewed in 2016 through 2017, which can be found in Minton (2017).

3.4.5 RESEARCH AND INFORMATION NEEDS

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 to address these needs as well as a list of revised and focused critical research needs for specific management concerns.

The Bigeye Tuna (BET) Initiative is a PIFSC initiative launched in 2019 that focuses on science to support EFH delineation and ecosystem-based fisheries management for bigeye tuna in Hawaii. The BET Initiative is a cross-divisional effort to learn as much as possible about BET and the environment that supports them, an environment which is dynamic in both time and space, and may experience large geographic shifts in the face of global climate change.
The initiative has multiple focus areas to advance BET and other pelagic research conducted at PIFSC:

- Delineate stock structure of BET caught in the Hawaii longline fishery
- Identify spawning grounds and larval distributions of BET
- Drivers of BET fishery ecosystem dynamics and forecasting future BET fishery performance
- Life history with an emphasis on age and growth
- Environmental linkage to BET recruitment into the Hawaii-based longline fishery
- Lancetfish (key prey item) project
- Network analysis for the Hawaii deep-set longline fishery
- Mesoscale features influencing longline catch
- Central equatorial Pacific BET CPUE and relationship to ENSO

Other proposed PIFSC research relevant to EFH includes using telemetry data to define pelagic habitat, projecting movement of the pelagic fishing fleet in response to climate change, developing automated underwater vehicle (AUV)-based sampling plans to understand and delineate the physiochemical parameters of major oceanic convergence zones, identifying key life history relationships and their responses to climate change, and mapping efforts to identify and integrate the influence of seamounts on pelagic reproduction, recruitment, and dispersal. The Pelagic Plan Team also previously recommended that Council staff explore a minimum depth for the definition of pelagic EFH that excludes depths seldom occupied by PMUS.

3.5 MARINE PLANNING

3.5.1 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 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.

3.5.2 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 with the Council to review the no-take regulations after three years. PIRO has 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 has been limiting fishing. Thus, there is no interest to fish within the monument boundaries. The Pelagics Plan Team deferred decision on Rose Atoll in 2017 until after the Administration reviews to make any decision on the monument provisions.

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 feet in length. The Council has examined the LVPA assessment with regards to, but not limited to catch rates of fishery participants; small vessel participation; and fisheries development initiatives. The LVPA regulations have been vacated through legal action, and Council action following the court's ruling is described at further length below.

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 last year's 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 US 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, whether commercial longline, commercial alia vessels, troll or other fishing sectors, because catch from all locally-based fishing sectors flows into the American Samoa community for cultural purposes.
- Did not receive a response from the American Samoa government to its request for an option that would address its concern over the proposed action. The Council received one response from the American Samoa government in October 2017 that Council member Henry Sesepasara is the point of contact on cultural fishing, but did not receive responses to the Council's requests to consult with the American Samoa government on cultural fishing on July 6 and November 17, 2017.
- 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 nmi around Tutuila, 12 nmi around Manua, 12 nmi around Swains, and 2 nmi around the offshore banks.
- Recommended annual monitoring of the American Samoa longline and troll catch rates, small vessel participation, and local fisheries development.

NMFS has appealed a federal district court's 2018 decision that invalidated the 2016 LVPA reduction to the U.S. Ninth Circuit Court of Appeals. Oral arguments are scheduled to be heard in early 2020 in Honolulu, Hawaii.

At its 176th meeting in March 2019, the Council directed staff and the spatial working group (SWG) to develop a white paper describing the following recommendations to be set as guidelines for any existing or proposed spatial management activity:

- Prior to developing spatial management areas, objectives and performance metrics must be explicitly specified to evaluate the effectiveness of spatial management. Performance metrics must concurrently address conservation objectives (e.g. increase in abundance or decrease in bycatch), economic objectives (e.g. net economic benefit, price per pound, quality of product), social objectives (e.g. crew safety, equitable access, food security, cultural value, transfer of local/cultural knowledge).
- Monitoring of performance metrics is needed with regularity to gauge efficacy of existing closures and suitability for future spatial fishing closures or modifying existing closures. Monitoring needs to account for changes in performance metrics before and after management action, such as counterfactual analyses.
- Modifying fishing gear or methods are likely to be more effective to minimize protected species bycatch rather than permanent closed areas.
- Maintain flexibility in regulations so that industry can find voluntary means to reduce bycatch interactions and have input in the development of mitigation measures.
- Research should evaluate whether existing closures meet stated objectives and performance metrics.
- Prior to implementing any closure or other spatial management action of any kind, compliance monitoring and enforcement should be planned and tenable.

At its 178th meeting in June 2019, the Council endorsed a workshop developed by the SSC Spatial Working Group on "Spatial Management of Blue Water Ecosystems" with the themes spatial management objectives and performance metrics, alternatives to spatial management, evaluation and monitoring, and policy and outreach approaches to spatial management, and directed Council staff to explore sources of funding and venues for a this workshop.

International negotiations are underway to incorporate area-based management tools in blue water ecosystems (including closing areas to fishing) to improve the governance of natural resources in areas beyond national jurisdiction. At present, science-based guidelines to plan, evaluate, identify unintended consequences, and monitor area-based management implementation discussed in these negotiations are lacking. Such guidelines and decision-making tools are imperative for regional fisheries management organizations and arrangements (RFMO/As) to evaluate and weigh objectives, identify performance metrics, and develop plans to address consequences of spatial management. In order to elucidate appropriate employment of area-based management measures in blue water ecosystems, a publishable paper: "Road Map to Effective Area-Based Management in Blue Water Ecosystems", is to be developed by a team of experts, followed by a workshop of global leaders on the subject matter in mid-2020.

3.5.3 MARINE MANAGED AREAS

Council-established MMAs are shown in Figure 183, and are compiled in Table 79.

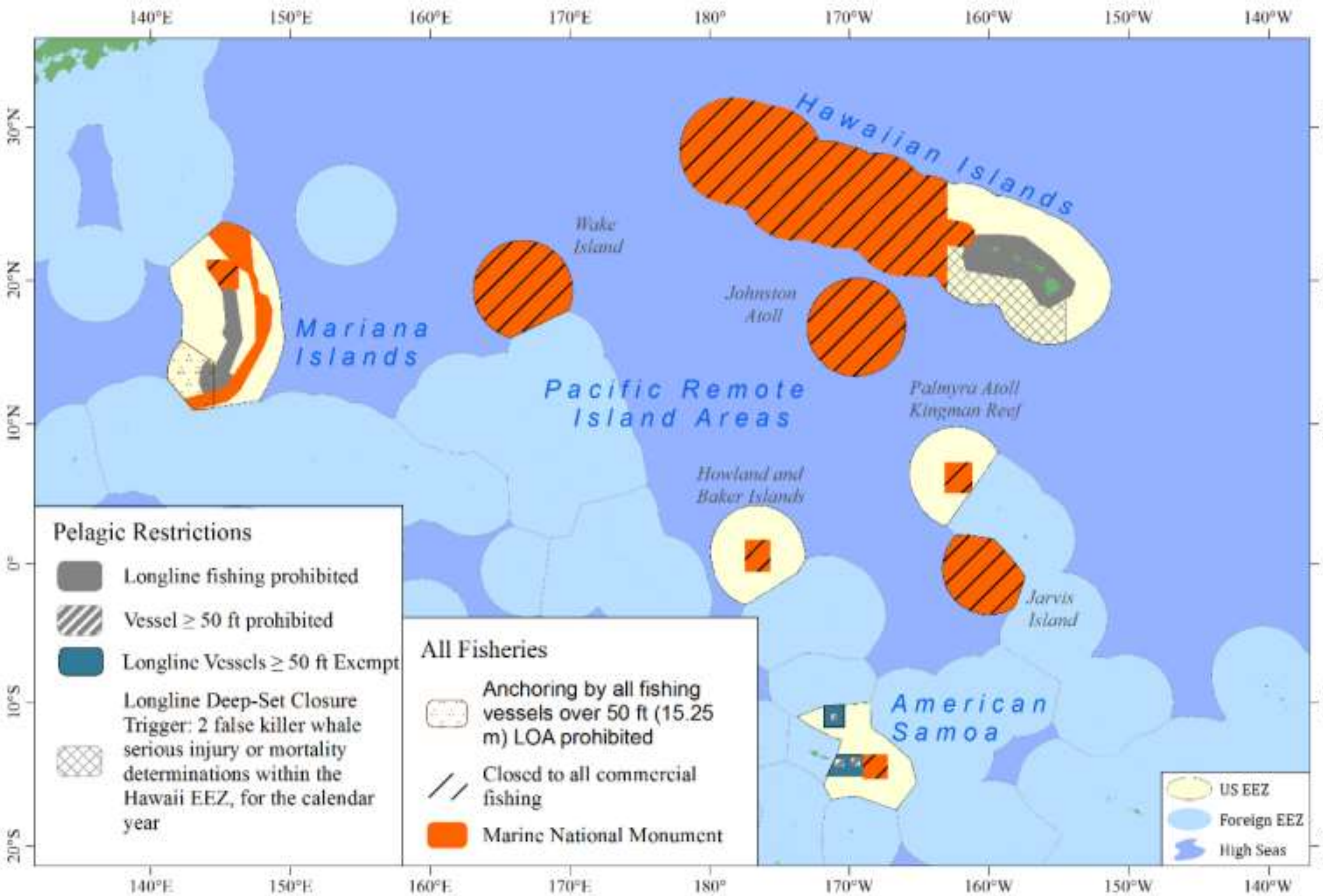


Figure 183. Regulated Fishing Areas of the Western Pacific Region

Table 79. MMAs established under FEPs from 50 CFR § 665

Name	FEP	Island(s)	50 CFR /FR /Amendment Reference	Marine Area (km²)	Fishing Restriction	Goals	Most Recent Evaluation	Review Deadline
Pelagic Restrictions								
NWHI Longline Protected Species Zone	Pelagic (Hawaii)	NWHI	665.806(a)(1) 56 FR 52214 76 FR 37287 Pelagic FMP Am. 3	351,514.00	Longline fishing prohibited	Prevent longline interaction with monk seals.	1991	-
MHI Longline Prohibited Area	Pelagic (Hawaii)	MHI	665.806(a)(2) 57 FR 7661 77 FR 71286 Pelagic FMP Am. 5	248,682.38	Longline fishing prohibited	Prevent gear conflicts between longline vessels and troll/handline vessels.	1992	-
Guam Longline Prohibited Area	Pelagic (Marianas)	Guam	665.806(a)(3) 57 FR 7661 Pelagic FMP Am. 5	50,192.88	Longline fishing prohibited	Prevent gear conflicts between longline vessels and troll/handline vessels.	1992	-
CNMI Longline Prohibited Area	Pelagic (Marianas)	Mariana Archipelago	665.806(a)(4) 76 FR 37287 Pelagic FEP Am. 3	88,112.68	Longline fishing prohibited	Reduce potential for nearshore localized fish depletion from longline fishing, and to limit catch competition and gear conflicts between the CNMI-based longline and trolling fleets.	2011	-

Name	FEP	Island(s)	50 CFR /FR /Amendment Reference	Marine Area (km²)	Fishing Restriction	Goals	Most Recent Evaluation	Review Deadline
Large Vessel Prohibited Area	Pelagic (American Samoa)	Tutuila, Manu'a, and Rose Atoll	665.806 (b)(1) 81 FR 5619	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)(2) 81 FR 5619 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 (nmi).	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 (km^2)	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 nmi 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 nmi 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 nmi in Am. 2.	2013	-

3.5.4 ACTIVITIES AND FACILITIES OCCURRING IN THE PACIFIC ISLANDS REGION

In the Western Pacific Region, wild 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 activities are assessed in environmental impact statements (EISs) 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.

