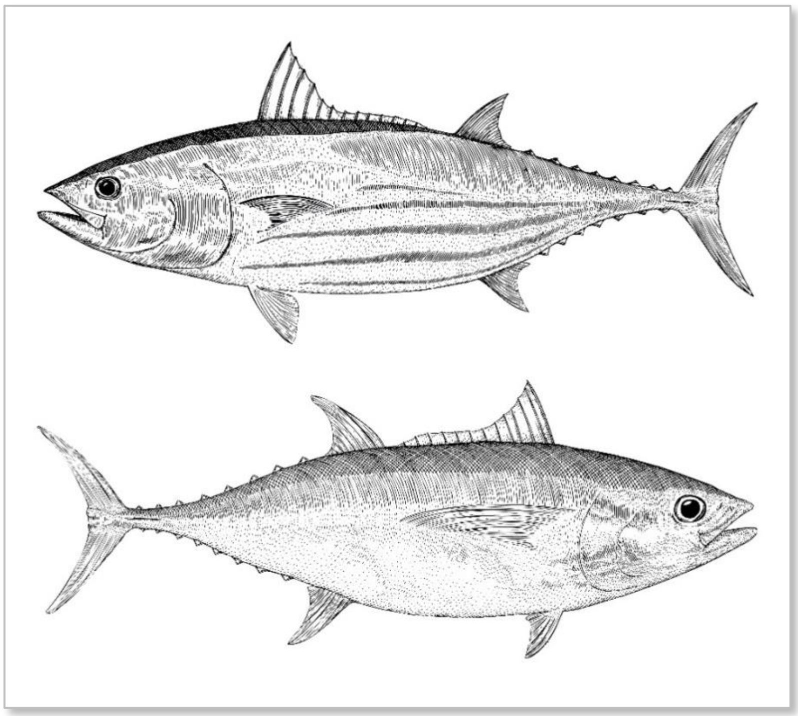
Annual Stock Assessment and Fishery Evaluation Report for U.S. Pacific Island Pelagic Fisheries Ecosystem Plan
2018



Western Pacific Regional Fishery Management Council
1164 Bishop St., Suite 1400
Honolulu, HI 96813

PHONE: (808) 522-8220
FAX: (808) 522-8226
www.wpcouncil.org

Cover image: Skipjack and Bigeye Tuna, iStock Photos (http://www.istockphoto.com/).

Prepared by: Council Staff and the Pelagics Plan Team.

Edited By: Thomas Remington, Mark Fitchett, and Asuka Ishizaki, WPRFMC.

This document can be cited as follows:
WPRFMC, 2019. Annual Stock Assessment and Fishery Evaluation Report Pacific Island Pelagic Fishery Ecosystem Plan 2018. Remington, T., Fitchett, M., Ishizaki, A., (Eds.) Western Pacific Regional Fishery Management Council. Honolulu, Hawaii 96813 USA.375 pp. + Appendices.

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

Hawaii Division of Aquatic Resources: Reginald Kokubun, Michael Fujimoto, and Ryan Okano.

American Samoa Department of Marine and Wildlife Resources: Tepora Toliniu Lavata'i.

Guam Division of Aquatic and Wildlife Resources: Brent Tibbatts.

CNMI Division of Fish and Wildlife: William Dunn.

NMFS Pacific Islands Fisheries Science Center: Keith Bigelow, Russel Ito, Stefanie Dukes, Justin Hospital, Phoebe Woodworth-Jefcoats, T. Todd Jones, Ashley Tomita, Minling Pan, Johanna Wren, and Michael Quach.

NMFS Pacific Islands Regional Office: Joshua Lee, Rebecca Walker, and Emily Crigler.

The Council also acknowledges the staff of the **NMFS PIFSC Western Pacific Fisheries Information Network (WPacFIN)** for providing the technical support to generate the data summaries.

The Council would like to thank Alexander Filardo for his contributions to the report.

This page was intentionally left blank.

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 fisheries catch and release program.
Commercial	Commercial fishing, where the catch is intended to be sold, bartered, or traded.
Guam	A U.S. territory in the Marianas Archipelago. South of and adjacent to the Commonwealth of Northern Marianas Islands.
Hawai`i	U.S. state. See MHI, NWHI. Composed of the islands, atolls and reefs of the Hawaiian Archipelago from Hawai`i 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.
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.

Term	Definition
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.
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
BiOp	Biological Opinion
BOEM	Bureau of Ocean Energy Management
BSIA	Best Scientific Information Available
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
COS	Chicken-of-the-Sea
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
DAWR	Division of Aquatic and Wildlife Resources, Territory of Guam
DEIS	Draft Environmental Impact Statement
DFW	Division of Fish & Wildlife, Northern Mariana Islands
DMWR	Department of Marine & Wildlife Resources, American Samoa
DOC	Department of Commerce
DOD	Department of Defense
DPS	Distinct Population Segment
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
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPO	East Pacific Ocean
ENSO	El Niño Southern Oscillation Index
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.
FAD	Fish Aggregating Device; a raft or buoy,drifting or anchored to the sea floor, and under which, pelagic fish will concentrate
FEP	Fisheries Ecosystem Plan

Acronym	Meaning
FMP	Fishery Management Plan
ft.	Feet
FWS	Fish and Wildlife Service
GAC	Global Area Coverage
GRT	Gross Registered Tonnes
HAPC	Habitat Areas of Particular Concern
HDAR	Hawai`i Division of Aquatic Resources. Also, DAR
HMRFS	Hawai`i Marine Recreational Fishing Survey
ISC	International Scientific Committee
ITS	Incidental Take Statement
JIMAR	Joint Institute for Marine and Atmospheric Research, University of Hawaii
IATTC	Inter-American Tropical Tuna Commission
km^2	Square Kilometers
LAA	Likely to adversely affect
lbs.	Pounds
LOC	Letter of Concurrence
LOF	List of Fisheries
LVPA	Large Vessel Protected Area
m	Meter
M&SI	Mortality and serious injury
MSA	Magnuson-Stevens Fishery Conservation and Management Act of 1996 - Sustainable Fisheries Act
ME	McCracken Estimates
MFMT	Maximum fishing mortality threshold
MHI	Main Hawaiian Islands
MITT	Mariana Islands Training and Testing
MMA	Marine Managed Area
MMPA	Marine Mammal Protection Act
MPA	Marine Protected Area
MPCCC	Marine Planning and Climate Change Committee
MRFSS	Marine Recreational Fishing Statistical Survey
MSST	Minimum Stock Size Threshold
MSY	Maximum Sustainable Yield
mt	Metric Tons.
MUS	Management Unit Species.
NCADAC	National Climate Assessment and Development Advisory Committee
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act
NLAA	Not likely to adversely affect
NMFS	National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce. Also NOAA Fisheries

Acronym	Meaning
nm	Nautical Miles
NOAA	National Oceanic and Atmospheric Administration, U.S. Department of Commerce
NOI	Notice of Intent
NESDIS	National Environmental Satellatie, Data, and Information Service.
NWHI	Northwestern Hawaiian Islands. All islands in the Hawaiian Archipelago, other than the Main Hawaiian Islands (MHI)
NWR	National Wildlife Refuge.
NS2	National Standard 2
OEIS	Overseas Environmental Impact Statement
OFP-SPC	Oceanic Fisheries Program of the Secretariat of the Pacific Community
ONI	Oceanic Niño Index
OR&R	NOAA's Office of Response and Restoration
OSDPD	Office of Satellite Data Processing and Distribution
OY	Optimum Yield
PBR	Potential Biological Removal
PDO	Pacific Decadal Oscillation
PIFSC	Pacific Islands Fisheries Science Center
PIRO	Pacific Islands Regional Office, National Marine Fisheries Service. Also, NMFS PIRO
PFRP	Pacific Pelagic Fisheries Research Program, JIMAR, University of Hawaii
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
RPB	Regional Planning Body
PRIA	Pacific Remote Island Area
ROD	Record of Decision
SAFE	Stock Assessment and Fishery Evaluation
SAR	Stock Assessment Report
SB	Spawning Biomass
SC	Standing Committee of the Western and Central Pacific Fisheries Commission
SDC	Status Determination Criteria
SEIS	Supplemental Environmental Impact Statement
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

Acronym	Meaning
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%.
SSC	Scientific & Statistical Committee, an advisory body to the Council comprising experts in fisheries, marine biology, oceanography, etc.
SST	Sea Surface Temperature
STF	Subtropical Font
TAC	Total Allowable Catch
TZCF	Transition Zone Chlorophyll Front
US	United States
USAF	United State Air Force
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service, Department of Interior
WCNPO	Western and Central North Pacific
WCP–CA	Western and Central Pacific Fisheries Commission Convention Area
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean
WPacFIN	Western Pacific Fishery Information Network, NMFS
WPRFMC	Western Pacific Regional Fishery Management Council

CONTENTS

Section **Page**

Table **Page**

Figure **Page**

EXECUTIVE SUMMARY

The Western Pacific Regional Fishery Management Council (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, Hawai`i, 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, now Fishery Ecosystem Plan [FEP]) for Pelagic Fisheries of the Western Pacific Region in 1987. 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 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, 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 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 FMPs (or FEPs), amendments, and other analytical documents needed for management decisions.

Table ES-1 was developed from a review of NS2 guidelines and the 2013 revisions 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 2018 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 2018, stock assessments were completed for the South Pacific albacore (Tremblay-Boyer et al., 2018), WCPO bigeye tuna (Vincent et al., 2018), North Pacific swordfish (ISC, 2018a), North Pacific shortfin mako shark (ISC 2017b), WCPO silky shark (Clark, 2018), Pacific bluefin tuna (ISC, 2018b), and North Pacific common thresher shark (Teo et al. 2018). Additionally, an indicator analysis was conducted for EPO bigeye tuna (Maunder et al. 2018). 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.

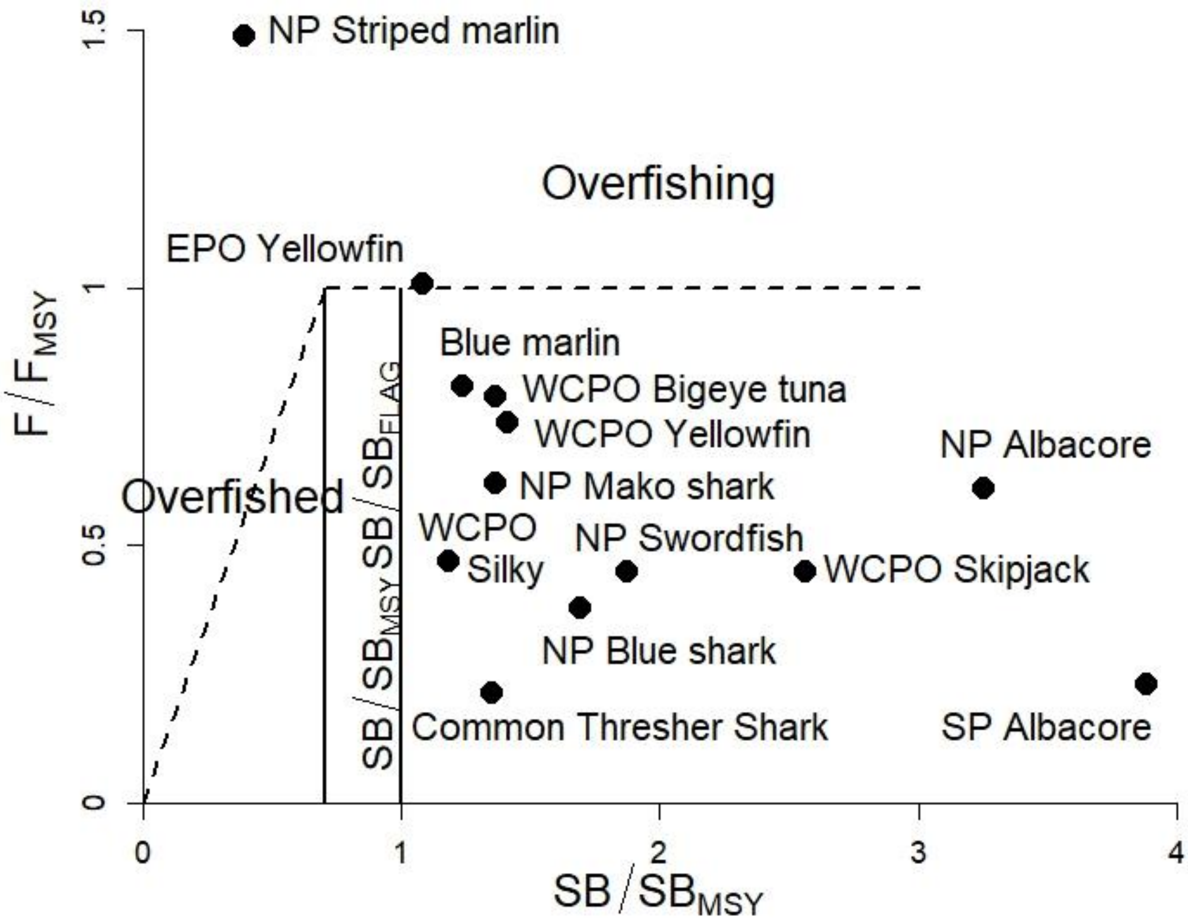


Figure ES-1. Specification of fishing mortality and biomass reference points in the Pelegic FEP and current stock status in the WCPO and EPO. As of this publication, NMFS has not yet determined the stock assessment for WCPO silky shark to be the best scientific information available for the purpose of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

SUMMARY OF FISHERY DATA IN THE PACIFIC ISLAND REGION

Table ES-2. Summary of the total pelagic landings during 2018 in the Western Pacific and the percentage change between 2017 and 2018

Species	American Samoa		CNMI		Guam		Hawai`i	
	Lbs.	% Change	Lbs.	% Change	Lbs.	% Change	Lbs.	% Change
Swordfish	13,434	8.80	-	-	-	-	2,330,000	-34.95
Blue marlin	70,827	-15.28	2,467	-16.82	24,516	-41.88	1,806,000	-1.47
Striped marlin	3,234	-18.95	-	-	-	-	1,050,000	15.39
Other billfish*	4,355	-34.87	0	0	-	-	543,000	-26.02
Mahimahi	10,835	-67.88	54,903	21.74	88,817	87.73	1,074,000	7.08
Wahoo	73,326	-44.70	5,849	-40.38	96,035	249.5	1,173,000	19.21
Opah (moonfish)	2,766	-1.74	-	-	-	-	3,039,000	32.53
Sharks (whole wt.)	9,573	1,127	0	0	-	-	139,000	-16.27
Albacore	3,122,421	2.52	-	-	-	-	236,000	-17.77
Bigeye tuna	103,391	-27.61	-	-	-	-	17,045,000	-5.07
Bluefin tuna	1,428	-	-	-	-	-	1,000	-66.67
Skipjack tuna	156,172	7.16	291,854	23.88	610,751	20.03	527,000	-28.01
Yellowfin tuna	552,422	-53.58	9,694	-42.87	52,555	-22.10	7,542,000	-0.71
Other pelagics**	2,507	-38.30	921	-66.56	-	-	1,192,000	-6.58
Total	4,127,892	-14.13	367,473	7.81	891,748	26.37	37,718,000	-4.18

Note: Total Pelagic Landings based on commercial reports or creel surveys; % change based on 2014 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 2018, there were 13 active longline vessels, with eight vessels greater than 70 ft., four vessels between 50 and 70 ft., and one vessel 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. Troll and handline fishing are the next largest fisheries with seven boats that landed pelagic species in 2018. Recreational pelagic fisheries in American Samoa are less common.

Landings. The estimated annual pelagic landings have varied widely, from 4.1 to nearly 11 million lbs. since 2009. The total estimated 2018 landings were approximately 4.1 million lbs., the lowest in the past decade, which contributes to the declining trend since recent peak landings in 2009-2010 (Figure 4). Pelagic landings consist mainly of five tuna species including albacore, yellowfin, skipjack, mackerel, and bigeye, which made up approximately 95% of the total estimated landings when combined with other tuna species. Albacore made up 79% 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 2018 (Table 12). In the longline fishery, less than 1% of the tuna caught were released. Albacore and yellowfin were the most released bycatch tuna species, while sharks and oilfish had the highest numbers of non-tuna released fish accounting for 86% release of non-tuna species. In total, only 6.7% of all pelagic species caught were released. 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 25 vessels known to be fishing in the waters of American Samoa according to federal logbooks collected. The 13 longline vessels that fished in 2018 made 145 trips (average 11 trips/vessel), deployed 2,185 sets, (168 sets/vessel) using 5.9 million hooks (Table 5). The troll fishery conducted 195 trips that landed pelagic species.

Catch Rate. The total pelagic catch rate by all longline vessels increased by 0.1 fish per 1,000 hooks in 2018 from the previous year. The tuna catch rate also increased by 0.3 fish per 1,000 hooks from 2017 levels. Non-tuna pelagic species showed a gradual catch rates from the beginning of available data (2003) to present. The longline catch rates for tuna species have fluctuated during the past decade ranging from 15 to nearly 30 fish per 1,000 hooks. Albacore catch rates have increase this year by 1.9 to 13.5 fish per 1,000 hooks. Troll trips have increased by 8% while troll hours have decreased by nearly 50% from their 2017 values. The average catch per troll hour for all pelagic species notably increased from the previous year's low of 14 lbs. to 23 lbs.

Revenue. In 2018, the total fleet revenue (estimated landed value) was $4.1 million, and albacore composed of over 86% of the total landed value. Other main species included yellowfin, bigeye, skipjack, and wahoo. The estimated value of the species landed were 10%, 2%, 2%, and 1%, respectively. Albacore had an estimated price of $1.40 per pound.

Protected Species Interactions. Protected species interactions are monitored in the American Samoa longline fishery with mandatory observer coverage at approximately 20% of all trips. Mitigation measures have been implemented to reduce green turtle interactions in this fishery. From 2016 to 2018, 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 (0.006 takes/1,000 hooks). Observed marine mammal interactions with the American Samoa longline fishery are relatively infrequent, usually no more than two of all species combined in any given year. This report also includes observed interactions with seabirds and the ESA-listed Indo-west Pacific distinct population segment (DPS) of scalloped hammerhead, both of which have infrequent interactions in the American Samoa longline 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 fishermen reporting commercial pelagic landings. In 2016, a decade-high 72 fishermen reported landings, a significant increase from 12 in the previous year but nearly twice as much as the 40 fishers in 2018.

Landings. Skipjack tuna is the principal species landed, comprising over 79% of the entire pelagic landings in 2018 based on creel survey data. Skipjack landings increased by almost 24% (291,854 lbs.), and total landings also increased over 7% (367,473 lbs.) since 2017. Landings of mahimahi and yellowfin tuna ranked second and third, respectively, by weight of landings during 2018. Creel data estimated 54,903 lbs. of mahimahi, a 22% increase from 2017. There was 9,694 lbs. of yellowfin landed in 2018, a 43% decrease from the 2017 landings.

Effort. In 2018, the number of trips decreased by almost 27% from 2017 based on commercial data receipts. Total trolling hours similarly showed an increase in 2018 of 21% at 17,537 hours. Average trip length has remained steady over the last decade, maintaining between 5.1 and 5.7 hours per trip over the last decade.

Catch Rate. In 2018, trolling catch rates decreased from 23.4 lbs. per trolling hour, to 20.9. The catch rate for skipjack, the primary target species in CNMI, slightly increased from 16.2 lbs. per hour fished in 2017 to 16.6 lbs. per hour in 2018. Yellowfin catch rate in 2018 also decreased to its decadal low at 0.6 lbs. per hour fished while the mahimahi catch rate was relatively consistent with 2017 levels.

Revenue. Commercial revenues, based on the commercial receipts, were $366,553 in 2018, thought not all 2018 receipts have been entered into the database. Average price per pound for all pelagics, tuna, and non-tuna pelagics, was lower than their long-term averages. The average price for all pelagics was $2.44.

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 2009 to 2018.

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 398 boats involved in Guam's pelagic fishery in 2018, a decrease of 2.45% from 2017. 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 (~5%) 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 2018 total expanded pelagic landings were 891,748 lbs., an increase of 48.4 % when compared to 2017. Tuna PMUS landings were 663,817lbs., while non-tuna PMUS were 214,168 lbs. Landings consisted primarily of five major species: mahimahi, wahoo, Bonita or skipjack tuna, yellowfin tuna, and Pacific blue marlin, with skipjack comprising over 68% of total landings. Sharks were also caught during 2018, as they were noted in specific fishermen interviews conducted in 2017 regarding shark encounters (see 'bycatch' below). However, these species were not encountered during offshore creel surveys and were not available for expansion in this year's report. Sharks are often discarded as bycatch. In addition to the above pelagic species, approximately half a dozen other species were landed incidentally this year.

There are wide year-to-year fluctuations in the estimated landings of the five major pelagic species. Landings for two of the five common species decreased in 2018 from 2017 levels: Skipjack tuna increased 24.2%, and mahimahi, which accounts for the largest percentage of non-tuna PMUS landed on Guam, increased 21.7%. Wahoo decreased 22.3%, blue marlin decreased 20.0%, and yellowfin tuna decreased 42.7% in 2018.

The amount of transshipped fish has ranged between 1,245 mt and 2,290 mt over the previous five years. In 2018, transshipments totaled 1,165 mt.

Effort. In 2018, the number of trolling trips increased by 4.5%, and hours spent trolling increased 2.3%. In early 2010, the U.S. military began exercises in an area south and southeast of Guam designated W-517. W-517 is a special use airspace (approximately 14,000 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 2018 was 87, equaling 87 closure days, down from 140 closure days in 2017.

Catch Rate. Trolling catch rates (lbs. per hour fished) increased 45.5% from 2017 to 2018. Skipjack tuna, wahoo, and mahimahi CPUE increased, while yellowfin tuna and blue marlin CPUE decreased. The fluctuations in CPUE can likely be attributed to variability in the year-to-year abundance and availability of the stocks.

Revenue. Commercial revenues slightly increased in 2018 with total adjusted revenues equalling to $877,523. Fish price was $2.39. 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 Guam's charter fishery. In 2018, there were 2 reported bycatch in 8344 fish caught, for a 0.02% rate. Bycatch occasionally occurs in the troll fishery including sharks, shark-bitten and undersized fish.

In 2018, fishers were asked if they experienced a shark interaction. There were a total of 806 interviews for boat based fishing in 2018, with 347 of these inappropriate for determining shark interaction. Of the remaining 459 interviews, 190 reported interactions with sharks, 269 reported no interactions with sharks, a 41% positive rate for interviews where fishers were asked about shark interactions.

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

HAWAI`I

Compared to the other regions, Hawai`i 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 Hawai`i longline fishery is by far the most important economically, accounting in 2018 for about 86% percent of the estimated ex-vessel value of the total commercial fish landings in the State. The MHI troll was the second largest fishery in Hawai`i at 7% of the catch and revenue, respectively. The shallow-set longline, MHI handline, aku boat, offshore handline fisheries and other gear types made up the remainder of the composition of the fishery.

Participation. A total of 3,308 fishermen were licensed in 2018, including 1,982 (60%) who indicated that their primary fishing method and gear were intended to catch pelagic fish. This is a 12% decrease in fishing licenses from the previous year. Most licenses that indicated pelagic fishing as their primary method were issued to longline fishermen (45%) and trollers (42%). The remainder was issued to ika shibi and palu ahi (handline) (13%).

Landings. Hawai`i commercial fisheries caught and landed 37,718,000 pounds of pelagic species in 2018, a decrease of 4% 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 86% (32,318,000 pounds) of all pelagic fisheries. The shallow-set longline fishery targeted swordfish and its catch was 1,438,000 pounds, or 4% of the total catch. The main Hawai'i Islands troll fishery targeted tunas, marlins and other PMUS caught 2,715,000 pounds or 7% of the total. MHI handline fishery targeted yellowfin tuna while the and offshore handline fishery targeted bigeye tuna. The MHI handline fishery accounted for 776,000 pounds (2% of the total). The offshore handline fishery was responsible for 366,000 pounds or 1% of the total catch.

The largest component of the pelagic catch was tunas, which comprised 67% of the total in 2018. Bigeye tuna alone accounted for 67% of the tunas and 45% of all pelagic catch. Billfish catch made up 15% of the total catch in 2018. Swordfish was the largest of these, at 41% of the billfish and 6% of the total catch. Catches of other PMUS represented 18% of the total catch in 2018 with moonfish being the largest component at 46% of the other PMUS and 8% of the total catch.

Bycatch. A total of 117,313 fish were released by the deep-set longline fishery in 2018. 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% 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 2018. A total of 3,569 fish were released by the shallow-set longline fishery in 2018. Sharks accounted for 80% 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 8% for targeted and incidentally caught pelagic species in 2018. 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 143 active Hawai`i-permitted deep-set longline vessels in 2018, two less vessels than the previous year, with 140 or more deep-set vessels in the past 5 years. The number of deep-set trips (1,641) and sets (20,977) were both deep-set effort records. The number of hooks set by the deep-set longline fishery reached a record 58.4 million hooks in 2018. The Hawai`i-permitted shallow-set longline fishery operates mainly in the first half of the year. In 2018, 11 vessels completed 30 trips and made 420 sets, which was significantly lower effort for this segment of the fishery due to the closure of the fishery in May as a result of reaching the loggerhead sea turtle interaction limit. The number of hooks set by this fishery also decreased 0.5 million in 2018, 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 1,380 fishers logging 21,663 days fished around the MHI in 2018. There were 428 MHI handline fishers that fished 4,022 days in 2018, both at their lowest levels in the ten-year period. The offshore handline fishery had 5 fishers and 217 days fished in 2018.

Catch Rate. The deep-set longline fishery targets bigeye tuna and this species had higher CPUE (3.7 fish per 1,000 hooks) compared to yellowfin tuna (1.1) and albacore (0.1). CPUE of blue marlin and striped marlin for the deep-set fishery were low (0.1 - 0.3 fish per 1,000 hooks, respectively), while the CPUE for blue shark, a bycatch species, is second only to bigeye at 1.6 fish per 1,000 hooks. The Hawai`i-permitted shallow-set longline fishery targets swordfish and achieved a CPUE of 12.2 fish per 1,000 hooks in 2018 followed by blue shark, a bycatch species of this fishery, with a CPUE of 5.1 fish per 1,000 hooks. The 2018 MHI troll fishery CPUE for yellowfin tuna and blue marlin were above the long-term average while CPUE for mahimahi and ono showed no trend during 2009-2018. MHI handline CPUE for yellowfin tuna peaked in 2015, dropped in 2016 and was the same the following two years. Albacore and bigeye tuna CPUE was substantially lower compared to yellowfin tuna and have shown no clear trend in recent years. CPUE of the offshore handline fishery was relatively steady from 2009-2018 with CPUE peaking in 2016.

Fish Size. The average weight for most species caught by the deep-set longline fishery was close to their respective long-term weights in 2018 although yellowfin tuna and swordfish were above their respective long-term average weights. Bigeye tuna caught in the deep-set fishery was 78 lbs. in 2018, 3% less than the long-term average. Yellowfin tuna average weight in the deep-set fishery was 89 lbs., 15% above the long-term average. The mean weight of black marlin, mako shark and thresher shark were below their long-term average weight. Swordfish caught by the shallow-set longline fishery was 214 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 above their long-term average in 2018. Troll and handline caught billfish, mahimahi, and ono were below their respective long-term mean weights.

Revenue. The total revenue from Hawaii’s pelagic fisheries was $110.8 million in 2017, a decrease of 4% from the previous year. The deep-set longline revenue was $96.1 million in 2017. This fishery represented 87% of the total revenue for pelagic fish in Hawaii. The shallow-set longline fishery increased to $4.2 million and accounted for 4% of the revenue. The MHI troll revenue was $6.4 million or 6% of the total in 2017 and was followed by the MHI handline fishery at $2.8 million (3%). The offshore handline fishery was worth $891,000 in 2017. The trend for revenue from the deep-set longline and offshore handline fisheries was increasing while revenue of the shallow-set longline and MHI troll fisheries was decreasing. The revenue from the offshore handline fishery was steady for the past four 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 minimum of 20% for deep-set vessels. Both and 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 2018, there were 476 sets and 546,371 hooks observed in the shallow-set fishery. This reduction is likely due to the closing of the fishery due to the 38 loggerhead sea turtle interactions that occurred in the first few months of the fising season. Since the most recent Biological Opinion for the shallow-set fishery in 2012 through the end of 2017, the fishery has not exceeded the two-year Incidental Take Statement (ITS) for any turtle species or for the humpback whale. Interactions of ESA-listed species remained under the Incidental Take Statements (ITS). The shallow-set fishery had an observed interaction with a Guadalupe fur seal in 2016, which was previously not known to interact with the fishery. Marine mammal interactions remain low in this fishery, with the level of mortality and serious injury well below the corresponding potential biological removal (PBR) determined in the marine mammal Stock Assessment Reports (SARs). Seabird interactions have remained relatively stable over time in this fishery, with a possible marginal increase in black-footed albatrosses after 2009 leading to an all-time high in recorded takes this year.

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 2018, there were 4,332 sets and 11,751,144 hooks observed in the deep-set fishery at 20.4% annual observer coverage. The ITSs for loggerhead and green turtles were exceeded during the fourth quarter of 2015 and the ITS for olive ridley turtle was exceed during the first quarter of 2016. Re-consultation for these species has been completed. Marine mammal interactions are generally rare in this fishery, with the level of mortality and serious injury for species other than false killer whales being well below the corresponding potential biological removal (PBR) determined in the marine mammal Stock Assessment Reports (SARs). The False Killer Whale Take Reduction Plan is currently in effect due to the M&SI for this species exceeding PBR. Interactions with black-footed albatrosses were substantially higher in recent years compared to previous years. Recent analysis of albatross interactions in the deep-set fishery suggest that the higher interactions observed in this fishery may be related to oceanographic factors.

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 2018 report provides a information on the following list of climate and oceanic indicators being tracked:

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

Section 3.3.3 provides a description of each of these indicators, a 2018 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 2018. Non-fishing and cumulative impact components were reviewed from 2016 through 2017 (see Minton 2017). An FEP amendment to updated precious coral EFH in the Hawaii Archipelago is scheduled for 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 2018 Annual SAFE Report includes the Council’s spatially-based fishing restrictions (or 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, as well as incidents that may contribute to cumulative impact. This includes observing fishing and non-fishing activities and facilities, including aquaculture facilities, 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 National Marine Fisheries Service (NMFS) on March 23rd, 1987. The Western Pacific Regional Fishery Management Council (WPRFMC or 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 U.S. Exclusive Economic Zone (EEZ) around American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), Guam, Hawai`i, 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.

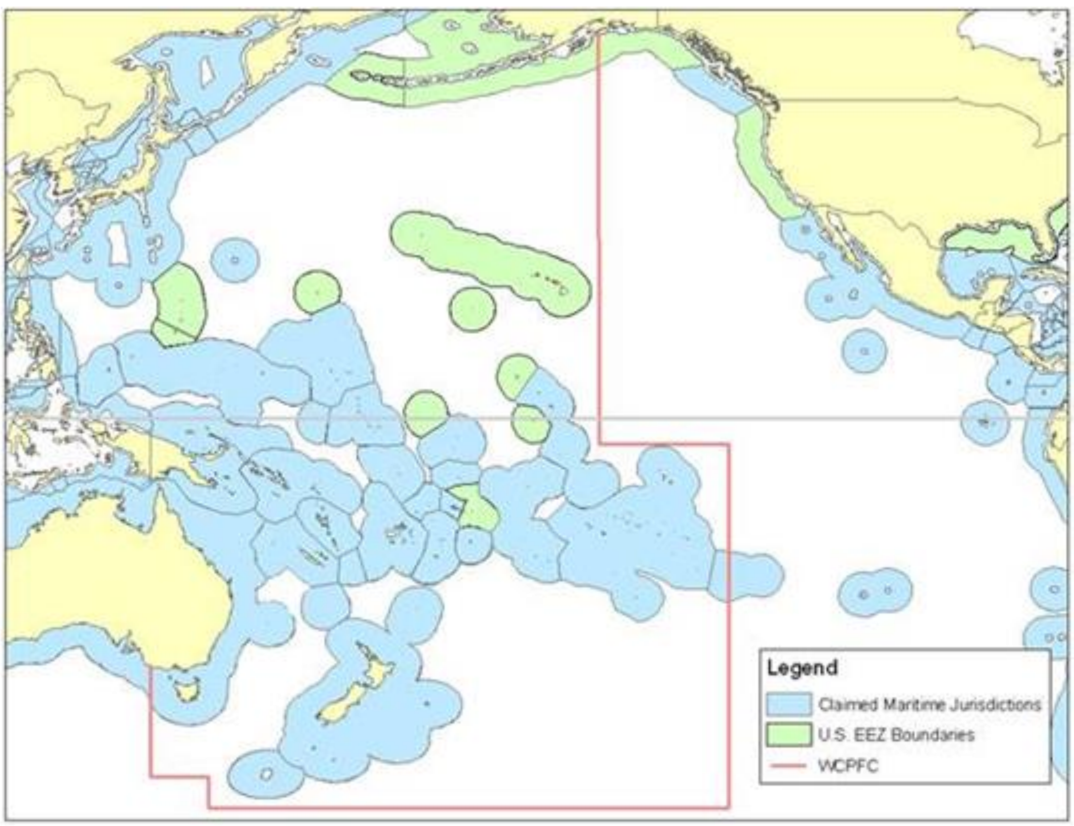
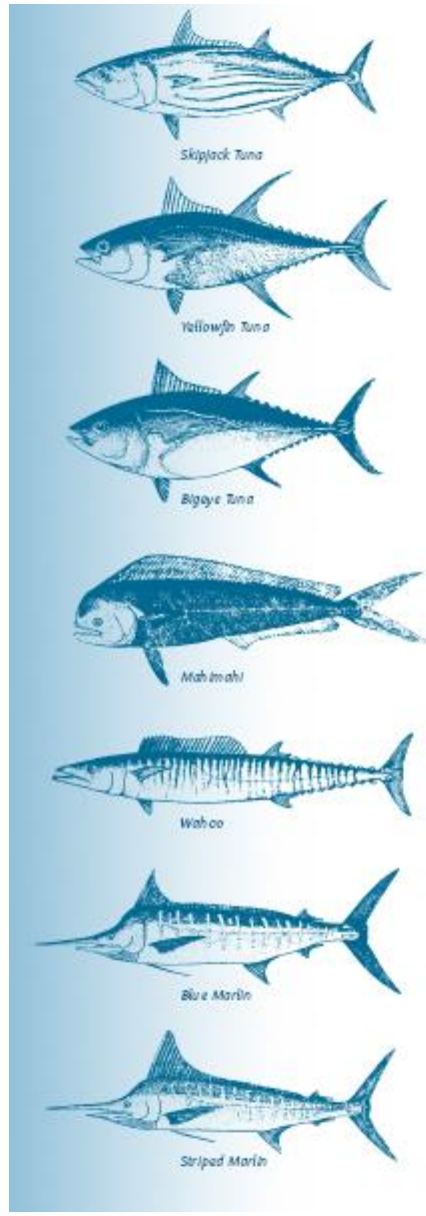


Figure 1. Map of the Western Pacific region

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 available information 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 second 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

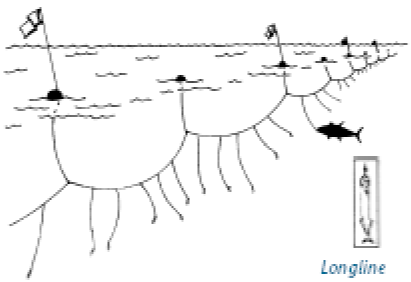
The Management Unit Species (MUS) managed under the Pelagic FEP include large pelagic species such as tunas (tribe Thunnini), billfishes (Istiophoridae and Xiphiidae), and other harvested species with distribution straddling domestic and international waters. The MUS excludes some scombrids found predominantly 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 excludes all jacks (Carangidae, e.g., rainbow runner, *Elagatis bipinnulata*), all barracudas (Sphyraenidae) and 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			

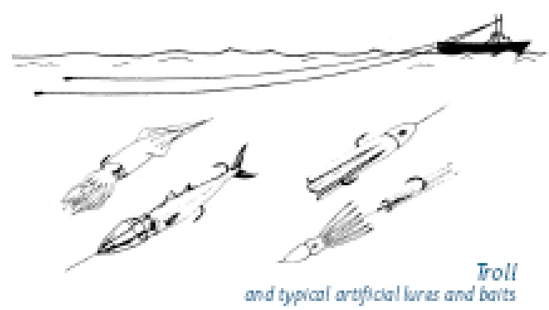
1.3 SUMMARY OF PELAGIC FISHERIES AND GEAR TYPES MANAGED UNDER THE FEP

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 Western Pacific Fishery Management Council, and is also not described in this report.



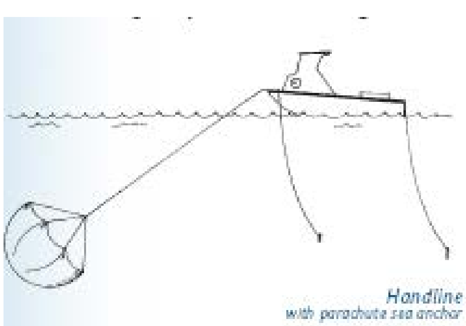
U.S. longline vessels in the Western Pacific Region are based primarily in Hawai`i and American Samoa, although Hawai`i-based vessels targeting swordfish and bigeye tuna have also fished seasonally out of California. The Hawai`i fishery, with 143 active vessels, targets a range of species, with vessels setting shallow longlines to catch swordfish or fishing deep to maximize catches of bigeye tuna. Catches by the Hawai`i fleet also include yellowfin tuna, mahimahi, wahoo, blue and striped marlins, opah (moonfish) and monchong (pomfret). The Hawai`i fishery does not freeze its catch, which is sold to the fresh fish and sashimi markets in Hawai`i, 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 consisted primarily of four tuna species: albacore, yellowfin, bigeye, and skipjack. The pelagic species wahoo, blue marlin, and mahimahi comprised most of the non-tuna landings.



Trolling and, to lesser extent, handline fishing for pelagics is the largest commercial fishery in terms of participation, although it catches annually a relatively modest volume of fish compared to longline and purse seine gears. Troll and handline catches are dominated by yellowfin tuna in Hawai`i, by skipjack tuna in Guam, and skipjack and yellowfin tuna in American Samoa. Other commonly caught troll catches include mahimahi, wahoo, and blue marlin. About 80 percent of the troll and handline landings are made by Hawai`i vessels.

Troll fishing for pelagics is the commonest recreational 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 WCPO supports the world's largest tuna fishery, with around with at a total tuna catch of 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 (when 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. 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 during June - October and the eastward-flowing South Equatorial Counter Current during November - April. Surface temperatures vary between 27° and 29°C and are highest in the January - April period. 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 conducted primarily in the American Samoa EEZ comprises the second-largest of the U.S. longline fisheries in the FEP (after Hawai`i). 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 1995, 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 lbs. with less effort and use less gasoline for trips. Initially the vessels used in 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 trans-shipment and processing of tuna taken by domestic fleets from other South Pacific nations, the distant-waters longline fleets, and purse seine fleets. Purse seine vessels land skipjack, yellowfin and other tunas, with little albacore.

1.3.1.2 CURRENT PELAGIC FISHERIES

The small-scale longline fishery is almost defunct with only one vessel 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 single remaining vessel is an alia boat 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 (WPRFMC, 2000). 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 is albacore, which is marketed to the local tuna canneries.

American Samoa’s domestic longline fishery expanded rapidly in 2001. Much of the recent (and anticipated future) growth is 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 2018, there were 13 active longline vessels. Poor economic conditions have plagued the large vessel feet for several years, as the lowest effort and catch was observed in 2018 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. There are about 15 recreational fishing vessels ranging 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 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 Hawai`i 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 & Wildlife Resources (DMWR) and provided to WPacFIN. While boat-based recreational catches were as high as 46,462 lbs. and averaged about 14,000 lbs. in the last ten years, the 2016 recreational catch was 1,208 lbs.

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 primarily from the island of Farallon de Medinilla south to the island of Rota. Trolling is the primary fishing method utilized in the pelagic fishery. The pelagic fishing fleet consists primarily of vessels less than 24 foot in length, which usually have a limited 20-mile travel radius from Saipan.

The primary target and most marketable species for the pelagic fleet is skipjack tuna (nearly 80% of 2018 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.

Yellowfin tuna and mahimahi are also easily marketable species but are seasonal. During their 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 did not do well, and found it very difficult to market their catch. 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: distant-water purse seiners and longliners that fish outside Guam's EEZ and transship through the island; and small, primarily recreational, trolling boats that are either towed to boat launch sites or berthed in marinas and fish only within local waters, either within Guam's EEZ or on some occasions in the adjacent EEZ of the Northern Mariana Islands. This annual report covers primarily the local, Guam-based, small-boat pelagic fishery.

Landings from Guam fisheries consisted primarily 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 398 boats active in Guam's domestic pelagic fishery in 2018. 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 HAWAI`I

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 counter clockwise, 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 Hawai`i 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 Hawai`i, 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 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 the longline, Main Hawai`ian Islands (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 37.7 million lbs. of commercial landings with a total ex-vessel value of $114.8 million in 2018. The deep-set longline fishery was the largest of all commercial pelagic fisheries in Hawai`i and represented 83% of the total commercial pelagic catch and 87% of the ex-vessel revenue. The MHI troll was the second largest fishery in Hawai`i and accounted for 7% of the catch and revenue, respectively. 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 67% of the total in 2018. Bigeye tuna alone accounted for 67% of the tunas and 45% of all pelagic catch. Billfish catch made up 15% of the total catch in 2018. Swordfish was the largest of these at 41% of the billfish and 6% of the total catch. Catches of other PMUS represented 17% of the total catch in 2018 with moonfish being the largest component at 46% of the other PMUS and 8% of the total catch.

The Hawai`i 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 2018. In 2013, it is estimated that the commercial seafood industry in Hawai`i 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 Hawai`i. The commercial harvest sector generated 3,800 jobs, $196 million in sales, $71 million in income, and $102 million in value added impacts (NMFS 2012[3]).

Recreational fisheries are also extremely important in the State of Hawai`i economically, socially, and culturally. The total estimated pelagic recreational fisheries production in 2018 was 6.57 million lbs. The number of small vessels in Hawai`i has declined to approximately 11,000 since a peak of over 16,000 vessels in 2008. Boat-based anglers took 231,551 fishing trips in 2016, with only 7,670 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 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.

[3] National Marine Fisheries Service, 2014. Fisheries Economics of the United States, 2012. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-F/SPO-137, 175 pp.

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 Hawai`i longline fleet does seasonally fish in those areas. For example, the EEZ around Palmyra is visited by Hawai`i-based longline vessels targeting yellowfin tuna, whereas at Johnston Atoll, albacore is often caught in greater numbers than yellowfin or bigyeye 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 & Wildlife Service (USFWS) prohibits fishing within the Howland Island, Jarvis Island, and Baker Island National Wildlife Refuge (NWR) 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 summary describes management actions for the pelagic fisheries that NMFS implemented from April 11, 2018 through the end of 2018.

On April 11, 2018 (83 FR 15503), NMFS issued a final rule under the Tuna Conventions Act to implement Resolution C-17-02 (Conservation of Tuna in the Eastern Pacific Ocean During 2018-2020 and amendment to resolution C-17-01), which was adopted at the 92nd Meeting of the Inter-American Tropical Tuna Commission (IATTC) in July 2017. This final rule implements the C-17-02 fishing management measures for tropical tuna (i.e., bigeye tuna (Thunnus obesus), yellowfin tuna (T. albacares), and skipjack tuna (Katsuwonus pelamis)) in the eastern Pacific Ocean (EPO). This final rule imposes the following on purse seine vessels with carrying capacity greater than 182 mt fishing for tropical tuna in the EPO: A 72-day EPO-wide closure, a 31-day area closure, and a requirement that—with some exceptions—all tropical tuna be retained and landed. In addition, this final rule revises the restrictions for exemptions due to force majeure, establishes a bigeye tuna catch limit of 750 mt for U.S. longline vessels greater than 24 meters in overall length, and regulates the use and design of fish aggregating devices. This final rule is necessary for the conservation of tropical tuna stocks in the EPO and for the United States to satisfy its obligations as a member of the IATTC. This rule was effective on May 11, 2018, except for the amendments to 50 CFR 300.24(qq) and 300.28(e), which became effective on January 1, 2019.

On May 11, 2018, (83 FR 21939), NMFS temporarily closed the Hawaii shallow-set pelagic longline fishery in compliance with an order of the U.S. District Court for the District of Hawaii, effective from May 11, 2018, through December 31, 2018 (the fishery must comply with the rule from May 4, 2018, through December 31, 2018). On December 27, 2017, the United States Ninth Circuit Court of Appeals affirmed in part, and reversed in part, a lower court's grant of summary judgment in favor of NMFS, holding that NMFS was arbitrary and capricious by failing to adequately explain its no-jeopardy finding for North Pacific loggerhead sea turtles in light of a climate model projecting a population decline. (TIRN v. NMFS (9th Cir. 2017)). All other determinations in the 2012 biological opinion were affirmed.

On June 12, 2018, (83 FR 27305), NMFS published an advance notice of proposed rulemaking to seek public input about the management of U.S. fishing vessels in the area of overlapping jurisdiction between the Inter-American Tropical Tuna Commission and the Western and Central Pacific Fisheries Commission.

On July 18, 2018, (83 FR 33851) NMFS published a final rule to implement recent decisions of the Western and Central Pacific Fisheries Commission. These regulations implement catch limits for the U.S. longline fleet operating in the western and central Pacific Ocean (WCPO), fishing effort limits for the U.S. WCPO purse seine fleet, restrictions on the use of fish aggregating devices for the purse seine fleet, and a prohibition on transshipments in the Eastern High Seas Special Management Area.

On July 18, 2018, (83 FR 33848), NMFS temporarily closed the Southern Exclusion Zone (SEZ) to deep-set longline fishing which was effective July 24, 2018 through December 31, 2018, for all vessels that were registered under the Hawaii longline limited access program. This resulted from the fishery reaching the established annual trigger of two observed false killer whale mortalities or serious injuries (M&SI) in the fishery within the U.S. Exclusive Economic Zone (EEZ) around Hawaii. This action was necessary to comply with False Killer Whale Take Reduction Plan (Plan) regulations that establish the SEZ closure trigger and procedures to limit M&SI of false killer whales in the Hawaii deep-set longline fishery.

On July 24, 2018, (83 FR 35062), NMFS published a final rule to designate critical habitat for the Main Hawaiian Islands (MHI) insular false killer whale distinct population segments (DPS). The critical habitat encompasses waters from 45 meter depth contour to the 3,200 meter depth contour around the main Hawaiian Islands from Niihau east to Hawaii, pursuant to section 4 of the Endangered Species Act, with 14 areas excluded from designation based on economic or national security impacts.

On August 30, 2018 (83 FR 44245), NMFS published a final rule for the collection-of-information requirement which was contained in regulations implementing recent decisions of the Western and Central Pacific Fisheries Commission, in a final rule published on July 18, 2018. The intent of this final rule is to inform the public of the effectiveness of the collection-of-information requirement associated with daily purse seine fishing effort reports included in the final rule. The reporting requirement was effective on August 30, 2018, but purse seine vessel owners and operators must report purse fishing effort daily only if and when directed by NOAA Fisheries.

On September 11, 2018 (83 FR 45849), NMFS temporarily closed the U.S. purse seine fishery on the high seas 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 between the latitudes of 20° N. and 20° S. as a result of reaching the 2018 purse seine fishing effort limit in that area. The closure was effective on September 18, 2018 through the rest of the calendar year.

On October 2, 2018 (83 FR 49495), NMFS published a final rule that revised number of allowable incidental interactions that may occur between the Hawaii shallow-set pelagic longline fishery and North Pacific loggerhead sea turtles from 34 to 17 annually, in compliance with an order of the U.S. District Court, District of Hawaii. The rule was effective on January 1, 2019.

For October 22, 2018, through December 31, 2017 (83 FR 53399, October 23, 2018), NMFS specified a 2018 limit of 2,000 mt of longline-caught bigeye tuna for each U.S. participating territory (American Samoa, Guam, and the Northern Mariana Islands). 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 November 7, 2018 (83 FR 55641), NMFS announced a valid specified fishing agreement that allocated up to 1,000 mt of the 2018 bigeye tuna limit for the Commonwealth of the Northern Mariana Islands (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 December 10, 2018 (83 FR 63428), NMFS announced a valid specified fishing agreement that allocates up to 1,000 mt of the 2018 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 the American Samoa.

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

A summary of the 2018 total pelagic landings in the Western Pacific and the change between 2017 and 2018 are shown in Table 2.

Table 2. Total pelagic landings (lbs.) in the Western Pacific Region in 2018 and percent change from the previous year

Species	American Samoa			CNMI			Guam			Hawai`i		
	2017 lbs.	2018 lbs.	% Change	2017 lbs.	2018 lbs.	% Change	2017 lbs.	2018 lbs.	% Change	2017 lbs.	2018 lbs.	% Change
Swordfish	12,347	13,434	8.80	-	-	-	-	-	-	3,582,000	2,330,000	-34.95
Blue marlin	83,603	70,827	-15.28	2,966	2,467	-16.82	42,183	24,516	-41.88	1,833,000	1,806,000	-1.47
Striped marlin	3,990	3,234	-18.95	-	-	-	-	-	-	910,000	1,050,000	15.39
Other billfish*	6,687	4,355	-34.87	0	0	0	-	-	-	734,000	543,000	-26.02
Mahimahi	33,729	10,835	-67.88	45,099	54,903	21.74	47,310	88,817	87.73	1,003,000	1,074,000	7.08
Wahoo	132,607	73,326	-44.70	9,811	5,849	-40.38	27,475	96,035	249.5	984,000	1,173,000	19.21
Opah (moonfish)	2,815	2,766	-1.74	-	-	-	-	-	-	2,293,000	3,039,000	32.53
Sharks (whole wt.)	780	9,573	1,127	0	0	0	-	-	-	166,000	139,000	-16.27
Albacore	3,045,774	3,122,421	2.52	-	-	-	-	-	-	287,000	236,000	-17.77
Bigeye tuna	142,823	103,391	-27.61	-	-	-	-	-	-	17,955,000	17,045,000	-5.07
Bluefin tuna	0	1,428	-	-	-	-	-	-	-	3,000	1,000	-66.67
Skipjack tuna	145,742	156,172	7.16	235,603	291,854	23.88	408,491	610,751	49.51	732,000	527,000	-28.01
Yellowfin tuna	1,190,111	552,422	-53.58	16,968	9,694	-42.87	67,463	52,555	-22.10	7,596,000	7,542,000	-0.71
Other pelagics**	4,063	2,507	-38.30	2,754	921	-66.56	11,789	-	-	1,276,000	1,192,000	-6.58
Total	**4,807,030**	**4,127,892**	**-14.13**	**340,869**	**367,473**	**7.81**	**600,826**	**891,748**	**48.42**	**39,364,000**	**37,718,000**	**-4.18**

Note: Total Pelagic Landings based on commercial reports and/or creel surveys; % change based on 2016 landings relative to 2017 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 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 COUNCIL AND PLAN TEAM RECOMMENDATIONS

Regarding the Pelagic Annual SAFE Report, the 2019 Pelagic Fishery Ecosystem Plan Team recommends that the Council:

a) requests that WPacFin to be engaged with the CNMI and the Council on data collection initiatives should proposed regulatory actions in CMNI to require mandatory fishery reporting be approved.

b) requests Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (DAWR) to clarify and provide the notification scheme of the military regarding spatial closures with mariners.

c) Directs staff to works with Hawaii Division of Aquatic Resources (DAR) and PIFSC to develop CPUE indices and indicators for Hawaii small-boat fisheries (troll, handline, etc) and investigate data filtering criteria to define fishing effort and targeting.

d) Directed staff to request PIFSC to convene a longline Electronic Report Plan Development and Implementation Team with suggested constituents of PIFSC, PIRO, WPRFMC, industry and Office of Law Enforcement (OLE).

In addition to formal recommendations from Pelagic Plan Team members to be forward to the Council, there were also Action Items suggested associated with general improvements to report modules:

- Action Item 1: For the recreational module, requests Hawaii DAR and PIFSC to estimate the 2018 percentage of commercial small boats and updated fleet size of the small boat fishery.

- Action Item 2: Council staff works with territorial agencies and PIFSC to populate recreational catches for the 2018 and future SAFE Report Recreational Modules.

- Action Item 3: Council staff works with Hawaii DAR to partition recreational catch records into retentions and releases of MHI troll charter and non-charter catch records.

- Action Item 4: For the web-based SAFE report, the Pelagic Plan Team directs Council staff to provide an online index of tables and figures.

- Action Item 5: For the web-based SAFE report, the Pelagic Plan Team directs Council staff to place a more prominent SAFE report online link on WPCouncil.org

- Action Item 6: Council staff and PIRO Sustainable Fisheries Division (SFD) to update SAFE report data integration section with regularity and to include notable changes or issues pertinent to the FEP as a guide for adaptive management. This may also include compiling abstracts on recent relevant studies. Council staff should work with PIRO SFD to review thematic priorities that were previously identified in the Data Integration Workshop.

- Action Item 7: Council staff to request that PIRO consider including interactions of ESA-listed elasmobranchs in PIROP quarterly and annual reports.

- Action Item 8: Council staff to work with PIRO SFD and utilize an operating agreement with the observer program that could serve as a vehicle to request new interaction data with respect to oceanic white tip, scalloped hammerhead shark, and giant manta rays.

- Action Item 9: Council staff should add ongoing status reviews to the candidate species tables (e.g., leatherback turtle status review) in the Protected Species Section.

- Action Item 10: The SAFE report on protected species should include tables on interactions based on both vessel arrival date and interaction date between shallow-set longline fishery and sea turtles; and for Protected Species Work Team to address discrepancies between interaction date and vessel arrival date in summary tables.

- Action Item 11: Council staff to convert the data tables in the SAFE report to products available on the website, similar to the online interface version of the Archipelagic SAFE report.

- Action Item 12: Council staff to work with appropriate PPT members to evaluate the Habitat Section of the Annual SAFE Report.

- Action Item 13: Council staff to work with PIRO SFD to augment the Marine Planning section to include a cumulative impacts section; it should be updated with regularity to include past and present issues impacting fisheries operating in pelagic fishery areas.

This page intentionally left blank.

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.

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, 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 2016, 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. This helped include information from alia longline vessels that did not frequent the canneries, and was designed to exclude alias that exclusively conducted bottomfishing and/or trolling.

DMWR implemented a fuel subsidy program during 2015-2018 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 whom 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, CPUE and species composition were not affected. There was an increase in the amount 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 2016, 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 during 2018. Over the course of 2016, PIFSC FRMD's 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. At the date of this report, that information is not available. It will be provided in the RFMO report for US Pacific longline fisheries.

Another item lost with the discontinuation of the longline cannery sampling program by 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 (e.g. mahimahi), 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, Scientific and Statistical Committee, and the Council.

2.1.2 SUMMARY OF AMERICAN SAMOAN PELAGIC FISHERY

Landings. The estimated annual pelagic landings have varied from 4 to 11 million lbs. between 2009 to 2018. The 2018 landings were approximately 4.1 million pounds, which continued to decline from 11 million lbs. in 2009 (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 13 vessels known to be fishing in the waters of American Samoa in 2018 according to the PIRO Sustainable Fisheries Division permit program. The following number of vessels were active in each class: 8 Class D vessels (> 70 foot), 4 Class C (50 - 60 foot), 0 Class B vessels (40 - 50 foot) and 1 Class A (< 40 foot). The number of active longline boats decreased from 15 in 2017 to 20 in 2016. The 13 vessels that fished in 2018 made 145 trips (average 11 trips/vessel), deployed 2,185 sets, (168 sets/vessel) using 5.9 million hooks (Table 5).

Longline Catch-Per-Unit-Effort (CPUE). The total pelagic catch rate by all longline vessels decreased by 1.5 fish/1,000 Hooks in 2018. The tuna catch rate also decreased by 1.4 fish/1,000 Hooks in 2018. Non-tuna and other pelagic species all showed relatively constant catch rates from 2009 to 2018. The longline catch rate for tuna species have fluctuated during the past ten years. Albacore, the species targeted by longline boats, have decreased this year (12.4 fish/1,000 Hooks).

Lbs.-Per-Hour Trolling. Trolling catch rate increased steeply from 2010 to 2011 and increased slightly to its long-term peak in 2012. The catch rate continued to decrease every year up until present. Troll trips have increased by 12% from 2017 and troll hours have decreased by 15%, while the average catch per troll hour for all pelagic species have still increased (Figure 19). The catch rate for blue marlin has decreased whereas catch rates for skipjack and yellowfin have increased (Figure 20 and Figure 21).

Fish Size. Since the last year of available data from the cannery sampling program was 2015 average weight-per-fish is not reported for the past two years. Average albacore weight ranged from 38-39 lbs. in 2015. There was a slight variation for yellowfin and bigeye tuna size in the last five years of data collected. For yellowfin, weight varied from 50-60 lbs., and varied from 45-54 lbs. for bigeye tuna. Mean weight for mahimahi and wahoo decreased slightly toward the end of the time series.

Revenues. Commercial landings of tuna species continue to decline, with the 2017 landings reaching an all-time-low (Figure 5). Tunas accounted for nearly 95% of total pelagic landings with an estimated adjusted revenue of $4.7 million in 2017, and an accumulated average $0.99 price per pound. In 2017, the average albacore price was $1.16 per pound (whole weight), or $0.01 per pound higher than that in the previous year. See the Human Dimensions (Section 3.1) section for socioeconomic data on American Samoa pelagic fisheries.

Bycatch. There was no recorded bycatch for the troll fishery in 2018 (Table 12). In the longline fishery, less than 1% of the tuna catch was released. Bigeye and yellowfin were the most released bycatch tuna species. Conversely, sharks and oilfish had the highest release numbers of non-tunas, nearing 100% of each species released, respectively (Table 6). In total, only 6.7% 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

There were no Plan Team recommendations forwarded to the Council for the American Samoa data module, though there were some relevant action items.

2.1.4 OVERVIEW OF PARTICIPATION – ALL FISHERIES

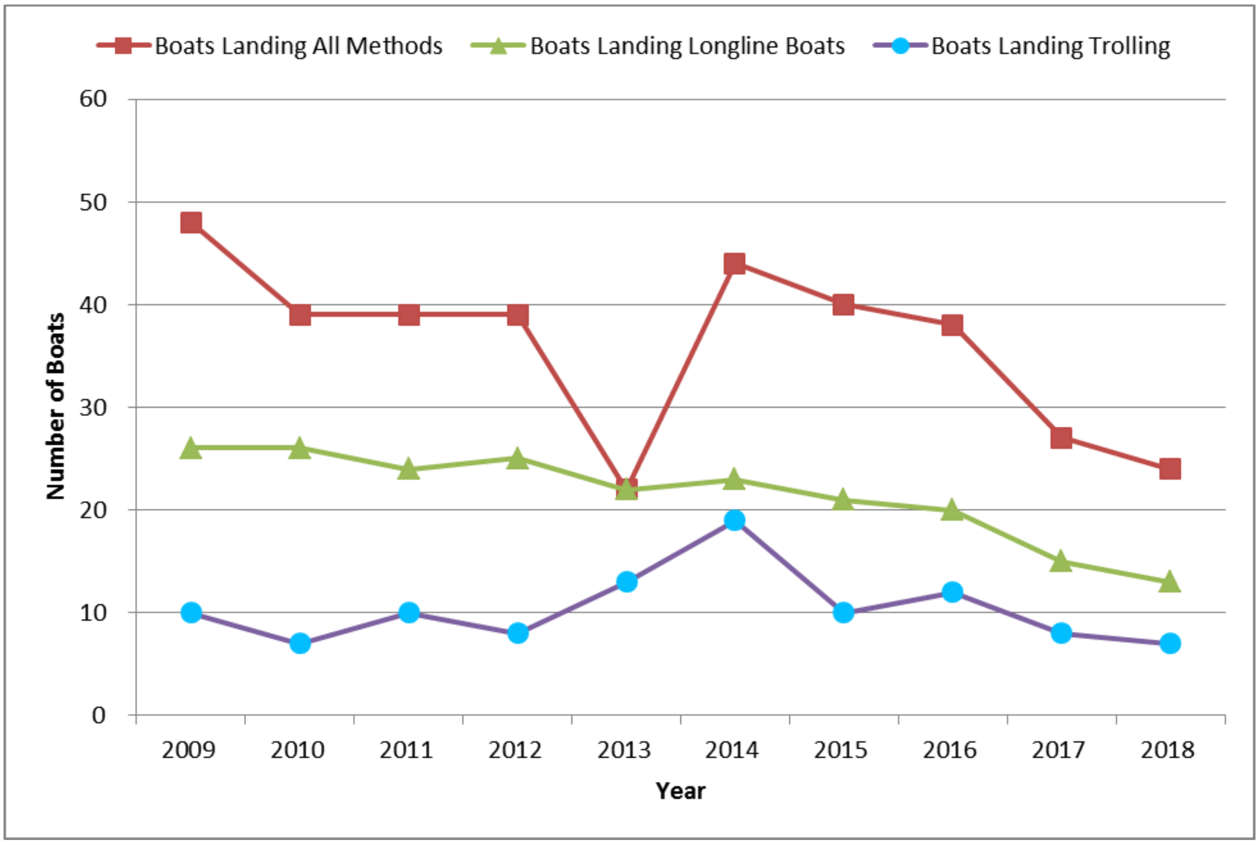


Figure 2. Number of American Samoa boats landing any pelagic species by longlining, trolling, and all methods from 2009-2018

Supporting data shown in Table A-2.

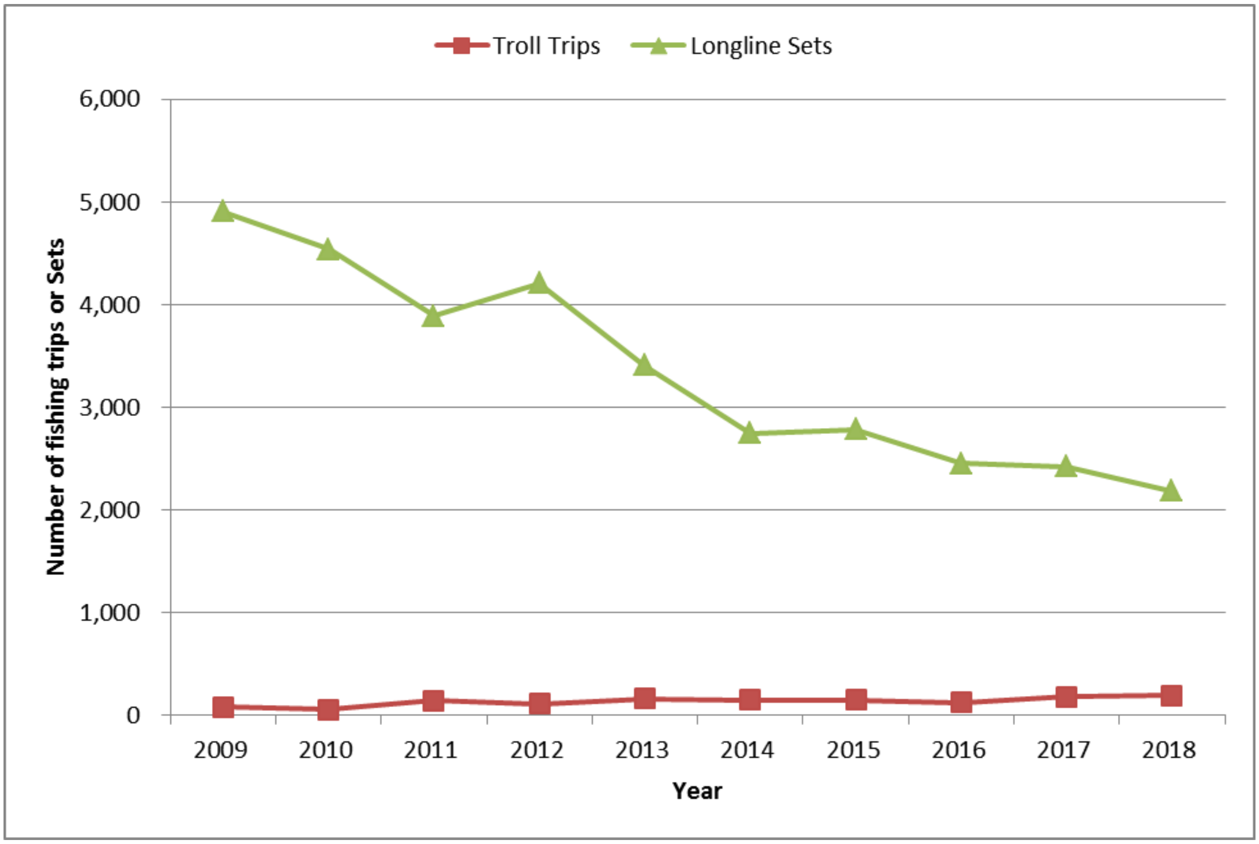


Figure 3. Number of American Samoa fishing trips or sets for all pelagic species from 2009-2018

Supporting data shown in Table A-3.

2.1.5 OVERVIEW OF LANDINGS – ALL FISHERIES

Table 3. 2018 Estimated total landings (lbs.) of pelagic species by gear in American Samoa

Species	Longline Pounds	Troll Pounds	Other Pounds	Total Pounds
Skipjack tuna	147,758	8,414	0	156,172
Albacore tuna	3,122,082	339	0	3,122,421
Yellowfin tuna	542,078	10,344	0	552,422
Kawakawa	0	266	0	266
Bigeye tuna	103,391	0	0	103,391
Bluefin tuna	1,428	0	0	1,428
Tunas (unknown)	0	0	0	0
TUNAS TOTAL	**3,916,737**	**19,363**	**0**	**3,936,100**
Mahimahi	9,881	954	0	10,835
Black marlin	0	629	0	629
Blue marlin	69,721	1,107	0	70,827

Striped marlin	3,234	0	0	3,234
Wahoo	72,172	1,154	0	73,326
Swordfish	13,434	0	0	13,434
Sailfish	1,702	0	0	1,702
Spearfish	2,024	0	0	2,024
Moonfish	2,766	0	0	2,766
Oilfish	95	0	405	499
Pomfret	378	0	58	436
Pelagic thresher shark	0	0	0	0
Thresher shark	1,163	0	0	1,163
Shark (unknown pelagic)	0	0	0	0
Snake mackerel	0	0	0	0
Bigeye thresher shark	0	0	0	0
Silky shark	715	0	0	715
White tip oceanic shark	0	0	0	0
Blue shark	6,972	0	0	6,972
Shortfin mako shark	723	0	0	723
Longfin mako shark	0	0	0	0
Billfishes (unknown)	0	0	0	0
NON-TUNA PMUS TOTAL	**184,980**	**3,844**	**463**	**189,285**
Pelagic fishes (unknown)	0	0	0	0
Double-lined mackerel	0	0	0	0
Mackerel	0	0	0	0
Long-jawed Mackerel	0	0	0	0
Barracudas	891	0	0	891
Great barracuda	0	193	88	280
Small barracudas	0	0	0	0
Rainbow runner	0	173	50	223
Dogtooth tuna	0	464	649	1,113
OTHER PELAGICS TOTAL	**891**	**830**	**787**	**2,507**
TOTAL PELAGICS	**4,102,608**	**24,037**	**1,250**	**4,127,892**

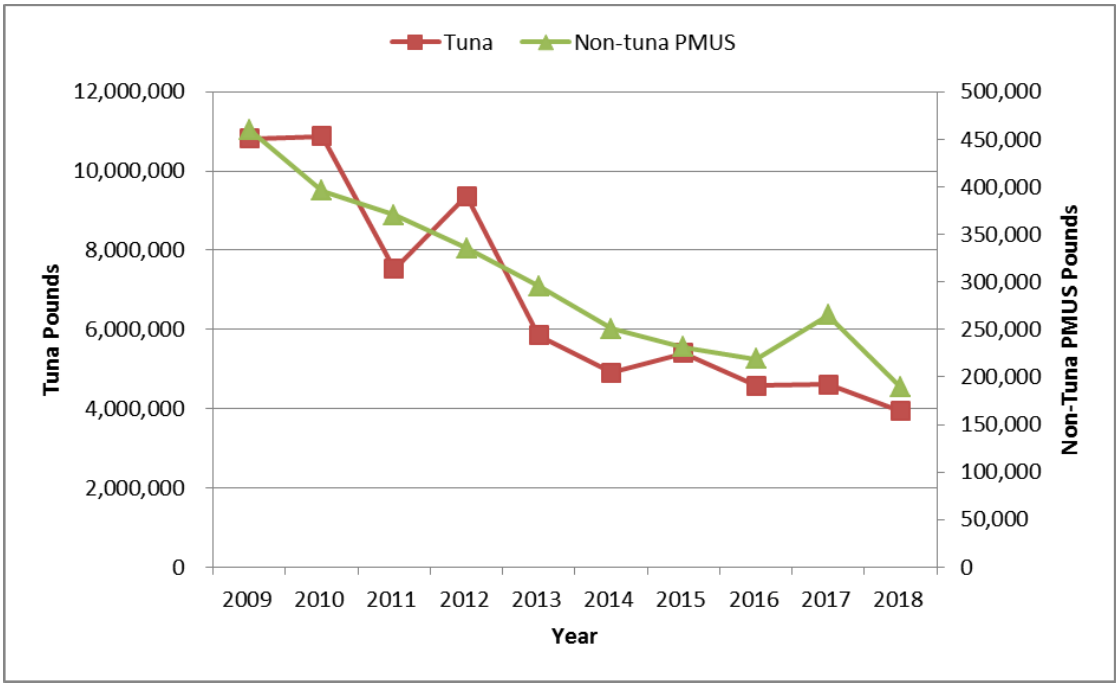


Figure 4. American Samoa annual estimated total landings of tuna species and non-tuna PMUS from 2009-2018

Supporting data shown in Table A-4.

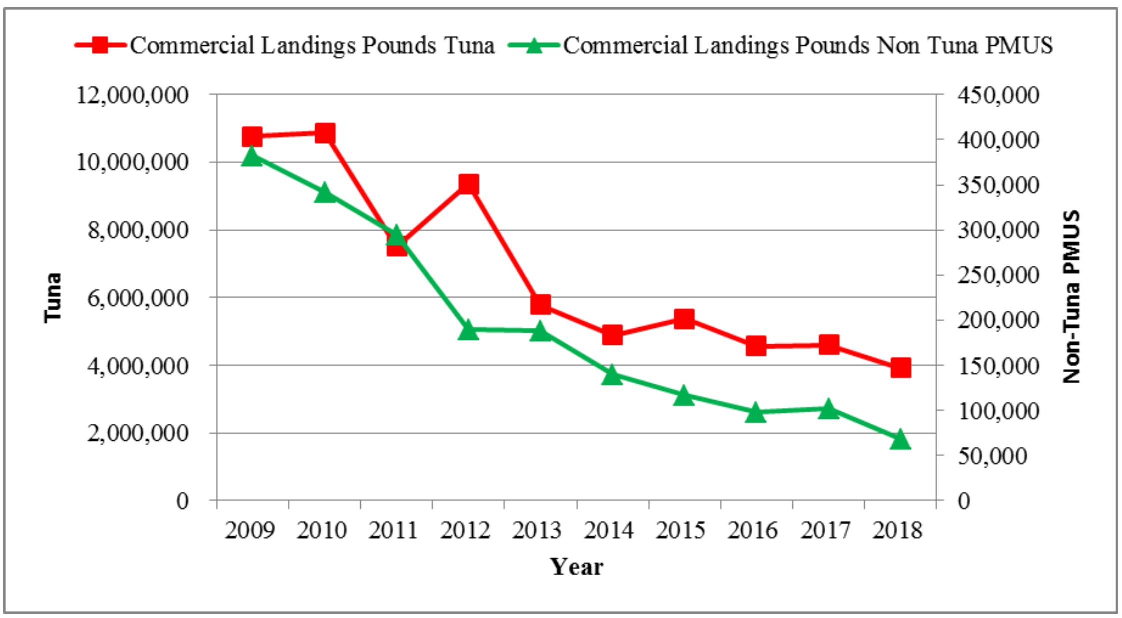


Figure 5. American Samoa annual commercial landings of tuna species and non-tuna PMUS from 2009-2018

Supporting data shown in Table A-5.

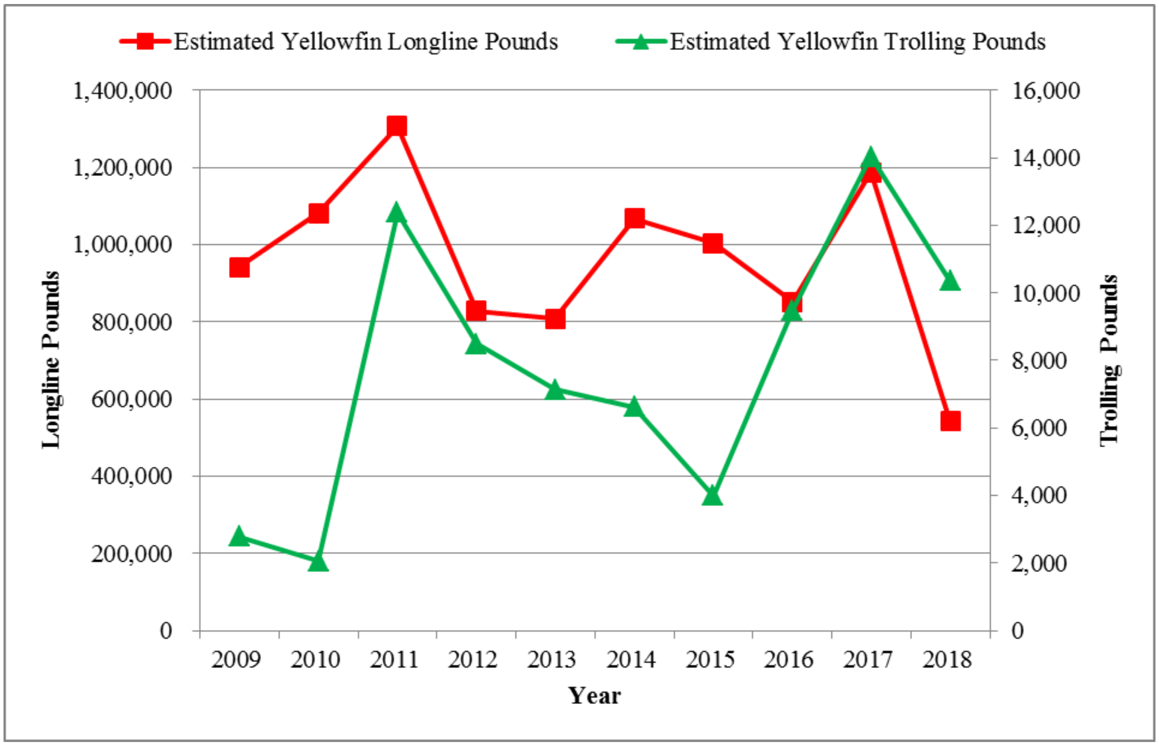


Figure 6. American Samoa annual estimated total landings of yellowfin tuna from 2009-2018

Supporting data shown in Table A-6.

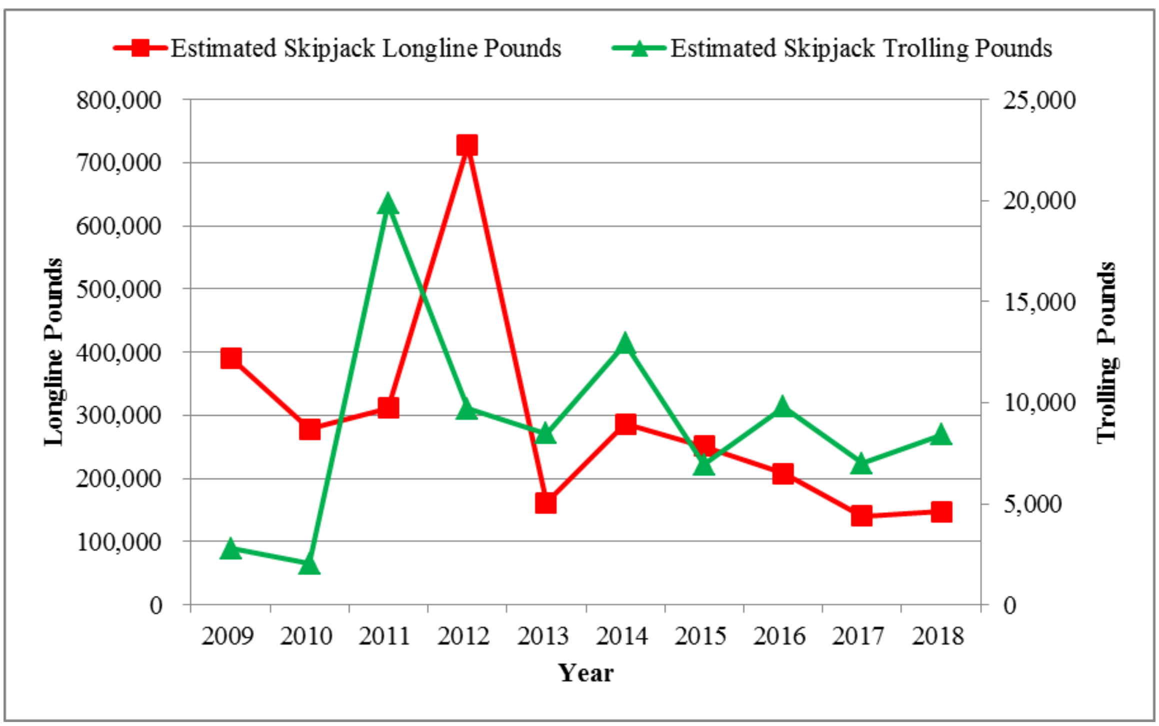


Figure 7. American Samoa annual estimated total landings of skipjack tuna from 2009-2018

Supporting data shown in Table A-7.

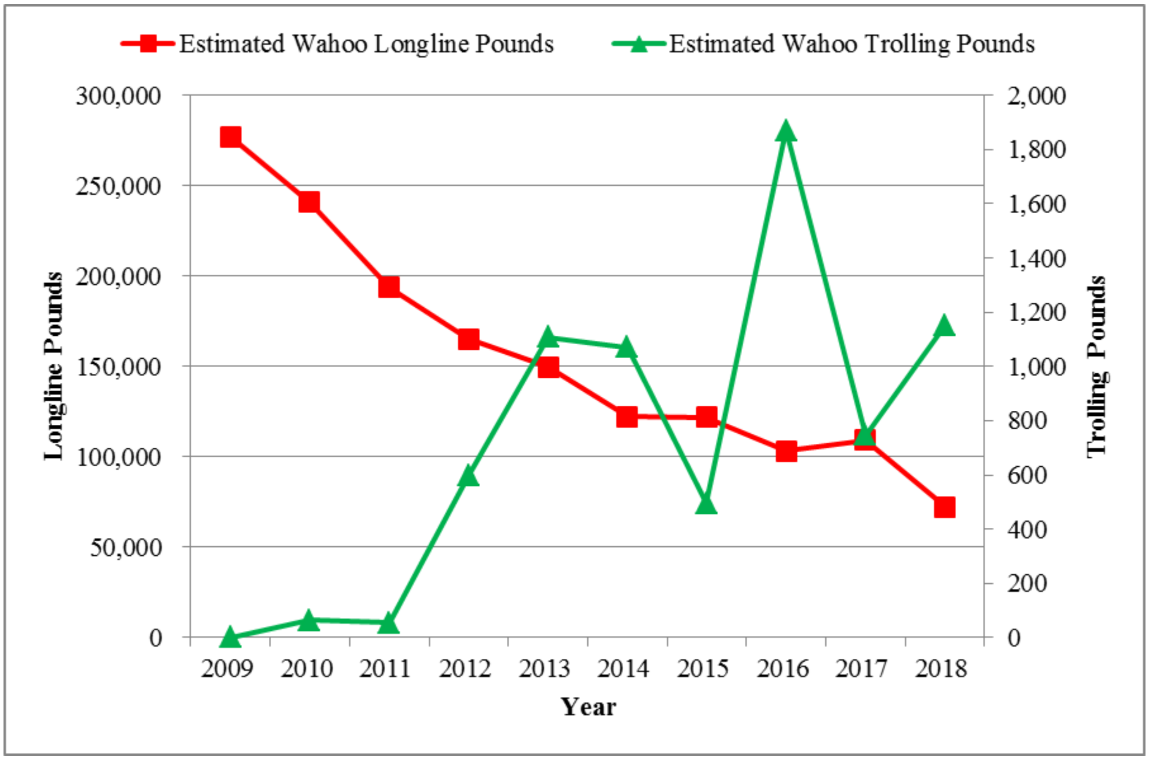


Figure 8. American Samoa annual estimated total landings of wahoo from 2009-2018

An unrepresentative amount of wahoo were caught on one day in the troll fishery in 2016. The supporting data is shown in Table A-8.

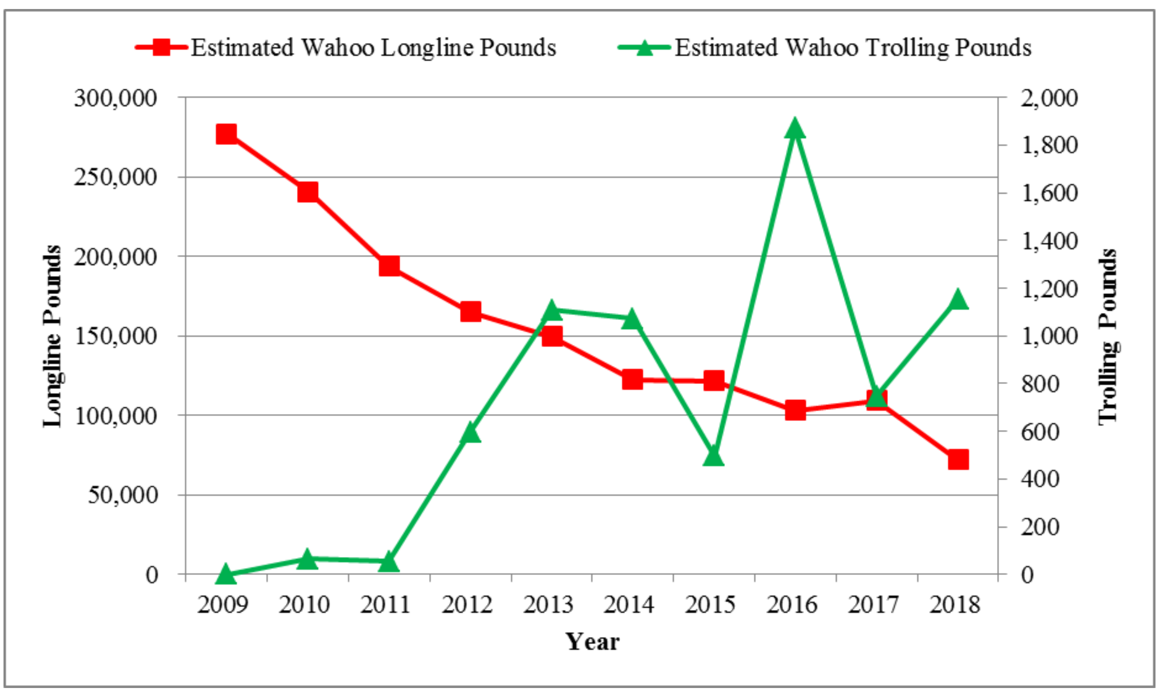


Figure 9. American Samoa annual estimated total landings of mahimahi from 2009-2018

Supporting data shown in Table A-9.

Figure 10. American Samoa annual estimated total landings of Blue Marlin from 2009-2018

Supporting data shown in Table A-10.

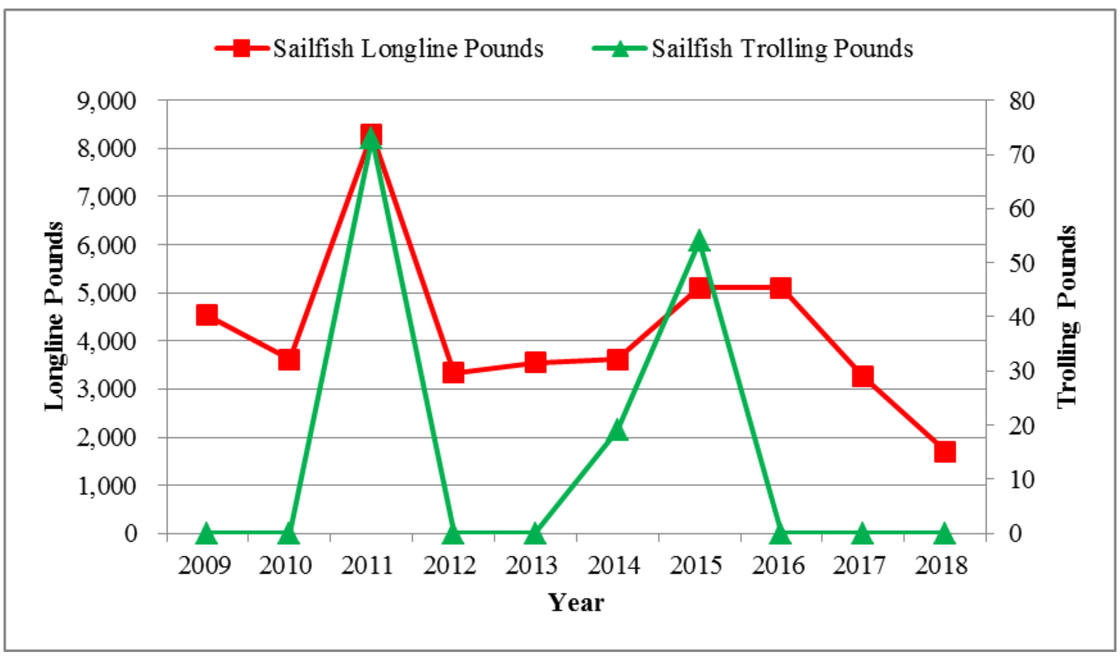


Figure 11. American Samoa annual estimated total landings of Sailfish from 2009-2018

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 2009-2018

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
2009	1	1	1	0	8	8	26	17
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	0	2	0	0	0	7	0	14
2015	0	3	0	0	0	6	0	12
2016	7	2	4	0	12	5	27	13
2017	7	1	3	0	11	5	27	9
2018	0	1	0	0	0	4	0	8

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 not included.

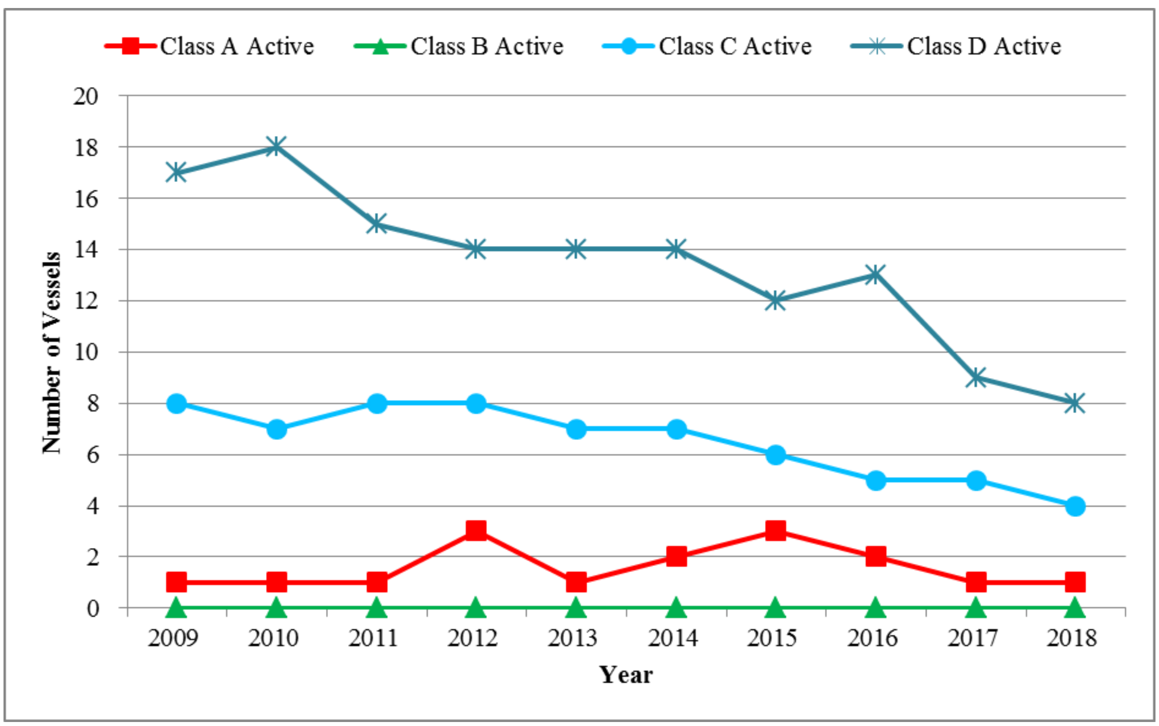


Figure 12. Number of active longline fishing vessels in size classes A (< 40 ft.), B (40-50 feet), C (51-70 feet) and D (> 70 ft.) from 2009-2018

Table 5. Longline Effort by American Samoan Vessels during 2018

Effort Type	# Vessels
Boats	13
Trips	145
Sets	2,185
1000 Hooks	5,952
Lightsticks	0

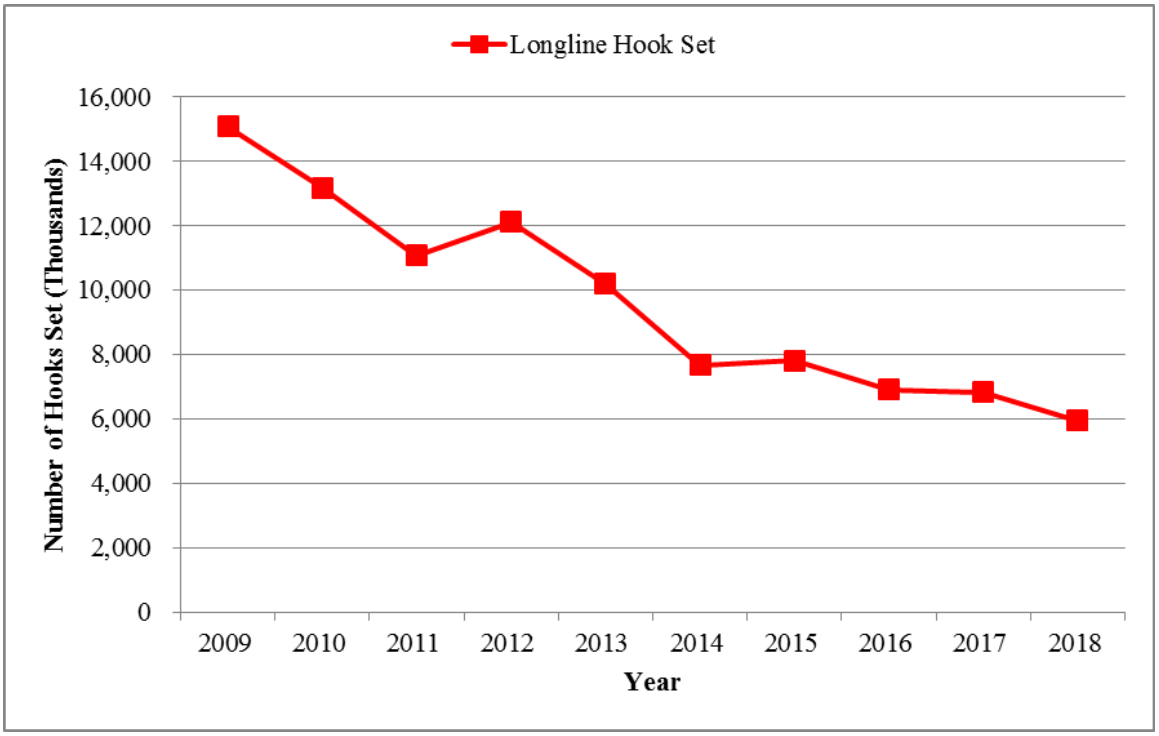


Figure 13. Thousands of American Samoa longline hooks set (Federal Logbook Data) from 2009-2018

Supporting data shown in Table A-12.

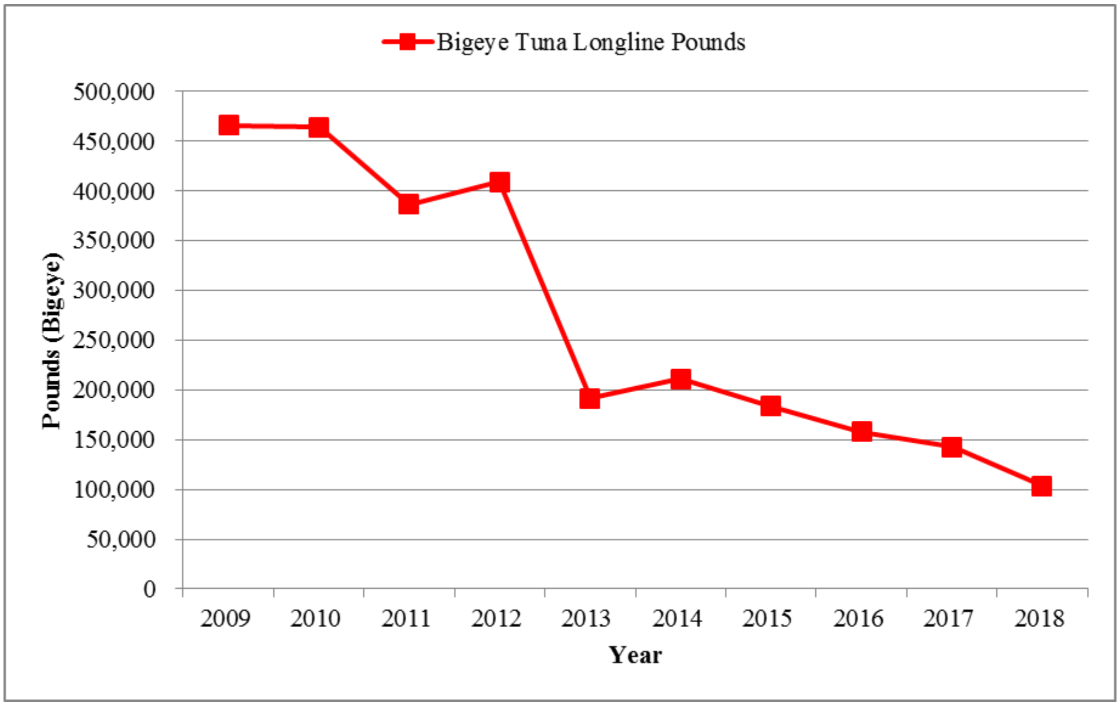


Figure 14. American Samoa annual estimated total landings of bigeye tuna by longlining from 2009-2018

Supporting data shown in Table A-13.

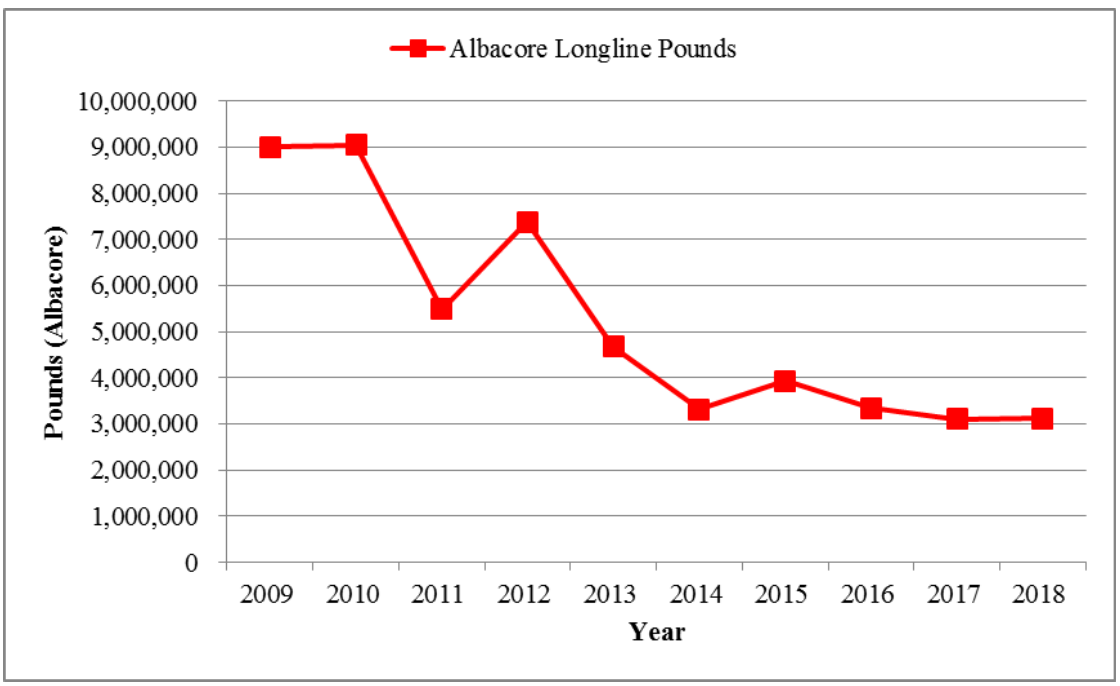


Figure 15. American Samoa annual estimated total landings of albacore by longlining from 2009-2018

Supporting data shown in Table A-14.

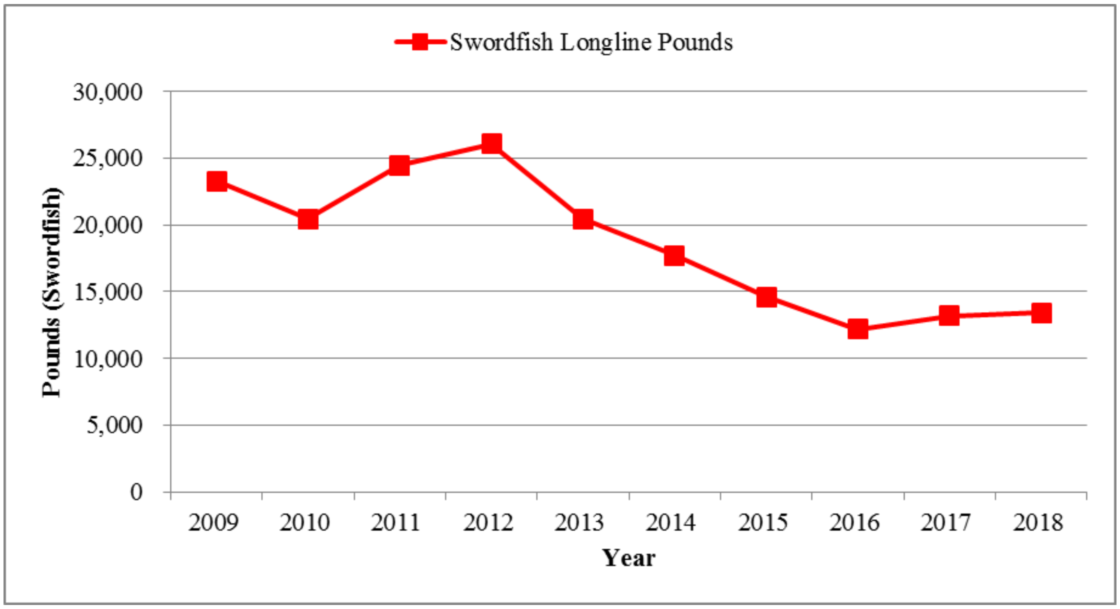


Figure 16. American Samoa total annual estimated landings of swordfish by longlining from 2009-2018

Supporting data shown in Table A-15.

Table 6. Number of fish kept, released, and percent released for all American Samoa longline vessels in 2018

Species	Number Kept	Number Released	Total Caught	Percent Released
Skipjack tuna	10,516	153	10,669	1.4
Albacore tuna	80,060	538	80,598	0.7
Yellowfin tuna	10,255	174	10,429	1.7
Kawakawa	0	0	0	0.0
Bigeye tuna	2,262	45	2,307	2.0
Bluefin tuna	6	0	6	0.0
Tunas (unknown)	0	0	0	0.0
TUNAS TOTAL	**103,099**	**910**	**104,009**	**0.9**
Mahimahi	459	8	467	1.7
Black marlin	0	2	2	100.0
Blue marlin	533	13	546	2.4
Striped marlin	47	4	51	7.8
Wahoo	2,767	34	2,801	1.2
Swordfish	119	31	150	20.7
Sailfish	24	44	68	64.7
Spearfish	44	83	127	65.4
Moonfish	56	14	70	20.0

Oilfish	5	1,619	1,624	99.7
Pomfret	43	257	300	85.7
Pelagic thresher shark	0	0	0	0.0
Thresher shark	6	376	382	98.4
Shark (unknown pelagic)	0	64	64	100.0
Snake mackerel	0	0	0	0.0
Bigeye thresher shark	0	0	0	0.0
Silky shark	11	433	444	97.5
White tip oceanic shark	0	525	525	100.0
Blue shark	83	3,024	3,107	97.3
Shortfin mako shark	8	195	203	96.1
Longfin mako shark	0	0	0	0.0
Billfishes (unknown)	4	0	4	0.0
NON-TUNA PMUS TOTAL	**4,209**	**6,726**	**10,935**	**61.5**
Pelagic fishes (unknown)	0	9	9	100.0
Double-lined mackerel	0	0	0	0.0
Mackerel	0	0	0	0.0
Long-jawed Mackerel	0	0	0	0.0
Barracudas	73	5	78	6.4
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	**73**	**14**	**87**	**16.1**
TOTAL PELAGICS	**107,381**	**7,650**	**115,031**	**6.7**

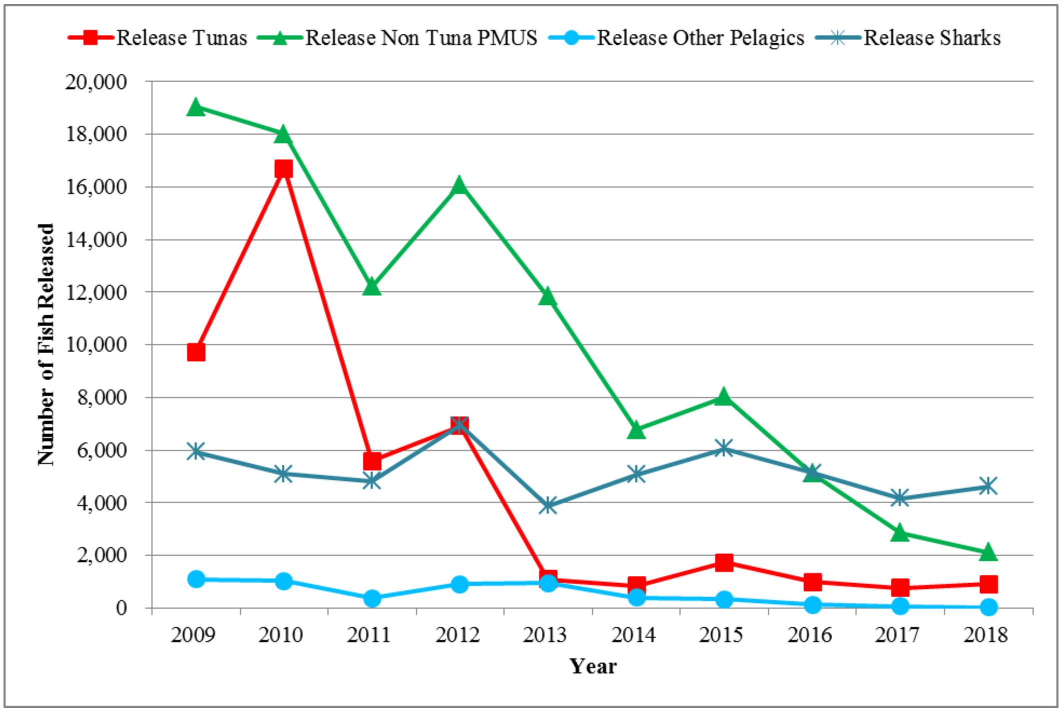


Figure 17. Number of Fish Released by American Samoa Longline Vessels from 2009-2018

Supporting data shown in Table A-16.

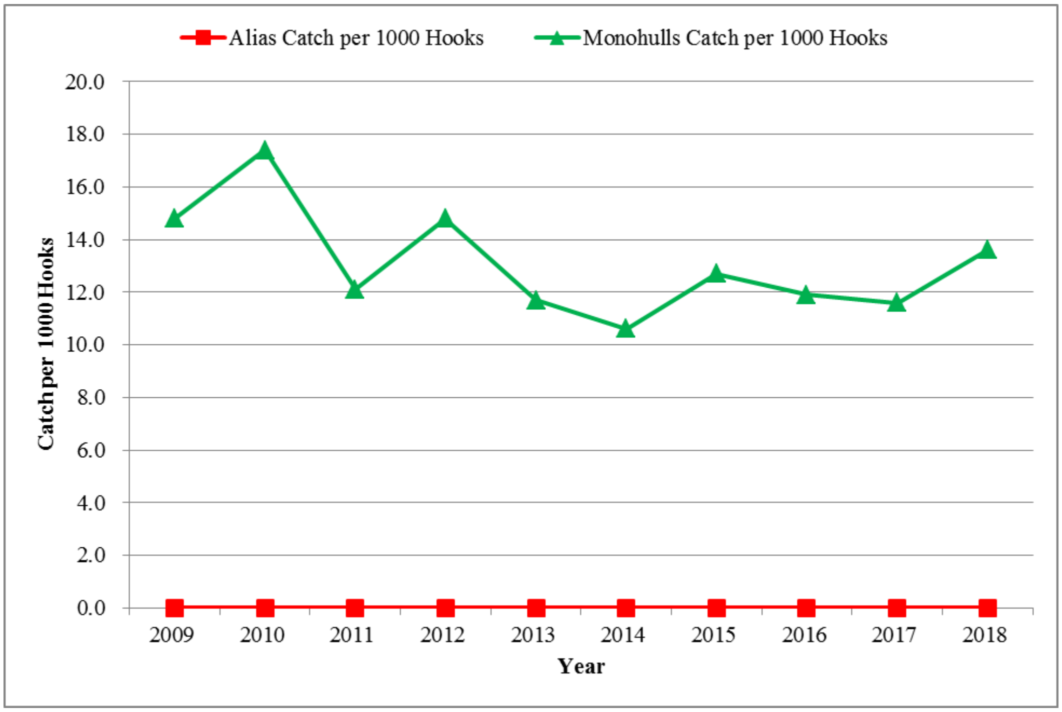


Figure 18. American Samoa Albacore catch/1,000 hooks by Monohull Vessels from Longline Logbook Data from 2009-2018

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

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

Species	Alias 1996	Alias 1997	Alias 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	Alias 1999	Monohulls 1999	Alias 2000	Monohulls 2000	Alias 2001	Monohulls 2001	Alias 2002	Monohulls 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
Tuna PMUS	**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
Sharks (unknown coa	0.1	1.2	0.0	0.7	0.0	0.7	0.0	0.8
Swordfish	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0
Sailfish	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Spearfish	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
Moonfish	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
Oilfish	0.0	0.6	0.0	0.1	0.0	0.2	0.0	0.5
Pomfret	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.1
Non-Tuna PMUS	**5.2**	**4.3**	**3.7**	**3.2**	**5.6**	**2.5**	**7.3**	**3.4**
Barracudas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Non-PMUS Pelagic	**0.3**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.4**
Total Pelagics	**36.7**	**26.4**	**32.1**	**37.0**	**39.9**	**39.9**	**38.2**	**36.7**

Table 9. American Samoa catch/1,000 hooks for two types of longline vessels from 2003-2005

Species	Alias 2003	Monohulls 2003	Alias 2004	Monohulls 2004	Alias 2005	Monohulls 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 2012-2018

Species	All Vessels 2012	All Vessels 2013	All Vessels 2014	All Vessels 2015	All Vessels 2016	All Vessels 2017	All Vessels 2018
Skipjack tuna	4.3	1.1	2.5	2.0	2.0	1.5	1.8
Albacore tuna	14.8	11.7	10.6	12.7	11.9	11.6	13.5
Yellowfin tuna	1.2	1.9	2.5	2.6	2.6	3.7	1.8
Bigeye tuna	0.6	0.4	0.7	0.6	0.5	0.4	0.4
TUNAS TOTAL	**20.9**	**15.1**	**16.3**	**17.9**	**17.0**	**17.2**	**17.5**
Mahimahi	0.1	0.2	0.2	0.1	0.1	0.2	0.1
Blue marlin	0.1	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	0.5
Spearfish	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Moonfish	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Oilfish	0.8	0.7	0.6	0.8	0.6	0.3	0.3
Pomfret	0.1	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	0.1
Silky shark	0.0	0.0	0.1	0.1	0.1	0.1	0.1
White tip oceanic shark	0.1	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	0.5
Shortfin mako shark	0.0	0.0	0.0	0.1	0.0	0.0	0.0
NON-TUNA PMUS TOTAL	**2.5**	**2.2**	**2.4**	**2.7**	**2.4**	**2.1**	**1.9**
Pelagic fishes (unknown)	0.1	0.1	0.0	0.0	0.0	0.0	0.0
OTHER PELAGICS TOTAL	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
TOTAL PELAGICS	**23.5**	**17.4**	**18.7**	**20.6**	**19.4**	**19.3**	**19.4**

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 12).

Table 12. American Samoa 2018 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
2018	0	0	0	0	744	0.0	0	59	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. Abbreviations: Dead Inj; released dead or injured; Unk: Released unknown condition; With BC: Number of fisherman interviewed during creel survey who reported bycatch.

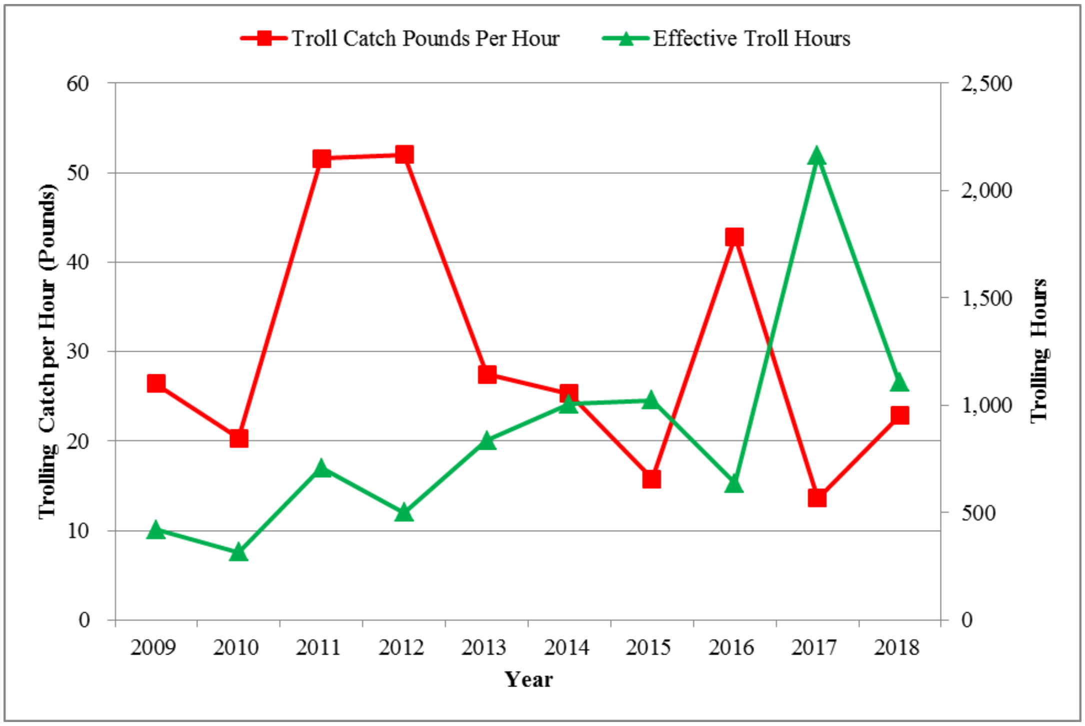


Figure 19. American Samoa pelagic catch-per-hour of trolling and number of trolling hours from 2009-2018

Supporting data shown in Table A-18.

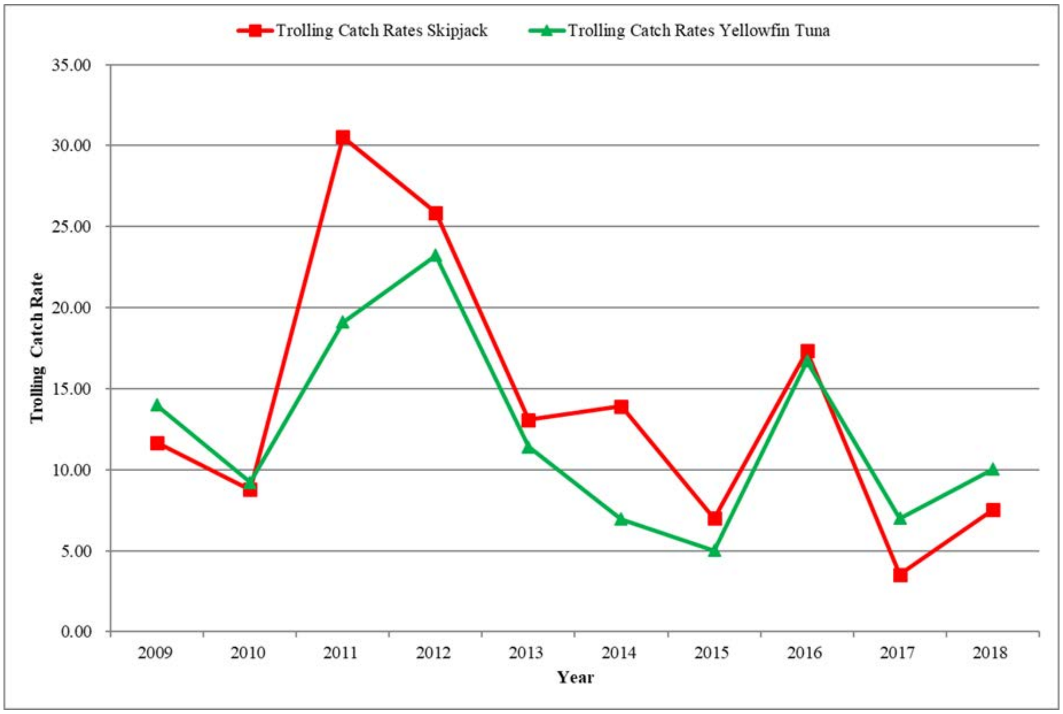


Figure 20. American Samoa trolling CPUE for Skipjack and Yellowfin Tuna from 2009-2018

Supporting data shown in Table A-19.

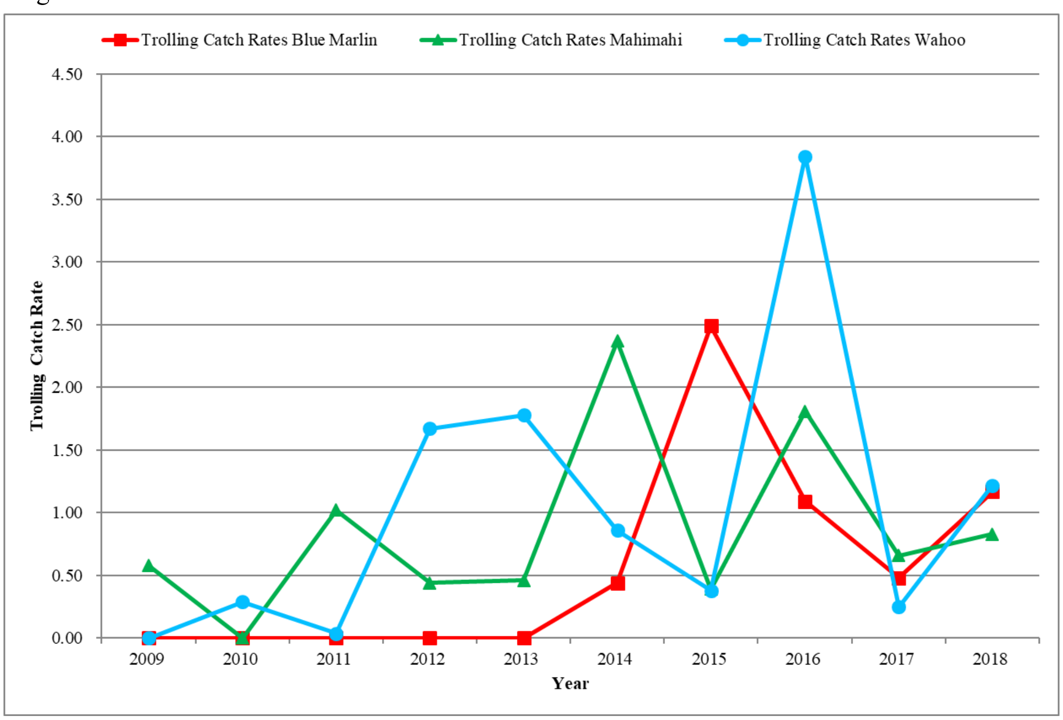


Figure 21. American Samoa trolling CPUE for Blue Marlin, Mahimahi, and Wahoo (creel survey) from 2009-2018

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 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 voluntary 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 recently 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 73 survey days in 2018 (see Table A-21). Total trips in 2018 increased by 27%, but staff were only able to conduct 93 interviews, which was a 15% decrease in interview numbers from 2017. This decrease in interviews was due to typhoon recovery. Between 2013 and 2015, DFW staff intercepted fewer than 3 charter vessels for interviews. Four were intercepted in 2016, but zero were intercepted in 2017. In 2018 Charter boats were again intercepted. 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 increased in 2018 compared to the previous year. 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 79% of the entire pelagic landings in 2018 based on creel survey data. Skipjack landings increased 24% (291,854 lbs.) and total landings increased 8% (367,473 lbs.) from landings in 2017.

Landings of mahimahi and yellowfin tuna ranked second and third by weight of landings during 2018. Creel data estimated 54,903 lbs. of mahimahi, a 22% increase from 2017. After three years (2015-2017) of high poundage of mahimahi landings, landed pounds returned to 2011-2013 levels over the past two years. There were 9,694 lbs. of yellowfin landed in 2018, a 43% decrease from the 2017 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.

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, 72 fishermen reported landings, a significant increase, but in 2017 the number of fishermen decreased by 50% to 36. In 2018 the number increased by 11% to 40. 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 2018, 1735 trips were recorded in the database (27% increase from 2017), and 3,375 trips estimated from the creel survey (29% increase from 2017. Total hours trolling was similar in 2018, with 17,537 hours (increase of 21% from 2017). Average trip length decreased slightly to 5.2 hours per trip which is the lowest since 2013. 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.

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.

Weather. Weather and typhoon conditions possibly played a key role in fishing as Typhoon Yutu passed over Saipan and Tinian in late October causing massive destruction to personal property and infrastructure used for fishing.

Fish Aggregating Devices (FADs). Five FADs were deployed in 2018. Two FADs were deployed around Saipan and three around Rota. The two FADs around Saipan were lost soon after deployment due to Typhoon Yutu. There have been no FAD deployments in the previous years because of the approval for in water work issue. The grant approval for in water work was gained in the beginning of 2018.

CPUE. In 2018, trolling catch rates decreased to 20.9 lbs. per trolling hour, a level similar to the 10 year average (19.4 lbs./hr). The skipjack catch rate, the primary target species in CNMI, increased to 16.6 lbs. per hour fished. This catch rate is a 2% increase, and is still higher than the 10 year average (14.7 lbs./hr). Yellowfin catch rate in 2018 was near the long-term average at 0.6 lbs. per hour, while the mahimahi catch rate increased slightly to 3.1lbs/hr in 2018, down from a peak in 2015. This mahimahi catch rate is equal to the 10 year average of 3.1lbs/hr.

Revenues. Commercial estimated inflation-adjusted revenues per trip, at $213.00, were down from 2017 by 29%. The total value of the pelagic fishery was $410,786.30. The average price for all pelagics was up slightly $2.45 driven by the $2.40 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 2007-2018.

2.2.3 PLAN TEAM RECOMMENDATIONS

For the CNMI Module in the 2018 Annual SAFE Report, the 2019 Pelagic Fishery Ecosystem Plan Team recommended that the Council request WPacFin to be engaged with the CNMI and the Council on data collection initiatives should proposed regulatory actions in CMNI to require mandatory fishery reporting be approved.

2.2.4 OVERVIEW OF PARTICIPATION AND EFFORT – NON-CHARTER AND CHARTER

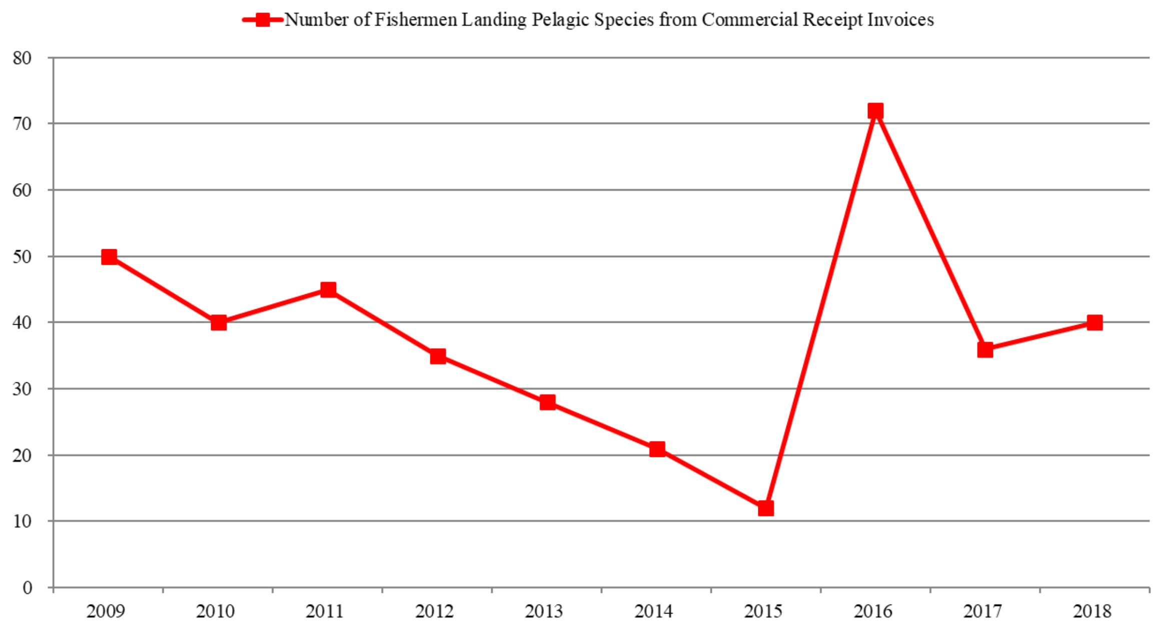


Figure 22. CNMI Fishermen (Boats) with Commercial Pelagic Landings from 2009-2018

Note: Due to data reporting methods, the number of fishermen may include duplicate counts. Supporting data shown in Table A-22.

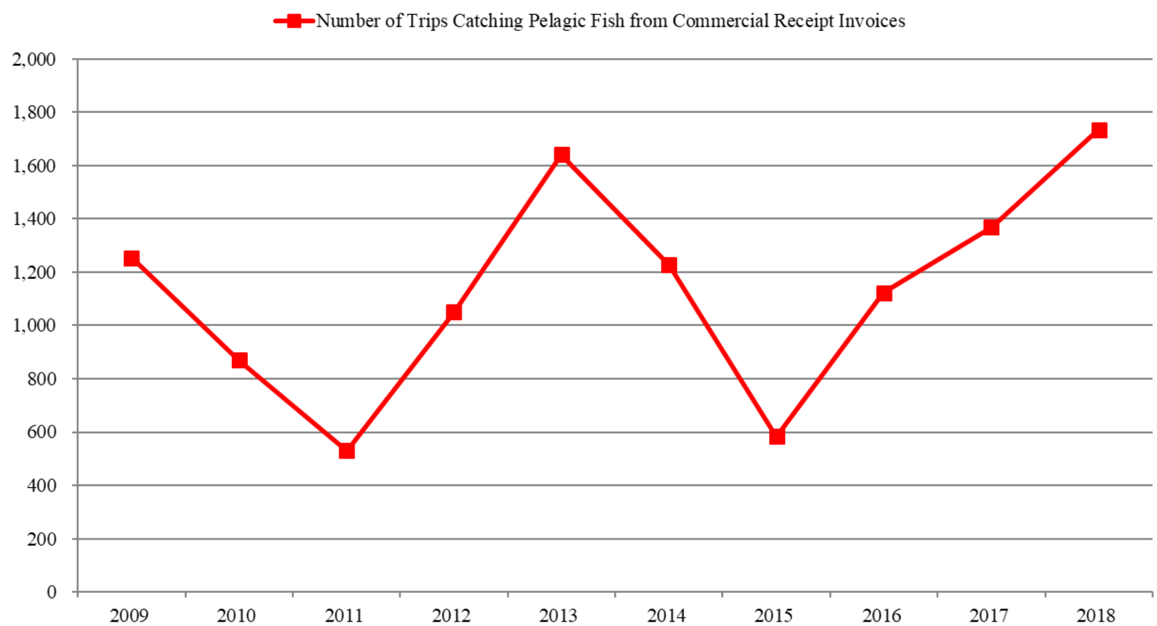


Figure 23. Numbers of Trips Catching Any Pelagic Fish from Commercial Receipt Invoices from 2009-2018

Supporting data shown in Table A-23.

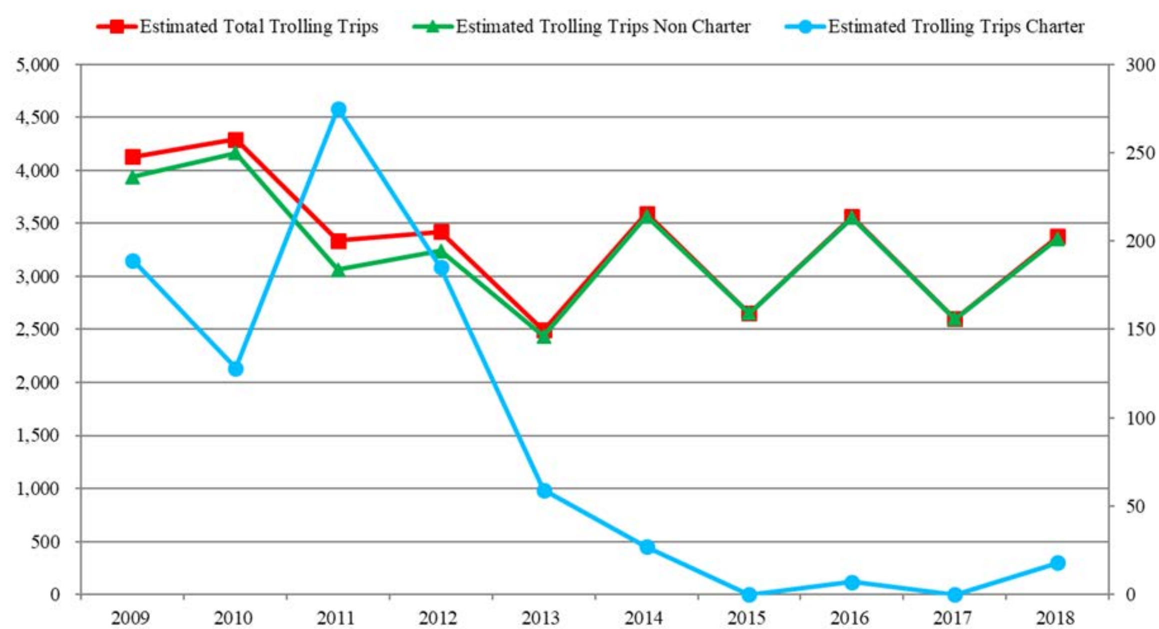


Figure 24. CNMI Boat-based Creel Estimated Number of Trolling Trips from 2009-2018

Supporting data shown in Table A-24.

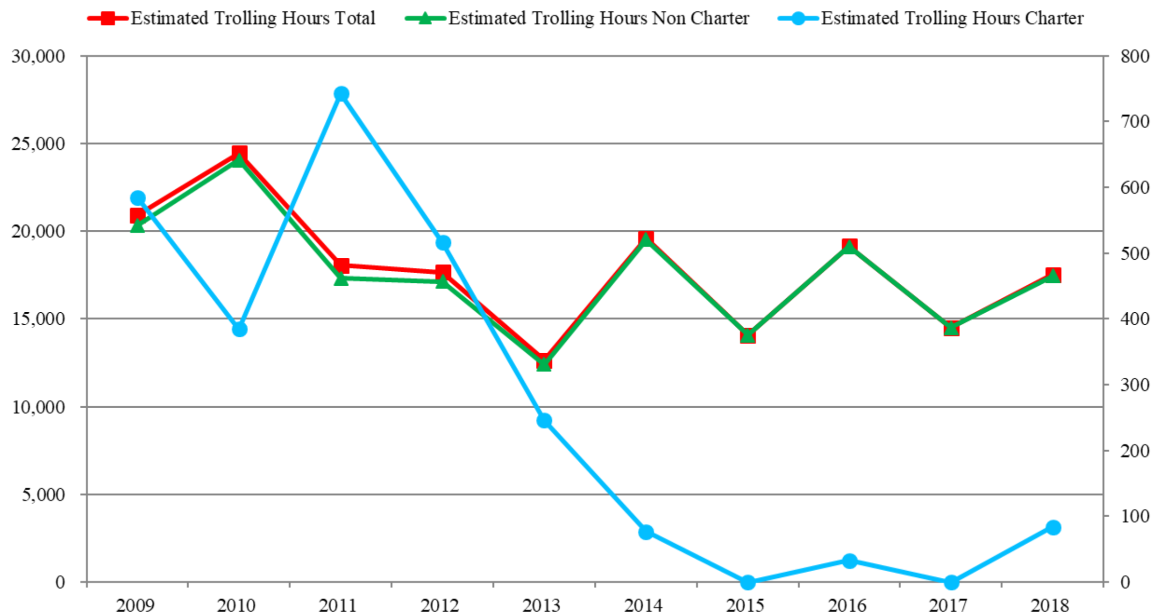


Figure 25. CNMI Boat-based Creel Estimated Number of Trolling Hours from 2009-2018
Supporting data shown in Table A-25.

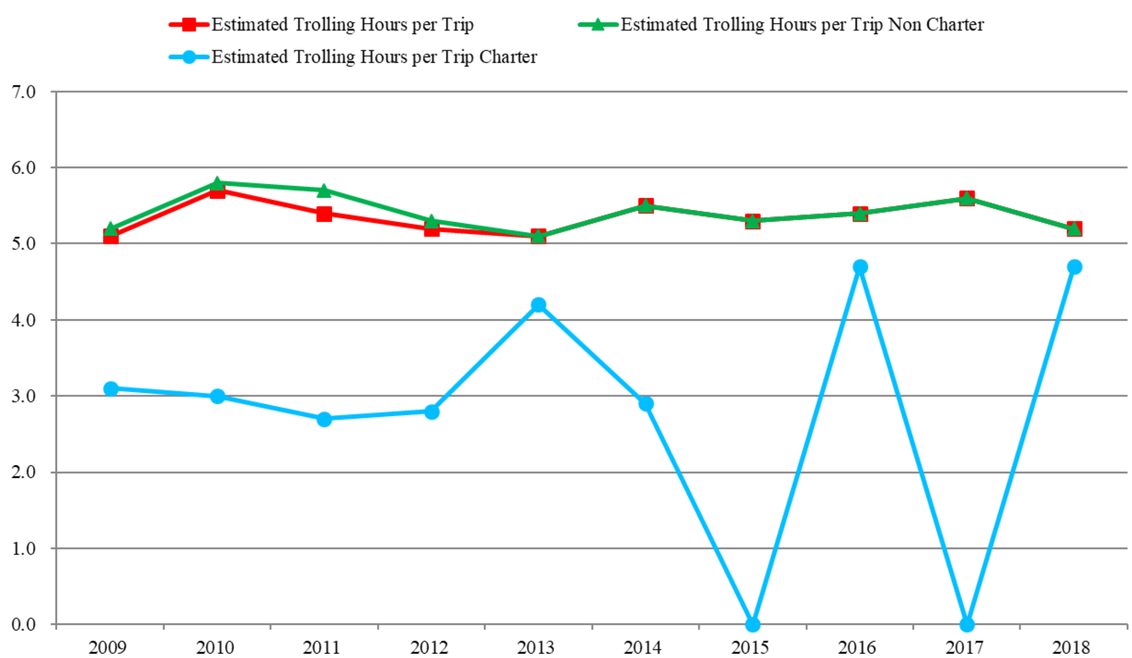


Figure 26. CNMI Boat-Based Creel Average Trip Length – Hours per Trip from 2009-2018
Supporting data shown in Table A-26.

2.2.5 OVERVIEW OF LANDINGS – NON-CHARTER AND CHARTER

Table 13. Pelagic species composition from creel surveys performed in the CNMI in 2018

Species	Total Landings	Non Charter	Charter
SKIPJACK TUNA	291,854	290,681	1,173
YELLOWFIN TUNA	9,694	9,694	0
SABA (KAWAKAWA)	460	460	0
TUNAS (MISC.)	1,325	1,325	0
TUNAS Total	**303,333**	**302,160**	**1,173**
MAHIMAHI	54,903	54,708	196
WAHOO	5,849	5,654	196
BLUE MARLIN	2,467	2,467	0
SAILFISH	0	0	0
SPEARFISH	0	0	0
SHARKS	0	0	0
SICKLE POMFRET (W/WOMAN)	0	0	0
NON-TUNA PMUS Total	**63,219**	**62,829**	**392**
DOGTOOTH TUNA	0	0	0
RAINBOW RUNNER	699	699	0
BARRACUDA	222	198	24
TROLL FISH (MISC.)	0	0	0
OTHER PELAGICS Total	**921**	**897**	**24**
TOTAL PELAGICS	**367,473**	**365,886**	**1,589**

Note: Total pelagic landings is 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 14. Commercial pelagic landings (lb.), revenues ($), and average prices ($) in the CNMI in 2018

Species	Pounds	Value	Average Price
SKIPJACK TUNA	125,009.5	296,182.8	2.37
YELLOWFIN TUNA	13,179.0	34,857.1	2.64
SABA (KAWAKAWA)	141.3	306.3	2.17
TUNAS (MISC.)	4,646.9	11,219.1	2.41
TUNAS TOTAL and AVERAGE PRICE	**142,976.6**	**342,565.2**	**2.40**
MAHIMAHI	14,271.0	40,133.0	2.81
WAHOO	686.9	1,969.4	2.87
BLUE MARLIN	373.8	971.9	2.60
SAILFISH	108.8	271.9	2.50
SICKLE POMFRET (W/WOMAN)	29.4	80.0	2.72
NON-TUNA PMUS TOTAL and AVERAGE PRICE	**15,469.8**	**43,426.1**	**2.81**
DOGTOOTH TUNA	1,558.8	4,174.4	2.68
RAINBOW RUNNER	1,384.1	3,431.3	2.48
TROLL FISH (MISC.)	6,365.0	17,189.4	2.70
OTHER PELAGICS TOTAL and AVERAGE PRICE	**9,307.8**	**24,795.0**	**2.66**
PELAGICS TOTAL and AVERAGE PRICE	**167,754.2**	**410,786.3**	**2.45**

Note: Total pelagic landings is 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. Bycatch summary of offshore daytime creel surveys in the CNMI from 2009-2018

Year	Total Trips	Total Bycatch	Bycatch Charter	Bycatch Non Charter
2009	137	0	0	0
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	101	0	0	0

Notes: “Catch” is the total number of fish counted and estimated in interviews for trolling method. Bycatch information is calculated from raw interview data and represents the percent of fish caught or percent of interviews (trolling trips) with bycatch. “With BC”: Number of fisherman interviewed during creel survey who reported bycatch.

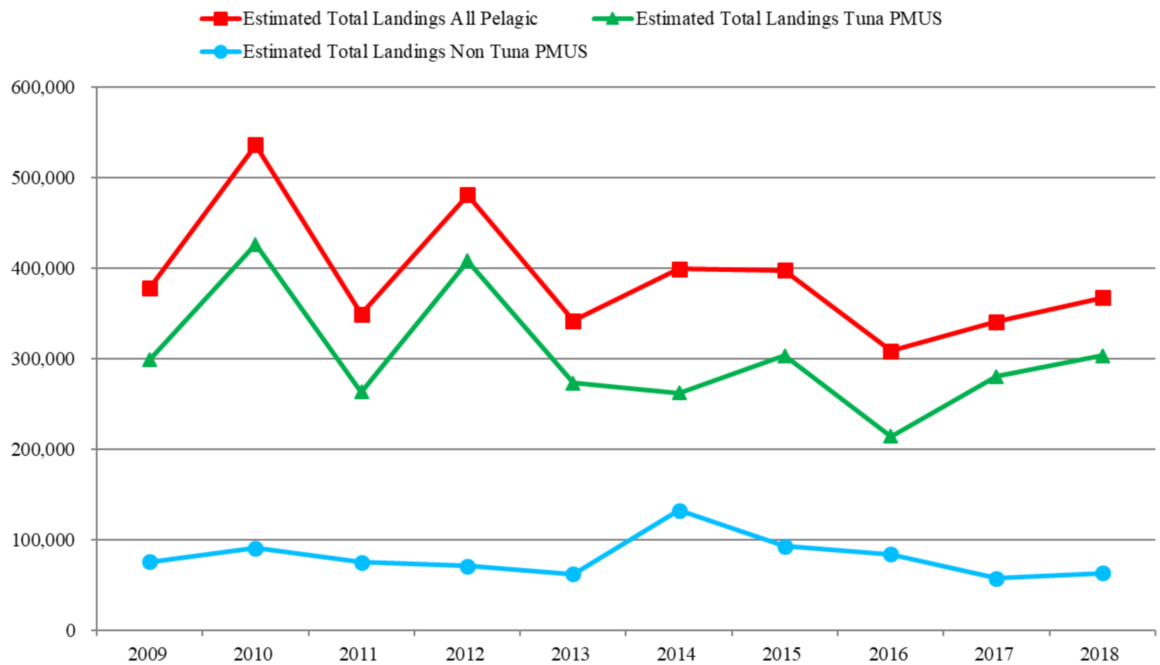


Figure 27. Total estimated annual catch for all pelagics, tuna PMUS, and non-tuna PMUS in the CNMI from 2009-2018

Supporting data shown in Table A-27.

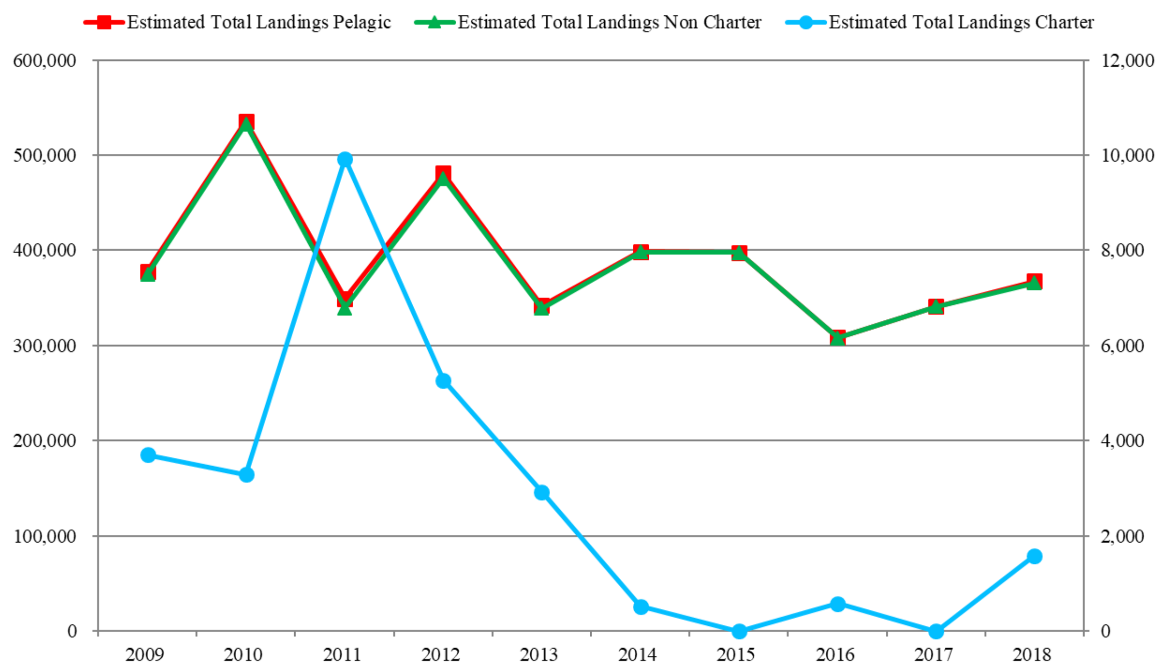


Figure 28. Total estimated annual catch for all pelagics in the CNMI from 2009-2018

Supporting data shown in Table A-28.

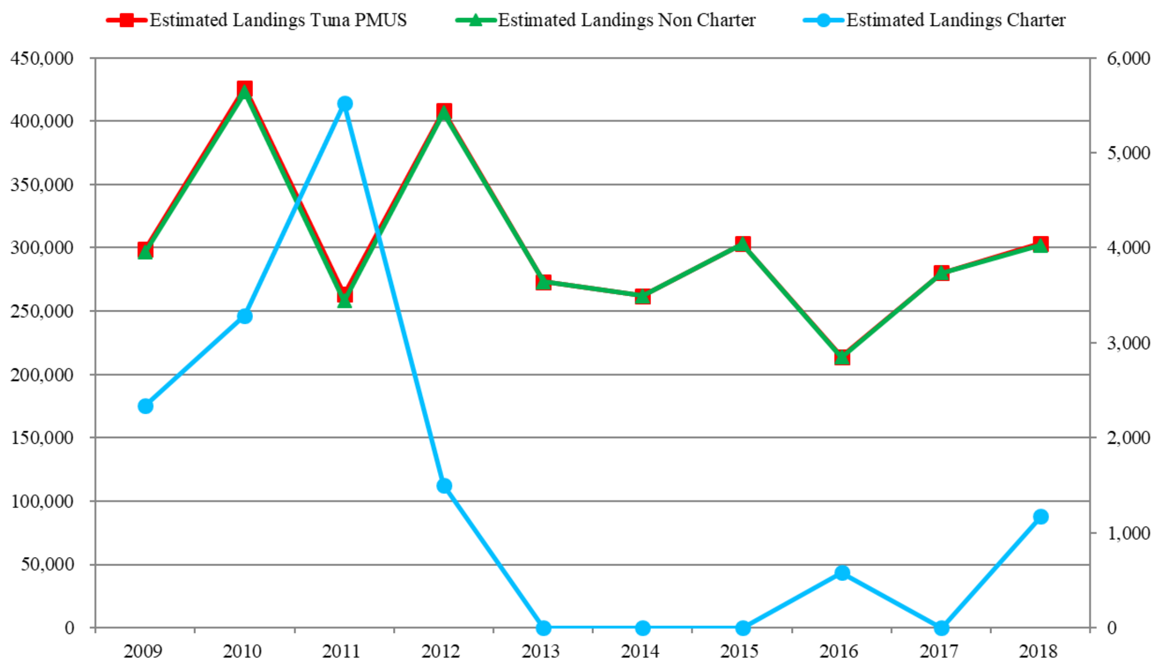


Figure 29. Total estimated annual catch for tuna PMUS in the CNMI from 2009-2018
Supporting data shown in Table A-29.

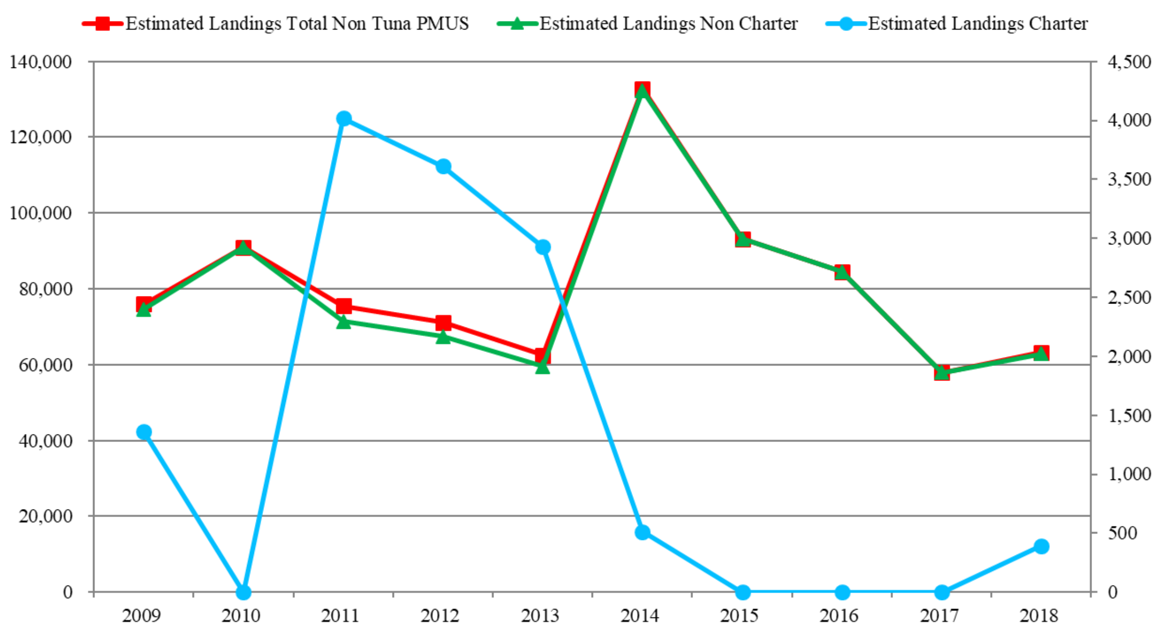


Figure 30. Total estimated annual catch for non-tuna PMUS in the CNMI from 2009-2018
Supporting data shown in Table A-30.

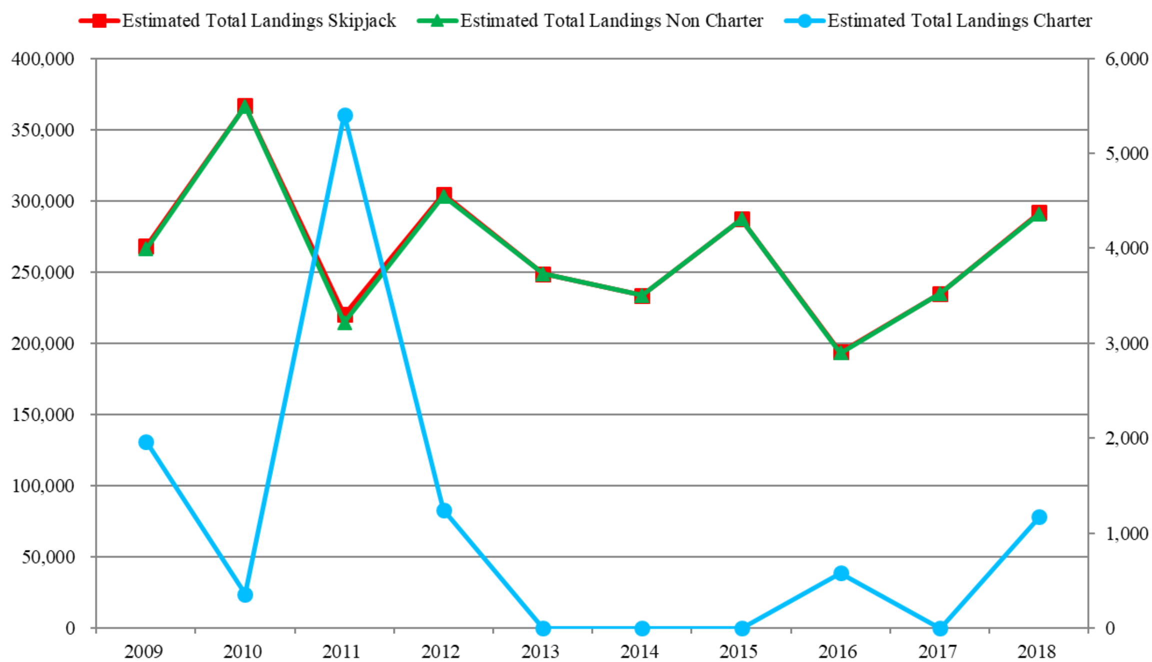


Figure 31. Total estimated annual catch for skipjack in the CNMI from 2009-2018
Supporting data shown in Table A-31.

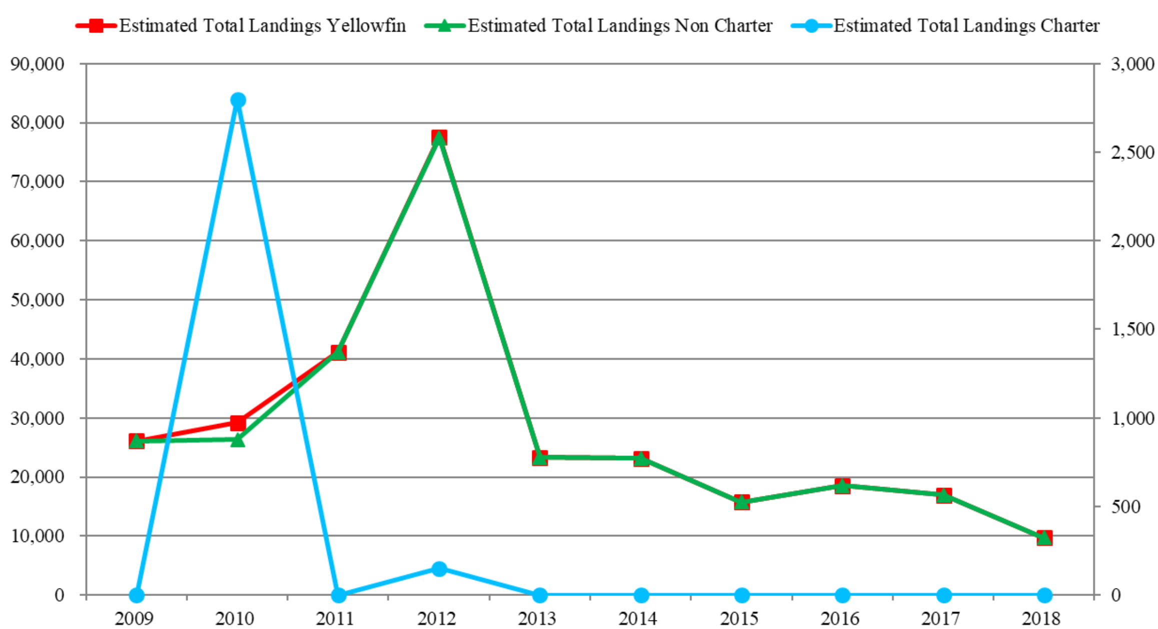


Figure 32. Total estimated annual catch for yellowfin in the CNMI from 2009-2018
Supporting data shown in Table A-32.

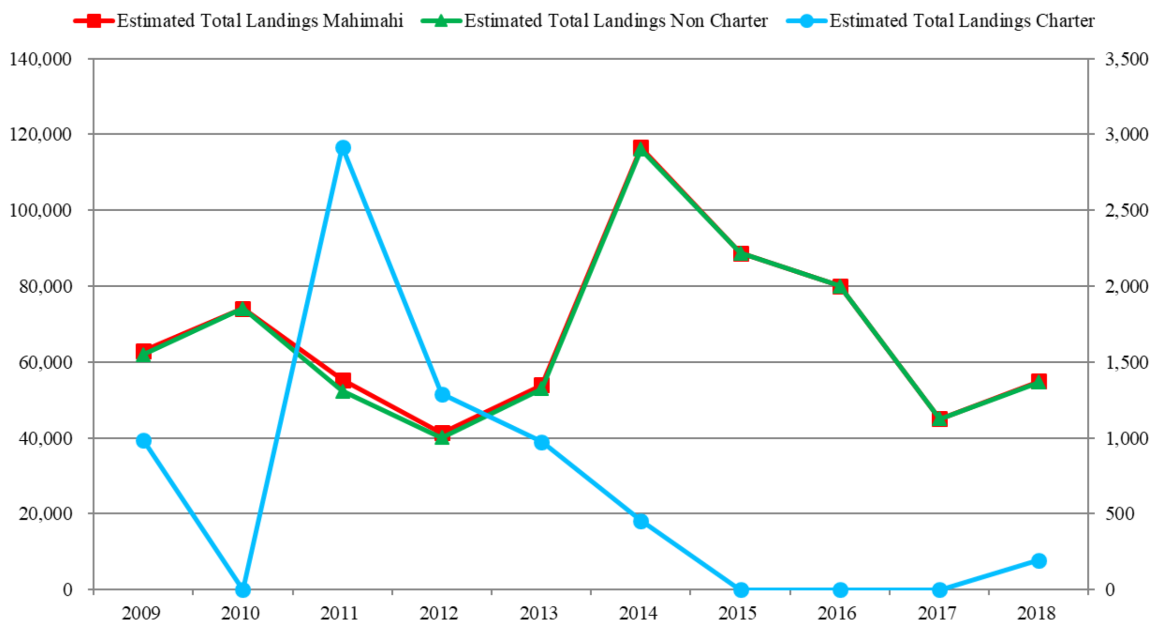


Figure 33. Total estimated annual catch for mahimahi in the CNMI from 2009-2018
Supporting data shown in Table A-33.

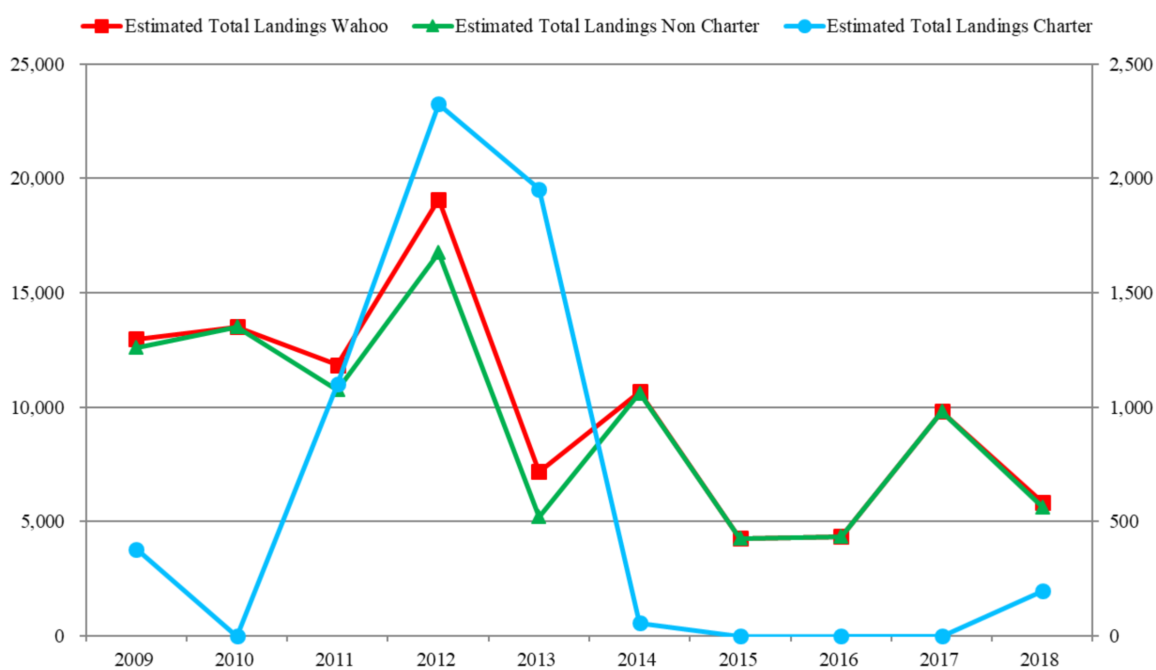


Figure 34. Total estimated annual catch for wahoo in the CNMI from 2009-2018
Supporting data shown in Table A-34.

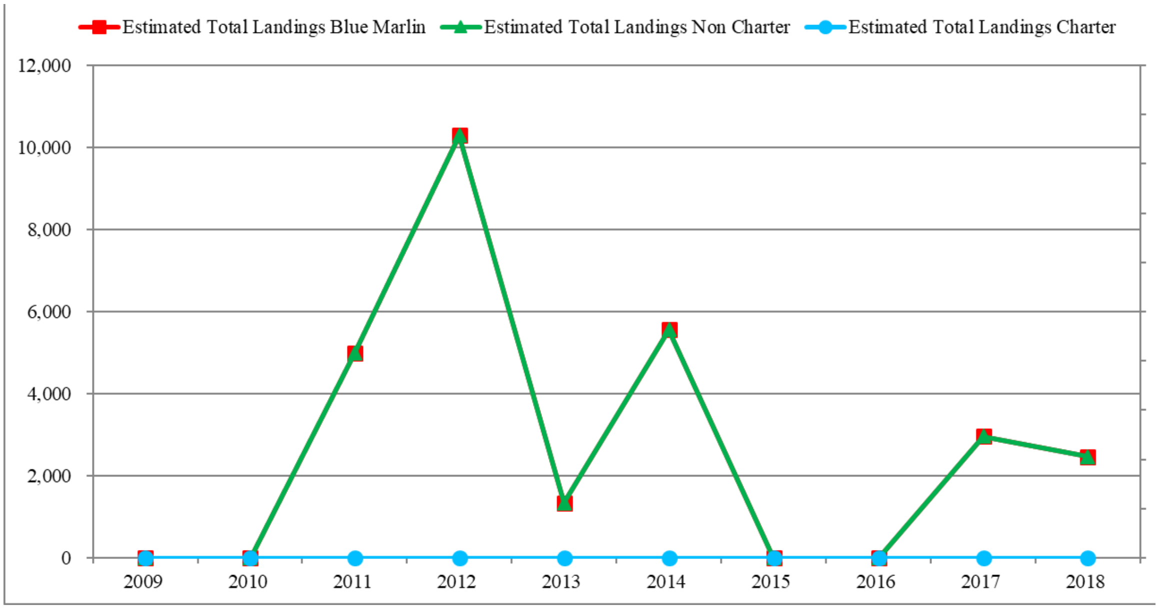


Figure 35. Total estimated annual catch for blue marlin in the CNMI from 2009-2018
Supporting data shown in Table A-35.

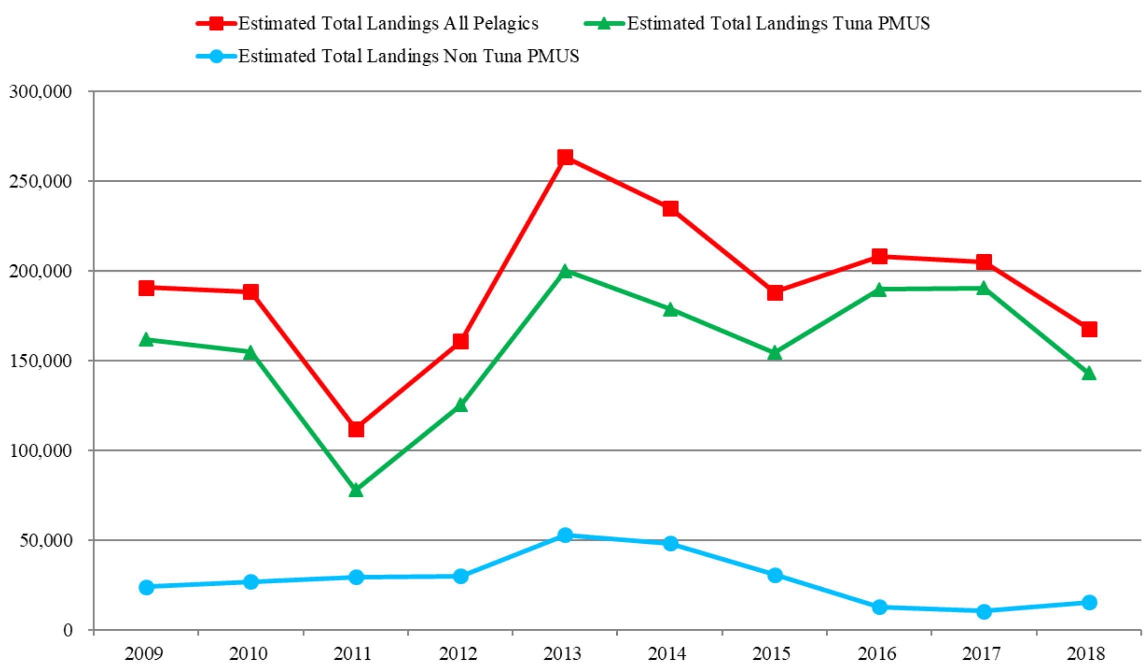


Figure 36. Annual commercial landings for all pelagics, tuna PMUS, and non-tuna PMUS in the CNMI from 2009-2018
Supporting data shown in Table A-36

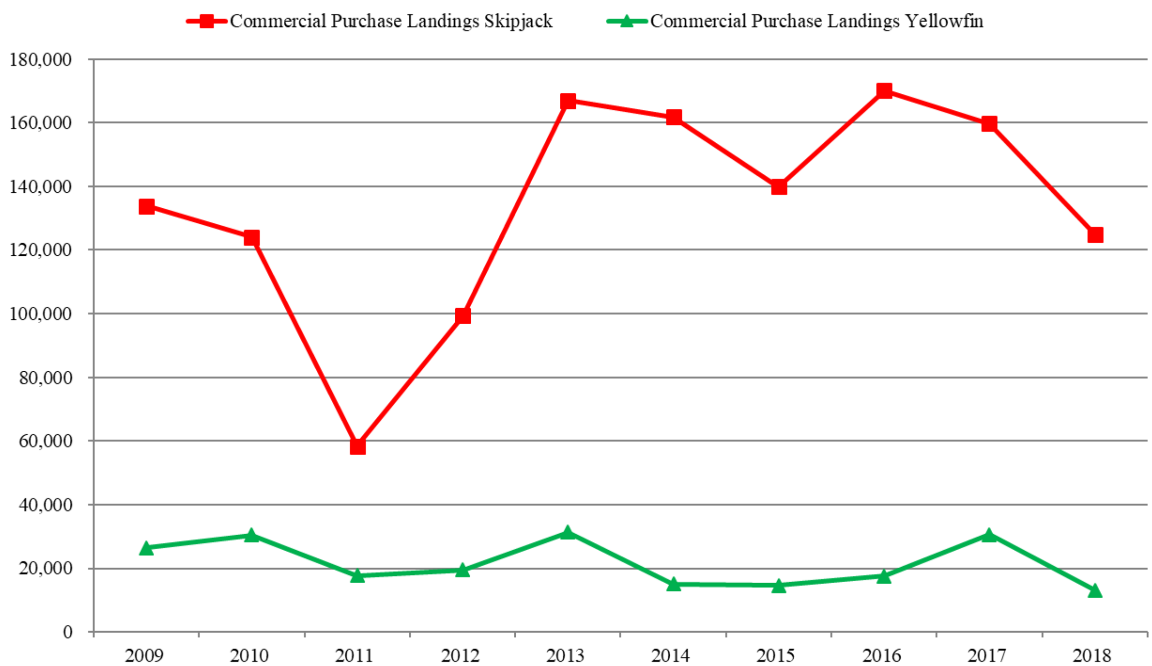


Figure 37. Annual commercial landings for skipjack and yellowfin in the CNMI from from 2009-2018

Supporting data shown in Table A-37.

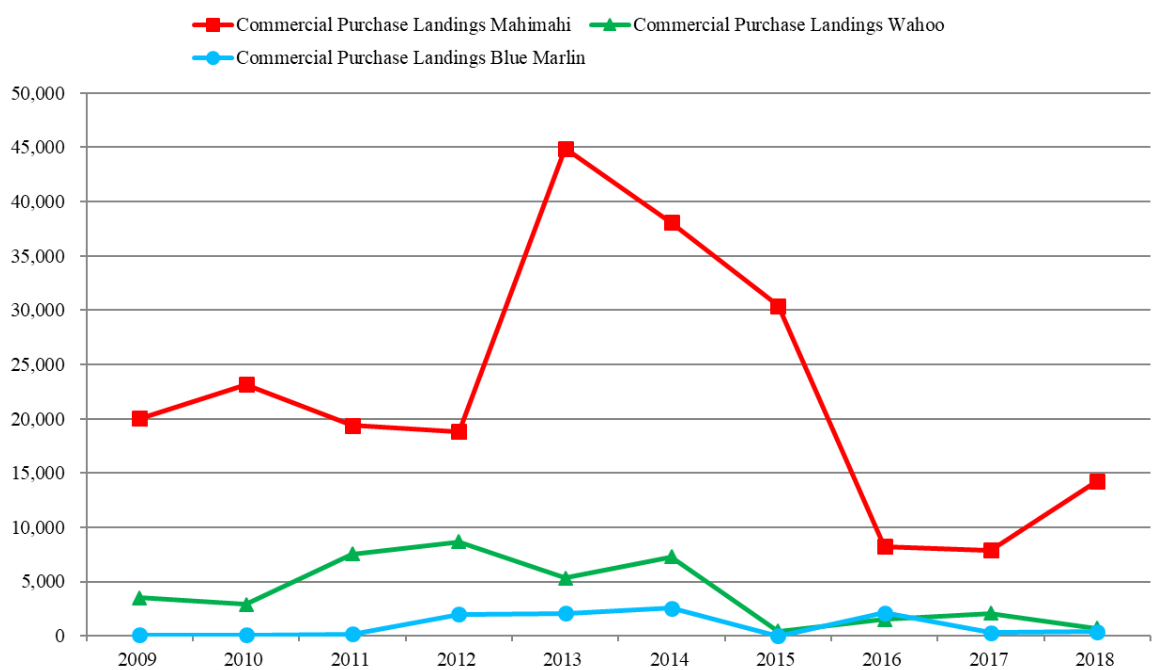


Figure 38. Annual commercial landings for mahimahi, wahoo, and blue marlin in the CNMI from 2009-2018

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.

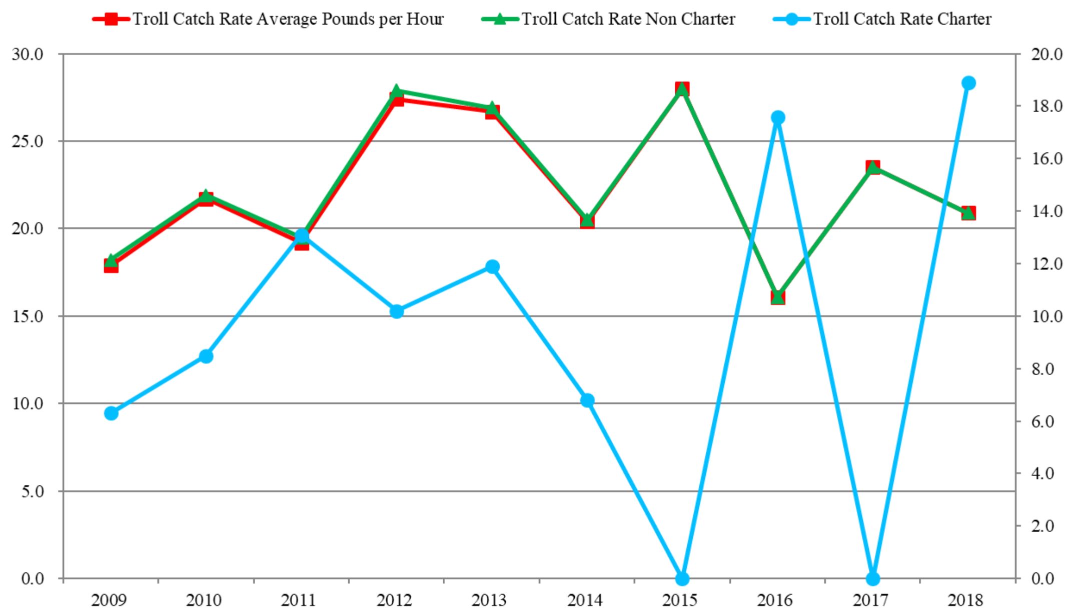


Figure 39. Estimated trolling catch rates (lbs./trip) from creel surveys in the CNMI from 2009-2018

Supporting data shown in Table A-39.

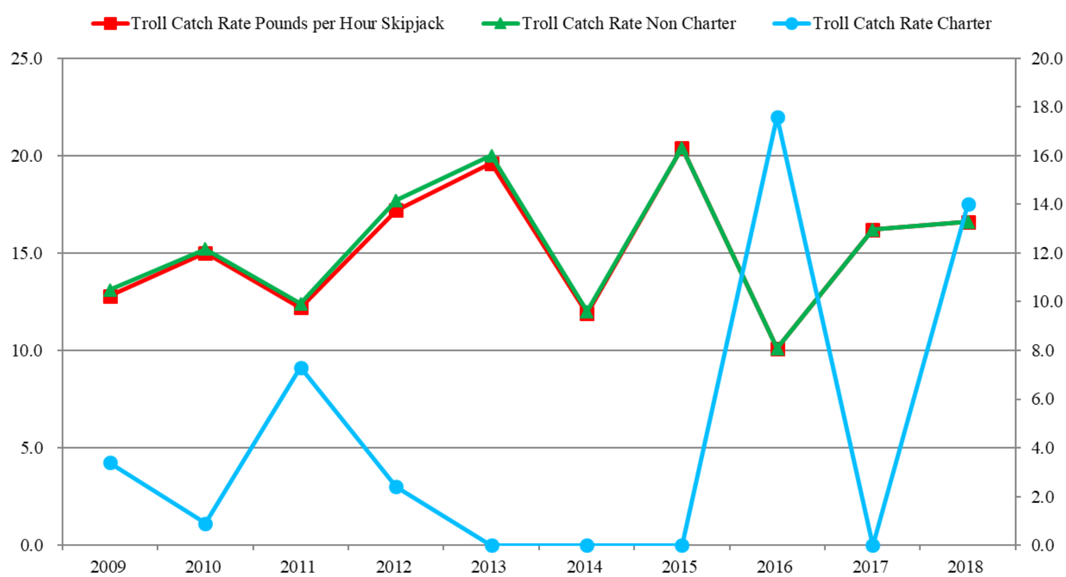


Figure 40. Estimated trolling catch rates (lbs./trip) for skipjack from creel surveys in the CNMI from 2009-2018

Supporting data shown in Table A-40.

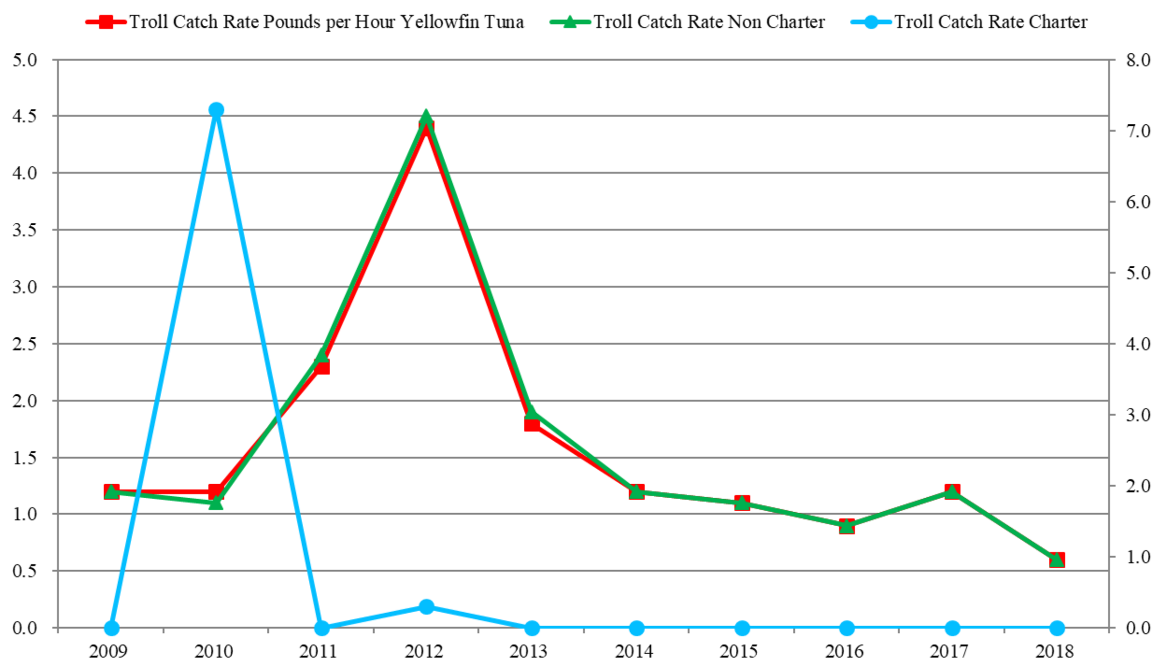


Figure 41. Estimated trolling catch rates (lbs./trip) for yellowfin from creel surveys in the CNMI from 2009-2018

Supporting data shown in Table A-41.

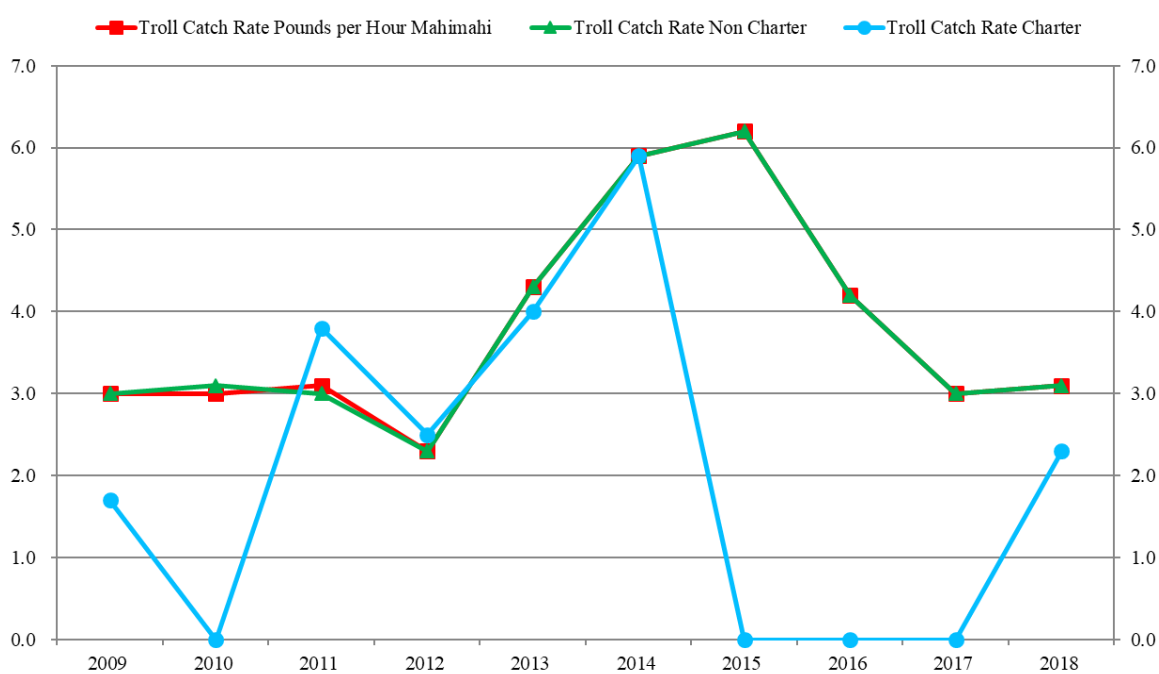


Figure 42. Estimated trolling catch rates (lbs./trip) for mahimahi from creel surveys in the CNMI from 2009-2018

Supporting data shown in Table A-42.

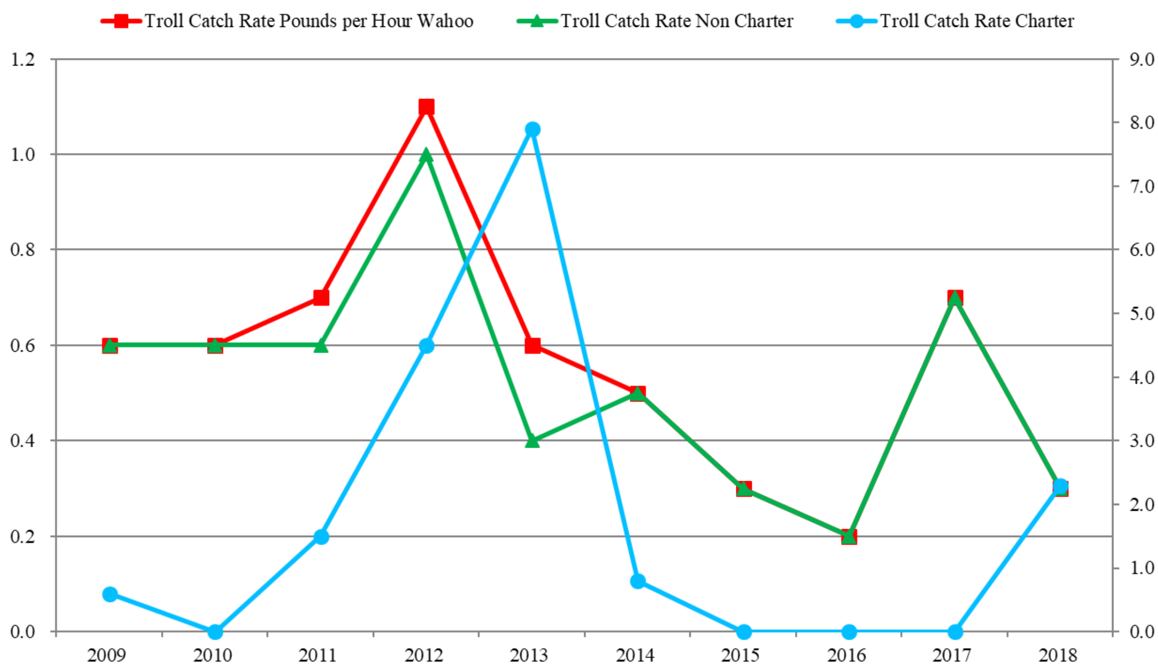


Figure 43. Estimated trolling catch rates (lbs./trip) for wahoo from creel surveys in the CNMI from 2009-2018

Supporting data shown in Table A-43.

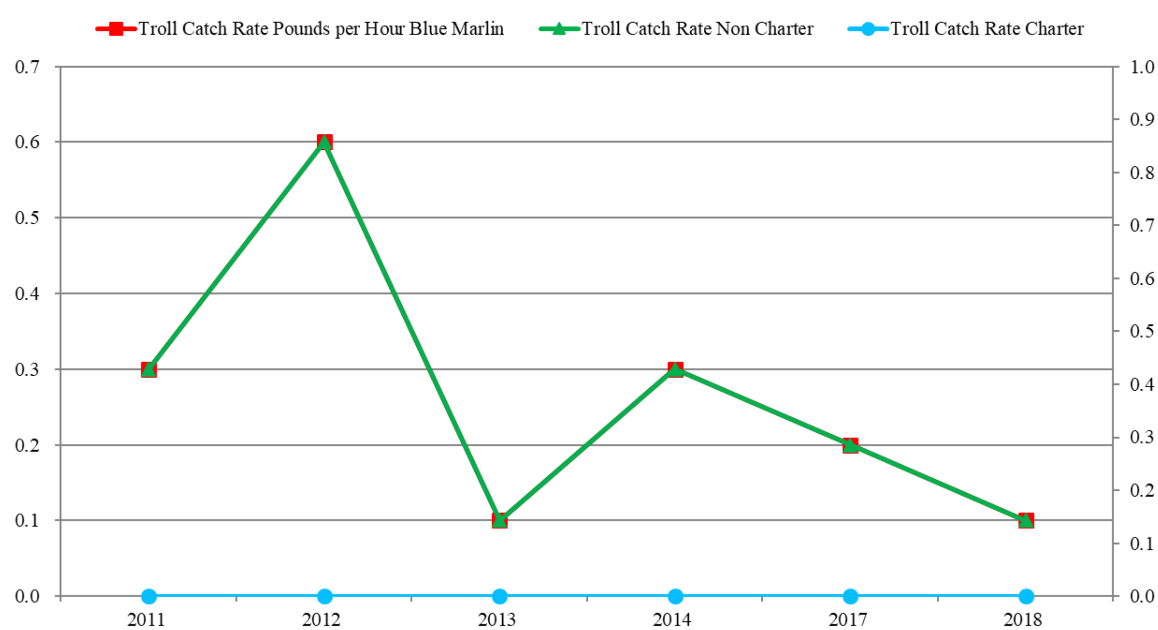


Figure 44. Estimated trolling catch rates (lbs./trip) for blue marlin from creel surveys in the CNMI from 2009-2018

Supporting data shown in Table A-44.

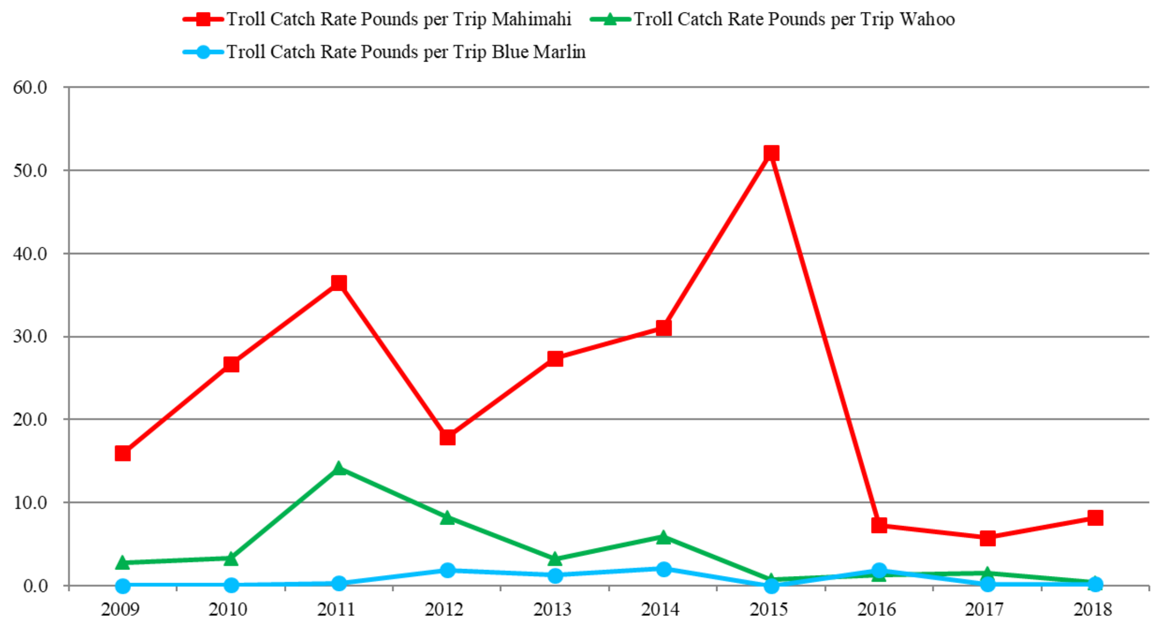


Figure 45. Estimated trolling catch rates (lbs./trip) for skipjack and yellowfin tuna in the CNMI from 2009-2018

Supporting data shown in Table A-45.

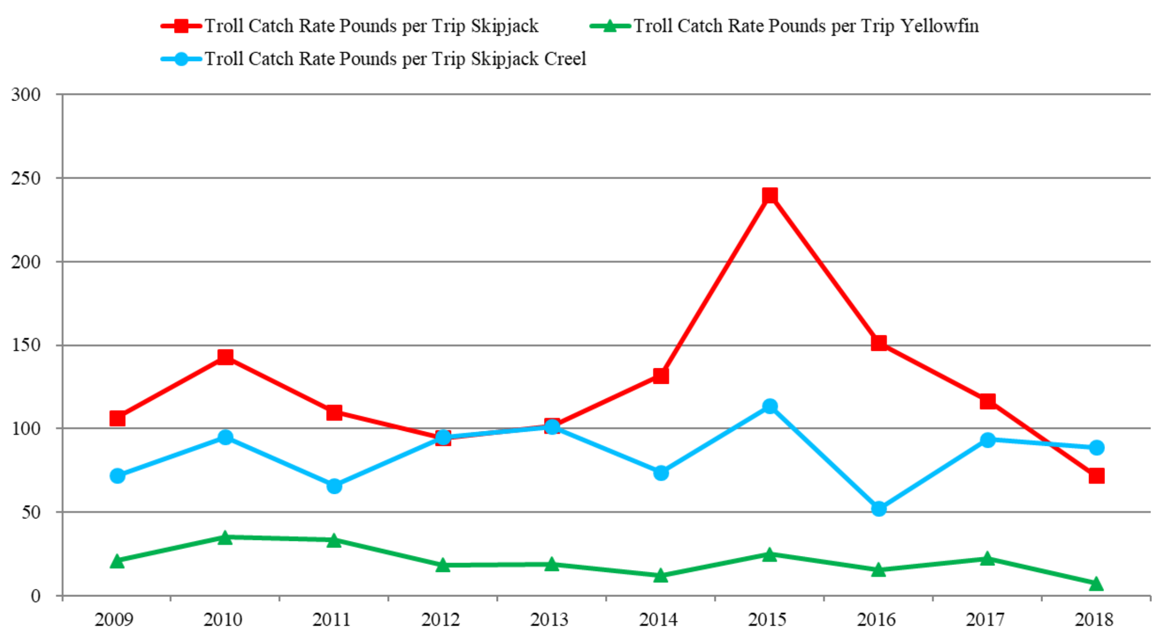


Figure 46. Estimated trolling catch rates (lbs./trip) for mahimahi, wahoo, and blue marlin in the CNMI from 2009-2018

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 1134 during that period, with the number of interviews slightly greater than half of that year's total trips. In 2018, DAWR completed 95 survey days, logging 972 trips during that time, and conducted 801 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 over the course of 2018, ranging between 383,000 and 958,000 lbs. in the 38-year time series. The average total catch has shown a slowly increasing trend over the reporting period. The 2018 total expanded pelagic landings were 891,748 lbs., an increase of 48.4 % when compared with 2017's total. Tuna PMUS increased 41.5%, while non-tuna PMUS increased 81.6%. Landings consisted primarily of five major species: mahimahi, wahoo, bonita or skipjack tuna, yellowfin tuna, and Pacific blue marlin, with skipjack comprising over 68% of total landings. Other minor species caught include rainbow runner, barracudas, and pomfrets. Sharks were also caught during 2018, with sharks noted in specific fishermen interviews conducted in 2018 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 2018 from the previous year's levels. Skipjack increased 49.5%, mahimahi catch, which accounts for the largest percentage of non-tuna PMUS landed on Guam, increased 124.8%, while wahoo increased by 104.4%.Yellowfin tuna catch decreased 13.2%, and blue marlin decreased 21.5%, 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. In 2018, transshipments totaled 1,165 mt. This total is 57.2% of the time series average.

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 398 boats involved in Guam's pelagic fishery in 2018, a decrease of 2.5% from 2017 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 2018 was 87, equaling 87 closure days, down from 140 closure days in 2017. This certainly impacted the number of fishing days south of Guam.

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

On Guam, the makeshift ramp at Ylig Bay was eliminated in 2010. Widening of the main road on the southeast coast of Guam will cause removal of the ramp. In December 2006, a new launch ramp and facility was opened in Acfayan Bay, located in the village on Inarajan on the southeast coast of Guam. Monitoring of this ramp for pelagic fishing activity began at the start of 2007. In early 2007, this facility was damaged by heavy surf and has yet to be repaired. Monitoring of this ramp is currently on hold until the ramp is repaired. The current financial situation in Guam makes it unlikely this ramp will be repaired in the near future. DAWR staff are meeting with land owners 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 an increase from 2017. Total CPUE increased 45.5%. Skipjack tuna, wahoo, and mahimahi CPUE increased, while yellowfin tuna CPUEs decreased slightly. The fluctuations in CPUE are probably due to variability in the year-to-year abundance and availability of the stocks.

Revenues. Commercial revenues decreased in 2018, with total adjusted revenues decreasing 19%. Tuna PMUS decreased 5.7%, non-tuna PMUS decreased 30.5%. Commercial landings have shown a decreasing trend over the past twenty years. 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 2018, there were 2 reported bycatch in 8344 fish caught, for a .02% rate. Bycatch occasionally occurs in the troll fishery including sharks, shark-bitten and undersized fish.

In 2018, fishers were asked if they experienced a shark interaction. There were a total of 806 interviews for boat based fishing in 2018, with 347 of these inappropriate for determining shark interaction. Of the remaining 459 interviews, 190 reported interactions with sharks, 269 reported no interactions with sharks, a 41% positive rate for interviews where fishers were asked about shark interactions.

2.3.3 PLAN TEAM RECOMMENDATIONS

For the Guam Module in the 2018 Annual SAFE Report, the 2019 Pelagic Fishery Ecosystem Plan Team recommended that the Council request Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (DAWR) to clarify and provide the notification scheme of the military regarding spatial closures with mariners.

2.3.4 OVERVIEW OF PARTICIPATION - NON-CHARTER AND CHARTER FISHERIES

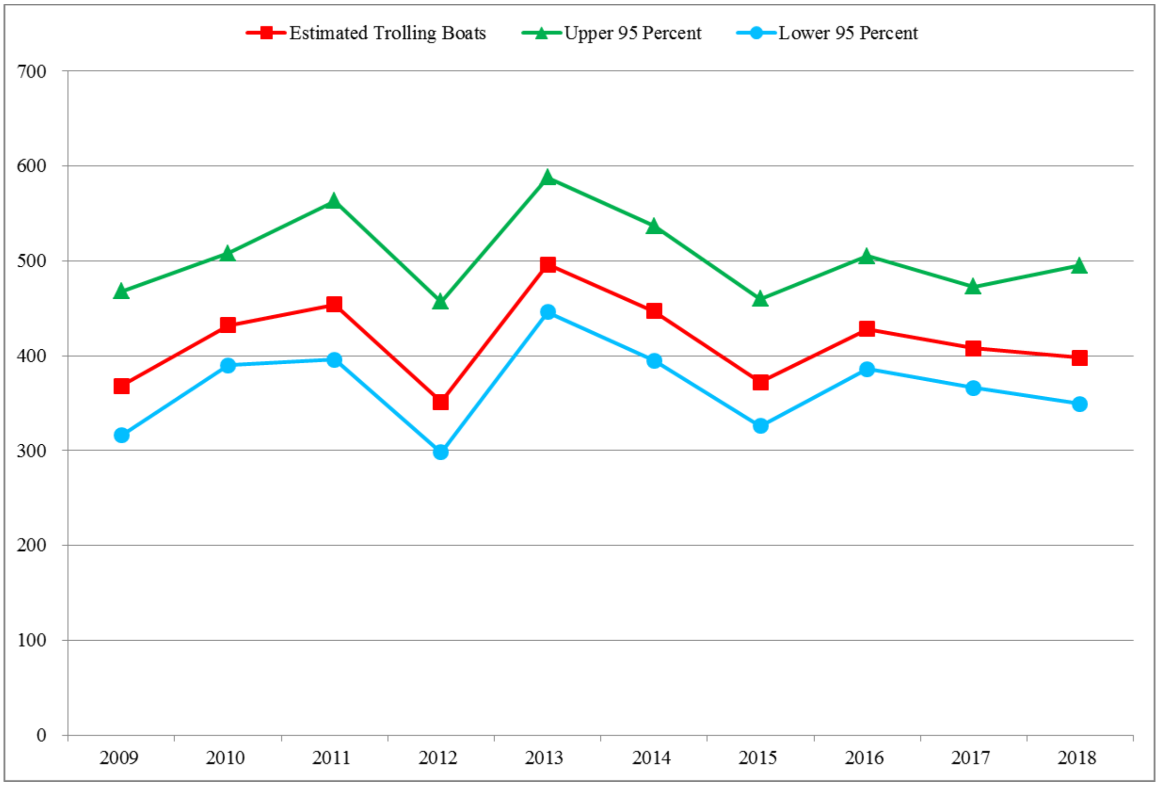


Figure 47. Total estimated vessels in Guam pelagic fisheries from 2009-2018
Supporting data shown in Table A-48.

2.3.5 OVERVIEW OF TOTAL AND REPORTED COMMERCIAL LANDINGS – NON-CHARTER AND CHARTER FISHERIES

Table 16. Total estimated, non-charter, and charter landings for Guam in 2018

Species	Total Landings	Non-Charter	Charter
Skipjack Tuna	610,751	603,412	7,339
Yellowfin Tuna	52,555	51,433	1,122
Kawakawa	511	511	0
Albacore	0	0	0

Bigeye Tuna	0	0	0
Other tuna PMUS	0	0	0
Total PMUS Total (lbs.)	**663,817**	**655,356**	**8,461**
Mahi mahi	88,817	77,314	11,503
Wahoo	96,035	81,248	14,787
Blue Marlin	24,516	12,754	11,763
Black Marlin	0	0	0
Striped Marlin	0	0	0
Sailfish	4,374	0	4,374
Shortbill Spearfish	0	0	0
Swordfish	0	0	0
Oceanic Sharks	0	0	0
Pomfrets	296	296	0
Oilfish	130	130	0
Non-Tuna PMUS (lbs.)	**214,168**	**171,742**	**42,427**
Rainbow Runner	2,700	2,419	282
Barracudas	5,336	5,120	216
Double- Lined Mackerel	5,727	5,669	58
Troll fish (misc)	0	0	0
Non-PMUS Pelagics Total (lbs)	0	0	0
Total Pelagics (lbs.)	**13,763**	**13,208**	**556**

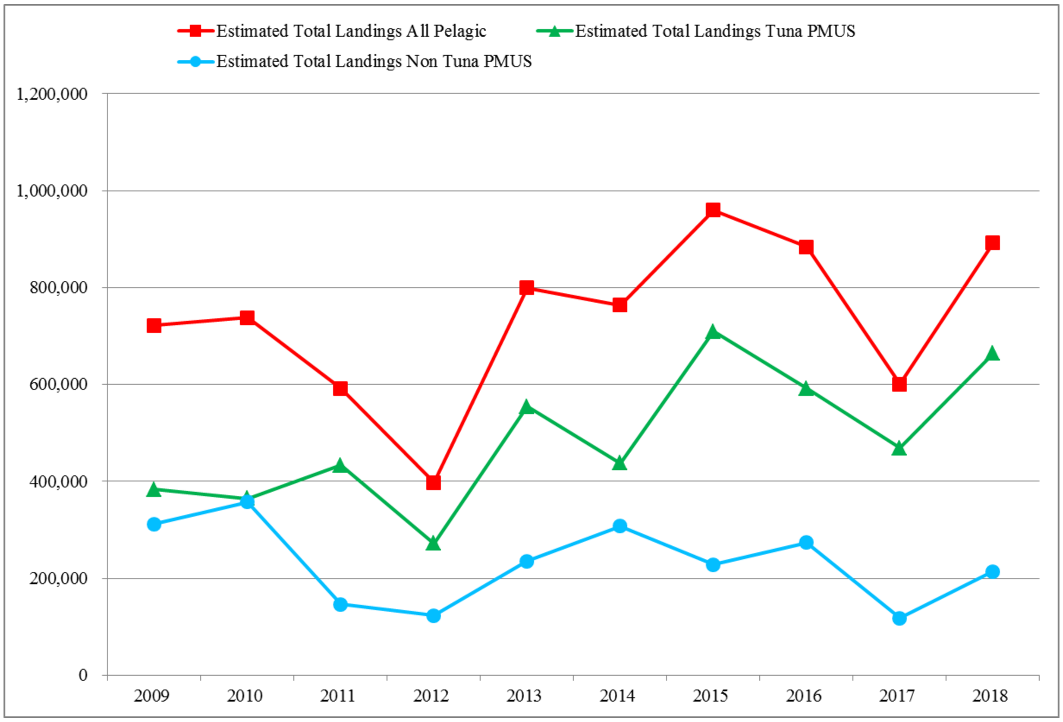


Figure 48. Total estimated annual landings in Guam for all pelagics, tuna PMUS, and non-tuna PMUS from 2009-2018

Supporting data shown in Table A-49.

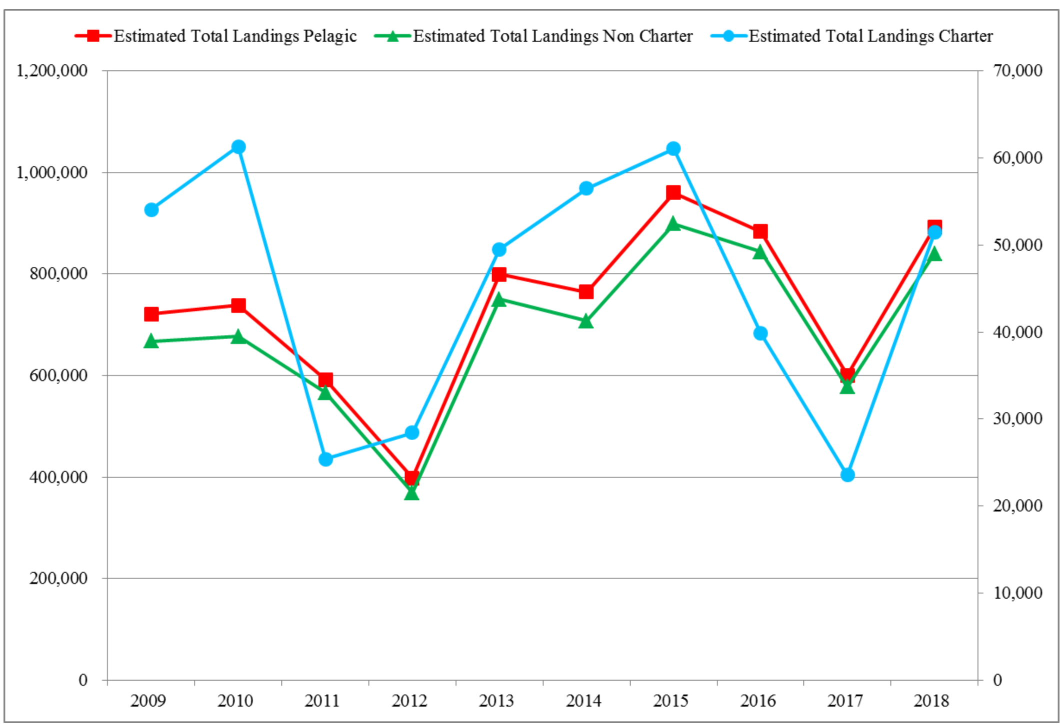


Figure 49. Total estimated annual pelagic landings in Guam from 2009-2018

Supporting data shown in Table A-50.

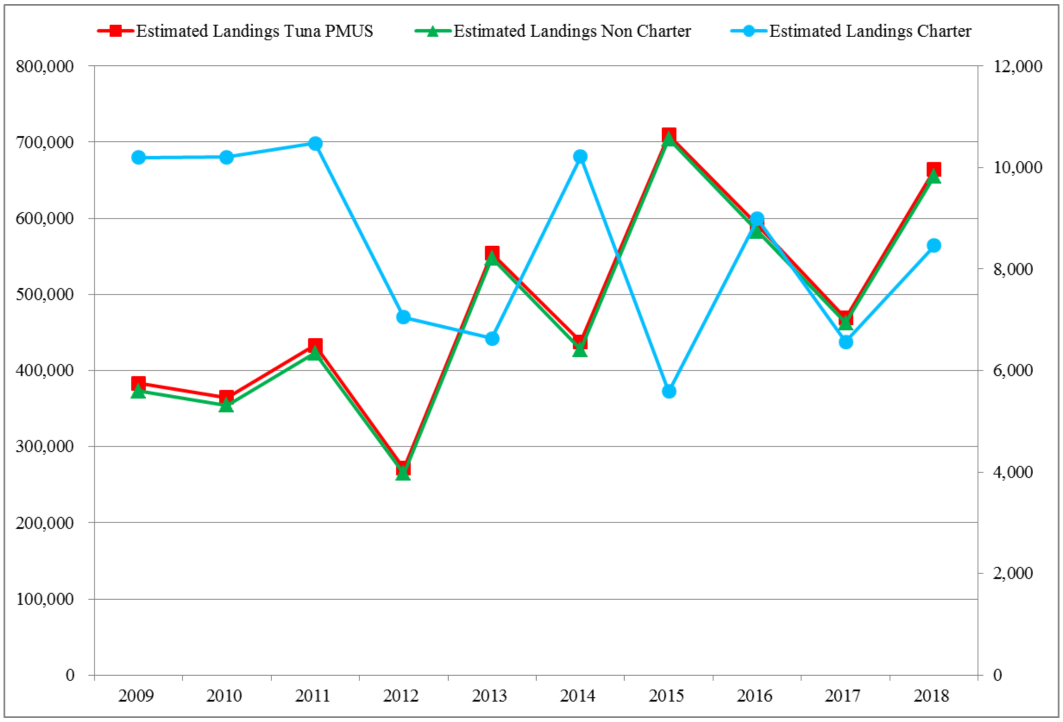


Figure 50. Total estimated annual tuna PMUS landings in Guam from 2009-2018
Supporting data shown in Table A-51.

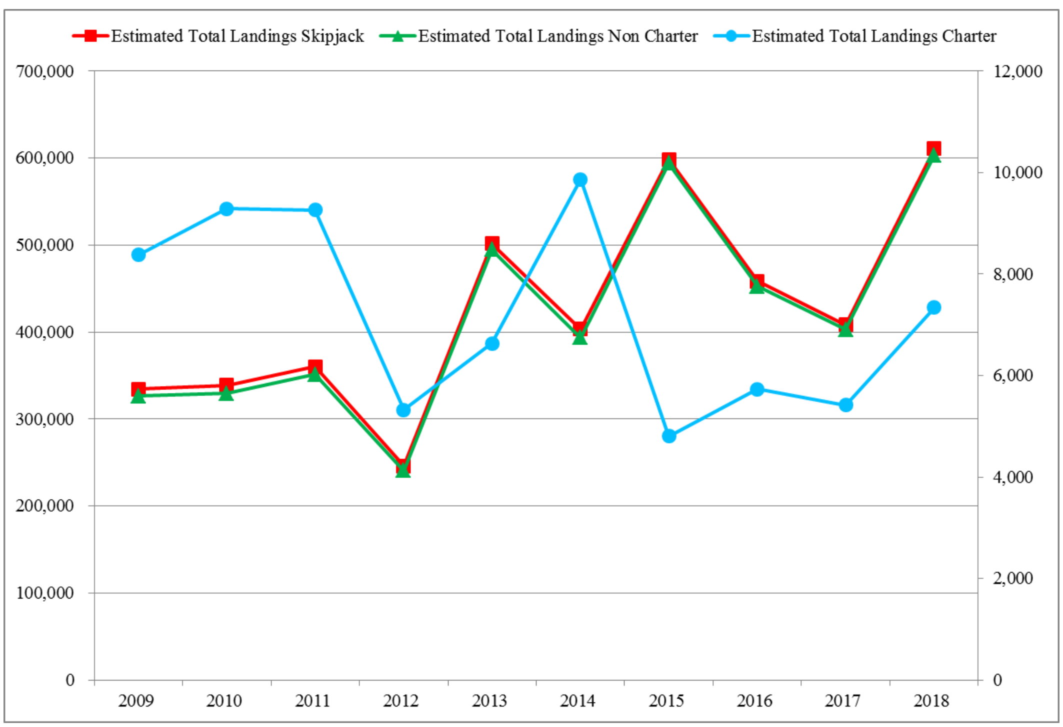


Figure 51. Total estimated annual skipjack tuna landings in Guam from 2009-2018
Supporting data shown in Table A-52.

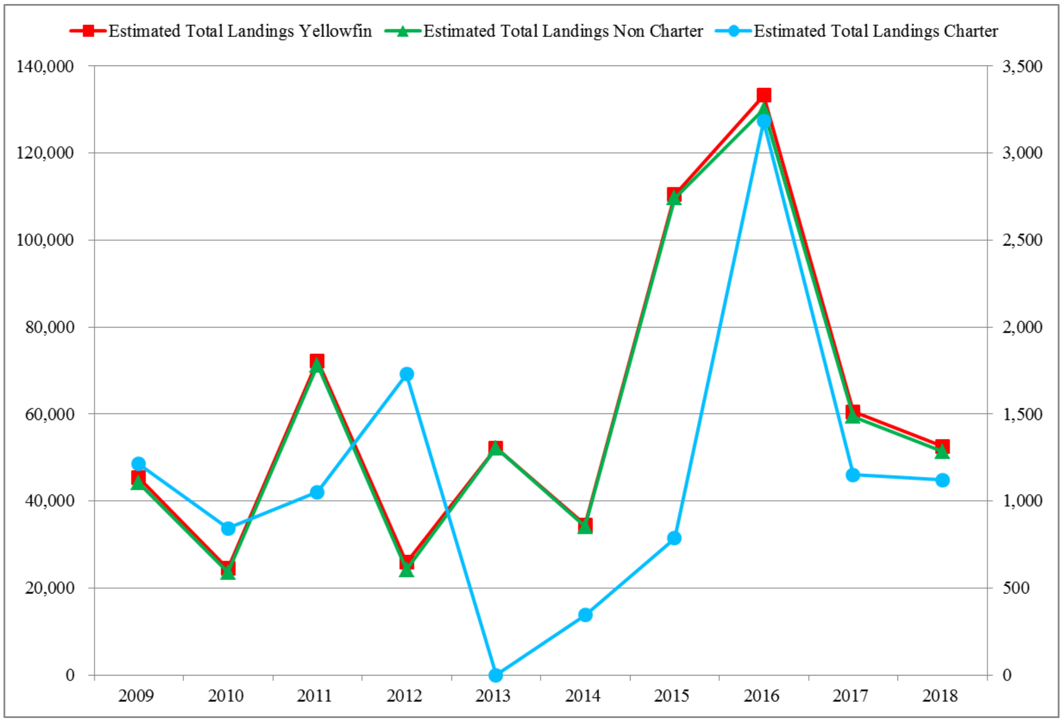


Figure 52. Total estimated annual yellowfin landings in Guam from 2009-2018

Supporting data shown in Table A-53.

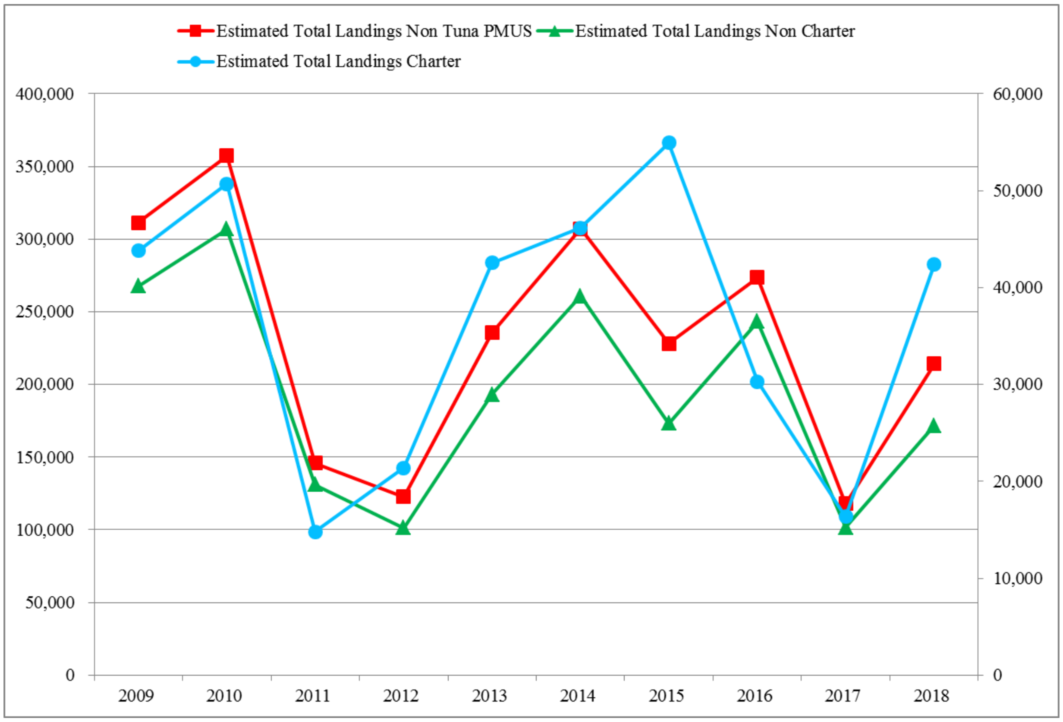


Figure 53. Total estimated annual non-tuna PMUS landings in Guam from 2009-2018
Supporting data shown in Table A-54.