3.5.4.1 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 80).

Table 80. 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 in currently in the process of renewing the SCREFP cooperatively with NMFS in order to harvest of two cohorts of fish, and the final determination on the renewal is expected in early 2020.

3.5.4.2 ALTERNATIVE ENERGY FACILITIES

There are no alternative energy facilities in state 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. There are still three existing alternative energy facilities (Table 81).

Table 81. 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 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 October 2018, HSWAC and the State of Hawaii finalized an agreement to provide seawater air conditioning for eight state buildings. Construction to start in late-2019 or early-2020 and planned to take an estimated 18-22 months.	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 Deep-water wave energy units operational in mid-2015. 1.25 mW Ocean Energy 35 Buoy planned to be connected in early 2020.	Final Environmental Assessment, NAVFAC PAC, January 2014 E&E News Hawaii Natural Energy Institute

3.5.4.3 MILITARY TRAINING AND TESTING ACTIVITIES AND IMPACTS

The Department of Defense (DOD) major activities are summarized in Table 82.

Table 82. 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.	ROD published August 29, 2015 after release of Final SEIS on July 18, 2015. Lawsuit filed for segmentation and range of reasonable alternatives under NEPA. DOJ asked US 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 announced it might hear oral arguments in early 2020. (http://www.saipantribune.com/index.php/doj-federal-court-lacks-jurisdiction/; https://www.guampdn.com/story/news/2019/10/08/cnmi-training-range-lawsuit-could-heard-us-court-appeals-hawaii/3905566002/).	Surface danger zone established at Ritidian – access restricted during training. Access will be negotiated between the Navy and USFWS. Northern District Wastewater Treatment Plant is non-compliant with NPDES permit; until plant is upgraded, increased wastewater discharge associated with buildup will significantly impact nearshore water quality. DOD to fund plant upgrades – see Economic Adjustment Committee Implementation Plan.
Mariana Islands Training and Testing – Supplemental	The supplement to the 2015 Final EIS/OEIS is being 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, will be used to update the MITT.	The 2019 MITT Final Supplemental EIS/OEIS is expected in spring 2020. Open House Public Meetings took place in March 2019. Public Comment was extended from March 18, 2019 to April 17, 2019 and is now closed. 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 impacts likely similar to previous analysis in 2015 EIS/OEIS.
Rim of the Pacific (RIMPAC) Exercise	Multinational, sea control/power projection fleet exercise that has been performed biennially for over 40 years and headquartered in Honolulu, 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.	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	Access – closures during training.

Action	Description	Phase	Impacts
		course of five years, from August 21, 2017 through August 22, 2022 (82 FR 1702; 82 FR 39684).	Final Environmental Assessment, October 2016 NMFS Biological Opinion, August 2017
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 US 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 announced it might hear oral arguments in early 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.
Garapan Anchorage	Military Pre-Positioned Ships anchor and transit.	Expired Memorandum of Understanding with the CNMI government. As of 2019, a new MOU had not been signed.	Access, invasive species, unmitigated damage to reefs
Farallon de Medinilla	Restricted airspace covering the island to 12 nmi 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 nmi radius and 12 nmi radius of FDM (82 FR 13389). Proposed surface danger zone to 12 nmi. Meetings with military officials established that the 12 nmi radius is closed when exercises are being conducted, but a 3 nmi 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.	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.

Action	Description	Phase	Impacts
		public scoping period will be 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 will be taken into consideration during preparation of the Final SEIS.	Access and transit to fishing grounds.

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 83.

Table 83. Notices to mariners for military exercises in the Mariana Archipelago from 2013-2019

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
	W-517	49	107
	W-12	6	13

Year	Location	Number of Notices to Mariners Issued	Number of Days Affected
	W-11	1	1
2019	FDM	39	165
	W-517	27	65
	W-12	3	22
	W-11	6	27
	W-13	15	37

3.5.5 PACIFIC ISLANDS REGIONAL PLANNING BODY REPORT

In June 2018, President Trump signed the Executive Order (EO) 13840 Regarding the Ocean Policy to Advance Economic, Security, and Environmental Interests of the United States, which revoked EO 13547. The new EO eliminated the mandate for the federal government to participate in ocean planning at a regional level and eliminated the regional planning bodies. As such, the Pacific Islands Regional Planning Body (RPB) no longer exists and ocean planning will now occur at a local level led by Hawaii and the territories (if they so desire).

However, EO 13840 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. The intent is for it to be expanded to include the Marianas, PRIA, and Hawaii and be titled the Pacific Islands Regional Marine Planner.

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. Also new in the 2019 report is the inclusion of abstracts from recent publications relevant to data integration for pelagic fisheries.

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.

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 3.2.2.3) 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 year 2, the Ensemble Random Forest approach will be expanded to investigate risk contours for a suite of species of interest. Datasets will be updated to incorporate recent years of data as well as explore model refinement to include derived products on weekly temporal frames. The relative importance of environmental covariates resulting from the Ensemble Random Forest approach can be used to establish recommendations similar in implementation to the existing TurtleWatch product for avoiding species of interest (e.g., leatherback and loggerhead turtles). The analysis will explore the potential benefit and impact of closures or voluntary avoidance of interaction hotspots on protected species bycatch of interest as well as on catch rates of primary and secondary target species in the fishery. The goal is to model how the redistribution of displaced effort may affect primary and secondary target catch rates as well as protected species interactions.

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[4].

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[5]. 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 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).

[4] http://www.samoanews.com/tri-marine-says-local-longline-fleet-vital-economy

[5] http://www.spc.int/coastfish/publications/bulletins/419-spc-fisheries-newsletter-142.html

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[6]. 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.

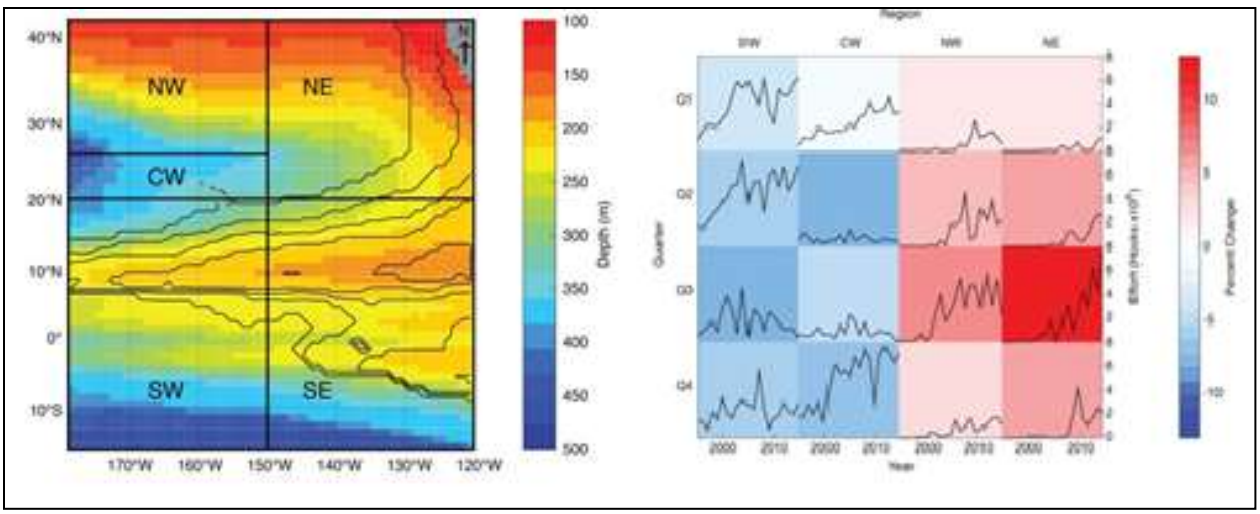


Figure 184. Left: Map depicting the five regions by which the fishery is examined overlaid on the climatological (1995-2015) median depth of preferred thermal habitat

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

[6] 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.

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 184).

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 184). 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 185).

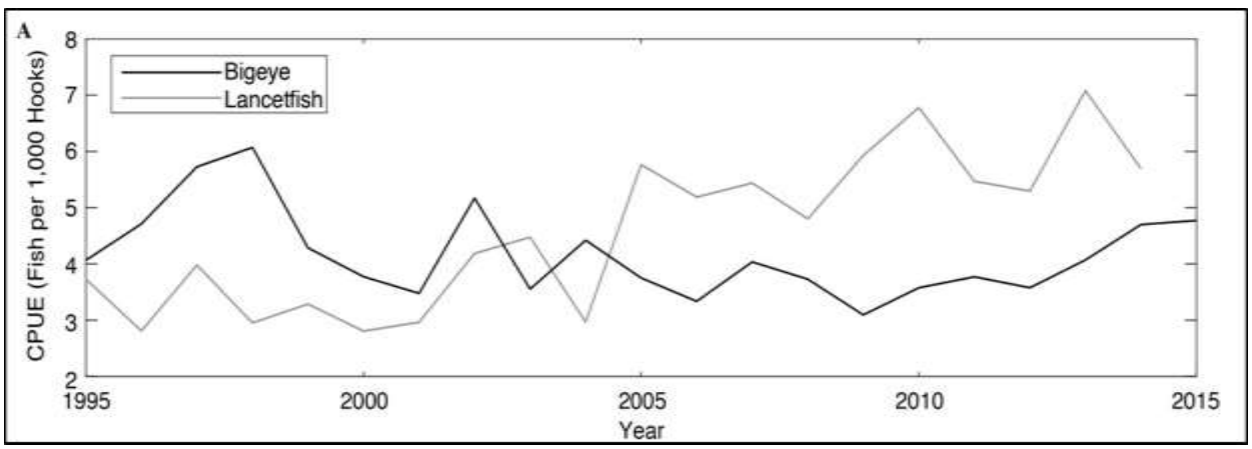


Figure 185. Annual deep-set bigeye tuna (black) and lancetfish (gray) CPUE

Trends in productivity and catch rates in the fishery over the past decades may be caused by spatiotemporal changes in the fishery itself, changes in the stock, or both. In order to better understand these trends A General Additive Models (GAM) was built to analyze time series of mean weight, catch per unit effort (CPUE, in number of fish caught per 1000 hooks) and weight per unit effort (WPUE, in kg caught per 1000 hooks). The GAM a llowed researchers to tease apart trends caused by changes in the stock from those caused by changes in seasonality and geographic location of the fishery. Over the past 16 years, mean weights of commercially important fish in the Hawaii- based longline fishery have declined 10%.