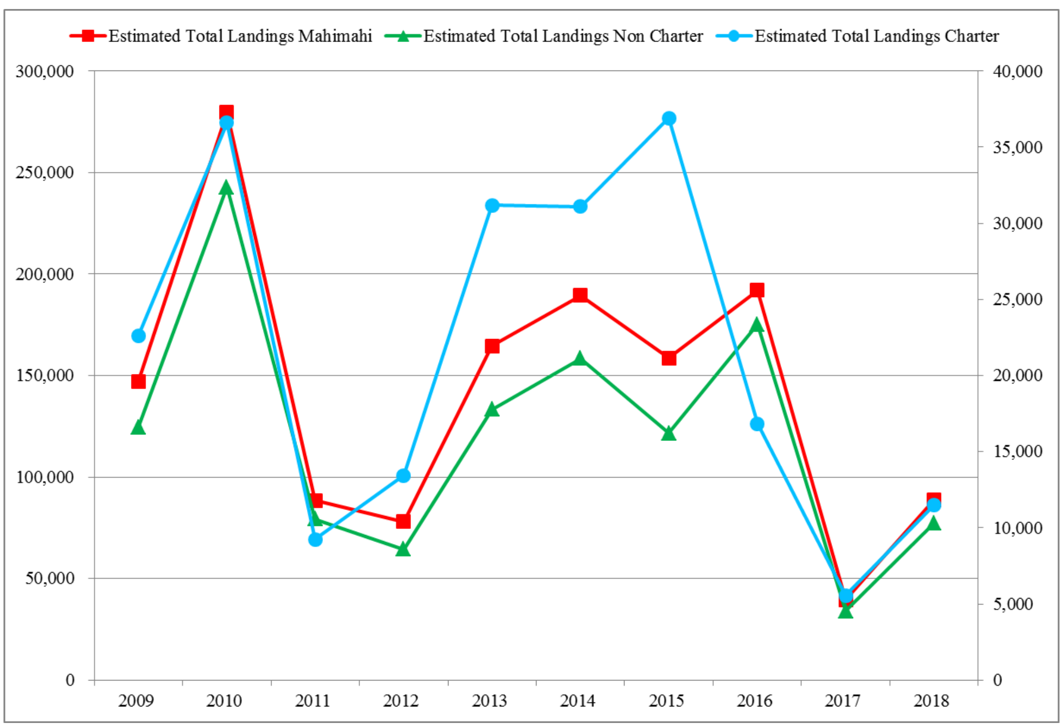


Figure 54. Total estimated annual mahimahi landings in Guam from 2009-2018
Supporting data shown in Table A-55.

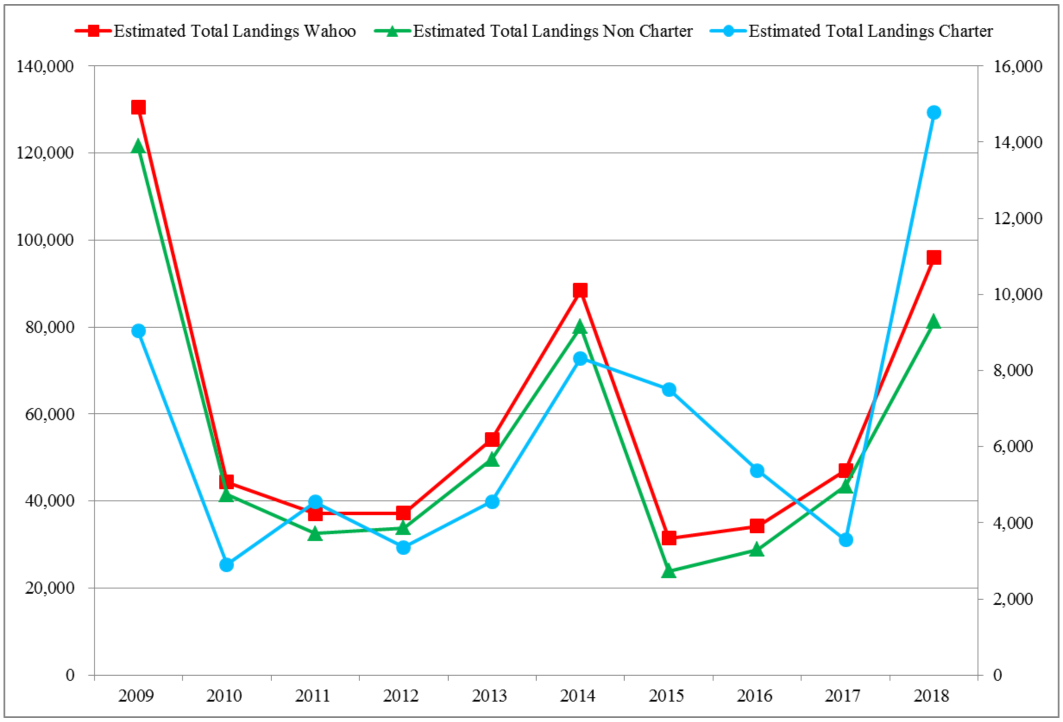


Figure 55. Total estimated annual wahoo landings in Guam from 2009-2018
Supporting data shown in Table A-56.

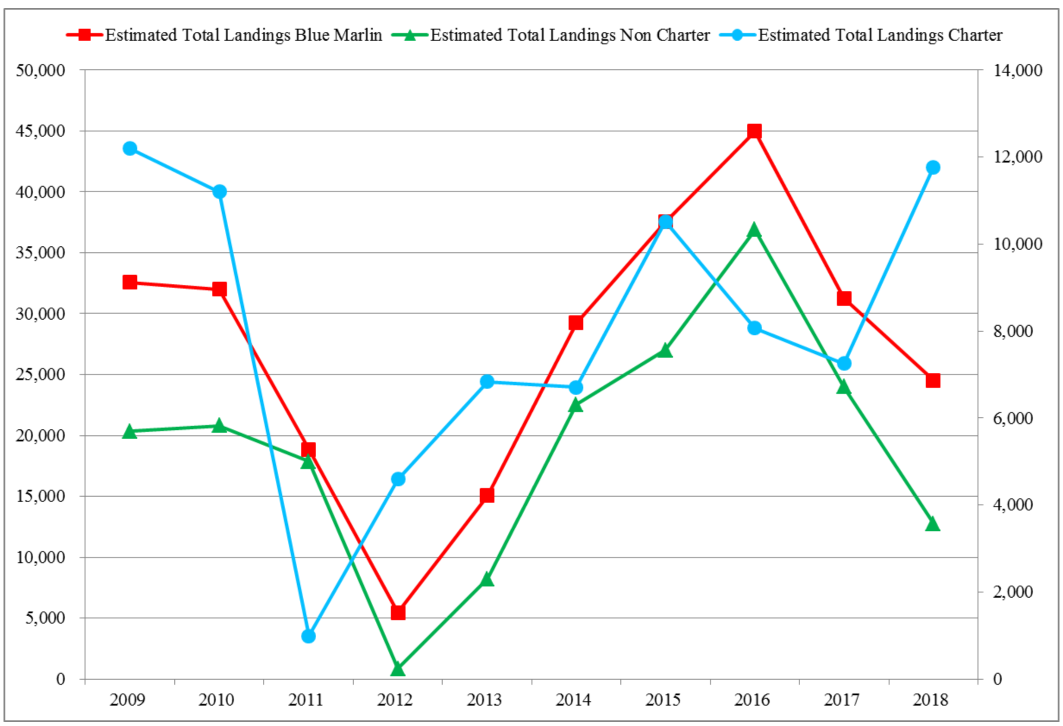


Figure 56. Total estimated annual blue marlin landings in Guam from 2009-2018
Supporting data shown in Table A-57.

Table 17. Bycatch summary for Guam charter and non-charter trolling fisheries in 2018

Year	Release Alive	Release Injured	Total Bycatch	Total Catch	Percent Bycatch	Total Interview	Percent Bycatch by Interview
2018	1	1	2	8,344	.02	801	N/A

"Percent Bycatch" represents the number of pieces that were discarded compared to the total number of fish caught trolling. The bycatch information is from unexpanded data, taken only from actual interviews that reported bycatch.

Table 18. Bycatch summary for Guam charter and non-charter trolling fisheries in 2018

Year	Species	Number Release	Percent Release	Number Kept	Number Caught	Charter
2009	Blue Marlin	3	23.1	10	13	F
2011	Skipjack Tuna	1	0.0	7,272	7,273	F
2013	Skipjack Tuna	21	0.4	5,474	5,495	F
2013	Rainbow Runner	1	3.0	32	33	F
2013	Yellowfin Tuna	6	1.6	373	379	F
2014	Barracudas	1	2.6	38	39	F
2014	Yellowfin Tuna	1	0.4	271	272	F
2014	Skipjack Tuna	19	0.5	3,914	3,933	F
2018	Wahoo	1	0.2	568	569	F
2018	Yellowfin Tuna	1	0.3	343	344	F
2016	Mahimahi	3	2.2	133	136	T
2016	Skipjack Tuna	3	2.4	124	127	T

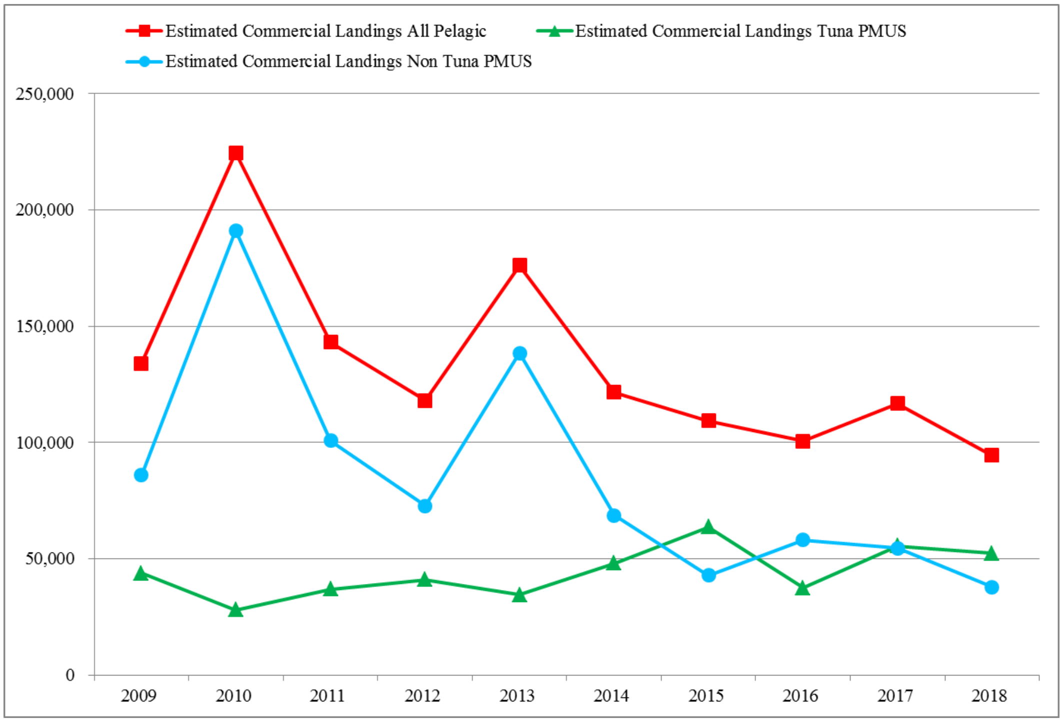


Figure 57. Annual estimated commercial landings for all pelagics, tuna PMUS, and non-tuna PMUS in Guam from 2009-2018

Supporting data shown in Table A-58.

2.3.6 OVERVIEW OF EFFORT AND CPUE – NON-CHARTER AND CHARTER FISHERIES

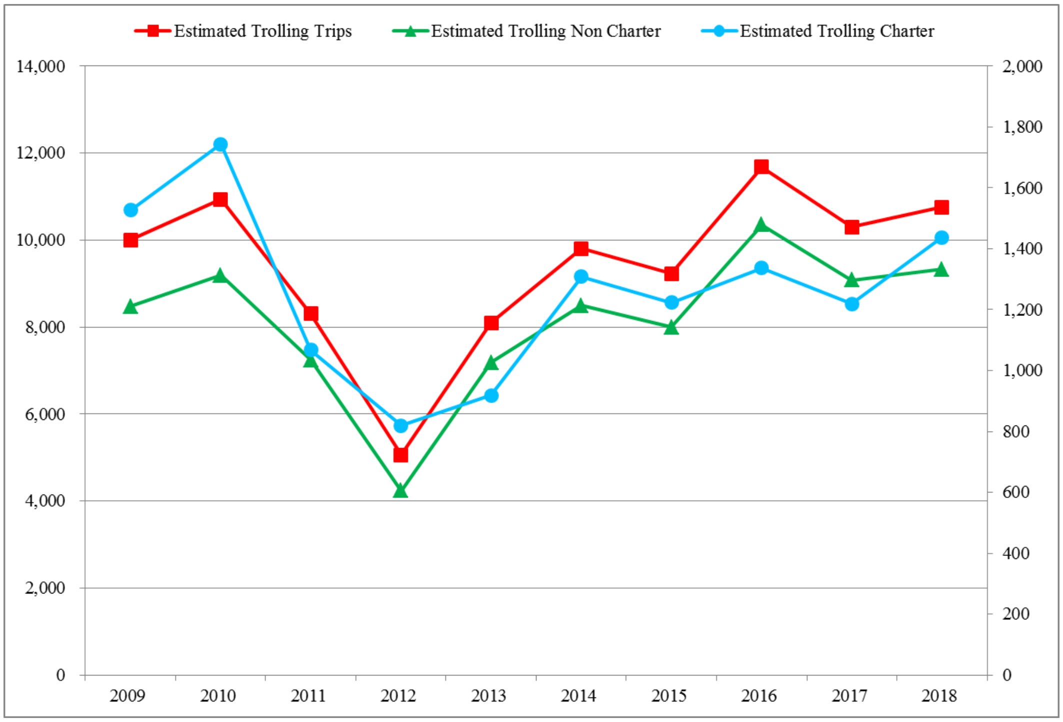


Figure 58. Total estimated number of trolling trips in Guam from 2009-2018

Supporting data shown in Table A-59.

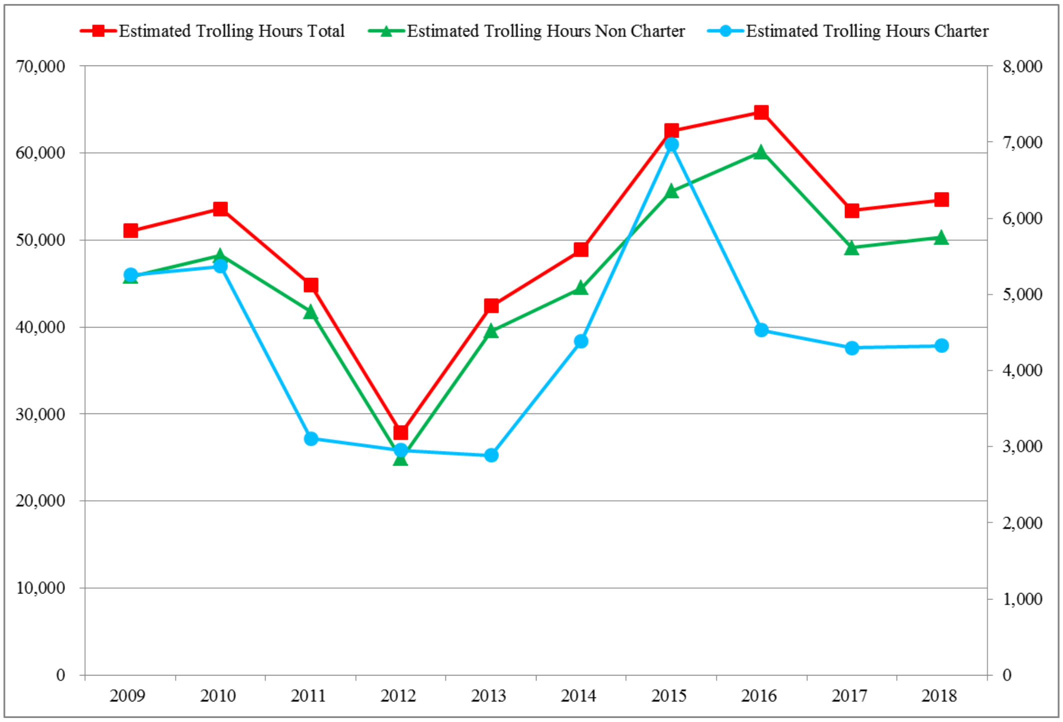


Figure 59. Total estimated number of trolling hours in Guam from 2009-2018

Supporting data shown in Table A-60.

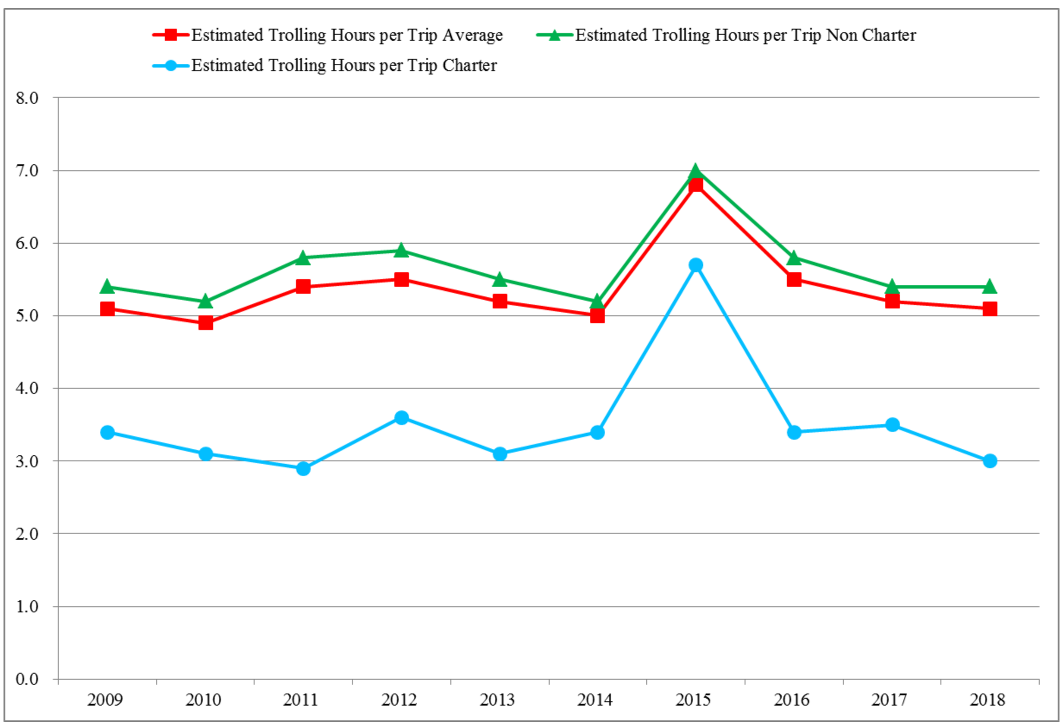


Figure 60. Estimated fishing trip length (hrs.) in Guam from 2009-2018

Supporting data shown in Table A-61.

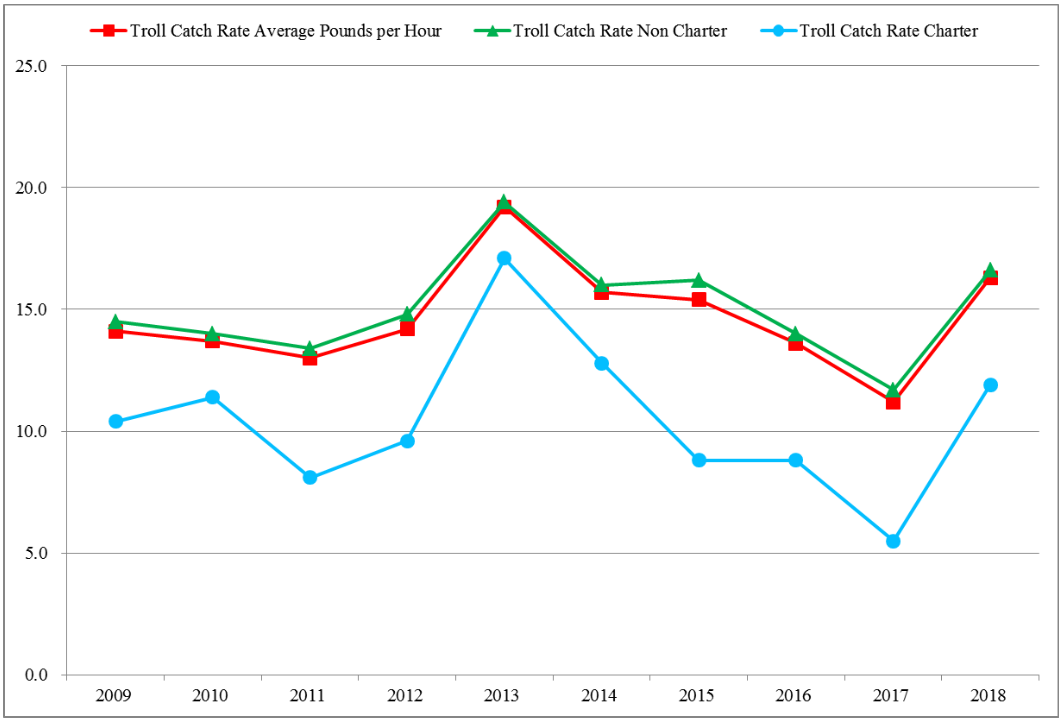


Figure 61. Trolling catch rates (lbs./hr.) in Guam from 2009-2018

Supporting data shown in Table A-62.

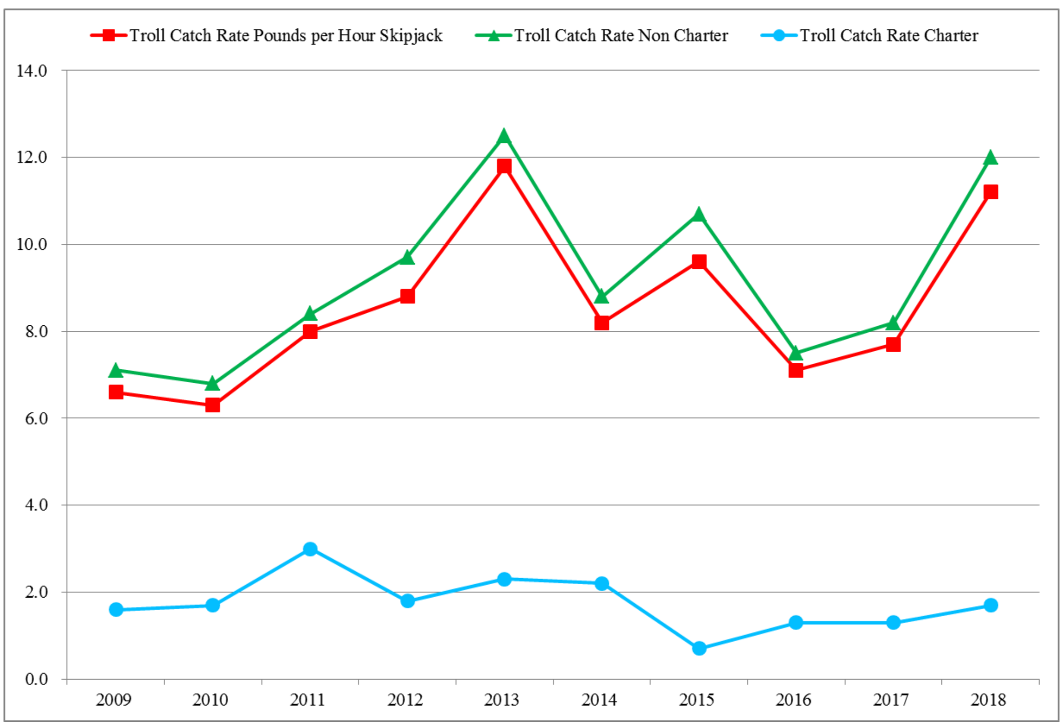


Figure 62. Trolling catch rates (lbs./hr.) for skipjack tuna in Guam from 2009-2018

Supporting data shown in Table A-63.

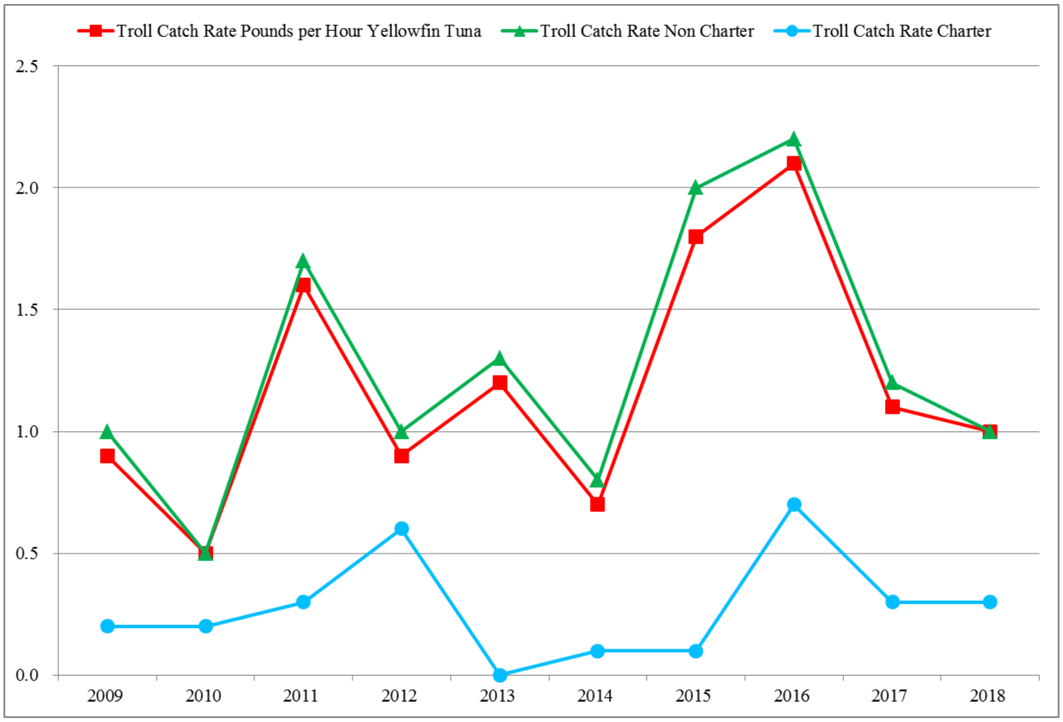


Figure 63. Trolling catch rates (lbs./hr.) for yellowfin tuna in Guam from 2009-2018
Supporting data shown in Table A-64.

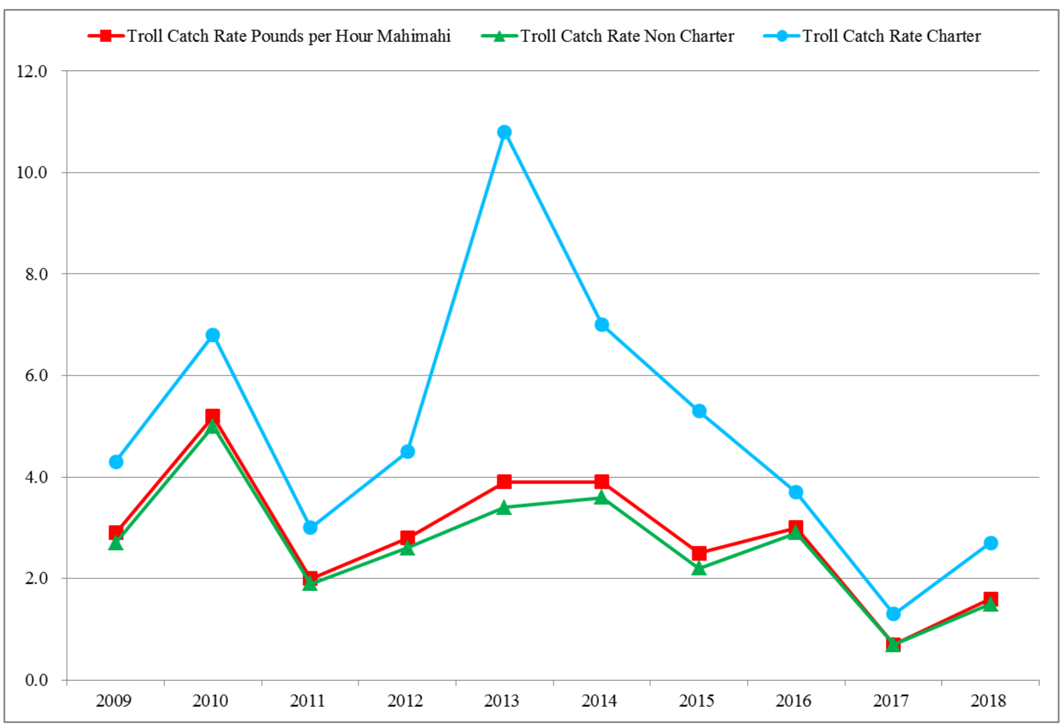


Figure 64. Trolling catch rates (lbs./hr.) for mahimahi in Guam from 2009-2018
Supporting data shown in Table A-65.

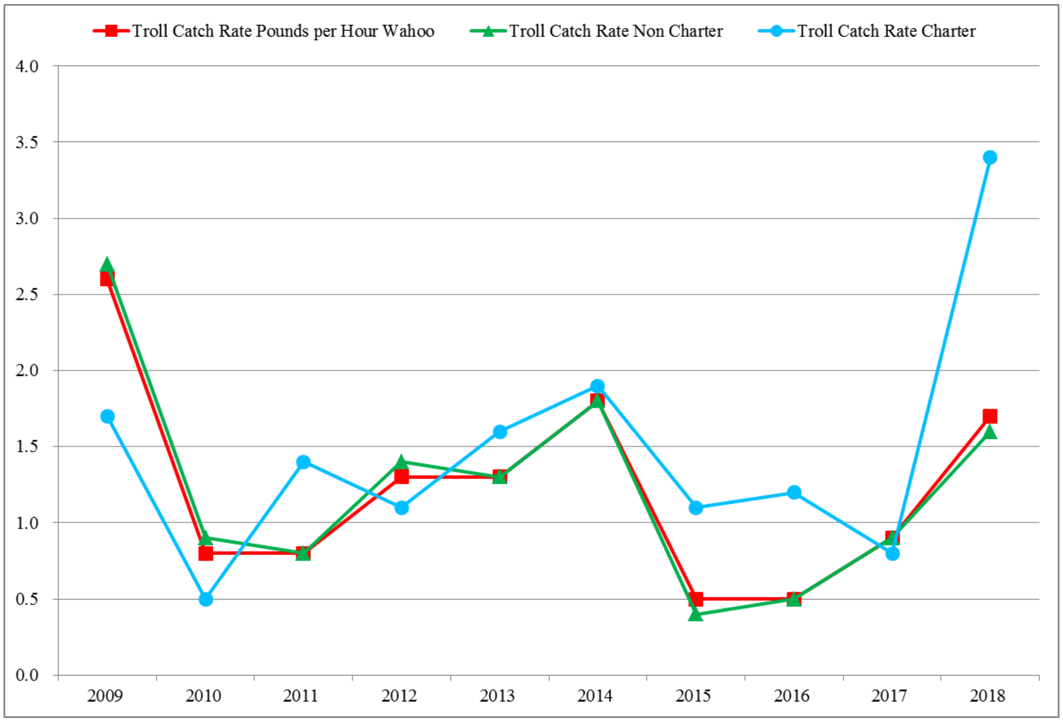


Figure 65. Trolling catch rates (lbs./hr.) for wahoo in Guam from 2009-2018

Supporting data shown in Table A-66.

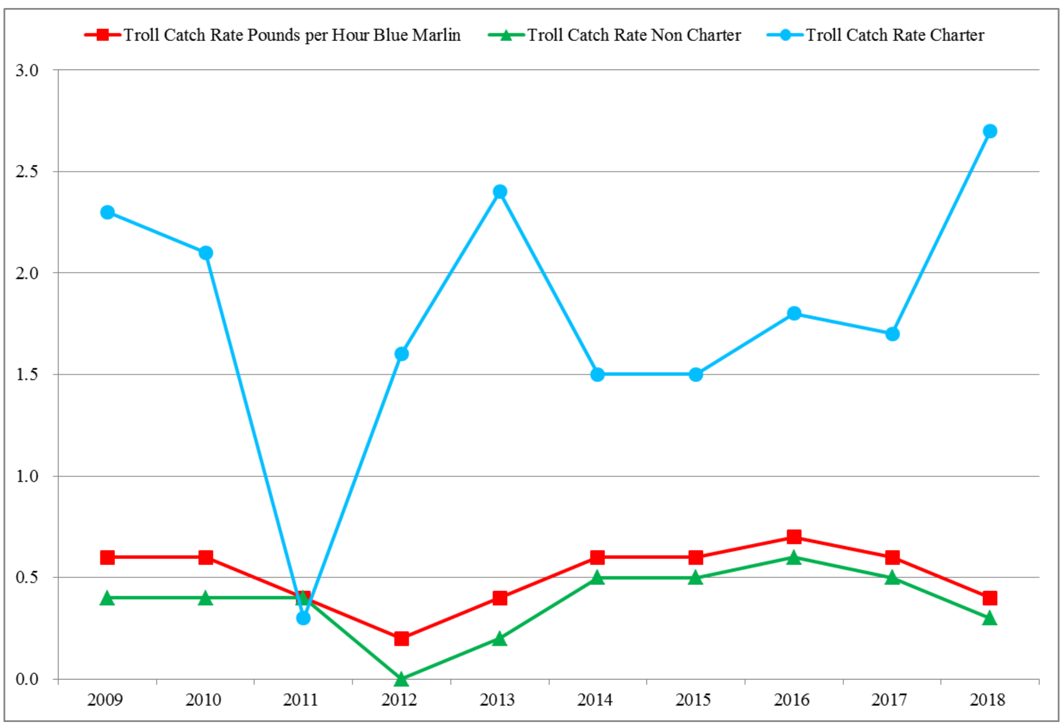


Figure 66. Trolling catch rates (lbs./hr.) for blue marlin in Guam from 2009-2018

Supporting data shown in Table A-67.

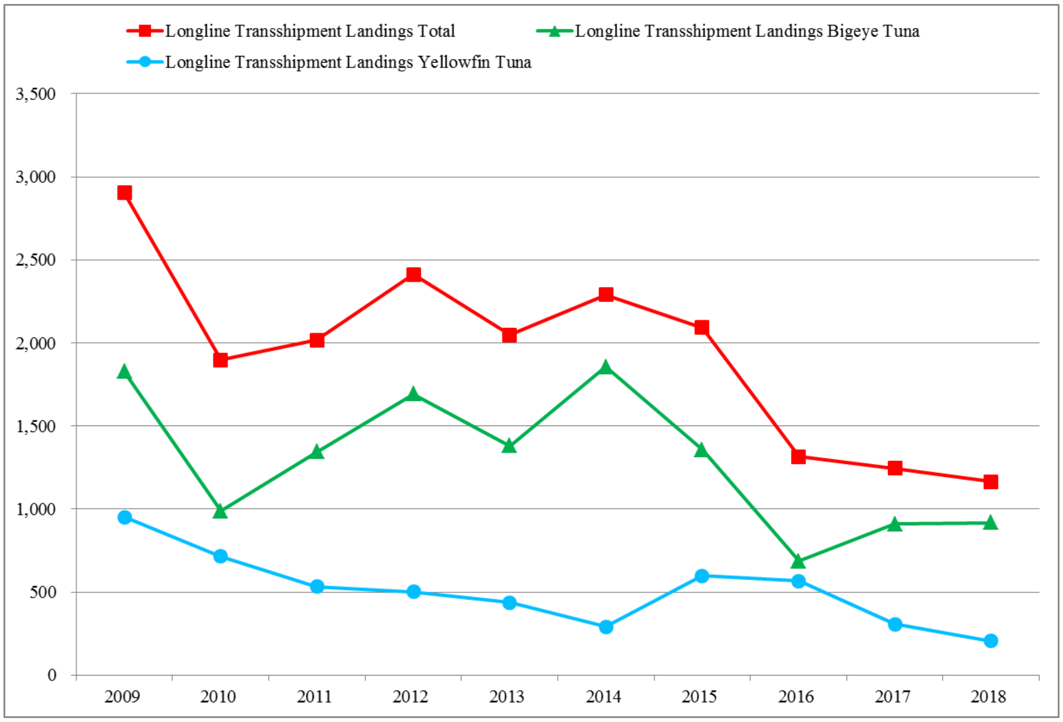


Figure 67. Guam foreign longline transshipment landings for longliners fishing outside the Guam EEZ from 2009-2018

Supporting data shown in Table A-68.

2.4 HAWAI`I

2.4.1 DATA SOURCES

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

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

The Hawai`i-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 Hawai`i-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 Hawai`i limited-entry permits. The only exception to summaries using RFMO standards was catch and effort statistics using boundaries within or outside of U.S. EEZs. Since there were substantial differences in operational characteristics and catch between the deep-set longline fishery targeting tunas and the shallow-set longline fishery targeting swordfish, separate summaries were provided for each longline fishery.

MHI Troll Fishery. Catch and effort by the MHI troll fishery was defined as using a combination of pelagic species, gear and area codes from the HDAR Fishing Report data. The HDAR codes for the MHI troll fishery includes summaries of PMUS caught by Miscellaneous Trolling Methods (gear code 6), Lure Trolling (61), Bait Trolling (62), Stick Trolling (63), Casting, Light Tackle, Spinners or Whipping (10) and Hybrid Methods (97) in HDAR statistical areas 100 through 642. These are areas that begin from the shoreline out to

20 minute squares around the islands of Hawai`i, Maui, Kahoolawe, Lanai, Molokai, 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.

Calculation. 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 CPI.

2.4.2 SUMMARY OF HAWAI`I 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 3,308 fishermen were licensed in 2018, including 1,982 (60%) who indicated that their primary fishing method and gear were intended to catch pelagic fish. This is a 12% decrease in fishing licenses from the previous year. Most licenses that indicated pelagic fishing as their primary method were issued to longline fishermen (45%) and trollers (42%). The remainder was issued to ika shibi and palu ahi (handline) (13%).

Catch. Hawai`i commercial fisheries caught and landed 37,718,000 pounds of pelagic species in 2018, a decrease of 4% 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 86% (32,318,000 pounds) of all pelagic fisheries. The shallow-set longline fishery targeted swordfish and its catch was 1,438,000 pounds, or 4% of the total catch. The main Hawai'i Islands troll fishery targeted tunas, marlins and other PMUS caught 2,715,000 pounds or 7% of the total. MHI handline fishery targeted yellowfin tuna while the and offshore handline fishery targeted bigeye tuna. The MHI handline fishery accounted for 776,000 pounds (2% of the total). The offshore handline fishery was responsible for 366,000 pounds or 1% of the total catch.

The largest component of the pelagic catch was tunas, which comprised 67% of the total in 2018. Bigeye tuna alone accounted for 67% of the tunas and 45% of all pelagic catch. Billfish catch made up 15% of the total catch in 2018. Swordfish was the largest of these, at 41% of the billfish and 6% of the total catch. Catches of other PMUS represented 18% of the total catch in 2018 with moonfish being the largest component at 46% of the other PMUS and 8% of the total catch.

Effort. There were 143 active Hawai`i-permitted deep-set longline vessels in 2018, two less vessels than the previous year, with 140 or more deep-set vessels in the past 5 years. The number of deep-set trips (1,641) and sets (20,977) were both deep-set effort records. The number of hooks set by the deep-set longline fishery reached a record 58.4 million hooks in 2018. The Hawai`i-permitted shallow-set longline fishery operates mainly in the first half of the year. In 2018, 11 vessels completed 30 trips and made 420 sets, which was significantly lower effort for this segment of the fishery due to the closure of the fishery in May as a result of reaching the loggerhead sea turtle interaction limit. The number of hooks set by this fishery also decreased 0.5 million in 2018, 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 1,380 fishers logging 21,663 days fished around the MHI in 2018. There were 428 MHI handline fishers that fished 4,022 days in 2018, both at their lowest levels in the ten-year period. The offshore handline fishery had 5 fishers and 217 days fished in 2018.

CPUE. The deep-set longline fishery targets bigeye tuna and this species had higher CPUE (3.7 fish per 1,000 hooks) compared to yellowfin tuna (1.1) and albacore (0.1). CPUE of blue marlin and striped marlin for the deep-set fishery were low (0.1 - 0.3 fish per 1,000 hooks, respectively), while the CPUE for blue shark, a bycatch species, is second only to bigeye at 1.6 fish per 1,000 hooks. The Hawai`i-permitted shallow-set longline fishery targets swordfish and achieved a CPUE of 12.2 fish per 1,000 hooks in 2018 followed by blue shark, a bycatch species of this fishery, with a CPUE of 5.1 fish per 1,000 hooks. The 2018 MHI troll fishery CPUE for yellowfin tuna and blue marlin were above the long-term average while CPUE for mahimahi and ono showed no trend during 2009-2018. MHI handline CPUE for yellowfin tuna peaked in 2015, dropped in 2016 and was the same the following two years. Albacore and bigeye tuna CPUE was substantially lower compared to yellowfin tuna and have shown no clear trend in recent years. CPUE of the offshore handline fishery was relatively steady from 2009-2018 with CPUE peaking in 2016.

Fish Size. The average weight for most species caught by the deep-set longline fishery was close to their respective long-term weights in 2018 although yellowfin tuna and swordfish were above their respective long-term average weights. Bigeye tuna caught in the deep-set fishery was 78 lbs. in 2018, 3% less than the long-term average. Yellowfin tuna average weight in the deep-set fishery was 89 lbs., 15% above the long-term average. The mean weight of black marlin, mako shark and thresher shark were below their long-term average weight. Swordfish caught by the shallow-set longline fishery was 214 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 above their long-term average in 2018. Troll and handline caught billfish, mahimahi, and ono were below their respective long-term mean weights.

Revenue. The total revenue from Hawaii's pelagic fisheries was $114.8 million in 2018, a increase of 2% from the previous year. The deep-set longline revenue was $101.3 million in 2018. This fishery represented 88% of the total revenue for pelagic fish in Hawaii. The shallow-set longline fishery decreased to $1.4 million and accounted for 1% of the revenue. The MHI troll revenue was $8.2 million or 7% of the total in 2018 and was followed by the MHI handline fishery at $2.5 million (2%). The offshore handline fishery was worth $1.1 million in 2018. The trend for revenue from the deep-set longline was increasing while revenue of the shallow-set longline fishery was decreasing. The revenue from the MHI troll, MHI handline and offshore handline fishery varied over the past ten years.

Bycatch. A total of 117,313 fish were released by the deep-set longline fishery in 2018. 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% 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 2018. A total of 3,569 fish were released by the shallow-set longline fishery in 2018. Sharks accounted for 80% 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 8% for targeted and incidentally caught pelagic species in 2018. 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

At the 2019 Pelagic Fishery Ecosystem Plan Team meeting, the Plan Team recommended the Council work with Hawaii Division of Aquatic Resources (DAR) and PIFSC to develop CPUE indices and indicators for Hawaii small-boat fisheries (troll, handline, etc.) and investigate data filtering criteria to define fishing effort and targeting.

2.4.4 OVERVIEW OF PARTICIPATION – ALL FISHERIES

Table 19. Number of HDAR Commercial Marine Licenses, 2017-2018

	Number of licenses	
Primary Fishing Method	**2017**	**2018**
Trolling	998	826
Longline	896	887
Ika Shibi & Palu Ahi	279	267
Aku Boat (Pole and Line)	4	2
Total Pelagic	2,177	1,982
Total All Methods	3,744	3,308

2.4.5 OVERVIEW OF LANDINGS AND ECONOMIC DATA

Table 20. Hawai`i commercial pelagic catch, revenue, and price by species, 2017-2018

	2017			2018		
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	287	$514	$1.86	236	$393	$1.79
Bigeye tuna	17,955	$65,764	$3.89	17,045	$66,510	$4.16
Bluefin tuna	3	$3	$8.40	1	$13	$8.40
Skipjack tuna	732	$785	$1.60	527	$650	$1.76
Yellowfin tuna	7,596	$21,576	$2.97	7,542	$26,621	$3.63
Other tunas	11	$27	$2.83	10	$18	$2.97
Tuna PMUS subtotal	**26,584**	**$88,670**	**$3.56**	**25,360**	**$94,205**	**$3.94**
Billfish PMUS						
Swordfish	3,582	$5,926	$2.32	2,330	$3,698	$2.12
Blue marlin	1,833	$2,157	$1.40	1,806	$1,615	$1.22
Spearfish (hebi)	688	$802	$1.17	504	$577	$1.19
Striped marlin	910	$1,715	$1.68	1,050	$1,701	$1.35
Other marlins	46	$82	$1.49	39	$57	$1.26
Billfish PMUS subtotal	**7,060**	**$10,682**	**$1.82**	**5,728**	**$7,648**	**$1.57**
Other PMUS						
Mahimahi	1,003	$3,515	$3.69	1,074	$3,493	$3.46
Ono (wahoo)	984	$3,031	$3.17	1,173	$3,039	$2.65
Opah (moonfish)	2,293	$3,252	$1.80	3,039	$3,300	$1.42
Oilfish	338	$267	$0.84	314	$235	$0.77
Pomfrets (monchong)	925	$3,328	$3.41	878	$2,854	$3.07
PMUS Sharks	166	$73	$0.79	139	$62	$0.67
Other PMUS subtotal	**5,709**	**$13,466**	**$2.64**	**6,617**	**$12,983**	**$2.24**
Other pelagics	**11**	**$15**	**$1.20**	**12**	**$12**	**$0.78**
Total pelagics	**39,364**	**$112,832**	**$3.14**	**37,718**	**$114,848**	**$3.32**

Table 21. Hawai`i commercial pelagic catch, revenue, and price by fishery, 2017-2018

Fishery	2017 Catch (1,000 lbs)	2017 Ex-vessel revenue ($1,000)	2017 Average price ($/lb)	2018 Catch (1,000 lbs)	2018 Ex-vessel revenue ($1,000)	2018 Average price ($/lb)
Deep-set longline	32,760	$97,927	$3.16	32,318	$101,259	$3.34
Shallow-set longline	3,007	$4,309	$2.43	1,438	$1,538	$2.08
MHI trolling	2,209	$6,493	$3.44	2,715	$8,171	$3.46
MHI handline	975	$2,944	$3.31	776	$2,493	$3.46
Offshore handline	323	$911	$2.94	366	$1,055	$3.01
Other gear	89	$250	$3.05	105	$331	$3.41
Total	**39,364**	**$112,832**	**$3.14**	**37,718**	**$114,848**	**$3.32**

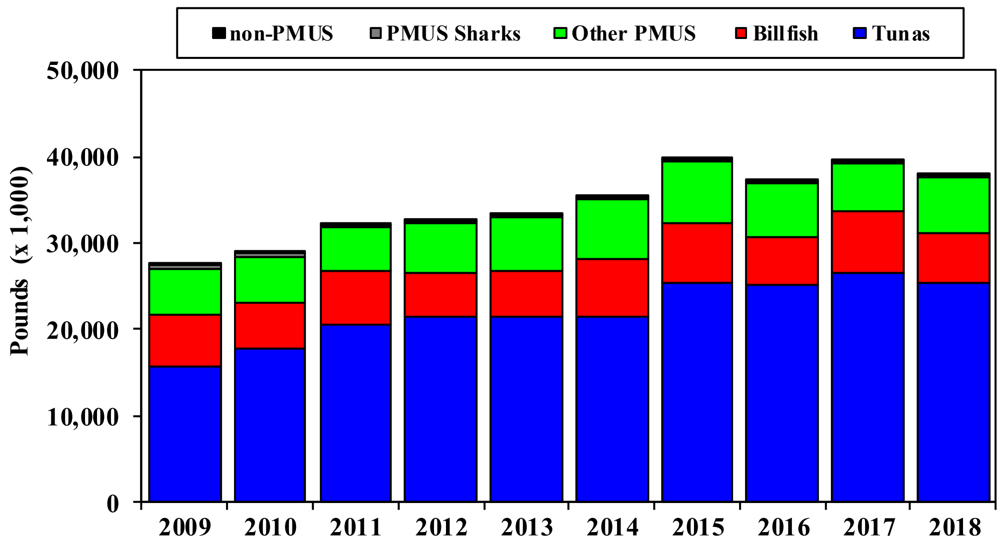


Figure 68. Hawai`i commercial tuna, billfish, other PMUS and PMUS shark catch, 2009-2018

Supporting data shown in Table A-69.

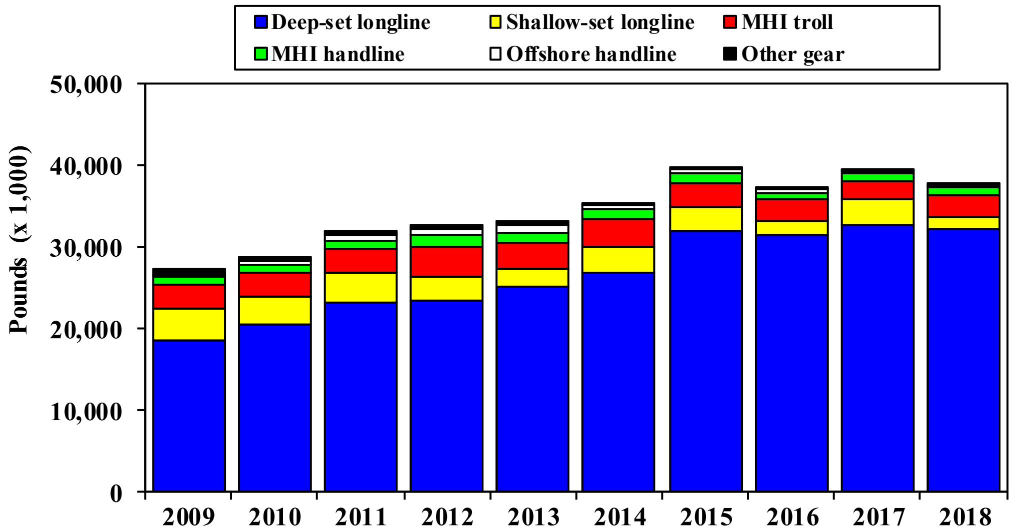


Figure 69. Total commercial pelagic catch by gear type, 2009-2018

Supporting data shown in Table A-70 .

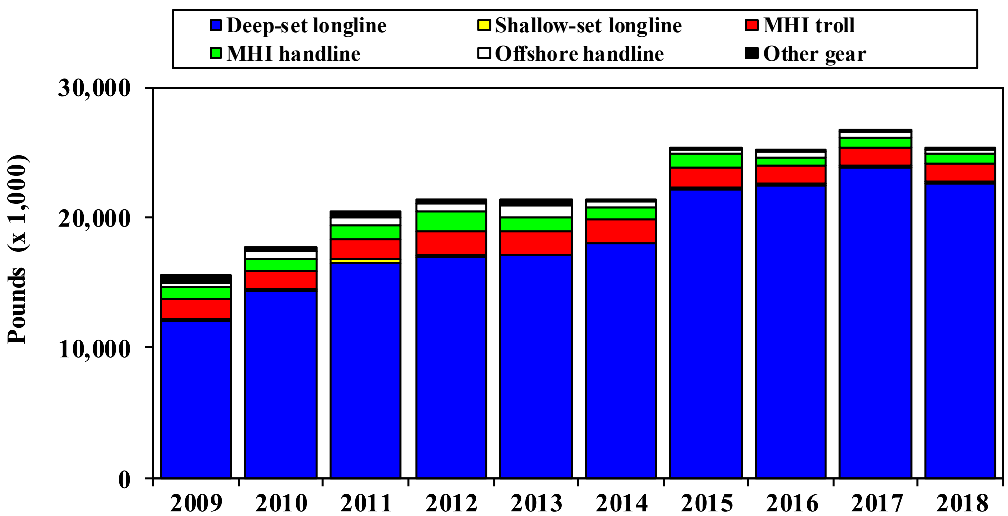


Figure 70. Hawai`i commercial tuna catch by gear type, 2009-2018

Supporting data shown in Table A-71.

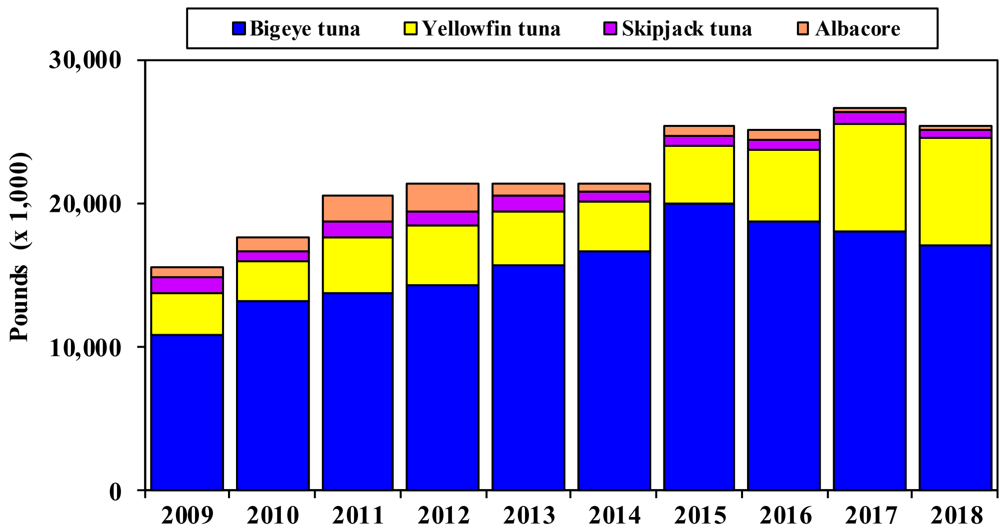


Figure 71. Species composition of the tuna catch, 2009-2018

Supporting data shown in Table A-72.

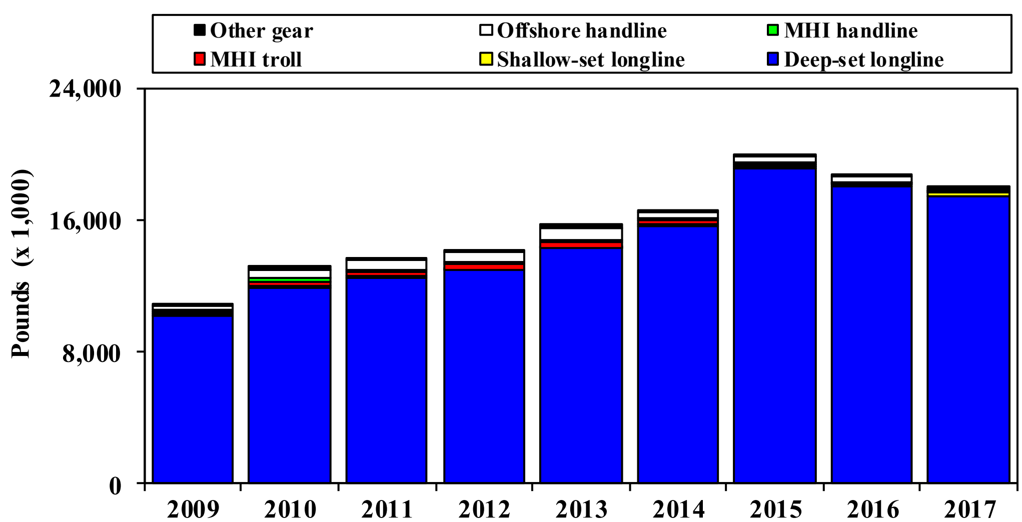


Figure 72. Hawai`i bigeye tuna catch by gear type, 2009-2018

Supporting data shown in Table A-73.

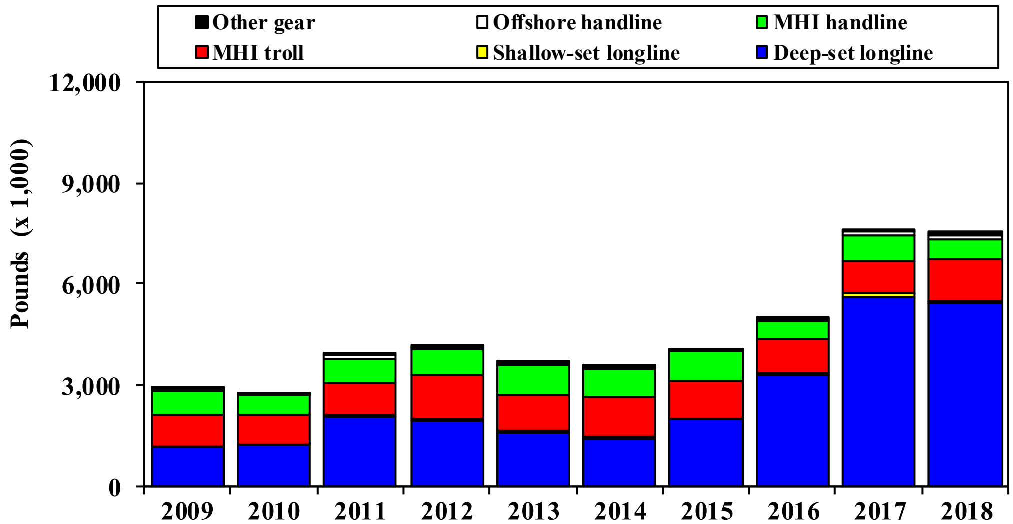


Figure 73. Hawai`i yellowfin tuna catch by gear type, 2009-2018

Supporting data shown in Table A-74.

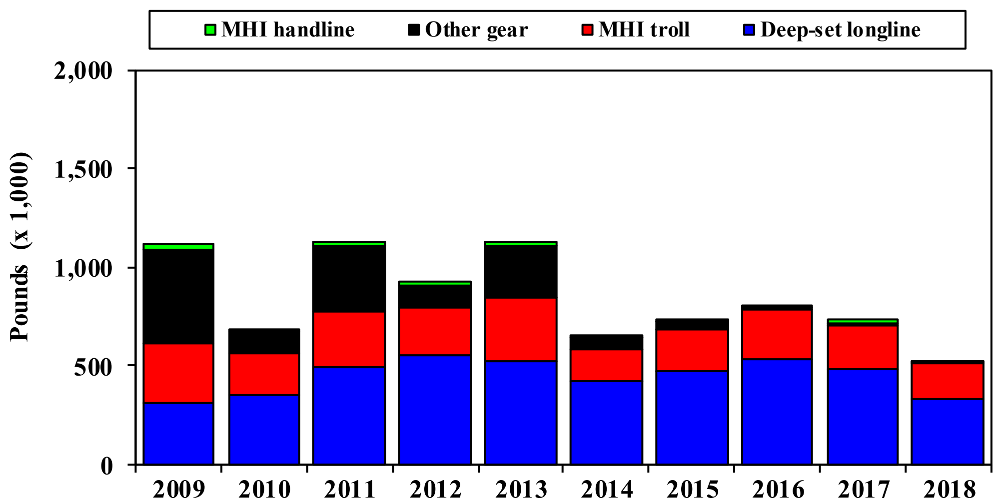


Figure 74. Hawai`i skipjack tuna catch by gear type, 2009-2018

Supporting data shown in Table A-75.

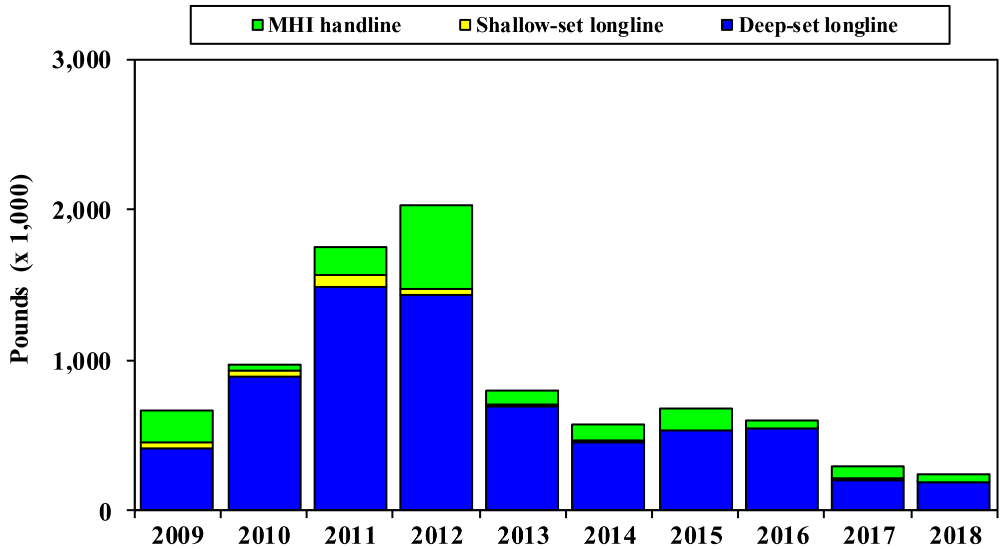


Figure 75. Hawai`i albacore catch by gear type, 2009-2018

Supporting data shown in Table A-76.

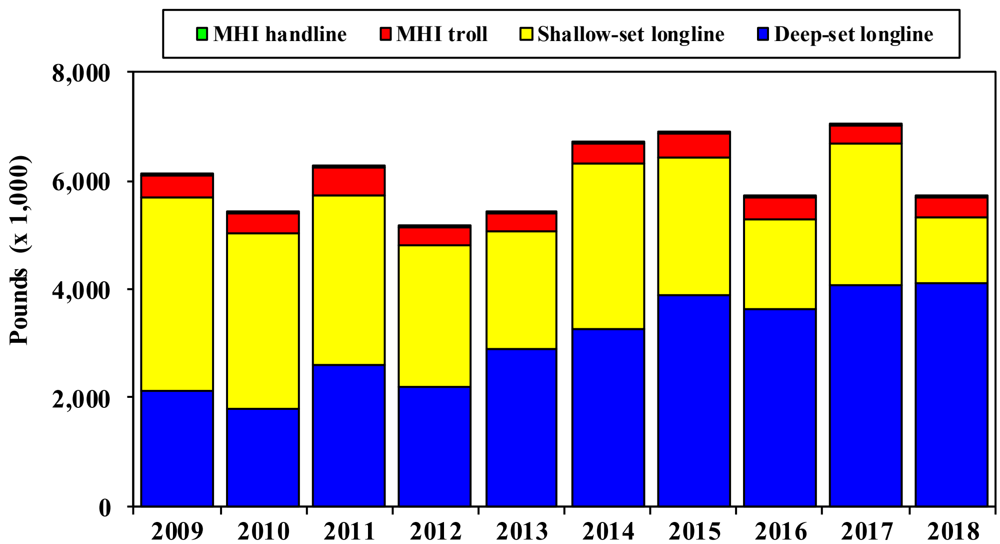


Figure 76. Hawai`i commercial billfish catch by gear type, 2009-2018

Supporting data shown in Table A-77.

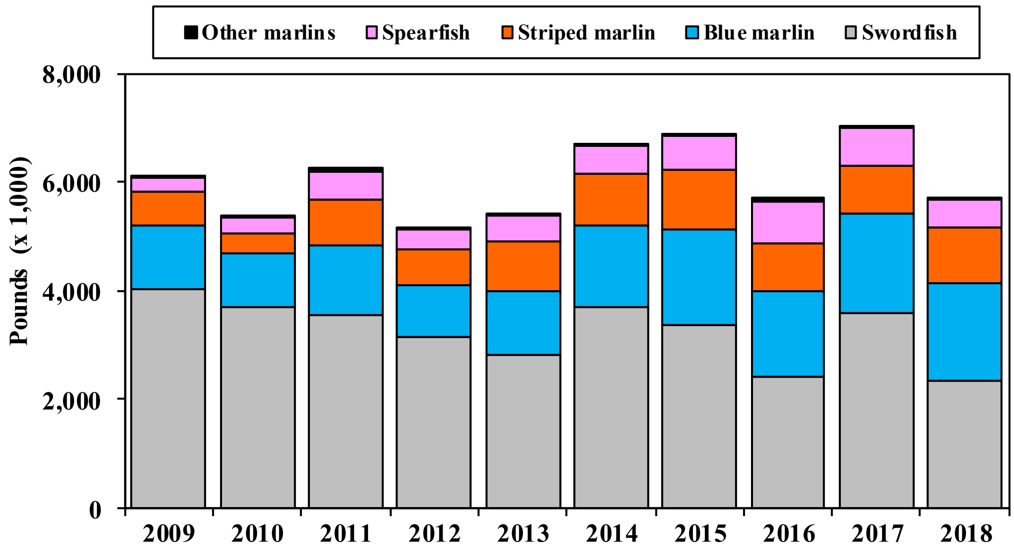


Figure 77. Species composition of the billfish catch, 2009-2018

Supporting data shown in Table A-78.

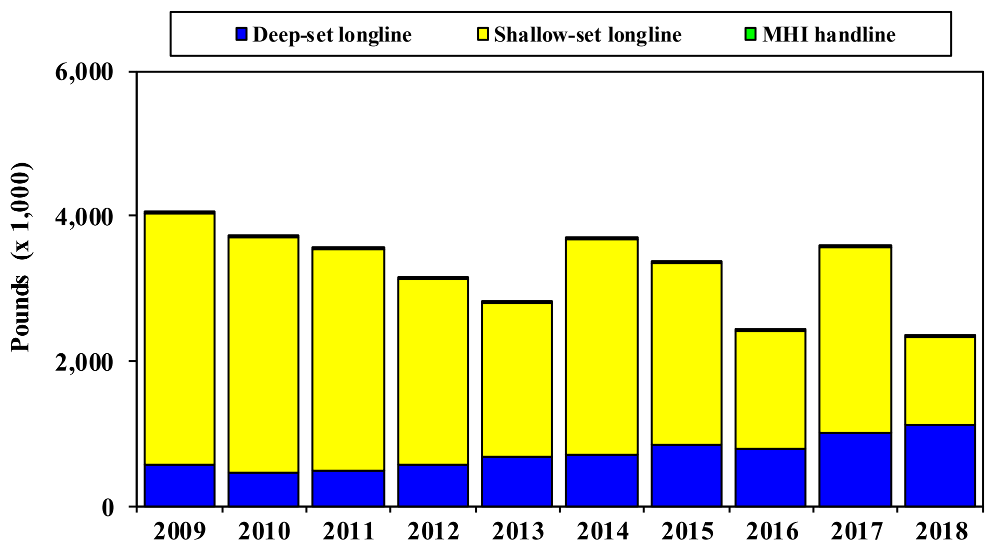


Figure 78. Hawai`i swordfish catch by gear type, 2009-2018

Supporting data shown in Table A-79.

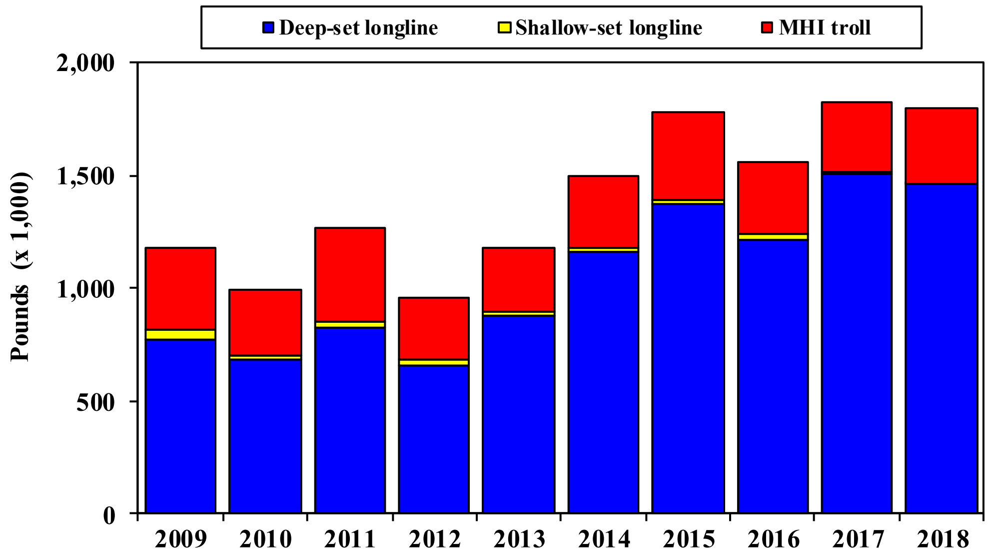


Figure 79. Hawai`i blue marlin catch by gear type, 2009-2018

Supporting data shown in Table A-80.

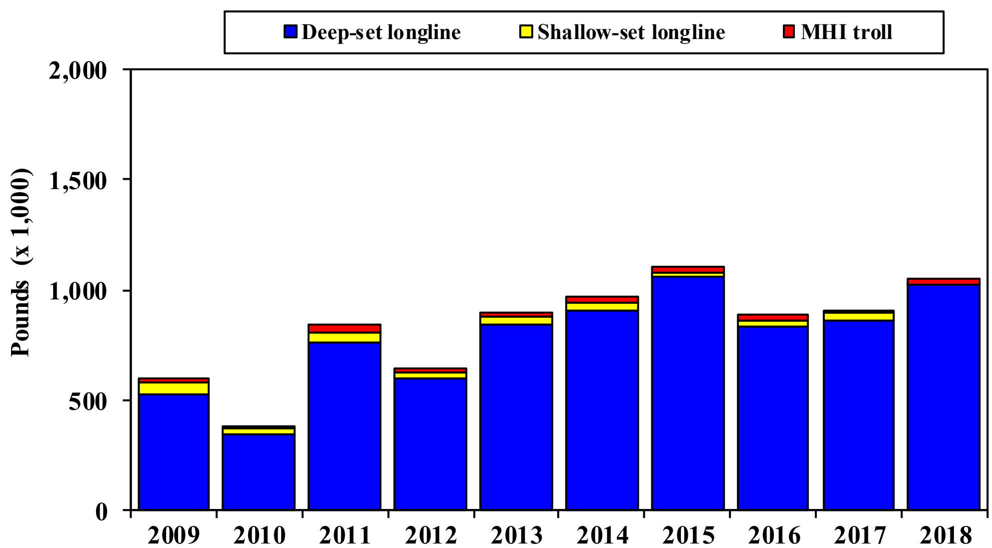


Figure 80. Hawai`i striped marlin catch by gear type, 2009-2018

Supporting data shown in Table A-81.

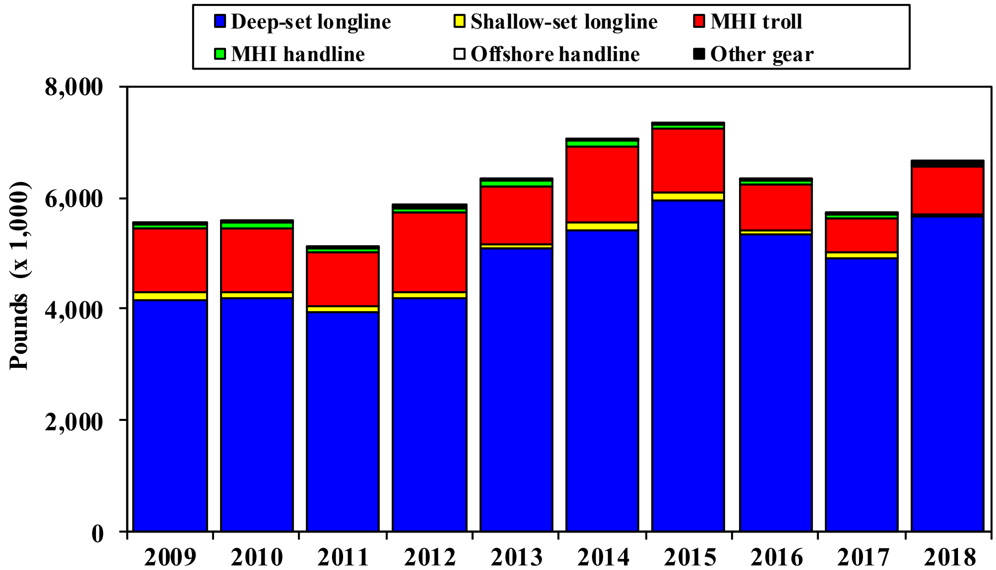


Figure 81. Hawai`i commercial catch of other PMUS by gear type, 2009-2018

Supporting data shown in Table A-82.

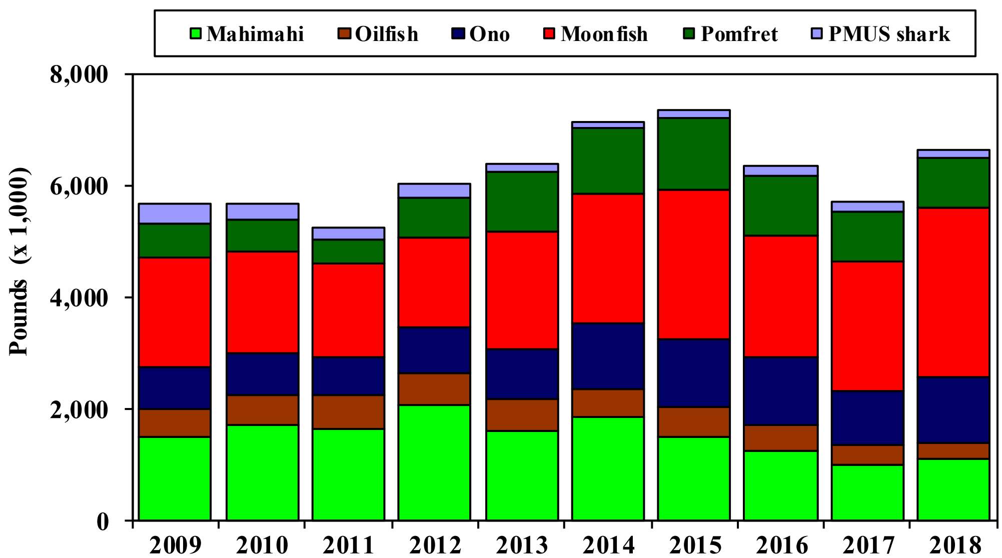


Figure 82. Species composition of other PMUS catch, 2009-2018

Supporting data shown in Table A-83.

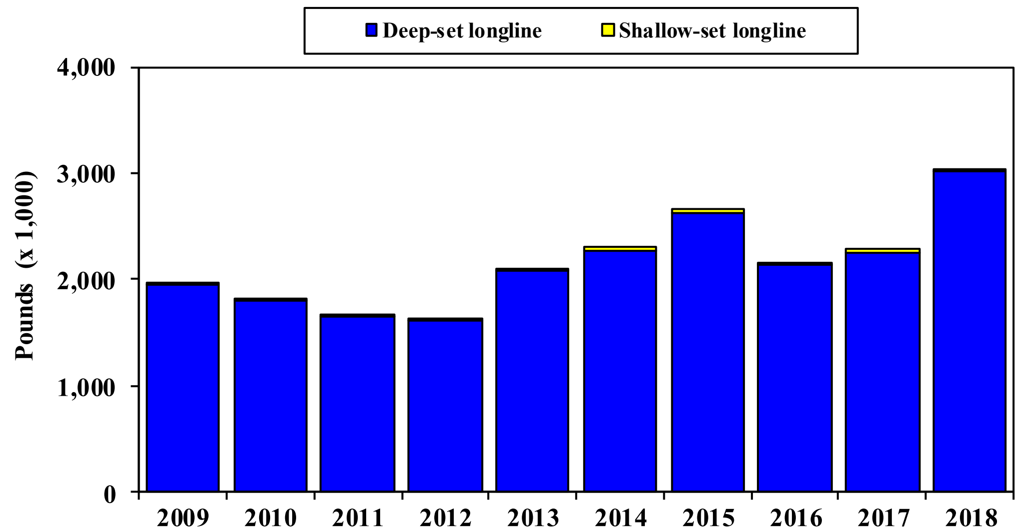


Figure 83. Hawai`i moonfish catch by gear type, 2009-2018

Supporting data shown in Table A-84.

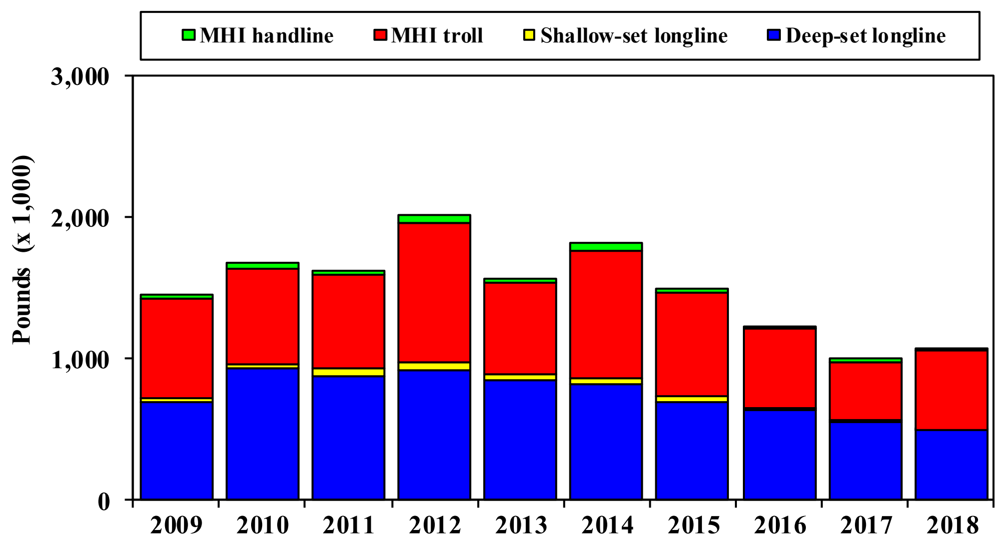


Figure 84. Hawai`i mahimahi catch by gear type, 2009-2018

Supporting data shown in Table A-85.

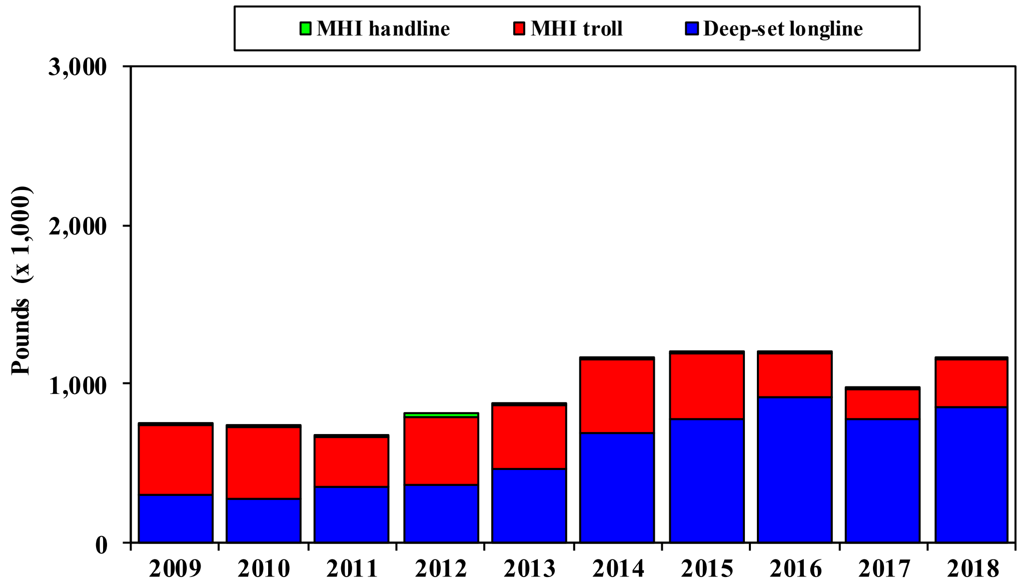


Figure 85. Hawai`i ono (wahoo) catch by gear type, 2009-2018

Supporting data shown in Table A-86.

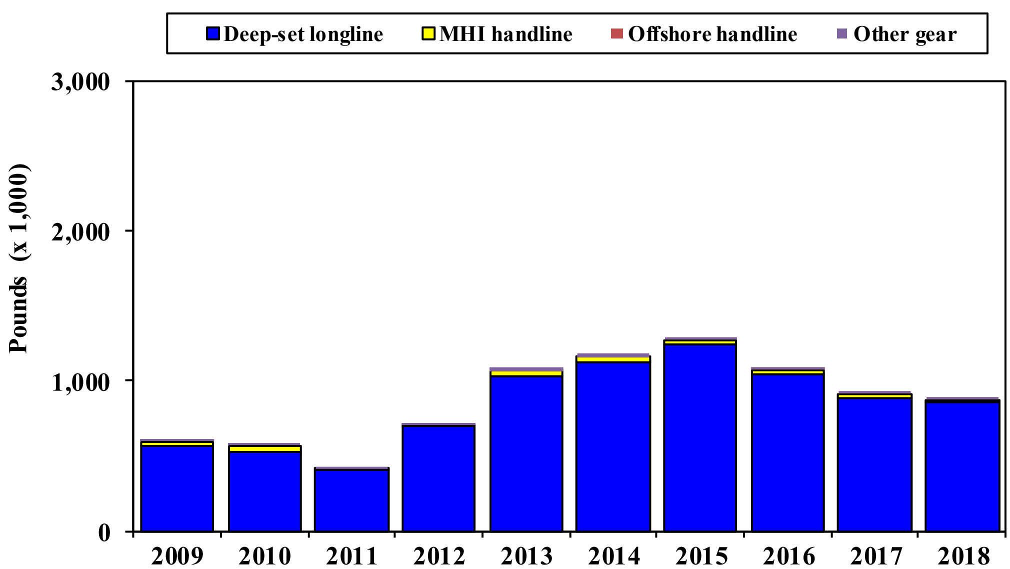


Figure 86. Hawai`i pomfret catch by gear type, 2009-2018

Supporting data shown in Table A-87

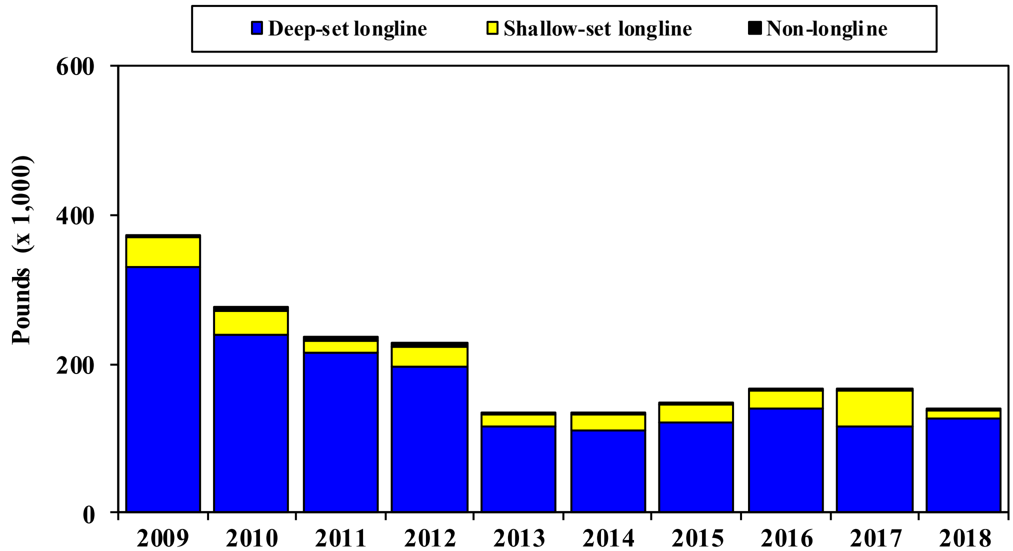


Figure 87. Hawai`i PMUS shark catch by gear type, 2009-2018

Supporting data shown in Table A-88.

2.4.6 HAWAI`I DEEP-SET LONGLINE FISHERY EFFORT, LANDINGS. REVENUE, AND CPUE

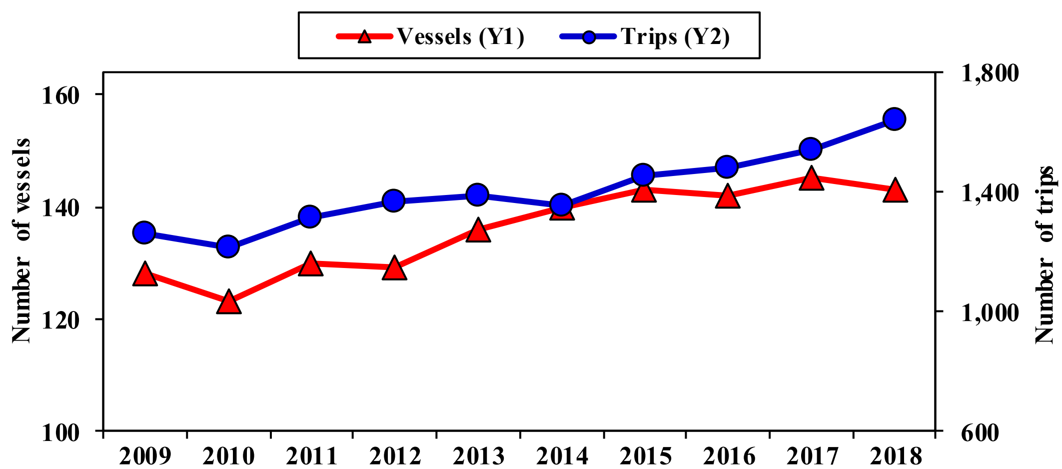


Figure 88. Number of Hawai`i-permitted deep-set longline vessels, trips and sets 2009-2018

Supporting data shown in Table A-89.

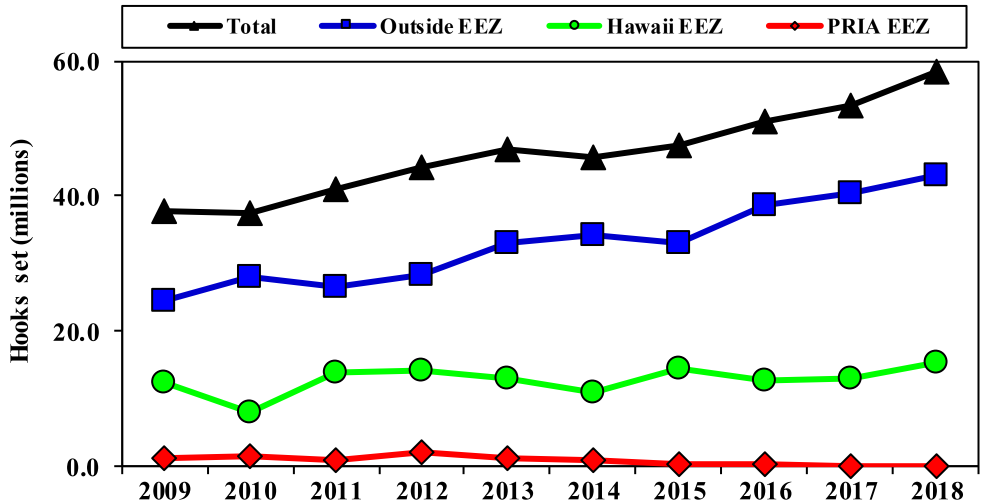


Figure 89. Number of hooks set by the Hawai`i-permitted deep-set longline fishery, 2009-2018

Supporting data shown in Table A-90.

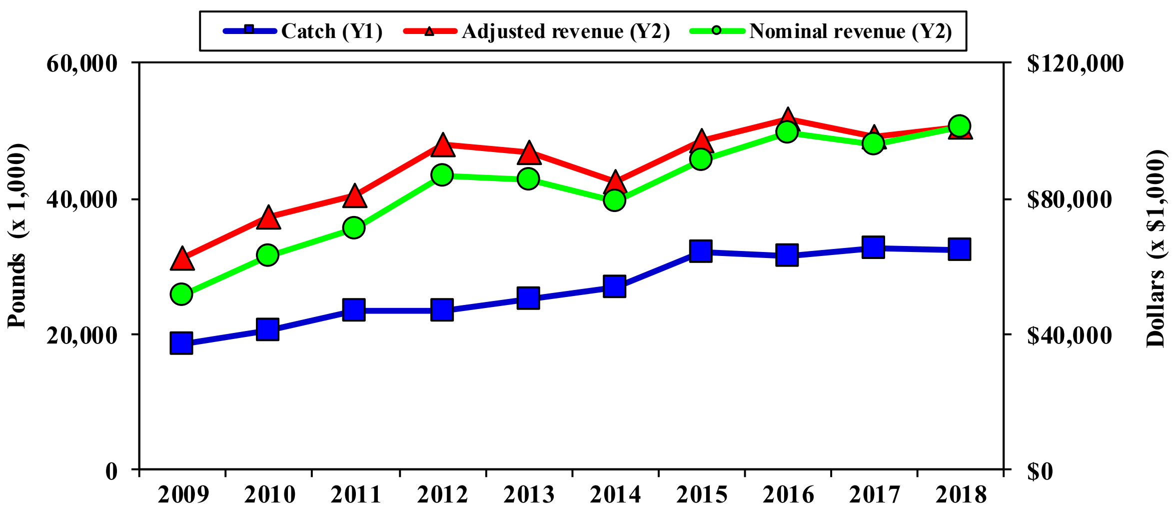


Figure 90. Catch and revenue for the Hawai`i-permitted deep-set longline fishery, 2009-2018

Supporting data shown in Table A-91.

Table 22. Hawai`i-permitted deep-set longline catch (number of fish) by area, 2009-2018

	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												
2009	39,058	6,250	3,331	978	1,049	3,145	2,836	11,228	2,272	3,653	9,587	18,986
2010	30,261	5,955	4,605	807	881	1,160	1,950	7,488	2,052	2,543	6,830	14,597
2011	48,162	15,393	12,026	962	1,634	7,599	6,165	22,556	2,639	3,239	11,699	24,406
2012	55,392	15,656	9,599	1,136	1,000	4,338	4,228	18,263	3,368	3,299	14,889	24,107
2013	53,569	8,642	4,896	1,034	1,378	5,813	5,916	17,677	3,695	3,079	13,514	22,725
2014	47,554	5,820	2,206	976	1,220	5,246	4,490	9,364	4,840	2,219	12,754	21,807
2015	62,393	11,939	3,135	1,349	2,647	5,966	7,146	15,434	6,562	2,756	22,092	26,359
2016	45,252	13,640	1,656	1,248	1,816	3,887	7,186	9,093	5,773	2,319	15,808	23,700
2017	52,338	24,320	276	825	2,298	4,314	5,506	8,849	5,147	1,795	12,731	27,699
2018	46,404	19,648	292	1,622	2,917	5,387	5,034	10,226	7,211	2,637	13,074	26,707
Outside EEZ												
2009	79,630	8,292	5,360	2,369	3,044	4,221	5,937	49,477	6,599	18,249	27,315	31,747
2010	106,767	7,923	14,910	2,131	2,515	2,514	6,425	84,974	6,724	17,361	30,905	36,592
2011	108,790	16,114	20,080	2,295	2,793	8,653	9,392	52,687	7,822	14,931	21,748	31,525
2012	105,373	12,455	20,315	2,434	2,296	4,759	7,069	59,781	8,096	14,248	37,035	33,055
2013	140,034	10,592	9,837	3,230	2,563	6,717	8,959	59,124	10,654	20,386	64,971	34,102
2014	170,269	11,406	6,756	3,604	4,475	9,558	11,348	61,366	18,296	23,564	69,312	51,064
2015	167,550	15,745	7,072	4,048	4,868	7,155	10,707	44,946	18,337	26,593	75,363	59,757
2016	175,897	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	172,172	42,041	3,309	4,490	4,643	10,340	10,443	33,895	24,038	30,234	42,826	75,994
All areas												
2009	118,688	14,542	8,691	3,347	4,093	7,366	8,773	60,705	8,871	21,902	36,902	50,733
2010	137,028	13,878	19,515	2,938	3,396	3,674	8,375	92,462	8,776	19,904	37,735	51,189
2011	156,952	31,507	32,106	3,257	4,427	16,252	15,557	75,243	10,461	18,170	33,447	55,931
2012	160,765	28,111	29,914	3,570	3,296	9,097	11,297	78,044	11,464	17,547	51,924	57,162
2013	193,603	19,234	14,733	4,264	3,941	12,530	14,875	76,801	14,349	23,465	78,485	56,827
2014	217,823	17,226	8,962	4,580	5,695	14,804	15,838	70,730	23,136	25,783	82,066	72,871
2015	229,943	27,684	10,207	5,397	7,515	13,121	17,853	60,380	24,899	29,349	97,455	86,116
2016	221,149	46,470	9,853	5,118	6,261	11,588	24,027	48,494	30,217	24,352	81,690	89,091
2017	224,391	79,620	4,108	5,576	8,018	13,019	20,668	46,146	25,426	24,794	67,736	98,986
2018	218,576	61,689	3,601	6,112	7,560	15,727	15,477	44,121	31,249	32,871	55,900	102,701

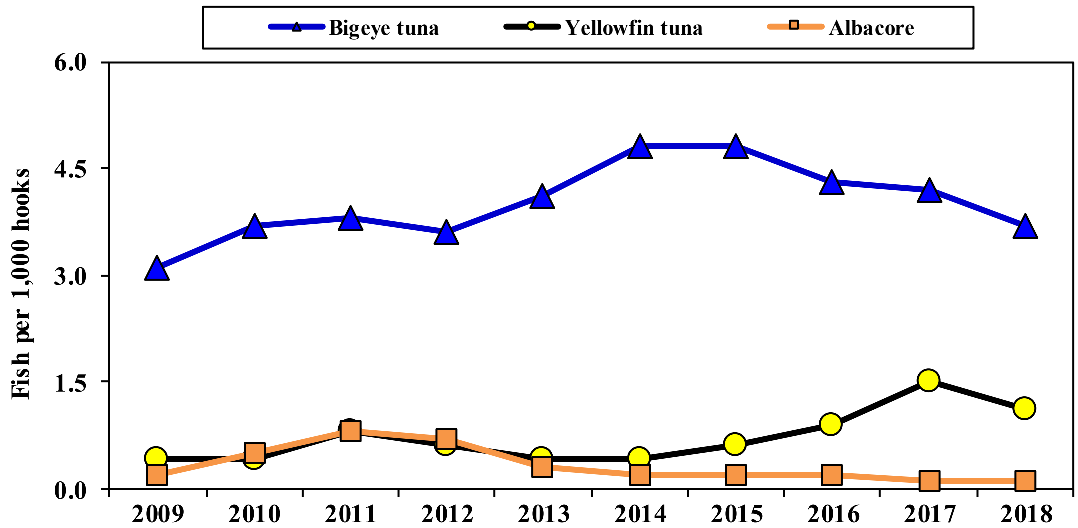


Figure 91. Tuna CPUE for the Hawai`i-permitted deep-set longline fishery, 2009-2018

Supporting data shown in Table A-92.

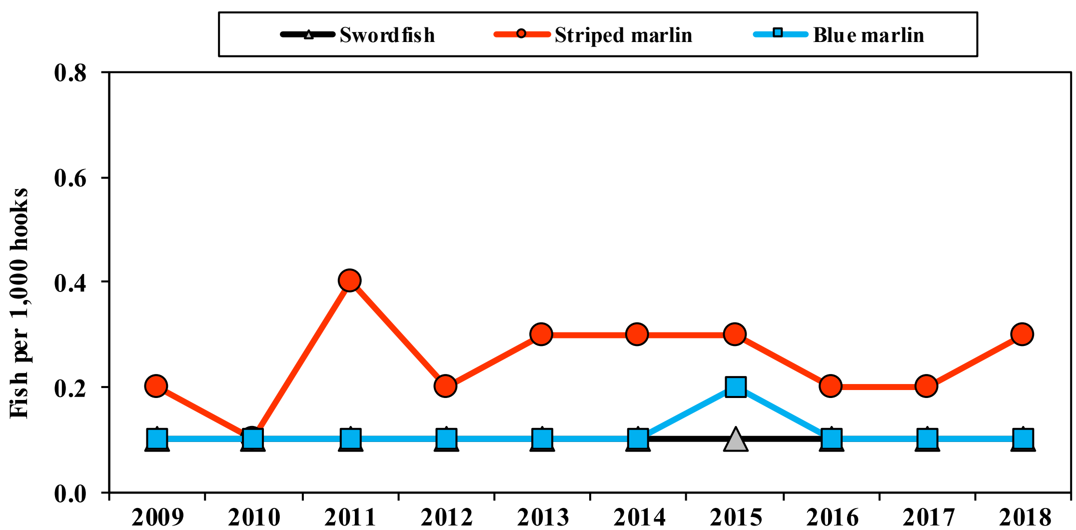


Figure 92. Billfish CPUE for the Hawai`i-permitted deep-set longline fishery, 2009-2018

Supporting data shown in Table A-93.

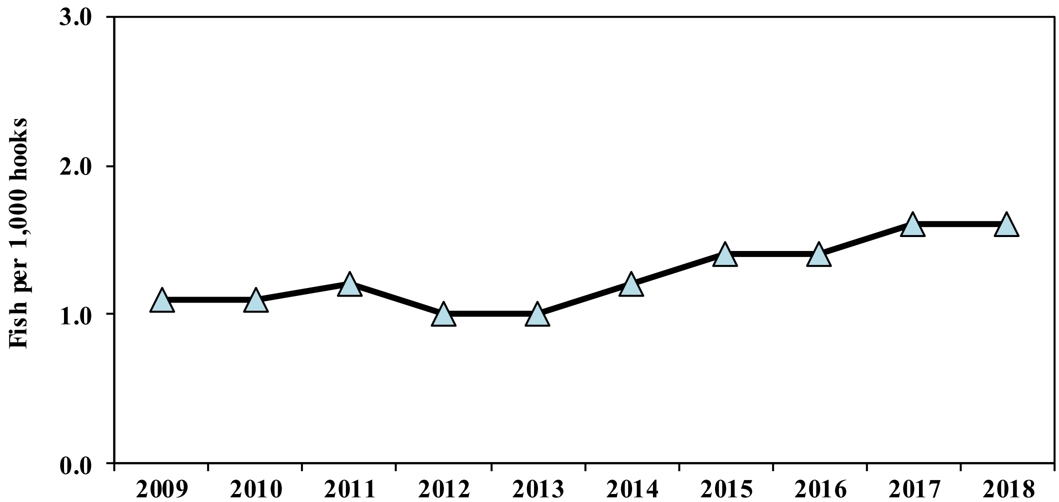


Figure 93. Blue shark CPUE for the Hawai`i-permitted deep-set longline fishery, 2009-2018
Supporting data shown in Table A-94.

Table 23. Released catch, retained catch, and total catch for the Hawai`i-permitted deep-set longline fishery, 2018

	Deep-set longline fishery			
	Released catch	**Percent released**	**Retained catch**	**Total Catch**
Tuna				
Albacore	43	1.2	3,558	3,601
Bigeye tuna	5,052	2.3	213,524	218,576
Bluefin tuna	2	40.0	3	5
Skipjack tuna	401	2.2	17,690	18,091
Yellowfin tuna	997	1.6	60,692	61,689
Other tuna	0	0.0	0	0
Total tunas	**6,495**	**2.2**	**295,467**	**301,962**
Billfish				
Swordfish	248	4.1	5,864	6,112
Blue marlin	131	1.7	7,429	7,560
Striped marlin	213	1.4	15,514	15,727
Spearfish	283	1.8	15,194	15,477
Other marlin	8	1.7	461	469
Total billfish	883	1.9	44,462	45,345
Other PMUS				
Mahimahi	576	1.3	43,545	44,121
Wahoo	165	0.5	31,084	31,249
Moonfish	356	1.1	32,515	32,871
Oilfish	2,251	13.4	14,507	16,758
Pomfret	462	0.8	55,438	55,900
Total other PMUS	**3,810**	**2.1**	**177,089**	**180,899**
Non-PMUS fish	**3,752**	**86.6**	**579**	**4,331**
Total non-shark	**14,940**	**2.8**	**517,597**	**532,537**
PMUS Sharks				
Blue shark	91,648	100.0	0	91,648
Mako shark	4,257	86.4	668	4,925
Thresher shark	5,471	99.6	22	5,493
Oceanic Whitetip shark	399	100.0	0	399
Silky shark	236	100.0	0	236
Total PMUS sharks	**102,011**	**99.3**	**690**	**102,701**
Non-PMUS sharks	**362**	**100.0**	**0**	**362**
Grand Total	**117,313**	**18.5**	**518,287**	**635,600**

Table 24. Average weight (lbs.) of the catch by the Hawai`i-permitted deep-set longline fishery, 2009-2018

	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
2009	87	80	48	18	266	181	72	189	28	44	188	12	34	90	15	16	190	205
2010	88	90	46	19	266	171	93	202	31	56	188	10	32	91	14	16	203	182
2011	81	67	47	20	266	173	47	188	33	58	188	12	34	91	12	16	187	172
2012	82	71	48	16	297	172	66	200	32	57	185	12	32	92	14	16	198	196
2013	75	84	47	16	266	184	68	225	32	62	188	11	33	89	13	18	196	173
2014	73	84	50	17	---	158	62	205	30	58	258	12	30	89	14	17	201	214
2015	85	74	52	18	266	165	81	185	33	59	219	12	31	91	13	18	195	219
2016	83	72	55	17	273	165	73	196	31	51	242	13	31	88	13	19	179	183
2017	79	72	49	19	277	190	67	188	32	63	286	12	31	92	13	20	181	200
2018	78	89	52	19	286	190	66	197	32	64	185	11	28	93	15	22	182	184
Average	**80.5**	**77.1**	**48.4**	**17.8**	**274.2**	**175.3**	**66.7**	**195.9**	**31.6**	**56.5**	**210.3**	**11.6**	**30.8**	**90.6**	**13.5**	**17.2**	**191.0**	**191.8**
SD	**5.0**	**8.2**	**2.9**	**1.1**	**11.3**	**10.7**	**12.1**	**11.7**	**1.4**	**5.7**	**36.9**	**0.7**	**1.9**	**1.5**	**1.1**	**2.1**	**8.7**	**16.7**

2.4.7 HAWAI`I SHALLOW-SET LONGLINE FISHERY EFFORT, LANDINGS. REVENUE, AND CPUE

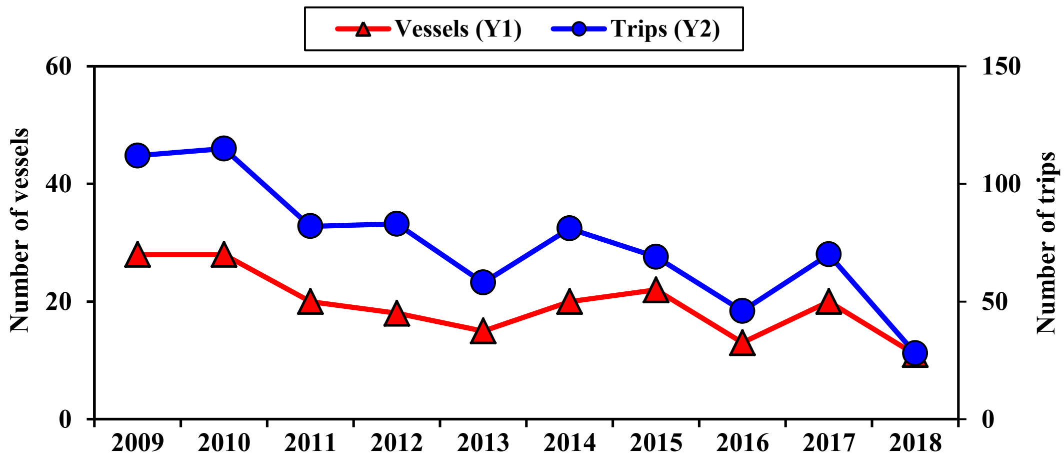


Figure 94. Number of Hawai`i-permitted shallow-set longline vessels, trips and sets, 2009-2018

Supporting data shown in Table A-95.

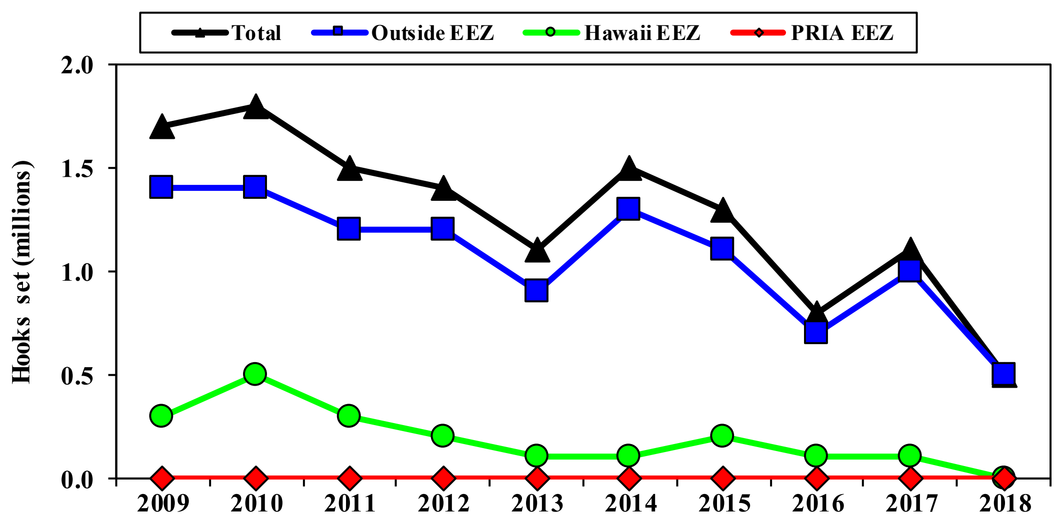


Figure 95. Number of hooks set by the Hawai`i-permitted shallow-set longline fishery, 2009-2018

Supporting data shown in Table A-96.

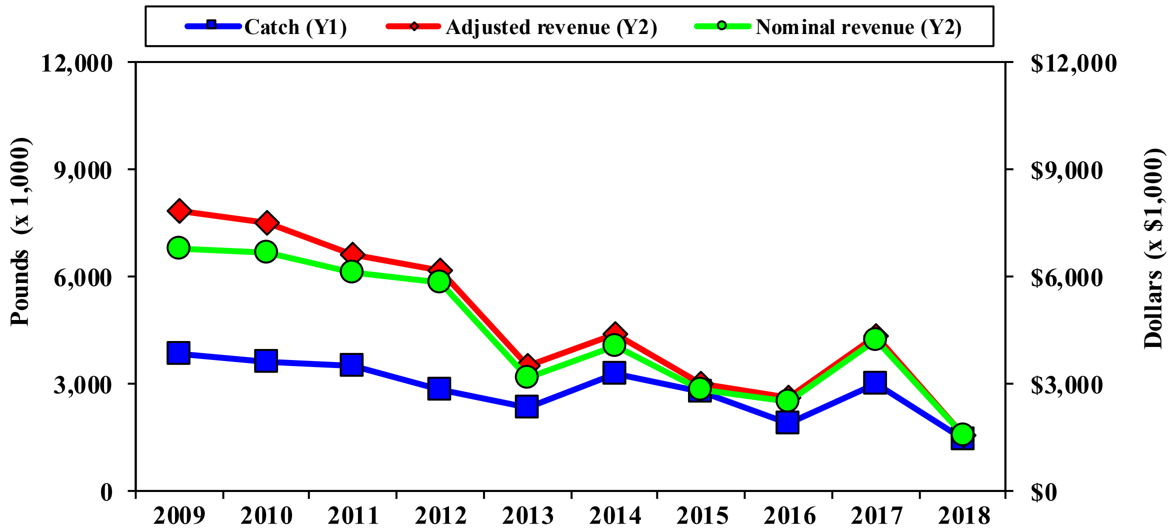


Figure 96. Catch and revenue for the Hawai`i-permitted shallow-set longline fishery, 2009-2018

Supporting data shown in Table A-97.

Table 25. Hawai`i-permitted shallow-set longline catch (number of fish) by area, 2009-2018

	Tunas			Billfish				Other PMUS				
Year	**Bigeye tuna**	**Yellowfin tuna**	**Albacore**	**Swordfish**	**Blue marlin**	**Striped marlin**	**Spearfish**	**Mahimahi**	**Ono (Wahoo)**	**Moonfish**	**Pomfrets**	**PMUS sharks**
Hawaii+PRIA EEZ												
2009	86	55	2	3,876	103	278	37	401	17	25	14	1,115
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
Outside EEZ												
2009	761	192	1,509	14,632	77	321	40	2,820	21	71	69	8,292
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
All areas												
2009	847	247	1,511	18,508	180	599	77	3,221	38	96	83	9,407
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

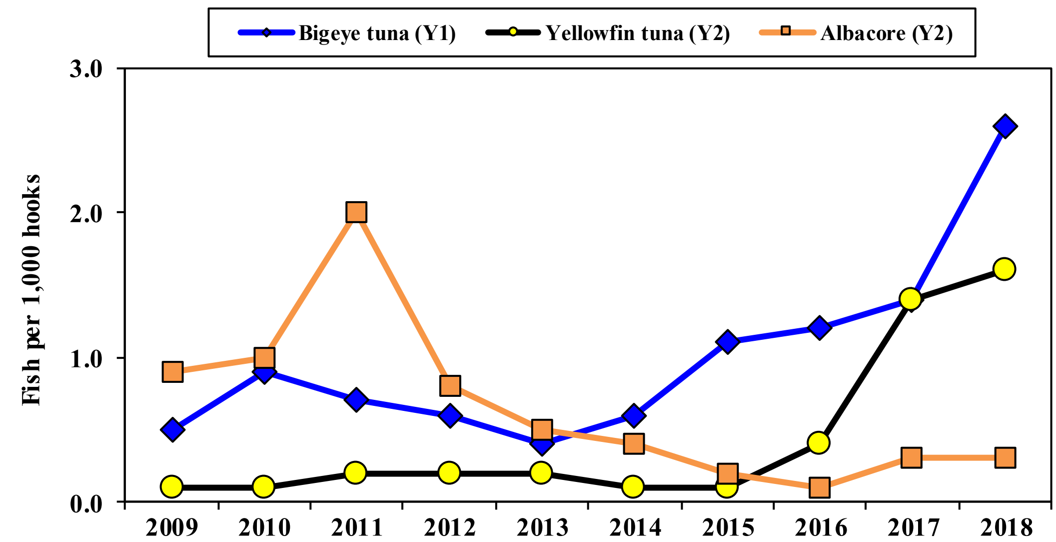


Figure 97. Tuna CPUE for the Hawai`i-permitted shallow-set longline fishery, 2009-2018
Supporting data shown in Table A-98.

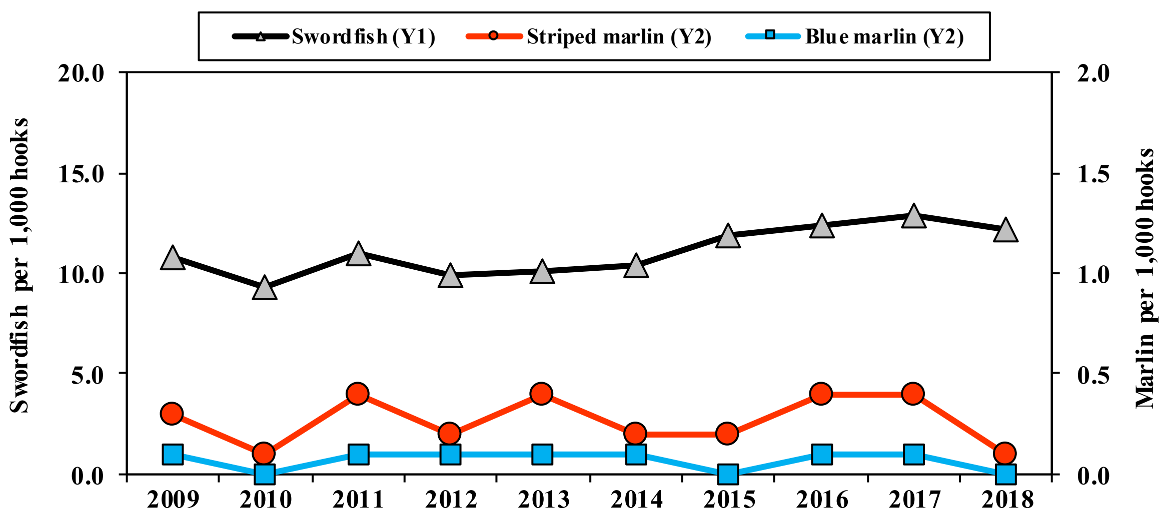


Figure 98. Billfish CPUE for the Hawai`i-permitted shallow-set longline fishery, 2009-2018
Supporting data shown in Table A-99.

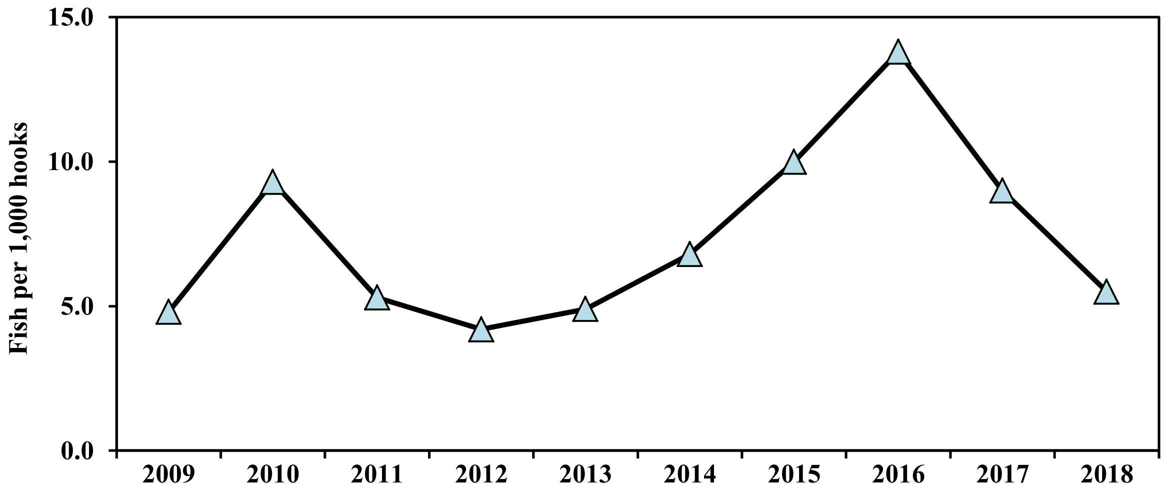


Figure 99. Blue shark CPUE for the Hawai`i-permitted shallow-set longline fishery, 2009-2018

Supporting data shown in Table A-100.

Table 26. Released catch, retained catch, and total catch for the Hawai`i-permitted shallow-set longline fishery, 2018

	Shallow-set longline fishery			
	Released catch	**Percent released**	**Retained catch**	**Total Catch**
Tuna				
Albacore	1	0.7	136	137
Bigeye tuna	70	5.4	1,221	1,291
Bluefin tuna	0	0.0	2	2
Skipjack tuna	0	0.0	16	16
Yellowfin tuna	17	2.2	761	778
Other tuna	0	0.0	0	0
Total tunas	**88**	**4.0**	**2,136**	**2,224**
Billfish				
Swordfish	466	7.6	5,644	6,110
Blue marlin	3	60.0	2	5
Striped marlin	21	33.9	41	62
Spearfish	5	11.4	39	44
Other marlin	0	0.0	0	0
Total billfish	**495**	**8.0**	**5,726**	**6,221**
Other PMUS				
Mahimahi	13	2.0	626	639
Wahoo	2	7.7	24	26
Moonfish	15	8.7	157	172
Oilfish	103	60.9	66	169
Pomfret	7	29.2	17	24
Total other PMUS	**140**	**13.6**	**890**	**1,030**
Non-PMUS fish	**0**	**0.0**	**0**	**0**
Total non-shark	**723**	**7.6**	**8,752**	**9,475**
PMUS Sharks				
Blue shark	2,538	100.0	0	2,538
Mako shark	283	81.8	63	346
Thresher shark	24	96.0	1	25
Oceanic Whitetip shark	0	0.0	0	0
Silky shark	0	0.0	0	0
Total PMUS sharks	**2,845**	**97.8**	**64**	**2,909**
Non-PMUS sharks	1	100.0	0	1
Grand Total	**3,569**	**28.8**	**8,816**	**12,385**

Table 27. Average weight (lbs.) of the catch by the Hawai`i-permitted shallow-set longline fisheries, 2009-2018

	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
2009	121	112	29	15	173	201	93	277	35	44	---	13	42	79	19	17	181	417
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	88	131	24	14	268	212	91	278	36	52	---	12	42	71	16	24	202	243
2015	78	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
Average	**95.5**	**104.0**	**28.4**	**16.5**	**183.9**	**201.3**	**95.6**	**274.2**	**36.6**	**52.1**	---	**11.9**	**39.9**	**77.5**	**15.2**	**18.6**	**178.6**	**277.7**
SD	**12.9**	**11.2**	**4.5**	**1.4**	**35.9**	**12.6**	**6.1**	**46.6**	**1.8**	**3.2**	---	**1.2**	**4.4**	**8.2**	**2.0**	**3.2**	**19.4**	**63.9**

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

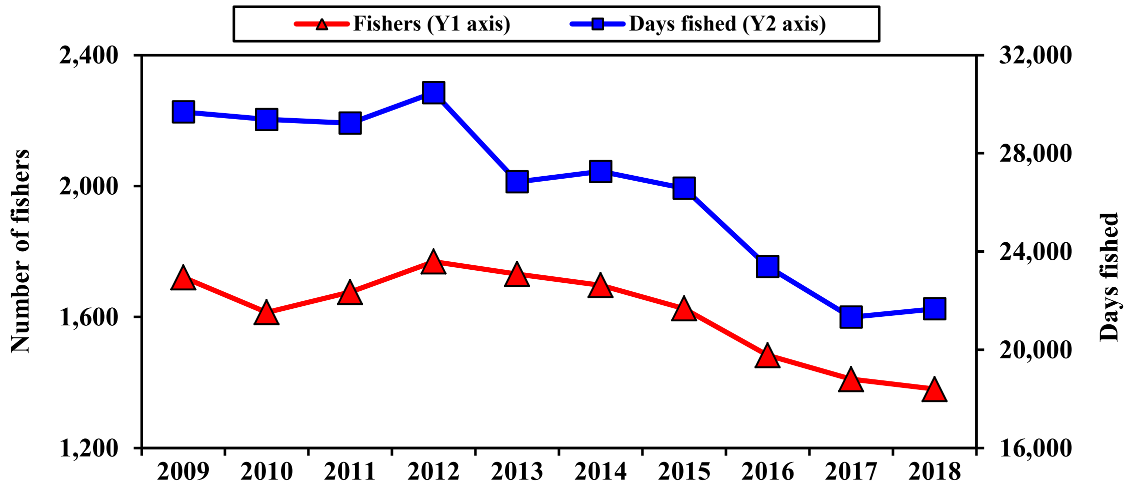


Figure 100. Number of MHI troll fishers and days fished, 2009-2018

Supporting data shown in Table A-101.

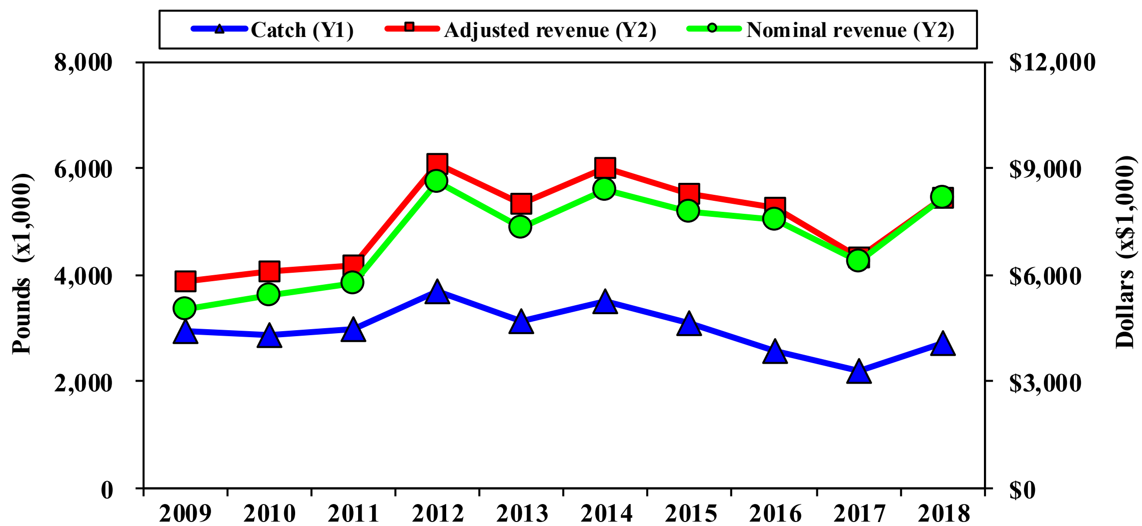


Figure 101. Catch and revenue for the MHI troll fishery, 2009-2018

Supporting data shown in Table A-102.

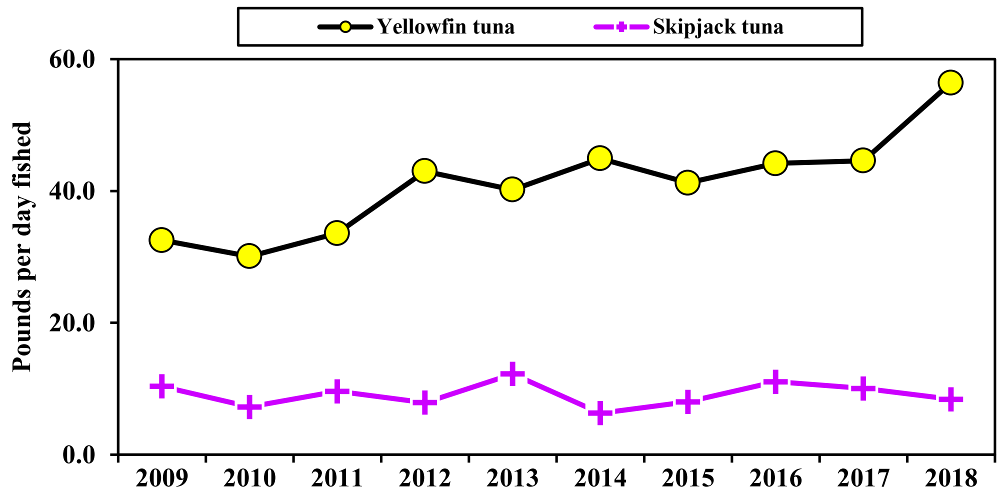


Figure 102. Tuna CPUE for the MHI troll fishery, 2009-2018

Supporting data shown in Table A-103.

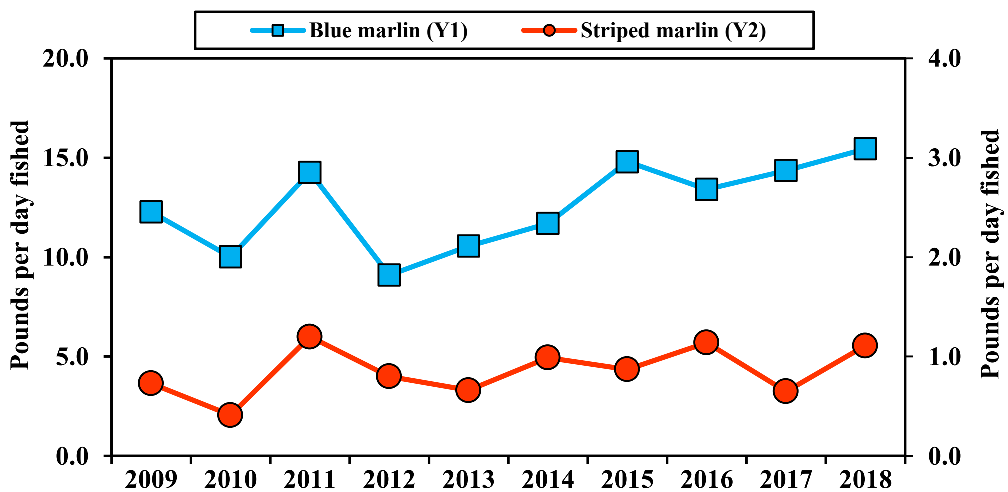


Figure 103. Marlin CPUE for the MHI troll fishery, 2009-2018

Supporting data shown in Table A-104.

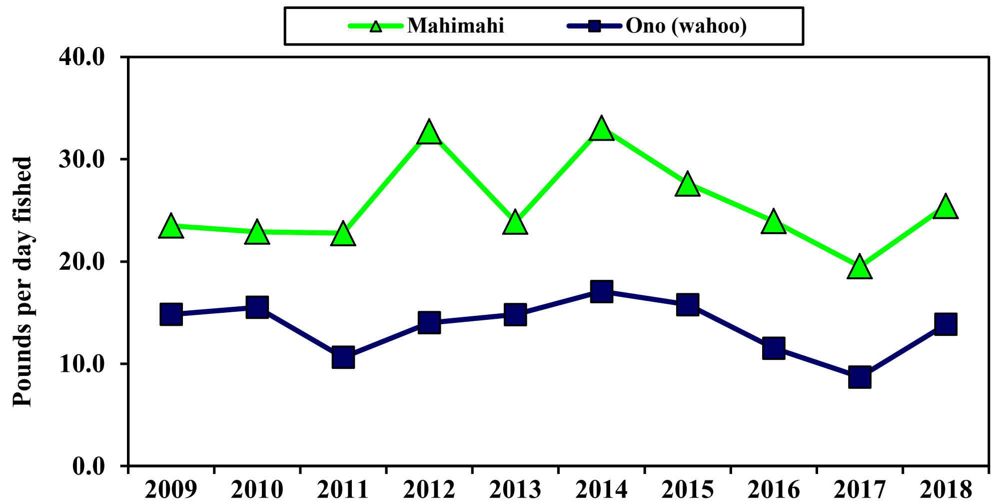


Figure 104. Mahimahi and Ono CPUE for the MHI troll fishery, 2009-2018

Supporting data shown in Table A-105.

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

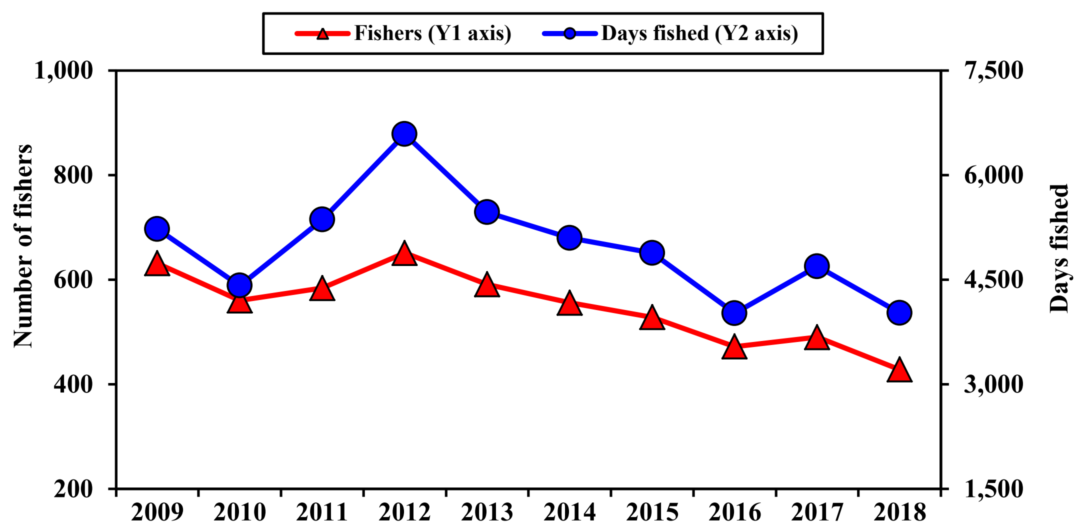


Figure 105. Number of MHI handline fishers and days fished, 2009-2018

Supporting data shown in Table A-106.

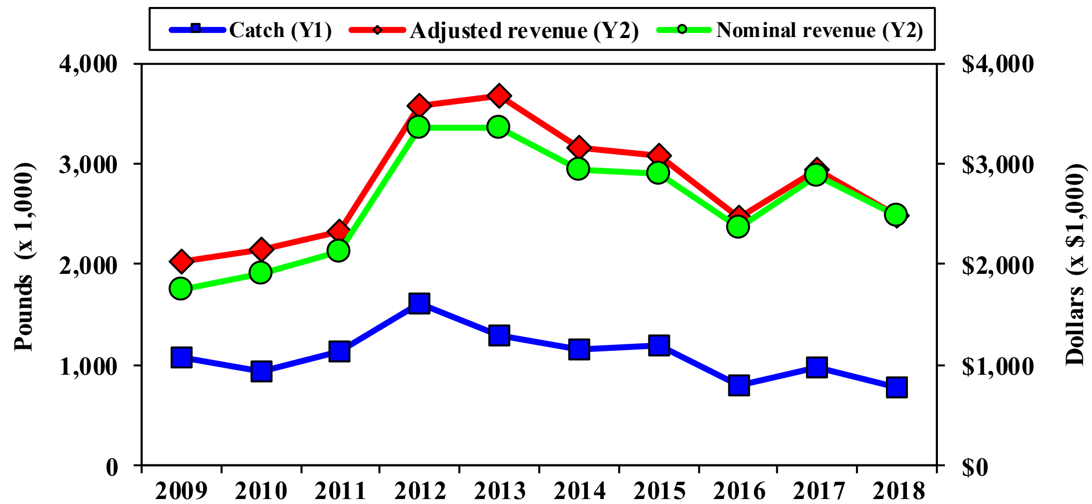


Figure 106. Catch and revenue for the MHI handline fishery, 2009-2018

Supporting data shown in Table A-107.

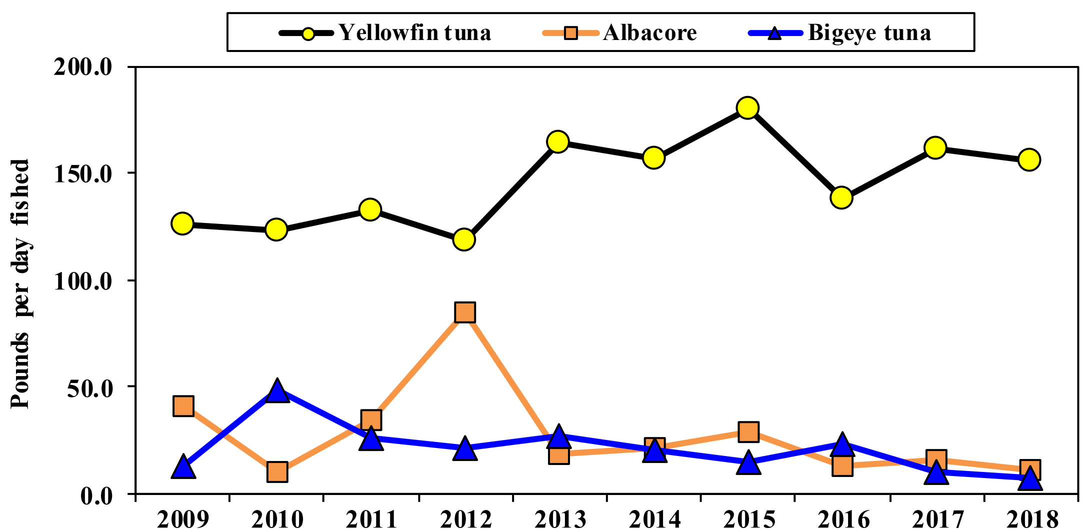


Figure 107. Tuna CPUE for the MHI handline fishery, 2009-2018

Supporting data shown in Table A-108.

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

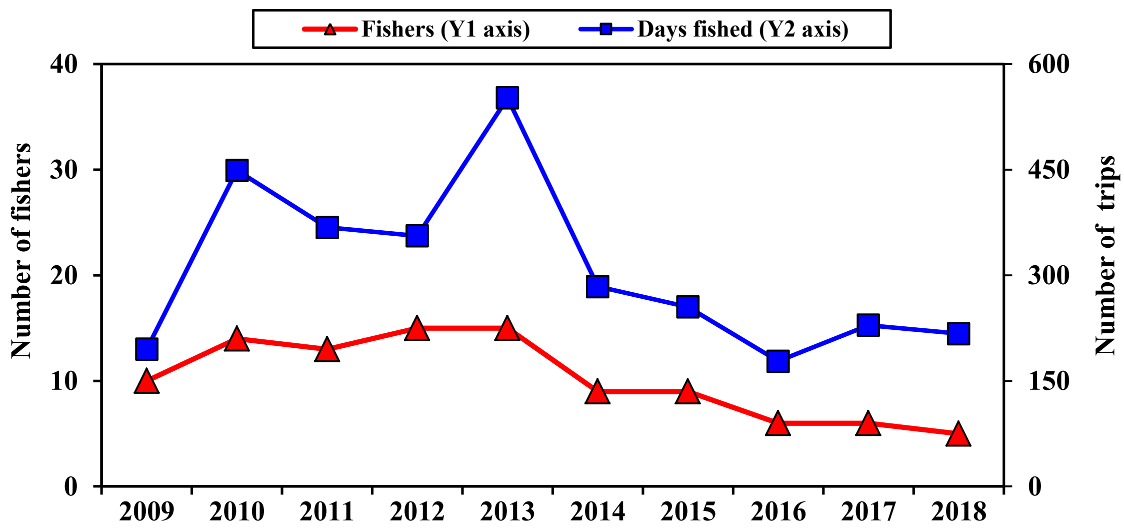


Figure 108. Number of offshore handline fishers and days fished, 2009-2018

Supporting data shown in Table A-109.

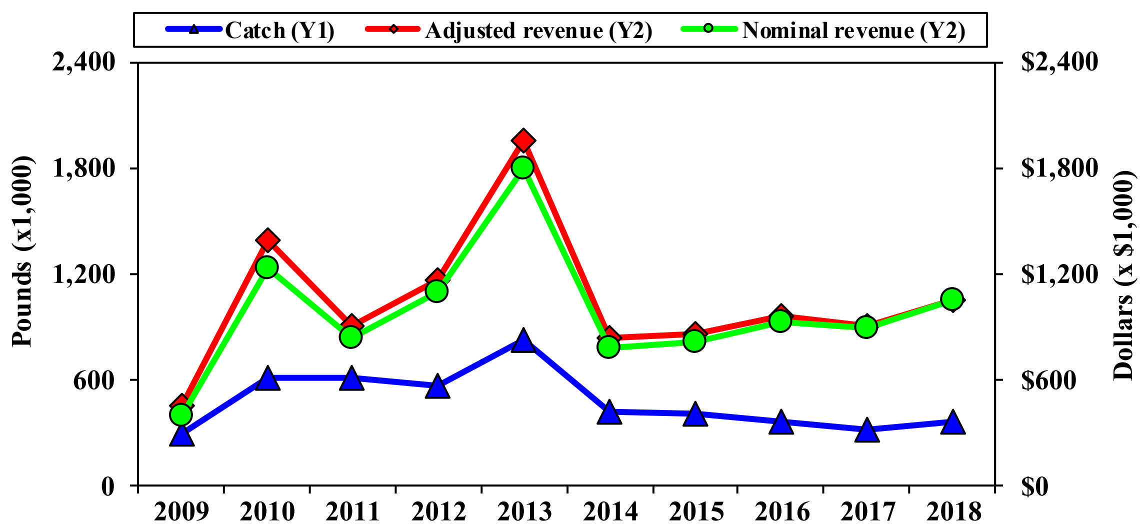


Figure 109. Catch and revenue for the offshore tuna handline fishery, 2009-2018

Supporting data shown in Table A-110.

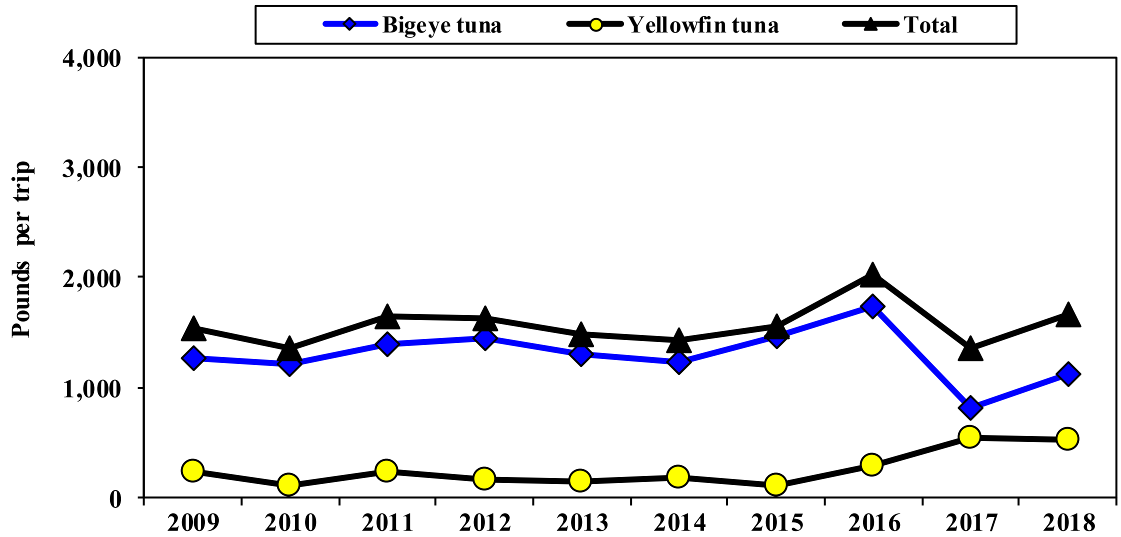


Figure 110. Tuna CPUE for the offshore tuna handline fishery, 2009-2018

Supporting data shown in Table A-111.

Table 28. Average weight (lbs.) of the catch by the Hawai`i troll and handline fisheries, 2009-2018

	Tunas				Billfish			Other PMUS	
Year	**Albacore**	**Bigeye tuna**	**Skipjack tuna**	**Yellowfin tuna**	**Blue marlin**	**Striped marlin**	**Swordfish**	**Mahimahi**	**Ono (wahoo)**
2009	45.3	26.0	7.1	28.4	219.9	79.7	109.8	13.9	24.2
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	25.9	7.8	45.0	191.9	65.6	108.5	11.8	20.6
Average	**47.4**	**24.6**	**7.4**	**34.4**	**212.7**	**67.5**	**119.1**	**12.5**	**23.6**
SD	**3.2**	**2.7**	**1.5**	**5.5**	**40.2**	**17.0**	**18.8**	**0.9**	**2.0**

2.5 NON-COMMERCIAL PELAGIC FISHERIES

2.5.1 INTRODUCTION

Fishing, either for subsistence or recreation continues to be an important activity throughout the Western Pacific Region in the four major populated island areas of the Western Pacific Region, Hawai`i, American Samoa, Guam and CNMI. Fish consumption in Micronesia and Polynesia typically averages about 130 lb./per capita/year (Dalzell *et al*., 1996). Per capita seafood consumption in Hawaii is estimated to be 37 lb./per capita, significantly more than the 16/lb. per year for all U.S. consumption (Loke *et al*., 2012). While the seafood consumed can come from commercial sources, there is an often equal to greater portion of seafood that is consumed from non-commercial sources as well.

Non-commercial fishing in the Western Pacific includes all forms of fishing that are not included in the MSA definition of "commercial fishing" (fishing in which the fish harvested, either in whole or in part, are intended to enter commerce or enter commerce through sale, barter or trade MSA §3). The terms recreational, subsistence, sustenance, sportsfishing, etc. are all subsumed under the definition of "non-commercial" fishing. Non-commercial fishing can also include shoreline, boat-based and charter fishing modes (with an exception in Hawaii where charter fishing is considered a commercial activity).

2.5.2 NON-COMMERCIAL FISHERIES IN THE WESTERN PACIFIC REGION

In Hawai`i, non-commercial shoreline fishing was more popular than boat fishing up to and after WWII. Boat 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 non-commercial fishing to inshore areas (Brock, 1947). Following WWII, the advent of better fishing equipment and 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 (**Figure 111**). By the early 1960s there were an estimated 5,300 small boats in the territory being used for non-commercial fishing. By the 1980s the number of non-commercial or pleasure craft had risen to almost 13,000 vessels and to about 15,000 vessels in the 1990s. There are presently about 30 fishing clubs in Hawai`i, and a variety of different non-commercial fishing tournaments organized both by 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, with over 20 boats and entry fees of $100. This level of interest in non-commercial fishing is sufficient to support local fishing magazines (Hawai`i Fishing News, Hawaii Skin Diver and Lawai'a) as well as TV shows (Hawaii Goes Fishing, Lets Go Fishing, Keiki Fishing Adventures, Hawaii Skin Diver), with articles and programming about local non-commercial fishing.

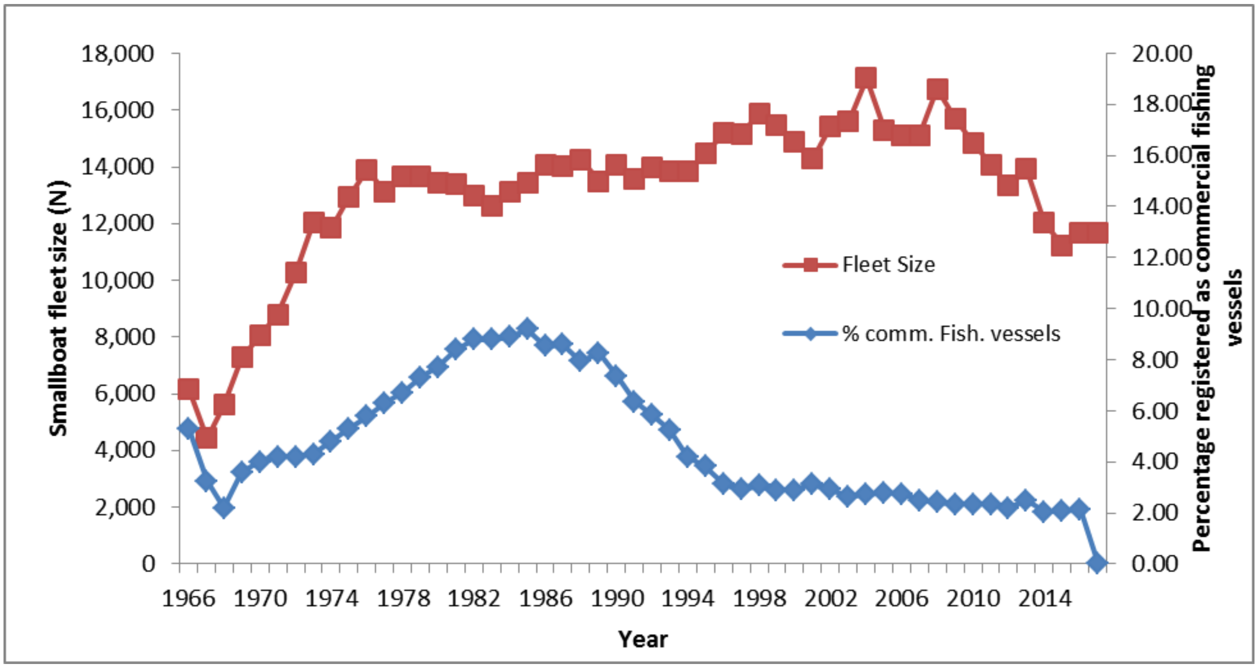


Figure 111. Annual number of small vessel fleet registrations in Hawai`i, 1966-2017
Note: Figure 111 shows total fleet size and percentage of vessels being registered for commercial fishing (Source: Hawai`i Division of Boating and Ocean Resources).

Elsewhere in the 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 10-15 people, along with their families. Four such clubs were founded in Guam during the past 20 years, but none lasted for more than a 2-3 years (Gerry Davis, NMFS PIRO pers. comm.). There was also a Guam Boating Association comprising mostly fishermen, with several hundred members. This organization functioned as a fishing club for about 10 years and then disbanded. Some school groups and the boy scouts have formed fishing clubs focused on rod and reel fishing, and there is still one spear-fishing club that has only a handful of members, but appears to be still being 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. However, there have been recent efforts to develop more tournaments as well as new fishing clubs in the past year, including a kayak fishing club.

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

There are few fishing clubs in the in the Northern Mariana Islands. The Saipan Fishermen's Association (SFA) has been in existence for over 35 years, and is the sponsor of the annual Saipan International Fishing Tournament, which is usually held in August or September.

Levine and Allen (2009) provide an overview of fisheries in American Samoa, including subsistence and non-commercial fisheries. Citing a survey conducted in American Samoa by Kilarski et al. (2006), Levine and Allen 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 non-commercial fishing categories were difficult to distinguish as one fishing outing could be motivated by all three reasons.

Boat-based non-commercial fishing in American Samoa has been influenced primarily by the fortunes of 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 in American Samoa (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 are 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).

The majority of tournament participants operated 28-foot alia, 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 non-commercial fishing is virtually unknown in American Samoa. Landing fish to meet cultural obligations is so important that releasing fish would generally be considered a failure to meet these obligations (Tulafono, 2001). Nevertheless, some pelagic fishermen who fish for subsistence release fish that are surplus to their subsistence needs.

More recently, non-commercial fishing has undergone a renaissance in American Samoa through the establishment of the PPGFA, which was founded by a group of non-commercial anglers in 2003[4]. The motivation to form the PPGFA was the desire to host regular fishing competitions. There are about 15 non-commercial fishing vessels ranging from 10 ft. single engine dinghies to 35 ft. twin diesel engine cabin cruisers. The PPGFA has annually hosted international tournaments in each of the past five years with fishermen from neighboring Samoa and Cook Islands attending. The non-commercial vessels use anchored FADs extensively, and on tournaments venture to the various outer banks which include 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 was no full-time regular charter fishery in American Samoa similar to those in Hawai`i or Guam. Pago Pago Marine Charters does include fishing charters among other services it offers.

[4] http://ppgfa.com/page/about-ppgfa

There is also some non-commercial fishing activity at some of the PRIAs, namely at Midway, Wake and Palmyra Islands. There are no resident populations at Howland & Baker, Johnston and Jarvis Islands 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 at Midway Atoll. The company operated five vessels for charter fishing at Midway: three 22-26 ft. catamarans for lagoon and nearshore fishing operations and two 38 ft. sport fishing 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 this total, 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, a 22 ft. catamaran is used for offshore trolling and four small boats operated within the lagoon used for bonefish angling. There are several craft used for non-commercial fishing at the military base on Wake Island including two landing craft and two small vessels.

2.5.3 NON-COMMERCIAL CATCHES

Estimates of non-commercial pelagic fish catch for the Western Pacific in 2016 are given in **Table 29**. Data for Guam, Northern Mariana Islands and American Samoa are based on the proportion of troll catches landed for sale and catches retained and not sold, in all landings sampled by creel surveys in each area. The ratio of unsold to sold catch in the samples was used in conjunction with the total catch estimate expanded from the creel survey data. This was adjusted downwards based on the creel surveys by the ratio of landings by vessels retaining 100 % of their catch to the total unsold catch. This accounts for that fraction of the catch not sold by commercial fishing vessels. The volume of fish landed by vessels retaining all their catch was labeled the nominal non-commercial catch.

The estimates for American Samoa are almost certainly under-estimates due to the creel surveys not sampling the activities of sports-fishermen belonging to the Pago Pago Yacht Club. Most of their activities are conducted on the weekend, when the creel survey conducted by DMWR is inactive. A special survey is being undertaken by DMWR staff to capture this non-commercial fishing activity.

The non-commercial catch for Hawai`i is generated from the Hawai`i Marine Recreational Fisheries Statistical Survey, which is a collaborative effort between the State of Hawai`i's Division of Aquatic Resources and the NMFS Office of Science and Technology. This survey is part of the NMFS Marine Fisheries Recreational Statistical Survey (MRFSS) which has been modified following a review by the National Academy of Science in 2006, under the auspices of the Marine Recreational Improvement Program.

Table 29. Estimated boat-based non-commercial pelagic fish catches in the four principal island groups of the Western Pacific Region in 2018

Location	Total catch (lb.)	Unsold catch (lb.)	Nominal non-commercial catch (lb.)	Recr. catch as % of total catch	Recr. fishing trips
Hawai`i	43,718,343	NA	6,572,343	15.0%	231,551

[a] Hawaii non-commercial catch includes boat-based and shore based landings from the Marine Recreational Information Program

2.5.4 CHARTER VESSEL SPORT-FISHING

Table 30 through **Table 34** present summaries of the charter vessel sports fishing in the Western Pacific in 2016. 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 2016 only formed just over quarter of the charter vessel catch and was superseded by yellowfin. Although commercial troll vessels take blue marlin, this species only forms about 10% of their catch, with the majority of the target species being yellowfin, mahimahi, and wahoo (**Table 31**). Unlike other parts of the U.S., there is little non-commercial fishery interest in catching sharks in Hawai`i.

Guam has a charter fishing sector, which unlike Hawai`i caters for both pelagic and bottomfish fishing. Until recently the troll charter fishery was expanding, but, over the past few years the number of vessels involved, and level of fishing, has decreased in response to lower tourist volume from Japan. Comprising about 11% % of Guam's commercial troll fleet fishing effort, the Guam troll charter industry accounts for about 4.5 % of the troll catch and 18% and 16 % of the Guam blue marlin and wahoo catch respectively. (See Guam module in this volume).

Charter fishing in NMI is limited, with about ten boats operating on Saipan, and a few vessels on Tinian conducting occasional fishing charters. Data collected on charter vessel fishing in NMI during 2016 cannot be reported because of confidentiality protocols. Tourism is not a significant component of the American Samoa economy, and hence there is little charter fishing activity.

Table 30. Estimated catches by pelagic charter fishing vessels in Hawai`i in 2018

Location	Catch (lb.)	Effort (trips)	CPUE (lb./trip	Principal species
Hawaii	517,978	7,429	69.72	Yellowfin, Blue marlin, mahimahi

Charter vessel fishing in the Western Pacific Region has elements of both non-commercial and commercial fishing. The primary motivation for charter patrons is non-commercial fishing, with the possibility of catching large game fish such as blue marlin. The charter vessel skipper and crew receive compensation in the form of the patron's fee, but are also able to dispose of fish on local markets, as is the case in Hawai`i. The catch composition of charter vessel catch versus conventional commercial trolling in Hawai`i reflects the different targeting in the two fisheries. Blue marlins are among the dominant feature of charter vessels in Hawaii (**Table 31**), along with yellowfin and mahimahi. In Guam, blue marlin are also a dominant feature in charter catches, though the single largest catch is wahoo and skipjack.

Table 31. Comparison of species composition of landings made by Hawai`i pelagic charter vessels versus commercial troll vessels, 2018

	Charter troll	
Species	**Landings (lb.)**	**Percentage of total**
Yellowfin tuna	186,157	35.94%
Blue marlin	151,901	29.33%
Mahimahi	75,746	14.62%
Ono	40,665	7.85%
Aku	30,376	5.86%
S.N. spearfish	13,824	2.67%
Striped marlin	10,393	2.01%
Bigeye tuna	1,437	0.28%
Kawakawa	1,584	0.31%
Uku	1,241	0.24%
Sailfish	1606	0.31%
Kamanu	149	0.03%
Kaku	47	0.01%
Omilu	109	0.02%
Kahala	141	0.03%
all others	2,604	0.50%
Total	517,978	100%

In Hawaii there is considerable variation in charter vessel catches between the various islands (**Table 32**), with the largest charter vessel fisheries based on the island of Hawai`i and Oahu, in terms of catch. The Hawai`i catch may be biased downwards due to the widespread practice of catch and release of billfish. Charter trips on Hawai`i and Oahu formed about 65% of the total charter activity in the State of Hawaii in 2018.

Table 32. Charter vessel catches in Hawai`i by County, 2018

Island	**Catch (lb.)**	**Percent**	**Trips**	**Percent**	**CPUE (lb./trip)**
Hawai`i	186,243	35.96%	3,335	44.89%	55.84
Kauai	124,740	24.08%	1,259	14.93%	99.08
Maui County*	57,441	11.09%	1,272	17.12%	45.16
Oahu	149,555	28.87%	1,563	21.04%	95.68
Total	517,979	100.00%	7,429	100.00%	69.72

* DAR confidentiality protocols prevent reporting 2007 charter vessel activity for Molokai and Lanai separately, and these are aggregated with data for Maui, reported collectively as Maui County

Overall, statewide charter catch, trips and number of fishermen were below the recent 10-year average in 2018, while CPUE was above the recent average (as seen in**Table 33**). This can be attributed to the decreases over the recent average seen in both Maui and Oahu. While Hawaii and Kauai both saw increases in catch and CPUE, only Kauai's number of trips in 2018 were an increase over the 10-year average. While O'ahu has the larger average catch over the 10-year period, Hawaii island reported more landings in 2018 than any other island.

Table 33. 2018 MHI Charter Catch, Trips, Fishers and Effort compared to the 10-year average

	Catch (lbs.)		Trips		# of Fishers		CPUE (lbs./trip)	
	10-yr Avg (2009-2018)	2018	10-yr Avg (2009-2018)	2018	10-yr Avg (2009-2018)	2018	10-yr Avg (2009-2018)	2018
Hawaii	175,885	186,243 (↑)	3,706	3,335 (↓)	69	54 (↓)	49.03	55.84 (↑)
Kauai	89, 812	124,740 (↑)	1,140	1,259 (↑)	17	16 (↓)	75.09	99.08 (↑)
Maui	73,658	57,441 (↓)	1,492	1,272 (↓)	19	11 (↓)	49.24	45.16 (↓)
*Oahu**	183,082	149,555 (↓)	1,834	1,563 (↓)	30	21 (↓)	99.02	95.68 (↓)
Statewide	522,438	517,979 (↓)	7,990	7,429 (↓)	132	102 (↓)	66.54	69.72 (↑)

*Oahu and statewide totals and averages do not include 2014 data
↑=above 10-year average; ↓=below 10-year average

Most charter vessel fishing on the island of Hawai`i is conducted from Kona's small boat harbor at Honokohau, and in 2018 over 42% of the charter vessel catch was comprised of blue marlin (**Table 34**). Blue marlin used to amount to about two-thirds of the catch, but, as noted above, this number has fallen considerably with the spread of a stronger catch and release ethic for billfish by charter vessel operators at Honokohau. Elsewhere, yellowfin and mahimahi tend to dominated charter vessel landings in 2018, except on Oahu where Blue Marlin was about a third of the catch.

In 2018, the charter fishing catch in Hawaii island was mainly comprised of Blue Marlin (42.10%), Yellowfin tuna (32.35%), Ono (7.99%), Mahimahi (6.93%) and Shortnosed Spearfish (5.24%). Other fish (5.40%) included Striped Marlin, Aku, Sailfish, Bigeye Tuna, and Kawakawa. Kauai's charter fishing top species included Yellowfin Tuna (54.70%), Aku (14.90%), Mahimahi (11.44%), Blue Marlin (8.30%) and Ono (7.22%), with other fish (Shortnosed spearfish, Striped Marlin, Sailfish, and Kawakawa) comprising 3.45% of the catch. On Maui, the species composition included Mahimahi (39.34%), Blue Marlin (19.84%), Ono (15.60%), Yellowfin Tuna (15.57%), Striped Marlin (2.47%) and all other fish (7.18%), which included Shortnosed Spearfish, Aku, Kaku, Bigeye Tuna, Omilu, and Kawakawa. Oahu's charter fishing catch was comprised of Blue Marlin (34.60%), Yellowfin Tuna (32.59%), Mahimahi (17.36%), Aku (5.69%), Ono (5.24%) and all other fish (4.51%) comprised of Shortnosed Spearfish, Striped Marlin, Sailfish, and Kawakawa.

Table 34. Composition of charter vessel catches in the MHI, 2018

Hawaii	Landings (lbs.)	%	Kauai	Landings (lbs.)	%
Blue marlin	78,402	42.10%	Yellowfin tuna	68,228	54.70%
Yellowfin tuna	60,243	32.35%	Aku	18,585	14.90%
Ono	14,872	7.99%	Mahimahi	14,272	11.44%
Mahimahi	12,911	6.93%	Blue marlin	10,353	8.30%
Shortnosed Spearfish	9,757	5.24%	Ono	9,002	7.22%
All Others	10,059	5.40%	All Others	4,300	3.45%
Total	186,243	100.00%	Total	124,740	100.00%
Maui County	**Landings (lbs.)**	**%**	**Oahu**	**Landings (lbs.)**	**%**
Mahimahi	22,599	39.34%	Blue marlin	51,749	34.60%
Blue marlin	11,398	19.84%	Yellowfin tuna	48,745	32.59%
Ono	8,958	15.60%	Mahimahi	25,964	17.36%
Yellowfin tuna	8,941	15.57%	Aku	8,516	5.69%
Striped Marlin	1,419	2.47%	Ono	7,834	5.24%
All Others	4,127	7.18%	All Others	6,747	4.51%
Total	57,441	100.00%	Total	149,555	100.00%

2.5.5 NON-COMMERCIAL FISHING DATA COLLECTION IN HAWAI`I

Non-commercial fish catches in Hawai`i are monitored through the Hawai`i Marine Recreational Fishing Survey (HMRFS), a collaborative project of the NMFS Office of Science and Technology and the Hawai`i Division of Aquatic Resources. This project is a segment of the nationwide MRFSS, which has been used by NMFS to estimate non-commercial catches in most of the coastal states of the U.S.

The MRFSS program uses a triple survey approach that has been developed over the 20+ years of its history. For each two-month survey period (wave) a random sample of households is called by telephone to determine how many have conducted any fishing in the ocean, their mode of fishing (private boat, rental boat, charter boat, or shoreline), what methods were used, and how much effort (number of trips and hours) was expended. Concurrently, surveyors are sent out to boat launch ramps, small boat harbors, and shoreline fishing sites to interview fishermen to fill out intercept survey forms. The intercept survey collects data on fishing area, fishing methods, trip/effort, species caught, and lengths and weights of fish. The sites are randomly selected, but stratified by fishing pressure so that the sites with the highest pressures are likely to be surveyed more often. In addition the charter boat operators are surveyed by a separate survey. This additional survey of the charter fleet serves the same function as the random digit dialing household survey and is necessary because out of town fishers that charter vessels would not be covered by randomly calling the Hawaiian populace. The telephone and charter survey data are used to estimate total statewide fishing effort and the intercept surveys provide detailed catch and trip information. Data from the three surveys are combined and expanded to yield statewide estimates of total effort and catch by species, mode, and county.

NMFS and HDAR contributed joint funding for intercept surveys and charter boat surveys on the islands of Oahu, Hawai`i, and Maui. NMFS also funded the Random Digit Dialing household telephone survey via a national contractor beginning in January 2001. The HMRFS project commenced in July 2001 but took until 2003 until annual results were first reported from this initiative.

In 2006, the MRFSS survey was reviewed by the National Research Council of the National Academy of Sciences (NRC, 2006). The reviewers were critical of the statistical methods employed to generate expansions of the survey data to annual non-commercial catch estimates for each state. Consequently, NMFS conducted an overhaul of the MRFSS survey to respond to the NRC criticisms. As such, readers of this report should understand that there is uncertainty surrounding the various expansions from the HMRFS survey and figures reported here may change as new methods are implemented to conduct the expansions from survey data.

Table 35 provides summaries of the non-commercial boat and shoreline fish catch between 2012 and 2018 for pelagic fish. Non-commercial catches of pelagic fish were considerably higher in 2018 than the previous two years, although these numbers are preliminary. However, if correct, the non-commercial catch halved in 2018 based on the mean catch for the previous four years (12,600,000 lbs.)

Table 35. Non-commercial boat-based pelagic fish catch in Hawai`i between 2011 and 2018

Year	Shore catch (lbs.)	Vessel catch (lbs.)	Total (lbs.)
2012	NA	12,330,638	12,330,638
2013	0	14,245,945	14,245,945
2014	0	10,833,018	10,833,018
2015	0	13,065,927	13,065,927
2016	0	6,572,343	6,572,343
2017	94,558	6,308,217	6,402,775
2018	0	15,306,329	15,306,329

Source: HDAR HMRFS and NMFS PIFSC

Figure 113. **Annual non-commercial fishery landings by weight of six major pelagic fish species in Hawai`i between 2014 and 2018** through Figure 116 summarize aspects of the boat-based non-commercial fishery landings for six major pelagic fish species in Hawai`i (blue marlin, striped marlin, mahimahi, skipjack, yellowfin and wahoo) between 2014 and 2018. Figure 115 shows the bimonthly distribution of boat-based fishing effort over the same time period. In 2018, yellowfin tuna was the most commonly non-commercially caught pelagic fish (Figure 112) followed by skipjack tuna, mahimahi and wahoo. In terms of weight, however, yellowfin tuna continued to dominate non-commercial pelagic fish catches in 2018.

Although blue marlin numbers in the catch are small compared to other species, the much greater average weight (Figure 113) means that it can comprise a significant fraction of the non-commercial catch by weight. Average weights for most species tended to be relatively similar between years for mahimahi, skipjack and wahoo, but may vary considerable between years for blue marlin, striped marlin and yellowfin tuna. This is also reflected in the nominal catch rate (lbs./trip) in Figure 115, where yellowfin catch rate was high in 2015, declined in 2016 and 2017, and then increased again in 2018. The distribution of fishing non-commercial fishing effort shows that boat based activity tends to be highest in the summer and fall when the weather is at its most calm in Hawai`i. 2018 also saw a historic high in November and December.

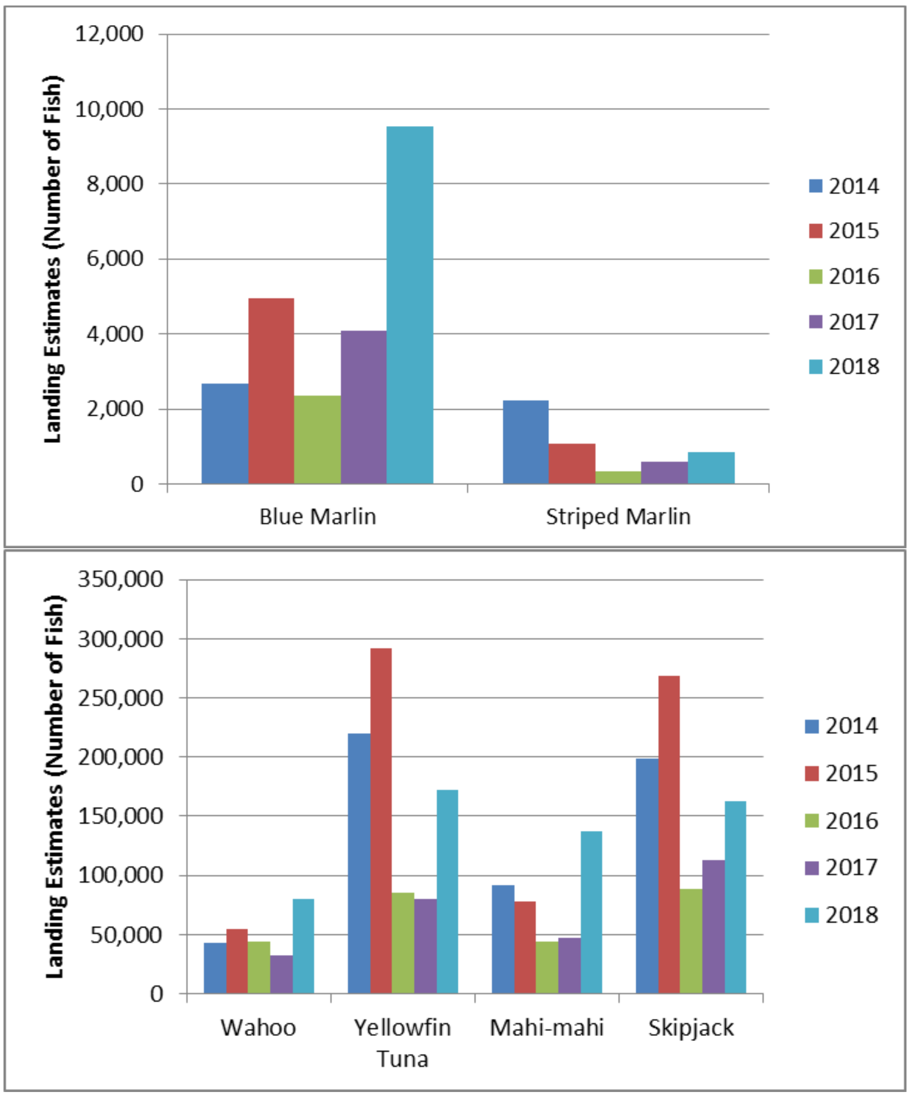


Figure 112. Annual non-commercial fishery landings by number for six major pelagic species between 2014 and 2018

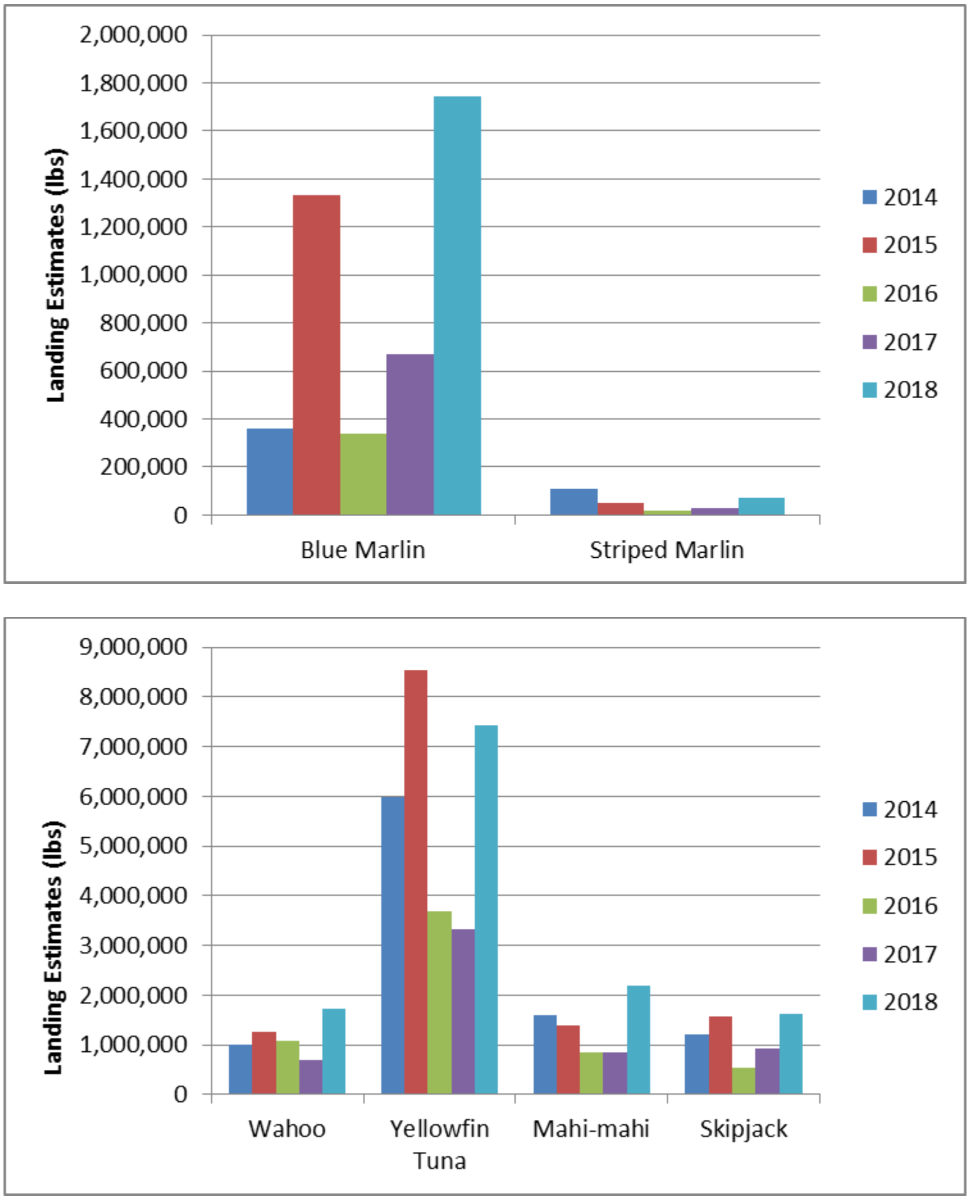


Figure 113. Annual non-commercial fishery landings by weight of six major pelagic fish species in Hawai`i between 2014 and 2018

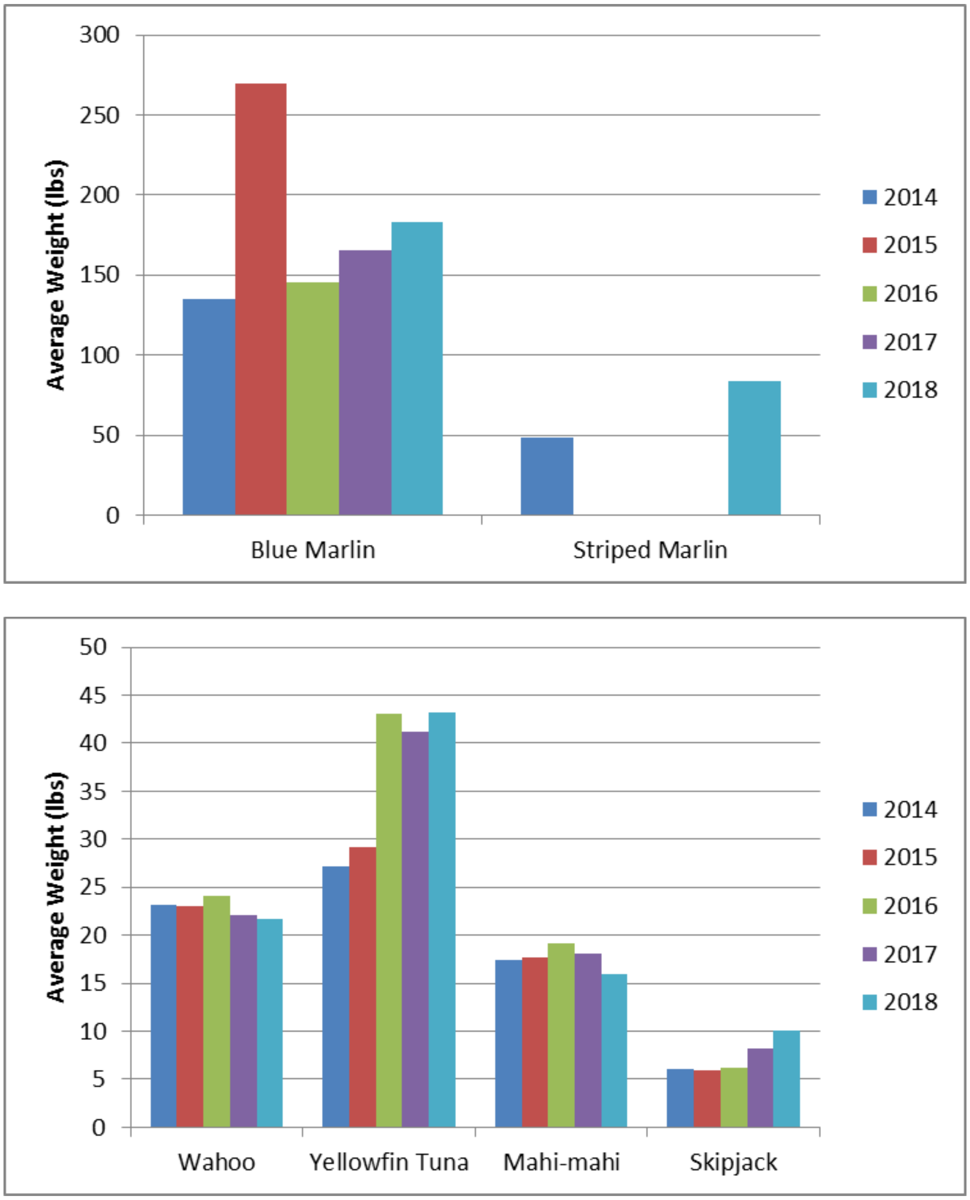


Figure 114. Average weight of six major pelagic fish species caught by non-commercial fishing in Hawai`i between 2014 and 2018

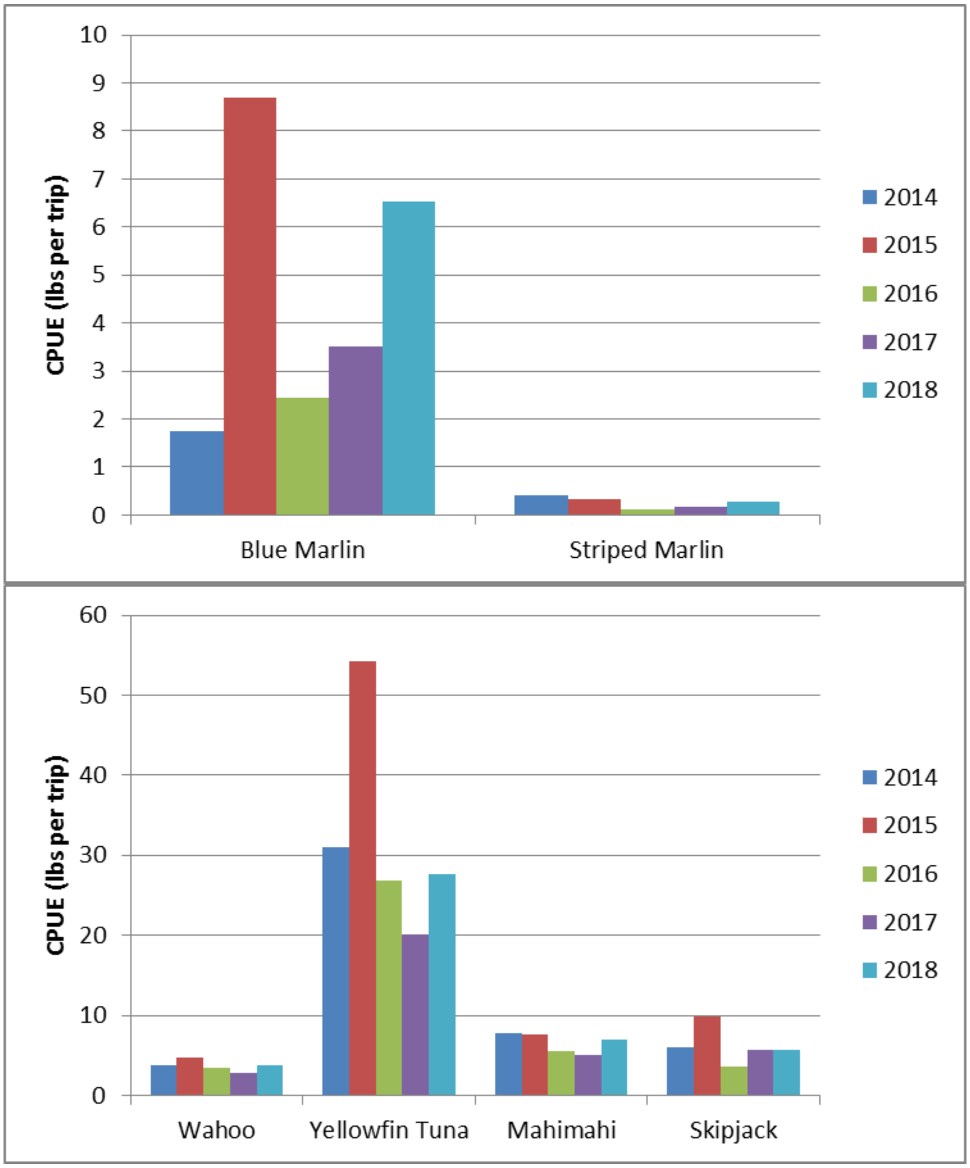


Figure 115. Annual non-commercial catch per unit effort (lbs. per trip) for six major pelagic species in Hawai`i between 2014 and 2018

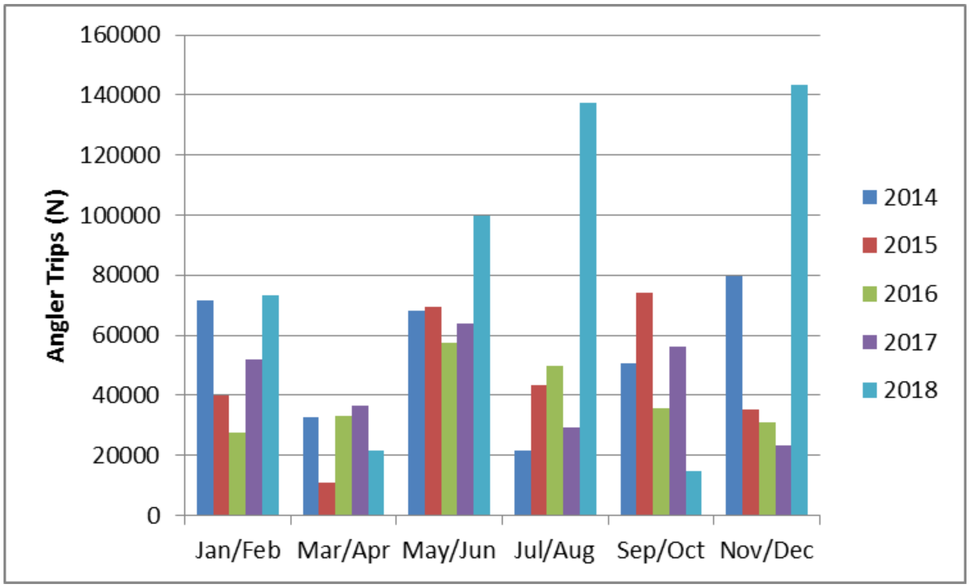


Figure 116. Boat fishing trip estimates (number of angler trip), 2012-2018

2.5.6 REFERENCES

Craig, P., Ponwith, B., Aitaoto, F. and D. Hamm, 1993. The commercial, subsistence, and recreational fisheries of American Samoa. *Marine Fisheries Review*, *55*(2), p.109.

Dalzell, P., Adams, T., and N. Polunin, 1996. Coastal fisheries in the South Pacific. *Oceanography and Marine Biology Annual Review*, *33*, pp. 395-531.

Glazier, E.W., 1999. Social aspects of Hawai`i's small vessel troll fishery. Phase II of the Social Aspects of Pacific Pelagic Fisheries Program, Univ. Hawai`i, JIMAR, 287 pp.

Kilarski, S., Klaus, D., Lipscomb, J., Matsoukas, K., Newton, R. and A. Nugent, 2006. Decision support for coral reef fisheries management: community input as a means of informing policy in American Samoa. *The Donald Bren School of Environmental Science and Management, University of California, Santa Barbara*.

Levine, A. and S. Allen, 2009. American Samoa as a fishing community. U.S. Dept. of Commerce, NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-19, 74 pp.

Loke, M.K., Geslani, C., Takanaka B., and P. Leung, 2012. Seafood consumption and supply sources in Hawaii, 2000-2009. *Mar. Fish. Rev.*, *74*(4), pp. 44-51

Tulafono, R., 2001. Gamefishing and tournaments in American Samoa. In, Proceedings of the 1998 Pacific Island Gamefish Symposium: Facing the Challenges of Resource Conservation, Sustainable Development, and the Sportfishing Ethic, 29 July-1 August, 1998, Kailua-Kona, Hawai`i, WPRFMC.

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 WCPFC Convention Area from 2014-2018, as reported to the WCPFC (NMFS 2019). The catches for 2018 are preliminary.

Table 42 through Table 44 provide the U.S. longline landings as submitted to the Western and Central Pacific Fisheries Commission (WCPFC) and Inter-American Tropical Tuna Commission (IATTC).

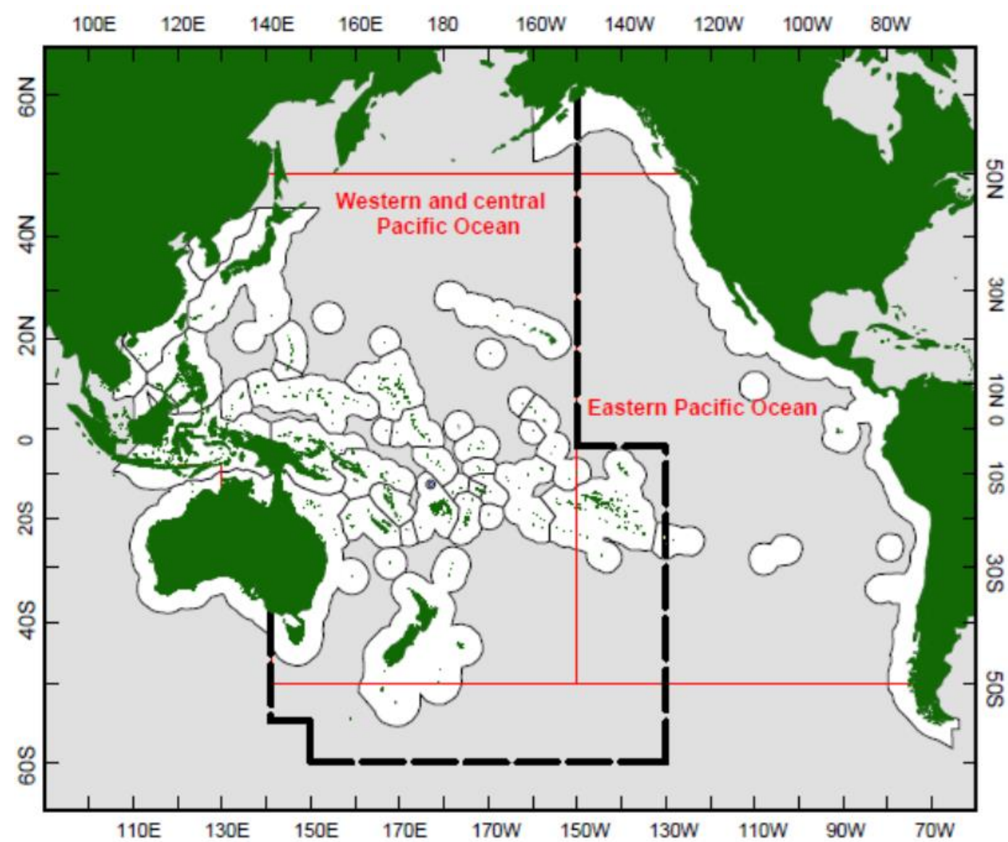


Figure 117. The Western and Central Pacific Ocean, Eastern Pacific Ocean and the WCPFC Convention Area (WCP–CA) [in dashed lines])

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 2018 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 36 and Figure 118 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 36. Estimated annual catch (mt) of tuna species in the Pacific Ocean

Year	Albacore	Bigeye	Skipjack	Yellowfin	Total
2008	130,995	250,251	1,917,652	801,831	3,100,729
2009	167,015	255,763	2,016,260	787,614	3,226,652
2010	155,865	227,077	1,839,281	820,379	3,042,602
2011	146,020	243,533	1,813,238	736,941	2,939,732
2012	179,911	257,896	2,028,327	815,581	3,281,715
2013	171,172	231,901	2,110,533	781,847	3,295,453
2014	162,760	245,775	2,269,235	839,114	3,516,884
2015	153,909	240,028	1,827,241	831,345	3,052,523
2016	126,541	238,457	2,133,763	884,972	3,383,733
2017	148,310	216,680	1,965,069	926,968	3,257,027
Average	154,250	240,736	1,992,060	822,659	3,209,705
STD deviation	16,979	12,880	149,663	53,583	175,468

Source: SPC 2018.

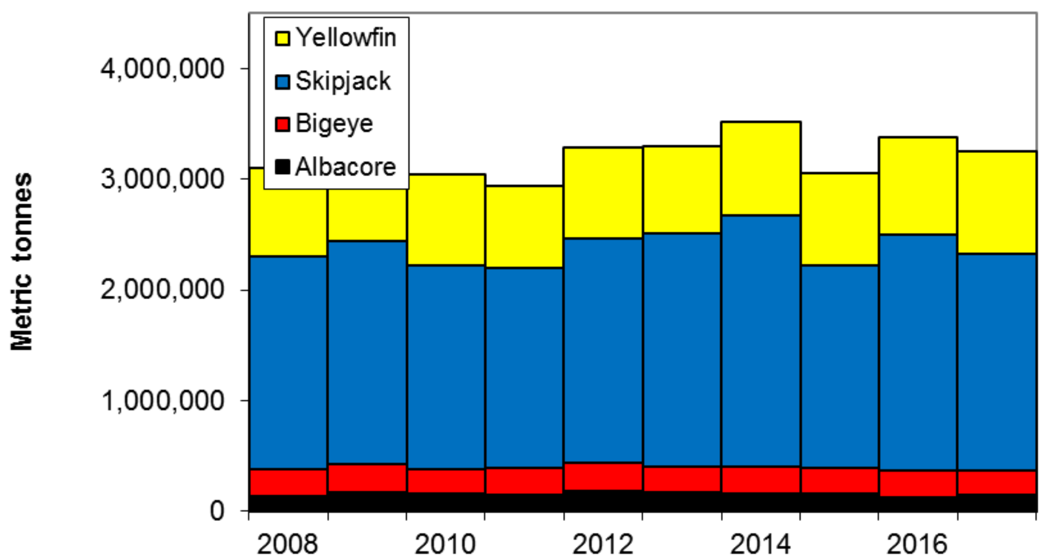


Figure 118. Estimated total annual catch of tuna species in the Pacific Ocean

Source: SPC 2018.

2.6.4.1 PURSE SEINE FISHERY IN THE WCPFC

Source: WCPFC-SC14-2018 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 (129 vessels in

2017). The Pacific Islands fleets have gradually increased in numbers over the past two decades to a level of 130 vessels in 2017. 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 307 vessels in 2014, before declining over the past two years (to 283 vessels in 2017).

Catch: The provisional 2017 purse-seine catch of 1,812,474 mt was slightly less than the most recent five-year average, and nearly 250,000 less than the record in 2014 (2,059,008 mt). While the total purse seine catch in 2017 was similar to the 2016 catch level, the species composition was clearly different. The 2017 purse-seine skipjack catch (1,280,311 mt; 71% of total catch) was the lowest since 2011 and nearly 350,000 mt lower than the record in 2014. In contrast, the 2017 purse-seine catch estimate for yellowfin tuna (472,279 mt; 26%) was the highest on record at nearly 50,000 mt higher than the previous record (423,788 mt in 2008); this record was mainly due to good catches of large yellowfin from unassociated-school set types in the west and central tropical WCP-CA areas. The provisional catch estimate for bigeye tuna for 2017 (56,194 mt) was a decrease on the catch in 2016 and lower than the most recent five-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 during 2017 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 in 2017.

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, neutral ENSO conditions were experienced during 2017 and yet there was a record yellowfin catch in the purse seine fishery, which was mainly due to higher than average catches from unassociated sets in the western and central areas.

Table 37. Total reported purse seine catch (mt) of skipjack, yellowfin and bigeye tuna in the Pacific Ocean

Year	Skipjack	Yellowfin	Bigeye	Total
2008	1,543,394	615,838	133,442	2,292,674
2009	1,671,832	559,963	135,343	2,367,138
2010	1,478,408	599,718	114,778	2,192,904
2011	1,475,566	514,166	130,156	2,119,888
2012	1,692,220	580,173	130,203	2,402,596
2013	1,778,424	567,997	123,291	2,469,712
2014	1,942,652	599,630	120,687	2,662,969
2015	1,469,317	552,306	112,328	2,133,951
2016	1,750,449	632,735	117,287	2,500,471
2017	1,652,242	729,639	114,993	2,496,874
Average	1,645,450	595,217	123,251	2,363,918
STD Deviation	155,695	58,274	8,482	178,017

Source: SPC 2018.

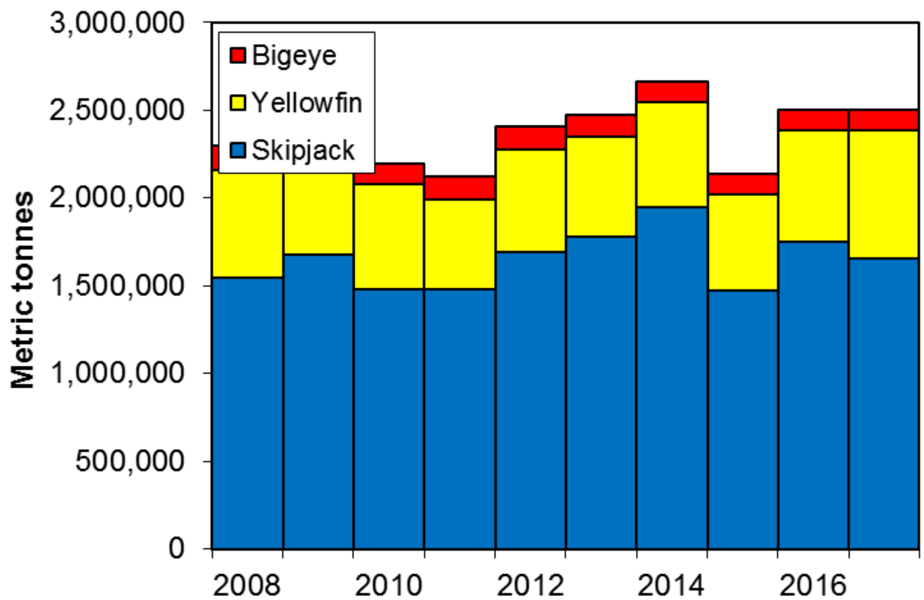


Figure 119. Total purse seine catch of skipjack, yellowfin and bigeye tuna in the Pacific Ocean, 1996–2017

Source: SPC 2018.

2.6.4.2 LONGLINE FISHERIES IN THE WCPFC

Source: WCPFC-SC14-2018 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 are just above 3,000 vessels.

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.
- 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 stabilised 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 (240,387 mt) for 2017 was lower than the average for the past five years. The WCP–CA albacore longline catch (96,280 mt – 40%) for 2017 was higher than the average catch over the past decade, and only 5,000 mt lower than the record of 101,816 mt attained in 2010. The provisional bigeye catch (58,164 mt – 25%) for 2017 was the lowest since 1996, presumably mainly due to continued reduction in effort in the main bigeye tuna fishery (refer to Brouwer et al., 2018 for more detail), although catch estimates are likely to be revised upwards for the distant-water fleets in the coming months. The yellowfin catch for 2017 (83,399 mt – 35%) was lower than the average for the past decade and more than 20,000 mt less that the record for this fishery. 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 38. Total reported longline catch (mt) of PMUS in the Pacific Ocean

Year	Albacore	Yellowfin	Bigeye	Striped Marlin	Black Marlin	Blue Marlin	Swordfish	Total
2008	87,435	91,028	103,287	4,930	1,871	16,716	34,771	340,038
2009	109,440	105,368	107,389	4,160	2,066	17,018	35,298	380,739
2010	113,324	102,943	99,362	4,983	2,253	18,734	35,740	377,339
2011	97,892	103,670	102,450	6,328	1,926	16,938	38,407	367,611
2012	120,865	97,914	111,316	6,461	2,007	18,262	43,138	399,963
2013	113,147	86,403	91,778	5,881	1,820	20,037	40,357	359,423
2014	108,965	104,047	105,551	5,615	2,200	20,823	39,343	386,544
2015	111,352	110,898	107,409	5,266	2,516	20,075	44,209	401,725
2016	90,934	93,604	96,019	4,320	1,291	18,346	41,031	345,545
2017	117,696	89,416	89,750	4,372	1,138	16,496	38,315	357,183
Average	107,105	98,529	101,431	5,232	1,909	18,345	39,061	371,611
STD deviation	11,239	8,077	7,099	827	421	1,562	3,220	21,341

Source: SPC 2017 and IATTC 2017.

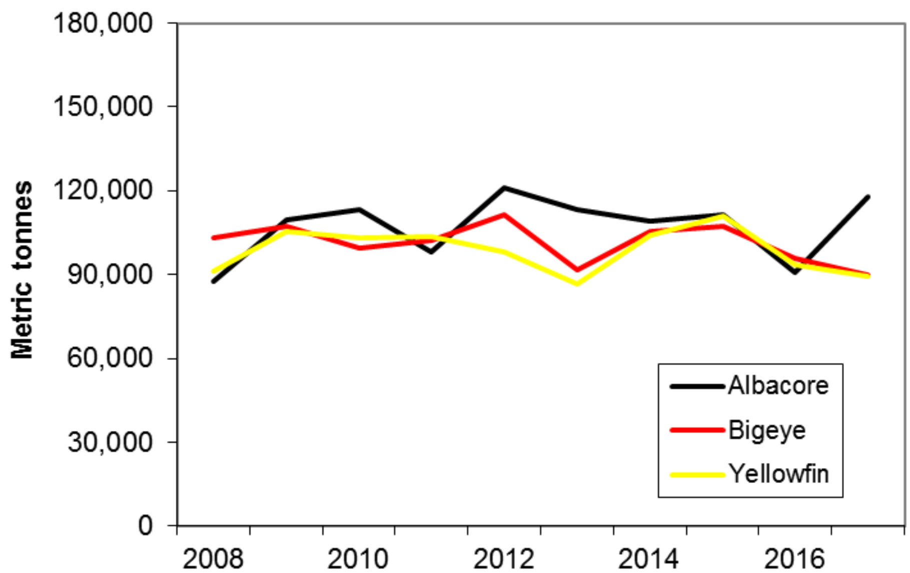


Figure 120. Reported longline tuna catches in the Pacific Ocean

Source: SPC 2017 and IATTC 2017.

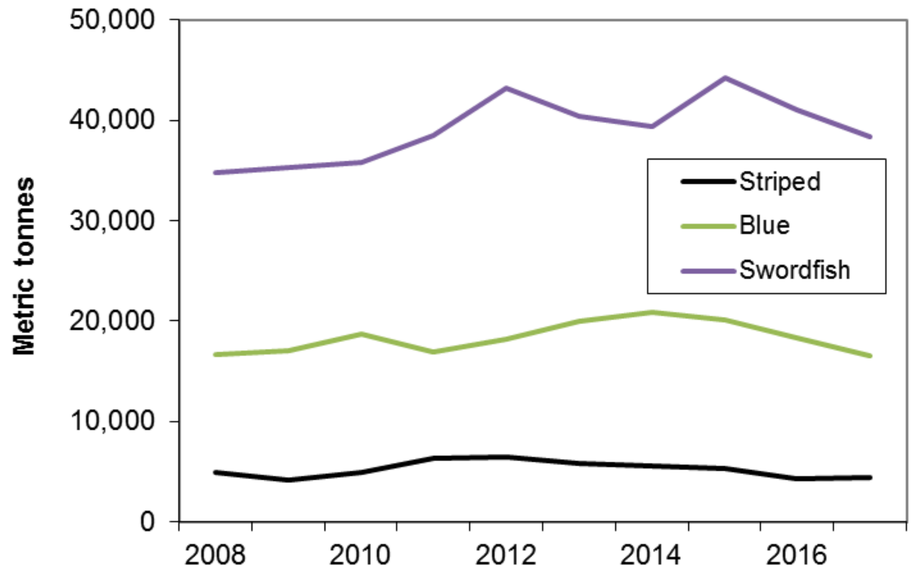


Figure 121. Reported longline billfish catches in the Pacific Ocean

Source: SPC 2018 and IATTC 2019.

2.6.4.3 POLE-AND-LINE FISHERY IN THE WCPFC

Source: WCPFC-SC14-2018 GN-WP-01

Vessels: Economic factors and technological advances in the purse seine fishery (primarily targeting the same species, skipjack) have resulted in a gradual decline in the number of vessels in the pole-and-line fishery and in the annual pole-and-line catch during the past 15–20 years. The gradual reduction in numbers of vessels has occurred in all pole-and-line fleets over the past decade. Pacific Island domestic fleets have declined in recent years – fisheries formerly operating in Fiji, Palau and Papua New Guinea are no longer active, only one vessel is now operating (occasionally) in Kiribati, and fishing activity in the Solomon Islands fishery during the 2000s was reduced substantially from the level experienced during the 1990s. Several vessels continue to fish in Hawai'i, and the French Polynesian *bonitier* fleet remains active (44 vessels in 2017), but an increasing number of vessels have turned to longline fishing.

Catch: The provisional 2017 pole-and-line catch (151,232 mt) was the lowest annual catch since the mid-1960s, with 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 2017), and the Indonesian fleets (79,759 mt in 2017), account for nearly all of the WCP–CA pole-and-line catch (99% in 2017). 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 (586 mt in 2017 from 2 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, Hawai`i and Fiji
- a seasonal albacore/skipjack fishery east of Japan (largely an extension of the Japan home-water fishery).

Table 39. Total reported pole-and-line catch (mt) of skipjack in the Pacific Ocean

Year	Catch
2008	218,070
2009	200,692
2010	222,948
2011	206,542
2012	170,234
2013	168,856
2014	148,452
2015	151,182
2016	156,397
2017	122,975
Average	176,635
STD deviation	33,611

Source: SPC 2017.

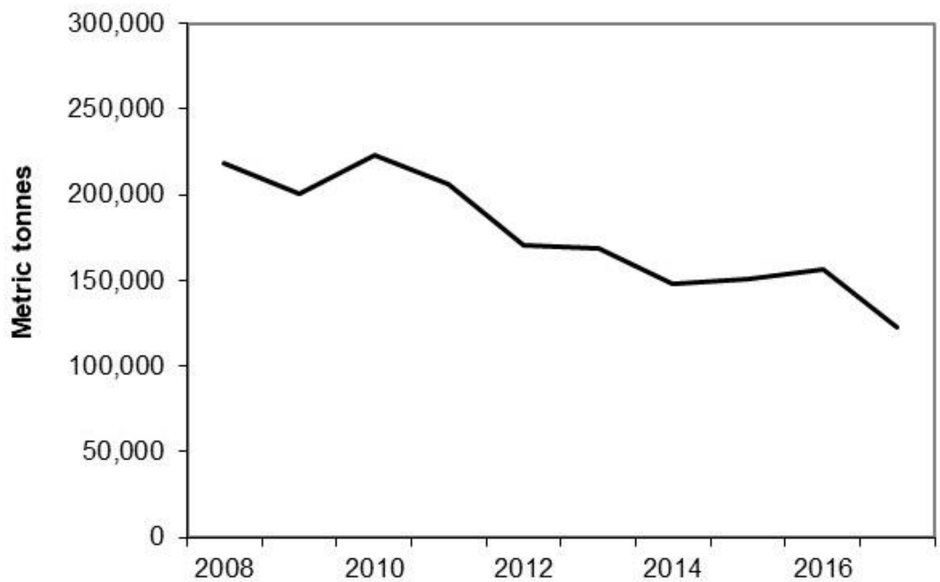


Figure 122. Reported pole-and-line catch (mt) in the Pacific Ocean

Source: SPC 2018.

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 123**. 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-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.

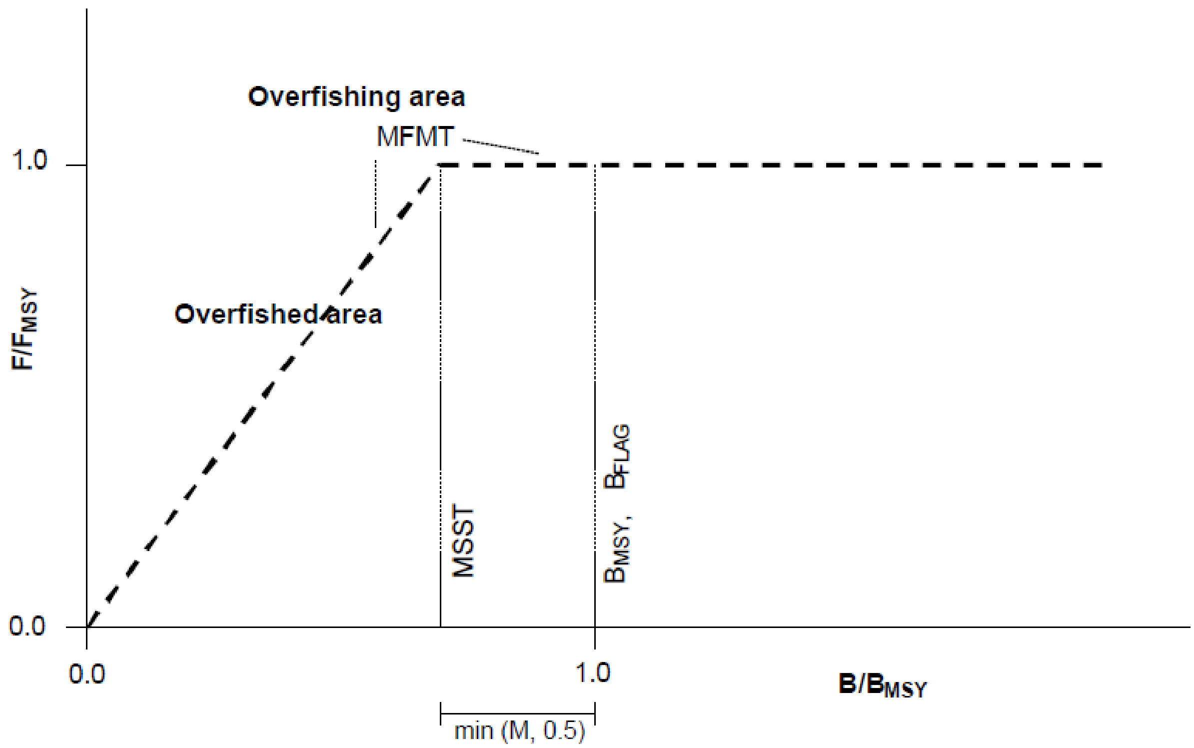


Figure 123. MSY control rule and reference points for pelagic MUS

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 40 summarizes the stock assessments for pelagic MUS completed or scheduled for completion between 2012 and 2018.

Table 40. 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)	2017		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	2018
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	2012
Skipjack Tuna (WCPO)	2016		Salmon Shark	
Striped Marlin (N. Pacific)	2015		Squid	

The following pages include a description of the most recent stock assessments and assessment results completed in 2018 based on the WCPFC SC14 Summary Report. For more information on stock assessments and assessment results completed prior to 2018, please see the past Annual Pelagic SAFE Reports.

2.6.7.1 WESTERN AND CENTRAL PACIFIC OCEAN BIGEYE TUNA

Stock assessment: Vincent et al. 2018.

a. Stock status and trends

The median values of relative recent (2012-2015) spawning biomass depletion ($SB_{recent}/ SB_{F=0}$) and relative recent (2011-2014) fishing mortality (F_{recent}/F_{MSY}) over the uncertainty grid of 36 models (Table BET-1) were used to define stock status. The values of the upper 90th and lower 10th percentiles of the empirical distributions of relative spawning biomass and relative fishing mortality from the uncertainty grid were used to characterize the probable range of stock status.

A description of the updated structural sensitivity grid used to characterize uncertainty in the assessment is set out in Table BET-1. Time series of total annual catch by fishing gear over the full assessment period is shown in Figure BET-1. Estimated trends in spawning biomass depletion for the 36 models in the structural uncertainty grid is shown in Figure BET-2, and juvenile and adult fishing mortality rates from the diagnostic case model is show in BET-3. Figure BET-4 displays Majuro plots summarising the results for each of the models in the structural uncertainty grid. Figures BET-5 show Kobe plots summarising the results for each of the models in the structural uncertainty grid. Table BET-2 provides a summary of reference points over the 36 models in the structural uncertainty grid.

SC14 agreed to use the "updated new growth" model to describe the stock status of bigeye tuna because SC14 considered it to be the best available scientific information. By removing results using the old growth model, the stock status becomes considerably more optimistic. However, SC14 also notes that questions remain regarding the "updated new growth" model.

Therefore, SC14 acknowledges that further study is warranted related to the new growth model, in particular as to the cause of the difference of growth between EPO and WCPO. An inter-laboratory ageing workshop is planned for late 2018 to review ageing approaches in the WCPO and EPO and to resolve differences, if they exist.

In addition, SC14 acknowledges that further study is warranted to refine the tagging dataset in the WCPO to assist validating age estimates of bigeye in the WCPO. SC14 further notes that adopting the updated new growth curve generates new broader questions related to the bigeye tuna stock assessment and agreed that several aspects need to be investigated further to inform future assessments.

Table BET-1. Description of the updated structural sensitivity grid used to characterize uncertainty

Axis	Levels	Option
Steepness	3	0.65, 0.80, 0.95
Growth	1	'Updated new growth'
Tagging over-dispersion	2	Default level (1), fixed (moderate) level
Size frequency weighting	3	Sample sizes divided by 10, 20, 50
Regional structure	2	10°N regions, 20°N regions

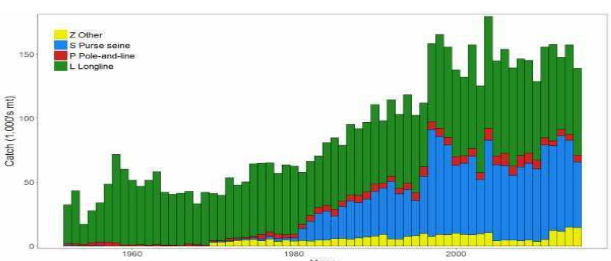


Figure BET-1. Time series of total annual catch (1000's mt) by fishing gear over the full assessment period

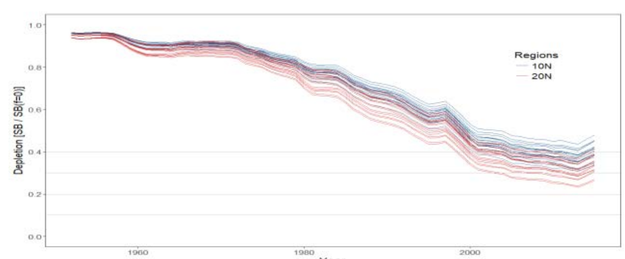


Figure BET-2. Plot showing the trajectories of spawning biomass depletion for the 36 model runs included in the structural uncertainty grid. The colours depict the models in the grid with the 10°N and 20°N spatial structures

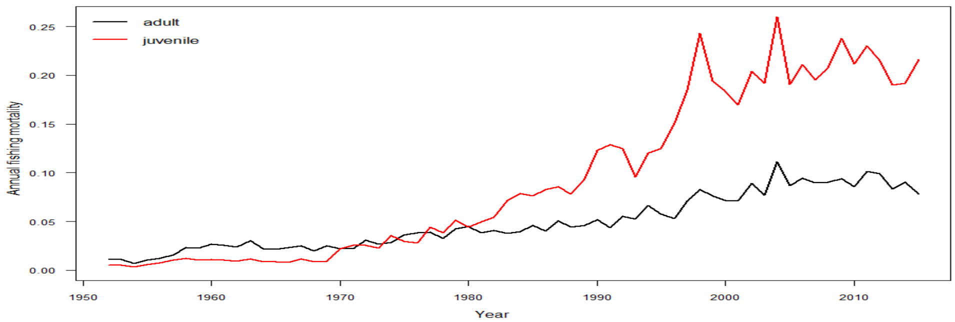


Figure BET-3. Estimated annual average juvenile and adult fishing mortality for the diagnostic case model

SB_{recent} (2012-2015) / $SB_{F=0}$ SB_{latest} (2015) / $SB_{F=0}$

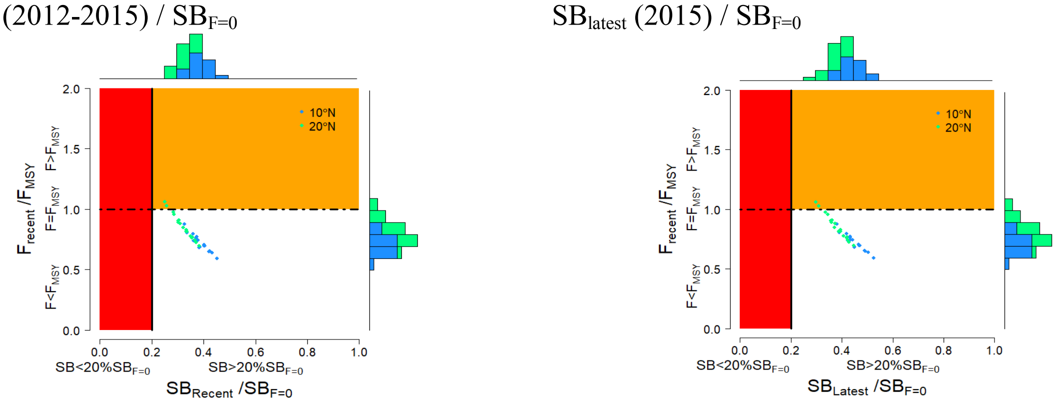


Figure BET-4. Majuro plot summarising the results for each of the models in the structural uncertainty grid. The plots represent estimates of stock status in terms of spawning biomass depletion and fishing mortality. The red zone represents spawning biomass levels lower than the agreed limit reference point, which is marked with the solid black line. The orange region is for fishing mortality greater than F_{MSY} (F_{MSY} is marked with the black dashed line). In the upper panel, the points represent $SB_{recent}/SB_{F=0}$, where SB_{recent} is the mean SB over 2012-2015. In the lower panel, the points represent $SB_{latest}/SB_{F=0}$, where SB_{latest} is from 2015. In both panels the colors depict the models in the grid with the 10°N and 20°N regional structures

SB_{recent} (2012-2015) / SB_{MSY} SB_{latest} (2015) / SB_{MSY}

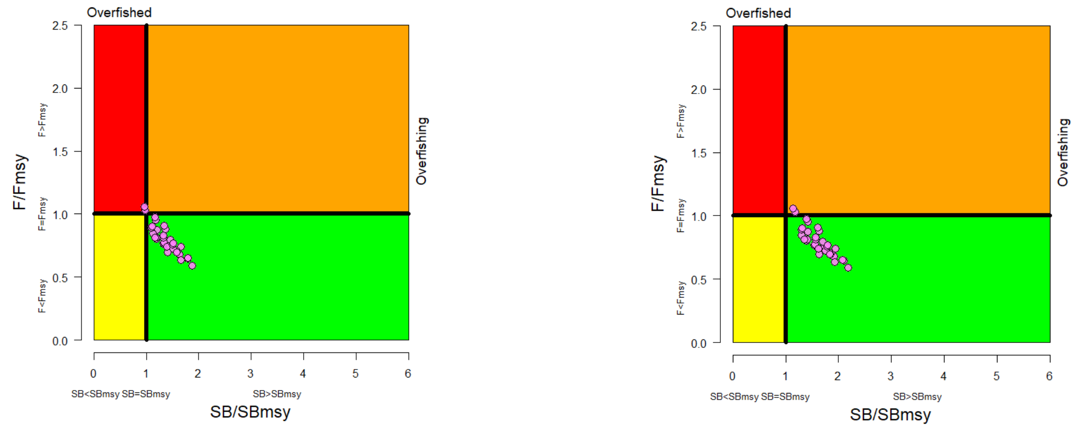


Figure BET-5. Kobe plot summarising the results for each of the models in the structural uncertainty grid. In the upper panel, the points represent SB_{recent}/SB_{MSY}, where SB_{recent} is the mean SB over 2012-2015. In the lower panel, the points represent SB_{latest}/SB_{MSY}, where SB_{latest} is from 2015

Table BET-2. Summary of reference points over the 36 models in the structural uncertainty grid. Note that $SB_{recent}/SB_{F=0}$ is calculated where SB_{recent} is the mean SB over 2012-2015 at the request of the Scientific Committee

	Mean	Median	Min	10%	90%	Max
C_{latest}	152,148	151,846	148,888	148,936	154,971	155,577
YF_{recent}	154,180	153,220	133,120	141,140	170,720	172,280
f_{mult}	1.291	1.301	0.946	1.075	1.499	1.690
F_{MSY}	0.050	0.049	0.044	0.045	0.054	0.056
MSY	158,551	159,020	133,520	143,040	173,880	180,120
F_{recent}/F_{MSY}	0.789	0.768	0.592	0.667	0.931	1.058
SB_0	1,674,833	1,675,500	1,261,000	1,415,500	1,941,000	2,085,000
$SB_{F=0}$	1,841,609	1,858,775	1,509,007	1,632,014	2,043,108	2,139,644
SB_{MSY}	471,956	476,050	340,700	386,600	577,400	614,200
SB_{MSY}/SB_0	0.281	0.280	0.260	0.262	0.300	0.302
$SB_{MSY}/SB_{F=0}$	0.255	0.255	0.226	0.235	0.280	0.287
SB_{latest}/SB_0	0.456	0.456	0.346	0.392	0.523	0.568
$SB_{latest}/SB_{F=0}$	0.414	0.420	0.298	0.351	0.480	0.526
SB_{latest}/SB_{MSY}	1.633	1.624	1.146	1.306	1.933	2.187
$SB_{recent}/SB_{F=0}$	0.353	0.358	0.251	0.295	0.412	0.452
SB_{recent}/SB_{MSY}	1.394	1.377	0.963	1.117	1.659	1.879

SC14 noted that there has been a long-term decrease in spawning biomass from the 1950s to the present for bigeye tuna and that this is consistent with previous assessments.