This is in part due to a decline in mean weight by five out of the eleven most commonly caught species, and partly due to a change in species composition of the catch. Smaller fishes, such as pomfrets and walu, are becoming more common while larger fishes, such as opah and striped marlin, make up a lesser proportion of the total catch (Figure 186A). 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 186C).

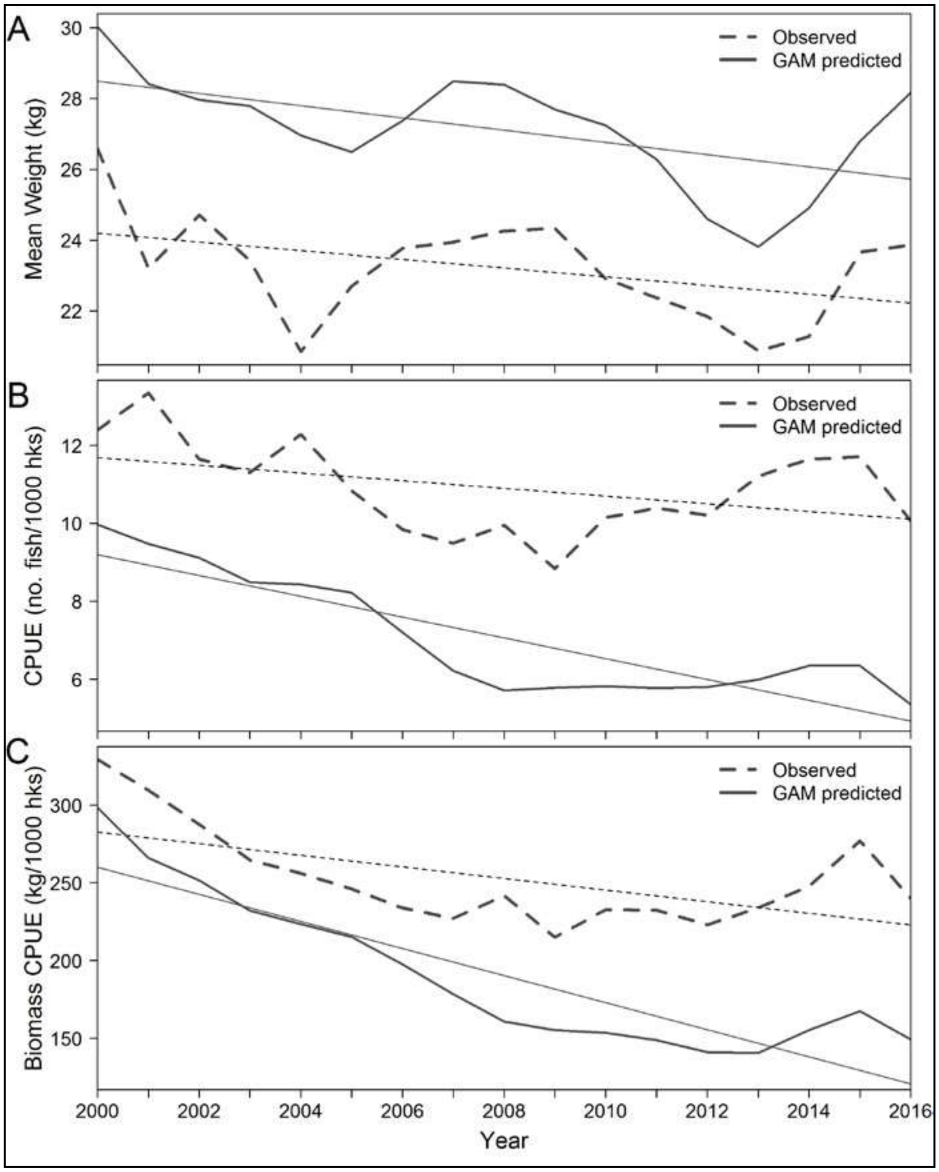


Figure 186. Mean weight (A), catch per unit effort (B), and weight per unit effort (WPUE) for all fish in the Hawaii-based longline fishery from dealer provided data.

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 187).

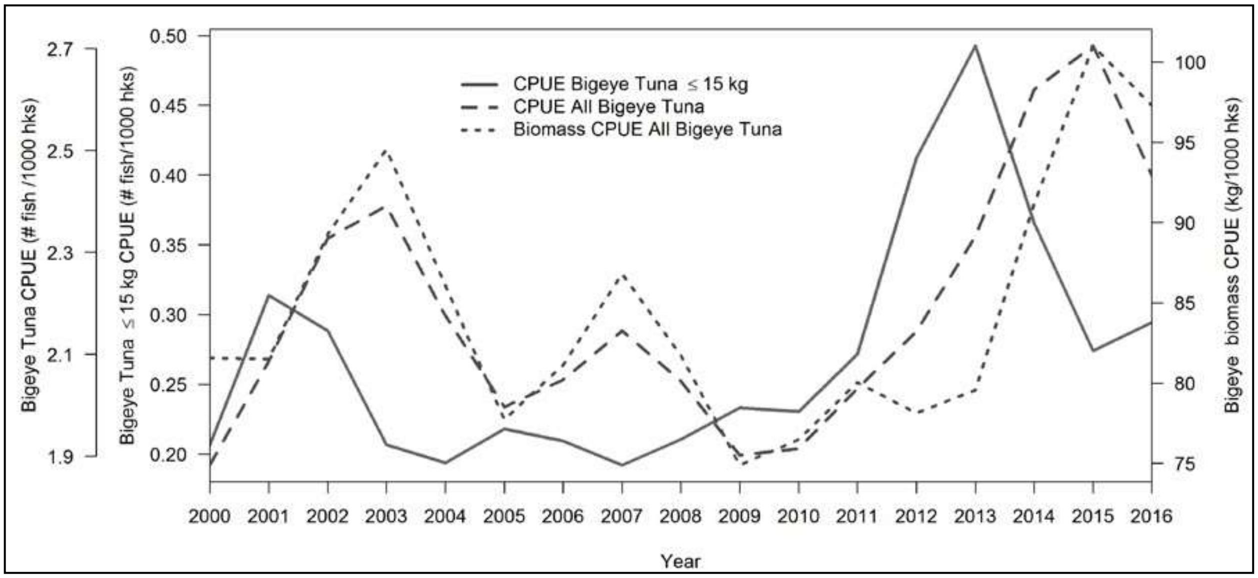


Figure 187. Temporally- and spatially-adjusted annual catch per 1000 hooks

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
2010	212	31	36	38	95
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

Table A-2. Supporting Data for Figure 2.

Year	Boats Landing All Methods	Boats Landing Longline Boats	Boats Landing Trolling
2010	39	26	7
2011	39	24	10
2012	39	25	8
2013	44	22	13
2014	44	23	19
2015	40	21	10
2016	38	20	12
2017	27	15	8
2018	24	13	7
2019	28	17	5
Average	**34**	**21**	**10**
Standard Deviation	**8**	**4**	**4**

Table A-3. Supporting Data for Figure 3.

Year	All Pelagic Species Troll Trips	All Pelagic Species Longline Sets
2010	55	4,537
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	2,212
2019	170	1,695
Average	**144**	**3,043**
Standard Deviation	**40**	**929**

Table A-4. Supporting Data for Figure 4.

Year	Total Pounds Landings Tuna	Total Pounds Landings Non Tuna PMUS
2010	10,884,632	396,173
2011	7,526,606	370,399
2012	9,375,076	335,277
2013	5,855,112	295,354
2014	4,904,315	250,461
2015	5,400,233	231,256
2016	4,603,412	217,450
2017	4,851,109	269,023
2018	4,282,708	185,739
2019	2,864,730	130,335
Average	**6,054,793**	**268,147**
Standard Deviation	**2,476,151**	**83,080**

Table A-5. Supporting Data for Figure 5.

Year	**Commercial Landings Pounds Tuna**	**Commercial Landings Pounds Non Tuna PMUS**
2010	10,860,578	341,790
2011	7,511,342	294,793
2012	9,358,657	189,573
2013	5,783,264	188,214
2014	4,893,375	139,381
2015	5,379,229	116,447
2016	4,595,614	96,296
2017	4,842,400	103,266
2018	4,276,094	64,249
2019	2,861,682	37,792
Average	**6,036,224**	**157,180**
Standard Deviation	**2,471,325**	**98,042**

Table A-6. Supporting Data for Figure 6.

Year	**Estimated Yellowfin Longline Pounds**	**Estimated Yellowfin Trolling Pounds**
2010	1,080,597	2,052
2011	1,306,703	12,379
2012	828,636	8,480
2013	808,271	7,137
2014	1,067,080	6,618
2015	1,003,907	3,981
2016	848,926	9,477
2017	1,233,113	14,023
2018	575,708	10,344
2019	399,298	3,140
Average	**915,224**	**7,763**
Standard Deviation	**282,325**	**3,953**

Table A-7. Supporting Data for Figure 7.

Year	Estimated Skipjack Longline Pounds	Estimated Skipjack Trolling Pounds
2010	277,946	2,043
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	149,917	12,958
Average	**270,051**	**9,811**
Standard Deviation	**171,707**	**4,727**

Table A-8. Supporting Data for Figure 8.

Year	Estimated Wahoo Longline Pounds	Estimated Wahoo Trolling Pounds
2010	240,776	64
2011	193,780	55
2012	165,186	597
2013	149,619	1,109
2014	122,369	1,072
2015	121,750	496
2016	101,693	1,871
2017	110,322	747
2018	67,510	1,154
2019	38,555	601
Average	**131,156**	**777**
Standard Deviation	**59,190**	**549**

Table A-9. Supporting Data for Figure 9.

Year	Estimated Mahimahi Longline Pounds	Estimated Mahimahi Trolling Pounds
2010	18,081	0
2011	23,153	611
2012	23,977	157
2013	39,138	300
2014	23,012	2,077
2015	11,822	372
2016	8,969	1,071
2017	30,883	1,373
2018	10,007	954
2019	3,250	714
Average	**19,229**	**763**
Standard Deviation	**10,986**	**630**

Table A-10. Supporting Data for Figure 10.

Year	Blue Marlin Longline Pounds	Blue Marlin Trolling Pounds
2010	92,479	0
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	62,905	834
Average	**70,805**	**564**
Standard Deviation	**12,983**	**592**

Table A-11. Supporting Data for Figure 11.

Year	Sailfish Longline Pounds	Sailfish Trolling Pounds
2010	3,616	0
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	3,758	181
Average	**4,134**	**33**
Standard Deviation	**1,750**	**58**

Table A-12. Supporting Data for Figure 13.

Year	Longline Hook Set
2010	13,184
2011	11,074
2012	12,112
2013	10,184
2014	7,667
2015	7,806
2016	6,909
2017	7,009
2018	6,009
2019	4,769
Average	**8,672**
Standard Deviation	**2,793**

Table A-13. Supporting Data for Figure 14.

Year	Bigeye Tuna Longline Pounds
2010	463,890
2011	386,653
2012	408,805
2013	191,554
2014	210,869
2015	183,849
2016	155,842
2017	139,424
2018	117,481
2019	66,547
Average	**232,491**
Standard Deviation	**136,711**

Table A-14. Supporting Data for Figure 15.

Year	Albacore Longline Pounds
2010	9,050,884
2011	5,482,742
2012	7,376,076
2013	4,673,320
2014	3,313,739
2015	3,937,366
2016	3,367,685
2017	3,296,465
2018	3,400,270
2019	2,232,098
Average	**4,613,065**
Standard Deviation	**2,125,442**

Table A-15. Supporting Data for Figure 16.

Year	Swordfish Longline Pounds
2010	20,437
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	8,128
Average	**17,114**
Standard Deviation	**5,722**

Table A-16. Supporting Data for Figure 17.

Year	Release Tunas	Release Non Tuna PMUS	Release Other Pelagics	Release Sharks
2010	16,703	18,007	1,025	5,099
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	1,834	16	3,208
Average	**3,650**	**8,516**	**383**	**4,911**
Standard Deviation	**5,088**	**5,783**	**415**	**1,049**

Table A-17. Supporting Data for Figure 18.

Year	Alias Catch per 1000 Hooks	Monohulls Catch per 1000 Hooks
2010	0.0	17.4
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	11.6
Average	**0.0**	**12.8**
Standard Deviation	**0.0**	**2.0**

Table A-18. Supporting Data for Figure 19.

Year	Troll Catch Pounds Per Hour	Effective Troll Hours
2010	20	316
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	840
Average	**30**	**914**
Standard Deviation	**14**	**503**

Table A-19. Supporting Data for Figure 20.

Year	**Trolling Catch Rates Skipjack**	**Trolling Catch Rates Yellowfin Tuna**
2010	8.78	9.23
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
Average	**14.40**	**11.31**
Standard Deviation	**8.55**	**6.35**

Table A-20. Supporting Data for Figure 21.

Year	**Trolling Catch Rates Blue Marlin**	**Trolling Catch Rates Mahimahi**	**Trolling Catch Rates Wahoo**
2010	0.00	0.00	0.29
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
Average	**0.68**	**0.89**	**1.08**
Standard Deviation	**0.81**	**0.71**	**1.14**

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
2010	70	123	4	119	115	3	112
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

Table A-22. Supporting Data for Figure 22.

Year	Number of Fishermen Landing Pelagic Species from Commercial Receipt Invoices
2010	40
2011	45
2012	35
2013	28
2014	21
2015	12
2016	73
2017	48
2018	56
2019	49
Average	**41**
Standard Deviation	**18**

Table A-23. Supporting Data for Figure 23.

Year	Number of Trips Catching Pelagic Fish from Commercial Receipt Invoices
2010	869
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
Average	**1,331**
Standard Deviation	**640**

Table A-24. Supporting Data for Figure 24.

Year	Estimated Total Trolling Trips	Estimated Trolling Trips Non Charter	Estimated Trolling Trips Charter
2010	4,293	4,164	128
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
Average	**3,336**	**3,262**	**74**
Standard Deviation	**626**	**614**	**93**

Table A-25. Supporting Data for Figure 25.

Year	Estimated Trolling Hours Total	Estimated Trolling Hours Non Charter	Estimated Trolling Hours Charter
2010	24,442	24,057	385
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
Average	**17,856**	**17,631**	**226**
Standard Deviation	**3,582**	**3,540**	**250**

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
2010	5.7	5.8	3.0
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
Average	**5.4**	**5.4**	**2.9**
Standard Deviation	**0.2**	**0.2**	**1.7**

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**
2010	535,874	426,315	90,926
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
Average	**408,539**	**320,150**	**82,092**
Standard Deviation	**75,078**	**74,173**	**21,053**

Table A-28. Supporting Data for Figure 28.

Year	**Estimated Total Landings Pelagic**	**Estimated Total Landings Non Charter**	**Estimated Total Landings Charter**
2010	535,874	532,585	3,288
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
Average	**408,539**	**405,815**	**2,725**
Standard Deviation	**75,078**	**74,805**	**3,064**

Table A-29. Supporting Data for Figure 29.

Year	Estimated Landings Tuna PMUS	Estimated Landings Non Charter	Estimated Landings Charter
2010	426,315	423,026	3,288
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
Average	**320,150**	**318,669**	**1,481**
Standard Deviation	**74,173**	**73,659**	**1,851**

Table A-30. Supporting Data for Figure 30.

Year	Estimated Landings Total Non-Tuna PMUS	Estimated Landings Non Charter	Estimated Landings Charter
2010	90,926	90,926	0
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
Average	**82,092**	**80,946**	**1,146**
Standard Deviation	**21,053**	**21,643**	**1,668**

Table A-31. Supporting Data for Figure 31.

Year	Estimated Total Landings Skipjack	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	366,579	366,217	361
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
Average	**280,882**	**279,729**	**1,152**
Standard Deviation	**64,549**	**64,627**	**1,729**

Table A-32. Supporting Data for Figure 32.

Year	Estimated Total Landings Yellowfin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	29,162	26,363	2,799
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
Average	**29,388**	**29,093**	**295**
Standard Deviation	**19,315**	**19,297**	**881**

Table A-33. Supporting Data for Figure 33.

Year	Estimated Total Landings Mahimahi	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	74,163	74,163	0
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
Average	**69,236**	**68,654**	**583**
Standard Deviation	**22,549**	**22,914**	**941**

Table A-34. Supporting Data for Figure 34.

Year	Estimated Total Landings Wahoo	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	13,514	13,514	0
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
Average	**8,956**	**8,393**	**563**
Standard Deviation	**5,060**	**4,621**	**901**

Table A-35. Supporting Data for Figure 35.

Year	Estimated Total Landings Blue Marlin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	0	0	0
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
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
2010	188,351	154,871	26,978
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
Average	**199,455**	**162,577**	**29,496**
Standard Deviation	**43,291**	**40,299**	**12,342**

Table A-37. Supporting Data for Figure 37.

Year	**Commercial Purchase Landings Skipjack**	**Commercial Purchase Landings Yellowfin**
2010	124,096	30,507
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
Average	**139,295**	**21,240**
Standard Deviation	**38,020**	**8,332**

Table A-38. Supporting Data for Figure 38.

Year	**Commercial Purchase Landings Mahimahi**	**Commercial Purchase Landings Wahoo**	**Commercial Purchase Landings Blue Marlin**
2010	23,157	2,887	73
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
Average	**23,947**	**3,790**	**1,051**
Standard Deviation	**10,563**	**3,163**	**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
2010	21.7	21.9	8.5
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
Average	**23.2**	**23.4**	**10.5**
Standard Deviation	**4.1**	**4.2**	**6.9**

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
2010	15.0	15.2	0.9
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
Average	**16.0**	**16.2**	**5.8**
Standard Deviation	**3.7**	**3.7**	**7.3**

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
2010	1.2	1.1	7.3
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
Average	**1.7**	**1.7**	**0.8**
Standard Deviation	**1.1**	**1.2**	**2.3**

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
2010	3.0	3.1	0.0
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
Average	**3.9**	**3.9**	**1.9**
Standard Deviation	**1.3**	**1.3**	**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
2010	0.6	0.6	0.0
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
Average	**0.5**	**0.5**	**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			
2016			
2017	0.2	0.2	0.0
2018	0.1	0.1	0.0
2019	0.2	0.2	0.0
Average	**0.3**	**0.3**	**0.0**
Standard Deviation	**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
2010	26.7	3.3	0.1
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
Average	**22.8**	**3.9**	**0.8**
Standard Deviation	**14.7**	**4.4**	**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
2010	143	35	95
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
Average	**121**	**19**	**89**
Standard Deviation	**51**	**10**	**19**

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
2010	96	1,134	684
2011	96	877	496
2012	97	498	274
2013	96	799	456
2014	90	964	511
2015	95	904	540
2016	94	1,147	728
2017	92	1,018	643
2018	91	979	652
2019	96	930	620

Table A-48. Supporting Data for Figure 47.

Year	Estimated Trolling Boats	Upper 95 Percent	Lower 95 Percent
2010	432	508.0	390.0
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	472	632.0	394.0
Average	**426**	**522**	**375**
Standard Deviation	**45**	**58**	**42**

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
2010	738,037	364,393	357,417
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	840,332	564,886	252,702
Average	**746,779**	**506,037**	**225,512**
Standard Deviation	**171,316**	**135,658**	**78,767**

Table A-50. Supporting Data for Figure 49.

Year	Estimated Total Landings Pelagic	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	738,037	676,719	61,316
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	840,332	786,896	53,437
Average	**746,779**	**701,727**	**45,052**
Standard Deviation	**171,316**	**160,796**	**14,666**

Table A-51. Supporting Data for Figure 50.

Year	Estimated Landings Tuna PMUS	Estimated Landings Non Charter	Estimated Landings Charter
2010	364,393	354,189	10,203
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	564,886	549,453	15,433
Average	**506,037**	**497,074**	**8,962**
Standard Deviation	**135,658**	**135,957**	**2,861**

Table A-52. Supporting Data for Figure 51.

Year	Estimated Total Landings Skipjack	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	338,652	329,365	9,286
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	479,966	466,653	13,313
Average	**440,553**	**432,855**	**7,698**
Standard Deviation	**113,839**	**114,095**	**2,698**

Table A-53. Supporting Data for Figure 52.