SC14 also noted that the central tendency of relative recent (2012-2015) spawning biomass depletion was median ($SB_{recent}/SB_{F=0}$) = 0.36 with a range of 0.30 to 0.41 (80% probability interval).

SC14 further noted that there was 0% probability (0 out of 36 models) that the recent spawning biomass had breached the adopted LRP.

SC14 noted that there has been a long-term increase in fishing mortality for both juvenile and adult bigeye tuna (Figure BET-3), consistent with previous assessments.

SC14 also noted that the central tendency of relative recent fishing mortality was median (F_{recent}/F_{MSY}) = 0.77 with an 80% probability interval of 0.67 to 0.93.

SC14 further noted that there was a roughly 6% probability (2 out of 36 models) that the recent fishing mortality was above F_{MSY}.

SC14 also noted that, regardless of the choice of uncertainty grid, the assessment results show that the stock has been continuously declining for about 60 years since the late 1950's, except for the recent small increase.

SC14 also noted the continued relatively higher levels of depletion in the equatorial and western Pacific (specifically Regions 3, 4, 7 and 8) and the associated higher levels of impact, especially on juvenile bigeye tuna, in these regions due to the associated purse-seine fisheries and the 'other' fisheries within the western Pacific (as shown in Figures 46 and 47 of SC13-SA-WP-03).

Table BET-3 summarises the median values of $SB/SB_{F=0}$ and F/F_{MSY} achieved in the long term, along with the potential risk of breaching the limit reference point (LRP) and exceeding F_{MSY}, under each of the future fishing and recruitment combinations. Figure BET-6 presents the corresponding distributions of long term $SB/SB_{F=0}$ and Figure BET-7 those for F/F_{MSY}.

Potential outcomes under the 2013-15 average and CMM scenario conditions were strongly influenced by the assumed future recruitment levels.

Under the assumption that recent positive recruitments will continue into the future, spawning biomass relative to unfished levels is predicted to increase from recent levels under all examined future scenarios by 0-18% ($SB_{2045}/SB_{F=0}$ ranges from 0.36 to 0.42; Table BET-3, Figure BET-6). While future uncertainty in stock status increases due to stochastic future recruitment levels, the risk of future spawning biomass falling below the LRP falls to between 0 and 5%, due to the improved overall stock size. Fishing mortality falls slightly under both the status quo and optimistic scenarios, assuming recent recruitment. However, fishing mortality increases under the pessimistic scenario, but remains below F_{MSY} (30% risk of $F > F_{MSY}$ Table BET-3, Figure BET-7).

Under the assumption that less positive long-term recruitments are experienced in the future, spawning biomass relative to unfished levels will decline under all scenarios ($SB_{2045}/SB_{F=0}$ ranges from 0.25 to 0.30). The risk of spawning biomass falling below the LRP increases to between 17 and 32% (Table BET-3). In all fishing scenarios, fishing mortality increases relative to recent levels (by 109-138%) and is well above F_{MSY}. Risk of fishing mortality exceeding F_{MSY} ranges from 93 to 98%.

It should be noted that even under assumption of long term recruitment levels, the risk of exceeding the LRP in the short term ranges between 2% and 7% (2020) and 12 and 26% (2025), with only the pessimistic scenario exceeding the 20% level of risk in 2025. (Table BET-4 and Figure BET-8).

Table BET-3. Including '2013-2015 average levels'. Median values of reference point levels (adopted limit reference point (LRP) of 20% $SB_{F=0}$; F_{MSY}) and risk[1] of breaching reference points from the 2018 bigeye stock assessment incorporating updated new growth information, and in 2045 under the three future harvest scenarios (2013-2015 average fishing levels, optimistic, and pessimistic) and alternative recruitment hypotheses. 'Updated new growth' runs only

Scenario		Scalars relative to 2013-2015		Median $SB_{2045}/SB_{F=0}$	Median $SB_{2045}/SB_{F=0}$ v $SB_{2012-15}/SB_{F=0}$	Median $F_{2041-2044}/F_{MSY}$	Median $F_{2041-2044}/F_{MSY}$ v $F_{2011-14}/F_{MSY}$	Risk	
Recruitment	**Fishing level**	**Purse seine**	**Longline**					**SB_{2045} < LRP**	**$F>F_{MSY}$**

Bigeye assessment ('recent' levels)				0.36	-	0.77	-	0%	6%
Recent	2013-2015 average	1	1	0.42	1.18	0.73	0.95	0%	11%
	Optimistic	1.11	0.98	0.41	1.15	0.75	0.98	0%	13%
	Pessimistic	1.12	1.35	0.36	1.00	0.89	1.15	5%	30%
Long-term	2013-2015 average	1	1	0.30	0.84	1.60	2.09	17%	93%
	Optimistic	1.11	0.98	0.29	0.82	1.64	2.13	18%	94%
	Pessimistic	1.12	1.35	0.25	0.70	1.84	2.38	32%	98%

[1] note risk within the stock assessment is calculated as the (weighted) number of models falling below the LRP (X / 36 models). Risk under a projection scenario is the number of projections across the grid that fall below the LRP (X / 3600 (36 models x 100 projections).

Table BET-4. Median values of $SB/SB_{F=0}$ and associated risk of breaching the adopted limit reference point (LRP) of 20% SBF=0 in 2020, 2025 and 2045 under the three future harvest scenarios (2013-2015 average fishing levels, optimistic, and pessimistic) and alternative recruitment hypotheses. 'Updated new growth' runs only

Scenario		**Scalars relative to 2013-2015**		**Median $SB_{2020}/SB_{F=0}$**	**Median $SB_{2025}/SB_{F=0}$**	**Median $SB_{2045}/SB_{F=0}$**	**Risk SB_{2020} < LRP**	**Risk SB_{2025} < LRP**	**Risk SB_{2045} < LRP**
Recruitment	**Fishing level**	**Purse seine**	**Longline**						
Recent	2013-2015 average	1	1	0.42	0.41	0.42	0%	1%	0%
	Optimistic	1.11	0.98	0.41	0.40	0.41	0%	1%	0%
	Pessimistic	1.12	1.35	0.38	0.35	0.36	0%	4%	5%
Long-term	2013-2015 average	1	1	0.35	0.30	0.30	2%	12%	17%
	Optimistic	1.11	0.98	0.35	0.30	0.29	2%	13%	18%
	Pessimistic	1.12	1.35	0.32	0.26	0.25	7%	26%	32%

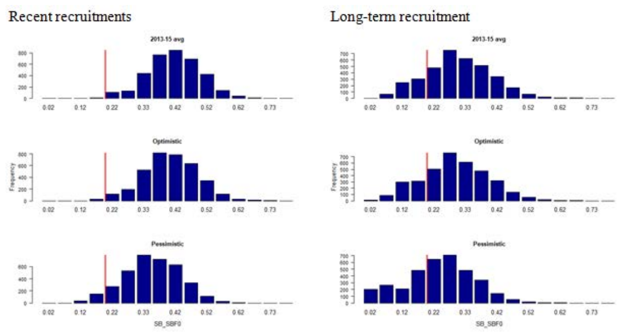


Figure BET-6. Distribution of $SB_{2045}/SB_{F=0}$ assuming recent and long term recruitment conditions (left and right columns, respectively), under the three future fishing scenarios: 2013-15 average (2013-15 average conditions, top row); optimistic conditions (middle row); and pessimistic conditions (bottom row). Projection results from 'updated new growth' models (3,600 projections) only where the red line indicates the LRP.

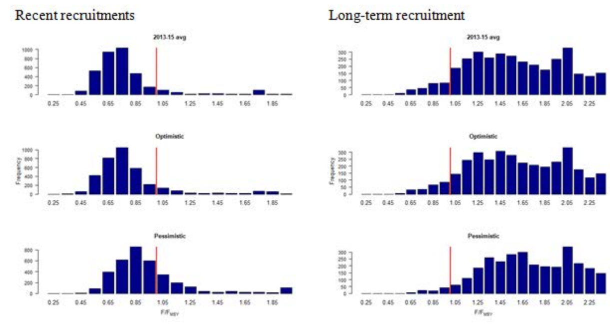


Figure BET-7. Distribution of F/F_{MSY} assuming recent and long term recruitment conditions (left and right columns, respectively), under the three future fishing scenarios: 2013-15 average (2013-15 average conditions, top row); optimistic conditions (middle row); and pessimistic conditions (bottom row). Projection results from 'updated new growth' models (3,600 projections) only.

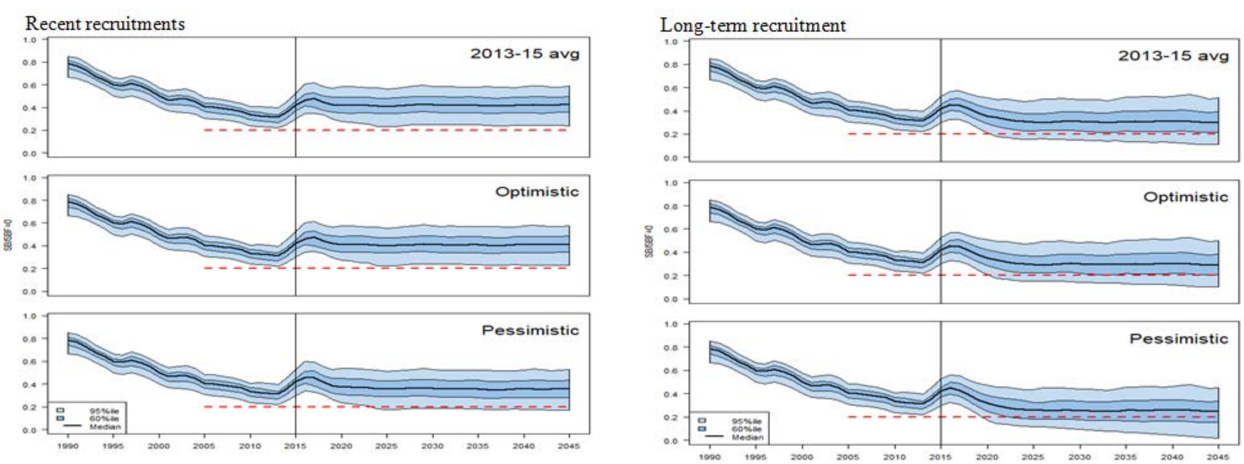


Figure BET-8. Time series of WCPO bigeye tuna spawning biomass ($SB/SB_{F=0}$) from the uncertainty grid of assessment model runs for the period 1990 to 2015 (the vertical line at 2015 represents the last year of the assessment), and stochastic projection results for the period 2016 to 2045 under the three future fishing scenarios ("2013-15 average", "Optimistic" and "Pessimistic"; rows). During the projection period (2016-2045) levels of recruitment variability are assumed to match those over the "recent" time period (2005-2014; left panel) or the time period used to estimate the stock-recruitment relationship (1962-2014; right panel). The red dashed line represents the agreed limit reference point.

b. Management advice and implications

SC14 noted that the preliminary estimate of total catch of WCPO bigeye tuna for 2017 was 126,929 mt, a 17% decrease from 2016 and a 19% decrease from the average 2012-2016. Longline catch in 2017 (58,164 mt) was an 8% decrease from 2016 and a 19% decrease from the 2012-2016 average. Purse seine catch in 2017 (56,194 mt) was a 12% decrease from 2016 and a 13% decrease from the 2012-2016 average. Pole and line catch (1,411 mt) was a 65% decrease from 2016 and a 70% decrease from the average 2012-2016 catch. Catch by other gear (11,160 mt) was a 48% decrease from 2016 and 28% decrease from the average catch in 2012-2016.

Based on the uncertainty grid adopted by SC14, the WCPO bigeye tuna spawning biomass is above the biomass LRP and recent F is very likely below F_{MSY}. The stock is not experiencing overfishing (94% probability $F<F_{MSY}$) and it is not in an overfished condition (0% probability $SB/SB_{F=0}$<LRP).

Although SC14 considers that the updated assessment is consistent with the previous assessment, SC14 also advises that the amount of uncertainty in the stock status results for the 2018 assessment update is lower than for the previous assessment due to the exclusion of old information on bigeye tuna growth.

SC14 noted that levels of fishing mortality and depletion differ among regions, and that fishery impact was higher in the tropical region (Regions 3, 4, 7 and 8 in the stock assessment model), with particularly high fishing mortality on juvenile bigeye tuna in these regions. SC14 therefore recommends that WCPFC15 could continue to consider measures to reduce fishing mortality from fisheries that take juveniles, with the goal to increase bigeye fishery yields and reduce any further impacts on the spawning biomass for this stock in the tropical regions.

SC14 noted that according to CMM 2017-01 bigeye tuna $SB/SB_{F=0}$ is to be maintained above the 2012-2015 level ($SB_{recent}/SB_{F=0}$ = 0.36; Table BET-3) pending the agreement on a TRP. SC14 also noted that the projection results based on scenarios estimating CMM 2017-01 indicated a high level of uncertainty on the levels of spawning stock biomass relative to the LRP and the objective of CMM 2017-01 in 2045. Under the scenario assuming long-term average recruitment continues into the future there was a high risk (18-32%) of breaching the LRPs and a zero probability of achieving the objective of CMM 2017-01, while under the scenario which assumes higher more recent recruitments continues into the future there was a low risk (0-5%) of breaching the LRPs and a 100% probability of achieving the objective of CMM 2017-01.

However, SC14 also noted that the projections assume that longline catches would be maintained regardless of the decrease in biomass. This may result in unlikely high levels of effort. Therefore, the catch estimates under the long term recruitment scenario, especially in the longer term projections, are more uncertain.

Based on these results, SC14 recommends that WCPFC15 takes note of the results of the projections in relation to achieving CMM 2017-01 and as a precautionary approach that the fishing mortality on bigeye tuna stock should not be increased from the recent average (2011-2014) level to maintain spawning biomass at or above the 2012-2015 average, until the Commission can articulate the management objectives and agree on an appropriate TRP for bigeye, although one CCM considers that SC14 could provide more options for the Commission to consider.

c. Research Recommendations

SC14 noted that the acceptance of the updated new growth model for BET raises a number of issues in relation to patterns of growth and stock structure of BET across the Pacific Ocean and recommended that the following research issues need to be addressed:

- Two different growth models separated at 150˚W effectively means that Pacific BET should be assessed as a two-stock resource between the WCPO and EPO. However, catch information indicates that the fishing grounds near 150˚W are a core area of BET catch, thus influencing the assessments of both the WCPFC and IATTC. Also, tagging information suggests movement of BET between the WCPO and EPO. Therefore, the appropriateness off delineating the two stocks at 150˚W needs to be investigated.
- The updated new growth analysis suggests area variant growth across the Pacific. While the level of variation is seen to be relatively small within the WCPO (and possibly within the

margins of observation error), there is a suggestion of substantial change in growth around the boundary between the WCPO and the EPO (c.f. Figure 14 in SC14-SA-WP-01). The reasons for this suggested change in growth remains unknown, but SC14 noted the utility of collecting more information from the regions either side of this boundary to inform a greater understanding of possible changes in growth around this area. While the incorporation of area-variant growth within the assessment model would also help explore this issue, SC14 noted the difficulty of this task.

- SC11 concluded that the stock status of WCPO BET from the Pan-Pacific assessment and the WCPO-only assessment were similar when the growth models were similar in the EPO and WCPO. This conclusion needs to be revisited in light of the different growth between EPO and WCPO by adopting the new growth.

The following additional research activities were also recommended by SC14 in order to improve the understanding of the age and growth of BET across the Pacific:

- A WCPO growth model based on size composition and tagging data, as well as the use of additional modeling approaches (e.g., length-conditional), should also be evaluated.
- Collaboration with the IATTC to analyze bigeye growth from otolith and tagging data collected across the entire Pacific, to better characterize the apparent regional difference in growth between the WCPO and EPO, and possible environmental determinants of such differences.
- Analyzing the same otoliths by different laboratories, to build confidence in ageing estimates and to estimate ageing error.
- Continued development of a high-confidence tagging dataset for growth analysis, with particular focus on larger bigeye tuna and events with reliable measurements at release. Such data would assist with the validation of the age estimates of large bigeye in the WCPO, and could potentially be incorporated directly into the assessment model as an additional data set. However, a reliable measurement of both length at release and recapture are necessary to accurately estimate incremental growth.
- Collect otoliths of very small bigeye that are captured by the Indonesian, Vietnamese, and Philippines domestic fisheries in region 7 and estimate age through daily ring counts to aid in the estimation of the size at age-1 qtr^{-1} parameter (L1) within the assessment model.

2.6.7.2 SOUTH PACIFIC ALBACORE TUNA (*THUNNUS ALALUNGA*)

SC14 accepted as SC14-SA-WP-05 as providing the best available scientific information for the purpose of stock assessment determination.

a. Stock status and trends

The median, 10 percentile and 90 percentile values of recent (2013-2016) spawning biomass ratio (SB_{recent}/ $SB_{F=0}$) and recent fishing mortality in relation to F_{MSY} (F_{recent}/F_{MSY}) over the structural uncertainty grid were used to characterize uncertainty and describe the stock status.

A description of the structural sensitivity grid used to characterize uncertainty in the assessment is set out in Table SPA-1. The regional structure used within the assessment is presented in Figure SPA-1, and the time series of total annual catch by fishing gear for the diagnostic case model over the full assessment period is shown in Figure SPA-2 for the total assessment region, and Figure SPA-3 by model region. Estimated annual average recruitment, spawning potential, juvenile and adult fishing mortality and fishing depletion for the diagnostic case model are shown in Figures SPA-4 – SPA-7. Figure SPA-8 displays Majuro plots summarising the results for each of the models in the structural uncertainty grid, while Figure SPA-9 shows equivalent Kobe plots for SB_{recent} and SB_{latest} across the structural uncertainty grid.

Figure SPA-10 provides estimates of reduction in spawning potential due to fishing by region, and over all regions attributed to various fishery groups (gear-types) for the diagnostic case model. Table SPA-2 provides a summary of reference points over the 72 models in the structural uncertainty grid. Figure SPA-11 presents the history of the annual estimates of MSY for the diagnostic case model, compared with annual catch by the main gear types. Finally, Figure SPA-12 presents the estimated time-series (or 'dynamic') Kobe plots for four example models from the assessment (one from each of the combinations of growth types, and natural mortality M set to 0.3 or 0.4)

SC14 noted that the median level of spawning biomass depletion from the uncertainty grid was $SB_{recent}/SB_{F=0}$ = 0.52 with a probable range of 0.37 to 0.63 (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. SC14 noted that the grid median F_{recent}/F_{MSY} was 0.20, with a range of 0.08 to 0.41 (80% probability interval) and that no values of F_{recent}/F_{MSY} in the grid exceeded 1.

SC14 also noted that there was a 0% probability (0 out of 72 models) that the recent fishing mortality had exceeded F_{MSY}.

SC14 noted that the structural uncertainty grid for the south Pacific albacore had changed since the 2015 assessment, with the 2018 assessment examining additional axes of uncertainty including assumptions on growth and CPUE standardization approach. As a consequence, the uncertainty identified is higher than in previous assessments.

SC14 also noted that the assessment results show that while the stock depletion ($SB/SB_{F=0}$) has exhibited a long-term decline (Figure SPA-7) the stock is not in an overfished state and overfishing is not taking place.

b. Management Advice and implications

SC14 noted that the preliminary estimate of total catch of south Pacific albacore (within the WCPFC Convention Area south of the equator) for 2017 was 75,707mt, which was a 33% increase from 2016 and a 13% increase over 2012-2016. (see SC14-SA-WP-02).

Preliminary catch for longliners in 2017 (72,785mt) was 34% higher compared with 2016 and a 14% increase over 2012-2016. Preliminary other gear (primarily troll) catch in 2017 (2,896t) was 17% higher compared with 2016 but a 1% decrease over 2012-2016. (see SC14-SA-WP-02).

Based on the uncertainty grid adopted by SC14, the South Pacific albacore tuna spawning biomass is very likely to be above the biomass LRP and recent F is very likely below F_{MSY}, and therefore the stock is not experiencing overfishing (100% probability $F < F_{MSY}$) and is not in an overfished condition (100% probability SB_{recent} > LRP).

SC14 recalled its previous advice from SC11, SC12, and SC13 that longline fishing mortality and longline catch be reduced to avoid decline in the vulnerable biomass so that economically viable catch rates can be maintained, especially for longline catch of adult albacore. SC14 recommends that this advice be taken into consideration when the TRP for South Pacific albacore is discussed at WCPFC15.

Table SPA-1. Description of the structural sensitivity grid used to characterize uncertainty in the 2018 south Pacific albacore assessment. Levels used within the diagnostic case are starred

Axis	Levels	Option
Steepness	3	0.65, 0.80*, 0.95
Natural mortality	2	0.3*, 0.4
Growth	2	Estimated* (K, L_∞) or fixed (Chen-Wells)
Size frequency weighting	3	Sample sizes divided by 20, 50* or 80
CPUE	2	Geostatistical*, Traditional

Table SPA-2. Summary of reference points over 72 individual models in the structural uncertainty grid

	Mean	Median	Min	10%	90%	Max
C_{latest}	61719	61635	60669	60833	62704	63180
MSY	100074	98080	65040	70856	130220	162000
$YF_{recentt}$	71579	71780	56680	62480	80432	89000
fmult	6.2	4.96	1.89	2.44	12.05	17.18
F_{MSY}	0.07	0.07	0.05	0.05	0.09	0.1
F_{recent}/F_{MSY}	0.23	0.2	0.06	0.08	0.41	0.53
SB_{MSY}	71407	68650	26760	39872	100773	134000
SB_0	443794	439800	308800	353870	510530	696200
SB_{MSY}/SB_0	0.16	0.17	0.07	0.1	0.21	0.23
$SB_{F=0}$	469004	462633	380092	407792	534040	620000
$SB_{MSY}/SB_{F=0}$	0.15	0.15	0.06	0.09	0.2	0.22
SB_{latest}/SB_0	0.55	0.56	0.33	0.42	0.69	0.74
$SB_{latest}/SB_{F=0}$	0.53	0.52	0.3	0.37	0.69	0.77
SB_{latest}/SB_{MSY}	4	3.42	1.45	1.96	7.07	10.74
$SB_{recent}/SB_{F=0}$	0.51	0.52	0.32	0.37	0.63	0.72
SB_{recent}/SB_{MSY}	3.88	3.3	1.58	1.96	6.56	9.67

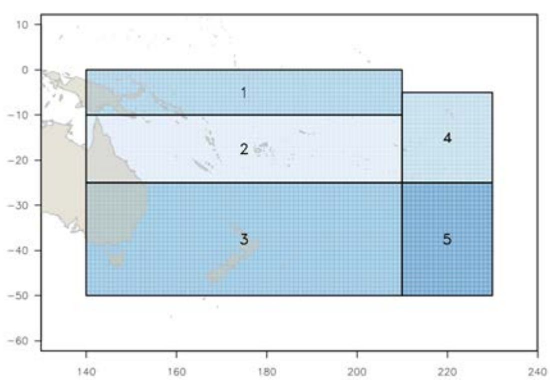


Figure SPA-1. The geographical area covered by the stock assessment and the boundaries for the 5 regions under the "updated 2018 regional structure".

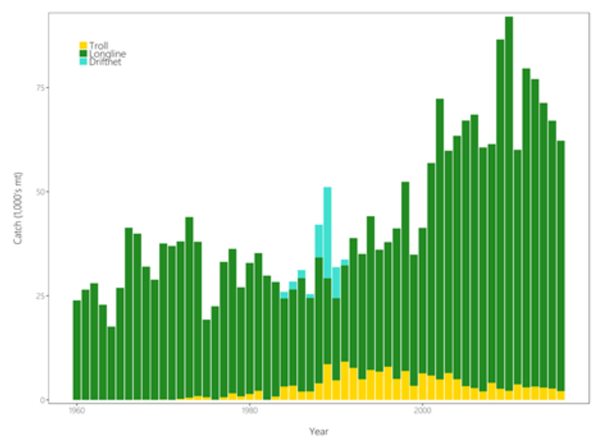


Figure SPA-2. Time series of total annual catch (1000's mt) by fishing gear for the diagnostic case model over the full assessment period. The different colours refer to longline (green), troll (yellow) and driftnet (turquoise). Note that the catch by longline gear has been converted into catch-in-weight from catch-in-numbers.

2.6.7.3 PACIFIC BLUEFIN TUNA (*THUNNUS ORIENTALIS*)

a. Stock status and trends

SC14 noted that ISC provided the following conclusions on the stock status of Pacific bluefin tuna.

> The base-case model results show that: (1) SSB fluctuated throughout the assessment period, (2) SSB steadily declined from 1996 to 2010; and (3) the slow increase of the stock continues since 2011 including the most recent two years (2015-2016). Based on the model diagnostics, the estimated biomass trend for the last 30 years is considered robust although SSB prior to the 1980s

is uncertain due to data limitations. Using the base-case model, the 2016 SSB (terminal year) was estimated to be around 21,000 t in the 2018 assessment, which is an increase from 19,000 t in 2014 (Figure PBF-1 andFigure PBF-11).

Historical recruitment estimates have fluctuated since 1952 without an apparent trend. The low recruitment levels estimated in 2010-2014 were a concern in the 2016 assessment. The 2015 recruitment estimate is lower than the historical average while the 2016 recruitment estimate (15.988 million fish) is higher than the historical average (13.402 million fish) (Figure PBF-4; Table PBF-1). The uncertainty of the 2016 recruitment estimate is higher than in previous years because it occurs in the terminal year of the assessment and is mainly informed by one observation from the troll age-0 CPUE index. The troll CPUE series has been shown to be a good predictor of recruitment, with no apparent retrospective error in the recruitment estimates of the terminal year given the current model construction. As the 2016 recruits grow and are observed by other fleets, the magnitude of this year class will be more precisely estimated in the next stock assessment. The above average recruitment estimated in 2016 had a positive impact on the projection results.

Estimated age-specific fishing mortalities (F) on the stock during the periods 2012-2014 and 2015-2016 compared with 2002-2004 estimates (the base period for the WCPFC Conservation and Management Measure) are presented in Figure PBF-2. A substantial decrease in estimated F is observed in ages 0-2 in 2015-2016 from the previous years. Note that stricter management measures in the WCPFC and IATTC have been in place since 2015.

The WCPFC adopted an initial rebuilding biomass target (the median SSB estimated for the period 1952 through 2014) and a second rebuilding biomass target (20%$SSB_{F=0}$ under average recruitment), without specifying a fishing mortality reference level.[5] The 2018 assessment estimated the initial rebuilding biomass target to be 6.7%$SSB_{F=0}$ and the corresponding fishing mortality expressed as SPR of $F_{6.7\%SPR}$ (Table PBF-2). SPR is the ratio of the cumulative spawning biomass that an average recruit is expected to produce over its lifetime when the stock is fished at the current intensity to the cumulative spawning biomass that could be produced by an average recruit over its lifetime if the stock was unfished. Because the projections include catch limits, fishing mortality is expected to decline, i.e., $F_{x\%SPR}$ will increase, as biomass increases. The Kobe plot shows that the point estimate of the SSB_{2016} was 3.3%$SSB_{F=0}$ and the 2016 fishing mortality corresponds to $F_{6.7\%SPR}$ (Figure PBF-3).

Table PBF-3 provides an evaluation of stock status against some common reference points. It shows that the PBF stock is overfished relative to biomass-based limit reference points adopted for other species in WCPFC (20%$SSB_{F=0}$) and is subject to overfishing relative to most of the common fishing intensity-based reference points.

Figure PBF-4 depicts the historical impacts of the fleets on the PBF stock, showing the estimated biomass when fishing mortality from respective fleets is zero. Historically, the WPO coastal fisheries group has had the greatest impact on the PBF stock, but since about the early 1990s the WPO purse seine fleets, in particular those targeting small fish (ages 0-1), have had a greater impact, and the effect of these fleets in 2016 was greater than any of the other fishery groups. The impact of the EPO fishery was large before the mid-1980s, decreasing significantly thereafter. The WPO longline fleet has had a limited effect on the stock throughout the analysis period, because the impact of a fishery on a stock depends on both the number and size of the fish caught by each fleet; i.e., catching a high number of smaller juvenile fish can have a greater impact on future spawning stock biomass than catching the same weight of larger mature fish.

5 The IATTC has adopted the first rebuilding target, the second target is to be discussed at a future IATTC meeting.

SC14 noted the following stock status from ISC:

Based on these findings, the following information on the status of the Pacific bluefin tuna stock is provided:

- No biomass-based limit or target reference points have been adopted to evaluate the overfished status for PBF. However, the PBF stock is overfished relative to the potential biomass-based reference points evaluated (SSB_{MED} and $20\%SSB_{F=0}$, Table PBF-3 and Figure PBF-3).
- No fishing intensity-based limit or target reference points have been adopted to evaluate overfishing for PBF. However, the PBF stock is subject to overfishing relative to most of potential fishing intensity-based reference points evaluated (Table PBF-3 and Figure PBF-3).

SC14 noted that the total PBF catch in 2017 was 14,707 mt, 11% increase from 2016 and 9% increase from the average 2012-2016. PBF is caught by various fishing gears including purse seine, longline, set net, troll, pole-and-line, handline and recreational fisheries. The detailed catch information by fishery is available in ISC 2018a stock assessment (SC14-SA-WP-06).

b. Management advice and implications

SC14 advises the Commission to note the current very low level of spawning biomass (3.3% B_0), the current level of overfishing, and that the projections are strongly influenced by the inclusion of a relatively high but uncertain recruitment in 2016. The majority of CCMs recommended a precautionary approach to the management of Pacific Bluefin tuna, especially in relation to the timing of increasing catch levels, until the rebuilding of the stock to higher biomass levels is achieved.

SC14 noted the following conservation advice from ISC:

After the steady decline in SSB from 1995 to the historical low level in 2010, the PBF stock appears to have started recovering slowly. The 2016 stock biomass is below the two biomass rebuilding targets adopted by the WCPFC while the 2015-2016 fishing intensity (spawning potential ratio) is at a level corresponding to the initial rebuilding target.

The 2018 base case assessment results are consistent with the 2016 model results. However, the 2018 projection results are more optimistic than the 2016 projections, mainly due to the inclusion of the relatively good recruitment in 2016, which is above the historical average level (119%) and twice as high as the median of the low recruitment scenario (which occurred 1980-1989).

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

- The projection based on the base-case model mimicking the current management measures by the WCPFC (CMM 2017-08) and IATTC (C-16-08) under the low recruitment scenario resulted in an estimated 98% probability of achieving the initial biomass rebuilding target (6.7%SSBF=0) by 2024. This estimated probability is above the threshold (75% or above in 2024) prescribed by the WCPFC Harvest Strategy (Harvest Strategy 2017-02) (scenario 0 of Table PBF-4; see also Figure PBF-5 and Figure PBF-6). The low recruitment scenario is more precautionary than the recent 10 years recruitment scenario.

- The Harvest Strategy specifies that recruitment switches from the low recruitment scenario to the average recruitment scenario beginning in the year after achieving the initial rebuilding target. The estimated probability of achieving the second biomass rebuilding target (20%SSBF=0) 10 years after the achievement of the initial rebuilding target or by 2034, whichever is earlier, is 96% (scenario 1 of Table PBF-3, Table PBF-4, and Table PBF-5; Figure PBF-5 and Figure PBF-6). This estimate is above the threshold (60% or above in 2034) prescribed by the WCPFC Harvest Strategy. However, it should be recognized that these projection results are strongly influenced by the inclusion of the relatively high, but uncertain recruitment estimate for 2016.

The Harvest Strategy adopted by WCPFC (Harvest Strategy 2017-02) guided projections conducted by ISC to provide catch reduction options if the projection results indicate that the initial rebuilding target will not be achieved or to provide relevant information for potential increase in catch if the probability of achieving the initial rebuilding target exceeds 75%. The projection results showed that the probability of achieving the initial rebuilding target was above the level (75% or above in 2024) prescribed in the WCPFC Harvest Strategy. Accordingly, the ISC examined some optional scenarios with higher catch limits, which can be found in Appendix 1 of the PBF 2018 stock assessment report (SC14-SA-WP-06).

Research needs

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

Table PBF-1. Total biomass, spawning stock biomass and recruitment of Pacific bluefin tuna (*Thunnus orientalis*) estimated by the base-case model, where coefficient of variation (CV) measures relative variability defined as the ratio of the standard deviation to the mean

Fishing year	Total biomass (t)	Spawning stock biomass (t)	CV for SSB	Recruitment (x1000 fish)	CV for R
1952	150825	114227	0.51	13352	
1953	146228	107201	0.49	21843	0.17
1954	147385	96239	0.49	34556	0.15
1955	152230	83288	0.50	14106	0.19
1956	169501	76742	0.49	34261	0.11
1957	188830	82975	0.46	12574	0.15
1958	208078	108677	0.41	3436	0.30
1959	214898	147004	0.39	7963	0.22
1960	218055	155183	0.39	7745	0.21
1961	211262	168125	0.39	23323	0.10
1962	197361	151993	0.42	10794	0.18
1963	181329	129755	0.45	27615	0.10
1964	169581	114448	0.45	5827	0.32
1965	159109	100628	0.46	11584	0.35
1966	144866	95839	0.44	8645	0.44
1967	121987	89204	0.44	10803	0.38
1968	107216	83374	0.45	13656	0.24
1969	93223	69074	0.47	6413	0.30
1970	81816	57958	0.48	7120	0.40
1971	71900	49980	0.48	12596	0.34
1972	67819	43035	0.46	22742	0.17
1973	65474	37205	0.44	11058	0.27
1974	65059	29896	0.44	13570	0.17
1975	63515	27733	0.38	11011	0.18
1976	66532	30485	0.30	9171	0.32
1977	64320	36220	0.25	25078	0.17
1978	69199	33382	0.25	15057	0.26
1979	69609	28007	0.29	11509	0.20
1980	71313	30757	0.25	7584	0.27
1981	72109	28867	0.21	11703	0.13
1982	53715	25408	0.21	6965	0.21
1983	31185	15086	0.29	10078	0.15
1984	33147	12813	0.31	9231	0.20
1985	36319	12846	0.28	9601	0.19
1986	35877	15358	0.23	7857	0.19
1987	31609	14632	0.25	6224	0.22
1988	33868	15709	0.25	8796	0.14
1989	38189	15519	0.25	4682	0.28
1990	46388	19468	0.23	18462	0.09
1991	61501	25373	0.21	11803	0.11
1992	70077	32022	0.20	4426	0.17
1993	79910	43691	0.18	4365	0.18
1994	90135	51924	0.19	28350	0.04
1995	103322	67152	0.18	17414	0.09
1996	98854	66841	0.18	17564	0.06
1997	99196	61069	0.19	10919	0.10
1998	95373	60293	0.19	15014	0.08
1999	91963	56113	0.20	23450	0.05
2000	87384	53835	0.21	14335	0.06
2001	76182	50222	0.21	15786	0.05
2002	77727	47992	0.20	13509	0.06
2003	74204	47569	0.19	7769	0.09
2004	68407	40707	0.20	26116	0.04
2005	63042	33820	0.21	14659	0.06
2006	50197	27669	0.23	11645	0.06
2007	43558	22044	0.24	21744	0.04
2008	41169	16754	0.27	20371	0.04
2009	35677	13011	0.27	8810	0.07
2010	33831	12188	0.25	15948	0.05
2011	34983	13261	0.23	13043	0.06
2012	37451	15892	0.20	6284	0.09
2013	39113	18107	0.20	11874	0.06
2014	38918	19031	0.19	3561	0.14
2015	38322	19695	0.20	7765	0.13
2016	41191	21331	0.22	15988	0.21
Average (1952-2016)	89579	53722	0.31	13402	0.17
Median (1952-2014)	71900	43035	0.25	11703	0.16

Table PBF-2. Spawning stock biomass and fishing intensity of Pacific bluefin tuna (*Thunnus orientalis*) in 1995 (recent high biomass), 2002-2004 (WCPFC reference year biomass), 2011 (biomass 5 years ago), and 2016 (latest) to those of the adopted WCPFC biomass rebuilding targets. SPR is used as a measure of fishing intensity; the lower the number the higher the fishing intensity that year

	Initial rebuilding target	Second rebuilding target	1995 (recent high)	2002-2004 (reference year)	2011 (5 years ago)	2016 (latest)
Biomass (%SSBF=0)	SSB median1952-2014 = 6.7%	20%	10.4%	7.1%	2.1%	3.3%
SPR	6.7%	20%	5.1%	3.4%	4.9%	6.7%

Table PBF-3. Ratios of the estimated fishing intensities mortalities (Fs and 1-SPRs for 2002-04, 2012-14, 2015-16) relative to potential fishing intensity-based reference points, and terminal year SSB (t) for each reference period, and depletion ratios for the terminal year of the reference period for Pacific bluefin tuna (*Thunnus orientalis*)

	F_{max}	F0.1	Fmed	Floss	(1-SPR)/(1-SPRxx%)				Estimated SSB for terminal year of each reference period	Depletion ratio for terminal year of each reference period
					SPR10%	SPR20%	SPR30%	SPR40%		
2002-2004	1.77	2.47	1.04	0.78	1.07	1.21	1.38	1.61	40,707	6.3%
2012-2014	1.47	2.04	0.86	0.65	1.05	1.19	1.36	1.58	19,031	3.0%
2015-2016	1.32	1.85	0.78	0.58	1.02	1.15	1.32	1.54	21,311	3.3%

Table PBF-4. Future projection scenarios for Pacific bluefin tuna (*Thunnus orientalis*)

Scenario #	WPO						EPO*3			Catch limit Increase			
	Fishing mortality*1	Catch limit					Catch limit		Sports	WPO		EPO	
		Japan*2		Korea		Taiwan	Commercial						
		Small	Large	Small	Large	Large	Small	Large		Small	Large	Small	Large
0*4	F	4,007	4,882	718		1,700	3,300		-	0%		0%	
1	F	4,007	4,882	718		1,700	3,300		–	0%		0%	

*1 F indicates the geometric mean values of quarterly age-specific fishing mortality during 2002-2004.
*2 The Japanese unilateral measure (transferring 250 mt of catch upper limit from that for small PBF to that for large PBF during 2017-2020) would be reflected.
*3 Fishing mortality for the EPO commercial fishery was assumed to be high enough to fulfill its catch upper limit (F multiplied by two). The fishing mortality for the EPO recreational fishery was assumed to be the F2009-11 average level.
*4 In scenario 0, the future recruitments were assumed to be the low recruitment (1980-1989) level forever. In other scenarios, recruitment was switched from low recruitment to average recruitment from the next year of achieving the initial rebuilding target.

Table PBF-5. Future projection scenarios for Pacific bluefin tuna (*Thunnus orientalis*) and their probability of achieving various target levels by various time schedules based on the base-case model.

Scenario #	Catch limit Increase				Initial rebuilding target			Second rebuilding target		Median SSB (mt) at 2034
	WPO		EPO		The year expected to achieve the target with >60% probability	Probability of achiving the target at 2024	Probability of SSB is below the target at 2024 under the low recruitment	The year expected to achieve the target with >60% probability	Probability of achiving the target at 2034	
	Small	Large	Small	Large						
0*1	0%		0%		2020	98%	2%	N/A	3%	74,789
1	0%		0%		2020	99%	2%	2028	96%	263,465

*1 In scenario 0, the future recruitments were assumed to be the low recruitment (1980-1989) level forever. In other scenarios, recruitment was switched from low recruitment to average recruitment from the next year of achieving the initial rebuilding target.

Table PBF-6. Expected yield for Pacific bluefin tuna (*Thunnus orientalis*) under various harvesting scenarios based on the base-case model

Scenario #	Catch limit Increase				Expected annual yield in 2019, by area and size category (mt)				Expected annual yield in 2024, by area and size category (mt)				Expected annual yield in 2034, by area and size category (mt)			
	WPO		EPO		WPO		EPO		WPO		EPO		WPO		EPO	
	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
0	0%	0%	0%		4,477	4,384	3,530		4,704	6,133	3,457		4,704	6,211	3,451	
1	0%	0%	0%		4,477	4,384	3,530		4,745	6,202	3,665		4,747	6,640	3,703	

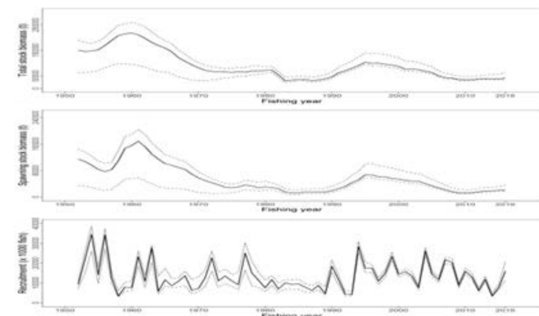


Figure PBF-1. Total stock biomass (top), spawning stock biomass (middle) and recruitment (bottom) of Pacific bluefin tuna (*Thunnus orientalis*) from the base-case model. The solid lines indicate point estimates and the dashed lines indicate the 90% confidence intervals.

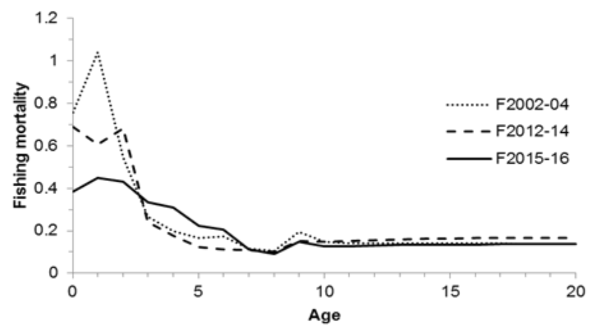


Figure PBF-2. Geometric means of annual age-specific fishing mortalities of Pacific bluefin tuna (*Thunnus orientalis*) in 2002-2004 (dotted line), 2012-2014 (dashed line), and 2015-2016 (solid line).

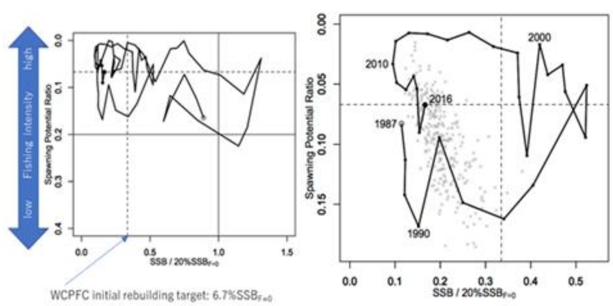


Figure PBF-3. Kobe plots for Pacific bluefin tuna (*Thunnus orientalis*). X axis shows the annual SSB relative to 20%SSB$_{F=0}$ and the Y axis shows the spawning potential ratio as a measure of fishing intensity. Solid vertical and horizontal lines in the left figure show 20%SSB$_{F=0}$ (which corresponds to the second biomass rebuilding target) and the corresponding fishing intensity, respectively. Dashed vertical and horizontal lines in both figures show the initial biomass rebuilding target (SSB$_{MED}$ = 6.7%SSB$_{F=0}$) and the

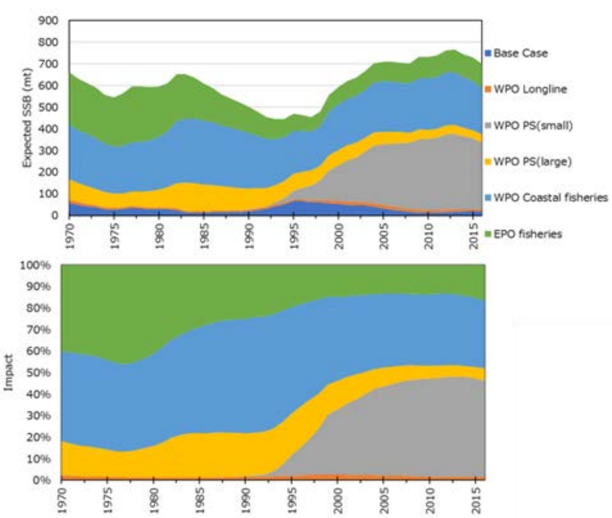


Figure PBF-4. Trajectory of the spawning stock biomass corresponding fishing intensity, respectively. SSB_{MED} is calculated as the median of estimated SSB over 1952-2014. The left figure shows the historical trajectory, where the open circle indicates the first year of the assessment (1952) while solid circles indicate the last five years of the assessment (2012-2016). The right figure shows the trajectory of the last 30 years, where grey dots indicate the uncertainty of the terminal year.

of a simulated population of Pacific bluefin tuna (*Thunnus orientalis*) when zero fishing mortality is assumed, estimated by the base-case model (top: absolute impact, bottom: relative impact). Fleet definition; WPO longline: F1, F12, F17. WPO purse seine for small fish: F2, F3, F18. WPO purse seine: F4, F5. WPO coastal fisheries: F6-11, F16, F19. EPO fisheries: F13, F14, F15.

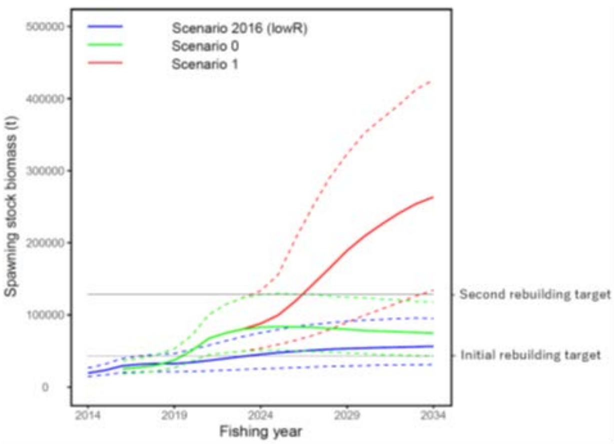


Figure PBF-5. Comparison of future SSB of Pacific bluefin tuna (*Thunnus orientalis*) under the current management measures assuming low recruitment using the 2016 assessment (scenario 2016 lowR), assuming low recruitment using the 2018 assessment (scenario 0), and assuming a shift of the recruitment scenario from low to average after achieving the initial rebuilding target using the 2018 assessment (scenario 1).

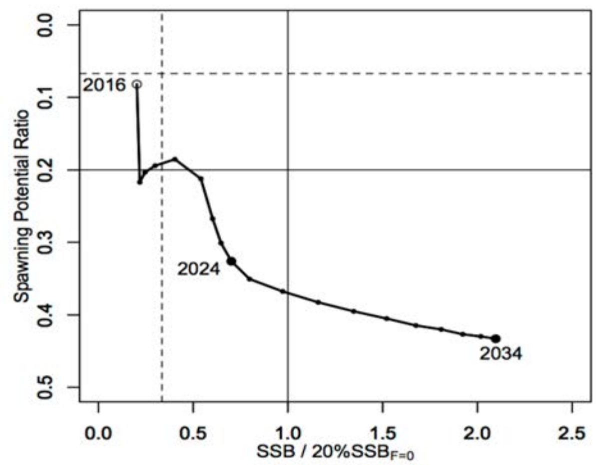


Figure PBF-6. A projection result (scenario 1 from Table PBF-4) for Pacific bluefin tuna (*Thunnus orientalis*) in a form of Kobe plot. The X axis shows the SSB value relative to $20\%SSB_{F=0}$ (second rebuilding target) and the Y axis shows the spawning potential ratio as a measure of fishing intensity. Vertical and horizontal solid lines indicate the second rebuilding target ($20\%SSB_{F=0}$) and the corresponding fishing intensity, respectively, while vertical and horizontal dashed lines indicate the initial rebuilding target ($SSB_{MED} = 6.7\%SSB_{F=0}$) and the corresponding fishing intensity, respectively.

2.6.7.4 NORTH PACIFIC SWORDFISH (*XIPHIAS GLADIUS*)

a. Status and trends

SC14 noted that ISC provided the following conclusions on the stock status of Western and Central North Pacific Swordfish in the Pacific Ocean in 2017 presented in SC14-SA-WP-07 (Stock Assessment for Swordfish (*Xiphias gladius*) in the Western and Central North Pacific Ocean through 2016).

Estimates of total stock biomass show a relatively stable population, with a slight decline until the mid-1990s followed by a slight increase since 2000. Population biomass (age-1 and older) averaged roughly 97,919 t in 1974-1978, the first 5 years of the assessment time frame, and has declined by only 20% to 71,979 t in 2016 (Figure NPS-3). Female spawning stock biomass was estimated to be 29,403 t in 2016, or about 90% above SSB_{MSY} (Table NPS-1 and Table NPS-2). Fishing mortality on the stock (average F, ages 1 – 10) averaged roughly F = 0.08 yr^{-1} during 2013-2015, or about 45% below F_{MSY}. The estimated SPR (the predicted spawning output at the current F as a fraction of unfished spawning output) is currently SPR_{2016} = 45%. Annual recruitment averaged about 717,000 recruits during 2012-2016, and no long-term trend in recruitment was apparent. Overall, the time series of spawning stock biomass and recruitment estimates indicate a stable spawning stock biomass and suggest a fluctuating pattern without trend for recruitment (Figure NPS-3). The Kobe plot depicts the stock status relative to MSY-based reference points for the base case model (Figure NPS-4) and shows that spawning stock biomass declined to almost the MSY level in the mid-1990s, but SSB has remained above SSB_{MSY} throughout the time series (Figure NPS-3B).

For this 2018 benchmark assessment, note that biomass status is based on female spawning stock biomass, whereas for the 2014 update assessment, biomass status was based on exploitable biomass (effectively age-2+ biomass). It is also important to note that there are no currently agreed upon reference points for the WCNPO swordfish stock and that retrospective analyses show that the assessment model appears to underestimate spawning stock biomass in recent years.

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

- The WCNPO swordfish stock has produced annual yields of around 10,200 t per year since 2012, or about 2/3 of the MSY catch amount.
- There is no evidence of excess fishing mortality above F_{MSY} ($F_{2013-2015}$ is 45% of F_{MSY}) or substantial depletion of spawning potential (SSB_{2016} is 87% above SSB_{MSY}).
- Overall, the WCNPO swordfish stock is not likely overfished and is not likely experiencing overfishing relative to MSY-based or 20% of unfished spawning biomass-based reference points.

b. Management advice and implications

SC14 noted the following conservation advice from ISC:

Stock projections were conducted using a two-gender projection model. The five stock projection scenarios were: (1) F status quo, (2) F_{MSY}, (3) F at $0.2*SSB_{F=0}$, (4) $F_{20\%}$, and (5) $F_{50\%}$ (Figure NPS-5). These projection scenarios were applied to the base case model results to evaluate the impact of alternative levels of fishing intensity on future spawning biomass and yield for swordfish in the Western and Central North Pacific Ocean. The projected recruitment pattern was generated by stochastically sampling the estimated stock-recruitment model from the base case model. The projection calculations employed model estimates for the multi-fleet, multi- season, size- and age-selectivity, and structural complexity in the assessment model to produce consistent results.

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

- The results show that projected female spawning biomass is expected to remain above SSB_{MSY} under all of the harvest scenarios (Table NPS-3 and Figure NPS-5), with increases in spawning biomass expected under lower fishing mortality rates.
- Similarly, projected catch is expected to increase under each of the five harvest scenarios, with greater increases expected under higher fishing mortality rates (Table NPS-3 and Figure NPS-5).

Research needs

The lack of sex-specific size composition data and the simplified treatment of the spatial structure of swordfish population dynamics remained as two important sources of uncertainty for this benchmark assessment.

Table NPS-1. Reported catch (mt) used in the stock assessment along with annual estimates of population biomass (age-1 and older, mt), female spawning biomass (mt), relative female spawning biomass (SSB/SSB_{MSY}), recruitment (thousands of age-0 fish), fishing mortality (average F, ages 1 to 10), relative fishing mortality (F/F_{MSY}), and spawning potential ratio of Western and Central North Pacific Ocean swordfish

Year	2010	2011	2012	2013	2014	2015	2016	Mean[1]	Min[1]	Max[1]
Reported Catch	12,716	9,971	10,608	9,241	9,211	11,672	10,068	12,863	9,211	17,793
Population Biomass	66,417	66,087	68,117	67,885	69,560	71,951	71,979	67,487	51,856	97,919
Spawning Biomass	26,136	26,448	26,569	27,546	28,580	28,865	29,404	24,442	17,191	44,100
Relative SB	1.66	1.68	1.69	1.75	1.82	1.84	1.87	1.56	1.09	2.81
Recruitment (age 0)	789	565	671	710	683	742	781	761	401	1241
Fishing mortality	0.10	0.08	0.09	0.07	0.07	0.09	0.07	0.12	0.07	0.18
Relative F	0.57	0.46	0.51	0.44	0.40	0.51	0.44	0.72	0.40	1.05
Spawning Potential Ratio	38%	41%	39%	45%	47%	39%	45%	29%	17%	47%

[1] During 1975-2016

Table NPS-2. Estimates of biological reference points along with estimates of fishing mortality (F), spawning stock biomass (SSB), recent average yield (C), and SPR of WCNPO swordfish, derived from the base case model assessment model, where "MSY" indicates reference points based on maximum sustainable yield

Reference Point	Estimate
F_{MSY}	0.17 yr^{-1}
$F_{0.2*SSB(F=0)}$	0.16 yr^{-1}
$F_{2013-2015}$	0.08 yr^{-1}
SSB_{MSY}	15,702 mt
SSB_{2016}	29,403 mt
SSBF=0	97,286 mt
MSY	14,941 mt
$C_{2012-2016}$	10,160 mt
SPR_{MSY}	18%
SPR_{2016}	45%

Table NPS-3. Projected values of WCNPO swordfish spawning stock biomass (SSB, mt) and catch (mt) under five constant fishing mortality rate (F, yr^{-1}) scenarios during 2017-2026

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
										Scenario 1: F = $F_{2013-2015}$
SSB	32,118	33,207	34,599	35,476	36,270	37,082	37,951	38,967	40,083	41,087
Catch	8,851	9,135	9,407	9,599	9,794	10,022	10,275	10,595	11,053	11,142
										Scenario 2: F = F_{MSY}

SSB	28,267	23,963	21,443	19,458	18,303	17,618	17,293	17,197	17,253	17,263
Catch	20,885	18,323	16,509	15,294	14,666	14,353	14,308	14,520	14,650	14,348
										Scenario 3: F = $F_{20\%SSB(F=0)}$
SSB	28,425	24,384	21,800	19,735	18,530	17,874	17,496	17,586	17,818	17,779
Catch	20,691	18,122	16,454	15,261	14,653	14,361	14,319	14,554	14,665	14,384
										Scenario 4: F = $F_{20\%}$
SSB	29,007	25,431	23,527	21,763	20,736	20,131	19,893	19,883	19,981	20,066
Catch	18,680	16,933	15,657	14,726	14,242	14,033	14,050	14,292	14,496	14,253
										Scenario 5: F = $F_{50\%}$
SSB	32,559	34,334	36,290	37,666	38,836	39,984	41,148	42,490	44,049	45,625
Catch	7,556	7,973	8,343	8,605	8,847	9,101	9,366	9,692	10,087	10,223

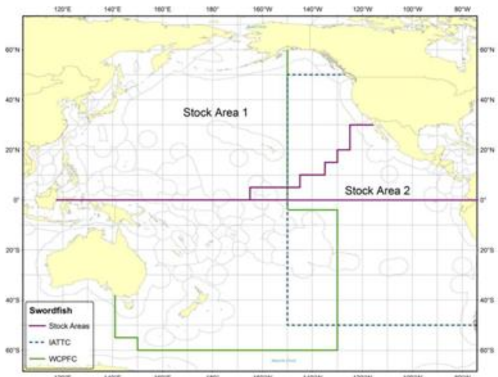


Figure NPS-1. Stock boundaries used for this assessment of North Pacific Ocean swordfish: purple lines indicate stock area divisions; stock area 1 was assessed as the WCNPO stock, stock area 2 contains the Eastern Pacific Ocean stock, the green line indicates Western Central Pacific Fisheries Commission convention area, blue dashed line indicates IATTC convention area.

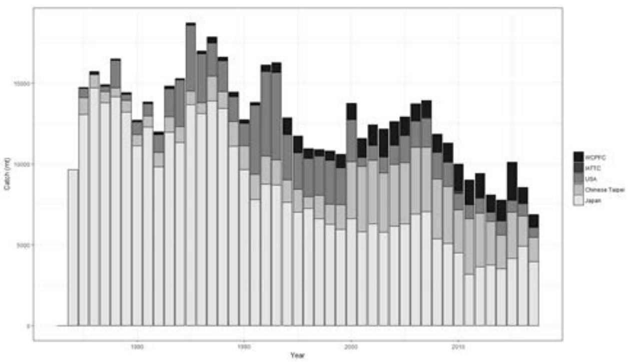
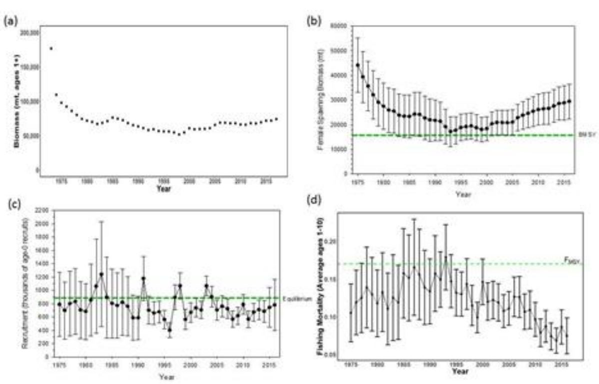


Figure NPS-2. Annual catch biomass (t) of WCNPO swordfish (*Xiphias gladius*) by country for Japan, Chinese Taipei, the U.S.A., and all other countries during 1975-2016.



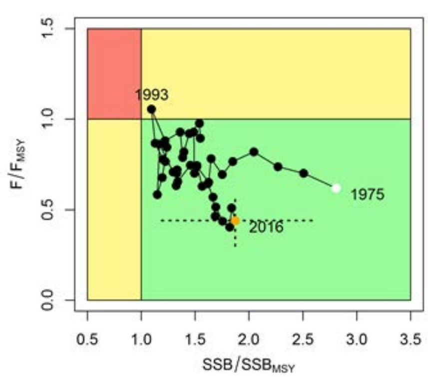


Figure NPS-3. Time series of estimates of (a) population biomass (age 1+) (first point in time series represents unfished biomass), (b) spawning biomass, (c) recruitment (age-0 fish), and (d)

Figure NPS-4. Kobe plot of the time series of estimates of relative fishing mortality (average of ages 1-10) and relative spawning stock biomass of WCNPO swordfish (*Xiphias* instantaneous fishing mortality (average for ages 1 to 10, yr^{-1}) for WCNPO swordfish (*Xiphias gladius*) derived from the 2018 stock assessment. The solid circles are the maximum likelihood estimates by year for each quantity and the error bars represent the uncertainty of the estimates (80% confidence intervals), green dashed lines indicate BMSY, equilibrium recruitment, and F_{MSY} except for the population biomass time series.

gladius) during 1975-2016. The white circle denotes the first year (1975) and the yellow circle denotes the last year (2016) of the assessment time horizon. The dashed lines represent the 95% confidence intervals around the 2016 estimate.

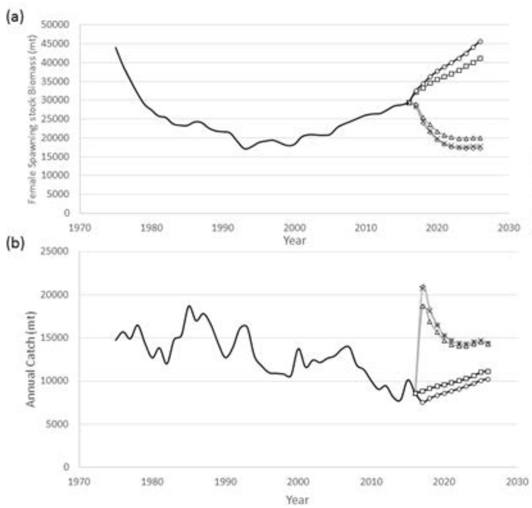


Figure NPS-5. Historical and projected trajectories of (a) spawning stock biomass and (b) total catch from the WCNPO swordfish base case model. Stock projection results are shown for S1 = the status quo or average fishing intensity during 2013-2015 ($F_{2013-2015}$= $F_{43\%}$); S2 = F_{MSY} ($F_{18\%}$); S3 = F to produce 20% of unfished spawning stock biomass or $F_{0.2}$*$SSB_{F=0}$ ($F_{22\%}$); S4 = the highest 3-year average F during 1975-2016 or High F ($F_{20\%}$); S5 = Low F ($F_{50\%}$).

Figure SPA-1. Time series of total annual catch (1000's mt) by fishing gear and assessment region from the diagnostic case model over the full assessment period. The different colours denote longline (green), driftnet (turquoise) and troll (yellow).

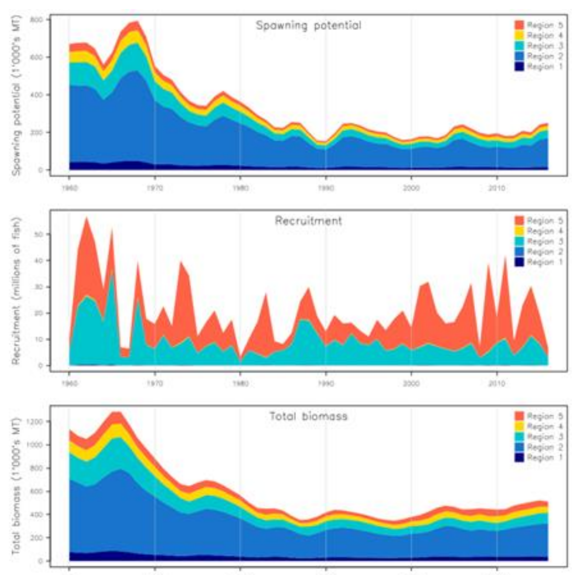


Figure SPA-2. Estimated annual average recruitment, spawning potential and total biomass by model region for the diagnostic case model, showing the relative sizes among regions.

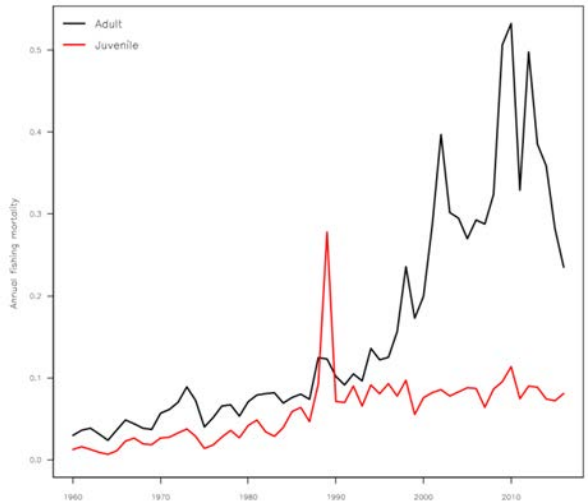


Figure SPA-3. Estimated annual average juvenile and adult fishing mortality for the diagnostic case model.

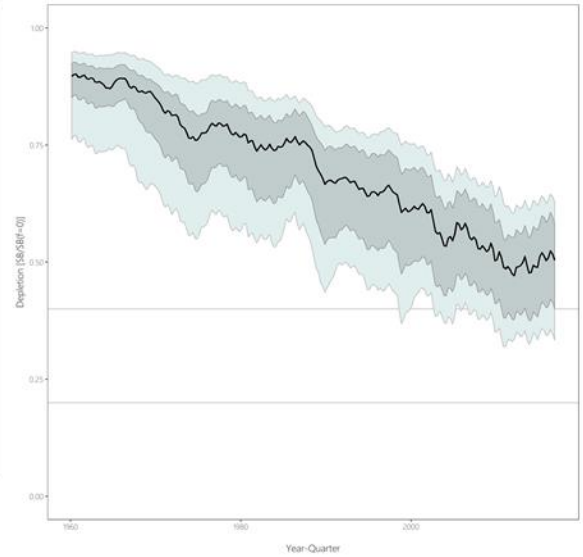
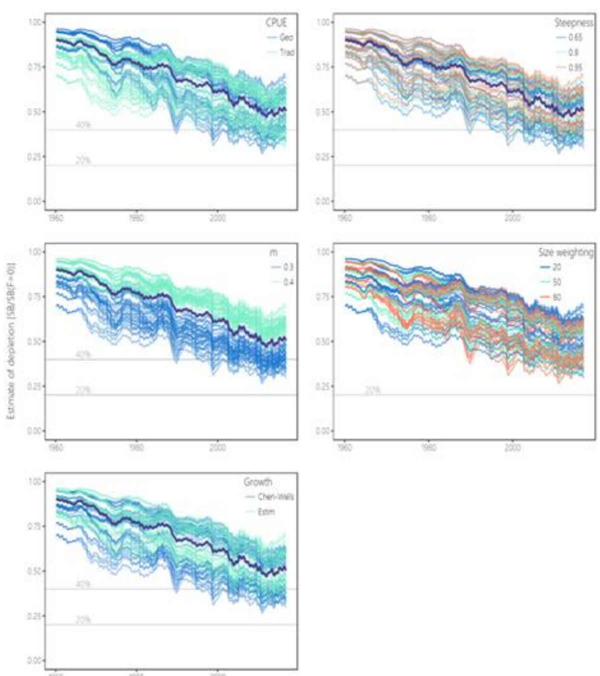


Figure SPA-4. Distribution of time series depletion estimates across the structural uncertainty grid. Black line represents the grid median trajectory, dark grey region represents the 50%ile range, light grey the 90%ile range.



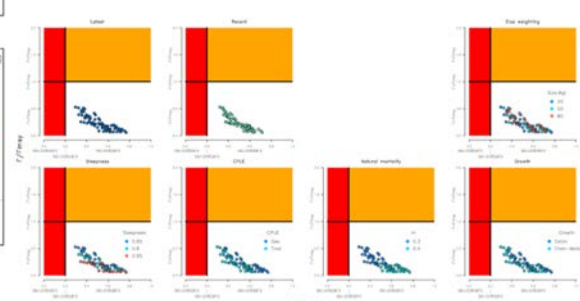


Figure SPA-5. Plots showing the trajectories of fishing depletion (of spawning potential) for the model runs included in the structural uncertainty grid. The five panels show the models separated on the basis of the five axes used in the grid, with the colour denoting the

Figure SPA-6. Majuro plots summarising the results for each of the models in the structural uncertainty grid under the $SB_{latest}/SB_{F=0}$ and the $SB_{recent}/SB_{F=0}$ reference points (top left) and each axis of uncertainty.

level within the axes for each model.

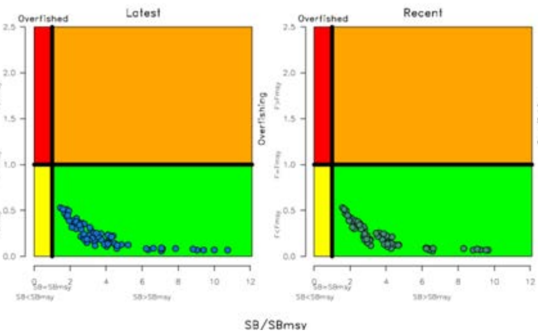


Figure SPA-7. Kobe plots summarising the results for each of the models in the structural uncertainty grid under the $SB_{latest}/SB_{F=0}$ and the $SB_{recent}/SB_{F=0}$ reference points.

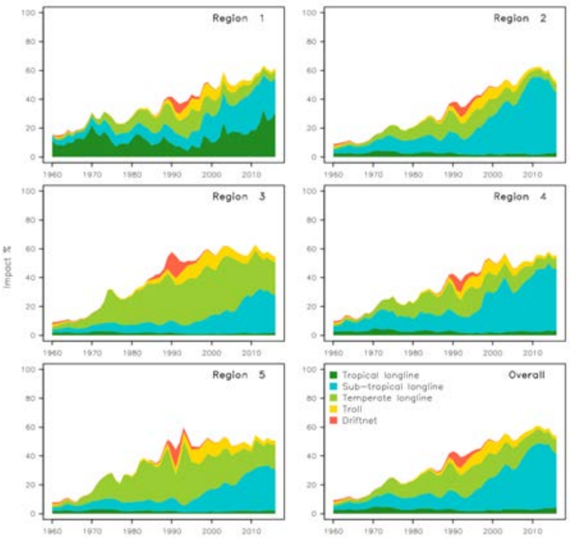


Figure SPA-8. Estimates of reduction in spawning potential due to fishing (fishery impact = 1-$SB_{latest}/SB_{F=0}$) by region, and over all regions (lower right panel), attributed to various fishery groups for the diagnostic case model.

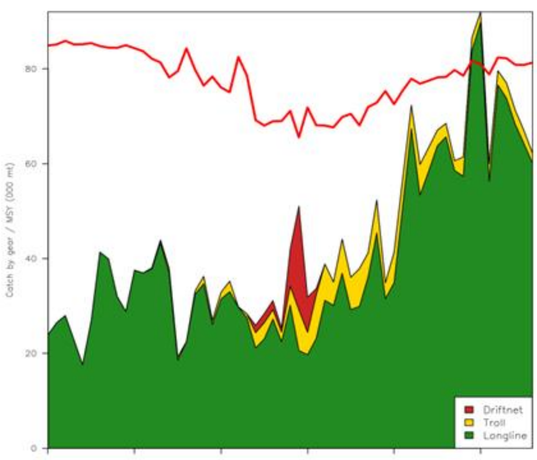


Figure SPA-9. History of the annual estimates of MSY (red line) for the diagnostic case model compared with annual catch by the main gear types.

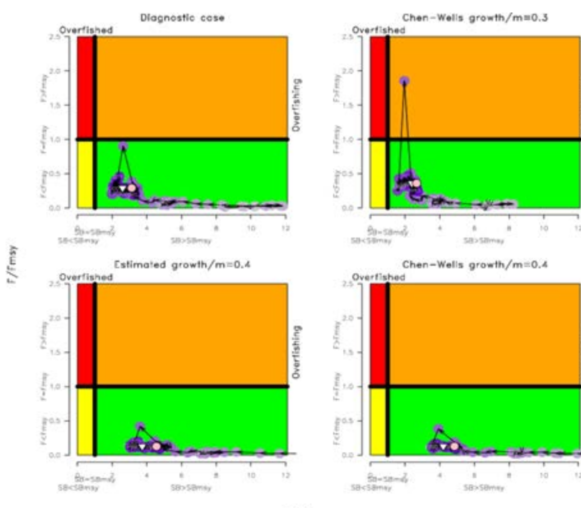


Figure SPA-10. Estimated time-series (or 'dynamic') Kobe plots for four example models from the assessment (one from each of the combinations of growth types, and natural mortality M set to 0.3 or 0.4).

2.6.7.5 WCPO SILKY SHARK (CARCHARHINUS FALCIFORMIS)

The SC accepts the WCPO silky shark stock assessment as best available science for this stock.

a. Stock status and trends

SC14 noted given the inherent uncertainty in the current assessment the current estimates of stock status should be considered indicative only. Although these estimates are not considered a reliable basis for management decision-making they represent progress since the 2013 assessment and the best available science concerning the status of silky sharks in the WCPO. Therefore, as part of its ongoing review of the established conservation and management measure for silky sharks (CMM 2013-08), the Commission may wish to consider these indicative results until such time as better estimates become available.

SC14 noted that indications from the 2018 WCPO model show that the stock declined steadily over the model period (1995-2016) (Figure FAL-1). The assessment model estimates spawning biomass in 2016 to have been at 47% of the unexploited level ($SB_{2016}/SB_0 = 0.469$). Current biomass is estimated to be above the MSY reference biomass level; however, there is considerable uncertainty associated with the estimate of stock status (SB_{2016}/SB_{MSY} = 1.178 95% CI 0.590-1.770) (Table FAL-1). On balance, the stock is not considered to be overfished, i.e. there is a 78% probability that SB_{2016} is greater than SB_{MSY} (Table FAL-1).

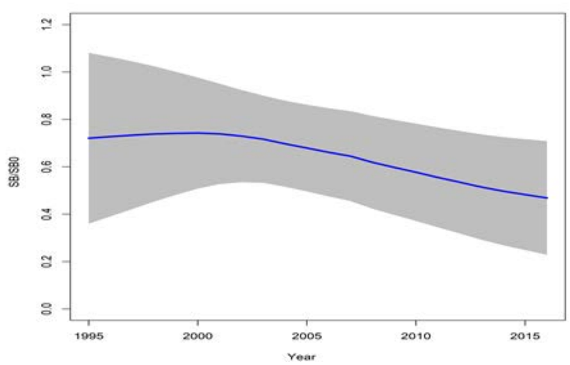


Figure FAL-1: Estimated spawning biomass relative to unexploited biomass (SB_0) for the WCPO assessment model (CPUEqdev)

Table FAL-1: Management quantities (and 95% confidence intervals) for the WCPO assessment model (*CPUEqdev*)

Management quantity	Value	Confidence interval (95%)
SB_0	11,865	6,412-17,318
SB_{1995}	8,552	2,590-14,513
SB_{MSY}	4,721	2,560-6,882
SB_{MSY}/SB_0	0.398	0.397-0.399
SB_{2016}	5,560	301-10,819
SB_{2016}/SB_0	0.469	0.229-0.729
SB_{2016}/SB_{MSY}	1.178	0.590-1.77
Pr($SB_{2016} > SB_{MSY}$)	0.78	
F_{2016}/F_{MSY}	1.607	0.316-2.810
Pr($F_{2016} > F_{MSY}$)	0.84	
F_{2016}	0.313	
MSY	12,162	6,711-17,615
Catch 2016 (mt)	22,503	

Fishing mortality is estimated to be above F_{MSY} (F_{2016}/F_{MSY} = 1.607, Pr($F_{2016} > F_{MSY}$) = 84%). The current level of catch is substantially higher than the MSY. If catches remain at the current level there is a high probability that the biomass will decline to below the SB_{MSY} level in the foreseeable future (~ 5 years).

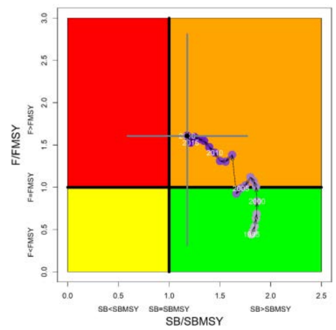


Figure FAL-2. Kobe plot for the WCPO assessment model (*CPUEqdev*).

b. Management advice and implications

SC14 concludes that on the basis of the best available science, and pending the availability of less uncertain stock status indicators, the stock is not overfished, but is subject to overfishing_(Figure FAL-2).

SC14 recommends, given that the WCPO silky shark stock continues to be subject to overfishing, that CMM 2013-08 be maintained as a precautionary measure.

2.6.7.6 NORTH PACIFIC SHORTFIN MAKO SHARK (*ISURUS OXYRINCHUS*)

a. Stock status and trends

SC14 noted that ISC provided the following conclusions on the stock status of North Pacific Shortfin Mako Shark in the Pacific Ocean in 2017, as presented in SC14-SA-WP-11 (Stock Assessment of Shortfin Mako Shark in the North Pacific Ocean Through 2016).

Based on these findings, the following information on the status of the SFM stock is provided:

- Target and limit reference points have not been established for pelagic sharks in the Pacific Ocean. Stock status is reported in relation to MSY.
- The results from the base case model show that, relative to MSY, the North Pacific shortfin mako stock is likely (>50%) not in an overfished condition and overfishing is likely (>50%) not occurring relative to MSY-based abundance and fishing intensity reference points (Table SFM-4; Figure SFM-9).
- Stock status was also examined under six alternative states of nature that represented the most important sources of uncertainty in the assessment. Results of these models with alternative states of nature were consistent with the base case model and showed that, relative to MSY, the North Pacific shortfin mako shark stock is likely (>50%) not in an overfished condition and overfishing is likely (>50%) not occurring (Figure SFM-9).

b. Management Advice and implications

SC14 noted the following conservation advice from ISC:

Stock projections of biomass and catch of North Pacific shortfin mako from 2017 to 2026 were performed assuming three alternative constant fishing mortality scenarios: 1) status quo, average of 2013-2015 ($F_{2013-2015}$); 2) $F_{2013-2015}$ + 20%; and 3) $F_{2013-2015}$ - 20% (Figure SFM-10).

Based on these future projections, the following conservation information is provided:

- If fishing mortality remains constant at F2013-15 or is decreased 20%, then the Stock Abundance is expected to increase gradually;
- If fishing mortality is increased 20% relative to F2013-2015, then the Stock Abundance is expected to decrease in the final years of the projection.
- It should be noted that, given the uncertainty in fishery data and key biological processes within the model, especially the stock recruitment relationship, the models' ability to project into the future is highly uncertain.

Research Needs

There is uncertainty in the estimated historical catches of North Pacific shortfin mako shark. Substantial time and effort was spent on estimating historical catch and more work remains to be conducted. In particular, the SHARKWG identified two future improvements that are critical: 1) identify all fisheries that catch shortfin mako shark in the NPO, including fisheries that were not previously identified by the SHARKWG; and 2) methods to estimate shortfin mako shark catches should be improved, especially for the early period from 1975 to 1993.

Table SFM-4. Summary of reference points and management quantities for the shortfin mako shark (*Isurus oxyrinchus*) base case model. The percentages in brackets are the CV of the estimated quantity in the base case model

Management Quantity	Symbol	Units	Base case
Spawning abundance (number of mature female sharks	SA_0	1000s of sharks	1465.8 (23%)
Maximum Sustainable Yield (MSY)	C_{MSY}	Metric tons (t)	3127.1 (22%)
Spawning Abundance at MSY	SA_{MSY}	1000s of sharks	633.7 (23%)
Fishing Intensity at MSY	$1\text{-}SPR_{MSY}$	NA	0.26
Current spawning abundance relative to MSY	SA_{2016}/SA_{MSY}	NA	1.36
Current spawning abundance relative to unfished level	SA_{2016}/SA_0	NA	0.58
Recent fishing Intensity relative to MSY	$(1\text{-}SPR_{2013-15})/(1\text{-}SPR_{MSY})$	MSY	0.62

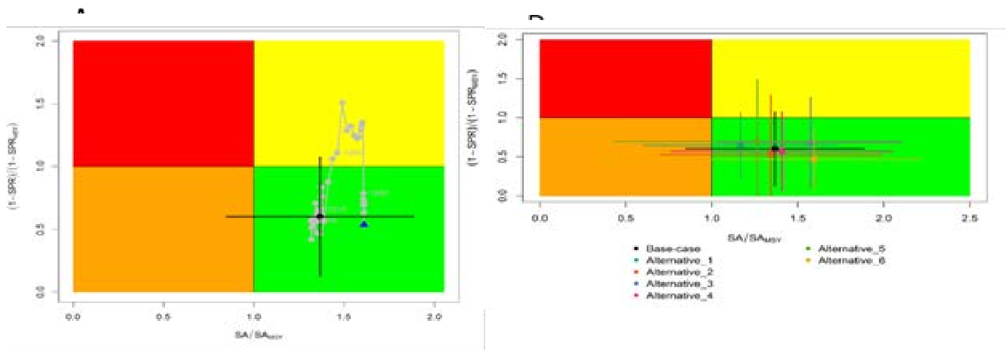


Figure SFM-9. Kobe plots of shortfin mako shark in the North Pacific Ocean showing. A) The time series of the ratio of SA to SA at MSY (SA_{MSY}) and fishing intensity to fishing intensity at MSY ($1\text{-}SPR_{MSY}$), and B) the same ratios for the terminal year (2016) for six alternative states of nature. SA is spawning abundance measured as the number of mature females. Fishing intensity is estimated as 1-SPR. Values for the start (1975) and end (2016) years in the time series (A) are indicated by the blue triangle and black circle, respectively. Gray numbers indicate selected years. Alternative states of nature in B) include: Alternative_1) higher catch, Alternative_2) lower catch; Alternative_3) higher uncertainty on Japan shallow-set CPUE index (1975-1993) (CV=0.3); Alternative_4) fit to Japan offshore distant water longline shallow-set fleet (JPN_SS_I; 1975-2016) and Hawaii longline shallow-set fleet (US_SS; 2005-2016), and no fit to initial equilibrium catch; Alternative_5) low steepness, h=0.26; and Alternative_6) high steepness, h=0.37. Solid lines indicate 95% confidence intervals.

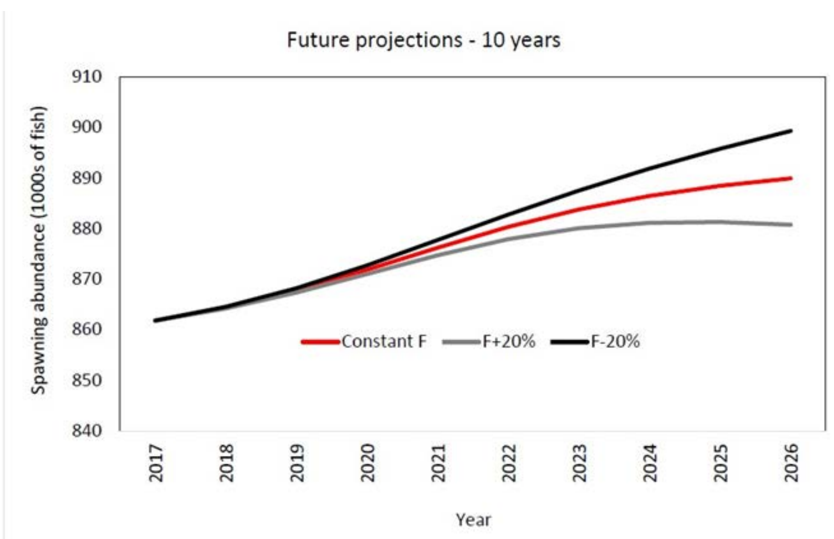


Figure SFM-10. Comparison of future projected North Pacific shortfin mako (*Isurus oxyrinchus*) spawning abundance under different F harvest policies (Constant F 2013-2015, +20%, -20%) using the base case model. Constant F was based on the average from 2013-2015.

2.6.7.7 EASTERN PACIFIC OCEAN BIGEYE TUNA

Stock indicator report: Maunder et al. 2018.

Stock status from Executive summary

Several uncertainties have been identified in the update assessment of bigeye tuna conducted in 2018 (Xu et al. 2018), and its usefulness for management has been questioned. Therefore, the staff developed a suite of stock status indicators for bigeye , 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 sets on fish aggregating devices (FADs), and the decreasing mean weight of the bigeye in the catch still indicate that the bigeye stock in the 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 . It is not clear why the number of floating-object sets, per day and per vessel, is increasing, but it is probably due to 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 further investigation into this phenomenon should be conducted.

The Kobe plot in Figure 124 is provided for demonstration purposes only, and NMFS has not determined that the reference points given in Xu et al. 2018 are suitable for stock status determinations.

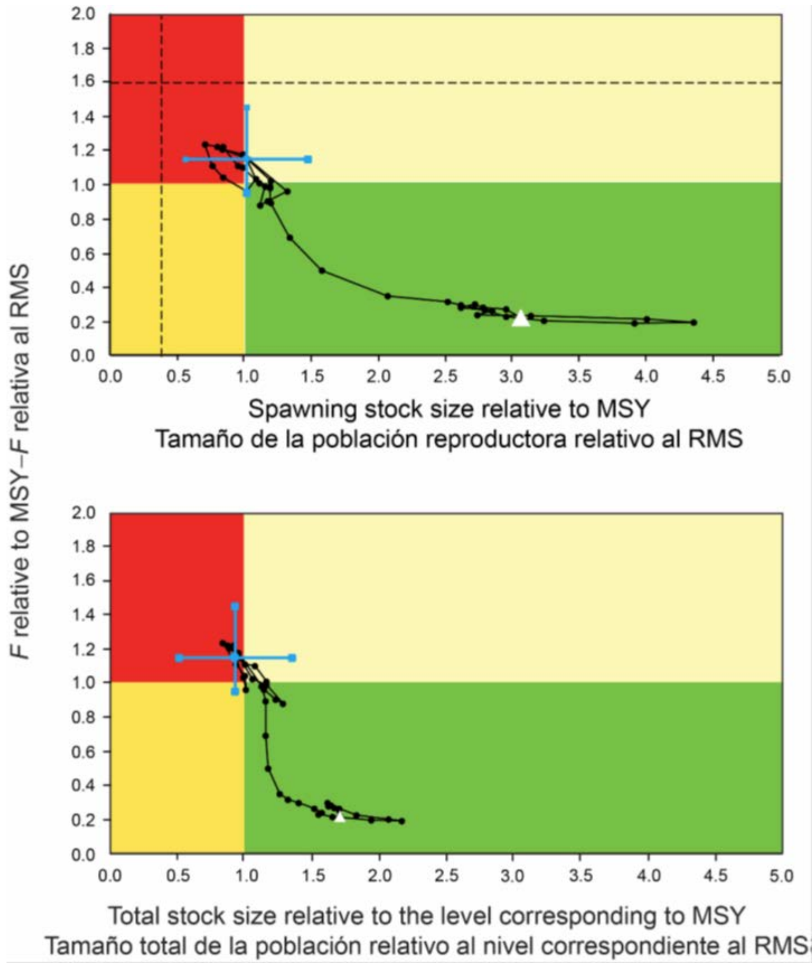


Figure 124. Xu et al. 2018, Figure 5. Kobe (phase) plot of the time series of estimates of spawning stock size (top panel: spawning biomass; bottom panel: total biomass aged 3+ quarters) and fishing mortality relative to their MSY reference points. The colored panels represent target reference points (S_{MSY} and $F_{MSY;}$ solid lines) and limit reference points (dashed lines) of 0.38 S_{MSY} and 1.6 F_{MSY}, which correspond to a 50% reduction in recruitment from its average unexploited level based on a conservative steepness value (h = 0.75) for the Beverton-Holt stock-recruitment relationship. Each dot is based on the average fishing mortality rate over three years; the large dot indicates the most recent estimate. The squares around the most recent estimate represent its approximate 95% confidence interval. The triangle represents the first estimate (1975).

2.6.7.8 EASTERN PACIFIC OCEAN YELLOWFIN TUNA

Stock assessment: Minte-Vera et al. 2018.

Stock status from Executive summary

The assessment of yellowfin tuna in the eastern Pacific Ocean in 2017 uses the same model as the previous assessment, and includes new and updated data.

There is uncertainty about recent and future levels of recruitment and biomass. There may have been three different recruitment productivity regimes since 1975, and the levels of maximum sustainable yield (MSY) and the biomasses corresponding to the MSY (*B*MSY, *S*MSY) may differ among the regimes. The recruitment was below average until 1982, mostly above average from 1983 to 2002, and then mostly below average until 2014. The annual recruitments for 2015 and 2016 were estimated to be at or above average, as is the annual recruitment for 2017. The spawning biomass ratio (SBR) was at or below the MSY level from 2005 through 2017, except during 2008-2010. However, at the start of 2018 it was above the MSY level, following the large recruitments of 2015 and 2016. Under the current (2015-2017 average) fishing mortality, the SBR is predicted to increase in the next two years, and level off at about the MSY level if recruitment is average.

The recent fishing mortality (*F*) is slightly above the MSY level (*F*MSY; *F* multiplier = 0.99). The current spawning biomass (*S*) is estimated to be above that level (*S*recent/*S*MSY = 1.08), as is the recent biomass of fish aged 3 quarters and older (*B*) (*B*recent/*B*MSY = 1.35). As noted in Document SAC-07-05b, these interpretations are uncertain, and highly sensitive to the assumptions made about the steepness parameter (*h*) of the stock-recruitment relationship, the average size of the oldest fish (*L*2), and the rate of natural mortality (*M*). The results are more pessimistic if a stock-recruitment relationship is assumed, if a higher value is assumed for *L*2, or if lower rates of *M* are assumed for adult yellowfin. Previous assessments reported that the data components diverge on their information about abundance levels: results are more pessimistic if the weighting assigned to length-frequency data is decreased, and more optimistic if the model is fitted more closely to the index of relative abundance based on the catch per unit of effort (CPUE) of the northern dolphin-associated purse-seine fishery rather than of the southern longline fishery.

The highest fishing mortality (*F*) has been on fish aged 11-20 quarters (2.75-5 years). The average annual *F* has been increasing for all age classes since 2009, but in 2017 it showed a slight decline for all age groups.

Increasing the average weight of the yellowfin caught could increase the MSY.

The following topics continue to be a priority for future research to improve the yellowfin stock assessment:

- Analysis of changes in spatial distribution of effort for the southern longline fishery, and potential changes in targeting, whether they invalidate the use of the CPUE of this fishery as the main abundance index in the assessment model, and whether a time change in selectivity is needed.
- Implementation of a large-scale tagging program to address hypotheses about stock structure and regional differences in life-history parameters and depletion.
- Improved estimates of growth, particularly for older fish.
- Weighting of the different data sets that are fitted in the assessment model.
- Refinement of fisheries definitions within the assessment model.
- Implementation of time-variant selectivity for purse-seine fisheries on floating objects.
- Exploration of alternative assumptions about stock structure within the assessment model.

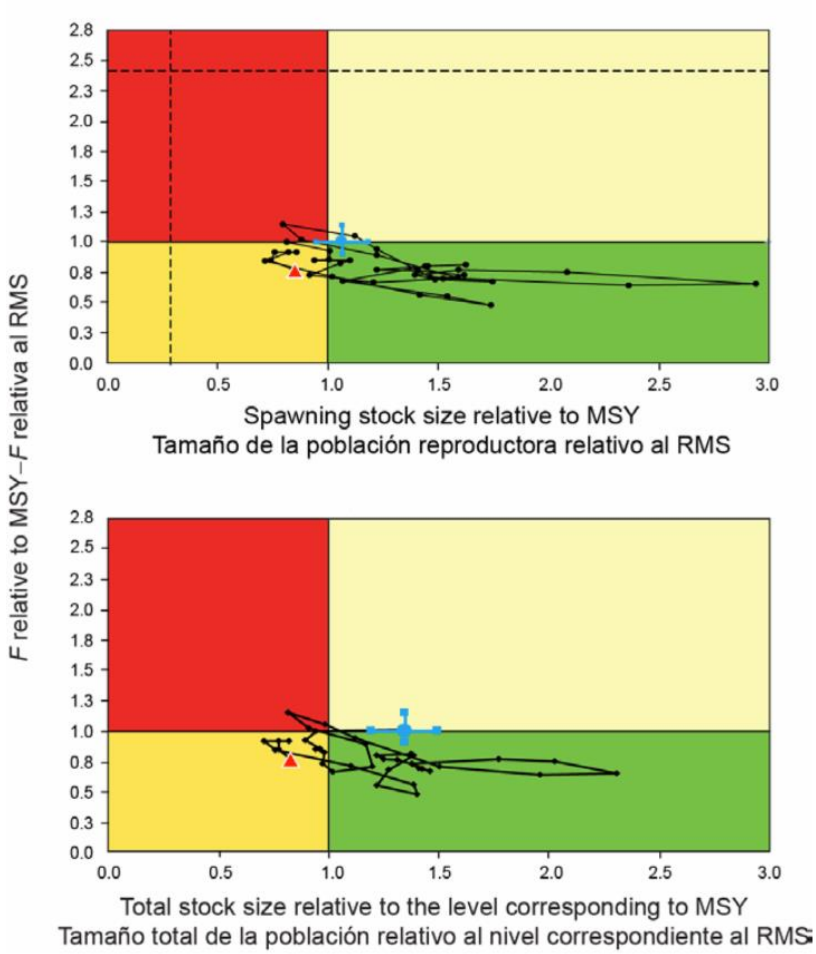


Figure 125. Minte-Vera et al. 2018, Figure 5. Kobe (phase) plot of the time series of estimates of stock size (top: spawning biomass; bottom: total biomass of fish aged 3 quarters and older) and fishing mortality relative to their MSY reference points. The panels represent target reference points (S_{MSY} and F_{MSY}). The dashed lines represent the interim limit reference points of 0.28 *S_{MSY} and 2.42*F_{MSY}, which correspond to a 50% reduction in recruitment from its average unexploited level based on a conservative steepness value (h = 0.75) for the Beverton-Holt stock-recruitment relationship. Each dot is based on the average exploitation rate over three years; the large red dot indicates the most recent estimate. The squares around the most recent estimate represent its approximate 95% confidence interval. The triangle is the first 3-year period (1975-1977)

Table 41. 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_{2015}/SB_{MSY}=2.56, $SB_{2015}/SB_{F=0}$=0.58	No	No	McKechnie et al. (2016) WCPFC (2017)	>0.5 yr^{-1}	0.5 B_{MSY}
Skipjack Tuna (EPO)	NA	NA	NA	NA	NA	NA	Maunder (2018)	NA	NA
Yellowfin Tuna (WCPO)	F/F_{MSY}=0.74	No	No	$SB_{2012-2015}/SB_{MSY}$=1.41, $SB_{2012-2015}/SB_{F=0}$=0.33	No	No	Tremblay-Boyer et al. (2017) WCPFC (2017)	0.8-1.6 yr^{-1}	0.5 B_{MSY}
Yellowfin Tuna (EPO)	F/F_{MSY}=1.01	TBD[2]	Not applicable	$SB_{2015-2017}/SB_{MSY}$=1.08, $B_{2015-2017}/B_{MSY}$=1.35	No	No	Minte-Vera et al. (2018)	0.2-0.7 yr^{-1}	0.5 B_{MSY}
Albacore (S. Pacific)	F/F_{MSY}=0.20	No	No	$SB_{2013-2016}/SB_{MSY}$=3.3, $SB_{2013-2016}/SB_{F=0}$=0.52,	No	No	Tremblay-Boyer et al. (2018) WCPFC (2018)	0.3 yr^{-1} 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/F_{MSY}=0.77	No	No	$SB_{2012-2015}/SB_{MSY}$=1.38, $SB_{2012-2015}/SB_{F=0}$=0.36	No, because SSB>MSST	No	Vincent et al. (2018) WCPFC (2018)	0.4 yr^{-1}	0.6 B_{MSY}
Bigeye Tuna (EPO)	NA	NA	NA	NA	NA	NA	Maunder et al. (2018)	NA	NA
Pacific Bluefin Tuna	F/F_{MSY} =1.17	Yes, because F>MFMT	Not applicable	SB_{2016}/MSST=0.21	Yes, because SSB<MSST	Not applicable	ISC (2018a)	0.25-1.6 yr^{-1}	~0.75 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 Marlin (Pacific)	F/F_{MSY}=0.81	No	Unknown	$SB_{2012-2014}/SB_{MSY}$=1.23	No	Unknown	ISC (2016)	0.22-0.42 yr^{-1}	~0.7 B_{MSY}
Swordfish (WCNPO)	$F_{2013-2015}/F_{MSY}$=0.45	No	Unknown	SB_{2016}/SB_{MSY}=1.87	No	Unknown	ISC (2018b)	0.22-0.42 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/F_{MSY}=1.49	Yes, because F>MFMT	Not applicable	SB_{2013}/SB_{MSY}=0.39	Yes, because SSB_{2013}<MSST	Not applicable	ISC (2015)	0.4 yr^{-1}	0.6 SB_{MSY}
Striped Marlin (NEPO)	Not provided in assessment	No	No	$SB_{(2009)}/SB_{MSY}$=1.5	No	Unknown	Hinton and Maunder (2011)	0.5 yr^{-1}	0.5 B_{MSY}
Blue Shark (N. Pacific)	F/F_{MSY}=0.38	No	Unknown	$SB_{2012-2014}/SB_{MSY}$=1.69	No	Unknown	ISC (2017a)	0.145-0.785 yr^{-1}	~0.8 B_{MSY}
Oceanic white-tip shark (WCPO)[3]	F/F_{MSY}=6.69	Yes	Not applicable	SB/SB_{MSY}=0.15	Yes	Not applicable	Rice and Harley (2012)	0.18 yr^{-1}	0.82 B_{MSY}
Silky shark (WCPO)[3]	F/F_{MSY}=1.61	Yes	Not applicable	SB_{2016}/SB_{MSY}=1.18, $SB_{2018}/SB_{F=0}$=0.47	No	Unknown	Clarke et al. (2018) WCPFC (2018)	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/F_{MSY}=0.62	No	Unknown	SA_{2016}/SA_{MSY}=1.36	No	Unknown	ISC (2018c)	0.128 yr^{-1}	0.872 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
Common thresher shark (N. Pacific)	F/F_{MSY}=0.21	No	Unknown	SB/SB_{MSY}=1.3	No	Unknown	Teo et al. (2018)	0.04 yr^{-1}	0.96 B_{MSY}
Bigeye thresher shark (N. Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Pelagic thresher shark (N. Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Salmon shark (N. Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Mahimahi (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Wahoo (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Opah (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Pomfret (family 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

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
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 2014-2018, as reported to the WCPFC (NMFS 2019). The catches for 2018 are preliminary.

Table 42. U.S. and Territorial longline catch (mt) by species in the WCPFC Statistical Area, 2014–2018

	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				
	2018	**2017**	**2016**	**2015**	**2014**	**2018**	**2017**	**2016**	**2015**	**2014**	**2018**	**2017**	**2016**	**2015**	**2014**	**2018**	**2017**	**2016**	**2015**	**2014**	**2018**	**2017**	**2016**	**2015**	**2014**	**2018**	**2017**	**2016**	**2015**	**2014**
Vessels	136	136	133	135	140	121	119	117	117	109			118	112		113	118	23	22	17	13	15	20	21	23	150	150	151	156	162
Species																														
Albacore, NPO	59	74	208	197	178											11	17	34	19							70	90	243	217	186
Albacore, SPO				0																	1,416	1,411	1,517	1,855	1,430	1,416	1,411	1,517	1,855	1,430
Bigeye tuna	3,392	2,948	3,747	3,427		993	999	879	999	1,000			932	856		798	1,346	586	441		47	65	72	116	82	5,230	5,357	6,216	5,840	5,141
Pacific bluefin tuna	0	1	0													0	0				1	2	0	6	3	1	2	1	6	3
Skipjack tuna	105	156	186	176	167											15	36	26	11	9	67	64	94	67	116	187	255	306	254	291
Yellowfin tuna	1,868	1,750	1,093	681	567											209	312	175	105	30	246	538	386	255	424	2,324	2,600	1,654	1,041	1,021
Other tuna			0	0														0										0	0	0
TOTAL TUNA	**5,424**	**4,928**	**5,234**	**4,482**	**4,734**	**993**	**999**	**879**	**999**	**1,000**			**932**	**856**		**1,034**	**1,710**	**821**	**577**	**283**	**1,776**	**2,079**	**2,069**	**2,299**	**2,055**	**9,227**	**9,717**	**9,936**	**9,214**	**8,072**
Black marlin		0	1	0	1												0		0	0		0					1	1	0	1
Blue marlin	529	485	419	445	428											38	87	57	55	31	32	39	30	25	28	598	612	506	525	486
Sailfish	9	9	15	11	15											1	2	2	2	0	1	1	2	2	2	11	12	19	15	17
Spearfish	171	205	251	188	163											15	27	28	15	11	1	2	2	1	1	187	234	281	204	175
Striped marlin, NPO	332	280	280	378	343											44	50	48	36	14						375	330	327	414	357
Striped marlin, SPO																					1	2	2	3	7	0	2	2	3	7
Other marlins	1	1	1	1													0		0							1	1	1	1	0
Swordfish, NPO	590	918	596	665	865											41	49	43	24	15						631	967	639	690	880
Swordfish, SPO																					6	6	6	8	10	6	6	6	8	10
TOTAL BILLFISH	1,631	1,899	**1,562**	**1,688**	**1,813**											**138**	**215**	**179**	**133**	**72**	**41**	**50**	**41**	**40**	**47**	**1,810**	**2,164**	**1,782**	**1,861**	**1,932**
Blue shark																		0			3	1	1	1	1	3	1	1	1	1
Mako shark	36	30	37	35	35											5	5	9	4	2	0	0	0			42	36	46	39	37
Thresher	2	2	3	5	5												0	0	1	1	1	2	0			2	5	4	6	6
Other sharks		0	0																			0	0				0	0		
Oceanic whitetip shark																							0							
Silky shark		0																			0					0				
Hammerhead shark			0																									0		
Tiger shark																														
Porbeagle																														
TOTAL SHARKS	**38**	**32**	**40**	**40**	**40**											**5**	**6**	**10**	**5**	**2**	**4**	**3**	**1**	**1**	**1**	**47**	**42**	**51**	**45**	**43**
Mahimahi	155	143	202	199	236											14	23	28	21	15	2	14	4	6	12	172	180	234	226	263
Moonfish	390	257	304	279	385											58	63	74	55	22	1	1	2	2	1	449	322	380	336	408
Oilfish	98	94	160	165	169											14	22	29	20	13	0	0	2	0	0	112	116	191	185	182
Pomfret	265	260	339	380	373											32	40	46	39	18	0	0	0	0	0	298	300	386	419	392
Wahoo	264	217	309	256	243											34	37	47	27	18	16	49	47	58	75	314	304	403	340	336
Other fish	4	2	7	7	6											0	0	1	1	0	0	0	1	1	0	4	3	9	9	6
TOTAL OTHER	**1,178**	**975**	**1,322**	**1,285**	**1,411**											**153**	**185**	**224**	**164**	**87**	**19**	**66**	**55**	**66**	**89**	**1,349**	**1,225**	**1,602**	**1,515**	**1,587**
GEAR TOTAL	**8,271**	**7,834**	**8,158**	**7,495**	**7,999**	**993**	**999**	**879**	**999**	**1,000**			**932**	**856**	**0**	**1,330**	**2,116**	**1,235**	**878**	**445**	**1,840**	**2,198**	**2,167**	**2,405**	**2,192**	**12,433**	**13,147**	**13,371**	**12,634**	**11,635**

Table 43. U.S. longline catch (mt) by species in the North Pacific Ocean, 2014-2018

	U.S. (ISC)				
	2018	**2017**	**2016**	**2015**	**2014**
Vessels	**145**	**145**	**141**	**143**	**141**
Species					
Albacore, North Pacific	86	95	248	243	208
Albacore, South Pacific					
Bigeye tuna	7,572	7,993	8,229	8,774	7,131
Pacific bluefin tuna	1	1	0	0	0
Skipjack tuna	149	221	240	212	187
Yellowfin tuna	2,496	2,593	1,512	921	658
Other tuna	0	0	0	0	0
TOTAL TUNA	**10,304**	**10,903**	**10,230**	**10,150**	**8,185**
Black marlin	0	1	1	0	1
Blue marlin	663	687	554	631	535
Sailfish	13	15	19	15	19
Spearfish	219	303	340	263	218
Striped marlin, North Pacific	465	406	390	493	426
Striped marlin, South Pacific					
Other marlins	1	1	1	2	
Swordfish, North Pacific	1,053	1,618	1,092	1,516	1,665
Swordfish, South Pacific					
TOTAL BILLFISH	**2,413**	**3,032**	**2,397**	**2,919**	**2,864**
Blue shark			0		
Mako shark	60	71	70	59	53
Thresher	2	4	4	7	7
Other sharks			0		
Oceanic whitetip shark					
Silky shark					

Hammerhead shark					
Tiger shark					
Porbeagle					
TOTAL SHARKS	**62**	**74**	**74**	**66**	**60**
Mahimahi	174	256	296	328	389
Moonfish	449	1,039	982	1,207	1,043
Oilfish	112	153	218	239	235
Pomfret	298	403	471	564	509
Wahoo	331	357	418	354	313
Other fish	5	3	9	8	6
TOTAL OTHER	**1,369**	**2,211**	**2,394**	**2,700**	**2,495**
GEAR TOTAL	**14,149**	**16,220**	**15,094**	**15,835**	**13,603**

Table 44. U.S. longline catch (mt) by species in the Eastern Pacific Ocean, 2014-2018

	All U.S. vessels					**U.S. vessels ≥ 24 m**					**U.S. vessels ≤ 24 m**				
	2018	**2017**	**2016**	**2015**	**2014**	**2018**	**2017**	**2016**	**2015**	**2014**	**2018**	**2017**	**2016**	**2015**	**2014**
Vessels	128	131	123	131	126	30	29	24	30	34	91	102	99	101	92
Albacore, North Pacific	16	5	6	26	23	2	2	2	19	17	13	3	4	7	6
Albacore, South Pacific	0	0	0	0							0				
Bigeye tuna	2,389	2,700	2,084	3,050	2,073	517	491	306	553	508	1,872	2,209	1,778	2,497	1,564
Pacific bluefin tuna	0	1	0	0	0		1			0	0			0	
Skipjack tuna	30	29	29	25	11	9	5	5	5	2	21	25	23	20	9
Yellowfin tuna	419	531	244	134	61	98	85	33	38	18	320	446	211	96	43
Other tuna	0	0	0	0	0						0				
TOTAL TUNA	**2,853**	**3,266**	**2,362**	**3,234**	**2,168**	**626**	**584**	**346**	**615**	**545**	**2,227**	**2,682**	**2,016**	**2,620**	**1,622**
Black marlin	0	0	0	0	0						0	0	0		
Blue marlin	97	115	78	131	76	11	15	7	9	17	86	100	70	123	59
Sailfish	3	4	2	2	4	1	0	0	0	1	2	4	2	2	2
Spearfish	32	71	60	59	44	7	10	7	6	9	25	61	53	53	35
Striped marlin, North Pacific	90	76	62	79	69	15	10	11	9	13	74	66	51	70	55
Striped marlin, South	0		0	0	0	0									

	All U.S. vessels					U.S. vessels ≥ 24 m					U.S. vessels ≤ 24 m				
	2018	**2017**	**2016**	**2015**	**2014**	**2018**	**2017**	**2016**	**2015**	**2014**	**2018**	**2017**	**2016**	**2015**	**2014**
Pacific															
Other marlins	0	0	0	1	0	0	0		0				0	1	
Swordfish, North Pacific	422	651	453	826	786	215	391	253	347	388	207	260	200	479	397
Swordfish, South Pacific	0	0	0	0	0	0									
TOTAL BILLFISH	**644**	**917**	**656**	**1,099**	**978**	**249**	**427**	**279**	**371**	**429**	**395**	**490**	**377**	**728**	**549**
Blue shark			0										0		
Mako shark	19	35	24	20	16	11	21	10	9	10	8	14	14	10	6
Thresher		1	0	2	1		0	0	0			1	0	1	1
Other sharks			0										0		
Oceanic whitetip shark															
Silky shark															
Hammerhead shark															
Tiger shark															
Porbeagle															
TOTAL SHARKS	**19**	**36**	**25**	**21**	**17**	**11**	**21**	**10**	**10**	**10**	**8**	**15**	**14**	**12**	**7**
Mahimahi	57	90	65	108	138	11	11	10	9	35	46	79	56	98	103
Moonfish	930	719	604	872	637	251	162	99	156	165	679	557	506	717	472
Oilfish	30	37	29	54	53	9	7	6	11	16	21	30	23	44	37
Pomfret	91	103	86	145	117	30	24	10	22	30	61	79	76	123	87
Wahoo	91	103	62	72	51	22	17	12	14	12	69	85	50	58	39
Other fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL OTHER	**1,200**	**1,051**	**847**	**1,252**	**997**	**324**	**221**	**136**	**212**	**258**	**876**	**830**	**710**	**1,040**	**739**
GEAR TOTAL	**4,715**	**5,271**	**3,889**	**5,606**	**4,160**	**1,210**	**1,253**	**772**	**1,207**	**1,243**	**3,505**	**4,018**	**3,117**	**4,399**	**2,917**

2.6.9 REFERENCES

Boggs C., Dalzell, P., Essington, T., Labelle, M., Mason, D., Skillman, R. and J. Wetherall, 2000. Recommended overfishing definitions and control rules for the Western Pacific Regional Fishery Management Council's pelagic fishery management plan. SWFSC Admin. Rep. H-00-05. 18 pp.

Clarke, S., Langley, A., Lennert-Cody, C., Aires-da-Silva, A., M.N. Maunder, 2018. Pacific-wide Silky Shark (*Carcharhinus falciformis*) Stock Status Assessment. WCPFC-SC14-2018/SA-WP-08, Busan, Korea, 8–16 August 2018.

Harley, S., Davies, N., Tremblay-Boyer, L., Hampton, J. and S. McKechnie, 2015. Stock assessment for South Pacific albacore tuna. WCPFC-SC11-2015/SA-WP-06, Pohnpei, Federated States of Micronesia, 5–13 August 2015.

Hinton, M.G. and M.N. Maunder, 2011. Status and trends of striped marlin in the Northeast Pacific Ocean in 2009. Inter-American Tropical Tuna Commission, Stock Assessment Reports.

IATTC, 2017. The fishery for tunas and billfishes in the eastern Pacific Ocean in 2016. IATTC Scientific Advisory Committee, 8th Meeting, La Jolla, California, 8–12 May 2017, DOCUMENT SAC-08-03a. 51 p.

ISC, 2014. Report of the fourteenth meeting of the international scientific committee for tuna and tuna-like species in the North Pacific Ocean. Plenary session, 16–21 July 2014, Taipei, Taiwan. 71 p.

ISC, 2015. Report of the fifteenth meeting of the international scientific committee for tuna and tuna-like species in the North Pacific Ocean. Plenary session, 15–20 July 2015 Kona, Hawaii, United States of America. 82 p.

ISC, 2016. Report of the sixteenth meeting of the international scientific committee for tuna and tuna-like species in the North Pacific Ocean. Plenary session, 13–18 July 2016 Sapporo, Hokkaido, Japan. 83 p.

ISC, 2017a. Stock assessment and future projections of blue shark in the north Pacific Ocean through 2015. Paper presented at: 17th Meeting of the ISC. Vancouver, Canada.

ISC, 2017b. Stock assessment of albacore tuna in the north Pacific Ocean in 2017. Paper presented at: 17th Meeting of the ISC.

ISC, 2018a. Stock Assesment of Pacific Bluefin Tuna (*Thunnus orientalis)* in the Pacific Ocean in 2018. Paper presented at: 18th Meeting of the ISC. Yeosu, Republic of Korea.

ISC, 2018b. Stock Assessment for Swordfish (*Xiphias gladius*) in the Western and Central North Pacific Ocean through 2016. Paper presented at: 14th Regular Session of the Scientific Committee of the WCPFC Busan, Republic of Korea. WCPFC-SC14-2018/ SA-WP-06, 8–16 August, 2018. Busan, Republic of Korea. 155 p.

ISC ,2018c. Stock Assessment of Shortfin Mako Shark in the North Pacific Ocean through 2016. Paper presented at: 18th Meeting of the ISC. Yeosu, Republic of Korea.ISC, 2017. Report of the seventeenth meeting of the international scientific committee for tuna and tuna-like species in the North Pacific Ocean. Plenary session, 12–17 July 2017 Vancouver, British Columbia, Canada. 90 p.

Lennert-Cody C, Aires-da-Silva A, Maunder MN. 2018. Updated stock status indicators for silky sharks in the eastern Pacific Ocean, 1994-2017. Paper presented at: 9th Meeting of the Scientific Advisory Committee of the IATTC. La Jolla, California.

Maunder MN. 2018. Updated indicators of stock status for skipjack tuna in the eastern Pacific Ocean. Paper presented at: 9th Meeting of the Scientific Advisory Committee of the IATTC. La Jolla, California.

Maunder, M.N., Lennert-Cody, C.E., and M. Román, 2018. Stock status indicators for bigeye tuna. SAC-09-16, Inter-America Tropical Tuna Commission, Scientific Advisory Committee, Ninth Meeting, La Jolla, CA, 14–18 May 2018.

McKechnie, S., Hampton, J., Pilling, G. and N. Davies, 2016. Stock assessment of skipjack tuna in the western and central Pacific Ocean. WCPFC- SC12-2016/SA-WP-04, Bali, Indonesia, 3–11 August 2016.

McKechnie, S., Pilling, G. and J. Hampton, 2017. Stock assessment of bigeye tuna in the western and central Pacific Ocean. WCPFC-SC13-2017/SA-WP-05, Rarotonga, Cook Islands, 9–17 August 2017.

Minte-Vera, C., Aires-Da-Silva, A. and M. Maunder, 2018. Status of yellowfin tuna in the eastern Pacific Ocean in 2017 and outlook for the future. IATTC Scientific Advisory Committee, 9th Meeting, La Jolla, California, 14–18 May 2018, SAC-09-06. 12 p.

NMFS, 2019. Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics. WCPFC-SC15-AR/CCM-27, Pohnpei, Federated State of Micronesia, 12-20 August 2019.

Rice, J.S. and S.J. Harley, 2012. Stock assessment of oceanic whitetip sharks in the western and central Pacific Ocean. WCPFC-SC8-2012/SA-WP-06, Busan, South Korea, 7–15 August 2012.

Rice, J. and S. Harley, 2013. Updated stock assessment of silky sharks in the western and central Pacific Ocean. WCPFC-SC9-2013/SA-WP-03, Pohnpei, Federated States of Micronesia, 6–14 August 2013.

Secretariat of the Pacific Community, 2017. Western and Central Pacific Fisheries Commission – Tuna Fishery Yearbook 2016. 153 p.

Takeuchi, Y., 2016, L. Tremblay-Boyer, G.M. Pilling and J. Hampton, 2016. Assessment of blue shark in the southwestern Pacific. Scientific Committee Twelfth Regular Session, Bali, Indonesia, August 3–11, 2016, WCPFC-SC12-2016/SA-WP-08 Revision 1. 51 pp.

Teo, S.L.H., Garcia Rodriguez, E.G., and O. Sosa-Nishizaki, 2018. Status of Common Thresher Sharks, *Alopias vulpinus*, Along the West Coast of North America: Updated Stock Assessment Based on Alternative Life History. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-595. p. 287.

Tremblay-Boyer, L., McKechnie, S., Pilling, G. and J. Hampton, 2017. Stock assessment of yellowfin tuna in the western and central Pacific Ocean. WCPFC-SC13-2017/SA-WP-06, Rarotonga, Cook Islands, 9–17 August 2017.

Tremblay-Boyer, Hampton, J., McKechnie, S. and G. Pilling, 2018. Stock assessment of south Pacific albacore tuna. WCPFC-SC14-2018/SA-WP-05, Busan, Korea, 8–16 August 2018.

Vincent, M., Pilling, G. and J. Hampton, 2018. Incorporation of updated growth information within the 2017 WCPO bigeye stock assessment grid, and examination of the sensitivity of estimates to alternative model spatial structures. WCPFC-SC14-2018/SA-WP-05, Busan, Korea, 8–16 August 2018.

Xu, H., Minte-Vera, C., Maunder, M. and A. Aires-da-Silva, 2018. Status of bigeye tuna in the eastern Pacific Ocean in 2017 and outlook for the future. IATTC Scientific Advisory Committee, 9th Meeting, La Jolla, California, 14–18 May 2018, Document SAC-09-05. 14 p.

WCPFC, 2017. Summary Report. Paper presented at: 13th Regular Session of the Scientific Committee of the WCPFC. Rarotonga, Cook Islands.

WCPFC, 2018. Summary Report. Paper presented at: 14th Regular Session of the Scientific Committee of the WCPFC. Busan, South Korea.

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, 2016). 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 126), which is reflected in local culture, customs, and traditions.

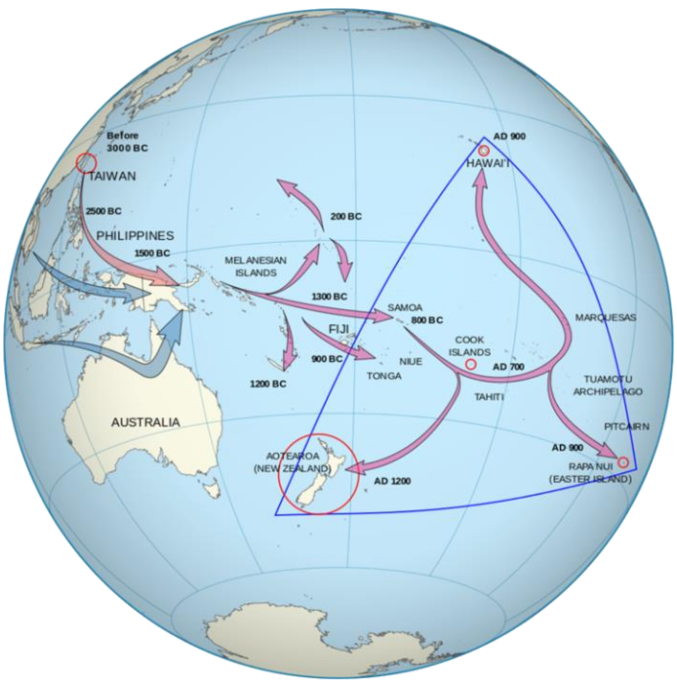


Figure 126. Settlement of the Pacific Islands[1]

[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 173rd meeting held in Wailea, Hawaii, the Council recommended PIFSC conduct an economic cost-benefit analysis on the use of large circle hooks in the American Samoa longline fishery. PIFSC staff prepared and delivered an internal report in October 2018 (Raynor, 2018). During the 174th Council meeting, PIFSC staff reviewed the feasibility assessment with Council staff and Council members. It was determined that no immediate next steps would be taken.

Also at its 173rd meeting held in Wailea, Hawaii the Council recommended NMFS to address data gaps and research needs for ESA-listed shark species, such as

1. improving data collection for oceanic whitetip shark capture data in non-longline pelagic fisheries;
2. conducting outreach to fishermen to improve species identification for shark species to facilitate improved accurate catch data reporting; and

At the 174th Council meeting in Saipan and Guam, PIFSC staff met with members of the Marianas fishing community to discuss their concerns related to shark depredation for both insular and pelagic fisheries across the Marianas Archipelago and consider possible research opportunities.

Current research by PIFSC social scientists is working towards identifying patterns in oceanic whitetip shark interactions, handling practices, and perceptions within West Hawaii's non-longline pelagic fisheries, based on interviews with the fishing community (Oct. 2017 - Sept. 2018). The goal of this research is to identify opportunities and barriers to engaging fishermen in science- and management-based efforts (like shark identification, catch reporting, and mortality reduction). Research results are expected by May 2019.

PIFSC received funding in early 2019 to extent this West Hawaii research to both insular and pelagic fisheries in the Marianas. Research will be conducted in 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.

3.1.2 AMERICAN SAMOA

3.1.2.1 INTRODUCTION

As described in Chapter 1, fishing has played a crucial role in American Samoan culture and society since the Samoan archipelago was populated. An overview of American Samoa history, culture, geography, and relationship with the U.S. is described in Section 1.3 of the American Samoa FEP (WPRFMC, 2016a). 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 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 127). Supporting data for Figure 127 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.

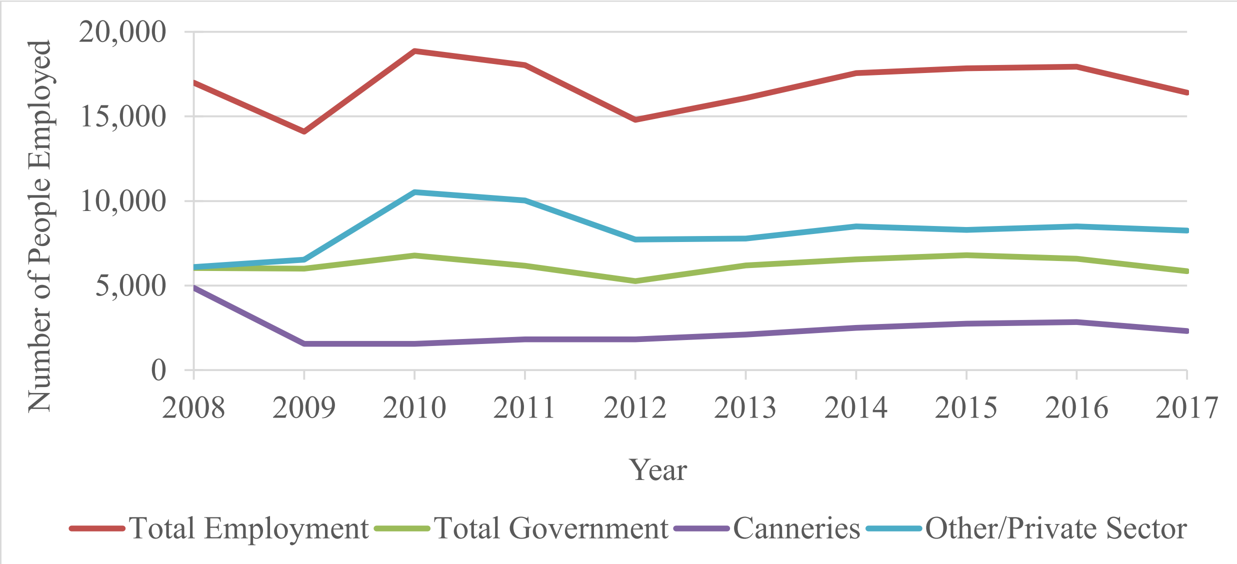


Figure 127. American Samoa Employment Estimates from 2008-2017[1]

[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).

3.1.2.2 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 are 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).

3.1.2.3 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.

3.1.2.3.1 Commercial Participation, Landings, Revenue, and Prices

American Samoa longline includes large longline vessels (> 50ft.) and small longline vessels (alia boats). There were 14 large longline active vessels (> 50 ft.) and only one active small (alia) vessel in 2018. The total landings and revenue presented in the "longline fishery" in this report included the alia longline vessel. American Samoa longline 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. In 2018, the total fleet revenue (estimated landed value) was $4.1 million, and albacore composed of over 86% of the total landed value. Other main species included yellowfin, bigeye, skipjack, and wahoo. The estimated value of the species landed were 10%, 2%, 2%, and 1%, respectively. All the five species are sold to the canneries in American Samoa and they composed of over 99% of the total revenue of the fleet. Figure 128 presents the trends of commercial landings and revenue from 2009-2018. Supporting data for Figure 128 are provided in Table A-113, and the table also shows the average fish price of total longline landings.

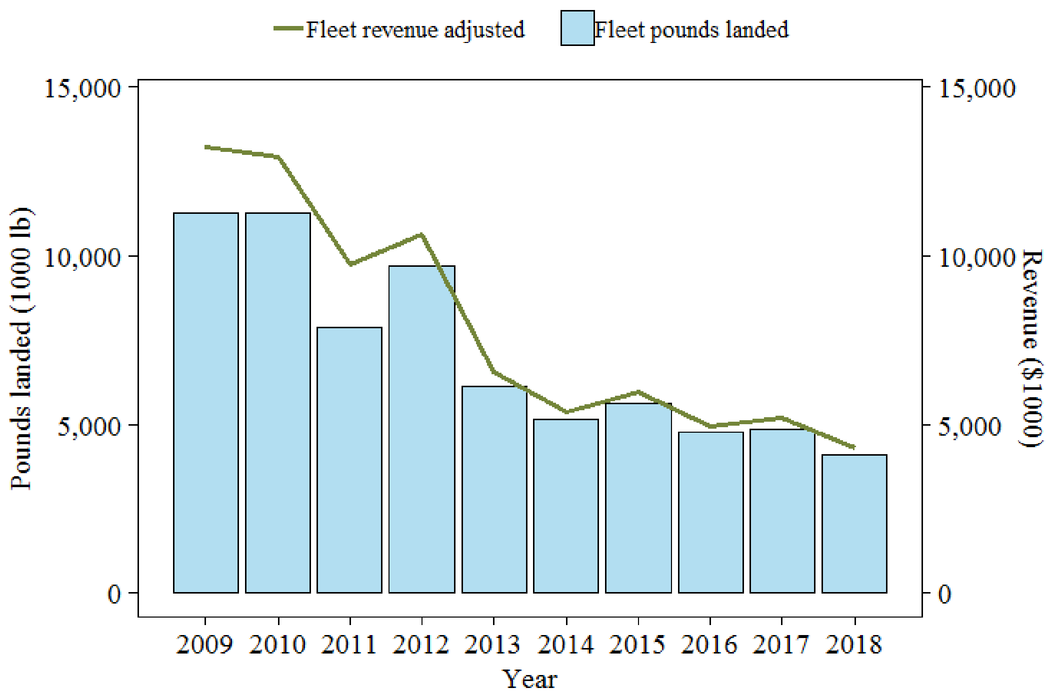


Figure 128. Commercial landings and revenues of the American Samoa longline fishery from 2009-2018 adjusted to 2018 dollars[1]

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

The price data for the five main species harvested by American Samoa longline were collected through in-person interview with fisheries since 2012. The trend of albacore price from 2012 to 2018 is presented in Figure 129. Supporting data for Figure 129 are presented in Table A-114. The albacore price was in the lowest in 2013, dropping from the peak at 2012. The albacore price went up in later years, but did not reach to its highest point. In 2018, the average albacore price was $1.40 per pound (whole weight), or $3,086 per metric ton, $0.24 per pound higher than that in the previous year.

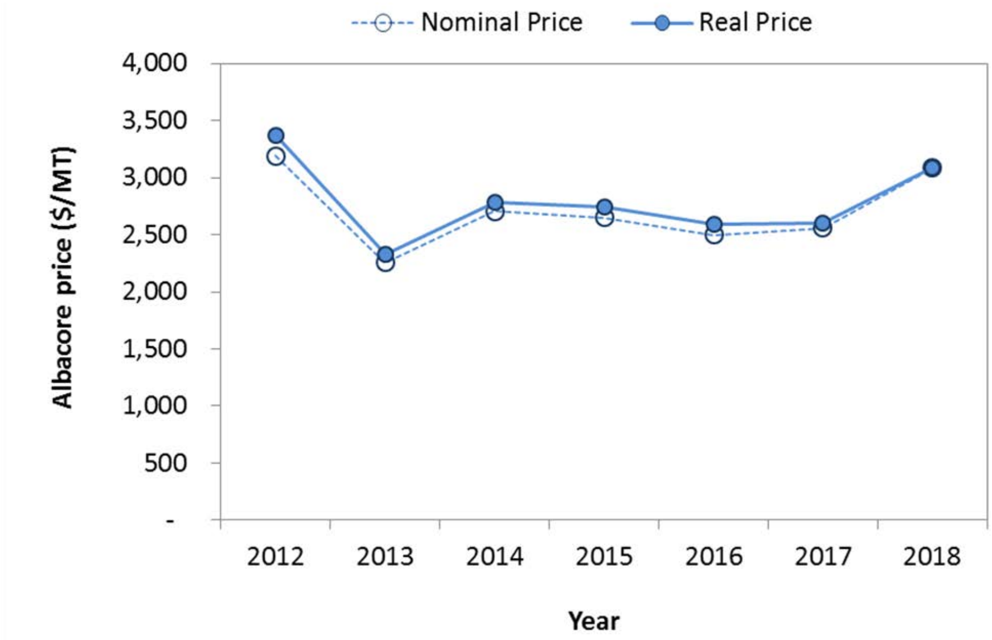


Figure 129. Albacore whole-weight price as reported by American Samoan fishers for 2012-2018 adjusted to 2018 dollars[1]

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

3.1.2.3.2 Cost of Fishing for American Samoa Longline

The American Samoa longline continuous economic data collection program started in 2006, the same time as the Pacific Islands Regional Office (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 were descripted in the NOAA tech memo (Pan, 2018).

Figure 130 shows the cost structure for an average trip of American Samoa longline in 2018, while Figure 131 presents the trends of costs per set for the period of 2009-2018. The data supporting Figure 131 are presented in Table A-115. Using the average 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 compose of about 50% of trip costs. The percentages of fuel costs to total trip costs were relatively lower in 2015-2017, compared to previous years, due to lower fuel price. Thus, the total fishing costs (per set) were also relatedly lower in 2015-2017. However, the cost per set in 2018 was higher than 2017, as Figure 131 shows, due to the fuel price increased to $2.86 per gallon in 2018 from $2.09 per gallon in 2017.

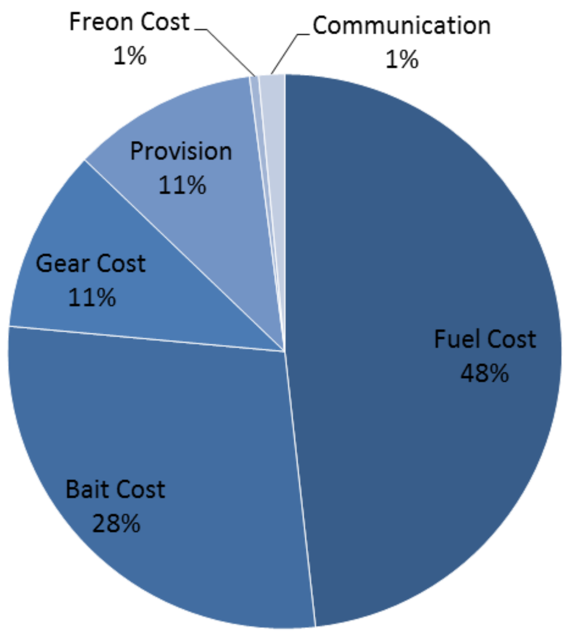


Figure 130. The cost structure for an average American Samoa longline trip in 2018[1]

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

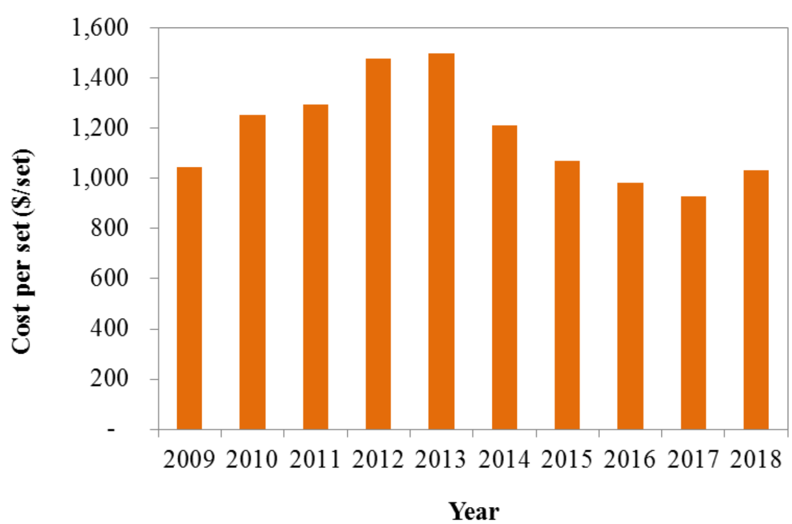


Figure 131. Costs per set[1] for the American Samoa Longline Fishery (not including labor cost and fixed costs)from 2009-2018 adjusted to 2018 dollars[2]

[1] Data source: PIFSC Continuous Economic Data Collection Program (Pan 2018).
[2] Inflation-adjusted revenue (in 2018 dollars) uses the American Samoa Consumer Price Index (CPI) published in (http://doc.as.gov/research-and-statistics/statistical-yearbook/) for 2009-2018.

3.1.2.3.3 Economic Performance Measures

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 term of net revenue and monitor the changes. Figure 132 presents the trends of net revenue per set for the period of 2009 to 2018. The data supporting Figure 132 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 132 shows a downward trend in the economic performance (net revenue) during 2009-2013, but recovered since 2014 and continued to improve to 2018.

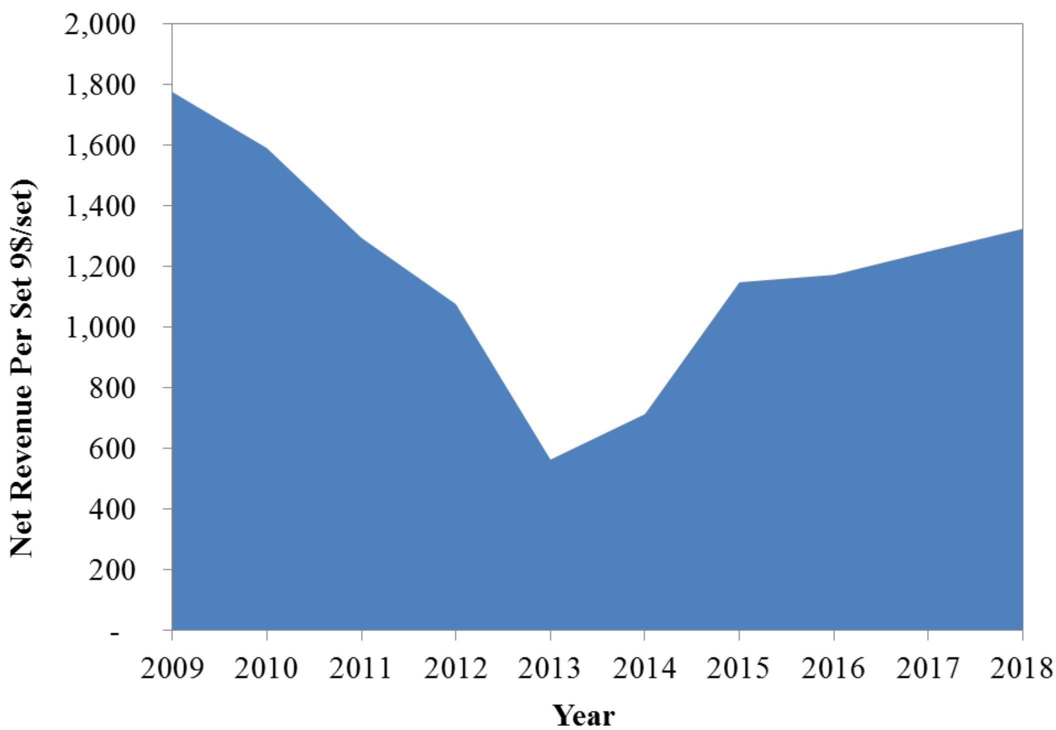


Figure 132. Net revenue per set for the American Samoa longline fishery from 2009-2018 (adjusted to 2018 dollars)[1]

[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 132, while the trends in revenue distribution (Gini coefficient) are shown in Figure 133. 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.

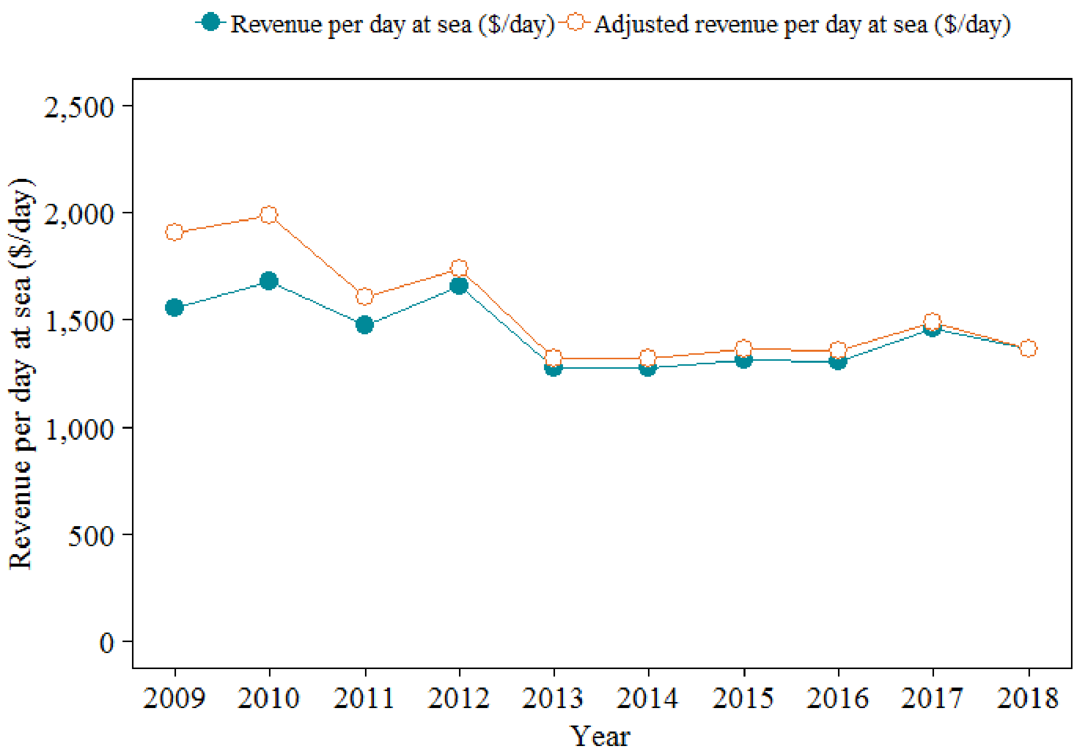


Figure 133. Revenue per-day-at-sea for the American Samoa longline fishery, 2009-2018[1]

[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.

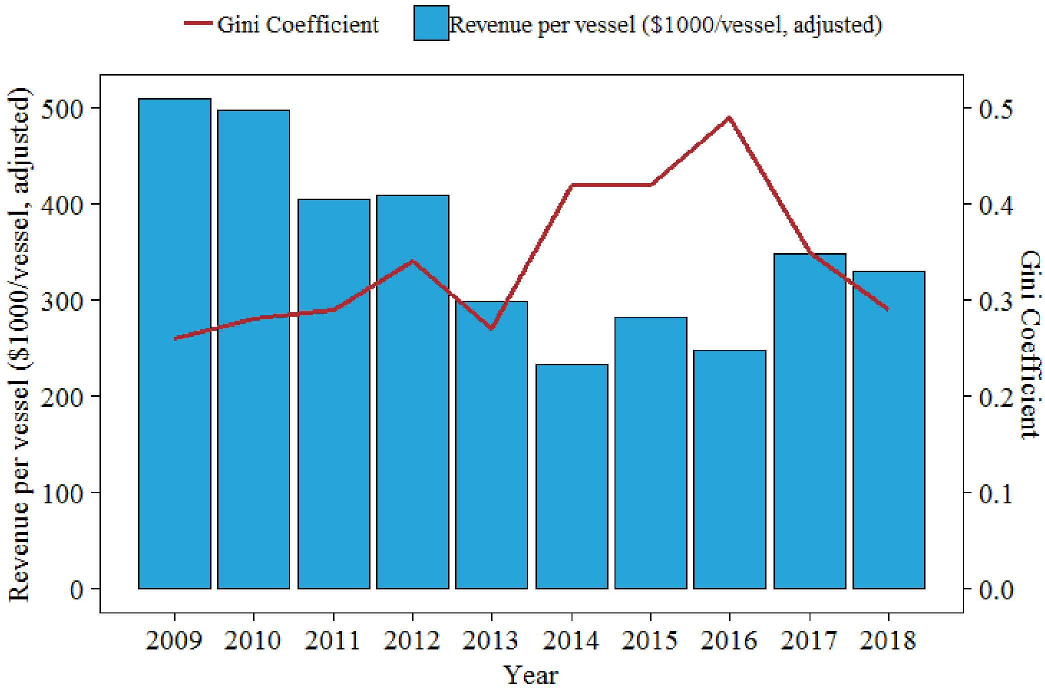


Figure 134. Revenue distribution (revenue per vessel and Gini coefficient) for the American Samoa longline fishery[1], 2009-2018[1]

[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.

3.1.2.4 AMERICAN SAMOA TROLL

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 included in the American Samoa longline section.

3.1.2.4.1 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 135 presents the trends of revenue and pounds sold of the troll fishery for American Samoa for 2009-2018 and Figure 136 presents the price trend of the pelagic price for the PMUS sold by the trollers during 2009-2018. Supporting data for Figure 135 and Figure 136 are presented in Table A-117. Table A-117. In 2018, PMUS pounds sold by trolling were 16,219 lbs and valued at $49,262. On average, the pounds sold recorded were 40% of the total landings during 2009-2018. The annual pounds sold in 2018 were much higher than the previous year. Fish price of pelagic fish was in an increasing trend since 2015.

Please notice 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 respectively, 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. 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, 2018.

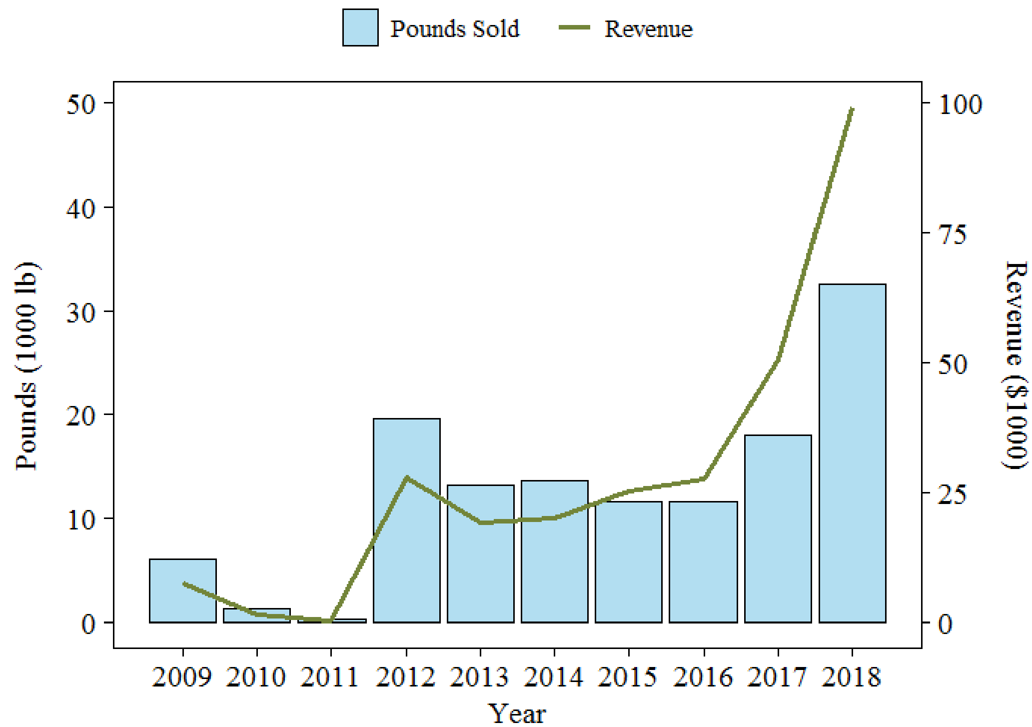


Figure 135. PMUS pounds sold and revenue trend by trolling gear from 2009-2018 adjusted to 2018 dollars[1]

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

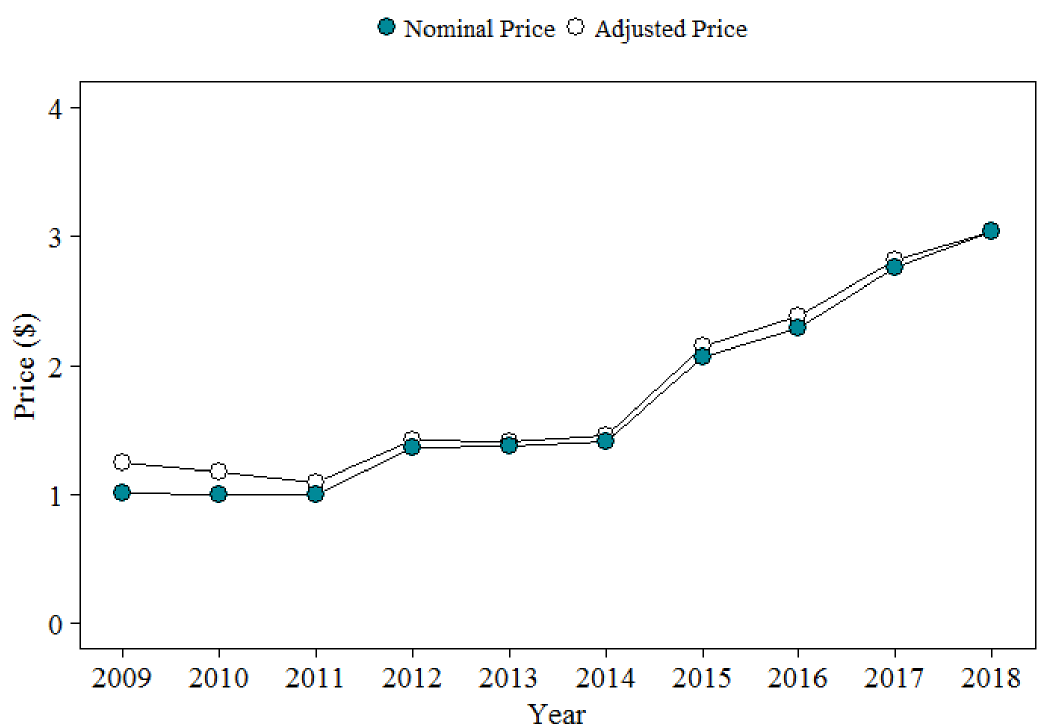


Figure 136. The real and nominal price of PMUS for fish sold by trolling gear from 2009-2018 adjusted to 2018 dollars[1]

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

3.1.2.4.2 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 137 presents the average trip costs for American Samoa troll trips, 2011–2018 (adjusted to 2018 dollars). Supporting data for Figure 137 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 was $79 in 2016, and it went up to $104 in 2017 and $118 in 2018.

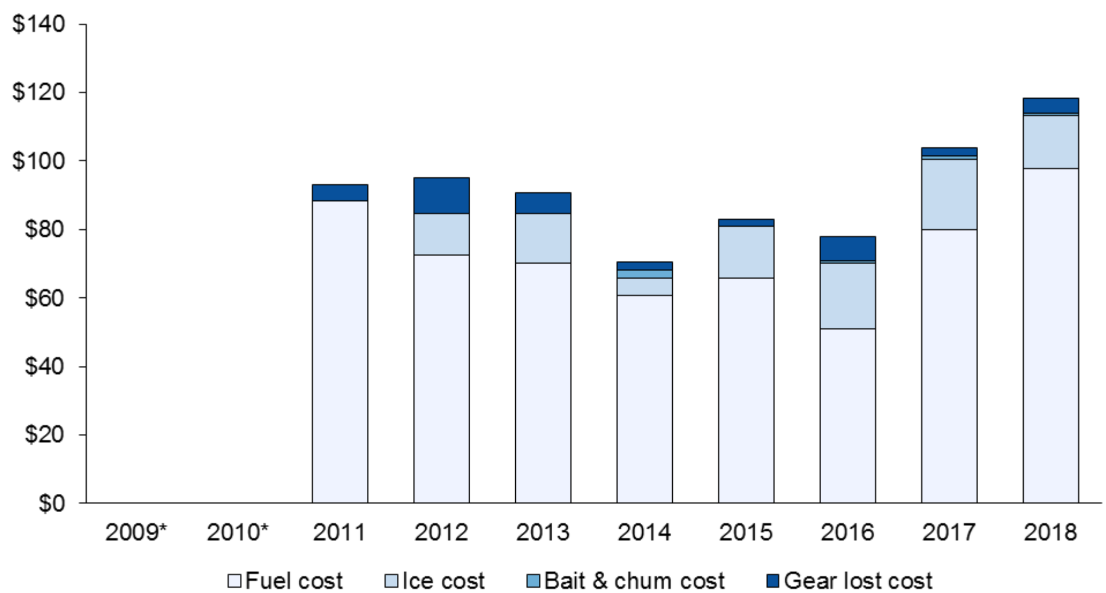


Figure 137. Average trip costs for American Samoa trolling trips from 2011–2018[1] adjusted to 2018 dollars[2]

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

3.1.3 CNMI

3.1.3.1 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, 2016c). 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).

3.1.3.2 PEOPLE WHO FISH

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

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

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

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

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

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

3.1.3.3 CNMI TROLL

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 in 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.

3.1.3.3.1 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 138 and Figure 139 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.

Please notice 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 respectively, 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.

The pelagic fishing is an important commercial fishery in CNMI, and the average annual total pounds sold during the past ten years (2009-2018) were 186 thousand pounds, 50% of the total pounds caught. In 2018, total pounds sold dropped to 158 thousand pounds, lower than the 10 years' average, while the total pounds caught were above the ten years average. Fish price in 2018 was slightly higher than 2017.

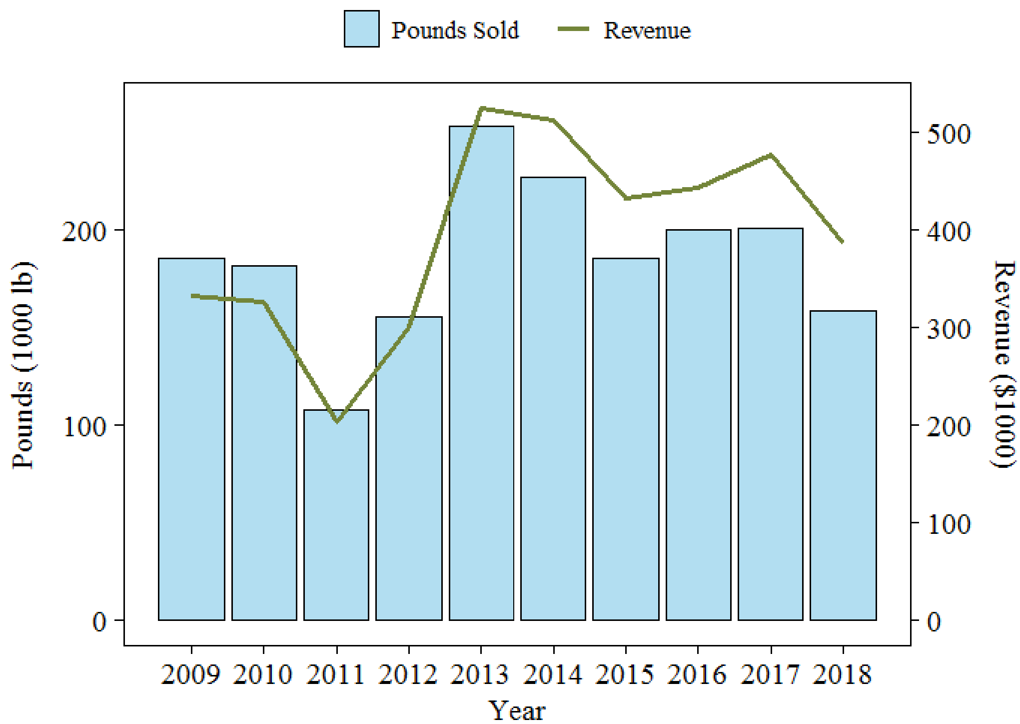


Figure 138. Total PMUS annual pounds sold and revenues in CNMI for all gears from 2009-2018 adjusted to 2018 dollars[1]

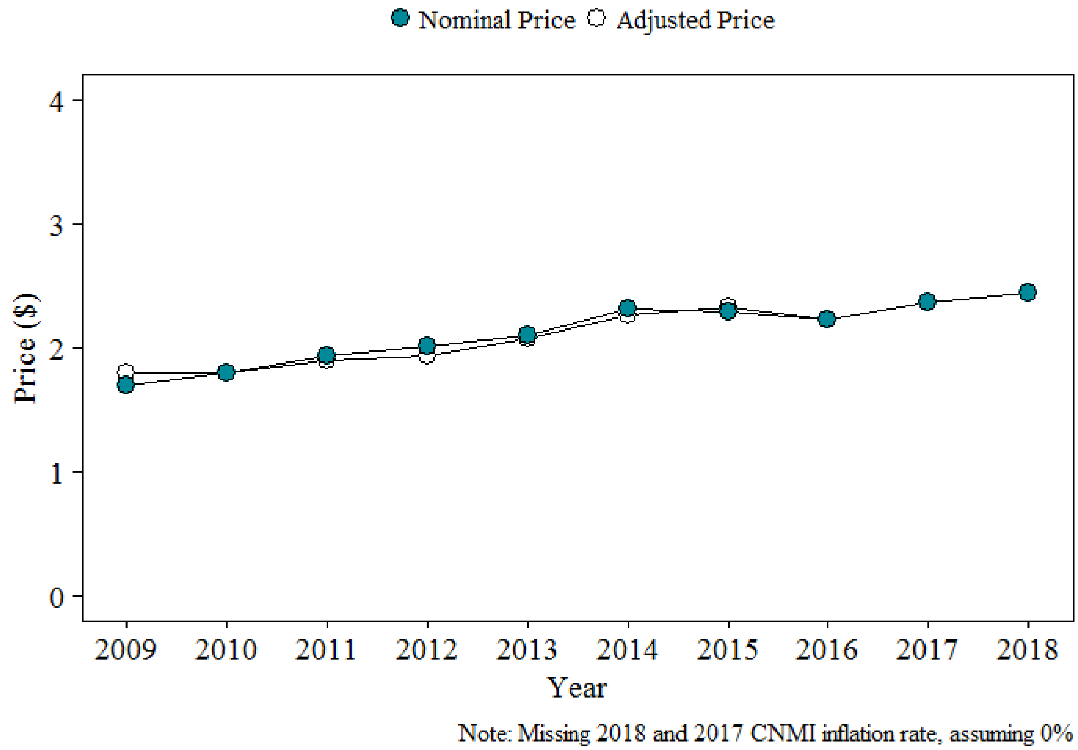


Figure 139. Real and nominal prices of PMUS for fish sold by all gears from 2008-2018[1]

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

3.1.3.3.2 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.

The update for 2018 cost data was not available due to limited observations. Figure 140 presents the average trip costs for CNMI troll trips from 2009 through 2017 (adjusted to 2017 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 2017, the average trip costs of trolling trips were around $76. Supporting data for Figure 140 is presented in Table A-120.

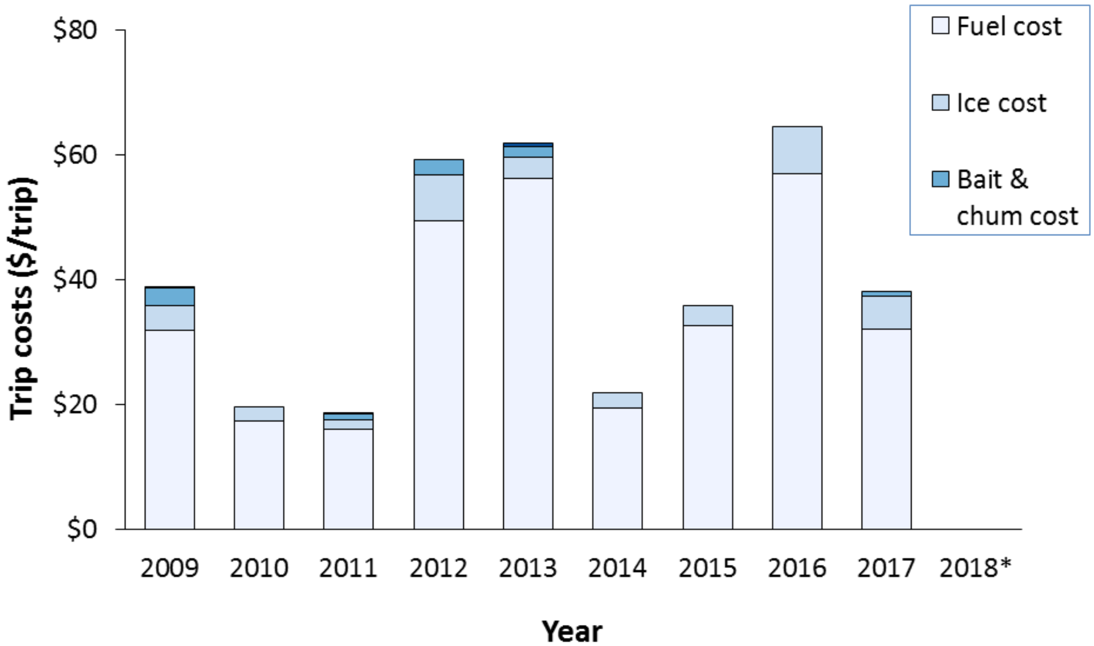


Figure 140. Average cost for CNMI trolling trips from 2009-2017 adjusted to 2017 dollars[1]

[1] Data sourced from PIFSC Continuous Cost Data Collection Program (Chan and Pan, 2019). *2018 data were not available.

3.1.4 GUAM

3.1.4.1 INTRODUCTION

An overview of Guam's history, culture, geography, and relationship with the U.S. is described in Section 1.3 of the Fishery Ecosystem Plan for the Mariana Archipelago (WPRFMC, 2016c). 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.

3.1.4.2 PEOPLE WHO FISH

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

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

3.1.4.3 GUAM TROLLING

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

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

3.1.4.3.1 Commercial Participation, Landings, Revenue, and Prices

This section will describe trends in commercial landings, revenues and prices of PMUS in Guam. Figure 141 presents the trends of pounds sold and revenue of PMUS in Guam fisheries and Figure 142 presents the trend of PMUS price during 2009 to 2018. Supporting data of Figure 141 and Figure 142 are shown in Table A-121. Figure 141 shows a generally declining trend of PMUS pounds sold and revenue in Guam. Although, pounds sold and revenue in 2017 were slightly higher than the previous year (2016), they dropped in 2018. The average of price of all PMUS was relatively flat over the ten year period and it went up slightly since 2016. In 2018, the commercial landings of PMUS were approximately 90,000 lbs., only 10% of the total PMUS landings.

The pelagic fishing is an important commercial fishery in Guam, and the average annual total pounds sold during the past ten years (2008-2018) were near 130 thousand pounds. 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%. Please notice 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 respectively, 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.

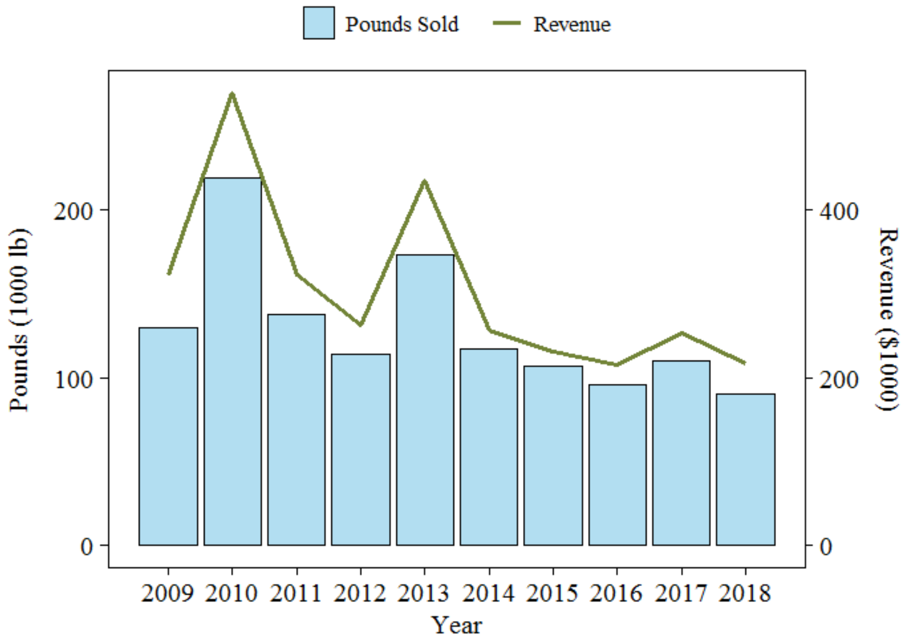


Figure 141. Total PMUS annual pounds sold and revenue in Guam from 2009-2018 adjusted to 2018 dollars[1]

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

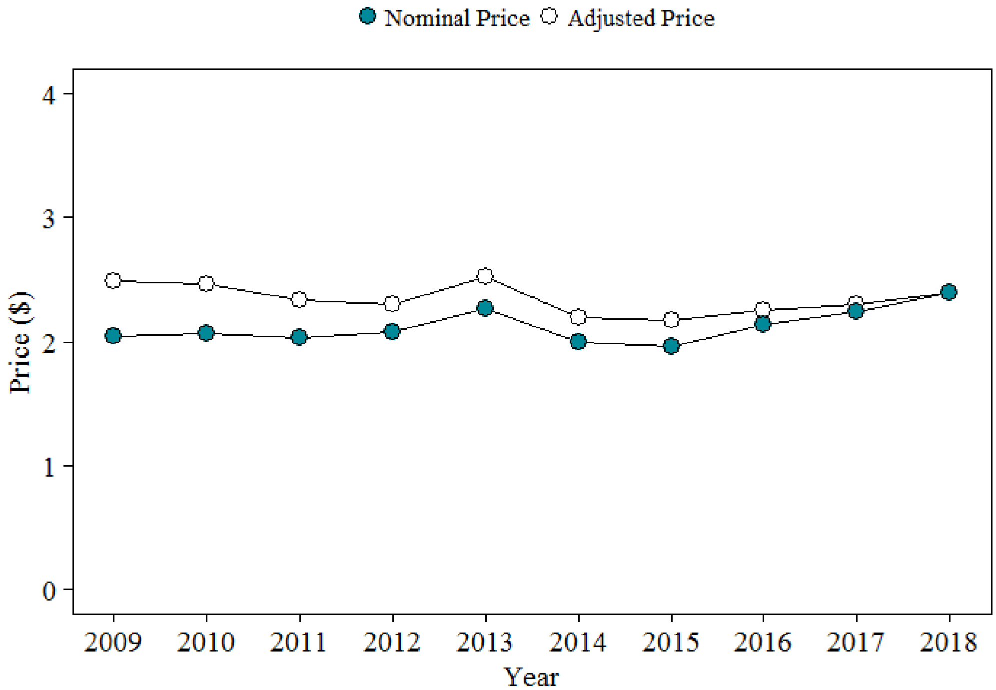


Figure 142. The real and nominal prices of PMUS sold by all gears in Guam from 2009-2018[1]

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

3.1.4.3.2 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.

These data are currently under PIFSC editorial review and future versions of this report will include a time-series of Guam boat-based pelagic trip costs by target species and/or gear (Chan and Pan, in review). Metadata for these data are available online (PIFSC 2016b). Figure 143 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 2018 were $112 in Guam, which was higher than that in the previous year. Supporting data for Figure 143 are presented in Table A-122.

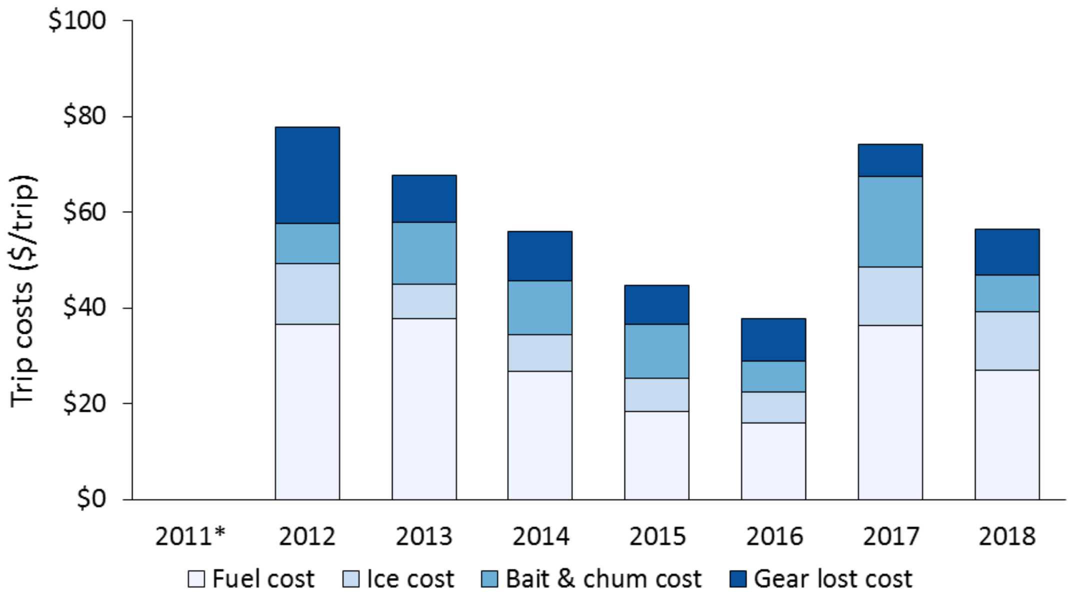


Figure 143. Average cost for Guam troll trips from 2011–2018 adjusted to 2018 dollars[1]

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

3.1.5 HAWAII

3.1.5.1 INTRODUCTION

The geography and overall history of the Hawaiian Archipelago, including indigenous culture and current demographics and description of fishing communities is described in section 1.3 of the Fishery Ecosystem Plan for the Hawaii Archipelago (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 Hawai‘i, with the level of commercial fishing-related employment well above the national average (Richmond et al., 2015). The Fisheries Economics of the United States 2014 report found that the seafood industry (including the commercial harvest sector, seafood processors and dealers, seafood wholesalers and distributors, importers, and seafood retailers) generated $743 million in sales impacts and approximately 10,000 full and part-time jobs that year (National Marine Fisheries Service, 2016). Recreational anglers took 1.4 million fishing trips, and 1,061 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 Hawai’i 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 Hawai’i is estimated at approximately two to three times higher than the entire U.S., and Hawai’i 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 (personal communication, Bottomfish Oral History project, in progress).

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 Hawai‘i'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).

3.1.5.2 PEOPLE WHO FISH

Hawaii includes a mix of commercial, non-commercial, and subsistence characteristics across fisheries. Pelagic fish are caught not only by the industrial-scale Hawaii longline fishery, but also by small boat fishermen. The longline fishery will be addressed in the following section. Within the small boat fleet, there is a nearly continuous gradation from the full-time and part-time commercial fleet to the charter and personal recreation fleets. A single boat (and trip) will often utilize multiple gear types and target fish from multiple fisheries. Thus, other than the longline fishery, the other fisheries are typically not studied individually. Rather, studies have typically been conducted based on ability to reach potential respondents. Studies have targeted fishermen via State of Hawaii Commercial Marine Licenses (CMLs; Chan and Pan, 2017; Madge et al., 2016), shoreline and boat ramp intercepts (Hospital et al., 2011; Madge et al., 2016), and vessel and angler registries (Madge et al., 2016). The 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 45.

Table 45. 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 motor boat (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 Hawaiʻi DAR have been collecting information on recreational fishing in Hawaiʻi, administered through the Hawaiʻi 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.

3.1.5.3 HAWAII LONGLINE

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

Owners and operators of Hawai'i'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 Hawai'i. 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.

3.1.5.3.1 Commercial Participation, Landings, Revenue, and Prices of Hawaii Longline

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 the fish auction (United Fishing Agency) in Honolulu while some of catches were landed and sold in the West Coast. During the period of 2009-2018, the fish landed and sold in the West Coast 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 the data quality concern on the commercial data of the West Coast landings.

The total revenue presented in Figure 144 included the revenue generated (landed and sold) only from Hawaii markets, not including the portion that landed and sold in the West Coast, which was less than 10% by estimation. 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 2009-2015, and leveled out in resent three years. Pounds sold in 2018 were 26.8 million pounds, valued at $102.3 million and priced at $3.82/lb in average. Supporting data of Figure 144 are presented in Table A-123.

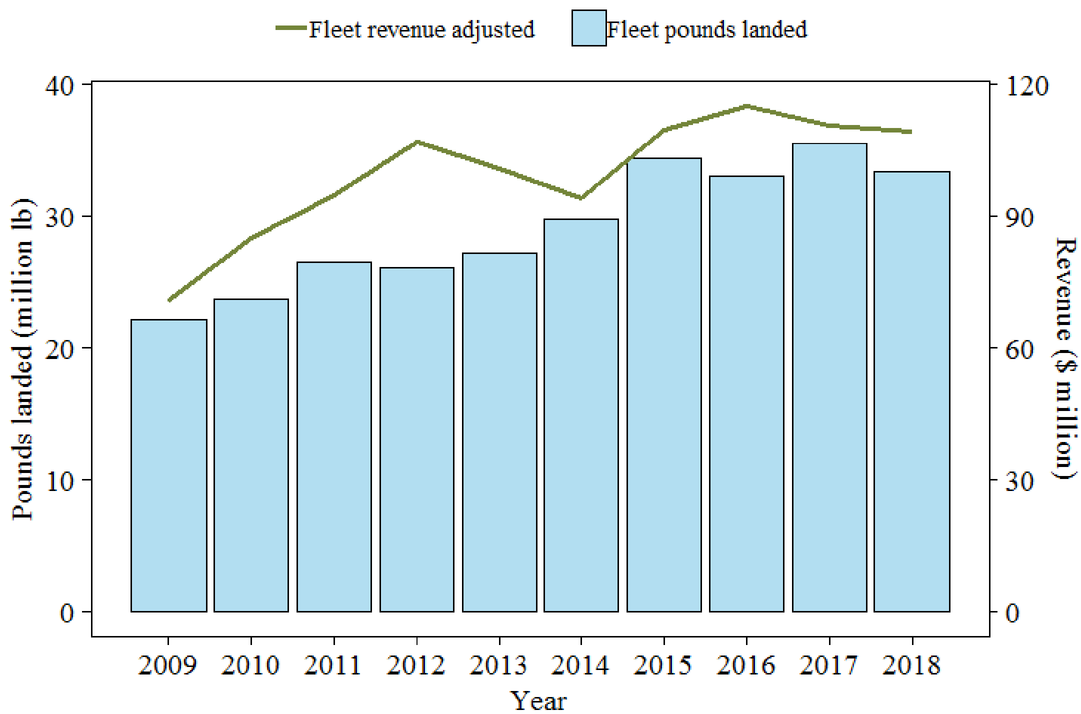


Figure 144. Commercial landings and revenue of Hawaii-permitted longline fleet from Hawaii 2009-2018 adjusted to 2018 dollars[1]

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

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 145 shows the trends of the revenue composition from the main species (bigeye, swordfish, yellowfin, and all others) during 2009-2018, while Figure 146 shows the price trends for bigeye, swordfish, and yellowfin for the same period. Supporting data for Figure 145 and Figure 146 are presented in Table A-124 and Table A-125, respectively.

It can be observed that the bigeye composed of main portion of the revenue of the longline fleet and it increased substantially during the period of 2009-2015, but dropped in 2016 and 2017 and flatted in 2018 compared to 2017. Revenue from yellowfin and other species also shows slow increase in general, while the revenue from swordfish declined for the same period. In 2018, bigeye composed of 63.6% of the Hawaii permitted longline vessels landed in Hawaii, followed by yellowfin, 18%, and swordfish 4%. Fish price fluctuated in general. Bigeye price peaked in 2012 and swordfish price peaked in 2013 before declining in recent years. Bigeye price picked up slightly in 2016 and 2018 while swordfish fish price decreased in 2017 and 2018. Yellowfin price varied over time, and it peaked in 2013.

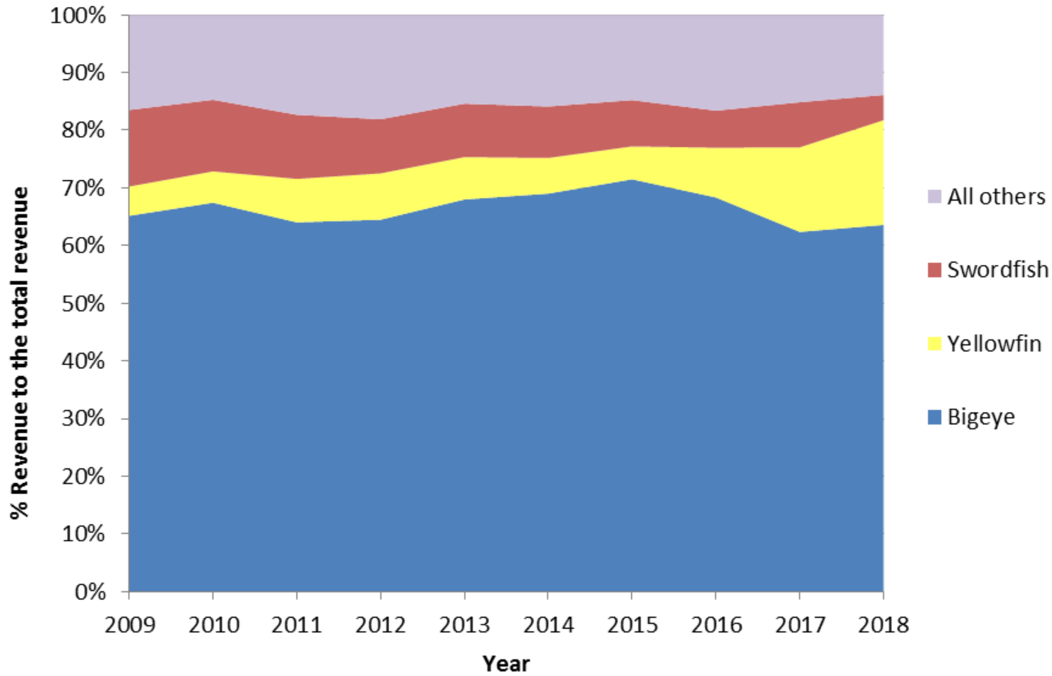


Figure 145. Trends in Hawaii longline revenue species composition from 2009-2018[1]

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

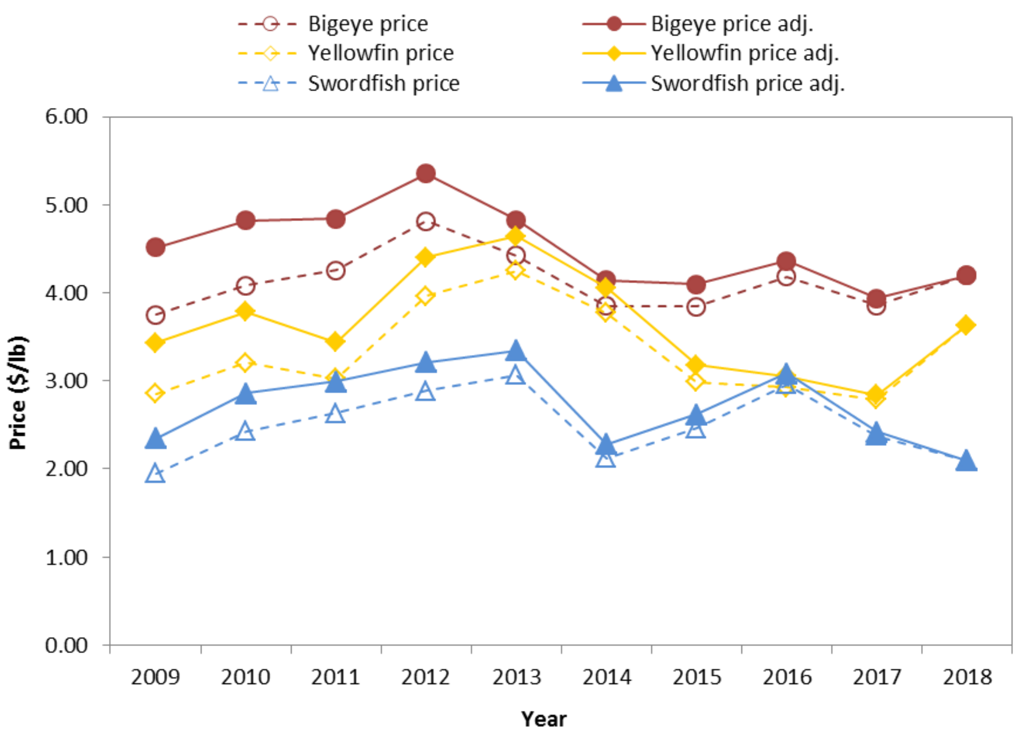


Figure 146. Price trends of nominal and adjusted of three main species (bigeye, yellowfin, and swordfish) from 2009-2018[1]

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

3.1.5.3.2 Fishing Costs of Hawaii Longline

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 Pacific Islands Fishery Science Center (PIFSC) Economics Program and the NOAA Observer Program managed by the Pacific Islands Regional Office (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, Curtis, and Travis, 1996; O'Malley and Pooley, 2003; 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 wouldn't 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 tech memo (Pan, 2018).

This report assessed the trip-level fishing cost for the two types of fishing trips (shallow set components of the fisheries respectively, since a swordfish trip often has a longer trip length compared to the tuna trip. The average trip length for swordfish trips was 32 days per trip during the period of 2009-2018, while it was 23 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 147 and Figure 148 show the cost structures of an average tuna trip and swordfish trip in 2018, respectively. In 2018, fuel cost was the leading item of trip costs, comprising 51% of trip costs for tuna trip costs. Bait was the second largest item making up 23% 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 49% of swordfish trip costs, while bait cost made up 19% of swordfish trip costs. The cost of the lightstick gear is unique to swordfish fishing, and it made of 10% of the total trip costs of swordfish trips.

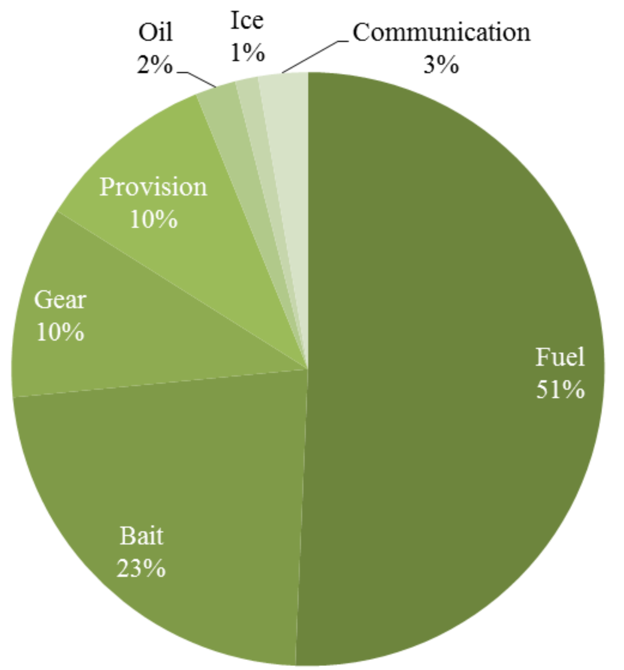


Figure 147. The cost structure of an average deep-set fishing trip in 2018[1]

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

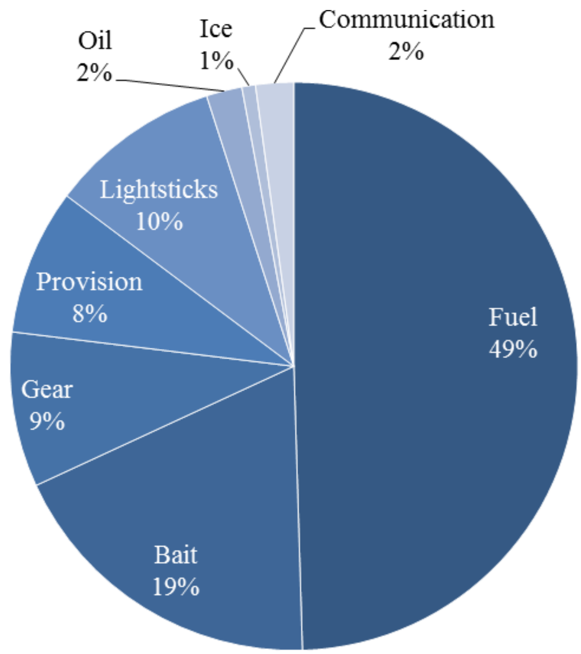


Figure 148. The cost structure of an average shallow-set fishing trip in 2018[1]

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

Figure 149 and Figure 150 show the trend of average trip costs and one standard deviation for the tuna and swordfish trips respectively of the Hawaii longline fishery for the 2009-2018 period.

Supporting data for Figure 149 and Figure 150 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 2009 to 2018. Swordfish trip costs more than tuna trips. In 2018, the average trip costs for swordfish trips were $43,390 while it was $25,329 for tuna trips.

In term of trend, the trip costs of tuna trips peaked in 2012, while swordfish trips peaked in 2011. Since then, the fishing costs turned downward, until 2018. Tuna trip costs went up slightly compared to the previous year (2017), but swordfish trip costs went up 15%.

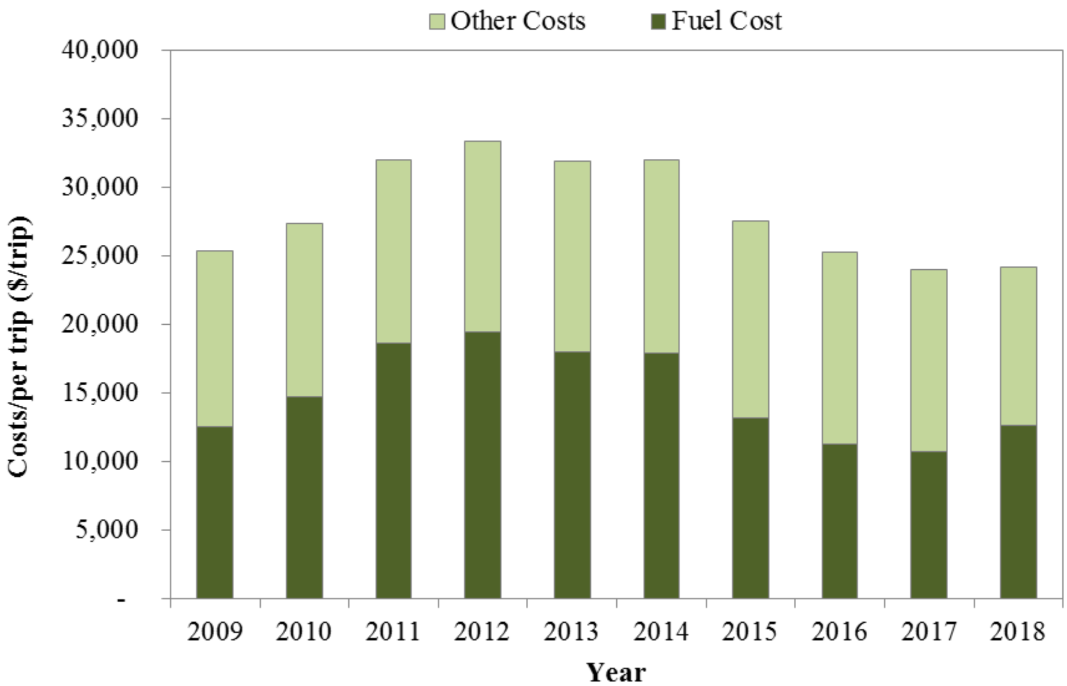


Figure 149. The trend of average trip costs with standard deviation for Hawaii longline deep-set fishing from 2009-2018 adjusted to 2018 dollars[1]

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

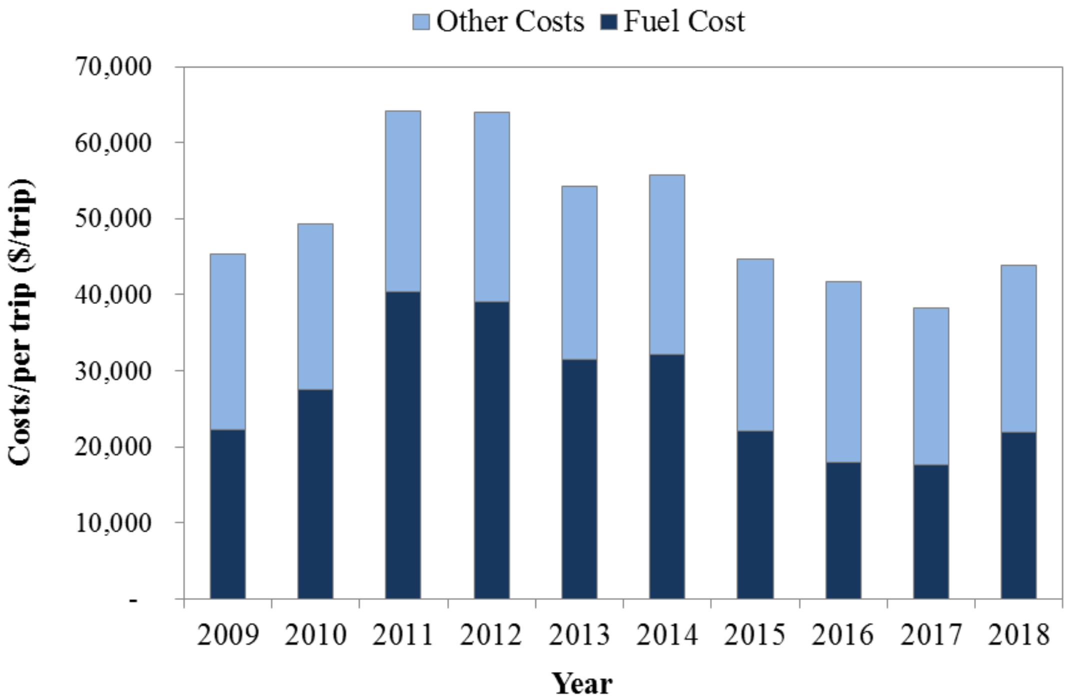


Figure 150. The trend of average trip costs with standard deviation for Hawaii longline shallow-set fishing from 2009-2018 adjusted to 2018 dollars[1]

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

3.1.5.3.3 Economic Performance Measures of Hawaii Longline

The continuous economic data collection program allows for the monitoring of movement in fishing cost over time. Compiling the revenue data allows for the measurement of the economic performance in term of net revenue and monitor the changes. Figure 151 and Figure 152 present the trends of trip level revenue, net revenues, and costs for the period of 2009 to 2018 for the two trip types respectively. Supporting data Figure 151 and Figure 152 are presented in Table A-128 and Table A-129. The net revenue of tuna (deep-set) fishing shows an upward trend during the period of 2009 to 2018 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.

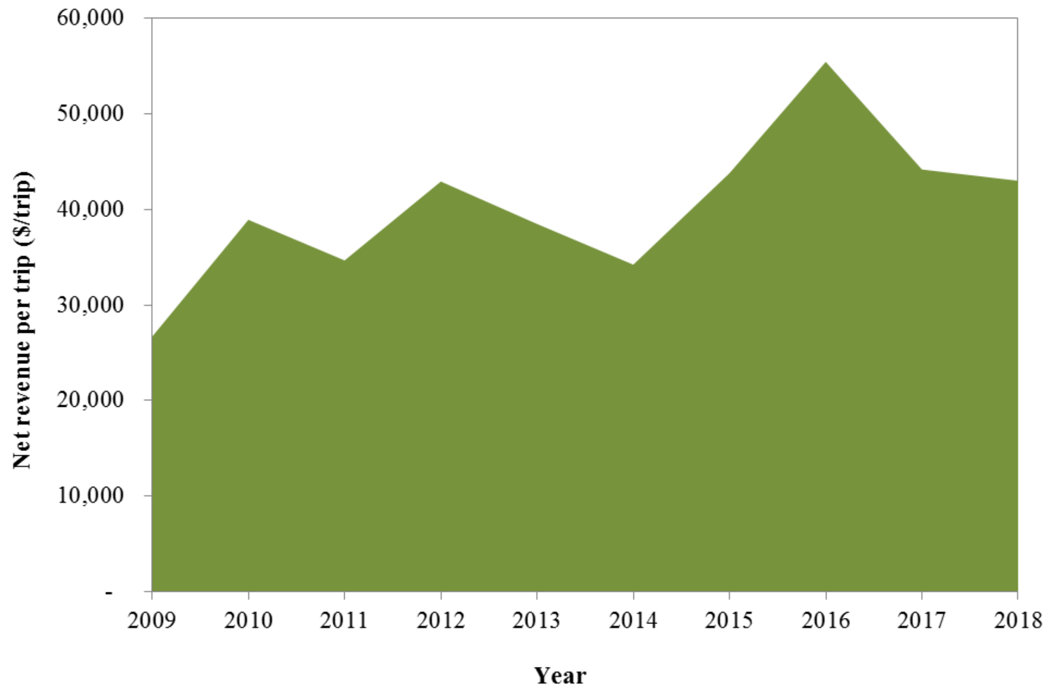


Figure 151. Average net revenue per trip for Hawaii longline deep-set trips from 2009-2018 adjusted to 2018 dollars[1]

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

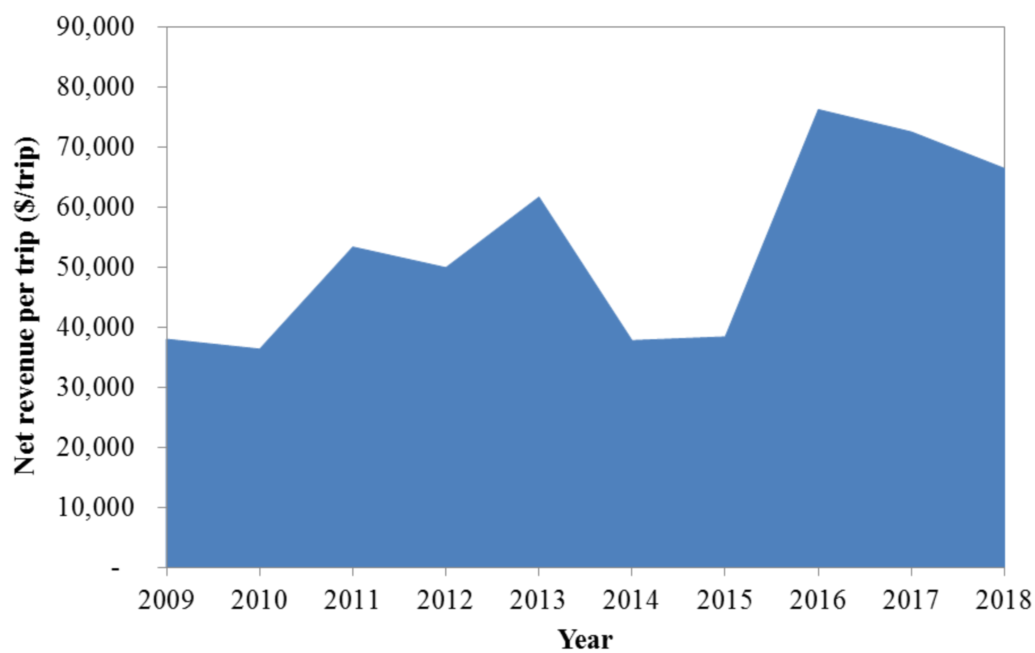


Figure 152. Average net revenue per trip for Hawaii longline shallow-set trips from 2009-2018 adjusted to 2018 dollars[2]

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 153 and Figure 154 presents the revenue per-day-at-sea and revenue per vessel and the Gini coefficient for the Hawaii longline fisheries during the period of 2009 to 2018. Supporting data for Figure 153 and Figure 154 are presented in Table A-130.

As an economic performance indicator, the revenue per-day-at-sea of the Hawaii longline fisheries presents an upward trend up to 2016. Similar to the indication from trip net revenue, the economic performance of the Hawaii longline, for deep-set tuna fishing and sallow-set swordfish fishing, declined in 2017 and 2018. Another economic performance indicator, the revenue per vessel also shows an upward trend in the beginning of the time period, but steady in recent four years. The income distribution (Gini coefficient in term of revenue per vessel) among vessels is relatively stable in the period.

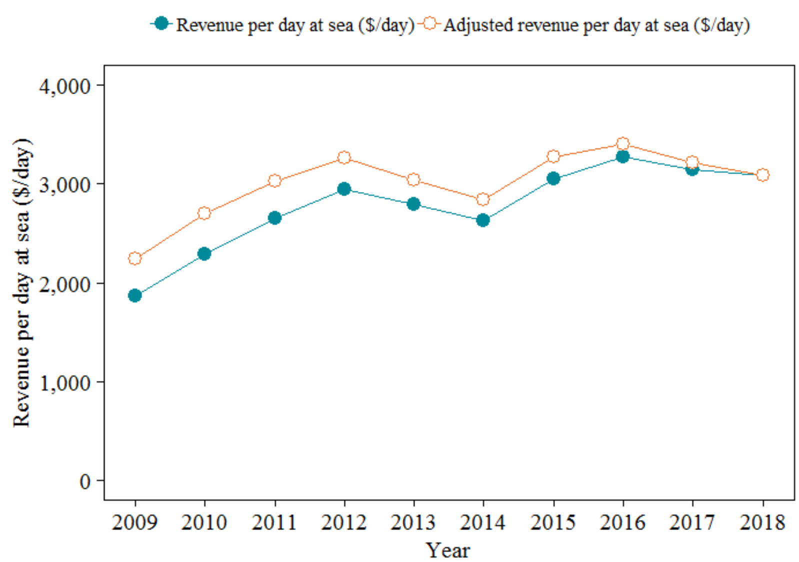


Figure 153. Revenue per-day-at-sea for Hawaii longline, 2009-2018, adjusted to 2018 dollars[1]

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

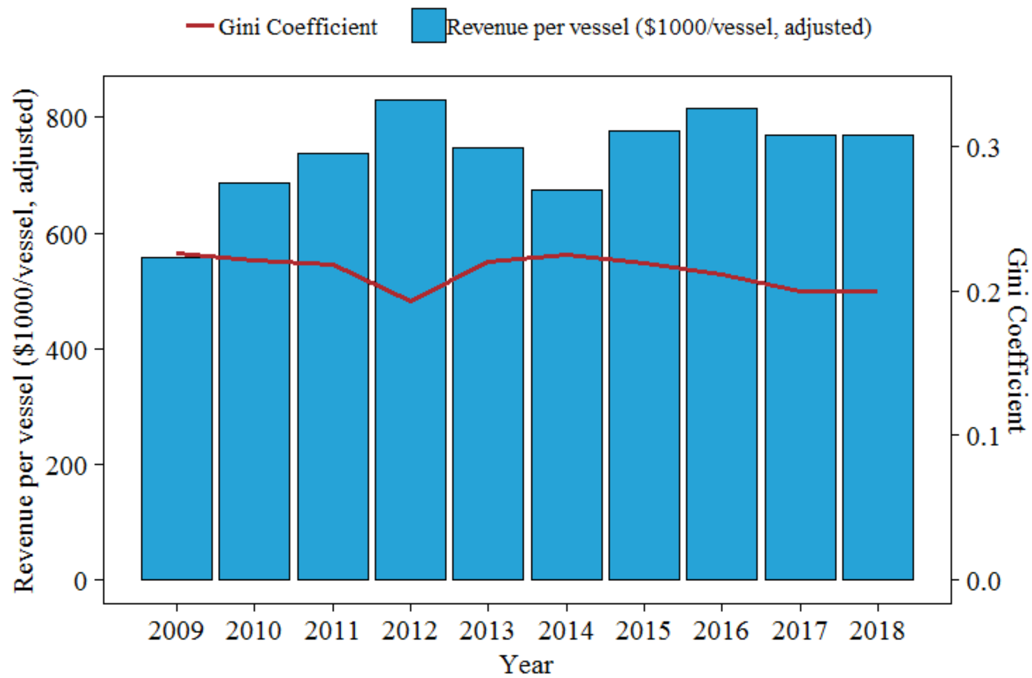


Figure 154. Revenue per vessel and Gini coefficient of the Hawaii longline fisheries[1] from 2009-2018 adjusted to 2018 dollars[2]

[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).

3.1.5.3.4 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.

If only counting the pelagic fish landed and sold in the Hawaii markets from all gear types, the total revenue generated from Hawaii's pelagic fisheries was $114.3 million in 2018. The Hawaii permitted longline fishery contributed 89% of the total revenue in 2018. 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 $8.2 million or 7% of the total in 2018 and was followed by the MHI handline fishery at $2.8 million (2%). The offshore handline fishery was worth $0.9 million in 2018. The sharp decline of the "other gears" reflected the decline of the aku boat fishing in the report period. Figure 155 presents the trend of commercial landings by different gears (not including longline), and Figure 156 presents the trend of commercial revenue by different gears (not including longline). Supporting data for the Figure 155 and Figure 156 are presented in Table A-133.

Figure 157 presents the price trends of PMUS harvested and sold by different gears, 2009-2018, (adjusted 2018 dollars). Supporting data for Figure 157 are presented in Table A-131. Figure 158 presents the fishing trip costs by the three main gears (small boats) for pelagic fishing. Supporting data are presented in Table A-132.

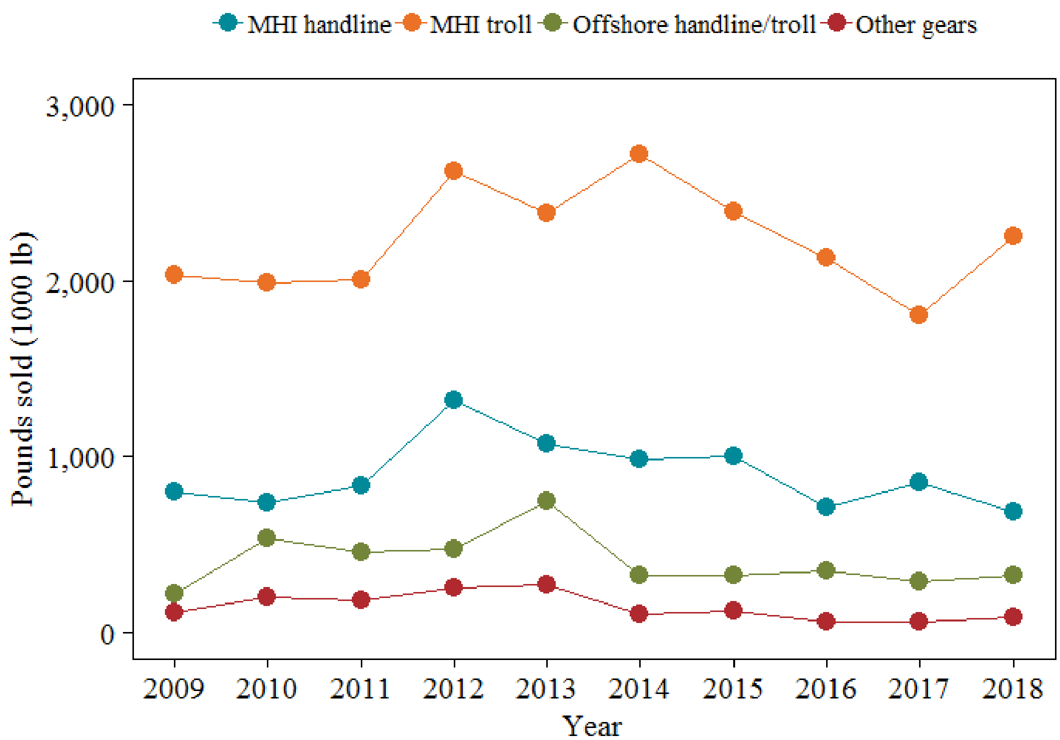


Figure 155. Pounds sold of various MHI commercial non-longline gears from 2009-2018[1]

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

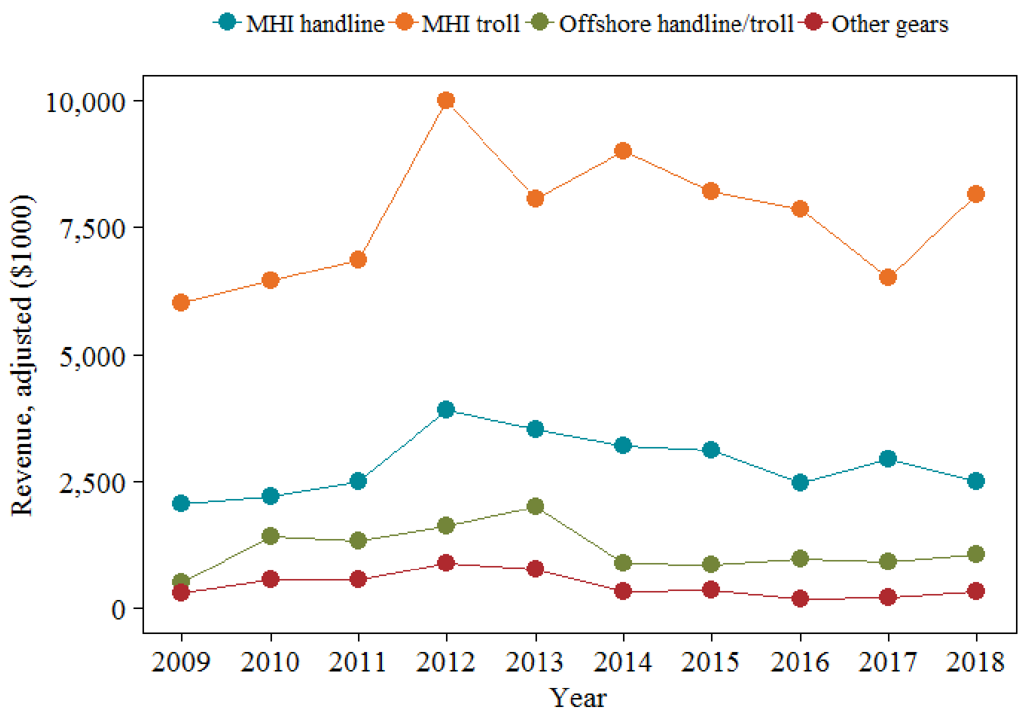


Figure 156. Revenue of non-longline gears from 2009-2018 adjusted to 2018 dollars[2]

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

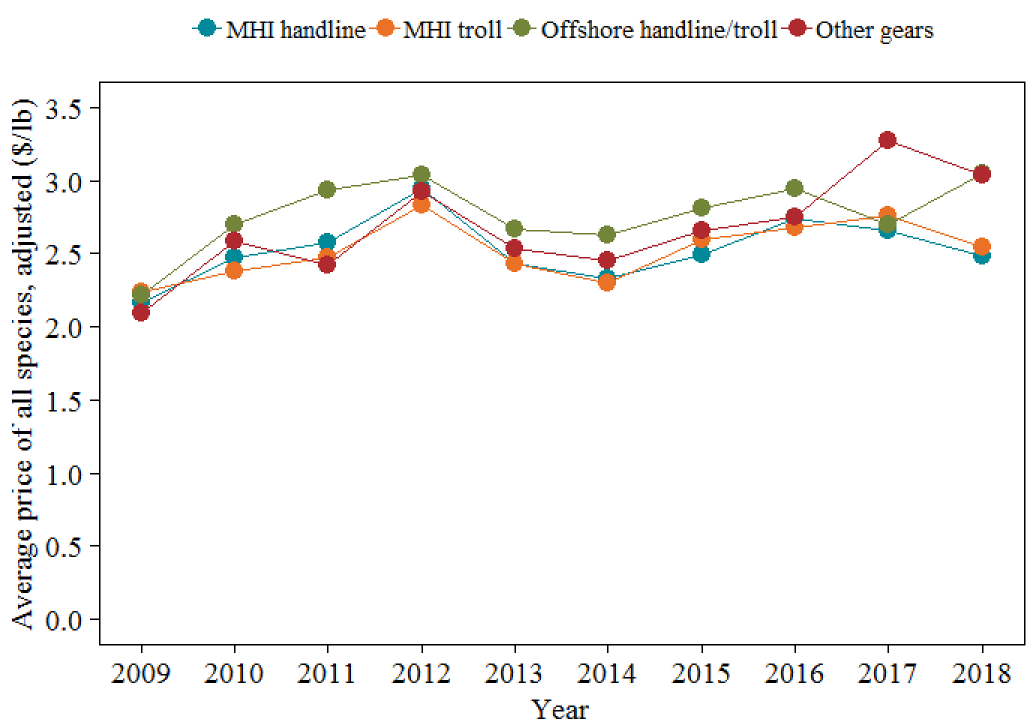


Figure 157. Price trends of PMUS by different gears, 2009-2018, adjusted to 2018 dollars[1]

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

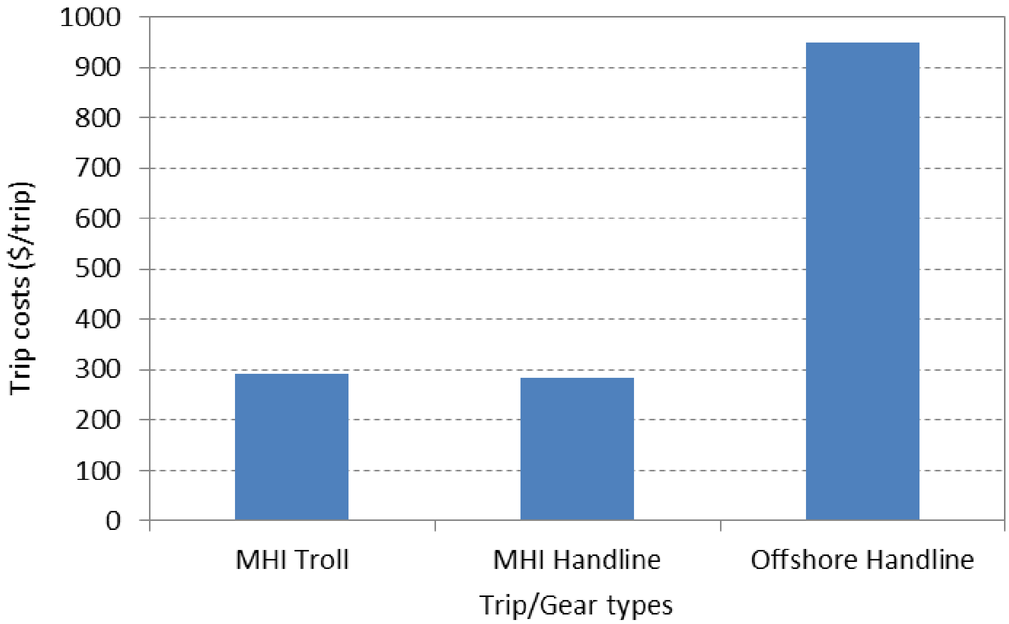


Figure 158. Fishing trip cost by gear type in 2014[2]

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

3.1.5.4 HAWAII TROLLING

Trolling was one of the gear types included in the 2014 Small Boat Survey (Chan and Pan, 2017). Fisher demographics and catch disposition were summarized in 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).

3.1.5.4.1 Commercial Participation, Landings, Revenue, and Prices

This section will describe trends in commercial participation, landings, revenues and prices for the Hawaii troll fishery. Figure 159 presents the pounds sold and revenue (adjusted to 2017 dollars) of the MHI troll, 2009-2018. Supporting data of Figure 159 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 2018 dollars) from 3.8 million pounds sold in 2012. 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.

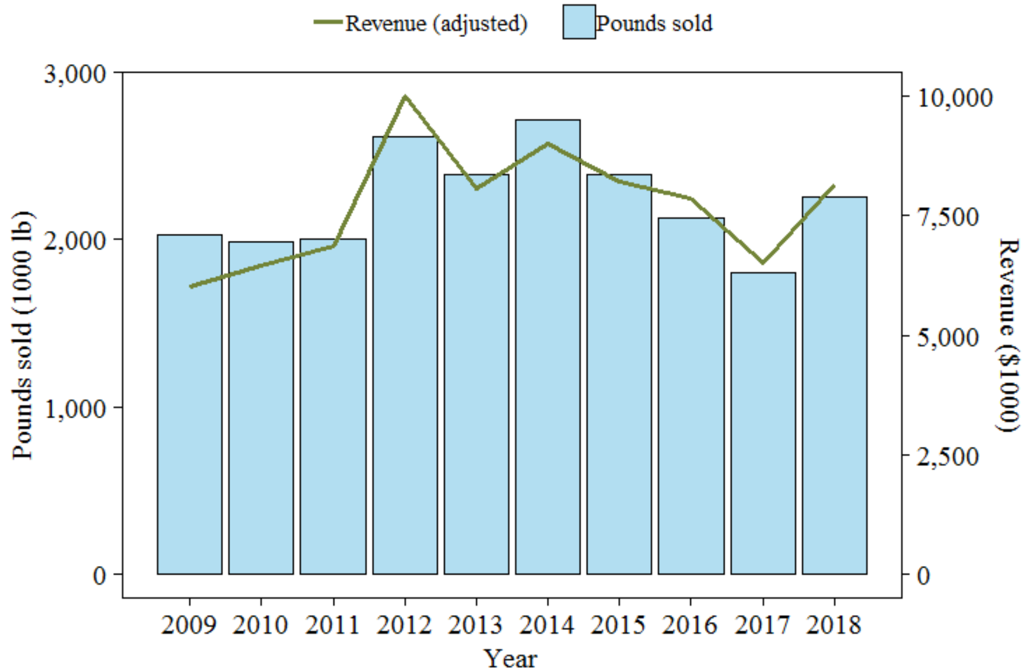


Figure 159. The pounds sold and revenue for the MHI troll from 2009-2018 adjusted to 2018 dollars [1]

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

3.1.5.4.2 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, 1998; Hospital et al., 2011; Chan and Pan, 2017). The most current data for a Hawaii trolling trip are presented in Figure 158.