Year	Estimated Total Landings Yellowfin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	24,456	23,613	843
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	84,825	82,705	2,120
Average	**65,089**	**63,856**	**1,233**
Standard Deviation	**35,912**	**35,394**	**916**

Table A-54. Supporting Data for Figure 53.

Year	Estimated Total Landings Non Tuna PMUS	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	357,417	306,721	50,695
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	252,702	214,998	37,704
Average	**225,512**	**189,782**	**35,730**
Standard Deviation	**78,767**	**68,235**	**14,321**

Table A-55. Supporting Data for Figure 54.

Year	Estimated Total Landings Mahimahi	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	279,491	242,901	36,589
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	162,541	136,431	26,109
Average	**144,129**	**122,280**	**21,848**
Standard Deviation	**70,793**	**61,440**	**11,843**

Table A-56. Supporting Data for Figure 55.

Year	Estimated Total Landings Wahoo	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	44,392	41,490	2,902
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	32,600	29,094	3,506
Average	**50,259**	**44,418**	**5,841**
Standard Deviation	**23,277**	**20,584**	**3,621**

Table A-57. Supporting Data for Figure 56.

Year	Estimated Total Landings Blue Marlin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2010	32,007	20,803	11,204
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	56,020	47,995	8,025
Average	**29,487**	**21,891**	**7,597**
Standard Deviation	**14,684**	**13,611**	**3,221**

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
2010	224,603	27,935	191,275
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	139,216	51,646	79,963
Average	**134,807**	**45,199**	**84,709**
Standard Deviation	**39,194**	**11,325**	**47,591**

Table A-59. Supporting Data for Figure 58.

Year	Estimated Trolling Trips	Estimated Trolling Non Charter	Estimated Trolling Charter
2010	10,930	9,188	1,743
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	11,801	10,189	1,613
Average	**9,597**	**8,329**	**1,268**
Standard Deviation	**2,041**	**1,800**	**288**

Table A-60. Supporting Data for Figure 59.

Year	Estimated Trolling Hours Total	Estimated Trolling Hours Non Charter	Estimated Trolling Hours Charter
2010	53,587	48,215	5,372
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	60,163	54,679	5,484
Average	**51,300**	**46,869**	**4,431**
Standard Deviation	**10,968**	**10,010**	**1,282**

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
2010	4.9	5.2	3.1
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	3.4
Average	**5.4**	**5.7**	**3.5**
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
2010	13.7	14.0	11.4
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	13.9	14.3	9.7
Average	**14.6**	**15.0**	**10.4**
Standard Deviation	**2.2**	**2.1**	**3.2**

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
2010	6.3	6.8	1.7
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	8.0	8.5	2.4
Average	**8.7**	**9.3**	**1.8**
Standard Deviation	**1.7**	**1.9**	**0.7**

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
2010	0.5	0.5	0.2
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	1.5	0.4
Average	**1.2**	**1.3**	**0.3**
Standard Deviation	**0.5**	**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
2010	5.2	5.0	6.8
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	2.7	2.5	4.8
Average	**2.8**	**2.6**	**5.0**
Standard Deviation	**1.3**	**1.2**	**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
2010	0.8	0.9	0.5
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	0.6
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
2010	0.6	0.4	2.1
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	0.9	0.9	1.5
Average	**0.5**	**0.4**	**1.7**
Standard Deviation	**0.2**	**0.2**	**0.6**

Table A-68. Supporting Data for Figure 67. Data for 2015 through 2019 are confidential.

Year	Longline Transshipment Landings Total	Longline Transshipment Landings Bigeye Tuna	Longline Transshipment Landings Yellowfin Tuna
2010	1,898	988	715
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	*	*	*
Average	**2,133**	**1,451**	**495**
Standard Deviation	**211**	**336**	**154**

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
2010	17,606	5,363	5,343	244	33	28,405
2011	19,945	6,229	4,936	190	51	31,343
2012	21,296	5,107	5,682	181	26	32,288
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	24,807	5,700	5,902	115	5	36,529
Average	**22,886.9**	**5,996.6**	**6,042.1**	**161.2**	**22.9**	**35,090.1**
SD	**2,970.1**	**693.9**	**705.7**	**37.9**	**12.9**	**3,718.9**

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
2010	20,075	3,614	2,855	933	614	314	28,405
2011	22,796	3,500	2,966	1,129	610	342	31,343
2012	22,975	2,814	3,690	1,602	562	645	32,288
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	31,955	837	2,460	675	470	131	36,529
Average	**27,816.4**	**2,543.7**	**2,920.2**	**1,052.1**	**496.8**	**260.9**	**35,090.1**
SD	**4,857.2**	**916.9**	**453.6**	**279.7**	**157.0**	**200.3**	**3,718.9**

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
2010	14,140	200	1,381	818	597	470	17,606
2011	16,250	209	1,509	1,061	602	314	19,945
2012	16,590	131	1,926	1,496	548	605	21,296
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	22,310	93	1,207	615	462	120	24,807
Average	**19,526.9**	**150.8**	**1,509.8**	**960.7**	**485.3**	**253.4**	**22,886.9**
SD	**3,470.8**	**63.3**	**230.6**	**265.5**	**153.5**	**203.0**	**2,970.1**

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
2010	13,208	2,747	662	963	0	26	17,606
2011	13,477	3,855	854	1,736	0	23	19,945
2012	13,956	4,103	1,158	2,011	1	67	21,296
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	17,758	5,952	828	255	4	10	24,807
Average	**16,438.2**	**4,806.5**	**804.5**	**812.7**	**1.2**	**23.8**	**22,886.9**
SD	**2,311.7**	**1,693.1**	**198.0**	**610.9**	**1.3**	**17.9**	**2,970.1**

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**
2010	11,736	143	261	212	542	314	13,208
2011	12,315	106	243	140	515	158	13,477
2012	12,741	75	341	131	491	177	13,956
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	17,068	60	77	63	428	62	17,758
Average	**15,520.7**	**90.1**	**190.6**	**104.4**	**415.5**	**116.9**	**16,438.2**
SD	**2,623.0**	**31.4**	**117.2**	**54.6**	**157.7**	**98.3**	**2,311.7**

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**
2010	1,202	23	881	542	49	50	2,747
2011	2,009	38	970	704	84	50	3,855
2012	1,886	29	1,304	759	53	72	4,103
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	4,436	30	892	507	31	56	5,952
Average	**2,885.6**	**42.4**	**1,065.7**	**700.7**	**66.7**	**45.4**	**4,806.5**
SD	**1,686.8**	**37.0**	**149.7**	**140.4**	**33.3**	**20.7**	**1,693.1**

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**
2010	332	1	211	14	3	101	662
2011	453	1	279	17	3	101	854
2012	541	1	240	20	4	352	1,158
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	575	0	230	20	1	1	828
Average	**463.8**	**0.7**	**232.9**	**15.4**	**2.6**	**89.1**	**804.5**
SD	**84.4**	**0.4**	**46.2**	**4.1**	**2.5**	**117.1**	**198.0**

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**
2010	870	33	4	48	3	5	963
2011	1,473	64	8	186	0	5	1,736
2012	1,421	26	7	554	0	3	2,011
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
Average	**655.7**	**17.4**	**4.1**	**133.1**	**0.6**	**1.8**	**812.7**
SD	**470.7**	**19.2**	**2.5**	**156.0**	**0.9**	**2.0**	**610.9**

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**
2010	1,710	3,305	335	11	1	1	5,363
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	4,572	722	383	15	3	6	5,700
Average	**3,284.7**	**2,303.3**	**384.2**	**16.7**	**2.6**	**5.1**	**5,996.6**
SD	**933.0**	**857.5**	**51.9**	**3.5**	**1.9**	**3.0**	**693.9**

Table A-78. Supporting Data for Figure 77.

	Hawaii billfish catch (1,000 lbs)					
Year	**Swordfish**	**Blue marlin**	**Striped marlin**	**Spearfish**	**Other marlins**	**Total**
2010	3,700	975	376	280	32	5,363
2011	3,568	1,244	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	1,625	2,335	1,238	452	50	5,700
Average	**3,017.8**	**1,519.2**	**892.0**	**524.1**	**43.4**	**5,996.6**
SD	**705.1**	**438.8**	**242.5**	**144.1**	**8.8**	**693.9**

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**
2010	432	3,258	1	9	0	0	3,700
2011	456	3,100	1	11	0	0	3,568
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	897	720	1	7	0	1	1,625
Average	**746.7**	**2,257.8**	**1.1**	**11.2**	**0.2**	**0.7**	**3,017.8**
SD	**224.5**	**839.5**	**0.6**	**3.7**	**0.3**	**0.7**	**705.1**

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**
2010	657	18	296	2	1	1	975
2011	797	27	414	4	1	1	1,244
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	1,988	0	332	8	2	5	2,335
Average	**1,164.9**	**16.2**	**327.9**	**4.8**	**2.0**	**3.3**	**1,519.2**
SD	**433.1**	**9.9**	**45.2**	**1.6**	**1.4**	**1.8**	**438.8**

Table A-81. Supporting Data for Figure 80.

Year	Striped marlin catch (1,000 lbs)						
	Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
2010	338	26	12	0	0	0	376
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	1,207	1	29	0	0	1	1,238
Average	**842.5**	**25.1**	**23.5**	**0.2**	**0.1**	**0.5**	**892.0**
SD	**245.2**	**13.2**	**7.1**	**0.3**	**0.2**	**0.5**	**242.5**

Table A-82. Supporting Data for Figure 81.

Year	Catch of other PMUS by gear type (1,000 lbs)						
	Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
2010	4,199	109	1,135	102	16	26	5,587
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	5,069	22	869	45	5	5	6,017
Average	**4,986.3**	**89.6**	**1,022.8**	**74.1**	**8.8**	**21.7**	**6,203.3**
SD	**677.3**	**36.6**	**251.7**	**24.4**	**4.7**	**13.3**	**682.7**

Table A-83. Supporting Data for Figure 82.

	Catch of other PMUS by species (1,000 lbs)						
Year	**Mahimahi**	**Moonfish**	**Oilfish**	**Ono**	**Pomfret**	**PMUS shark**	**Total**
2010	1,703	1,781	521	758	580	244	5,587
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	1,000	2,255	306	1,591	749	115	6,017
Average	**1,455.2**	**2,175.7**	**473.6**	**1,047.9**	**889.7**	**161.2**	**6,203.3**
SD	**357.8**	**456.2**	**111.3**	**277.7**	**275.1**	**37.9**	**682.7**

Table A-84. Supporting Data for Figure 83.