3.1.5.5 HAWAII PELAGIC HANDLINE

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

3.1.5.5.1 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in commercial participation, landings, revenues and prices for the Hawaii pelagic handline fishery. Figure 160 presents the pounds sold and revenue (adjusted to 2018 dollars) of the MHI troll, 2009-2018. Supporting data for Figure 160 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 $3.7 million respectively, then was in a declining trend since 2013. Both revenue and commercial landings of Hawaii handline in 2018 were lower than 2017.

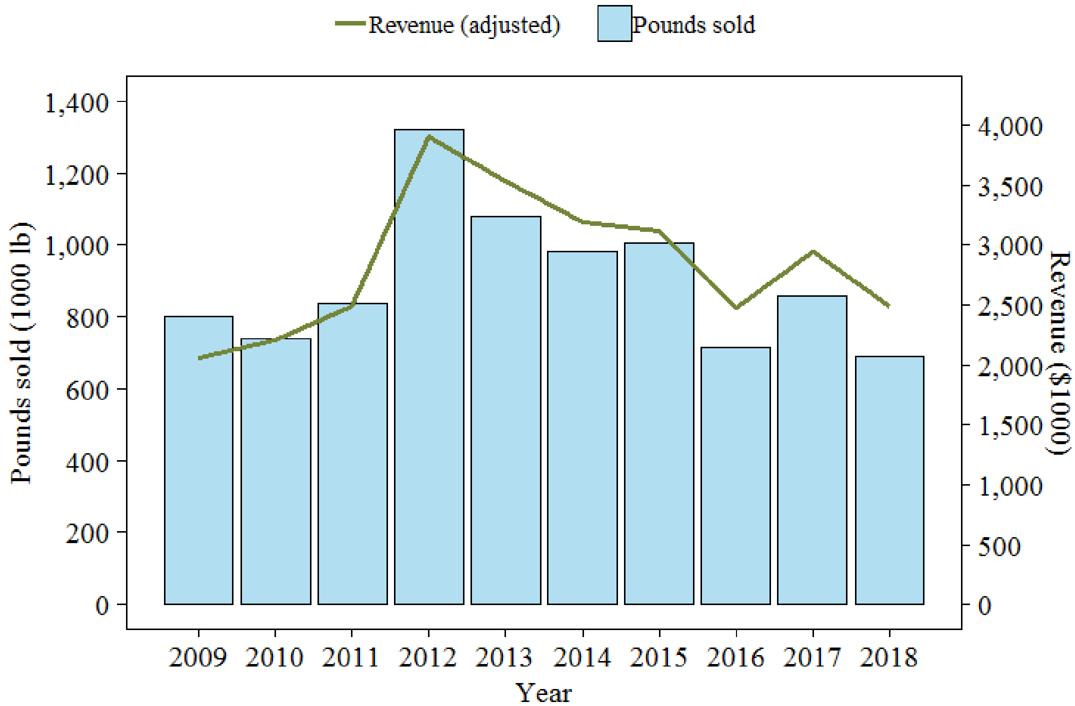


Figure 160. Pounds sold and revenue for MHI handline, 2009-2018, adjusted to 2018 dollars[1]

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

3.1.5.5.2 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; B\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 data for a MHI handline trip are presented in Figure 158.

3.1.5.6 OFFSHORE HANDLINE

Pelagic offshore handline was one of the gear types included in the 2014 Small Boat Survey (Chan and Pan 2017) and fisher demographics and catch disposition on the offshore handline were available in Chan and Pan (2018, in review).

3.1.5.6.1 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in pounds sold and revenues for the Hawaii offshore handline fishery. Figure 161 presents the pounds sold and revenue (adjusted to 2018 dollars) of the offshore handline, 2009-2018. Supporting data for Figure 161 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 2009-2018, except that the pounds sold and revenue jumped up considerably in 2010 and 2013, respectively.

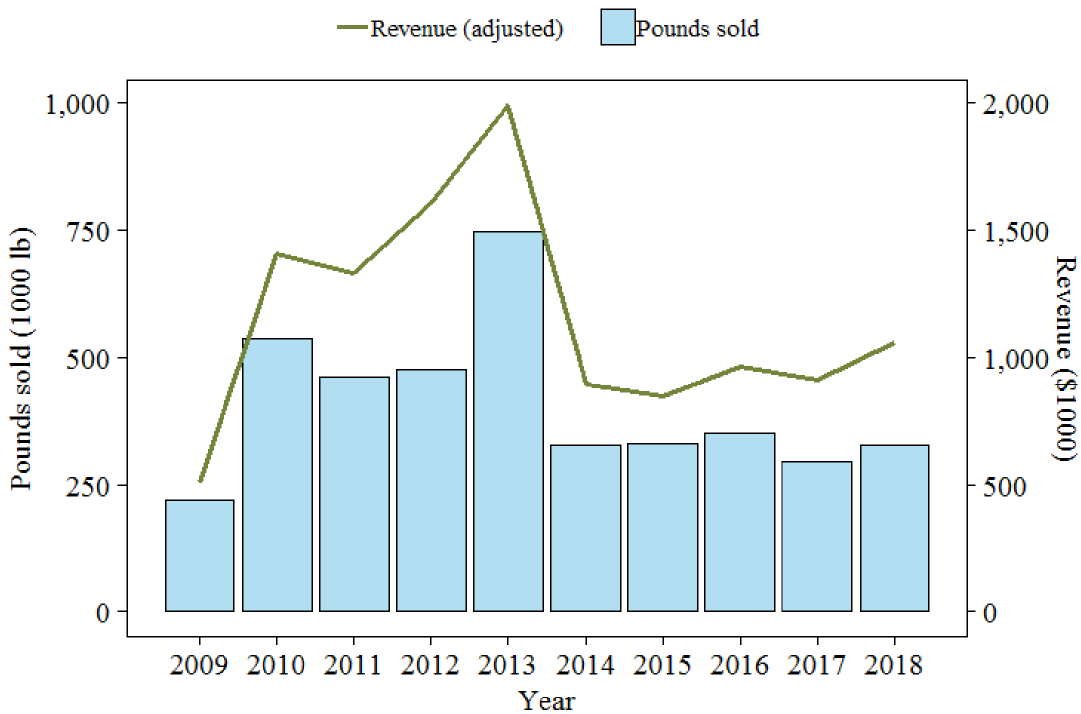


Figure 161. The pounds sold and revenue for the offshore handline from 2009-2018 adjusted to 2018 dollars[1]

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

3.1.5.6.2 Fishing Costs

Fishing costs for offshore handline were first studied in the 2014 Hawaii small boat survey (Chan and Pan 2018, in review). 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 offshore handline trip are presented in Figure 158.

3.1.5.7 OTHER GEARS (INCLUDING AKU BOAT/POLE AND LINE)

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

3.1.5.7.1 Commercial Participation, Landings, Revenue, and Prices

This section will describe trends in commercial pounds sold and revenues for the "other gears". Figure 162 presents the pounds sold and revenue (adjusted to 2018 dollars) of the other gears (including aku boats), 2009-2018. Supporting data for Figure 162 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 2018 composed less than 0.2% to the total revenue of pelagic sold by the Hawaii fisheries.

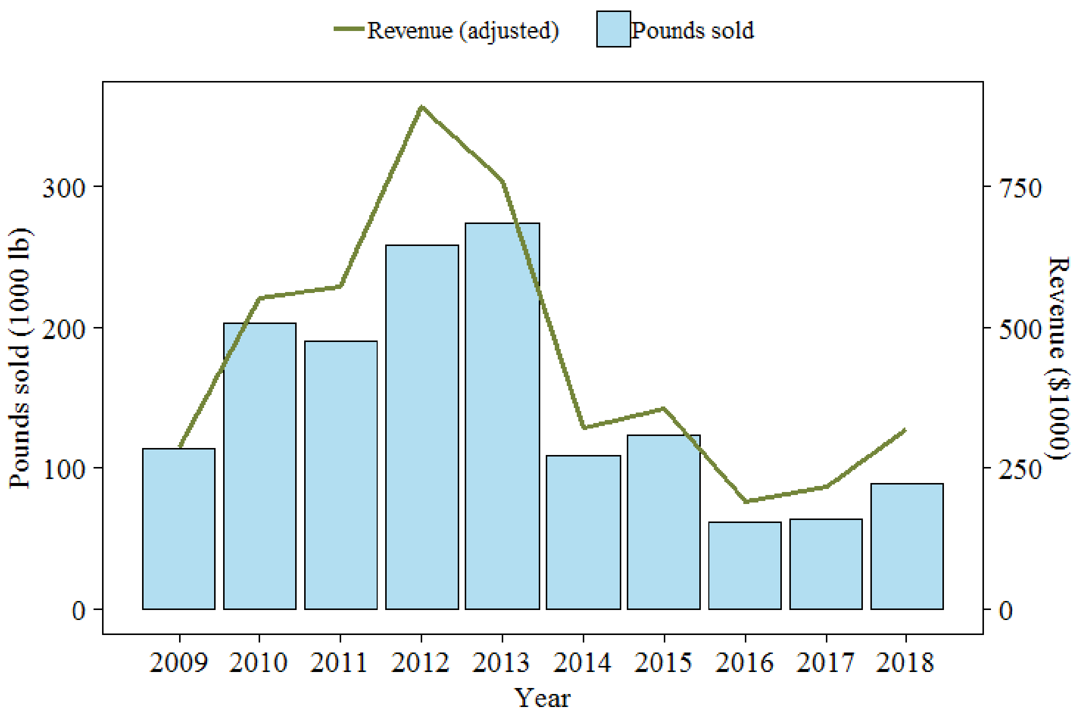


Figure 162. The pounds sold and revenue for all other gears from 2009-2018 adjusted to 2018 dollars[1]

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

3.1.5.7.2 Fishing Costs

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

3.1.6 PACIFIC REMOTE ISLAND AREAS

3.1.6.1 INTRODUCTION

Human habitation in the Pacific Remote Island Area is limited. The Fishery Ecosystem Plan for the Pacific Remote Islands Area provides a description of the geography, history, and socio-economic considerations of the archipelago in Section 1.3 (WPRFMC 2016e). Grace-McCaskey (2014) provided a brief review of the importance of this area from a cultural perspective. She noted that although this region was uninhabited when first visited by Westerners, Polynesians, and Micronesians likely had been periodically visiting all of the islands periodically for centuries. Most of the islands in the PRIA were modified during WWII and many have subsequently become National Wildlife Refuges and part of the Pacific Remote Islands Marine National Monument. Only Wake, Johnston, and Palmyra have seasonal and year-round residents, primarily related to military and refuge management. Because they are located far from areas of high human population, they are considered to be some of the healthiest reef ecosystems in the world, although some are experiencing residual impacts from military use. There are no designated fishing communities in the PRIA. Most of the fishing effort has been concentrated around Johnston and Palmyra by members of the Hawaii fishing community.

3.1.7 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 2018. 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 46. Pacific Islands Region 2018 Commercial Fishing Economic Assessment Index

	2018 Projected CFEAI				
	2018 Reporting Year (e.g. 1/2018-12/2018)				
	Data			Assessment	
Pacific Islands Fisheries	Anticipated Fishing Revenue Most Recent Year	Anticipated Operating Cost Most Recent Year	Anticipated Fixed Cost Most Recent Year	Anticipated Returns Above Operating Costs (Quasi Rent) Assessment Most Recent Year	Anticipated Profit Assessment Most Recent Year
HI Longline	**2018**	**2018**	**2013**	**2018**	**2016**
ASam Longline	**2018**	**2018**	**2017**	**2018**	**2016**
HI Offshore Handline	**2018**	**2014**	**2014**	**2018**	**2018**
HI Small Boat (pelagic)	**2018**	**2014**	**2014**	**2017**	**2017**
HI Small Boat (bottomfish)	2018	2014	2014	2017	2017
HI Small Boat (reef)	2018	2014	2014	2017	2017
Guam Small boat	**2018**	**2018**	**2018**	**2018**	
CNMI Small boat	**2018**	**2018**	**2018**	**2018**	
ASam Small boat	**2018**	**2018**	**2018**	**2018**	

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, 2019) during 2019. Additionally PIFSC conducted a cost-earnings survey for the American Samoa longline fishery in 2017 and results, including a profit assessment, are set for publication in 2019.

Table 47. 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	Anticipated Fishing Revenue Most Recent Year	Anticipated Operating Cost Most Recent Year	Anticipated Fixed Cost Most Recent Year	Anticipated Returns Above Operating Costs (Quasi Rent) Assessment Most Recent Year	Anticipated Profit Assessment Most Recent Year
HI Longline	**2019**	**2019**	**2019**	**2019**	**2016**
ASam Longline	**2019**	**2019**	**2017**	**2019**	**2019**
HI Offshore Handline	**2019**	**2014**	**2014**	**2018**	**2018**
HI Small Boat (pelagic)	**2019**	**2014**	**2014**	**2017**	**2017**
HI Small Boat (bottomfish)	2019	2014	2014	2017	2017
HI Small Boat (reef)	2019	2014	2014	2017	2017
Guam Small boat	**2019**	**2019**	**2018**	**2019**	**2020**
CNMI Small boat	**2019**	**2019**	**2018**	**2019**	**2020**
ASam Small boat	**2019**	**2019**	**2018**	**2019**	

Looking a bit further out, PIFSC intends for results of the 2018 Marianas cost-earnings survey, including a profit assessment, published by 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 funding and 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 intends to 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.st.nmfs.noaa.gov/humandimensions/social-indicators/index). 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 will conduct 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.

3.1.8 RELEVANT PIFSC ECONOMICS AND HUMAN DIMENSIONS PUBLICATIONS: 2018

Ayers, A.L., 2018. The commonwealth of the Northern Mariana Islands fishing community profile: 2017 update. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-66, 57 p. doi:10.7289/V5/TM-PIFSC-66.

Ayers A.L., Hospital, J., and C. Boggs, 2018. Bigeye tuna catch limits lead to differential impacts for Hawai`i longliners. *Marine Policy*, *94*, pp. 93-105.

Finkbeiner EM, Micheli F, Bennett NJ, Ayers AL, Le Cornu E, Doeer AN. 2018. Exploring trade-offs in climate change response in the context of Pacific Island fisheries. *Marine Policy*, *88*, pp. 359-364.

Kleiber D, Kotowicz D, Hospital J. 2018. Applying national community social vulnerability indicators to fishing communities in the Pacific Island region. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-65, 63 pp.

Kleiber, D. and K. Leong, 2018. Cultural fishing in American Samoa. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-18-03, 21 pp.

Pan, M., 2018. Tracking changes on fishery economic performance -- continuous economic data collection programs for the Hawaii and American Samoa longline fisheries 2005-2016. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-73, 48 pp.

Raynor, J., 2018. Measuring the Net Economic Benefits of a Large Circle Hook Policy in American Samoa. PIFSC Internal Report IR-18-017. 3 pp.

Rollins, E., and S. Lovell, 2018. Charter fishing in Hawaii: A multi-region analysis of the economic linkages and contributions within and outside Hawaii. *Marine Policy*, *100*, pp. 277-287.

3.1.9 REFERENCES

Allen, S.D. and J.R. Amesbury, 2012. Commonwealth of the Northern Mariana Islands as a fishing community. U.S. Dep. Commer., NOAA Tech. Memo., NOAAPPENDIX ATM-NMFSPIFSC-36, 89 pp.

Allen, S.D. and N.J. Bartlett, 2008. Hawaii Marine Recreational Fisheries Survey: How Analysis of Raw Data Can Benefit Regional Fisheries Management and How Catch Estimates are Developed, an Example Using 2003 Data. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-08-04, 33 pp. + Appendices.

Allen, S.D. and P. Bartram, 2008. Guam as a fishing community. Pacific Islands Fisheries Science Center Administrative Report H-08-01, 61 pp.

Allen, S.D. and A. Gough, 2007. Hawai'i longline fishermen's experiences with the observer Program. In: U.S. Dep. Commer., NOAA Tech. Memo. NOAAPPENDIX ATM-NMFSPIFSC-8, 39 pp.

Allen, S.D. and A. Gough, 2006. A sociocultural assessment of Filipino crew members working in the Hawai'i -based longline fleet. In: U.S. Dep. Commer., NOAA Tech. Memo. NOAAPPENDIX ATM-NMFS-PIFSC-6, 54 pp.

American Samoa Government, 2018. American Samoa Statistical Yearbook 2017. American Samoa Government, Department of Commerce Statistics Division. Pago Pago, American Samoa. 211 pp.

Arita, S. and M. Pan, 2013. Cost-Earnings Study of the American Samoa Longline Fishery Based on Vessel Operations in 2009. PIFSC Working Paper WP-13-009, issued 12 July 2013.

Arita, S., Pan, M., Hospital, J., and P.S. Leung, 2011. Contribution, linkages and impacts of the fisheries sector to Hawaii's economy: a social accounting matrix analysis. Joint Institute for Marine and Atmospheric Research, SOEST Publication 11-01, JIMAR Contribution 11-373. University of Hawaii: Honolulu, HI, 54 pp.

Armstrong, K., Herdrich, D., and A. Levine, 2011. Historic fishing methods in American Samoa. U.S. Dep. Commer., NOAA Tech. Memo., NOAAPPENDIX ATM-NMFS-PIFSC-24, 70 pp. + Appendices.

Barnes-Mauthe, M., Arita, S., Allen, S.D., Gray, A., and P.S. Leung, 2013. The influence of ethnic diversity on social network structure in a common-pool resource system: implications for collaborative management. *Ecology and Society*, *18*(1), 23 pp.

Chan, H.L., M. Pan. 2017. Economic and Social Characteristics of the Hawaii Small Boat Fishery 2014, NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-63, 107 p. https://doi.org/10.7289/V5/TM-PIFSC-63.

Chan, H.L. and Pan, M., 2019. Tracking economic performance indicators for small boat fisheries in America Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-79, 76 p. https://doi.org/10.25923/8etp-x479.

Davidson, K., Pan, M., Hu, W., and D. Poerwanto, 2012. Consumers' willingness to pay for aquaculture fish products vs. wild-caught seafood - a case study in Hawaii. *Aquaculture Economics and Management*, *16*(2), pp. 136-154.

Geslani, C., Loke, M., Takenaka, B., and P.S. Leung, 2012. Hawaii′s seafood consumption and its supply sources. Joint Institute for Marine and Atmospheric Research, SOEST Publication 12-01, JIMAR Contribution 12-0379, Honolulu, HI: University of Hawaii.

Gough, A., 2016. Rapid assessment of foreign crew on Hawaii longline vessels: Assessing vulnerabilities of foreign crew to forced labor and human trafficking. Prepared for the Hawaii Longline Association. 65 pp.

Grace-McCaskey, C.A., 2014. Examining the potential of using secondary data to better understand human-reef relationships across the Pacific. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96818-5007. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-14-01, 69 pp.

Grace-McCaskey, C.A., 2015. American Samoa Fishing Community Profile: 2013 Update. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96818-5007. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-15-04, 30 p.

Honolulu Star Advertiser, 2016. Tuna cannery in American Samoa to halt production. Updated 13 October 2016. Business Breaking Top News. http://www.staradvertiser.com/2016/10/13/business/business-breaking/tunAPPENDIX Acannery-in-american-samoAPPENDIX Ato-halt-production/

Hospital, J. and M. Pan, 2009. Demand for Hawaii bottomfish revisited: incorporating economics into total allowable catch management. U.S. Dep. Commer., NOAA Tech. Memo., NOAAPPENDIX ATM-NMFS-PIFSC-20, 19 p. + Appendices.

Hospital, J. and C. Beavers, 2012. Economic and social characteristics of Guam's small boat fisheries. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-12-06, 60 p. + Appendices.

Hospital, J. and C. Beavers, 2014. Economic and Social Characteristics of Small Boat Fishing in the Commonwealth of the Northern Mariana Islands. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96818-5007. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-14-02, 58 p.+ Appendices.

Hospital, J., Bruce, S.S., and M. Pan, 2011. Economic and social characteristics of the Hawaii small boat pelagic fishery. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-11-01, 50 p. + Appendices.

Kalberg, K.O. and M. Pan, 2015. 2012 Economic cost earnings of pelagic longline fishing in Hawaii. U.S. Dep. Commer., NOAA Tech. Memo., NOAAPPENDIX ATM-NMFS-PIFSC-56, 60p. doi:10.7289/V5/TM-PIFSC-56.

Kotowicz, D.M. and S.D. Allen, 2015. Results of a survey of CNMI and Guam residents on the Marianas Trench Marine National Monument. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-13-009, 55 p.

Kotowicz, D.M. and L. Richmond, 2013. Traditional Fishing Patterns in the Marianas Trench Marine National Monument. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-13-05, 54 p.

Levine, A. and S.D. Allen, 2009. American Samoa as a fishing community. U.S. Dep. Commer., NOAA Tech. Memo., NOAAPPENDIX ATM-NMFS-PIFSC-19, 74 p.

Levine, A., Dillard, M., Loerzel, J., and P. Edwards, 2016. National Coral Reef Monitoring Program Socioeconomic Monitoring Component. Summary Findings for American Samoa, 2014. U.S. Dep. Commerce., NOAA Technical Memorandum CRCP 24, 80 p. + Appendices.

Ma, H., and T.K. Ogawa, 2016. Hawaii Marine Recreational Fishing Survey: A Summary of Current Sampling, Estimation, and Data Analyses. U.S. Dep. Commer., NOAA Tech. Memo., NOAAPPENDIX ATMNMFS-PIFSC-55, 43p. doi: 10.7289/V5/TM-PIFSC-55.

Madge, L., J. Hospital, and E.T. Williams, 2016. Attitudes and Preferences of Hawaii Non-commercial Fishers: Report from the 2015 Hawaii Saltwater Angler Survey. U.S. Dep. Commer., NOAA Tech. Memo., NOAAPPENDIX ATM-NMFS-PIFSC-58, 36 p. + Appendices. doi:10.7289/V5/TM-PIFSC-58.

Markrich, M. and C. Hawkins, 2016. Fishing Fleets and Fishery Profiles: Management – Vessels – Gear – Economics. Pacific Islands Fishery Monographs No. 5 September 2016. Western Pacific Regional Fishery Management Council. Honolulu, HI. 34 p.

NCRMP, 2016a. Guam Infographic: Connections between Coral Reefs and Communities. Accessed from https://www.coris.noaa.gov/monitoring/resources/GuamCoral.pdf.

NCRMP, 2016b. Socioeconomic Monitoring For Hawaii. Presentation for the NOAA Coral Reef Conservation Program & National Centers for Coastal Ocean Science. Updated 16 June 2016. Accssed from https://data.nodc.noaa.gov/coris/library/NOAA/CRCP/monitoring/SocioEconomic/NCRMPSOCHawaiiReportOut2016_FINAL_061616_update.pdf.

NMFS, 2016. Fisheries Economics of the United States, 2014. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-163, 237p.

Pacific Islands Report, 2016. American Samoa Cannery to Scale Back Operations Due To Fish Shortages. Updated 28 September 2016. Accssed from http://www.pireport.org/articles/2016/09/28/american-samoAPPENDIX Acannery-scale-back-operations-due-fish-shortages.

Pacific Islands Report, 2017. Tri Marine Has 'No Plans' To Reopen Tuna Cannery In American Samoa. Updated 20 April 2017. Accssed from http://www.pireport.org/articles/2017/04/20/tri-marine-has-no-plans-reopen-tunAPPENDIX Acannery-american-samoa.

Pan, M., in review. Tracking Changes on Fishery Economic Performance — Continuous Economic Data Collection Programs for the Hawaii and American Samoa Longline Fisheries 2005-2016. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAAPPENDIX ATM-NMFS-PIFSC-XX, 46 pp.

Pan, M., 2014. Economic characteristics and management challenges of the Hawaii elagic longline fisheries: Will a catch share program help? *Marine Policy*, *44*, pp. 18-26.

Pan, M., 2015. Economic performance and status of American Samoa longline fishery, 2014. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-15-015, 9 pp.

PIFSC, 2016a. American Samoa Longline Fishery Trip Expenditure (2006 to present). Pacific Islands Fisheries Science Center. Accssed from https://inport.nmfs.noaa.gov/inport/item/10373.

Pan, M. 2018. "Tracking changes on fisheries economic performance – continuous economic data collection programs for the Hawaii and American Samoa longline fisheries 2005-2016." U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-73, 48 p. https://doi.org/10.25923/hqhf-d906.

PIFSC, 2016b. CNMI, American Samoa, and Guam Small Boat Fishery Trip Expenditure (2009 to present). Pacific Islands Fisheries Science Center. Accssed from https://inport.nmfs.noaa.gov/inport/item/20627.

PIFSC, 2016c. Hawaii Longline Fishery Trip Expenditure (2004 to present). Pacific Islands Fisheries Science Center. Accssed from https://inport.nmfs.noaa.gov/inport/item/5662.

PIFSC Socioeconomics Program, 2017. Potential Economic Impacts of the Papahānaumokuākea Marine National Monument Expansion. PIFSC Internal Report IR-17-06.

Polovina, J., Dreflak, K., Baker, J., Bloom, S., Brooke, S., Chan, V., Ellgen, S., Golden, D., Maison, M.M., Oliver, T. and S. Spalding, 2016. Pacific Islands Regional Action Plan. NOAA Fisheries climate science strategy. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAAPPENDIX ATM-NMFS-PIFSC-59, 33 pp. doi:10.7289/V5/TM-PIFSC-59.

Richmond, L. and A. Levine, 2012. Institutional analysis of community-based marine resource management initiatives in Hawaii and American Samoa. U.S. Dep. Commer., NOAA Tech. Memo., NOAAPPENDIX ATM-NMFS-PIFSC-35, 48 pp. + Appendices.

Richmond, L. and D.M. Kotowicz, 2015. Equity and access in marine protected areas: The history and future of 'traditional indigenous fishing' in the Marianas Trench Marine National Monument. *Applied Geography*, *59*, pp. 117-124.

Richmond, L., Kotowicz, D.M., and J. Hospital, 2015. Monitoring socioeconomic impacts of Hawai'i's 2010 bigeye tuna closure: Complexities of local management in a global fishery. *Ocean & Coastal Management*, *106*, pp. 87-96.

Rubinstein, D., 2001. A Sociocultural Study of Pelagic Fishing Activities in Guam. Final progress report available from University of Hawaii Joint Institute for Marine and Atmospheric Research, Pelagic Fisheries Research Program. Accessed from http://www.soest.hawaii.edu/PFRP/pdf/rubinstein01.pdf.

Stoffle, B.W. and S.D. Allen, 2012. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAAPPENDIX ATM-NMFS-PIFSC-31, 38 pp.

U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

WPRFMC, 2016a. Draft Fishery Ecosystem Plan for the American Samoan Archipelago. Honolulu, HI. 80 pp. + Appendices.

WPRFMC, 2016b. Draft Fishery Ecosystem Plan for the Hawaii Archipelago. Honolulu, HI. 88 pp. + Appendices.

WPRFMC, 2016c. Draft Fishery Ecosystem Plan for the Mariana Archipelago. Honolulu, HI. 114 pp. + Appendices.

WPRFMC, 2016d. Draft Fishery Ecosystem Plan for the Pacific Pelagic Fisheries. Honolulu, HI. 137 pp. + Appendices.

WPRFMC, 2016e. Draft Fishery Ecosystem Plan for the Pacific Remote Island Area. Honolulu, HI. 81 pp. + Appendices.

WPRFMC, 2016f. Minutes of the 168th Meeting of the Western Pacific Regional Fishery Management Council. Honolulu, HI. 124 pp.

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 HAWAI`I SHALLOW-SET LONGLINE FISHERY

3.2.1.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS AND EFFECTIVENESS OF MANAGEMENT MEASURES IN THE HAWAI`I SHALLOW-SET LONGLINE FISHERY

This report monitors the status of protected species interactions in the Hawai`i 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") of 26 leatherback and 34 loggerhead turtles

3.2.1.1.2 ESA Consultations

The Hawai`i shallow-set longline fishery is covered under a NMFS Biological Opinion dated January 30, 2012 and modified on May 22, 2012 (NMFS, 2012). NMFS concluded that the fishery is not likely to jeopardize four sea turtle species (loggerhead, leatherback, olive ridley and green turtles) and humpback whales (the Hawai`i DPS was delisted under the ESA in 2016), and not likely to adversely affect hawksbill turtles. NMFS also concluded that the fishery will not destroy or adversely modify the designated critical habitat for leatherback sea turtles. In a Biological Opinion dated January 6, 2012 (USFWS, 2012a), USFWS concluded that the fishery is not likely to jeopardize short-tailed albatrosses. Several informal consultations conducted by NMFS have determined that the fishery is not likely to adversely affect other ESA-listed marine mammals, the Eastern Pacific distinct population segment (DPS) of scalloped hammerhead shark or Hawaiian monk seal critical habitat (Table 48). NMFS has determined that Pacific Island pelagic fisheries, including the shallow-set longline fishery, would have no effect on ESA-listed species of shallow reef-building corals because there is sufficient spatial separation between the listed reef corals and the activities of pelagic fishing vessels.

NMFS and USFWS have issued incidental take statements (ITS) for species included in the two 2012 Biological Opinions (Table 50). The 1-year ITSs for loggerhead and leatherback turtles in the NMFS 2012 BiOp form the basis for the hard caps, and trigger closures for this fishery. Exceedance of the 2-year or 5-year ITSs requires reinitiation of consultation on the fishery under the ESA.

In December 2017, the Ninth Circuit Court of Appeals issued a 2-1 opinion finding that the BiOp's no-jeopardy determination and associated ITS for loggerhead turtles was arbitrary and capricious and inconsistent with assessments that projected future loggerhead population decline (*TIRN* v. *NMFS (9th Cir. 2017)*). In May 2018, NMFS agreed to a settlement resulting in the closure of the shallow-set longline fishery for the remainder of 2018. Additionally, the hard cap limit of 17 loggerhead turtles was reinstated based on the 2004 Biological Opinion when the fishery re-opened on January 1, 2019.

In 2016, NMFS documented the fishery's first interaction with a Guadalupe fur seal (the interaction was observed in late 2015, but the vessel arrived in 2016). NMFS documented three additional interactions in 2017, however no interactions were reported in 2018. On April 6, 2016, NMFS and USFWS issued a final rule to list 11 distinct population segments (DPS) of green sea turtle under the ESA (81 FR 20058). This final rule removed the previous range-wide listing and, in its place, listed eight DPSs as threatened and three as endangered. Additionally, in January 2018, oceanic whitetip sharks and giant manta rays were listed under the ESA (83 FR 4153 and 83 FR 2916, respectively). These recent developments triggered the requirement to re-initiate consultation for the fishery pursuant to Section 7 of the ESA. Consultation for the Hawai`i shallow-set longline fishery was reinitiated on April 20, 2018, and was completed on June 26, 2019 (NMFS 2019).

Table 48. Summary of ESA consultations for the Hawai`i shallow-set longline fishery

Species	Consultation Date	Consultation Type[a]	Outcome[b]
Loggerhead turtle, North Pacific DPS	2012-01-30	BiOp	LAA, non-jeopardy
Leatherback turtle	2012-01-30	BiOp	LAA, non-jeopardy
Olive ridley turtle	2012-01-30	BiOp	LAA, non-jeopardy
Green turtle	2012-01-30	BiOp	LAA, non-jeopardy
Hawksbill turtle	2012-01-30	BiOp	NLAA
False killer whale, MHI insular DPS	2015-03-02	LOC	NLAA
Fin whale	2015-09-16	LOC	NLAA
Blue whale	2008-08-27	LOC	NLAA
North Pacific right whale	2008-08-27	LOC	NLAA
Sei whale	2008-08-27	LOC	NLAA
Sperm whale	2008-08-27	LOC	NLAA
Hawaiian monk seal	2008-08-27	LOC	NLAA
Scalloped hammerhead shark, Eastern Pacific DPS	2015-03-02	LOC	NLAA
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.

Table 49. Summary of Incidental Take Statements (ITS) for the Hawai`i shallow-set longline fishery[a]

Species	ITS Time Period	Takes	Mortalities	Source BiOp
Loggerhead turtle (North Pacific DPS)	2-year	68	14	NMFS 2012
Leatherback turtle	2-year	52	12	NMFS 2012
Olive ridley turtle	2-year	4	2	NMFS 2012
Green turtle	2-year	6	2	NMFS 2012
Short-tailed albatross	5-year	1 injury or death		USFWS 2012a

[a] Baesd on the 2012 BiOp applicable to the fishery in 2018. NMFS completed a new BiOp for the Hawai`i shallow-set longline fishery on June 26, 2019. Summary of the ITS from the new BiOp will be included in the 2019 Annual SAFE Report.

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 Hawai`i shallow-set longline fishery is a Category II under the MMPA 2019 List of Fisheries (LOF; 84 FR 22051, May 16, 2019), meaning that this fishery has occasional incidental mortality and serious injuries of marine mammals. The 2019 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
- Northern elephant seal, CA breeding
- Risso's dolphin, HI stock
- Rough-toothed dolphin, HI stock
- Short-beaked common dolphin, CA/OR/WA stock
- Short-finned pilot whale, HI stock
- Striped dolphin, HI stock

Most bycatch estimates in the SARs are based on the most recently available 5-year period, but there is a data lag of 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 HAWAI`I SHALLOW-SET LONGLINE FISHERY

Protected species interactions in the Hawai`i longline fishery have been monitored through mandatory observer coverage since 1994. Observer coverage in the Hawai`i 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 Hawai`i 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 50) and by interaction date (Table 51) for the Hawai`i 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.

3.2.1.3 SEA TURTLE INTERACTIONS IN THE HAWAI`I SHALLOW-SET LONGLINE FISHERY

Table 50 summarizes the incidental take data of sea turtles from 2004 to 2018 in the Hawai`i shallow-set longline fishery summarized by vessel arrival date in accordance with the Observer

Program. Additionally, Table 51 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 51), nearly all sea turtles observed in the Hawai`i shallow-set longline fishery from 2004 to 2018 were released alive, with the exception of two loggerhead turtles released dead in 2018. Additionally, one loggerhead in 2013 was entangled in marine debris that became 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 (average takes/1,000 hooks = 0.0064 and 0.0134, respectively), whereas interactions with greens, olive ridleys, and unidentified hard shell turtles were much less frequent (0.0005, 0.0006, and 0.0003 respectively).

The observed number of sea turtle takes per year has been variable for greens (0-4), olive ridleys (0-4), leatherbacks (1-19) and unidentified hard shell turtles (0-2). At the end of 2017, relatively higher numbers of interactions with loggerheads were observed, with higher numbers continuing into 2018. In total, 21 and 33 loggerhead turtles were observed in 2017 and 2018, respectively, based on interaction date summary (Table 51). Additional discussion regarding the higher number of loggerhead turtle interactions observed since 2017 is provided in Section 3.2.1.3.2.

Table 50. Observed takes and takes per fishing effort (1,000 hooks) for sea turtles in the Hawai`i shallow-set longline fishery based on vessel arrival date associated with Pacific Islands Regional Observer Program annual reports, 2004-2018[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	Takes/ 1,000 hooks	Takes	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	0.070	1	0.002	0	0.000

[a] Take data are based on vessel arrival dates

[b] The released conditions of two loggerheads were unknown.

[c] The released condition of one unidentified hard shell turtle was unknown.

[d] Due to vessel confidentiality rules, data for the fourth quarter in 2007 are combined with data for 2008. Take data for 2007 reflect those from first, second and third quarters.

[e] The released condition of one leatherback was unknown.

[f] One injured loggerhead was entangled in marine debris, which became entangled with fishing gear. This loggerhead 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: 2004-2018 PIRO Observer Program Annual and Quarterly Status Reports

Table 51. Observed takes and takes per fishing effort (1,000 hooks) for sea turtles in the Hawai`i shallow-set longline fishery based on interaction date for comparison with the shallow-set sea turtle hard caps, 2004-2018[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	Takes/ 1,000 hooks	Takes	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	0.019	4	0.004	0	0.000
2018	100	420	486,013	1	0.002	6	0.012	33	0.068	1	0.002	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

The Hawai`i shallow-set longline fishery operates under the ITSs in the 2012 Biological Opinion (NMFS 2012). The 1-year ITSs for leatherback and loggerhead turtle interactions in this fishery are used as a “hard cap” of interactions in any given year, in that the fishery will be closed for the remainder of the year if these numbers are reached. The 2-year ITSs are used for purposes of reinitiating ESA Section 7 consultation if fishery interactions reach these numbers in any given two-year time period.

NMFS began monitoring the ITSs for the Hawai`i shallow-set longline fishery in Quarter 1 of 2012 and uses 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 52), 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 50). 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. The two-year monitoring period between 2017 and 2018 was the first period to exceed the 2-year ITS for olive ridley turtles. The fishery has not exceeded the 2-year ITS for any other species since the 2012 Biological Opinion (Table 52). Consultation for the Hawai`i shallow-set longline fishery was reinitiated on April 20, 2018, and is ongoing. On April 24, 2018, NMFS determined that the conduct of the shallow-set longline fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d).

Table 52. Observed interactions and estimated total mortality (M) (using Ryder et al., 2006) of sea turtles in the Hawai`i 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
Green turtle	6(2)	0	1(0.25)	1(0.25)	0	2(0.10)	3(0.11)
Leatherback turtle	52(12)	18(3.05)	27(4.27)	21(4.07)	10(2.5)	9(2.35)	10(2.50)
Loggerhead turtle	68(14)	12(0.95)	21(2.31)	28(2.95)	28(3)	36(5.85)	54(9.42
Olive ridley turtle	4(2)	0	1(0.05)	2(0.15)	1(0.1)	4(0.25)	5(0.75)

[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 Hawai`i 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 51), 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 51). 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.

Management measures in the Hawai`i 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 and 2018, loggerhead turtle interactions in the Hawai`i 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 and 33 interactions occurred from January 2018 to the fishery closure in May. 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 Hawai`i 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 at its 173rd Meeting in June 2018 recommended amending the Pelagic FEP to establish a management framework consisting of 1) annual limits on the number North Pacific loggerhead and leatherback turtle interactions consistent with the anticipated level of annual interactions that is set forth in the current valid BiOp and 2) individual trip interaction limits for loggerhead and leatherback turtles. Implementation of the FEP amendment has been delayed pending completion of the new BiOp for the shallow-set longline fishery.

3.2.1.4 MARINE MAMMAL INTERACTIONS IN THE HAWAI`I SHALLOW-SET LONGLINE FISHERY

Table 53 through Table 57 summarize the incidental take data of marine mammals from 2004 to 2018 in the Hawai`i 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 53**). Of these species, Risso's dolphins had the highest rate of interactions (average takes/1,000 hooks = 0.0023), followed by bottlenose dolphins (0.0011), striped dolphins (0.0004), common dolphins (0.0001), and rough-toothed dolphins (0.0001) with a single take. Marine mammals grouped as small whales (**Table 54**) and large whales (**Table 55**) had comparatively lower rates of interactions than most small dolphin species. For small whales, false killer whales had the highest interaction rate (0.0002) with a total of 5 interactions since 2004, and there was only one take each of a Blainville's beaked whale in 2011, a pygmy sperm whale and an unidentified *Kogia* species in 2008, and a ginkgo-tooth beaked whale in 2015. In the large whale group, humpback whales had the highest rate of interactions (0.0003), and there was only one take each of a Bryde's whale in 2005 and a fin whale in 2015. Observed interactions with unidentified cetacean groups are shown in **Table 56**.

Interactions with pinnipeds, including Northern elephant seals, Guadalupe fur seals, and unidentified pinnipeds and sea lions have been occasionally observed since 2013 (**Table 57**). 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 Hawai`i 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. No interactions with pinnipeds were documented in 2018.

There are no obvious temporal trends evident in the annual take data of any species of marine mammal for the Hawai`i shallow-set fishery for this time range. For most species, interactions were relatively infrequent and thus, appeared random. Interactions with Risso's dolphins and bottlenose dolphins were more frequent, but fluctuations in the number of interactions from year to year do not suggest a clear trend for either species over time.

Table 53. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for dolphins in the Hawai`i shallow-set longline fishery, 2004-2018[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

[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: 2004-2018 PIRO Observer Program Annual and Quarterly Status Reports

Table 54. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for small whales in the Hawai`i shallow-set longline fishery, 2004-2018[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

[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: 2004-2018 PIRO Observer Program Annual and Quarterly Status Reports

Table 55. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for large whales in the Hawai`i shallow-set longline fishery, 2004-2018[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

[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: 2004-2018 PIRO Observer Program Annual and Quarterly Status Reports

Table 56. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for unidentified dolphins, beaked whales, whales, and cetaceans in the Hawai`i shallow-set longline fishery, 2004-2018[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

[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: 2004-2018 PIRO Observer Program Annual and Quarterly Status Reports

Table 57. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for pinnipeds in the Hawai`i shallow-set longline fishery, 2004-2018[a]

Year	Obs. Cov. (%)	Sets	Hooks	Northern elephant seal		Guadalupe fur seal		Unidentified pinniped		Unidentified sea lion	
				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	0	0.000	0	0.000
2006	100	939	745,125	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
2008	100	1,487	1,350,127	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
2010	100	1,879	1,828,529	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
2012	100	1,307	1,418,843	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
2014	100	1,349	1,509,727	1	0.001	0	0.000	0	0.000	1	0.001
2015	100	1,178	1,286,628	0	0.000	0	0.000	3[c]	0.002	2[c]	0.002
2016	100	778	849,681	0	0.000	1	0.001	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
2018	100	476	446,371	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] The interactions with these pinnipeds and sea lions occurred off the California coast, outside the EEZ, while fishing under the Hawai`i Longline Permit.

Source: 2004-2018 PIRO Observer Program Annual and Quarterly Status Reports

3.2.1.4.1 Comparison of Interactions with ITS

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 Hawai`i 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 Hawai`i shallow-set longline fishery is presented in Table 58. The PBR of a stock reflects only marine mammals of that stock observed within the EEZ around Hawai`i, 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 Hawai`i 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 Hawai`i is well below the corresponding PBR in the time period covered by the current SAR (Table 58).

Table 58. Summary of mean annual mortality and serious injury (M&SI) and potential biological removal (PBR) by marine mammal stocks with observed interactions in the Hawai`i shallow-set longline fishery

Stock	Years Included in 2017 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	2009-2013	0.2[b]		83[b]
Fin whale, HI	2011-2015	0	0	0.1
Guadalupe fur seal, CA	2010-2014	0[d]		542[d]

[a] PBR estimates are not available for portions of the stock outside of the U.S EEZ around Hawai`i, 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 Hawai`i stocks are only available for portions of the stock within the U.S. EEZ around Hawai`i.

[d] PBR and M&SI estimates for the Guadalupe fur seal use data from 2010-2014, which only include data from the U.S. West Coast and therefore do not include the seals taken in 2016 and 2017 in the Hawai`i shallow-set longline fishery. The M&SI estimate is only for the Hawai`i shallow-set longline fishery, and the PBR estimate applies to the entire population.

Source: 2017 Marine Mammal SARs, Draft 2018 Marine Mammal SARs.

3.2.1.5 SEABIRD INTERACTIONS IN THE HAWAI`I SHALLOW-SET LONGLINE FISHERY

Table 59 summarizes the incidental take data of seabirds from 2004 to 2018 in the Hawai`i shallow-set longline fishery. Since there is full observer coverage for this fishery, the interactions in Table 59 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 Hawai`i 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 (average takes/1,000 hooks = 0.0274) and black-footed albatrosses (0.0191). There have also been four interactions with shearwaters (0.0002) and one with 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. The table suggests an increase in takes of black-footed albatrosses after 2008, with a high of 51 takes (0.0485 takes/1,000 hooks) in 2017. However, only nine black-footed albatrosses were taken in 2018 (resulting in 0.0165 takes/1,000 hooks). The lower number of black-footed albatross interactions in 2018 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 fishing effort in that quarter in 2018 as the shallow-set longline fishery was closed in May 2018 through the end of the calendar year. Laysan albatross interactions were also low in 2017-2018.

Table 59. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for seabirds in the Hawai`i shallow-set longline fishery, 2004-2018[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

[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: 2004-2018 PIRO Observer Program Annual and Quarterly Status Reports

3.2.1.5.1 Comparison of Interactions with ITS

The short-tailed albatross ITS in the USFWS 2012 Biological Opinion for the Hawai`i 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 2018.

3.2.1.6 ELASMOBRANCH INTERACTIONS IN THE HAWAI`I SHALLOW-SET LONGLINE FISHERY

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, although other hammerheads have been taken in the 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. 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).

Table 60 summarizes the incidental take data of elasmobranchs from 2004 to 2018 in the Hawai`i shallow-set longline fishery. Oceanic whitetip sharks constitute the majority of the interactions (average takes/1,000 hooks = 0.0110) 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. Giant manta rays, however, are taken more rarely (0.0004) with takes ranging between 0 and 5. There were no observed interactions with scalloped hammerheads in the shallow-set fishery since 2004.

Oceanic whitetip shark interactions have been observed throughout the time series, although substantially lower interactions occurred in 2006 and 2018. Spatial distribution of shallow-set fishing effort typically overlaps with oceanic whitetip shark distribution (south of 30°N) in the summer months. However, the fishery closed in March and early May in 2006 and 2018, respectively, thus likely minimizing the overlap and contributing to the lower number of interactions. Most of the oceanic whitetip sharks that are caught in the shallow-set fishery are released alive.

Table 60. Observed and estimated interactions with elasmobranchs in the Hawai`i shallow-set longline fishery, 2004-2018[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

[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 HAWAI`I DEEP-SET LONGLINE FISHERY

3.2.2.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS AND EFFECTIVENESS OF MANAGEMENT MEASURES IN THE HAWAI`I DEEP-SET LONGLINE FISHERY

In this annual report, the Council monitors protected species interactions in the Hawai`i 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 Hawai`i 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 60). The humpback whale Hawai`i 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 2012a). An additional informal consultation dated September 16, 2015 concluded that the fishery is not likely to adversely affect fin whales or Hawaiian monk seal critical habitat. In 2017, NMFS completed a Supplement to the 2014 Biological Opinion for green, loggerhead, and olive ridley sea turtles due to exceedance of the ITS for these three species (NMFS 2017).

NMFS and USFWS have issued ITSs for species included in the Biological Opinions and determined not to jeopardize the species (Table 62). Exceedance of the 3-year or 5-year ITSs requires reinitiation of consultation on the fishery under the ESA. The ITSs for green turtle and loggerhead turtles were exceeded in 2015 and the ITS for olive ridley turtles was exceeded during the first quarter of 2016, and reconsultation was completed on March 24, 2017.

In January 2018, oceanic whitetip sharks and giant manta rays were listed under the ESA (83 FR 4153 and 83 FR 2916, respectively). On October 4, 2018, NMFS reinitiated the consultation for the Hawai`i deep-set longline fishery and determined that the conduct of the Hawai`i deep-set longline fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d).

Table 61. Summary of ESA consultations for the Hawai`i deep-set longline fishery

Species	Consultation Date	Consultation Type[a]	Outcome[b]

Loggerhead turtle, North Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Leatherback turtle	2014-09-19	BiOp	LAA, non-jeopardy
Olive ridley turtle, Endangered Mexico and threatened eastern Pacific populations	2017-03-24	BiOp[c]	LAA, non-jeopardy
Olive ridley turtle, Threatened western Pacific population	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, East Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, Central North Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, East Indian-West Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, Southwest Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, Central West Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, Central South Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Hawksbill turtle	2014-09-19	BiOp	NLAA
False killer whale, MHI insular DPS	2014-09-19	BiOp	LAA, non-jeopardy
Fin whale	2015-09-16	LOC	NLAA
Blue whale	2014-09-19	BiOp	NLAA
North Pacific right whale	2014-09-19	BiOp	NLAA
Sei whale	2014-09-19	BiOp	NLAA
Sperm whale	2014-09-19	BiOp	LAA, non-jeopardy
Hawaiian monk seal	2014-09-19	BiOp	NLAA
Scalloped hammerhead shark, Eastern Pacific DPS	2014-09-19	BiOp	NLAA
Scalloped hammerhead shark, Indo-West Pacific DPS	2014-09-19	BiOp	LAA, non-jeopardy
Short-tailed albatross	2012-01-06	BiOp (FWS)	LAA, non-jeopardy
Critical Habitat: Hawaiian monk seal	2015-09-16	LOC	NLAA

[a] BiOp = Biological Opinion; LOC = Letter of Concurrence.

[b] LAA = likely to adversely affect; NLAA = not likely to adversely affect.

[c] Supplement to the 2014 BiOp.

Table 62. Summary of ITSs for the Hawai`i 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		FWS 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 Hawai`i deep-set longline fishery is a Category I fishery under the MMPA 2019 List of Fisheries (LOF; 84 FR 22051, May 16, 2019), meaning that NMFS has determined that this fishery has frequent incidental mortality and serious injuries of marine mammals. The 2019 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 HAWAI`I DEEP-SET LONGLINE FISHERY

Protected species interactions in the Hawai`i longline fishery have been monitored through mandatory observer coverage since 1994. Observer coverage in the Hawai`i 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 Hawai`i 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 50). 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 51).

3.2.2.3 SEA TURTLE INTERACTIONS IN THE HAWAI`I DEEP-SET LONGLINE FISHERY

Table 63 summarizes the incidental take data of sea turtles from 2002 to 2018 in the Hawai`i 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, ranging between 0-3 greens (0-16 expanded estimates), 0-7 leatherbacks (0-38), 0-4 loggerheads (0-17), and 3-31 olive ridleys (10-162). Using the expansion factor estimates, the average annual numbers of incidental takes from 2002 to 2018 were five greens, ten leatherbacks, four loggerheads, and 88 olive ridleys. The highest observed interaction rates involved olive ridley sea turtles (2002-2018 average observed takes/1,000 hooks = 0.0011), whereas interactions with leatherbacks, greens, and loggerheads were much less frequent (0.0003, 0.0001, and 0.0001 respectively).

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 Hawai`i deep-set longline fishery. Leatherback turtle interactions in 2017-2018 were lower than 2014-2015.

The highest number of observed olive ridley interactions occurred in 2016 with 31 takes. This was followed by two years of high olive ridley interactions with 26 and 18 interactions in 2017 and 2018, respectively. Due to the depth of the deep-set longline gear, most of the interactions result in mortalities (). The higher level of olive ridley turtle interactions was considered in the 2017 Supplement to the 2014 Biological Opinion, which analyzed impacts with data through the second quarter of 2016 (25 of the 31 interactions occurred in the first two quarters). The 2017 Supplement to the 2014 Biological Opinion concluded that the fishery is not likely to jeopardize olive ridley turtles after considering this higher level of interactions. The Council's Protected Species Advisory Committee at its March 2017 meeting discussed the olive ridley turtle interaction trend and recommended evaluation of the increasing trend in conjunction with the previously recommended effort to evaluate ecosystem factors influencing bycatch in the longline fishery.

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 Hawai`i deep-set longline fishery include temperature at the mixed layer, sea surface temperature, and current divergence. The next steps include modeling three case studies (olive ridley sea turtles, black-footed albatross and oceanic whitetip sharks) to evaluate the efficacy of management strategies in the Hawai`i and American Samoa longline fisheries. Additionally, the ensemble random forest model can be used to validate TurtleWatch. Furthermore, the model can incorporate multiple species as well as target species to determine if avoiding one protected species will result in greater interactions with others.

Table 63. Observed takes, mortalities (M), takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates and ME for sea turtles in the Hawai`i deep-set longline fishery, 2002-2018[a]

				Green				Leatherback				Loggerhead				Olive ridley				Unidentified hard shell		
				Observed				Observed				Observed				Observed				Observed		
Year	Obs. Cov. (%)	Sets	Hooks	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	ME
2002	24.6	3,523	6,786,303	1(1)	0.0001	-	3	2	0.0003	-	5	4(1)	0.0006	-	17	7(7)	0.0010	-	31	0	0.0000	-
2003	22.2	3,204	6,442,221	0	0.0000	-	0	1(1)	0.0002	-	4	0	0.0000	-	0	3(3)	0.0005	-	14	0	0.0000	-
2004	24.6	3,958	7,900,681	1(1)	0.0001	-	5	3	0.0004	-	15	0	0.0000	-	0	13(13)	0.0016	-	46	0	0.0000	-
2005	26.1	4,602	9,360,671	0	0.0000	-	0	1	0.0001	-	4	0	0.0000	-	0	4(4)	0.0004	-	16	0	0.0000	-
2006	21.2	3,605	7,540,286	2(2)	0.0003	-	6	2(2)	0.0003	-	9	0	0.0000	-	0	11(10)	0.0015	-	54	0	0.0000	-
2007	20.1	3,506	7,620,083	0	0.0000	-	0	2	0.0003	-	4	1(1)	0.0001	-	7	7(7)	0.0009	-	26	0	0.0000	-
2008	21.7	3,915	8,775,951	0	0.0000	-	0	1	0.0001	-	11	0	0.0000	-	0	3(3)	0.0003	-	18	0	0.0000	-
2009	20.6	3,520	7,877,861	0	0.0000	-	0	1(1)	0.0001	-	4	0	0.0000	-	0	4(4)	0.0005	-	18	0	0.0000	-
2010	21.1	3,580	8,184,127	1(1)	0.0001	-	1	1(1)	0.0001	-	6	1(1)	0.0001	-	6	4(3)[b]	0.0005	-	10	0	0.0000	-
2011	20.3	3,540	8,260,092	1(1)	0.0001	-	5	3	0.0004	-	14	0	0.0000	-	0	7(6)	0.0008	-	36	0	0.0000	-
2012	20.4	3,659	8,768,728	0	0.0000	-	0	1(1)	0.0001	-	6	0	0.0000	-	0	6(6)	0.0007	-	34	0	0.0000	-
2013	20.4	3,830	9,278,133	1(1)	0.0001	-	5	3	0.0003	-	15	2(2)	0.0002	-	11	9(9)	0.0010	-	42	0	0.0000	-
2014	20.8	3,831	9,608,244	3(3)	0.0003	-	16	7(2)	0.0007	-	38	0	0.0000	-	0	8(7)	0.0008	-	50	0	0.0000	-
2015	20.6	3,728	9,393,234	1(1)	0.0001	-	4	4(2)	0.0004	-	18	2(2)	0.0002	-	9	13(12)	0.0014	-	69	0	0.0000	-
2016	20.1	3,880	9,872,439	1(1)	0.0001	-	5	3(1)	0.0003	-	15	2(1)	0.0002	-	7	31(28)	0.0031	-	162	1(1)	0.0001	5
2017	20.4	3,832	10,148,195	3(1)	0.0003	15	-	0	0.0000	0	-	3	0.0003	15	-	26(23)	0.0026	127	-	0	0.0000	-
2018	20.4	4,332	11,751,144	3(3)	0.0003	15	-	2	0.0002	10	-	1(1)	0.0001	5	-	18(16)	0.0015	88	-	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 Hawai`i deep-set fishery because the vessel departed Honolulu under the Hawai`i longline permit.

Sources: Take data—2002-2018 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

3.2.2.3.1 Comparison of Interactions with ITS

The Hawai`i deep-set longline fishery operates under the 3-year ITS in the 2014 Biological Opinion for leatherback sea turtles, and in the 2017 Supplement to the 2014 Biological Opinion for all other sea turtle species (**Table 64**; **Table 65**). 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 Hawai`i 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 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).

Table 64. Estimated total interactions (extrapolated using quarterly observer coverage) and total mortalities (M) (using Ryder et al., 2006) of sea turtles in the Hawai`i 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
Leatherback turtle	72(27)	21.12(8.6)
2017 Supp. BiOp		
Species	**3-year ITS Interactions (M)**	**Estimated Total Interactions and Mortalities Interactions (M)**
		Q3 2016-Q4 2018
Green turtle[b]	-	-
East Pacific DPS	12(12)	20.38(18.67)
Central North Pacific DPS	6(6)	3.49(3.19)
East Indian-west Pacific DPS	6(6)	2.33(2.13)
Southwest Pacific DPS	6(6)	2.04(1.87)
Central West Pacific DPS	3(3)	0.29(0.27)
Central South Pacific DPS	3(3)	0.29(0.27)
Loggerhead turtle[b]	18(13)	15(9.5)
Olive ridley turtle[b]	-	-

Endangered Mexico and threatened eastern Pacific populations	141(134)	179(168.09)
Threatened western Pacific populations	42(40)	53(49.77)

[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 HAWAI`I DEEP-SET LONGLINE FISHERY

Table 65 through **Table 71** summarize the incidental take data of marine mammals from 2002 to 2018 in the Hawai`i deep-set longline fishery. The incidental take data in this section were compiled from the PIRO Observer Program Annual Status Reports and are for monitoring purposes. Reported interactions listed in these tables reflect all observed interactions, including mortalities, serious injuries, and non-serious injuries. Refer to the most recent SARs for mortality and serious injury estimates and stock-specific abundance estimates and geographic range. Many of these interactions have been further examined, and updated information necessary for any data analyses is available from PIFSC. Observed take data are expanded to represent the estimated number of annual incidental takes for the entire fishery by PIFSC (referred to in this document as "ME"). When ME are not available, a standard expansion factor estimate is listed in the table (EF Est. = 100 / % observer coverage * # takes).

The majority of observed interactions and all observed mortalities since 2002 involved dolphin and small whale species. False killer whales had the highest interaction rate over the 2002-2018 period (average takes/1,000 hooks = 0.0006), followed by short-finned pilot whales (<0.0001), bottlenose dolphins (<0.0001) and Risso's dolphins (<0.0001). 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 67**). Observed interactions with unidentified cetacean groups are shown in **Table 68**.

There are no obvious temporal trends evident in the observed annual take data of each species of marine mammal for the Hawai`i deep-set fishery for this time range. For most species, interactions were rare, only being observed once or twice during the 2002-2018 period. Observed interactions with false killer whales were more frequent, with the highest number of observed interactions occurring in 2018 with 12 interactions. However, the fluctuations in the number of interactions (ranging between 6 and 59 expanded annual estimated takes) do not suggest a clear trend for this species over time. There was also variability in expanded annual estimated takes of other marine mammals such as bottlenose dolphins (0-11 takes), Risso's dolphins (0-10 takes), and short-finned pilot whales (0-6 takes).

Table 65. Observed takes, mortalities (M), takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates and ME for dolphins in the Hawai`i deep-set longline fishery, 2002-2018[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	5	-	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	5	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-	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—2002-2018 PIRO Observer Program Annual and Quarterly Status Reports

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

Table 66. Observed takes, mortalities (M), takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates and ME for small whales in the Hawai`i deep-set longline fishery, 2002-2018[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	35	-	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	39	-	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	59	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-

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

Source: Take data—2002-2018 PIRO Observer Program Annual and Quarterly Status Reports

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

Table 67. Observed takes, takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates and ME for large whales in the Hawai`i deep-set longline fishery, 2002-2018[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	-

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

Source: Take data—2002-2018 PIRO Observer Program Annual and Quarterly Status Reports

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

Table 68. Observed takes, takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates for unidentified species of cetaceans in the Hawai`i deep-set longline fishery, 2002-2018[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—2002-2018 PIRO Observer Program Annual and Quarterly Status Reports

3.2.2.4.1 Comparison of Interactions with ITS

The Hawai`i deep-set longline fishery operates under the 3-year ITS in the 2014 Biological Opinion for all marine mammals protected under the ESA, which includes sperm whales and the MHI insular DPS of false killer whales (**Table 69**). 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 Hawai`i 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 Hawai`i 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.

Table 69. Estimated total interactions (extrapolated using quarterly observer coverage) and total mortalities (M) of cetaceans in the Hawai`i 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
Sperm whale	9(3)	0
MHI insular false killer whale	1(0.74)	0.25(0.2)

[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 Hawai`i deep-set longline fishery is presented in Table 70 and Table 71. The PBR of a stock reflects only marine mammals of that stock observed within the EEZ around Hawai`i, 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 Hawai`i is well below the PBR in the time period covered by the most current SAR (**Table 70**).

The M&SI interactions inside the Hawai`i EEZ for the HI Pelagic stock of false killer whales in 2009-2013 was 10.85, which exceeded the PBR of 9.3 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 Hawai`i-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 Hawai`i-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 Hawai`i EEZ for the HI Pelagic stock for 2011 to 2015 was 7.5, which is below this stock's PBR (Table 71). 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 the remainder of the year and was reopened on January 1, 2019.

Table 70. Mean estimated annual M&SI and PBR by marine mammal stocks with observed interactions in the Hawai`i deep-set longline fishery

Stock	Years Included in 2017 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[c]	0[c]	403
Rough-toothed dolphin, HI	2011-2015	0	0	46
Risso's dolphin, HI	2011-2015	0.9	0.6	42
Striped dolphin, HI	2011-2015	0.8	0	154
Blainville's beaked whale, HI	2011-2015	0	0	11
Kogia spp. whale (Pygmy or dwarf sperm whale), HI	2007-2011	Pygmy = 0 Dwarf = 0	Pygmy = 0 Dwarf = 0	undetermined
Short-finned pilot whale, HI	2011-2015	1.0	0.1	70
Humpback whale, Central North Pacific	2009-2013	0		83[d]
Sperm whale, HI	2011-2015	0	0.7	10.2

[a] PBR estimates are not available for portions of the stock outside of the U.S. EEZ around Hawai`i, 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 Hawai`i.

[c] M&SI estimates were not included in the draft 2017 SARs because there were no known takes in 2011-2015 by the deep-set or shallow-set Hawai`i longline fisheries.

[d] PBR for the Central North Pacific stock for humpback whales apply to the entire stock.

Source: 2017 Marine Mammal SARs, Draft 2018 Marine Mammal SARs.

Table 71. Summary of mean estimated annual M&SI and PBR for false killer whale stocks with observed or prorated interactions in the Hawai`i deep-set longline fishery

False Killer Whale Stock	Years Included in 2017 SAR	Outside EEZ[a]	Inside EEZ	
		Mean Estimated Annual M&SI	Mean Estimated Annual M&SI	PBR (Inside EEZ only)
MHI Insular	2011-2015	-	0.0	0.3
HI Pelagic	2011-2015	15.2	7.5	9.3
NWHI	2011-2015	-	0.4	2.3
Palmyra Atoll	2006-2010	-	0.3	6.4

[a] PBR estimates are not available for portions of the stock outside of the U.S EEZ around Hawai`i and Palmyra Atoll.

Source: 2017 Marine Mammal SARs, Draft 2018 Marine Mammal SARs.

3.2.2.5 SEABIRD INTERACTIONS IN THE HAWAI`I 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 Hawai`i 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 72 and **Table 73** summarize the incidental take data of seabirds from 2002 to 2018 in the Hawai`i deep-set longline fishery. The most common observed interactions during this time period involved black-footed albatrosses (average observed takes/1,000 hooks = 0.0049) and Laysan albatrosses (0.0027), averaging approximately 47 and 23 interactions per year, respectively. Additional takes of unidentified shearwaters (0.0003), sooty shearwaters (<0.0001), brown boobies (<0.0001), red-footed boobies (<0.0001), unidentified gulls (<0.0001), unidentified albatross (<0.0001), and unidentified seabirds (<0.0001) 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 reaching a maximum in 2018 of 194 observed interactions, including 168 observed mortalities. Expanded annual estimated takes for other seabird species suggested a high degree of variability from year to year. The expanded annual estimate ranges between 7 and 236 for Laysan albatrosses, 16 and 951 for black-footed albatrosses, 0 and 12 for booby species, and 0 and 62 for shearwater species. Interactions with sooty shearwaters and boobies are relatively infrequent.

Results from an analysis of seabird interaction rates in the Hawai`i 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 Hawai`i 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 Hawai`i 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 Hawai`i 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 Hawai`i 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 Hawai`i deep-set longline fishery including addressing captain effects through strategic outreach, identifying tori line designs suitable for the Hawai`i fishery, encouraging trials for making minor modifications to existing required measures, and progressing international bycatch assessments for North Pacific albatross species.

Additional discussion on the factors influencing seabird interaction trends is included in Section 3.6 of this report.

Table 72. Observed takes, mortalities (M), takes per fishing effort (sets and 1,000 hooks), and estimated annual takes using expansion factor estimates and ME for albatross species in the Hawai`i deep-set longline fishery, 2002-2018[a]

				Laysan albatross				Black-footed albatross				Unidentified albatross				Short-tailed albatross
				Observed				Observed				Observed				Observed
Year	Obs. Cov. (%)	Sets	Hooks	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Take s (M)	Takes/1,000 hooks	EF Est.	ME	Takes (M)
2002	24.6	3,523	6,786,303	16(13)	0.002	65	-	18(17)	0.003	73	-	0	0.000	-	-	0
2003	22.2	3,204	6,442,221	44(44)	0.007	198	-	24(23)	0.004	108	-	0	0.000	-	-	0
2004	24.6	3,958	7,900,681	2(2)	0.000	-	10	4(4)	0.001	-	16	0	0.000	-	-	0
2005	26.1	4,602	9,360,671	6(6)	0.001	-	43	12(12)	0.001	-	82	0	0.000	-	-	0
2006	21.2	3,605	7,540,286	1(1)	0.000	-	7	17(17)	0.002	-	70	0	0.000	-	-	0
2007	20.1	3,506	7,620,083	7(7)	0.001	-	44	14(14)	0.002	-	77	0	0.000	-	-	0
2008[d]	21.7	3,915	8,775,951	14(13)	0.002	-	55	34(33)	0.004	-	118	0	0.000	-	-	0
2009	20.6	3,520	7,877,861	18(18)	0.002	-	60	23(23)	0.003	-	110	0	0.000	-	-	0
2010	21.1	3,580	8,184,127	39(38)	0.005	-	155	17(17)	0.002	-	65	0	0.000	-	-	0
2011	20.3	3,540	8,260,092	32(31)	0.004	-	187	13(12)	0.002	-	73	0	0.000	-	-	0
2012	20.4	3,659	8,768,728	30(25)	0.003	-	136	35(35)	0.004	-	167	0	0.000	-	-	0
2013	20.4	3,830	9,278,133	48(46)	0.005	-	236	50(47)	0.005	-	257	0	0.000	-	-	0
2014	20.8	3,831	9,608,244	13(10)	0.001	-	77	32(29)	0.003	-	175	0	0.000	-	-	0
2015	20.6	3,728	9,393,234	24(22)	0.003	-	119	107(92)	0.011	-	541	0	0.000	-	-	0
2016	20.1	3,880	9,872,439	34(32)	0.003	-	166	104(99)	0.011	-	485	1(1)	0.001	-	7	0
2017	20.4	3,832	10,148,195	38(38)	0.004	186	-	97(85)	0.010	475	-	0	0.000	0	-	0
2018	20.4	4,332	11,751,144	33(29)	0.003	162	-	194(168)	0.017	951	-	0	0.000	0	-	0

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

Source: Take data—2002-2018 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.

Table 73. Observed takes, mortalities (M), takes per fishing effort (sets and 1,000 hooks), and estimated annual takes using expansion factor estimates and ME for other seabird species in the Hawai`i deep-set longline fishery, 2002-2018[a]

Year	Obs. Cov. (%)	Sets	Hooks	Booby species				Sooty shearwater			Unidentified shearwater				Unidentified gull			
				Observed		EF Est.	ME	Observed		EF Est.	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		
2002	24.6	3,523	6,786,303	0	0.000	0	-	0	0.000	0	0	0.000	0	-	0	0.000	-	-
2003	22.2	3,204	6,442,221	0	0.000	0	-	0	0.000	0	0	0.000	0	-	0	0.000	-	-
2004	24.6	3,958	7,900,681	0	0.000	0	-	0	0.000	0	2(2)	0.000	8	-	0	0.000	-	-
2005	26.1	4,602	9,360,671	1(1)[b]	0.000	4	-	0	0.000	0	0	0.000	0	-	0	0.000	-	-
2006	21.2	3,605	7,540,286	0	0.000	0	-	3(3)	0.000	14	2(2)[c]	0.000	9	-	0	0.000	-	-
2007	20.1	3,506	7,620,083	0	0.000	0	-	0	0.000	0	0	0.000	0	-	0	0.000	-	-
2008[d]	21.7	3,915	8,775,951	1[e]	0.000	-	4	0	0.000	0	14(14)[c]	0.002	-	62	0	0.000	-	-
2009	20.6	3,520	7,877,861	0	0.000	-	0	0	0.000	0	4(4)[c]	0.001	-	24	0	0.000	-	-
2010	21.1	3,580	8,184,127	0	0.000	-	0	0	0.000	0	1(1)[c]	0.000	-	0	0	0.000	-	-
2011	20.3	3,540	8,260,092	0	0.000	-	0	0	0.000	0	3(3)[c]	0.000	-	19	0	0.000	-	-
2012	20.4	3,659	8,768,728	0	0.000	-	0	1(1)	0.000	5	6(6)[c]	0.001	-	36	0	0.000	-	-
2013	20.4	3,830	9,278,133	0	0.000	-	0	0	0.000	0	8(8)[c]	0.001	-	43	0	0.000	-	-
2014	20.8	3,831	9,608,244	0	0.000	-	0	0	0.000	0	1(1)[c]	0.000	-	7	0	0.000	-	-
2015	20.6	3,728	9,393,234	1(1)[g]	0.000	-	6	5(4)	0.001	5	0	0.000	-	21[f]	0	0.000	-	-
2016	20.1	3,880	9,872,439	2(1)[g]	0.000	-	12	4(4)	0.000	20	0	0.000	0	-	0	0.000	-	-
2017	20.4	3,832	10,148,195	0	0.000	0	-	0	0.000	0	0	0.000	0	-	1	0.001	5	-
2018	20.4	4,332	11,751,144	2(2)[h]	0.000	10	-	0	0.000	0	10(10)	0.001	49	-	0	0.000	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 Hawai`i 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.

3.2.2.5.1 Comparison of Interactions with ITS

The short-tailed albatross ITS in the USFWS 2012 Biological Opinion for the Hawai`i 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 2017.

3.2.2.6 ELASMOBRANCH INTERACTIONS IN THE HAWAI`I DEEP-SET LONGLINE FISHERY

Table 74 summarizes the incidental take data for the Indo-west Pacific DPS of scalloped hammerhead sharks, oceanic whitetip sharks, and giant manta rays in the Hawai`i deep-set longline fishery. The most common observed interactions from 2004 to 2018 include oceanic whitetip sharks (average takes/1,000 hooks = 0.0331), ranging between 144 and 531 interactions per year. Giant manta rays were taken occasionally (0.0003), with 0 to 17 interactions per year. Three observed interactions with the Indo-west Pacific DPS of scalloped hammerhead shark have been recorded since 2004.

Total interaction for the fleet are estimated using the expansion factor calculations (EF Est. = 100 / % observer coverage * # takes). The annual expanded interaction estimates range between 664 and 2,578 for oceanic whitetips, 0 and 81 for giant manta rays, and 0 and 8 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).

The 2014 Biological Opinion includes a three-year ITS of 6 takes from the Indo-west Pacific DPS of scalloped hammerhead shark. 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 the 2016 are monitored against this ITS, and there has been no observed interaction with this DPS through the end of 2018.

Table 74. Observed and estimated interactions with elasmobranchs in the Hawai`i deep-set longline fishery, 2004-2018[a]

Year	Obs. Cov. (%)	Sets	Hooks	Scalloped hammerhead shark			Oceanic whitetip shark			Giant manta ray		
				Observed		EF Est.	Observed		EF Est.	Observed		EF Est.
				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	8	434(101)	0.0549	1764	1	0.0001	4
2005	26.1	4,602	9,360,671	0	0.0000	0	341(80)	0.0364	1307	2	0.0002	8
2006	21.2	3,605	7,540,286	0	0.0000	0	331(78)	0.0439	1561	2(1)	0.0003	9
2007	20.1	3,506	7,620,083	1	0.0001	5	262(72)	0.0344	1303	2	0.0003	10
2008	21.7	3,915	8,775,951	0	0.0000	0	144(36)	0.0164	664	2	0.0002	9
2009	20.6	3,520	7,877,861	0	0.0000	0	244(55)	0.0310	1184	4	0.0005	19
2010	21.1	3,580	8,184,127	0	0.0000	0	253(44)	0.0309	1199	17(1)	0.0021	81
2011	20.3	3,540	8,260,092	0	0.0000	0	225(43)	0.0272	1108	1	0.0001	5
2012	20.4	3,659	8,768,728	0	0.0000	0	172(38)	0.0196	843	2	0.0002	10
2013	20.4	3,830	9,278,133	0	0.0000	0	196(36)	0.0211	961	1	0.0001	5
2014	20.8	3,831	9,608,244	0	0.0000	0	374(68)	0.0389	1798	3	0.0003	14
2015	20.6	3,728	9,393,234	0	0.0000	0	531(139)	0.0565	2578	2	0.0002	10
2016	20.1	3,880	9,872,439	0	0.0000	0	423(123)	0.0428	2104	4	0.0004	20
2017	20.4	3,832	10,148,195	0	0.0000	0	242(57)	0.0238	1186	0	0.0000	0
2018	20.4	4,332	11,751,144	0	0.0000	0	224(62)	0.0191	1098	1	0.0001	5

[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)

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 75**). 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 76**). Exceeding the three-year ITSs requires reinitiation of consultation on the fishery under the ESA.

In January 2018, oceanic whitetip sharks and giant manta rays were listed under the ESA (83 FR 4153 and 83 FR 2916, respectively). On April 3, 2019, NMFS reinitiated consultation for the American Samoa longline fishery and determined that the conduct of the American

Samoa longline fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d).

Table 75. 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 76. 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 2019 LOF (84 FR 22051, May 16, 2019), meaning that this fishery has occasional incidental mortality and serious injuries of marine mammals. The 2019 LOF lists the following marine mammal stocks that are incidentally killed or injured in this fishery:

- Bottlenose dolphin, unknown stock
- Cuvier's beaked whale, unknown stock
- 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 77**). 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 BiOp (e.g.,**Table 78**).

3.2.3.3 SEA TURTLE INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 77 summarizes the incidental take data of sea turtles from 2006 to 2018 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 2018, 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 (2006-2018 average takes/1,000 hooks = 0.0022), whereas interactions with leatherbacks, olive ridleys, and hawksbills were less frequent (0.0006, 0.0008, and 0.0003 respectively).

Green sea turtle takes were variable year to year, ranging between 0-11 observed takes (0-50 expanded annual estimated takes). From 2016 to 2018, 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 (0.006 takes/1,000 hooks).

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 (average observer coverage = 19.6%). 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 77. 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, 2006-2018[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)	0.004	37	-	0	0.000	0	-	0	0.000	0	-	0	0.000	-	-
2007	7.1	410	1,255,329	1(1)	0.001	14	-	0	0.000	0	-	0	0.000	0	-	0	0.000	-	-
2008	6.4	379	1,194,096	1(1)	0.001	16	-	0	0.000	0	-	0	0.000	0	-	0	0.000	-	-
2009	7.7	306	880,612	3(3)	0.003	39	-	0	0.000	0	-	0	0.000	0	-	0	0.000	-	-
2010	25.0	798	2,301,396	6(5)	0.003	-	50	0	0.000	-	0	0	0.000	-	0	0	0.000	-	-
2011	33.3	1,257	3,605,897	11(10)	0.003	-	32	2(1)	0.001	-	4	1	0.000	-	4	0	0.000	-	-
2012	19.8	662	1,880,525	0	0.000	-	0	1	0.001	-	6	1(1)	0.001	-	6	0	0.000	-	-
2013	19.4	585	1,690,962	2(2)	0.001	-	19	2(1)	0.001	-	13	1	0.001	-	4	0	0.000	-	-
2014	19.4	565	1,490,416	2(2)	0.001	-	17	0	0.000	-	4	2	0.001	-	5	0	0.000	-	-
2015	22.0	504	1,441,706	0	0.000	-	0	3(3)	0.006	-	22	1	0.002	-	6	0	0.000	-	-
2016	19.4	424	1,179,532	4(4)	0.003	21	-	1(1)	0.001	5	-	3(3)	0.003	15	-	1(1)	0.001	5	-
2017	20.0	447	1,271,803	4(4)	0.003	20	-	1	0.001	5	-	2(2)	0.002	10	-	0	0.000	0	-
2018	17.5	276	732,476	4(4)	0.006	23	-	1	0.001	6	-	2(2)	0.003	11	-	2(2)	0.003	0	-

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

Source: Take data—2006-2018 PIRO Observer Program Annual and Quarterly Status Reports

ME—McCracken, 2015a; McCracken, 2017a.

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 78). 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.

DPS-specific ITSs for green turtles included in a Conference Opinion in the 2015 Biological Opinion became effective at the time of the final listing in 2016 (81 FR 20058, April 5, 2016). The estimated total interactions for each of the DPSs are prorated based on the estimated proportions indicated in the 2015 Biological Opinion (NMFS 2015).

Unlike the Hawai`i shallow-set longline fishery, the American Samoa longline fishery does not have hard caps and the ITS triggers reinitiation of consultation when exceeded. The ITSs for green, olive ridley, and hawksbill turtles were exceeded in 2018. On April 3, 2019, NMFS reinitiated consultation for the American Samoa longline fishery and determined that the conduct of the American Samoa longline fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d).

Table 78. 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 for 2016 – 2018 Interactions (M)
Green turtle [b]	60(54)	62.9(57.87)
Central South Pacific DPS[b]	30(27)	31.9(29.35)[c]
Southwest Pacific DPS[b]	20(17.82)	21.1(19.41)[c]
East Pacific DPS[b]	7(6.48)	7.1(6.53)[c]
Central West Pacific DPS[b]	2(1.62)	1.7(1.56)[c]
East Indian-West Pacific DPS[b]	1(1.08)	1.2(1.1)[c]
Leatherback turtle	69(49)	10.6(7.21)
Olive ridley turtle	33(10)	36.2(23.53)
Loggerhead turtle	6(3)	0
Hawksbill turtle	6(3)	20.4(20.4)

[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).

3.2.3.4 MARINE MAMMAL INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 79 summarizes the incidental take data of marine mammals from 2006 to 2018 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 2018 were relatively infrequent with only two marine mammal interactions in 2018. False killer whales had the highest interaction rate over this period (average observed takes/1,000 hooks = 0.0006), followed by rough-toothed dolphins (0.0005), Cuvier's beaked whales (<0.0001), short-finned pilot whales (<0.0001), and 2 unidentified cetaceans (<0.0001). Between 2006 and 2018, there were 5 years of no observed marine mammal interactions with this fishery (2006, 2007, 2009, 2010, and 2012).

Table 79. 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, 2006-2018[a]

Year	Obs. Cov. (%)	Sets	Hooks	Cuvier's beaked whale			False killer whale			Rough-toothed dolphin			Short-finned pilot whale			Unidentified cetacean		
				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	
2006	8.1	287	797,221	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0
2007	7.1	410	1,255,329	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0
2008	6.4	379	1,194,096	0	0.000	0	2(1)	0.002	31	1	0.001	16	0	0.000	0	0	0.000	0
2009	7.7	306	880,612	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0
2010	25.0	798	2,301,396	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0
2011	33.3	1,257	3,605,897	1(1)	0.000	3	3	0.001	9	5	0.001	15	0	0.000	0	2	0.001	6
2012	19.8	662	1,880,525	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0
2013	19.4	585	1,690,962	0	0.000	0	1	0.001	5	1(1)	0.001	5	0	0.000	0	0	0.000	0
2014	19.4	565	1,490,416	0	0.000	0	0	0.000	0	0	0.000	0	1	0.001	5	0	0.000	0
2015	22.0	504	1,441,706	0	0.000	0	2(1)	0.001	9	0	0.000	0	0	0.000	0	0	0.000	0
2016	19.4	424	1,179,532	0	0.000	0	2	0.002	10	2(2)	0.002	10	0	0.000	0	0	0.000	0
2017	20.0	447	1,271,803	0	0.000	0	1	0.001	5	1	0.001	5	0	0.000	0	0	0.000	0
2018	17.5	276	732,476	0	0.000	0	1	0.001	6	1(1)	0.001	6	0	0.000	0	0	0.000	0

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

Source: 2006-2018 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.

3.2.3.4.1 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.

3.2.3.5 SEABIRD INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 80 summarizes the incidental take data of seabirds from 2006 to 2018 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 2018 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.

Table 80. 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, 2006-2018[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	0.000	0	-	0	0.000	0	-	0	0.000	0	-
2007	7.1	410	1,255,329	0	0.000	0	-	1(1)	0.001	14	-	0	0.000	0	-
2008	6.4	379	1,194,096	0	0.000	0	-	0	0.000	0	-	0	0.000	0	-
2009	7.7	306	880,612	0	0.000	0	-	0	0.000	0	-	0	0.000	0	-
2010	25.0	798	2,301,396	0	0.000	0	-	0	0.000	-	0	0	0.000	-	0
2011	33.3	1,257	3,605,897	0	0.000	0	-	1(1)	0.000	-	2	0	0.000	-	0
2012	19.8	662	1,880,525	0	0.000	0	-	0	0.000	-	0	0	0.000	-	0
2013	19.4	585	1,690,962	0	0.000	0	-	0	0.000	-	0	1(1)	0.001	-	5
2014	19.4	565	1,490,416	0	0.000	-	0	0	0.000	0	-	0	0.000	-	0
2015	22.0	504	1,441,706	13(13)[b]	0.026	-	13	0	0.000	0	-	0	0.000	-	0
2016	19.4	424	1,179,532	0	0.000	0	-	0	0.000	0	-	0	0.000	0	-
2017	20.0	447	1,271,803	0	0.000	0	-	0	0.000	0	-	0	0.000	0	-
2018	17.5	276	732,476	0	0.000	0	-	0	0.000	0	-	0	0.000	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: 2006-2018 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 81 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 (average takes/1,000 hooks = 0.0713) are most common in the American Samoa longline fishery from 2006 to 2018 ranging between 45 and 197 observed annual interactions with expanded estimates ranging between 315 and 1,015 takes per year. Scalloped hammerheads (0.0009) and giant manta rays (0.0005) are taken less frequently. There have been between 0 and 4 observed scalloped hammerhead interactions per year with expanded total takes ranging between 0 and 17 per year. Similarly, there have been between 0 and 3 observed giant manta ray takes, although there have been no takes in the last four years.

The 2015 Biological Opinion includes a three-year ITS of 36 takes from the Indo-west Pacific DPS of scalloped hammerhead sharks. 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 27 scalloped hammerhead interactions based on the expansion factor estimate in the American Samoa longline fishery from 2016 to 2018, thus the three-year ITS has not been exceeded.

Table 81. Observed and estimated total elasmobranch interactions with the American Samoa longline fishery for 2006-2018[a]

Year	Obs. Cov. (%)	Sets	Hooks	Scalloped hammerhead				Oceanic whitetip			Giant manta ray		
				Observed		EF Est.	ME	Observed		EF Est.	Observed		EF Est.
				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	520	3	0.0013	12
2011	33.3	1,257	3,605,897	2(1)	0.0006	-	7	116(44)	0.0322	348	3	0.0008	9
2012	19.8	662	1,880,525	0	0.0000	-	0	71(26)	0.0378	359	3	0.0016	15
2013	19.4	585	1,690,962	0	0.0000	-	0	88(15)	0.0520	454	2	0.0012	10
2014	19.4	565	1,490,416	1	0.0007	-	6	104(37)	0.0698	536	1	0.0007	5
2015	22.0	504	1,441,706	1(1)	0.0007	-	3	168(59)	0.1165	764	0	0.0000	0
2016	19.4	424	1,179,532	1	0.0008	5	-	197(70)	0.1670	1015	0	0.0000	0
2017	20.0	447	1,271,803	1	0.0008	5	-	63(22)	0.0495	315	0	0.0000	0
2018	17.5	276	732,476	3	0.0041	17	-	108(39)	0.1474	617	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: NMFS American Samoa Longline Observer Program Annual Reports 2006–2011 (NMFS 2006b, 2007, 2008b, 2009, 2010b, 2011, 2012, 2013, 2014d) and unpublished data, 2010–2018; McCracken 2015a; McCracken 2017a.

3.2.4 HAWAI`I TROLL FISHERY

3.2.4.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS IN THE HAWAI`I TROLL FISHERY

In this report, the Council monitors protected species interactions in the Hawai`i 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 Hawai`i 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 List of Fisheries (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 2019 LOF (84 FR 22051, May 16, 2019), the Hawai`i 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 2019 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 Hawai`i 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 HAWAI`I TROLL FISHERY

NMFS has determined that the Hawai`i 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 Hawai`i 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 2019 LOF (84 FR 22051, May 16, 2019), 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 HAWAI`I OFFSHORE HANDLINE FISHERY

3.2.6.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS IN THE HAWAI`I OFFSHORE HANDLINE FISHERY

In this report, the Council monitors protected species interactions in the Hawai`i 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 Hawai`i 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 2019 LOF (84 FR 22051, May 16, 2019), the Hawai`i 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 HAWAI`I OFFSHORE HANDLINE FISHERY

NMFS has determined that the Hawai`i 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 Hawai`i 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 2019 LOF (84 FR 22051, May 16, 2019), 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 Hawai`i 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.

Loggerhead turtle interactions in the Hawai`i shallow-set longline fishery since the start of the 2017-2018 fishing season (2017 fall through 2018 summer) were higher than levels observed since the fishery reopened in 2004 through 2016. The total number of loggerhead interactions (based on observed interaction date) for 2017 was 21, and 33 loggerhead interactions were observed from January to May 2018, preceding the fishery closure. While the factors influencing the recent spike in loggerhead turtle interactions are unclear at this time, available observer data indicate that sea turtle interactions can accumulate quickly in some years and have the potential to fluctuate substantially between years. Additional discussion on the higher loggerhead turtle interactions is included in section 3.2.1.3.2 of this report.

Potential interactions between Hawai`i non-longline pelagic fisheries and cetaceans have been identified and are summarized in the most recent marine mammal SARs. Available information do 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.

One species that may occur within the effort range of fisheries managed under the Pelagic FEP is currently a candidate for listing under the ESA, and several more ESA-listed species are being evaluated for critical habitat designation (**Table 82**). If this species is listed or critical habitat are designated, they will be included in this SAFE report and impacts from FEP-managed fisheries will be evaluated under applicable mandates.

Table 82. 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)	Not determinable because of insufficient data (83 FR 4153, 1/30/18)	In development
Pacific bluefin tuna	*Thunnus orientalis*	Positive (81 FR 70074, 10/11/2016)	Not warranted (82 FR 37060, 8/8/17)	N/A	N/A	N/A
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)	N/A	N/A
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)	Not determinable because of insufficient data (83 FR 2916, 1/22/18)	TBA
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, proposal expected TBA	In development, expected TBA, interim recovery outline in place
Cauliflower coral	*Pocillopora meandrina*	Positive (83 FR 47592, 9/20/2018)	TBA (status review ongoing)	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)	Critical habitat 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, peer review expected 2019
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[a]	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 ongoing)	TBA	N/A	N/A
Loggerhead sea turtle (North Pacific DPS)	*Caretta caretta*	Positive (72 FR 64585, 11/16/2007)	9 DPSs listed as endangered and threatened (76 FR 15932, 03/22/2011)	9 DPSs listed as endangered and threatened (76 FR 58867, 10/24/2011)	Critical habitiat designated for Atlantic Ocean and Gulf of Mexico DPSs (79 FR 39855, 08/11/2014)	In development, public comment expected 2019; concurrent 5-year status review ongoing

[a] NMFS and USFWS have been tasked with higher priorities regarding sea turtle listings under the ESA, and do not anticipate proposing green turtle critical habitat designations in the immediate future.

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 Protected Species Advisory Committee and Plan Team:

- Research on at-sea foraging behavior of albatross species to improve understanding of interaction rates in the Hawai`i 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);

- 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; and

- 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 oceanic whitetip shark in longline fisheries to record release condition, handling, trailing gear, size and sex for every observed interaction; and

- Improve data collection for oceanic whitetip shark capture data in non-longline pelagic fisheries.

3.2.10 REFERENCES

50 C.F.R. §226.201. Endangered and Threatened Species: Final Rulemaking To Revise Critical Habitat for Hawaiian Monk Seals, 50 C.F.R. §226.201 (21 August 2015).

50 C.F.R. §229.3 and §665.806. Taking of Marine Mammals Incidental to Commercial Fishing Operations; False Killer Whale Take Reduction Plan, 50 C.F.R. §229.3 and §665.806 (29 November 2012).

Carretta, J.V., K.A. Forney, E.M. Oleson, D.W. Weller, A.R. Lang, J. Baker, M.M. Muto, B. Hanson, A.J. Orr, H. Huber, M.S. Lowry, J. Barlow, J.E. Moore, D. Lynch, L. Carswell, and R.L. Brownell Jr., 2017. U.S. Pacific Marine Mammal Stock Assessments: 2016. U.S. Department of Commerce, NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-577. 407 pp.

Gilman, E., Kobayashi, D., Swenarton, T., Brothers, N., Dalzell, P., and I. Kinan-Kelly, 2007. Reducing sea turtle interactions in the Hawai`i-based longline swordfish fishery. *Biological Conservation*, *139*(1), pp. 19-28.

Gilman, E., Chaloupka, M., Peschon, J., and S. Ellgen, 2016. Risk factors for seabird bycatch in a pelagic longline tuna fishery. *PLoS ONE*, *11*(5), e0155477.

Gilman, E., Ishizaki, A. (Eds.) 2018. Report of the Workshop to Review Seabird Bycatch Mitigation Measures for Hawaii's Pelagic Longline Fisheries, September 18-19, 2018. Western Pacific Regional Fishery Management Council, Honolulu. Available online at: http://www.wpcouncil.org/wp-content/uploads/2018/11/WPRFMC_2018-Seabird-bycatch-mgmt-workshop_FinalReport.pdf.

Kobayashi, D., and K. Kawamoto, 1995. Evaluation of shark, dolphin, and monk seal interactions with Northwestern Hawaiian Island bottomfishing activity: A comparison of two time periods and an estimate of economic impacts. *Fisheries Research*, *23*, pp. 11-22.

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 pp. doi:10.7289/V5/AR-PIFSC-H-16-07.

McCracken, M.L., 2005. Estimation of Year 2004 Incidental Takes of Sea Turtles, Seabirds, and Marine Mammals in the Hawai`i Longline Deep Set Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-05-001, 3 pp. 21 March 2005.

McCracken, M.L., 2006. Estimation of Incidental Interactions with Sea Turtles, Seabirds, and Marine Mammals in the 2005 Hawai`i Longline Deep Set Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-06-006, 3 pp. 19 April 2006.

McCracken, M.L., 2007. Estimation of Incidental Interactions with Sea Turtles, Seabirds, and Marine Mammals in the 2006 Hawai`i Longline Deep Set Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-07-006, 4 pp. 20 April 2007.

McCracken, M.L., 2008. Estimation of Incidental Interactions with Sea Turtles and Seabirds in the 2007 Hawai`i Longline Deep Set Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-08-007, 3 pp. 24 April 2008.

McCracken, M.L., 2009. Estimation of Incidental Interactions with Sea Turtles and Seabirds in the 2008 Hawai`i Longline Deep Set Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-09-011, 4 pp. 10 April 10 2009.

McCracken, M.L., 2010. Estimation of Incidental Interactions with Sea Turtles and Seabirds in the 2009 Hawai`i Longline Deep Set Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-10-009, 3 pp. 16 April 2010.

McCracken, M.L., 2011a. Assessment of incidental interactions with marine mammals in the Hawai`i longline deep and shallow set fisheries from 2006 through 2010. Pacific Islands Fisheries Science Center, PIFSC Working Paper, WP-11-012, 30 pp.

McCracken, M.L., 2011b. Estimation of Incidental Interactions with Sea Turtles and Seabirds in the 2010 Hawai`i Deep-set Longline Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-11-005, 3 pp. 19 April 2011.

McCracken, M.L., 2012. Estimation of Incidental Interactions with Sea Turtles and Seabirds in the 2011 Hawai`i Deep-set Longline Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-12-012, 3 pp. 13 April 2012.

McCracken, M.L., 2013. Estimation of Incidental Interactions with Sea Turtles and Seabirds in the 2012 Hawai`i Deep-set Longline Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-13-014, 6 pp. 5 June 2013.

McCracken, M.L., 2014. Estimation of Incidental Interactions with Sea Turtles and Seabirds in the 2013 Hawai`i Deep-set Longline Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-14-022, 4 pp. 24 June 2014.

McCracken, M.L., 2015a. American Samoa Longline Fishery Protected Species Takes and Cetaceans Takes Resulting in a Classification of Dead or Serious Injury for Years 2010 through 2013. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-15-10. 13 February 2015.

McCracken, M.L., 2016. Assessment of Incidental Interactions with Marine Mammals in the Hawai`i Longline Deep and Shallow-set Fisheries from 2010 through 2014. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-16-008, 2 pp. 10 May 2016.

McCracken, M.L., 2017a. American Samoa Longline Fishery Marine Mammal, Seabirds, Sea Turtles, and Fish Bycatch for Years 2014 and 2015. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-17-027, 16 pp. 22 June 22 2017.

McCracken, M.L., 2017b. Assessment of Incidental Interactions with Marine Mammals in the Hawai`i Longline Deep and Shallow Set Fisheries from 2011 through 2015. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-17-003, 2p. 2 February 2017.

McCracken, M.L., 2017c. Estimation of Bycatch with Sea Turtles, Seabirds, and Fish in the 2014 and 2015 Hawaii Permitted Deep-Set Longline Fishery. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-17-010, 14 pp. 7 April 2017.

McCracken, M.L., 2017d. Estimation of Bycatch with Sea Turtles, Seabirds, and Fish in the 2016 Hawaii Permitted Deep-Set Longline Fishery. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-17-015, 17 pp. 25 May 2017.

Muto, M.M., Helker, V.T., Angliss, R.P., Allen, B.A., Boveng, P.L., Breiwick, J.M., Cameron, M.F., Clapham, P.J., Dahle, S.P., Dahlheim, M.E., Fadely, B.S., Ferguson, M.C., Fritz, L.W., Hobbs, R.C., Ivashchenko, Y.V., Kennedy, A.S., London, J.M., Mizroch, S.A., Ream, R.R., Richmond, E.L., Shelden, K.E.W., Towell, R.G., Wade, P.R., Waite, J.M., and A.R. Zerbini, 2016. Alaska marine mammal stock assessments, 2015. U.S. Dep. Commer., NOAA Tech. Memo. NMFSAFSC-323, 300 pp. doi:10.7289/V5/TM-AFSC-323.

Nitta, E. 1999. Draft: Summary report: Bottomfish observer trips in the Northwestern Hawaiian Islands, October 1990 to December 1993. NMFS Pacific Islands Area Office, Pacific Islands Protected Species Program, Honolulu, HI.

NMFS, 1978. Biological Opinion on the Fishery Management Plan for Precious Corals Fisheries of the Western Pacific Region. 4 October 1978.

NMFS, 2002. Endangered Species Act Section 7 Consultation on the Fishery Management Plan for the Bottomfish and Seamount Groundfish Fisheries in the Western Pacific Region. Sustainable Fisheries Division, Southwest Region, Pacific Islands Area Office. 8 March 2002.

NMFS, 2005. Biological Opinion: Continued authorization of the Hawai`i-based pelagic, deep-set, tuna longline fishery based on the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region. Pacific Islands Region, Protected Resources Division. 4 October 2005.

NMFS, 2008. Biological Opinion and Incidental Take Statement: Implementation of Bottomfish Fishing Regulations within Federal Waters of the Main Hawaiian Islands. Pacific Islands Region, Protected Resources Division. 18 March 2008.

NMFS, 2009. Biological Opinion: Continued Authorization of Pelagic Troll and Handline Fisheries, as Managed under the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region. 1 September 2009.

NMFS, 2012. Biological Opinion: Continued operation of the Hawai`i-based Shallow-set Longline Swordfish Fishery – under Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region (modified May 29, 2012 for technical corrections). Pacific Islands Region, Protected Resources Division. 30 January 2012.

NMFS, 2014. Biological Opinion: Continued operation of the Hawai`i-based deep-set pelagic longline fishery. Pacific Islands Region, Protected Resources Division. 19 September 2014.

NMFS, 2015. Biological Opinion: Continued operation of the American Samoa longline fishery. Pacific Islands Region, Protected Resources Division. 30 October 2015.

NMFS, 2016. Annual Report on Seabird Interactions and Mitigation Efforts in the Hawai`i Longline Fisheries for 2014. NMFS Pacific Islands Regional Office. Honolulu, HI. 16 pp. January 2016 (revised February 2016).

NMFS, 2019. Biological Opinion: Conitnued Authorization of the Hawai`i Pelagic Shallow-set Longline Fishery. Pacific Islands Region, Protected Resources Division. 26 June 2019.

Ryder C.E., Conant T.A., and B.A. Schroeder, 2006. Report of the Workshop on Marine Turtle Longline Post-Interaction Mortality. U.S. Dep. Commerce, NOAA Technical Memorandum NMFS-F/OPR-29, 36 p.

USFWS, 2012. Biological Opinion of the U.S. Fish and Wildlife Service for the Operation of Hawai`i-based Pelagic Longline Fisheries, Shallow Set and Deep Set, Hawaii. Pacific Islands Fish and Wildlife Office. 6 January 2012.

WPRFMC, 2008. Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region – Management Modifications for the Hawai`i-based Shallow-set Longline Swordfish Fishery that Would Remove Effort Limits, Eliminate the Set Certificate Program, and Implement New Sea Turtle Interaction Caps. 12 August 2008.

WPRFMC, 2009. Fishery Ecosystem Plan for the Hawaii Archipelago. 24 September 2009.

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 2018 Annual SAFE Report includes a now standard chapter on indicators of climate and oceanic conditions in the Western Pacific region. These indicators reflect both global climate variability and change, as well as trends in local oceanographic conditions.

The 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 Hawai`i 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:

4 To identify and prioritize research that examines the effects of climate change on Council-managed fisheries and fishing communities.
5 To ensure climate change considerations are incorporated into the analysis of management alternatives.
6 To monitor climate change related variables via the Council's Annual Reports.
7 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.

3.3.1 RESPONSE TO PREVIOUS COUNCIL RECOMMENDATIONS

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. There were no Council recommendations relevant to the climate and oceanic indicators section of the Annual SAFE Report 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.

3.3.2 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:

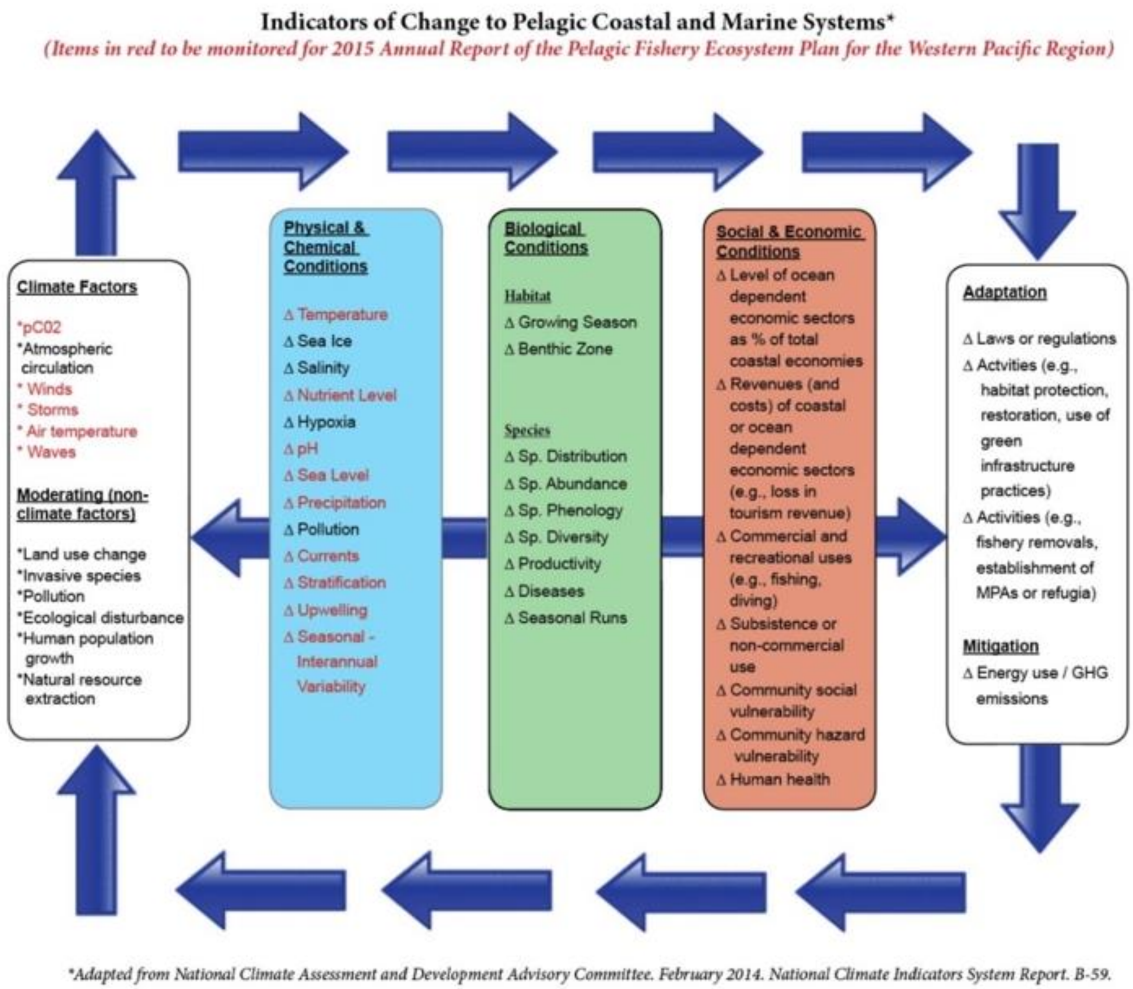


Figure 163. Indicators of change of pelagic coastal and marine systems; conceptual model

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.

3.3.3 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;
- Oceanic Niño Index (ONI);
- Pacific Decadal Oscillation (PDO);
- Tropical cyclones;
- Sea surface temperature (SST);
- Ocean temperature at 300 m depth;
- Ocean color;
- North Pacific Subtropical Front (STF) and Transition Zone Chlorophyll Front (TZCF);
- Estimated Mean Phytoplankton Size
- Fish community size structure;
- Bigeye tuna weight-per-unit-effort; and
- Bigeye tuna recruitment index.

Figure 164Figure 165 provide a description of these indicators and illustrate how they are connected to each other in terms of natural climate variability and anthropogenic climate change.