	Moonfish catch (1,000 lbs)			
Year	**Deep-set longline**	**Shallow-set longline**	**Other gear**	**Total**
2010	1,772	9	0	1,781
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	2,253	3	0	2,255
Average	**2,157.8**	**17.6**	**0.3**	**2,175.7**
SD	**452.0**	**12.0**	**0.6**	**456.2**

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**
2010	934	31	671	41	14	12	1,703
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	431	2	548	17	2	1	1,000
Average	**714.1**	**29.4**	**666.4**	**31.2**	**5.7**	**8.5**	**1,455.2**
SD	**179.3**	**19.1**	**171.6**	**14.0**	**5.1**	**6.0**	**357.8**

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**
2010	277	3	463	11	1	3	758
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	1,252	0	321	14	2	2	1,591
Average	**673.9**	**1.3**	**355.4**	**13.4**	**1.0**	**2.8**	**1,047.9**
SD	**307.8**	**0.9**	**92.3**	**3.5**	**0.6**	**1.1**	**277.7**

Table A-87. Supporting Data for Figure 86.

	Pomfret catch (1,000 lbs)					
Year	Deep-set longline	Shallow-set longline	MHI handline	Offshore handline	Other gear	Total
2010	525	1	43	1	10	580
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	731	0	15	2	2	749
Average	**850.5**	**1.3**	**27.0**	**2.0**	**8.9**	**889.6**
SD	**267.8**	**1.5**	**12.9**	**2.4**	**6.8**	**275.1**

Table A-88. Supporting Data for Figure 87.

	PMUS shark catch (1,000 lbs)			
Year	Deep-set longline	Shallow-set longline	Non-longline	Total
2010	210	28	6	244
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	98	16	1	115
Average	**134.8**	**22.9**	**3.5**	**161.2**
SD	**34.3**	**10.7**	**1.7**	**37.9**

Table A-89. Supporting Data for Figure 88.

	Deep-set longline		
Year	**Vessels**	**Trips**	**Sets**
2010	122	1,206	16,075
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	150	1,724	22,513
Average	**137.5**	**1,444.1**	**18,897.3**
SD	**8.8**	**157.4**	**1865.9**

Table A-90. Supporting Data for Figure 89.

	Number of deep-set hooks by area (millions)			
Year	**Outside EEZ**	**Hawaii EEZ**	**PRIA EEZ**	**Total**
2010	27.9	7.9	1.4	37.2
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	48.9	14.3	0.0	63.2
Average	**35.32**	**12.88**	**0.66**	**48.86**
SD	**7.33**	**2.15**	**0.68**	**7.94**

Table A-91. Supporting Data for Figure 90.

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2010	20,075	$75,549	$63,014	234.9
2011	22,796	$82,310	$71,211	243.6
2012	22,975	$97,780	$86,627	249.5
2013	25,006	$93,571	$84,376	253.9
2014	26,615	$85,942	$78,617	257.6
2015	32,136	$98,740	$91,229	260.2
2016	31,434	$105,288	$99,190	265.3
2017	32,760	$99,523	$96,137	272.0
2018	32,410	$102,982	$101,332	277.1
2019	31,955	$92,861	$92,861	281.6
Average	**27,816.4**	**$93,454.6**	**$86,459.5**	
SD	**4,857.2**	**$9,521.3**	**$12,421.8**	

Table A-92. Supporting Data for Figure 91.

	Deep-set longline CPUE (fish per 1,000 hooks)		
Year	Bigeye tuna	Yellowfin tuna	Albacore
2010	3.6	0.4	0.5
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
Average	**4.03**	**0.77**	**0.32**
SD	**0.47**	**0.36**	**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**
2010	0.1	0.1	0.1
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
Average	**0.10**	**0.26**	**0.12**
SD	**0.00**	**0.08**	**0.04**

Table A-94. Supporting Data for Figure 93.

	Deep-set CPUE (fish per 1000 hooks)
Year	**Blue shark**
2010	1.1
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
Average	**1.33**
SD	**0.28**

Table A-95. Supporting Data for Figure 94.

	Shallow-set longline		
Year	**Vessels**	**Trips**	**Sets**
2010	28	115	1,873
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
Average	**18.1**	**65.8**	**1,052.6**
SD	**5.0**	**27.1**	**484.6**

Table A-96. Supporting Data for Figure 95.

	Number of hooks set by area (milions)			
Year	**Outside EEZ**	**Hawaii EEZ**	**PRIA EEZ**	**Total**
2010	1.4	0.5	0.0	1.8
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
Average	**0.97**	**0.16**	**0.00**	**1.14**
SD	**0.34**	**0.15**	**0.00**	**0.46**

Table A-97. Supporting Data for Figure 96.

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2010	3,614	$7,921	$6,607	234.9
2011	3,500	$7,057	$6,105	243.6
2012	2,814	$6,548	$5,801	249.5
2013	2,345	$3,526	$3,180	253.9
2014	3,255	$4,454	$4,074	257.6
2015	2,778	$3,041	$2,810	260.2
2016	1,849	$2,638	$2,486	265.3
2017	3,007	$4,379	$4,230	272.0
2018	1,438	$1,576	$1,551	277.1
2019	837	$1,969	$1,969	281.6
Average	**2,543.7**	**$4,310.9**	**$3,881.2**	
SD	**916.9**	**$2,200.8**	**$1,791.8**	

Table A-98. Supporting Data for Figure 97.

	Shallow-set longline CPUE (fish per 1,000 hooks)		
Year	Bigeye tuna	Yellowfin tuna	Albacore
2010	0.9	0.1	1.0
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
Average	**1.20**	**0.52**	**0.58**
SD	**0.77**	**0.57**	**0.57**

Table A-99. Supporting Data for Figure 98.

	Shallow-set longline CPUE (fish per 1,000 hooks)		
Year	**Swordfish**	**Striped marlin**	**Blue marlin**
2010	9.3	0.1	0.0
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
Average	**10.99**	**0.24**	**0.06**
SD	**1.27**	**0.15**	**0.05**

Table A-100. Supporting Data for Figure 99.

	Shallow-set CPUE (fish per 1000 hooks)
Year	**Blue shark**
2010	9.3
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
Average	**7.69**
SD	**3.00**

Table A-101. Supporting Data for Figure 100.

Year	Fishers	Days fished
2010	1,614	29,378
2011	1,676	29,274
2012	1,769	30,537
2013	1,731	26,974
2014	1,697	27,383
2015	1,626	26,553
2016	1,485	23,461
2017	1,414	21,399
2018	1,383	21,851
2019	1,291	20,359
Average	**1,568.6**	**25,716.9**
SD	**164.1**	**3,677.7**

Table A-102. Supporting Data for Figure 101.

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2010	2,855	$6,110	$5,410	234.9
2011	2,966	$6,279	$5,766	243.6
2012	3,690	$9,139	$8,594	249.5
2013	3,117	$8,151	$7,350	253.9
2014	3,486	$9,148	$8,368	257.6
2015	3,094	$8,403	$7,763	260.2
2016	2,582	$8,023	$7,558	265.3
2017	2,209	$6,598	$6,374	272.0
2018	2,743	$8,121	$7,991	277.1
2019	2,460	$7,229	$7,229	281.6
Average	**2,920.2**	**$7,720.0**	**$7,240.5**	
SD	**453.6**	**$1,111.7**	**$1,071.4**	

Table A-103. Supporting Data for Figure 102.

MHI troll tuna CPUE (pounds per day fished)		
Year	Yellowfin tuna	Skipjack tuna
2010	30.1	7.2
2011	33.5	9.6
2012	42.9	7.9
2013	40.0	12.2
2014	44.7	6.3
2015	41.3	8.0
2016	44.1	11.0
2017	44.5	10.0
2018	56.7	8.5
2019	43.8	11.3
Average	**42.17**	**9.20**
SD	**7.13**	**1.94**

MHI troll tuna CPUE (pounds per hour fished)		
Year	Yellowfin tuna	Skipjack tuna
2010	4.6	1.1
2011	5.0	1.4
2012	6.3	1.2
2013	5.9	1.8
2014	6.6	0.9
2015	6.4	1.2
2016	6.8	1.7
2017	6.9	1.6
2018	8.6	1.3
2019	6.7	1.7
Average	**6.38**	**1.39**
SD	**1.09**	**0.30**

Table A-104. Supporting Data for Figure 103.

MHI troll marlin CPUE (pounds per day fished)		
Year	Blue marlin	Striped marlin
2010	10.0	0.4
2011	14.3	1.2
2012	9.1	0.8
2013	10.5	0.7
2014	11.6	1.0
2015	14.8	0.9
2016	13.4	1.1
2017	14.3	0.6
2018	15.4	1.2
2019	16.3	1.4
Average	**12.97**	**0.93**
SD	**2.49**	**0.31**

MHI troll marlin CPUE (pounds per hour fished)		
Year	Blue marlin	Striped marlin
2010	1.5	0.1
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
Average	**1.97**	**0.14**
SD	**0.40**	**0.05**

Table A-105. Supporting Data for Figure 104.

MHI troll mahimahi and ono CPUE (pounds per day fished)		
Year	Mahimahi	Ono (wahoo)
2010	22.9	15.5
2011	22.7	10.6
2012	32.6	14.0
2013	23.8	14.8
2014	32.9	17.0
2015	27.6	15.8
2016	23.9	11.5
2017	19.5	8.7
2018	25.3	13.8
2019	26.9	15.8
Average	**25.83**	**13.75**
SD	**4.30**	**2.65**

MHI troll mahimahi and ono CPUE (pounds per hour fished)		
Year	Mahimahi	Ono (wahoo)
2010	3.5	2.4
2011	3.4	1.6
2012	4.8	2.1
2013	3.5	2.2
2014	4.9	2.5
2015	4.3	2.4
2016	3.7	1.8
2017	3.0	1.4
2018	3.8	2.1
2019	4.1	2.4
Average	**3.90**	**2.08**
SD	**0.61**	**0.39**

Table A-106. Supporting Data for Figure 105.

Year	Fishers	Days fished
2010	560	4,416
2011	584	5,362
2012	651	6,585
2013	592	5,467
2014	556	5,096
2015	528	4,880
2016	471	4,009
2017	491	4,669
2018	427	4,023
2019	438	3,629
Average	**529.8**	**4,813.6**
SD	**72.3**	**869.5**

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.

Year	MHI handline CPUE (pounds per day fished)			
	Yellowfin tuna	Albacore	Bigeye tuna	Total
2010	122.8	10.5	48.5	181.8
2011	132.8	34.2	26.2	193.2
2012	118.8	84.7	21.6	225.1
2013	164.2	18.5	26.9	209.6
2014	157.0	21.2	20.9	199.1
2015	179.9	28.6	15.2	223.7
2016	137.9	13.3	23.3	174.5
2017	162.3	16.3	10.3	188.9
2018	156.2	11.1	7.4	174.7
2019	139.7	6.0	17.4	163.1
Average	**147.16**	**24.44**	**21.77**	**193.36**
SD	**19.75**	**22.85**	**11.35**	**21.08**

Year	MHI handline CPUE (pounds per hour fished)			
	Yellowfin tuna	Albacore	Bigeye tuna	Total
2010	17.9	1.5	7.1	26.4
2011	18.8	4.9	3.7	27.4
2012	16.6	11.8	3.0	31.4
2013	22.5	2.5	3.7	28.7
2014	21.7	2.9	2.9	27.5
2015	26.4	4.2	2.2	32.8
2016	20.3	2.0	3.4	25.7
2017	22.3	2.2	1.4	25.9
2018	23.4	1.7	1.1	26.2
2019	21.4	0.9	2.7	24.9
Average	**21.11**	**3.46**	**3.12**	**27.69**
SD	**2.87**	**3.17**	**1.64**	**2.57**

Table A-109. Supporting Data for Figure 108.

Year	Fishers	Days fished
2010	14	449
2011	13	368
2012	15	356
2013	15	552
2014	9	284
2015	9	255
2016	6	178
2017	6	229
2018	5	218
2019	7	261
Average	**9.9**	**315.0**
SD	**4.0**	**116.3**

Table A-110. Supporting Data for Figure 109.

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2010	614	$1,389	$1,230	234.9
2011	610	$908	$834	243.6
2012	562	$1,163	$1,094	249.5
2013	831	$1,994	$1,798	253.9
2014	416	$851	$778	257.6
2015	409	$879	$812	260.2
2016	366	$980	$923	265.3
2017	323	$926	$894	272.0
2018	366	$973	$958	277.1
2019	470	$1,018	$1,018	281.6
Average	**496.8**	**$1,108.1**	**$1,033.9**	
SD	**157.0**	**$349.8**	**$301.5**	

Table A-111. Supporting Data for Figure 110.

	Offshore handline CPUE (pounds per day fished)			
Year	**Bigeye tuna**	**Yellowfin tuna**	**Mahimahi**	**Total**
2010	1,208	110	32	1,350
2011	1,400	229	18	1,647
2012	1,443	154	36	1,634
2013	1,304	150	21	1,476
2014	1,228	183	20	1,431
2015	1,457	99	9	1,564
2016	1,744	289	3	2,036
2017	808	541	6	1,356
2018	1,118	524	7	1,649
2019	1,640	120	7	1,767
Average	**1,335.0**	**239.9**	**15.9**	**1,590.8**
SD	**267.5**	**164.6**	**11.5**	**208.2**

TABLES FOR SECTION 3.1: SOCIOECONOMICS

Table A-112. Supporting Data for Figure 119.

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 120.

Year	**Est. Pounds landed**	**Est. Pounds sold to canneries (lb.)**	**Est. Revenue ($ nominal)**	**Est. Revenue ($ adjusted)**	**CPI adjustor**
2010	11,277,555	11,115,052	10,952,491	12,923,939	1.18
2011	7,863,080	7,682,010	8,917,093	9,719,631	1.09
2012	9,694,833	9,509,956	10,135,225	10,641,986	1.05
2013	6,133,179	5,983,900	6,376,652	6,567,952	1.03

2014	5,135,626	5,004,402	5,207,728	5,363,960	1.03
2015	5,618,517	5,497,704	5,709,718	5,938,107	1.04
2016	4,799,175	4,685,645	4,780,704	4,971,932	1.04
2017	5,095,672	4,935,771	5,376,452	5,483,981	1.02
2018	4,445,622	4,329,426	5,577,185	5,577,185	1
2019	2,976,795	2,886,415	3,899,222	3,899,222	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-114. Supporting Data for Figure 121.

Year	Albacore price ($/MT)	Albacore price ($/MT Adjusted)	Average fish price ($/lb)	Average fish price adj ($/lb)	CPI adjustor
2010			0.99	1.16	1.18
2011			1.16	1.27	1.09
2012	3,193	3,352	1.07	1.12	1.05
2013	2,254	2,322	1.07	1.10	1.03
2014	2,707	2,788	1.04	1.07	1.03
2015	2,651	2,757	1.04	1.08	1.04
2016	2,498	2,598	1.02	1.06	1.04
2017	2,559	2,611	1.09	1.11	1.02
2018	3,086	3,086	1.29	1.29	1
2019	3,542	3,542	1.35	1.35	1

Table A-115. Supporting Data for Figure 123 and Figure 124.

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
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 125 and Figure 126.

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
2010	1,682	1,984	421,250	497,075	0.28	1.18
2011	1,476	1,609	371,546	404,985	0.29	1.09
2012	1,658	1,741	389,816	409,307	0.34	1.05
2013	1,279	1,318	289,848	298,543	0.27	1.03
2014	1,279	1,318	226,423	233,216	0.42	1.03
2015	1,314	1,367	271,891	282,767	0.42	1.04
2016	1,309	1,362	239,035	248,597	0.49	1.04
2017	1,501	1,531	358,430	365,599	0.33	1.02
2018	1,751	1,751	429,014	429,014	0.28	1
2019	1,407	1,407	229,366	229,366	0.61	1

Table A-117. Supporting Data for Figure 127 and Figure 128.

Year	Est. pounds caught (lb.)	Est. pounds sold (lb.)	Est. revenue ($)	Est. revenue ($ adj.)	% of pounds sold	Fish price ($)	Fish price ($ adj.)	CPI adjustor
2010	6,428	4,648	7,104	8,369	72%	1.53	1.80	1.178
2011	36,516	640	821	895	2%	1.28	1.40	1.09
2012	26,047	9,800	13,294	14,026	38%	1.36	1.43	1.055
2013	22,961	6,627	9,336	9,653	29%	1.41	1.46	1.034
2014	25,441	6,946	10,128	10,401	27%	1.46	1.50	1.027
2015	16,100	6,240	12,577	13,030	39%	2.02	2.09	1.036
2016	27,400	5,838	13,340	13,834	21%	2.29	2.37	1.037
2017	29,363	8,863	24,353	24,743	30%	2.75	2.79	1.016
2018	25,332	16,314	49,597	49,597	64%	3.04	3.04	1
2019	20,479	13,715	37,710	37,710	67%	2.75	2.75	1

Table A-118. Supporting Data for Figure 129.

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
2010*								
2011	90	98	88	0	0	5	4.68	1.09
2012	94	99	73	12	0	10	4.51	1.05

2013	92	95	70	15	0	6	4.38	1.03
2014	71	73	61	5	3	2	2.19	1.03
2015	82	85	66	15	0	2	2.23	1.04
2016	77	80	51	20	1	7	2.34	1.04
2017	105	106	80	21	1	2	2.44	1.02
2018	121	121	98	16	1	4	3.06	1
2019	129	129	92	22	1	12	3.07	1

Table A-119. 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
2010	535,875	188,351	339,846	339,166	35%	1.8	1.80	0.998
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	1.000
2017	340,870	224,443	524,444	524,444	66%	2.34	2.34	1.000
2018	465,007	221,509	535,222	535,222	48%	2.42	2.42	1.000
2019	466,269	177,619	464,101	464,101	38%	2.61	2.61	1.000

Table A-120. 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
2010	72.9	72.8	17.26	2.29	0.00	0.00	3.84	1.00
2011	81.2	79.2	16.03	1.50	0.98	0.10	4.57	0.98
2012	91.3	88.1	49.35	7.53	2.37	0.00	4.74	0.97
2013	97.2	96.2	56.23	3.41	1.75	0.58	4.96	0.99
2014	93.7	91.8	19.43	2.54	0.00	0.00	4.83	0.98
2015	78.5	80.2	32.63	3.20	0.00	0.00	4.16	1.02
2016	69.4	69.4	57.08	7.50	0.00	0.00	3.59	1.00
2017	76.0	76.0	32.05	5.36	0.71	0.00	3.87	1.00
2018	78.4	78.4	28.96	4.10	0.00	0.00	4.17	1.00
2019	75.5	75.5	64.35	4.92	0.00	0.00	3.94	1.00

Table A-121. 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
2010	738,036	224,603	462,964	554,631	30%	2.06	2.47	1.20
2011	591,947	143,048	289,751	336,111	24%	2.03	2.35	1.16
2012	397,776	118,038	244,382	274,685	30%	2.07	2.33	1.12
2013	799,482	176,108	398,716	448,157	22%	2.26	2.54	1.12
2014	764,150	121,632	242,719	270,632	16%	2.00	2.23	1.12
2015	959,906	109,395	214,560	241,380	11%	1.96	2.21	1.13
2016	883,582	100,551	216,029	229,207	11%	2.15	2.28	1.06
2017	600,826	118,457	265,559	274,854	20%	2.24	2.32	1.04
2018	891,746	97,019	231,632	233,717	11%	2.39	2.41	1.01
2019	840,332	139,216	312,708	312,708	17%	2.25	2.25	1.00

Table A-122. 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	96	112	83.0	11.9	4.71	11.17	5.26	1.160
2012	116	130	84.3	12.7	5.28	27.09	5.35	1.120
2013	92	104	70.3	12.8	0.97	18.96	5.32	1.120
2014	101	112	70.7	12.2	4.15	24.65	5.16	1.110
2015	92	103	53.4	12.1	7.90	29.28	4.27	1.120
2016	76	81	44.4	10.9	3.94	21.13	3.75	1.060
2017	99	103	47.7	20.3	9.81	23.96	3.92	1.040
2018	112	113	63.1	18.5	12.52	17.73	4.13	1.010
2019	96	96	54.7	16.4	1.47	23.19	4.08	1

Table A-123. Supporting Data for Figure 136.

Year	Estimated total landings (million lbs.)	Estimated total value (million lbs.)	Pounds sold in Hawaii markets (million lbs.)	Revenue from Hawaii markets ($ million)	Revenue adjusted (millions)	Price ($/lb.)	Price adjusted ($/lb.)	CPI adjustor
2010	19.47	72.12	19.47	69.56	83.47	3.57	4.29	1.2
2011	26.52	83.33	21.17	78.54	91.11	3.71	4.30	1.16

2012	26.14	96.54	21.33	92.44	104.45	4.33	4.90	1.13
2013	27.28	92.56	22.66	88.45	98.18	3.90	4.33	1.11
2014	29.81	87.31	23.93	82.81	90.26	3.46	3.77	1.09
2015	34.40	102.44	27.12	94.01	101.53	3.47	3.74	1.08
2016	33.12	110.67	26.32	102.13	108.26	3.88	4.11	1.06
2017	35.60	108.48	28.37	101.03	105.07	3.56	3.70	1.04
2018	33.49	109.29	26.80	102.37	104.41	3.82	3.90	1.02
2019	32.38	99.89	26.78	94.01	94.01	3.51	3.51	1.00

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 137.

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
2010	48.64	3.92	8.95	10.61	58.60	4.70	10.80	12.80	1.204
2011	53.37	6.27	9.27	14.42	63.00	7.40	10.90	17.00	1.180
2012	62.22	7.73	9.05	17.45	70.70	8.80	10.30	19.80	1.137
2013	62.98	6.79	8.57	14.24	70.00	7.50	9.50	15.80	1.111
2014	60.27	5.39	7.80	13.86	65.80	5.90	8.50	15.10	1.091
2015	73.24	5.85	8.22	15.13	78.80	6.30	8.80	16.30	1.076
2016	75.64	9.54	7.12	18.37	80.60	10.20	7.60	19.60	1.065
2017	67.68	15.90	8.48	16.42	70.70	16.60	8.80	17.10	1.044
2018	69.53	19.85	4.85	15.21	70.80	20.20	4.90	15.50	1.019
2019	65.85	15.29	4.24	14.51	65.80	15.30	4.20	14.50	1.000

Table A-125. Supporting Data for Figure 138.

Year	Bigeye price	Bigeye price adj.	Yellowfin price	Yellowfin price adj.	Swordfish price	Swordfish price adj.	CPI Adjustor
2010	3.75	4.50	2.85	3.42	2.43	2.91	1.199
2011	4.08	4.72	3.21	3.71	2.63	3.05	1.156
2012	4.26	4.81	3.03	3.42	2.89	3.26	1.129
2013	4.82	5.34	3.96	4.40	3.07	3.40	1.109
2014	4.43	4.84	4.25	4.65	2.12	2.32	1.094
2015	3.85	4.17	3.77	4.08	2.46	2.66	1.082
2016	3.85	4.08	2.99	3.17	2.96	3.14	1.061
2017	4.18	4.33	2.92	3.02	2.38	2.46	1.035
2018	3.86	3.92	2.79	2.83	2.09	2.13	1.016

2019	4.20	4.20	3.63	3.63	2.63	2.63	1

Data source: Pacific Islands Fisheries Science Center pelagic module data request.

Table A-126. Supporting Data for Figure 141.

Year	Total trip costs ($)	Total trip costs ($ adjusted)	Fuel cost ($ adjusted)	Ice cost ($ adjusted)	Bait & chum cost ($ adjusted)	Gear cost ($ adjusted)	Communication cost ($ adjusted)	Provision cost ($ adjusted)	Engine oil cost ($ adjusted)	CPI Adjustor
2010	$23,204	$27,821	$14,980	$1,193	$5,341	$2,682	$488	$2,345	$588	1.199
2011	$28,097	$32,480	$18,933	$978	$6,337	$2,737	$452	$2,496	$601	1.156
2012	$29,981	$33,849	$19,764	$867	$6,630	$2,819	$619	$2,489	$688	1.129
2013	$29,264	$32,453	$18,296	$644	$6,620	$3,096	$603	$2,523	$599	1.109
2014	$29,750	$32,546	$18,219	$619	$6,917	$2,964	$581	$2,633	$695	1.094
2015	$25,881	$28,003	$13,444	$593	$6,850	$3,171	$661	$2,740	$576	1.082
2016	$24,242	$25,720	$11,425	$477	$6,874	$3,091	$624	$2,710	$595	1.061
2017	$23,653	$24,481	$10,894	$503	$6,332	$2,992	$683	$2,511	$624	1.035
2018	$25,529	$25,938	$13,069	$321	$5,798	$2,657	$687	$2,514	$567	1.016
2019	$25,874	$25,874	$13,652	$229	$5,885	$2,654	$720	$2,641	$542	1

Table A-127. Supporting Data for Figure 142.

Year	Total trip costs ($)	Total trip costs ($ adjusted)	Fuel cost ($ adjusted)	Ice cost ($ adjusted)	Bait & chum cost ($ adjusted)	Gear cost ($ adjusted)	Communication cost ($ adjusted)	Provision cost ($ adjusted)	Engine oil cost ($ adjusted)	CPI Adjustor
2010	$41,770	$50,082	$28,011	$418	$7,380	$4,109	$794	$3,447	$5,120	1.199
2011	$56,518	$65,335	$41,069	$373	$8,264	$4,419	$768	$3,667	$5,949	1.156
2012	$57,621	$65,054	$39,798	$282	$9,674	$3,808	$751	$3,823	$5,930	1.129
2013	$49,740	$55,162	$31,961	$282	$8,435	$3,866	$1,030	$3,552	$4,974	1.109
2014	$51,878	$56,755	$32,625	$200	$9,320	$3,526	$1,083	$3,506	$5,563	1.094
2015	$41,984	$45,427	$22,424	$248	$8,203	$3,769	$1,200	$3,681	$4,860	1.082
2016	$39,993	$42,433	$18,176	$0	$8,384	$3,716	$820	$3,884	$6,541	1.061
2017	$37,604	$38,920	$17,863	$152	$7,146	$3,462	$733	$3,597	$5,079	1.035
2018	$44,255	$44,963	$22,266	$347	$8,361	$3,968	$973	$3,734	$4,398	1.016
2019	$34,548	$34,548	$18,090	$0	$5,979	$3,047	$675	$3,206	$2,821	1

Table A-128. Supporting Data for Figure 143.

Year	**Trip costs ($)**	**Trip costs ($ adjusted)**	**Revenue ($ adjusted)**	**Net revenue ($ adjusted)**	**CPI Adjustor**
2010	23,204	27,821	67,376	39,555	1.199
2011	28,097	32,480	67,739	35,259	1.156
2012	29,981	33,849	77,482	43,633	1.129
2013	29,264	32,453	71,159	38,705	1.109
2014	29,750	32,546	67,352	34,806	1.094
2015	25,881	28,003	72,518	44,515	1.082
2016	24,242	25,720	82,088	56,367	1.061
2017	23,653	24,481	69,412	44,931	1.035
2018	25,529	25,938	67,742	41,805	1.016
2019	25,874	25,874	59,779	33,906	1

Table A-129. Supporting Data for Figure 144.

Year	Trip costs ($)	Trip costs adjusted ($)	Revenue adjusted ($)	Net revenue adjusted ($)	CPI Adjustor
2010	41,754	50,063	87,048	36,985	1.199
2011	56,508	65,323	119,607	54,284	1.156
2012	57,602	65,033	115,800	50,767	1.129
2013	49,739	55,160	117,892	62,732	1.109
2014	51,829	56,701	95,145	38,444	1.094
2015	41,966	45,407	84,448	39,040	1.082
2016	39,912	42,346	119,869	77,523	1.061
2017	37,584	38,900	112,595	73,696	1.035
2018	43,390	44,084	111,621	67,537	1.016
2019	34,720	34,720	107,887	73,167	1

Table A-130. Supporting Data for Figure 145 and Figure 146.

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
2010	2,287	2,744	581,613	697,936	0.22	1.2
2011	2,652	3,076	645,948	749,300	0.22	1.16
2012	2,943	3,326	748,341	845,625	0.19	1.13
2013	2,791	3,098	685,658	761,080	0.22	1.11
2014	2,624	2,860	623,658	679,787	0.23	1.09
2015	3,055	3,300	726,504	784,625	0.22	1.08
2016	3,269	3,465	784,913	832,008	0.21	1.06
2017	3,147	3,273	753,348	783,482	0.20	1.04
2018	3,092	3,154	769,632	785,025	0.20	1.02
2019	2,662	2,662	684,163	684,163	0.18	1.00

Table A-131. Supporting Data for Figure 147, 150, 152, 153, and 154.

Year	MHI troll	MHI handline	Offshore handline	Other gears	Total commercial landings
2010	1,991,478	738,344	535,309	201,522	3,466,652
2011	2,006,516	842,589	461,658	190,634	3,501,398

2012	2,614,952	1,321,891	471,747	256,750	4,665,341
2013	2,388,139	1,080,059	750,582	275,328	4,494,109
2014	2,719,593	984,240	327,223	108,784	4,139,840
2015	2,391,194	1,009,188	329,122	123,634	3,853,138
2016	2,129,458	713,939	352,155	62,486	3,258,038
2017	1,799,547	857,076	291,831	63,220	3,011,674
2018	2,203,539	662,986	301,282	83,251	3,251,058
2019	1,984,498	586,069	373,741	107,961	3,052,270

Table A-132. Supporting Data for Figure 148, 150, 152, 153, and 154..

Year	MHI handline adjusted	MHI troll adjusted	Offshore handline adjusted	Other gears adjusted
2010	2,247,330	6,568,321	1,421,730	556,871
2011	2,528,162	6,957,506	1,348,380	579,806
2012	3,967,197	10,165,975	1,624,650	902,573
2013	3,594,412	8,212,381	2,031,923	776,695
2014	3,233,005	9,116,281	904,363	327,103
2015	3,159,187	8,323,671	856,942	360,693
2016	2,529,293	8,026,706	984,255	195,597
2017	2,985,856	6,595,868	919,139	219,804
2018	2,428,110	8,121,708	973,316	303,241
2019	2,153,028	7,229,877	1,017,564	349,109

Table A-133. Supporting Data for Figure 149.

Year	MHI troll price ($/lb), adjusted	MHI handline price ($/lb), adjusted	Offshore price ($/lb), adjusted	Other gears price ($/lb), adjusted
2010	3.04	3.30	2.66	2.76
2011	3.00	3.47	2.92	3.04
2012	3.00	3.89	3.44	3.52
2013	3.33	3.44	2.71	2.82
2014	3.28	3.35	2.76	3.01
2015	3.13	3.48	2.60	2.92
2016	3.54	3.77	2.79	3.13
2017	3.48	3.67	3.15	3.48
2018	3.66	3.69	3.23	3.64
2019	3.67	3.64	2.72	3.23

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
Emily Crigler; NMFS PIRO	International Fisheries
Josh Lee; NMFS PIRO	Sustainable Fisheries
Michael Quach; NMFS PIFSC	Fisheries Research & Monitoring
Stefanie Dukes, NMFS PIFSC	Observer Program
Michael Fujimoto; Hawaii Division of Aquatic Resources	Hawaii
Sean Felise; A.S. Dept. of Marine & Wildlife Resources	American Samoa
William Dunn; CNMI Division of Fish & Wildlife	CNMI
Brent Tibbatts; Guam Division of Aquatic & Wildlife Resources	Guam
Reginald Kokubun; Hawaii Division of Aquatic Resources	Ex-Officio
Felipe Carvalho; NMFS PIFSC	Ex-Officio