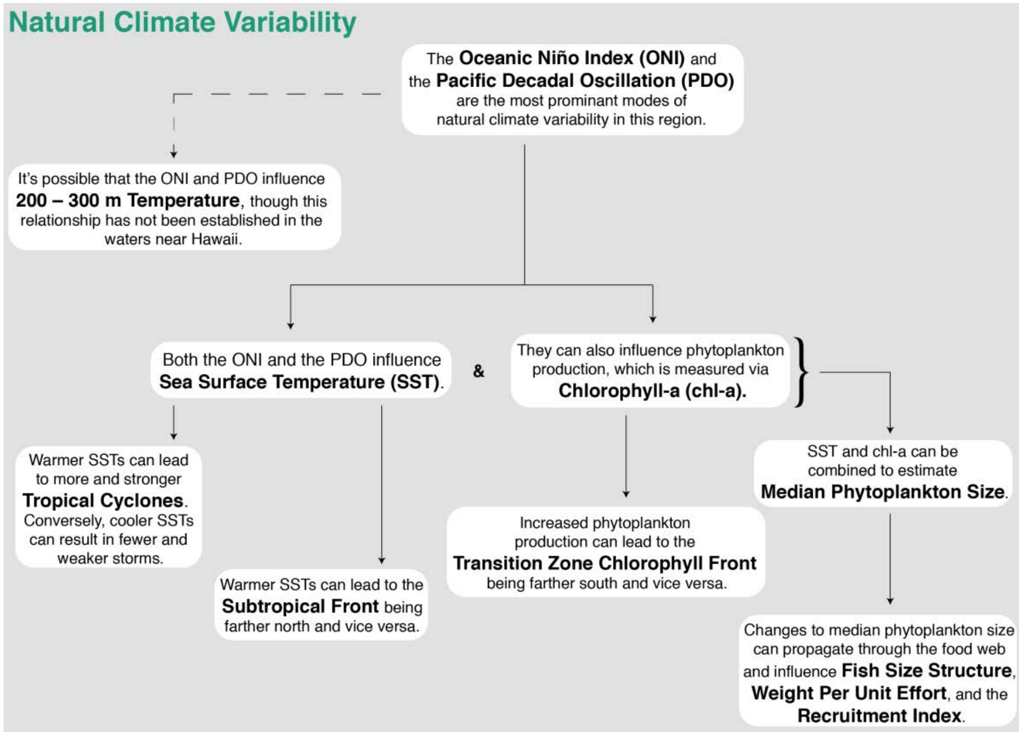


Figure 164. Schematic diagram illustrating how indicators are connected to one another and how they vary as a result of natural climate variability

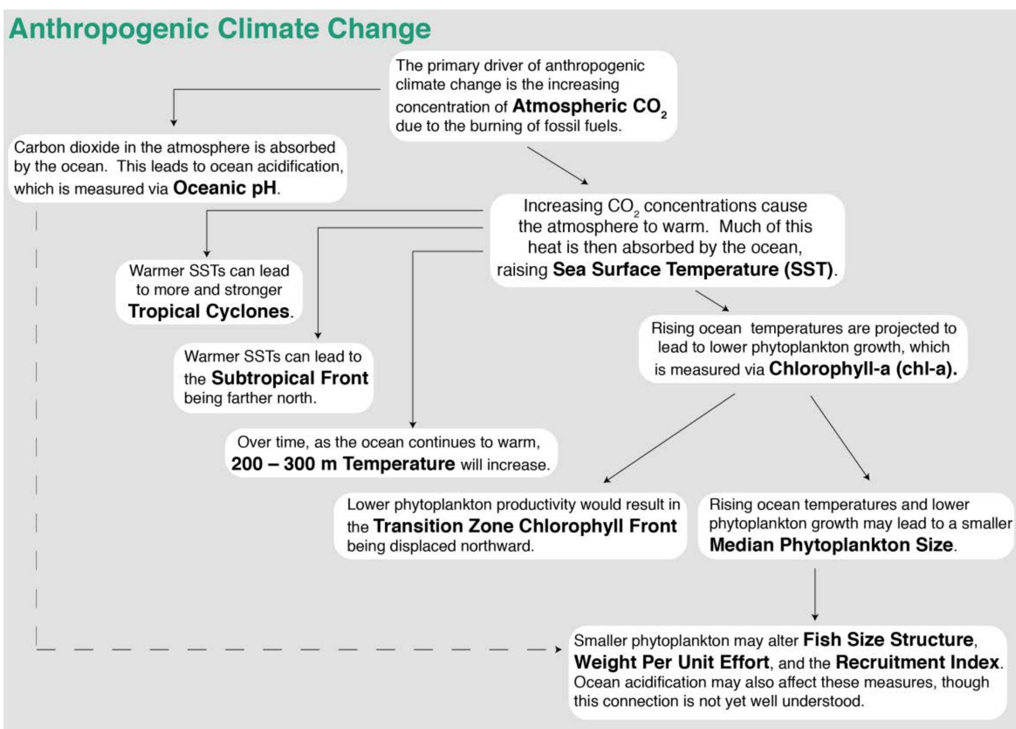


Figure 165**.** Schematic diagram illustrating how indicators are connected to one another and how they vary as a result of anthropogenic climate change

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

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 2018, the annual mean concentration of CO_2 was 409 ppm. In 1959, the first year of the time series, it was 316 ppm. The annual mean passed 350 ppm in 1988, and 400 ppm in 2015.

Description: Monthly mean atmospheric carbon dioxide (CO_2) at Mauna Loa Observatory, Hawai`i in parts per million (ppm) from March 1958 to present. The observed increase in monthly average carbon dioxide concentration is primarily due to CO_2 emissions from fossil fuel burning. Carbon dioxide remains in the atmosphere for a very long time, and emissions from any location mix throughout the atmosphere in approximately one year. The annual variations at Mauna Loa, Hawai`i are due to the seasonal imbalance between the photosynthesis and respiration of terrestrial plants. During the summer growing season, photosynthesis exceeds respiration, and CO_2 is removed from the atmosphere. In the winter (outside the growing season), respiration exceeds photosynthesis, and CO_2 is returned to the atmosphere. The seasonal cycle is strongest in the northern hemisphere because of its larger land mass.

Timeframe: Annual, monthly.

Region/Location: Mauna Loa, Hawai`i, 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 (2019a).

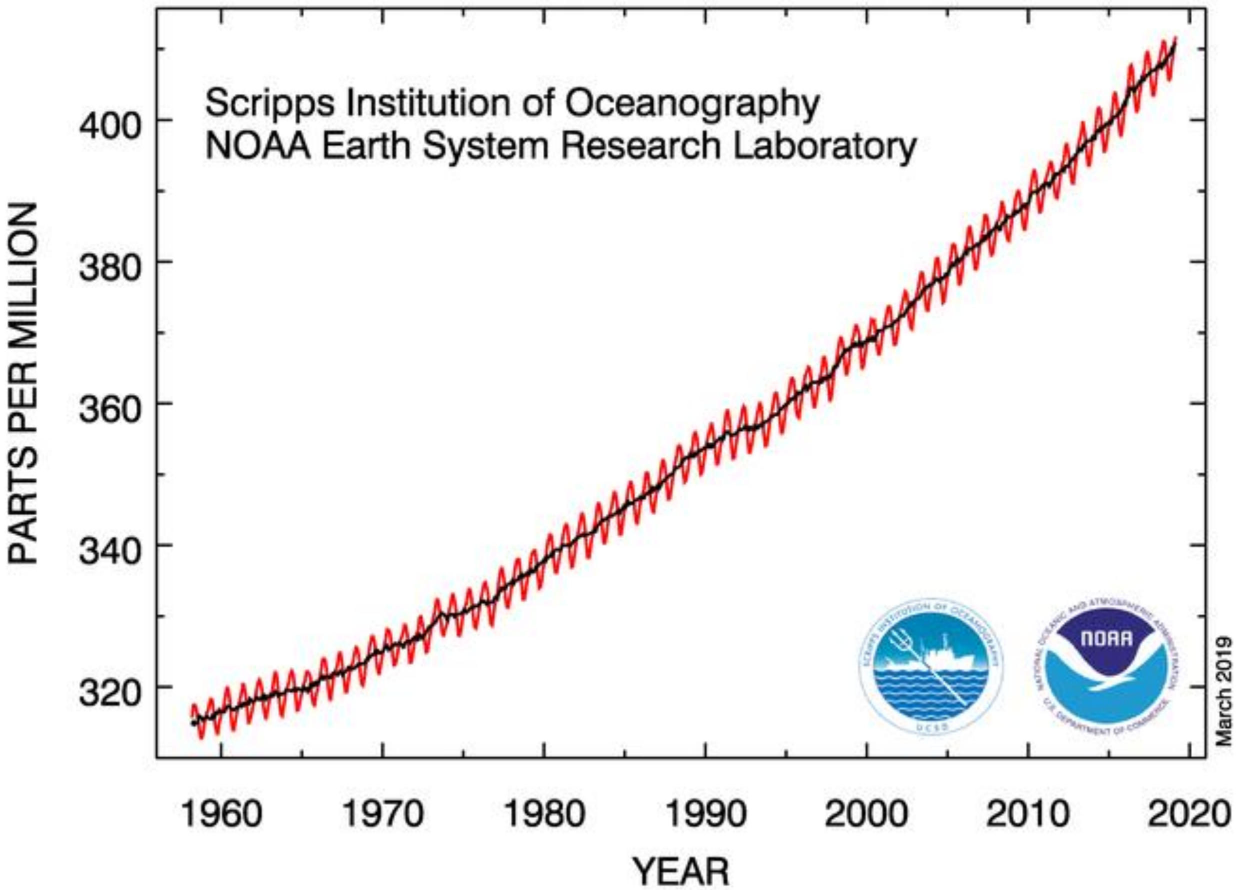


Figure 164. Monthly mean (red) and seasonally-corrected (black) atmospheric carbon dioxide (ppm) at Mauna Loa Observatory, Hawai`i

3.3.3.2 OCEANIC PH

Rationale: Oceanic pH is a measure of how greenhouse gas emissions have already impacted the ocean. This indicator demonstrates that oceanic pH has decreased significantly over the past several decades (i.e. the ocean has become more acidic). Increasing ocean acidification limits the ability of marine organisms to build shells and other calcareous structures. Recent research has shown that pelagic organisms such as pteropods and other prey for commercially-valuable fish species are already being negatively impacted by increasing acidification (Feely *et al*., 2016). The full impact of ocean acidification on the pelagic food web is an area of active research (Fabry et al., 2008).

Status: The ocean is roughly 9.4% more acidic than it was nearly 30 years ago at the start of this time series. Over this time, pH has declined by 0.0389 at a constant rate. In 2017, 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 now outside the range seen in the first year of the time series. The highest pH value reported for the most recent year (8.0831) 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 Hawai`i 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, 2018).

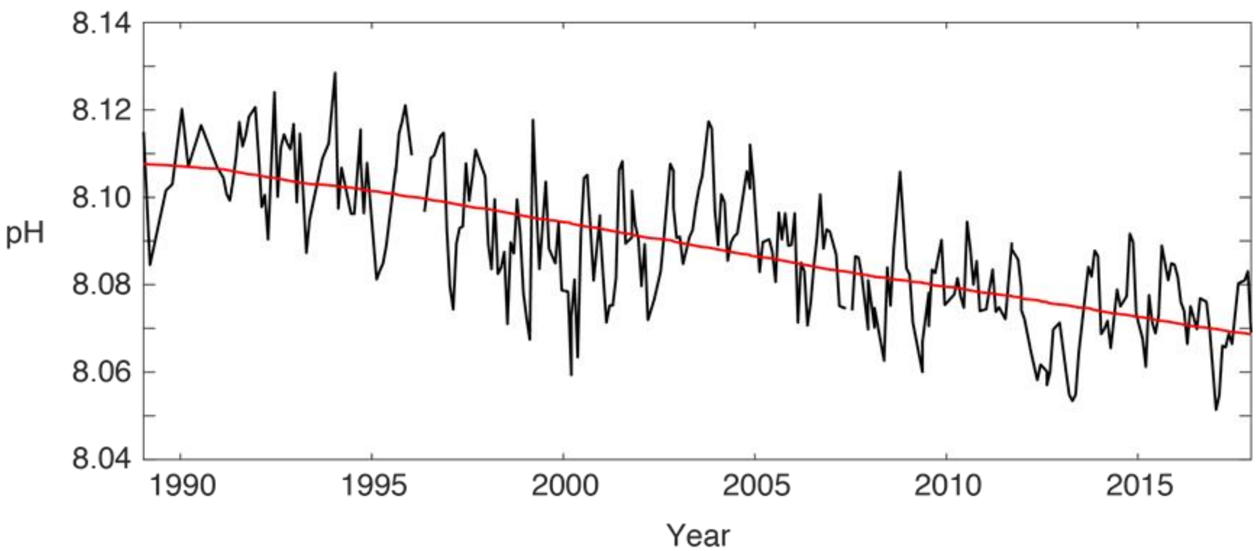


Figure 165. Trend in oceanic pH (black) at Station ALOHA from 1989-2017

3.3.3.3 OCEANIC NIÑO INDEX (ONI)

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 2018, the ONI transitioned from a weak La Niña 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 (2019).

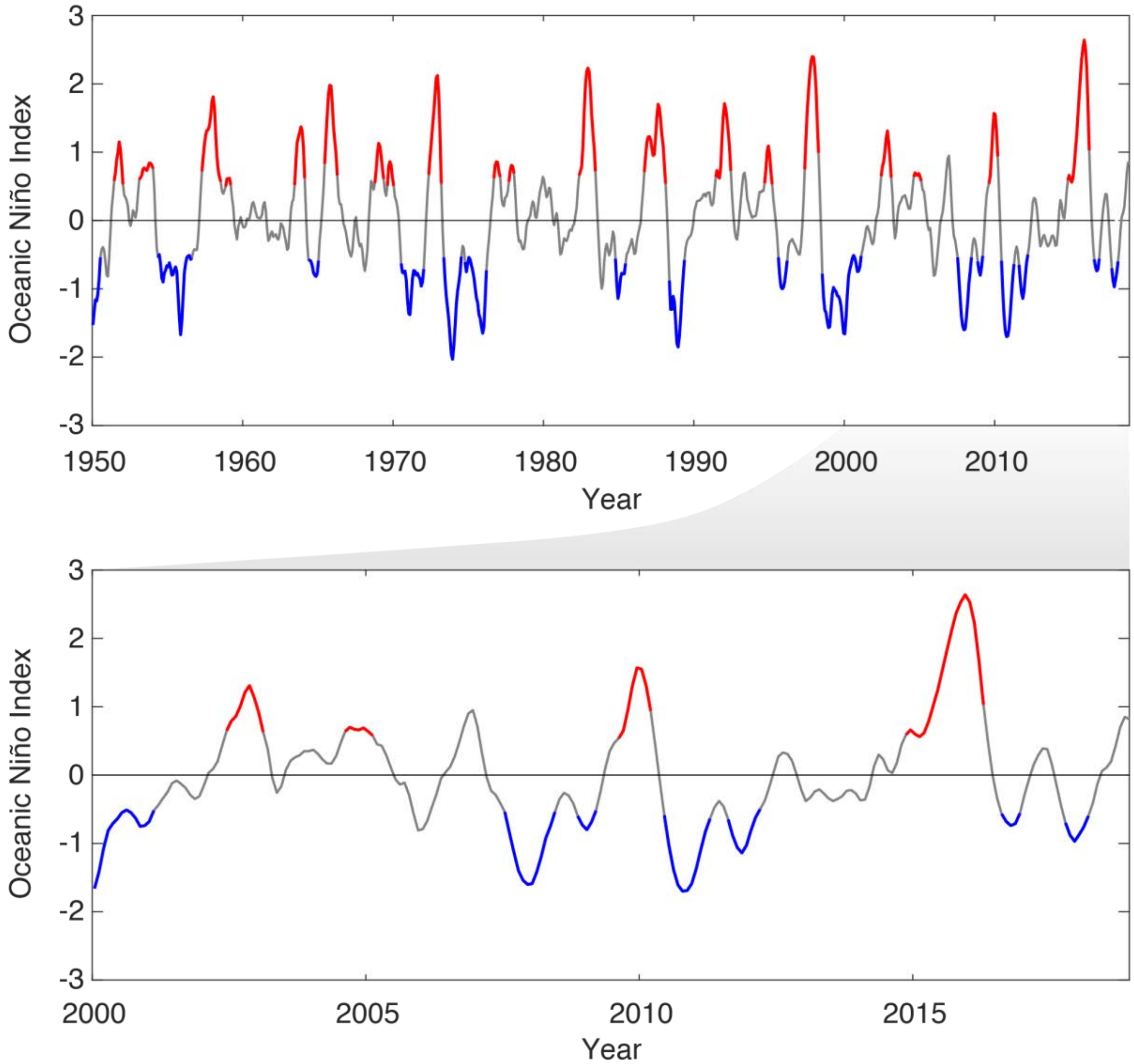


Figure 168. Oceanic Niño Index from 1950-2018 (top) and 2000–2018 (bottom) with El Niño periods in red and La Niña periods in blue

3.3.3.4 PACIFIC DECADAL OSCILLATION (PDO)

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 finger prints of the PDO are most visible in the Northeastern Pacific, but secondary signatures exist in the tropics.

Status: The PDO was positive, or warm, for much of 2018. In March and June, the index dipped just below zero but returned to a positing value the following months. PDO index values were not yet available for the last three months of 2018 at the time of publication.

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 (2019b) and Mantua (2018).

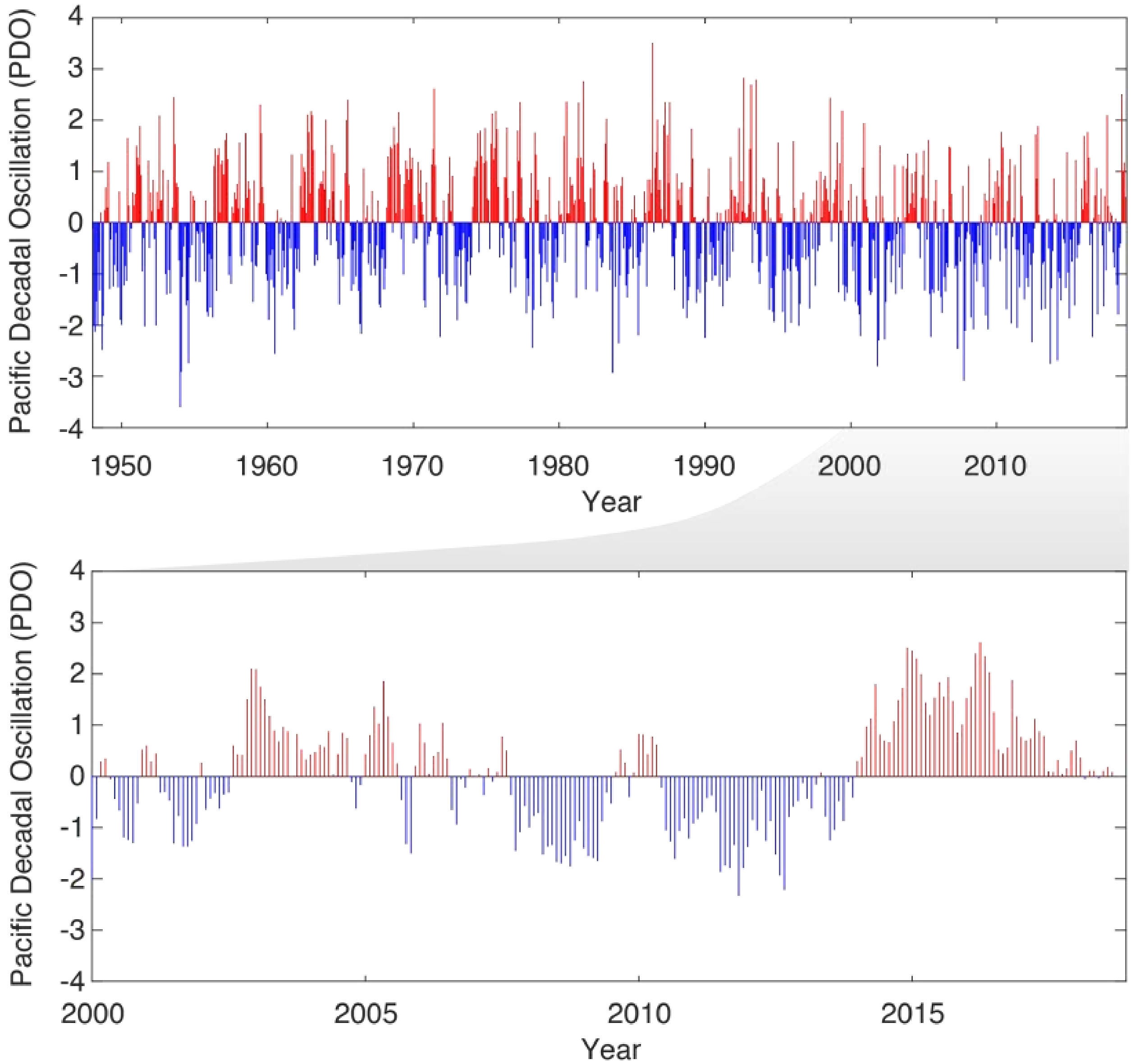


Figure 169. Pacific Decadal Oscillation from 1950–2018 (top) and 2000–2018 (bottom) with positive warm periods in red and negative cool periods in blue

3.3.3.5 TROPICAL CYCLONES

Rationale: The effects of tropical cyclones are numerous and well known. At sea, storms disrupt and endanger shipping traffic as well as fishing effort and safety. The Hawai`i longline fishery, for example, has had serious problems with vessels dodging storms at sea, delayed departures, and inability to make it safely back to Honolulu because of bad weather. When cyclones encounter land, their intense rains and high winds can cause severe property damage, loss of life, soil erosion, and flooding. Associated storm surge, the large volume of ocean water pushed toward shore by cyclones' strong winds, can cause severe flooding and destruction.

Status:

Eastern North Pacific. Overall, the 2018 eastern Pacific hurricane season featured well above average activity. There were 22 named storms, of which 12 became hurricanes and 9 became major hurricanes - category 3 or higher on the Saffir-Simpson Hurricane Wind Scale. This compares to the long-term averages of 15 named storms, 8 hurricanes, and 4 major hurricanes. There were also 3 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 2018 was the 3rd highest on record, behind 1990 and 1992. Summary inserted from https://www.nhc.noaa.gov/text/MIATWSEP.shtml.

Central North Pacific. Tropical cyclone activity in 2018 was high. The ACE index was the second highest since 1980, second only to 2015, and well above the 1981 – 2010 average of just under 20 (x 10^4 knots^2). Of note was Hurricane Lane, which reached Category 5 strength and passed within 110 miles of Honolulu. Lane was only the second Category 5 hurricane to pass within 250 miles of Hawaii, with the last being Hurricane John in 1994. Some of the impacts associated with Hurricane Lane include widespread reports of more than 40 inches of rain the islands of Hawaii and Kauai. There was one preliminary report of more than 52 inches of rain. At least one fatality was blamed on Hurricane Lane. Summary inserted from https://www.ncdc.noaa.gov/sotc/tropical-cyclones/201808.

Western North Pacific. Tropical cyclone activity was roughly average. The ACE Index was slightly above average in the Western North Pacific. Of note was Super Typhoon Yutu which made landfall on the islands of Tinian and Saipan as a Category 5 equivalent typhoon with estimated winds of 180 mph and a central minimum pressure of 905 mb. This marked the second strongest tropical cyclone to impact any U.S. territory on record. The storm devastated most of Tinian and Saipan with nearly every structure on the two islands being damaged or destroyed, including the Saipan International Airport. There were two fatalities reported in the Northern Marianas. Summary inserted from https://www.ncdc.noaa.gov/sotc/tropical-cyclones/201810.

South Pacific. Tropical cyclone activity and 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 stacked time series plot 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: NOAA NCEI (2019), and Knapp et al. (2010).

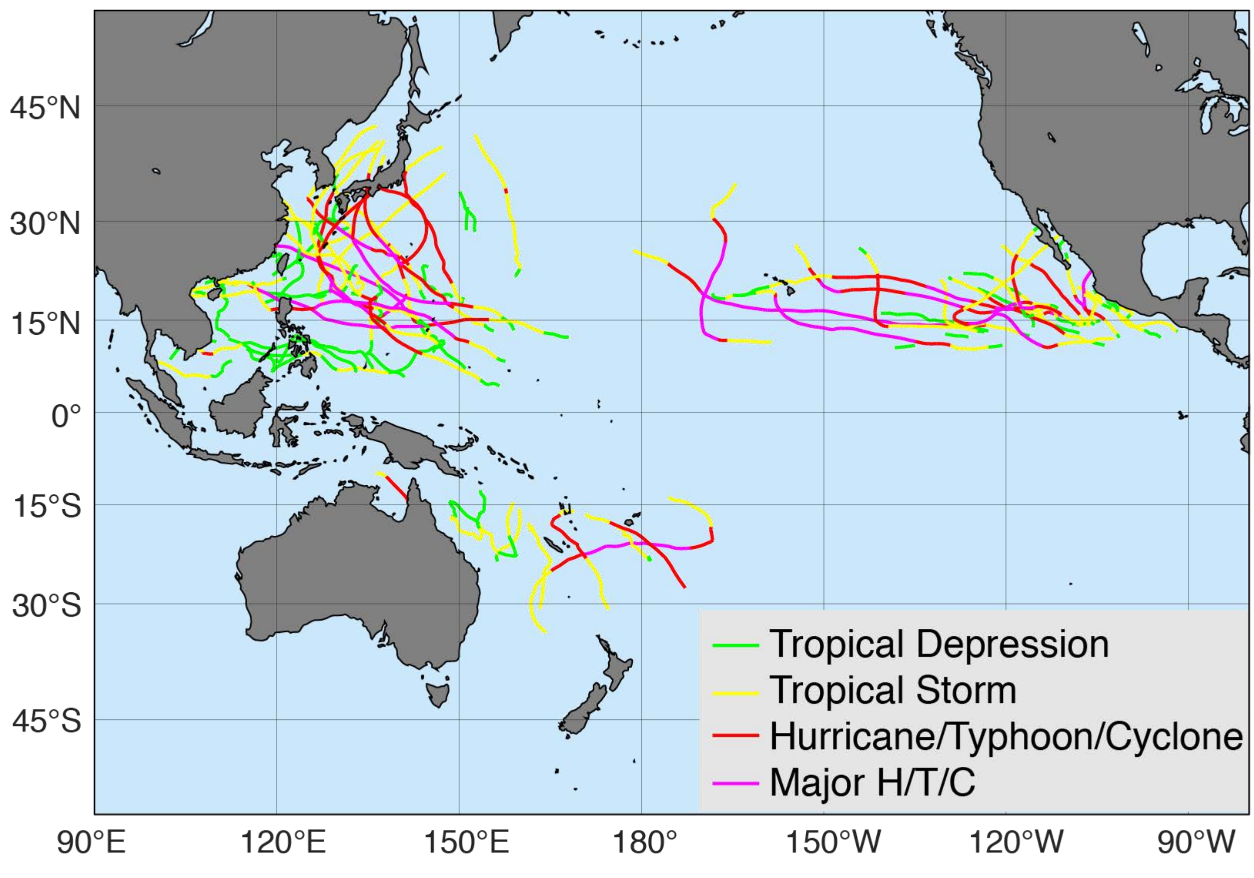


Figure 170. 2018 Pacific basin tropical cyclone tracks

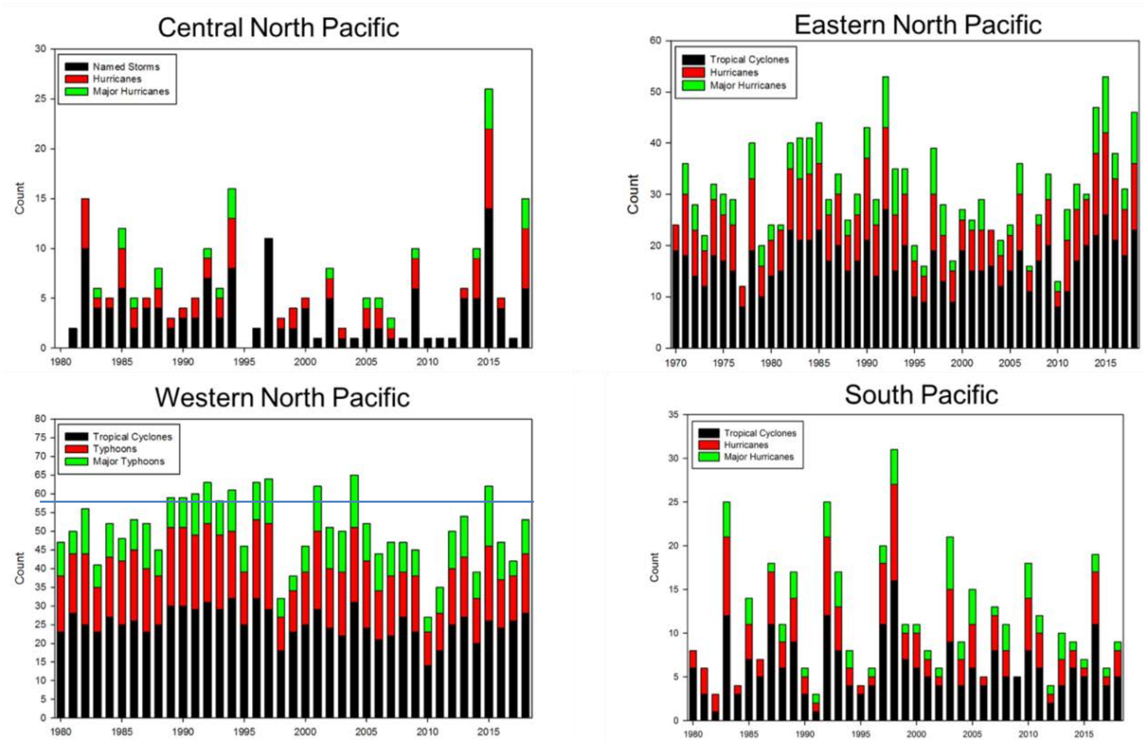


Figure 171. 2018 tropical storm totals by region

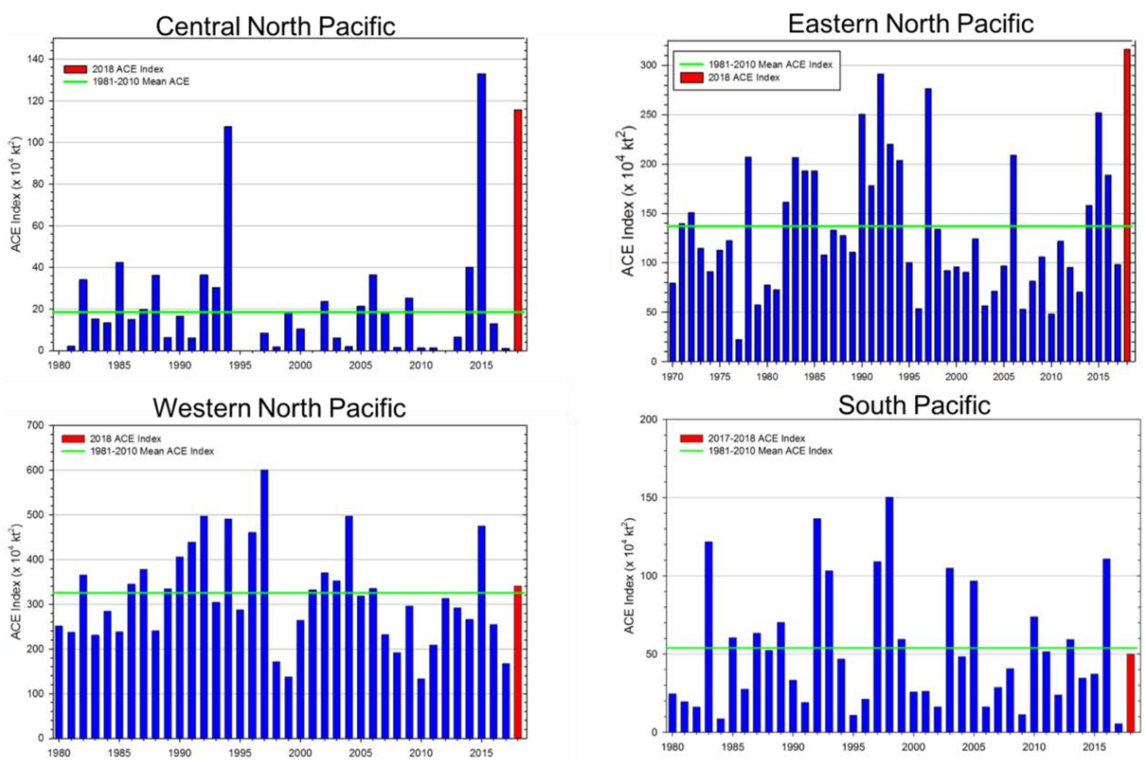


Figure 172. 2018 Accumulated Cyclone Energy (ACE) Index by region

3.3.3.6 SEA SURFACE TEMPERATURE (SST)

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 20.9 ºC in 2018. Over the period of record, annual SST has increased at a rate of 0.02 ºC yr^{-1}. Monthly SST values in 2018 ranged from 18.7 – 23.5 ºC, within the time series range of 16.8 – 24.3 ºC. Overall, SST was above the long-term average across the Hawaii longline region in 2018.

Note that from the top to bottom in Figure 173, panels show climatological SST (1982-2017), 2018 SST anomaly, time series of monthly mean SST, and time series of monthly SST anomaly. The white box in the upper panels indicates the area over which SST is averaged for the time series plots.

Description: Satellite remotely-sensed monthly sea surface temperature (SST) is averaged across the Hawai`i-based longline fishing grounds (15° – 45°N, 180° – 120°W). A time series of monthly mean SST averaged over the Hawai`i longline region is presented. Additionally, spatial climatologies and anomalies are shown. NOAA Pathfinder v5.3 data are used to calculate this indicator (Saha et al. 2018, Casey et al. 2010).

Timeframe: Monthly.

Region/Location: Hawai`i longline region: 15° – 45°N, 180° – 120°W.

Measurement Platform: Satellite.

Sourced from: NOAA OceanWatch (2019).

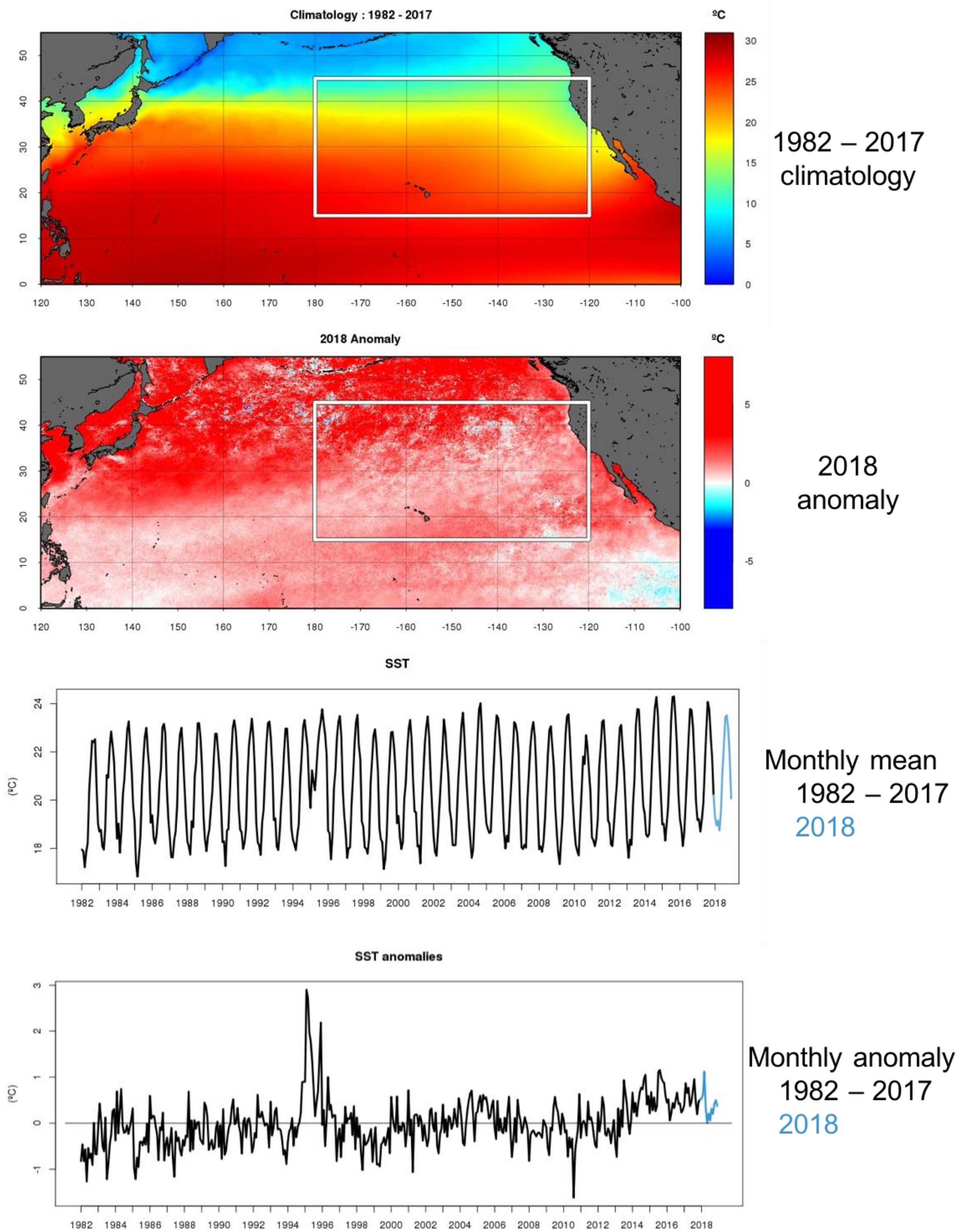


Figure 173. Sea surface temperature climatology and anomalies from 1982-2018

3.3.3.7 TEMPERATURE AT 300 M DEPTH

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 2018, 200 – 300 m temperatures ranged from 11.02 – 11.12 °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). The spatial pattern of temperature anomalies was mixed with cooler than average temperatures at depth in the southern portion of the fishing grounds and warmer than average temperatures to the north.

Note that, from top to bottom in Figure 174, panels show climatological 200 – 300 m temperature (1980-2017), 2018 anomaly, time series of monthly mean 200 – 300 m temperature, and time series of monthly 200 – 300 m temperature anomaly. The white box in the upper panels indicates the area over which temperature is averaged for the time series plots.

Description: Ocean temperature at 200 – 300 m depth is averaged across the Hawai`i-based longline fishing grounds (15° – 45°N, 180° – 120°W). Global Ocean Data Assimilation System (GODAS) data are used. GODAS incorporates global ocean data from moorings, expendable bathythermographs (XBTs), and Argo floats.

Timeframe: Annual, monthly.

Region/Location: Hawai`i longline region: 15° – 45°N, 180° – 120°W.

Measurement Platform: *In-situ* sensors, model.

Sourced from: NOAA ESRL (2019c).

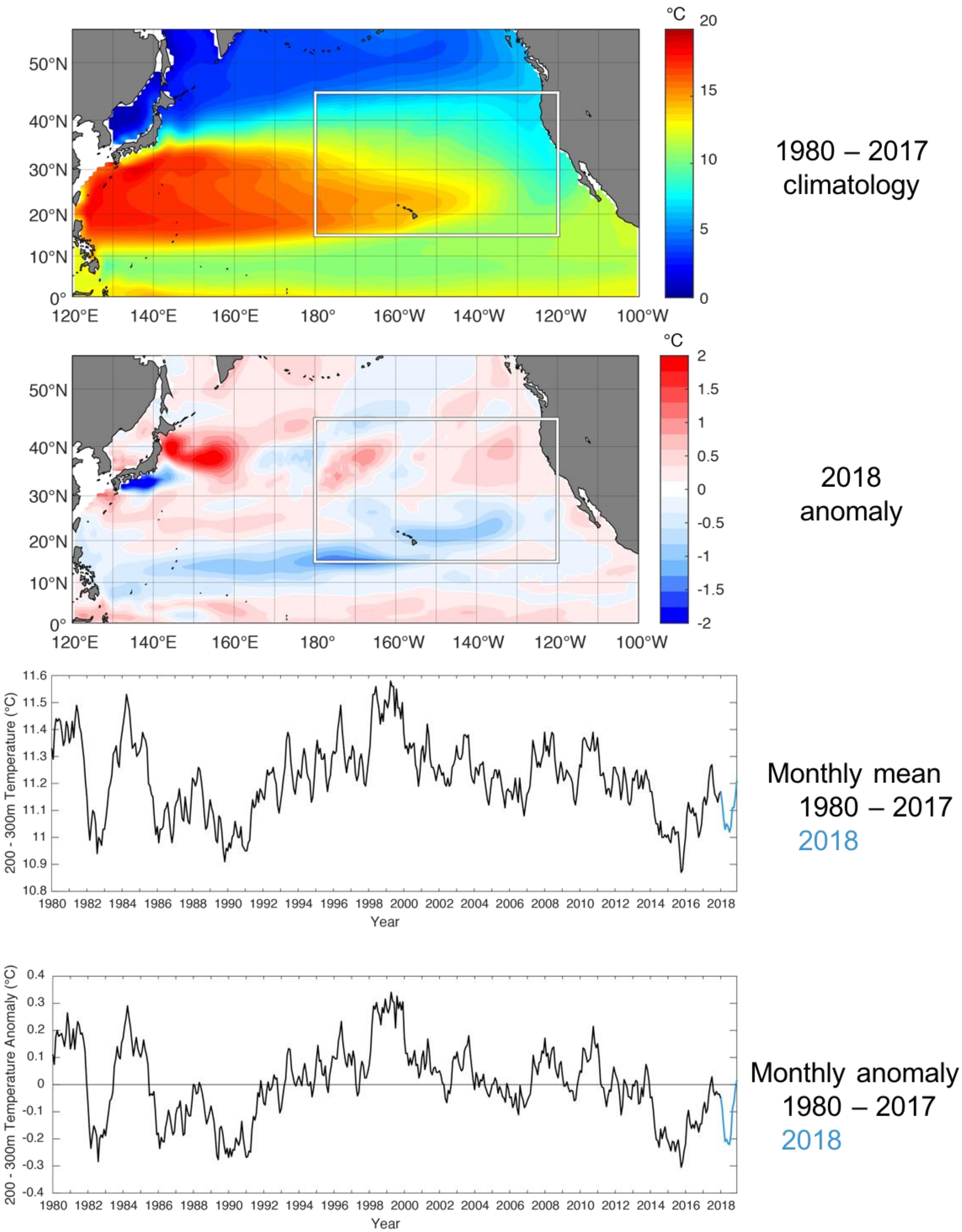


Figure 174. Ocean temperature at 200 – 300 m depth means and anomalies from 1980-2018

.

3.3.3.8 OCEAN COLOR

Rationale: Phytoplankton are the foundational food source for the fishery. Changes in phytoplankton abundance have been linked to both natural climate variability and anthropogenic climate change. These changes have the potential to impact fish abundance, size, and catch.

Status: The mean monthly chlorophyll concentration was 0.13 mg chl m^{-3} in 2017. Monthly mean chlorophyll concentrations ranged from 0.09 – 0.15 mg chl m^{-3}, within the range of values observed over the period of record. 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.

Note that, from top to bottom in Figure 175, panels show climatological chlorophyll concentration (2003-2016), 2017 anomaly, time series of monthly mean chlorophyll concentration, and time series of monthly chlorophyll anomaly. The white box in the upper panels indicates the area over which ocean color is averaged for the time series plots.

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 Hawai`i longline region is presented. Additionally, spatial climatologies and anomalies are shown. MODIS-Aqua data are used for this indicator.

Timeframe: Monthly

Region/Location: Hawai`i longline region: 5° – 45°N, 180° – 120°W

Measurement Platform: Satellite

Sourced from: NOAA OceanWatch (2018).

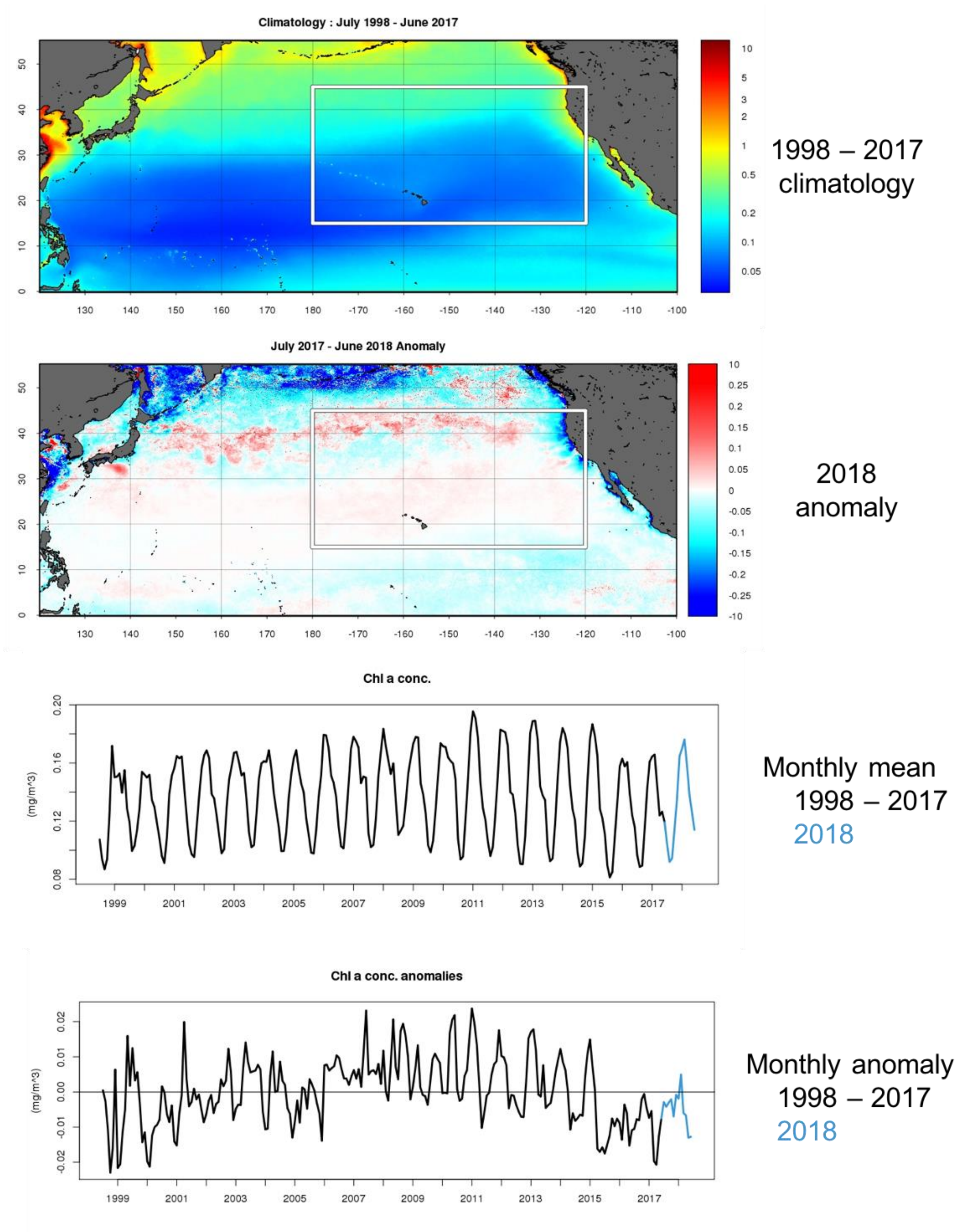


Figure 175. Ocean color means and anomalies from 1998-2018

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

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 2018, the STF was located at roughly its average latitude west of 140°W and was north of average to the east of 140°W. The TZCF was fairly close to its climatological average position across the region.

Description: The subtropical front (STF) is marked by the 18 °C sea surface temperature (SST) isotherm and the transition zone chlorophyll front (TZCF) by the 0.2 mg chl-a m^{-3} isopleth (Bograd *et al*. 2004; Polovina *et al*. 2001). They roughly mark the northern boundary of the North Pacific subtropical gyre as well as the northern extent of the Hawai`i-based longline fishery. Both fronts migrate 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 NOAA Pathfinder-GAC and GOES-POES data (see SST indicator) and the TZCF is determined from MODIS-Aqua data (see ocean color indicator).

Timeframe: Annual, seasonal

Region: Hawai`i longline region: 5° – 45°N, 180° – 120°W

Measurement Platform: Satellite

Sourced from: Bograd et al. (2004), Polovina et al. (2001), and NOAA OceanWatch (2019).

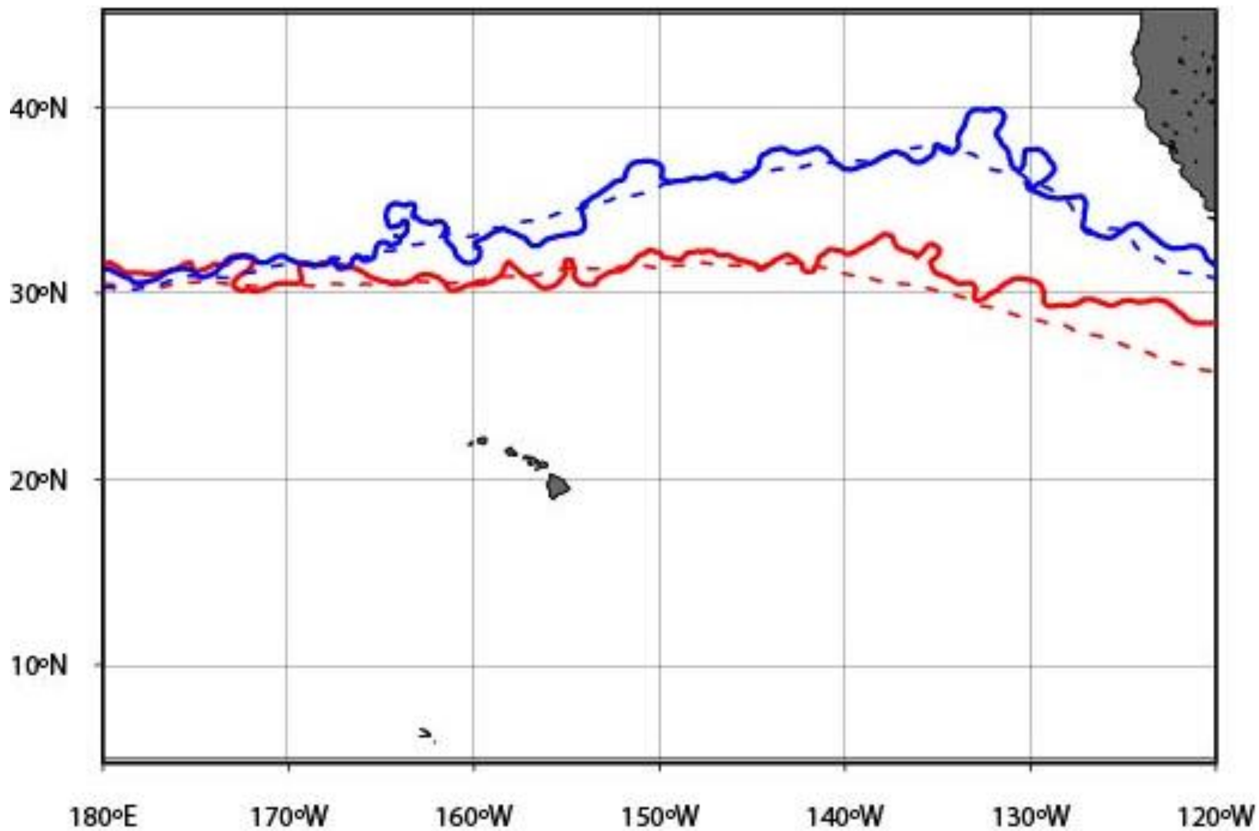


Figure 176. Subtropical Front and Transition Zone Chlorophyll Front

Note that the climatological (dashed) and 2018 (solid) positions of the subtropical front (red) and the transition zone chlorophyll front (blue) in the first quarter of the year (Jan. - Mar.). The climatological period for the STF is 1982-2017. The climatological period for the TZCF is 1998-2017.

3.3.3.10 ESTIMATED MEDIAN PHYTOPLANKTON SIZE

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 1.57 µm Equivalent Spherical Diameter (ESD) in the period from July 2017 - June 2018. Monthly mean cell size ranged from 1.18 – 1.80 µm ESD during this period, within the range of values observed over the period of record. The spatial pattern of phytoplankton cell size was mixed, though cell size was notably above the long-term average across the northernmost portion of the longline fishing grounds (north of 40°N).

Note that, from top to bottom in, panels show climatological phytoplankton cell size (July 1998 – June 2017), July 2017 – June 2018 anomaly, time series of monthly mean phytoplankton cell size, and time series of monthly cell size anomaly. Chlorophyll data are not yet available for the second half of 2018.

Description: Median phytoplankton cell size can be estimated from satellite remotely sensed SST and ocean color (Barnes et al. 2011). A time series of monthly median phytoplankton cell size averaged over the Hawai`i longline region is presented. Additionally, spatial climatologies and anomalies are shown. NOAA Pathfinder v5.3 (see SST indicator) and ESA OC-CCI data (see ocean color indicator) are used to calculate median phytoplankton cell size.

Timeframe: Monthly

Region: Hawai`i longline region: 15° – 45°N, 180° – 120°W

Measurement Platform: Satellite

Sourced from: NOAA OceanWatch (2019) and Barnes et al. (2011).

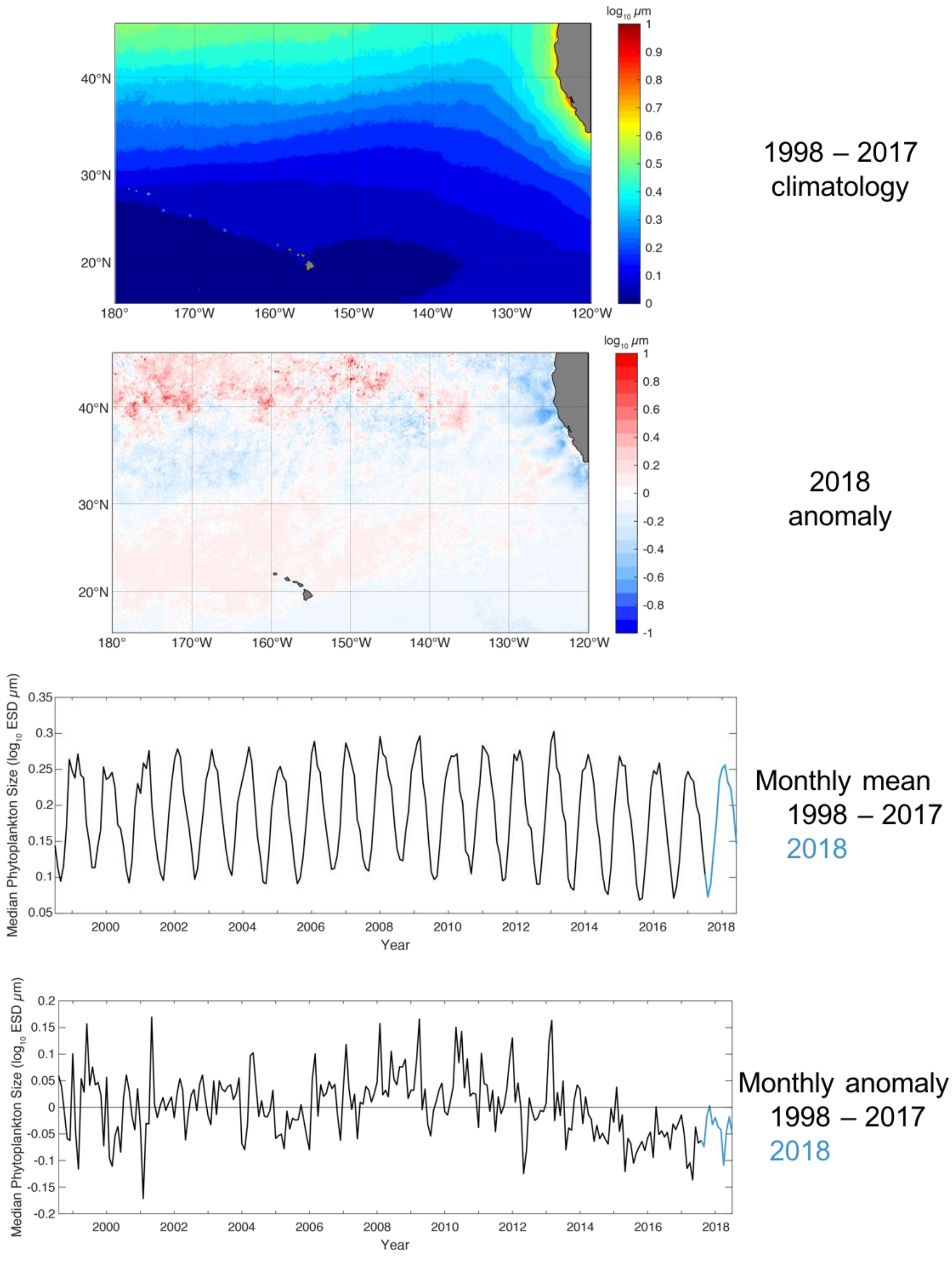


Figure 177. Estimated median phytoplankton size means and anomalies from 1998-2018

3.3.3.11 FISH COMMUNITY SIZE STRUCTURE

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 2018 with a higher proportion of 40 – 45 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 2018, with the greatest proportion of fish being in the 90 – 100 kg range rather than the climatological average of 30 – 40 kg.

In 2018, 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 22.4 kg. The median weight of swordfish exceeded the range of median weights seen across previous years, 50.9 – 80.9 kg. Median weights for all species and for bigeye were within the bounds observed over the time series from 2000 to 2017. 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 2017 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: Hawai`i-based longline fishing grounds.

Measurement Platform: *In-situ* measurement.

Sourced from: Hawai`i Division of Aquatic Resources Measurement Platform and Langley et al. (2006).

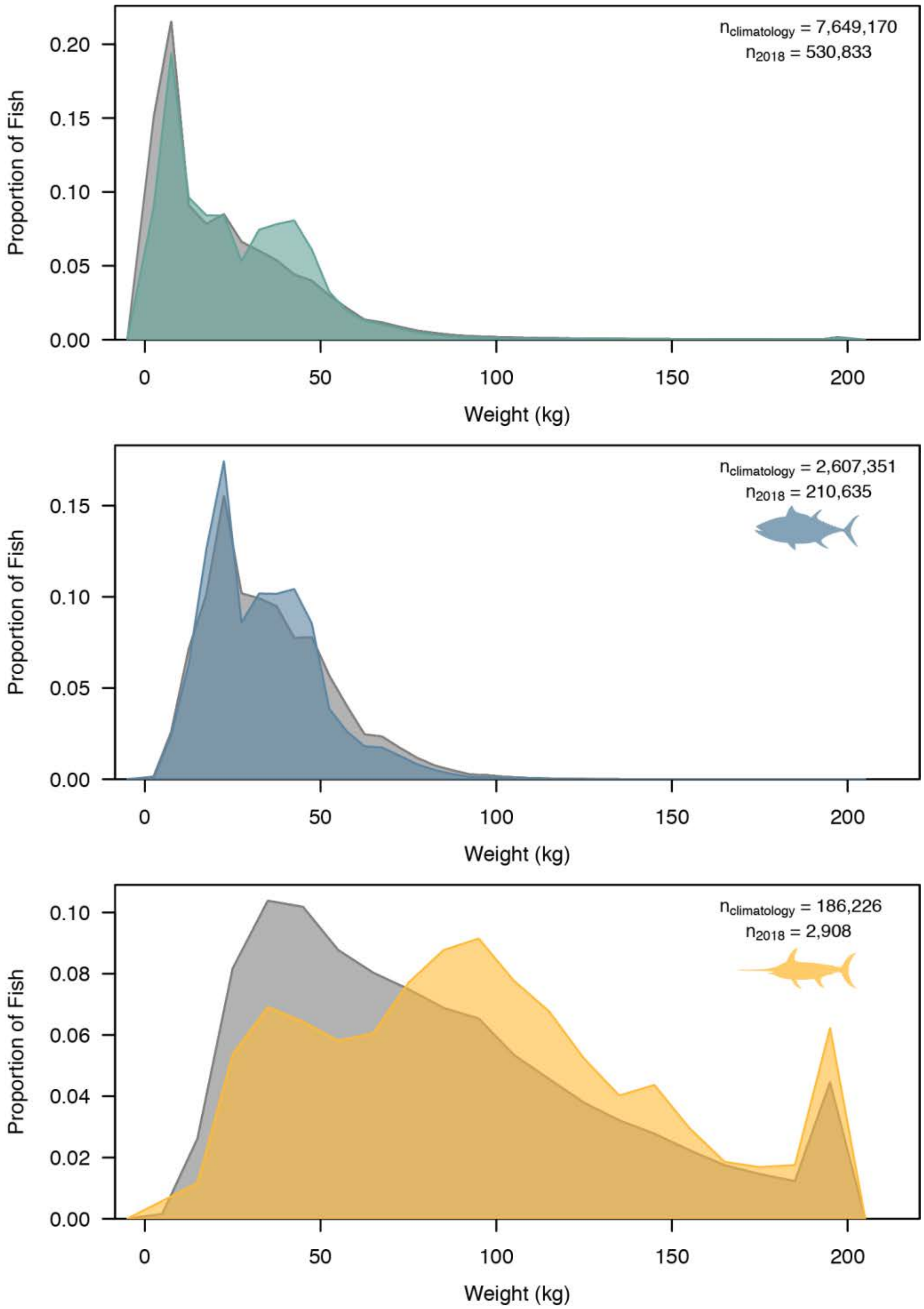


Figure 178. Longline fishery fish weights in Hawaii in 2018

Note the climatological (2000-2017; grey) and 2018 (colored) distributions of all fish weights (top), bigeye tuna weights (middle), and swordfish weights (bottom). Bigeye weights are from sets using ≥ 15 hooks per float and swordfish weights are from sets using < 15 hooks per float.

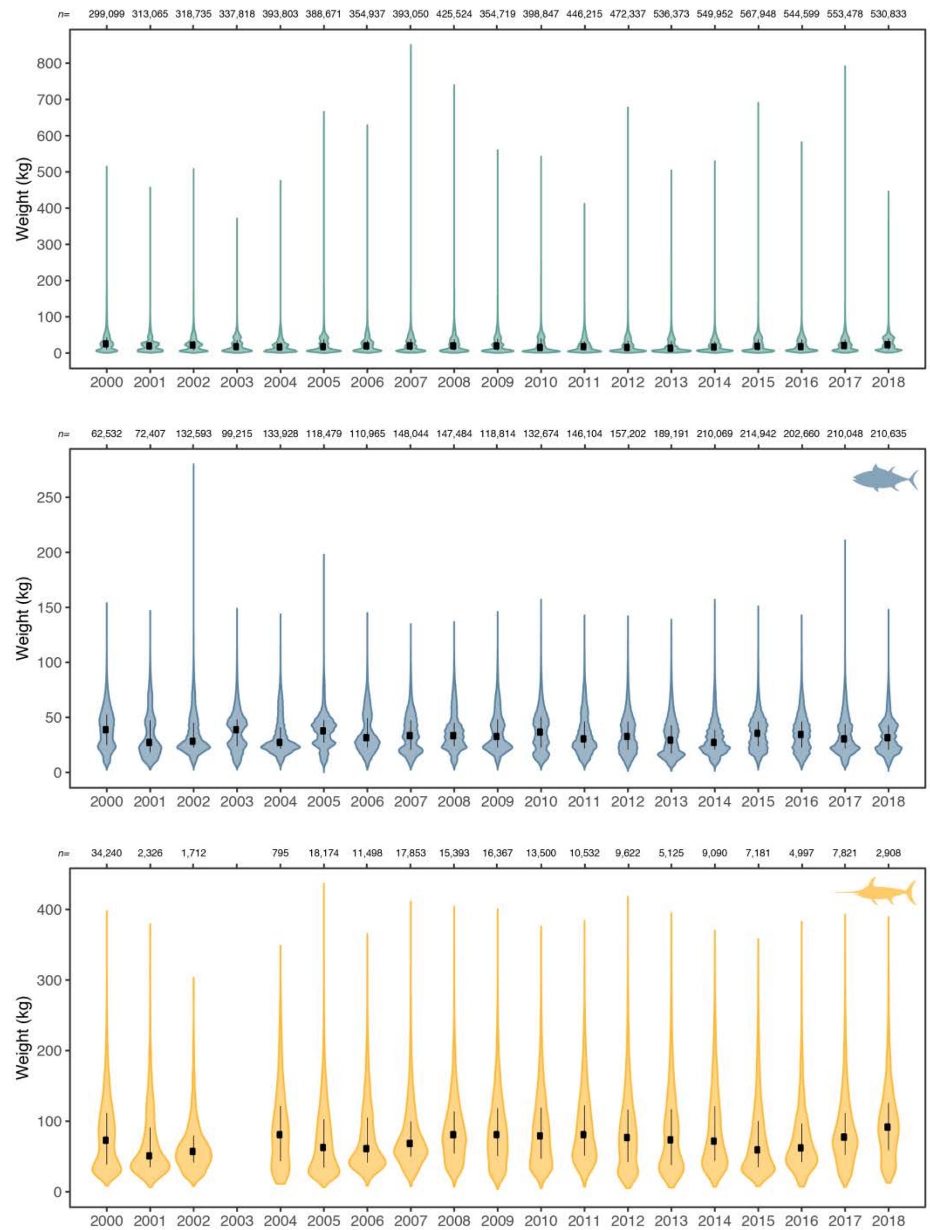


Figure 179. Distribution of annual longline fishery weights in Hawaii from 2000-2018

Note: Violin plots show the annual distribution of all fish weights (top), bigeye tuna weights (middle), and swordfish weights (bottom). Violin width is proportional to the number of fish of a given weight. The black lines note the range of the middle 50% of fish. The black squares note the median weight. Bigeye weights are from sets using ≥ 15 hooks per float. Swordfish weights are from sets using < 15 hooks per float.

3.3.3.12 BIGEYE WEIGHT-PER-UNIT-EFFORT

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, 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 (hooks set) is presented for the previous three 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 . The vertical dashed line shows 15 kg. Bigeye weights are from sets using ≥ 15 hooks per float.

Timeframe: Quarterly.

Region: Hawai`i-based longline fishing grounds.

Measurement Platform: *In-situ* measurement.

Sourced from: Hawai`i Division of Aquatic Resources.

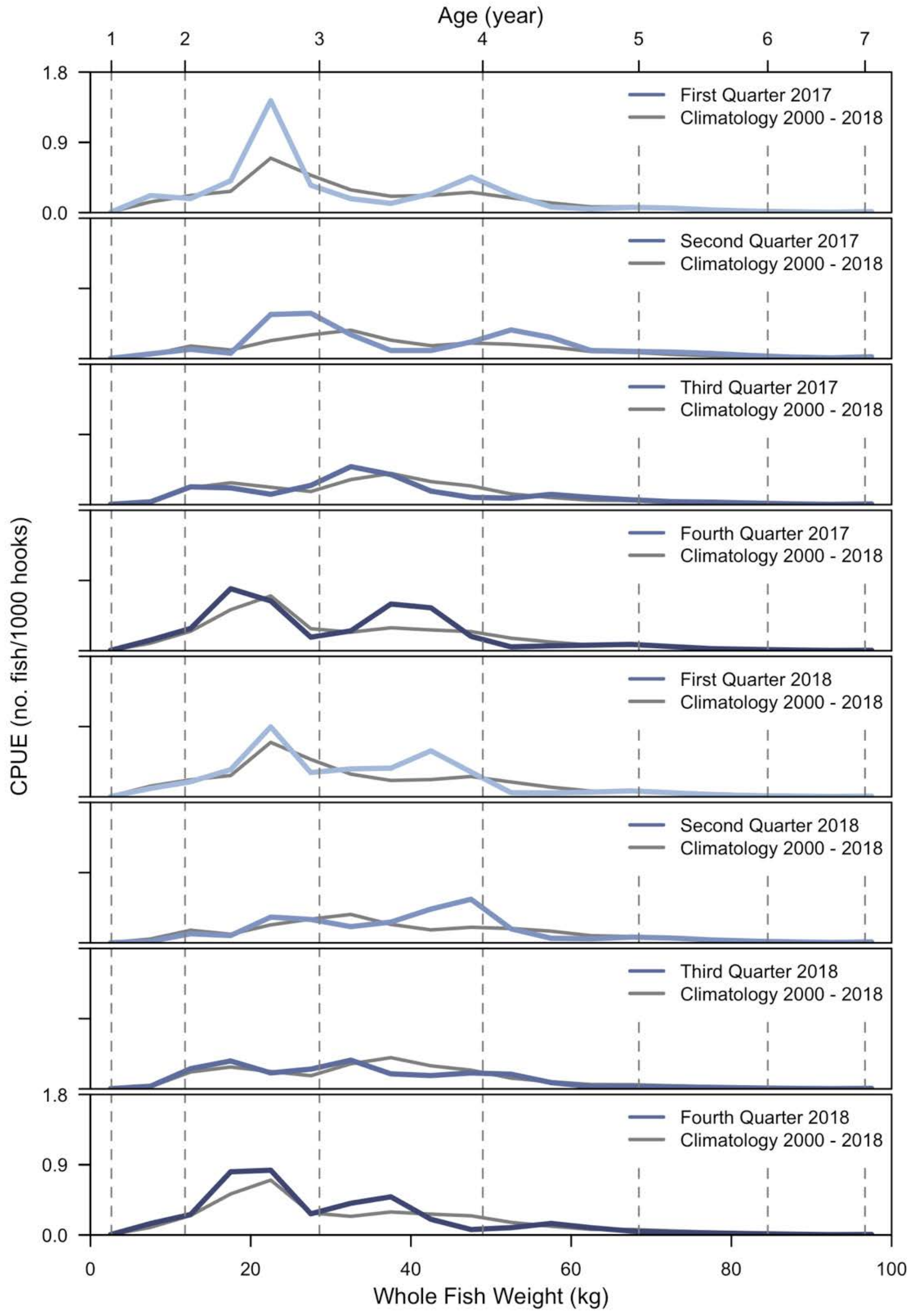


Figure 180. Bigeye weight-per-unit-effort 2017-2018

3.3.3.13 BIGEYE RECRUITMENT INDEX

Rationale: Catch rates of small bigeye tuna (≤ 15 kg) peak one year 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 2018, the CPUE of bigeye ≤ 15 kg was 0.31 fish per 1,000 hooks set. This is within the range observed over the previous 18 years (0.12 – 0.65 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.

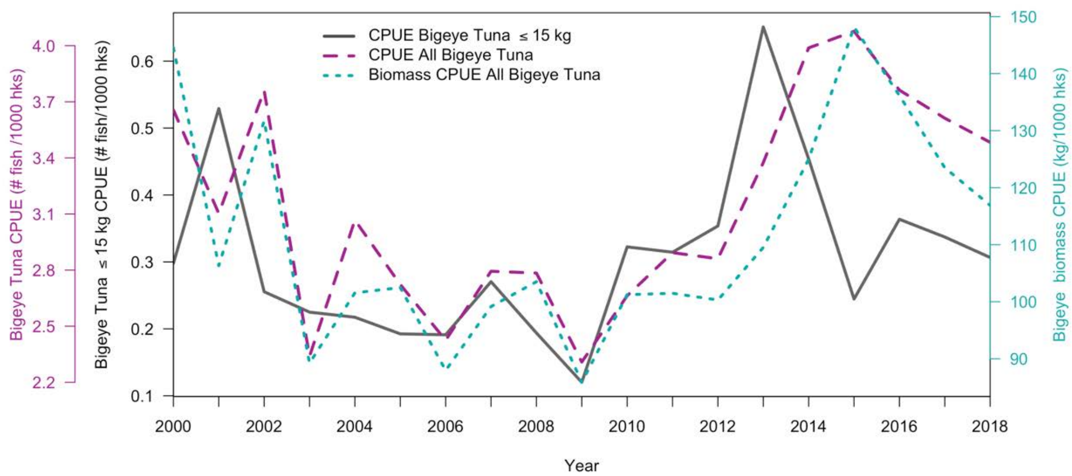


Figure 181. Bigeye tuna catch- and weight-per-unit-effort from 2000-2018

Note: Time series of CPUE of all bigeye tuna (blue, dashed), CPUE of bigeye tuna ≤ 15 kg (yellow, solid), and biomass CPUE, or weight-per-unit-effort, of all bigeye tuna (red, dotted). Y-axes follow this order, from left to right. Data are from sets with ≥ 15 hooks per float.

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: Hawai`i-based longline fishing grounds.

Measurement Platform: Model-derived.

Sourced from: Hawai`i Division of Aquatic Resources and Langley et al. (2006).

3.3.4 OBSERVATIONAL AND RESEARCH NEEDS

Through preparation of this and previous Annual Pelagic 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.

3.3.5 REFERENCES

Barnes, C., Irigoien, X., De Oliveira, J.A.A., Maxwell, D., and S. Jennings, 2011. Predicting marine phytoplankton community size structure form empirical relationships with remotely sensed variables. *Journal of Plankton Research, 33*(1), pp. 13-24. doi: 10.1093/plankt/fbq088

Bograd, S.J., Foley, D.G., Schwing, F.B., Wilson, C., Laurs, R.M., Polovina, J.J., Howell, E.A., and R.E. Brainard, 2004. On the seasonal and interannual migrations of the transition zone chlorophyll front. *Geophysical Research Letters*, *31*, L17204. doi: 10.1029/2004GL020637.

Casey, K.S., Brandon, T.B., Cornillon, P., and R. Evans, 2010. The Past, Present and Future of the AVHRR Pathfinder SST Program, *Oceanography from Space: Revisited*, eds. V. Barale, J.F.R. Gower, and L. Alberotanza, Springer. https://doi.org/10.1007/978-90-481-8681-5_16

Fabry, V.J., Seibel, B.A., Feely, R.A., and J.C. Orr, 2008. Impacts of ocean acidification on marine fauna and ecosystem processes. *ICES Journal of Marine Science*, *65*(3), pp. 414-432.

Feely, R.A., Alin, S.R., Carter, B., Bednarsek, N., Hales, B., Chan, F., Hill, T.M., Gaylord, B., Sanford, E., Byrne, R.H., Sabine, C.L., Greeley, D., and L. Juranek, 2016. Chemical and biological impacts of ocean acidification along the west coast of North America. *Estuarine, Coastal and Shelf Science*, *183*, pp. 260-270. doi: 10.1016/j.ecss.2016.08.04.

HOT, 2019. Hawaii Ocean Time Series. School of Ocean and Earth Science and Technology, University of Hawaii Manoa. Accessed from http://hahana.soest.hawaii.edu/hot/.

Howell, E.A., Hawn, D.R., and J.J. Polovina, 2010. Spatiotemporal variability in bigeye tuna (*Thunnus obesus*) dive behavior in the central North Pacific Ocean. *Progress in Oceanography*, *86*, pp. 81-93. doi: 10.1016/j.pocean.2010.04.013.

Karl, D.M. and R. Lukas, 1996. The Hawaii Ocean Time-series (HOT) program: Background, rationale and field implementation. *Deep Sea Research Part II: Topical Studies in Oceanography*, *43*(2-3), pp.129-156.

Keeling, C.D., Bacastow, R.B., Bainbridge, A.E., Ekdahl, C.A., Guenther, P.R., and L.S. Waterman, 1976. Atmospheric carbon dioxide variations at Mauna Loa Observatory, Hawaii. *Tellus*, *28*(6), pp. 538-551.

Knapp, K.R., Kruk, M.C., Levinson, D.H., Diamond, H.J., and C.J. Neumann, 2010. The International Best Track Archive for Climate Stewardship (IBTrACS): Unifying tropical cyclone best track data. *Bulletin of the American Meteorological Society*, *91*, pp. 363-376. doi:10.1175/2009BAMS2755.1.

Langley, A., Okamoto, H., Williams, P., Miyabe, N., Bigelow, K., 2006. A summary of the data available for the estimation of conversion factors (processed to whole fish weights) for yellowfin and bigeye tuna. ME IP-3, WCPFC-SC2, Manila, Philippines, *7*, 18 pp.

Mantua, N., 2019. The Pacific Decadal Oscillation. Joint Institute for the Study of Atmosphere and Ocean, University of Washington. Last updated August 2018. Accessed from http://research.jisao.washington.edu/pdo/.

NOAA Climate.gov, 2016. El Niño and La Niña: Frequently asked questions. Authored 18 January 2016. Accessed from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions.

NOAA ESRM, 2019a. Climate Indices: Monthly Atmospheric and Oceanic Time-Series. Earth System Research Laboratory, Physical Sciences Division. Accessed from https://www.esrl.noaa.gov/psd/data/correlation/pdo.data

NOAA ESRL, 2019b. Full Mauna Loa CO_2 Record. Trends in Atmospheric Carbon Dioxide. Earth System Research Laboratory, Global Monitoring Division. Accessed from https://www.esrl.noaa.gov/gmd/ccgg/trends/full.html.

NOAA ESRL, 2019c. NCEP Global Ocean Data Assimilation System (GODAS). Earth System Research Laboratory, Physical Sciences Division. Accessed from https://www.esrl.noaa.gov/psd/data/gridded/data.godas.html.

NOAA NCEI, 2019. NOAA National Centers for Environmental Information, State of the Climate: Hurricanes and Tropical Storms for Annual 2018, published online January 2019. Accessed from https://www.ncdc.noaa.gov/sotc/tropical-cyclones/201813.

NOAA OceanWatch, 2019. Conditions in the Hawaii longline fishing ground. OceanWatch Central Pacific Node. Accessed from http://oceanwatch.pifsc.noaa.gov/indicators-longline.html.

Polovina, J.J., Howell, E.A., Kobayashi, D.R., and M.E. Seki, 2001. The transition zone chlorophyll front, a dynamic global feature defining migration and forage habitat for marine resources. *Progress in Oceanography*, *49*, pp. 469-483.

Saha, K., Zhao, X., Zhang, H.-M., Casey, K.S., Zhang, D., Baker-Yeboah, S., Kilpatrick, K.A., Evans, R.H., Ryan, T., and J.M. Relph, 2018. AVHRR Pathfinder version 5.3 level 3 collated (L3C) global 4km sea surface temperature for 1981-Present. NOAA National Centers for Environmental Information. Dataset. https://doi.org/10.7289/v52j68xx.

Thoning, K.W., Tans, P.P., and W.D. Komhyr, 1989. Atmospheric carbon dioxide at Mauna Loa Observatory 2. Analysis of the NOAA GMCC data, 1974-1985. *Journal of Geophysical Research*, *94*(D6), pp. 8549-8565.

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 2018 SAFE report. 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 impact to EFH sections of the FEPs, incorporating the non-fishing impacts EFH review report by Minton (2017) by reference. An options paper has been developed.

At its 173rd meeting in June 2018, the Council directed staff to develop options to redefine EFH and any HAPC for precious corals in Hawaii for Council consideration for an FEP amendment. An options paper was developed.

At its 174th meeting in October 2018, the Council directed staff to prepare an amendment to the Hawaii FEP to revise the Precious Corals EFH and selected the following preliminarily preferred options for the staff to further analyze:

- Action 1: Option 4 - Revise existing beds and designate new beds as EFH
- Action 2: Option 2 - Update Geographic Extent and Habitat Characteristics
- Action 3: Option 1 - Update the FEPs

An FEP amendment is being developed to present to the Council in 2019.

The 2019 Pelagic Fishery Ecosystem Plan Team recommended that Council staff work appropriate Plan Team members to evaluate the Essential Fish Habitat section of the Annual SAFE Report to see how it may be refined going forward.

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 Change Indicators (Section 3.1) provides data and trends relevant to pelagic EFH, including oceanic pH, the Oceanic Nino Index, Pacific Decadal Oscillation, 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 2018. 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 identified scientific data needs to more effectively address the EFH provisions in the FEP. In subsequent SAFE reports, this section will include 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 Pelagic Plan Team recommended that Council staff explore a minimum depth for the definition of pelagic EFH that excludes depths seldom occupied by PMUS.

3.4.6 REFERENCES

64 FR 19067. Fisheries Off West Coast States and in the Western Pacific; Pelagic Fisheries, Amendment 8; Crustacean Fisheries, Amendment 10; Bottomfish and Seamount Groundfish Fisheries, Amendment 6; Precious Corals Fisheries, Amendment 4, Rule. *Federal Register* 64 (19 April 1999): 19067-19069. Downloaded from https://www.govinfo.gov/content/pkg/FR-1999-04-19/pdf/99-9728.pdf.

Minton, D. 2017. Non-fishing effects that may adversely affect essential fish habitat in the Pacific Islands region, Final Report. NOAA National Marine Fisheries Service, Contract AB-133F-15-CQ-0014. 207 pp.

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, Hawai`i, 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

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, 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 exemptio 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 nm around Tutuila;
12 nm around Manua;
12 nm around Swains; and
2 nm around the offshore banks.

- Recommended annual monitoring of the American Samoa longline and troll catch rates, small vessel participation, and local fisheries development.

Also at its 173rd meeting, the Council directed staff to investigate whether harbor vulnerability studies have been conducted in the Western Pacific region, and if they are lacking, write to the appropriate federal and or/local agencies requesting that the studies be conducted. Efforts on this recommendation are ongoing.

The 2019 Pelagic Fishery Ecosystem Plan Team recommended that Council staff work with PIRO SFD to augment the Marine Planning section to include a cumulative impacts section; it should be updated with regularity to include past and present issues impacting fisheries operating in pelagic fishery areas that will better allow for the section to be utilized in composing associated environmental assessments (EAs).

3.5.3 MARINE MANAGED AREAS

Council-established MMAs are shown inFigure 182, and are compiled in Table 83.

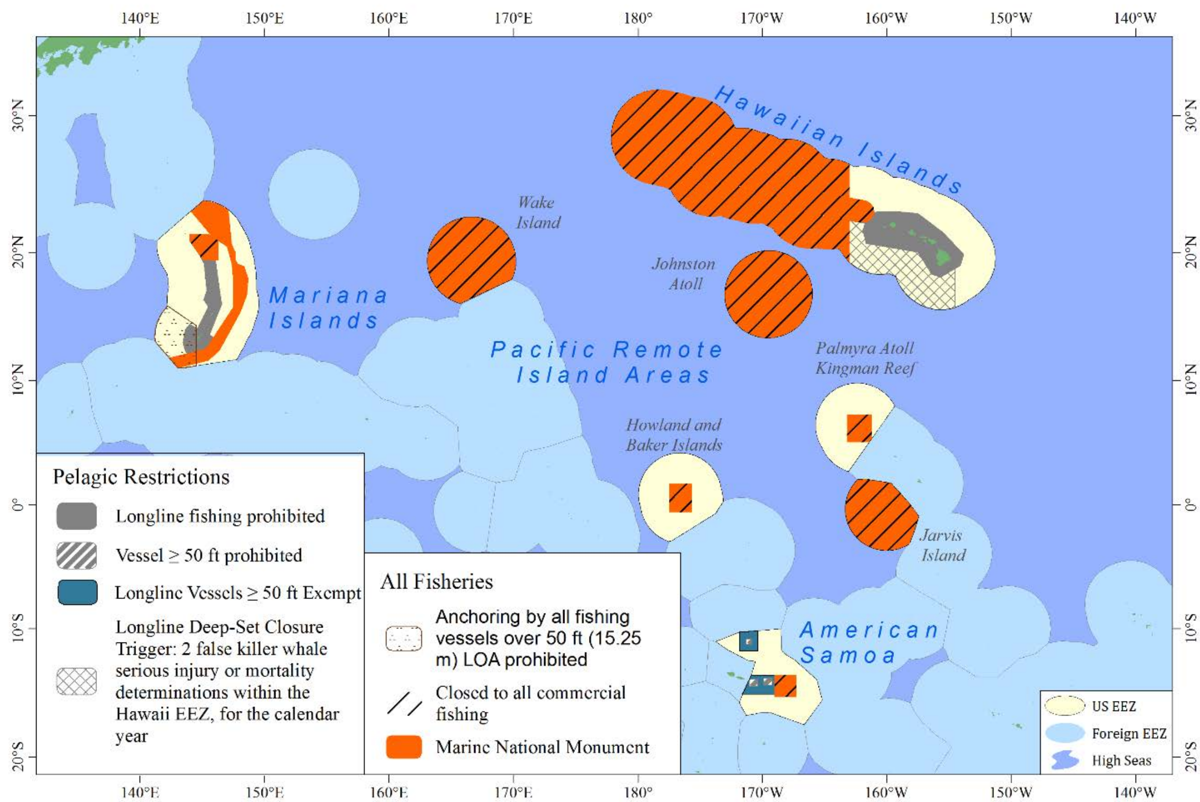


Figure 182. Regulated Fishing Areas of the Western Pacific Region

Table 83. 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 (Hawai`i)	NWHI	665.806(a)(1) 56 FR 52214 Pelagic FEP Am. 3	351,514.00	Longline fishing prohibited	Prevent longline interaction with monk seals.	1991	-
MHI Longline Prohibited Area	Pelagic (Hawai`i)	MHI	665.806(a)(2) 57 FR 7661 Pelagic FEP 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 FEP 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	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 FEP 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 FEP 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 FEP 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 FEP 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 (PPT deferred in 2017; Council took no action in 2018)

Name	FEP	Island(s)	50 CFR /FR /Amendment Reference	Marine Area (km²)	Fishing Restriction	Goals	Most Recent Evaluation	Review Deadline
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 FEP 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	-
Guam No Anchor Zone	Mariana Archipelago	Guam	665.399 69 FR 8336 Coral Reef Ecosystem FEP	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 FEP 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 FEP 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	-

Name	FEP	Island(s)	50 CFR /FR /Amendment Reference	Marine Area (km²)	Fishing Restriction	Goals	Most Recent Evaluation	Review Deadline
Wake Island Low-Use MPA/PRI Marine National Monument	PRIA/Pelagic	Wake Island	69 FR 8336 Coral Reef Ecosystem FEP 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 PIR

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 may occur in previous reports.

3.5.4.1 AQUACULTURE FACILITIES

There are no offshore aquaculture projects in federal waters, proposed or existing, in American Samoa, Guam, CNMI, or the PRIA. Hawai`i has one permitted offshore aquaculture facility. The information in Table 84 was transferred from the Joint NMFS and USACE EFH Assessment for the Proposed Issuance of a Permit to Authorize the Use of a Net Pen and Feed Barge Moored in Federal Waters West of the Island of Hawai`i to Fish for a Coral Reef Ecosystem Management Unit Species, Seriola rivoliana (RIN 0648-XD961; Van Fossen and Wunderlich 2015), unless otherwise noted.

Table 84. Aquaculture facilities in the Western Pacific region.

Name	Size	Location	Species	Status
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 Hawai`i Island 19 deg 33 min N 156 deg 04 min W. mooring scope is 10,400 foot radius.	*Seriola rivoliana*	Permit authorizes culture and harvest of 30,000 kampachi over 2 years. Array broke loose from mooring on Dec. 12, 2016; net pen sank in 12,000 feet of water. NMFS working with operators to understand cause of mooring line failure and plans for future activities under permit (pers. comm. David Nichols, March 1, 2017).

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.

Hawai`i previously had four proposed wind energy facilities in federal waters through BOEM, but these projects have been disengaged in the past year. There are, however, three existing alternative energy facilities (Table 85).

Table 85. Alternative Energy Facilities and Development in the Western Pacific region.

Name	Type	Location	Impact to Fisheries	Stage of Development	Source
Natural Energy Laboratory of Hawai`i	120 kW OTEC Test Site/ 1 MW Test Site	West Hawai`i	Intake	120 kW operational; DEA for 1 MW Test Site using existing infrastructure submitted July 2012 HEPA Exemption List memo Dec. 27, 2016.	http://nelha.Hawai`i.gov/energy-portfolio/ Final Environmental Assessment, NELHA, July 2012.
Honolulu Sea Water Air Conditioning	SWAC	4 miles S of Kaka'ako, O'ahu	Benthic impacts; intake	USACE Record of Decision (ROD) signed; completion and commissioning in 2017.	http://honoluluswac.com/pressroom.html https://www.trenchlessinternational.com/2016/05/11/mapping-utilities-downtown-honolulu/
Marine Corps Base Hawai`i Wave Energy Test Site	Shallow- and Deep-Water Wave Energy	1, 2 and 2.5 km N of Mokapu, O'ahu	Hazard to navigation	Shallow and Deep-water wave energy units are operational.	Final Environmental Assessment, NAVFACPAC, January 2014. http://www.eenews.net/stories/1060046254

3.5.4.3 MILITARY TRAINING AND TESTING ACTIVITIES AND IMPACTS

The Department of Defense (DOD) major activities are summarized in Table 86.

Table 86. 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/AAFB, a live-fire individual training range complex at the Ritidian Unit of the Guam National Wildlife Refuge.	ROD published August 29, 2015. Suit filed for segmentation and range of reasonable alternatives under NEPA, requesting that DON vacate the ROD. DOJ asked U.S. District Court for the NMI to dismiss the plaintiff's complaint with prejudice to prevent refiling (http://www.saipantribune.com/index.php/doj-federal-court-lacks-jurisdiction/).	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 was completed 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 best available science, will be used to update the MITT 2019 Final EIS/OEIS currently in preparation.	The 2019 MITT Final Supplemental EIS/OEIS is expected in spring 2020. Public Comment and Open House Public Meetings to take place in March and April of 2019.	Likely access and habitat impacts similar to previous analysis .
Hawai`i-Southern California Training and Testing	Increase naval testing and training activities.	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).	EFH consultation has not been initiated. Likely access and habitat impacts similar to previous analysis.
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 on NMFS authorization to take marine mammals incidental to conducting munitions testing for their Long Range Strike Weapons Systems Evaluation Program (LRS WSEP) over the course of five years, from September 1, 2017 through August 31, 2022 (82 FR 1702).	Access – closures during training.
CNMI Joint Military Training	Establish unit and combined level training ranges on Tinian and Pagan.	Supplemental Draft EIS expected in 2019. Suit filed for segmentation and range of reasonable alternatives under NEPA. DOJ asked U.S. District Court for the NMI to dismiss the plaintiff's complaint with prejudice to prevent refiling.	Significant access and habitat impacts
Garapan	Military Pre-Positioned Ships anchor and	Expired Memorandum of Understanding with	Access, invasive species,

Action	Description	Phase	Impacts
Anchorage	transit.	the CNMI government. As of October 2018, MOU had not been signed.	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. Damage to submerged lands and fisheries to be included within consultation establishing continued U.S. 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 Infrastruture Improvements	Construction of a fuel pipeline and associated support facilities, and improvements to certain existing roadways on the island of Tinian in the Commonwealth of the Northern Mariana Islands CNMI.	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 public scoping period will be taken into consideration during preparation of the Draft SEIS.	Access – to fishing grounds and transit to fishing grounds.

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.

3.5.6 REFERENCES

57 FR 7661. Pelagic Fisheries of the Western Pacific Region, Final Rule. *Federal Register* 57 (4 March 1992), pp. 7661-7665. Accessed from http://www.wpcouncil.org/pelagic/Documents/FMP/Amendment5-FR-FinalRule.pdf.

58 FR 52214. Pelagic Fisheries of the Western Pacific Region, Final Rule. *Federal Register* 56 (18 October 1991), pp. 52214-52217. Accessed from http://www.wpcouncil.org/pelagic/Documents/FMP/Amendment3-FR-FinalRule.pdf.

69 FR 8336. Coral Reef Ecosystems Fishery Management Plan for the Western Pacific, Final Rule. *Federal Register* 69 (24 February 2004), pp. 8336-8349. Accessed from http://www.wpcouncil.org/precious/Documents/FMP/Amendment5-FR-FinalRule.pdf.

71 FR 64474. Western Pacific Bottomfish and Seamount Groundfish Fisheries; Guam Bottomfish Management Measures, Final Rule. *Federal Register* 71 (2 November 2006), pp. 64474-64477. Accessed from http://www.wpcouncil.org/bottomfish/Documents/FMP/Bottomfish%20A9%20Final%20Rule%202006.pdf.

73 FR 47098. Black Coral Quota and Gold Coral Moratorium, Final Rule. *Federal Register* 73 (13 August 2008), pp. 47098-47100. Accessed from http://www.wpcouncil.org/precious/Documents/FMP/Coral%20Reef%20A7%20Final%20Rule%2008-2008.pdf.

73 FR 75615. Bottomfish and Seamount Groundfish Fisheries; Management Measures for the Northern Mariana Islands, Final Rule."*Federal Register* 73 (12 December 2008), pp. 75615-75622. Accessed from http://www.wpcouncil.org/bottomfish/Documents/FMP/Bottomfish%20A10%20Final%20Rule%202008.pdf.

75 FR 52921. Hawai`i Bottomfish and Seamount Groundfish Fisheries; Management Measures for Hancock Seamounts to Rebuild Overfished Armorhead, Proposed Rule. *Federal Register* 75 (30 August 2010), pp. 52921-52923. Accessed from https://www.gpo.gov/fdsys/pkg/FR-2010-08-30/pdf/2010-21537.pdf.

76 FR 37287. Western Pacific Pelagic Fisheries; Prohibiting Longline Fishing Within 30 nm of the Northern Mariana Islands, Final Rule. *Federal Register* 76 (27 June 2011), pp. 37287-37289. Accessed from https://www.gpo.gov/fdsys/pkg/FR-2011-06-27/pdf/2011-16039.pdf.

78 FR 32996. Western Pacific Fisheries; Fishing in the Marianas Trench, Pacific Remote Islands, and Rose Atoll Marine National Monuments, Final Rule. *Federal Register* 78 (3 June 2013), pp. 32996-33007. Accessed from http://www.wpcouncil.org/precious/Documents/FMP/Amendment5-FR-FinalRule.pdf.

81 FR 5619. Pacific Island Pelagic Fisheries; Exemption for Large U.S. Longline Vessels to Fish in Portions of the American Samoa Large Vessel Prohibited Area, Final Rule. *Federal Register* 81 (3 February 2016), pp. 5619-5626. Accessed from https://www.gpo.gov/fdsys/pkg/FR-2016-02-03/pdf/2016-01891.pdf.

82 FR 1702. Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to Long Range Strike Weapons Systems Evaluation Program. *Federal Register* 82 (6 January 2017), pp. 1702-1703. Accessed from https://www.gpo.gov/fdsys/pkg/FR-2017-01-06/pdf/2016-31947.pdf.

82 FR 13389. Modification of Restricted Area R-7201; Farallon de Medinilla Island, Mariana Islands. *Federal Register* 82 (13 March 2017), pp. 13389-13390. Accessed from https://www.gpo.gov/fdsys/pkg/FR-2017-03-13/pdf/2017-04892.pdf.

83 FR 66255. Notice of Availability of Record of Decision for the Hawaiian Islands and Southern California Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement. *Federal Register* 83 (26 December 2018), pp. 66255-66256. Accessed from https://www.govinfo.gov/content/pkg/FR-2018-12-26/pdf/2018-27811.pdf.

Barber, G.P., 2016. Memo to Mr. Scott Glenn, Office of Environmental Quality Control, on NELHA Draft Comprehensive Exemption List. Retrieved 27 December 2016.

BOEM. Hawai`i Activities. Retrieved 28 February 2017. Accessed from http://www.boem.gov/hawai`i/.

CNMI Joint Military Training EIS. DOD to Issue Revise Draft EIS on CJMT. Retrieved 5 March 2018. Accessed from http://www.cnmijointmilitarytrainingeis.com/announcements/26.

DOD. Department of the Navy. Hawai`i-Southern California Training and Testing EIS/OEIS. Retrieved 5 March 2018. Accessed from http://hstteis.com/.

DOD. Department of the Navy; Naval Facilities Engineering Command, Pacific; Naval Facilities Engineering and Expeditionary Warfare Center; Marine Corps Base Hawai`i. Wave Energy Test Site Final Environmental Assessment. Updated January 2014.

DOD. Department of the Navy. Record of Decision for the Final Supplemental Environmental Impact Statement for Guam and Commonwealth of the Northern Mariana Islands Military Relocation. Updated 28 August 2015.

DOD. Department of the Navy. Record of Decision for the Mariana Islands Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). Updated 23 July 2015.

DOD. United States Air Force. Record of Decision for Divert Activities and Exercises, Commonwealth of the Northern Mariana Islands. Updated 7 December 2016.

e-CFR. Title 50 *Code of Federal Regulations,* Pt. 665. Electronic Code of Federal Regulations current as of 16 March 2016. Accessed from http://www.ecfr.gov/cgibin/retrieveECFR?gp=&SID=b28abb7da3229173411daf43959fcbd1&n=50y13.0.1.1.2&r=PART&ty=HTML#_top.

Environmental Impact Statement for Divert Activities and Exercises, Commonwealth of the Northern Mariana Islands. Home page. Updated 17 March 2016. Accessed from http://www.pacafdivertmarianaseis.com/index.html.

Ferdie De La Torre, 2016. DOJ: Federal court lacks jurisdiction. Saipan Tribune. Updated 25 November 2016. Retrieved 28 February 2017. Accessed from http://www.saipantribune.com/index.php/doj-federal-court-lacks-jurisdiction/.

Greenwire, 2016. 2016-the end or beginning of an era for marine energy? Lasted updated 28 November 2016. Retrieved 28 February 2017. Accessed from http://www.eenews.net/stories/1060046254.

Hawai`i Ocean Science & Technology Park, Administered by the Natural Energy Laboratory of Hawai`i Authority. Energy Portfolio. Retrieved 28 February 2017. Accessed from http://nelha.Hawai`i.gov/energy-portfolio/.

Hawaiian Electric Companies. Power Supply Improvement Plan Update Report: December 2016.

Letter sent from K. Simonds to R. Seman, CNMI DLNR, on May 5, 2015.

Mariana Islands Testing and Training Supplemental Environmental Impact Statement. Retrieved 5 March 2018. Accessed from https://mitt-eis.com/Public-Involvement/Public-Information/Public-Informational-Material.

Progression Hawai`i Offshore Wind, Inc. Unsolicited Application for a Section 585 Commercial Wind Lease on the Outer Continental Shelf Offshore of the South Coast of Oahu. Updated on 8 October 8 2015. Accessed from http://www.boem.gov/Progression-Hawai`i-OCS-Lease-Application/.

Report to the President on 902 Consultations, 2017. Special Representatives of the United States and the Commonwealth of the Northern Mariana Islands. Updated January 2017. Retrieved 10 March 10 2017. Accessed from http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/archive/2013/methodology.pdf.

Robichaux, D.M., 2012. Draft Environmental Assessment for the Ocean Thermal Energy Conversion Technology Research, Development and Demonstration Facility, Keahole, North Kona, Hawai`i. July 11, 2012.

Trenchless International, 2016. Mapping utilities in Honolulu. May 11, 2016. Retrieved 2 February 2017. Accessed from https://www.trenchlessinternational.com/2016/05/11/mapping-utilities-downtown-honolulu/.

Van Fossen, L. and M. Wunderlich, 2015. Joint National Marine Fisheries Service and U.S. Army Corps of Engineers Essential Fish Habitat Assessment. Project Name: Proposed Issuance of a Permit to Authorize the Use of a Net Pen and Feed Barge Moored in Federal Waters West of the Island of Hawai`i to Fish for Coral Reef Ecosystem Management Unit Species, *Seriola rivoliana* (RIN 0648-XD961). Honolulu, Hawai`i. Updated 16 October 2015.

WPRFMC. Fishery Management Plan and Fishery Ecosystem Plan Amendments available from http://www.wpcouncil.org/fishery-plans-policies-reports/.

This page was intentionally left blank.

3.6 FACTORS INFLUENCING SEABIRD INTERACTION RATES IN THE HAWAII LONGLINE FISHERY

Seabird mitigation measures implemented in the Hawaii longline fishery in the early 2000s significantly reduced Laysan and black-footed albatross interaction rates (Gilman et al. 2008). The fishery has since seen a gradual increasing trend in albatross interaction rates, especially for black-footed albatrosses. Recent analysis conducted by Gilman et al. 2016 using data from October 2004 to May 2014 indicated that seabird interaction rates in the deep-set longline fishery significantly increased as annual mean multivariate ENSO index (MEI) values increased, suggesting 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 following vessels, which may also be contributing to the increasing seabird catch rates. An earlier analysis of seabird interactions in the shallow-set longline fishery also indicated that catch rates significantly increased with increased albatross density (Gilman et al. 2014). The deep-set longline fishery analysis showed that both side setting and blue-dyed bait significantly reduced the seabird catch rate compared to stern setting and untreated bait, respectively (Gilman et al. 2016). Of two options for meeting regulatory requirements, side setting had a marginally significantly lower seabird catch rate than blue-dyed bait (Gilman et al. 2016).

From 2015 to 2016, black-footed albatross interaction rates in the deep-set and shallow-set longline fishery exhibited continued increasing trends, with substantially higher number of interactions and interaction rates in the deep-set fishery, although the estimated total interactions and interaction rates are still substantially lower than pre-seabird measure years. Laysan albatross interaction rates were similar or lower in 2015 and 2016 compared to previous years in both the deep-set and shallow-set longline fishery. The higher number of overall seabird interactions in 2015 and 2016 coincided with the strong El Niño (see Section 3.3.3) and the high MEI values, suggesting that the recent interaction trend is consistent with the findings of Gilman et al. 2016.

At its 166th Meeting in June 2016, the Council directed the Plan Team and the Protected Species Advisory Committee to continue monitoring interactions through the SAFE report 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.

The Council and NMFS Pacific Island Regional Office will continue undertaking efforts in 2018 to improve the understanding of the factors underlying the higher seabird interaction rates in 2015 through 2017 through data analyses and an expert workshop. Results of these efforts will be considered in future editions of this SAFE report and are expected to inform this data integration chapter.

This page intentionally left blank.

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-se 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.

Initially, this chapter will include abstracts of recent publications and a qualitative discussion of these research results with respect to data streams included in Chapters 2 and 3. In later years the subject of the publications may be updated through the SAFE report process as more data become available and an update may have significance for management. The 2019 Pelagic Fishery Ecosystem Plan Team recommended action items including 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; this may also include compiling abstracts on recent relevant studies. 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.

4.1 ATTRITION IN LONGLINE FLEETS

4.1.1 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[6].

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

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

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[7]. 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.

4.1.2 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).

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.

---

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

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.

4.1.2.1 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.

4.1.2.2 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.

4.1.2.3 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).

4.1.2.4 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.

4.1.3 FACTORS AFFECTING CPUE OF TARGET SPECIES

The work of PIFSC researchers in spatial and temporal changes in Hawaiʻi 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[8]. Additional explanatory text was provided by Phoebe Woodworth-Jefcoats (pers. comm.)

A comprehensive examination of the spatial and temporal trends in the Hawai‘i-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.

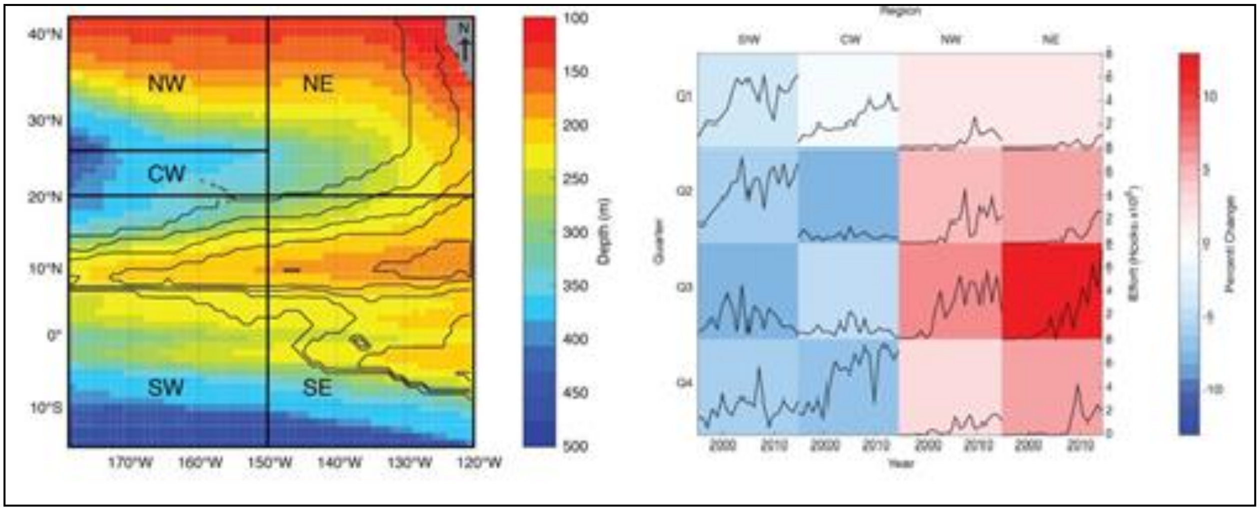


Figure 183. Left: Map depicting the five regions by which the fishery is examined overlaid on the climatological (1995-2015) median depth of preferred thermal habitat

Note: (8 – 14 °C, shaded) and the depth of the 1 mL/L oxygen threshold (contoured every 100 m from 100 to 500 m, with stippling where the depth is less than 100 m). Right: The difference between the proportion of total annual effort set in each region and quarter from the beginning (1995 – 1997 mean) to the end (2013 – 2015 mean) of the time series is shaded. Total annual effort in each region and quarter is plotted in black. Note: nearly no effort is deployed in the SE region.

The deep-set longline fishery, which targets bigeye tuna, has expanded considerably over the past two decades. Not only has total effort increased from nearly 8.4 million hooks set in 1995 to over 47 million hooks set in 2015, but the spatial footprint of the fishery has expanded as well. At the beginning of the time series, nearly all (97%) of Hawai‘i’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

[8] 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.

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).

The marked northeastward expansion of the fishery appears to have several drivers. First, it is possible that waters closer to Hawai‘i were unable to support an increase in effort due to both Hawai‘i-based and international effort. Waters northeast of Hawai‘i 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 Hawai‘i. Finally, preferred bigeye thermal habitat and oxygen levels overlap most completely with deep-set gear in waters to the northeast of Hawai‘i (Figure). 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 Hawai‘i 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 184).

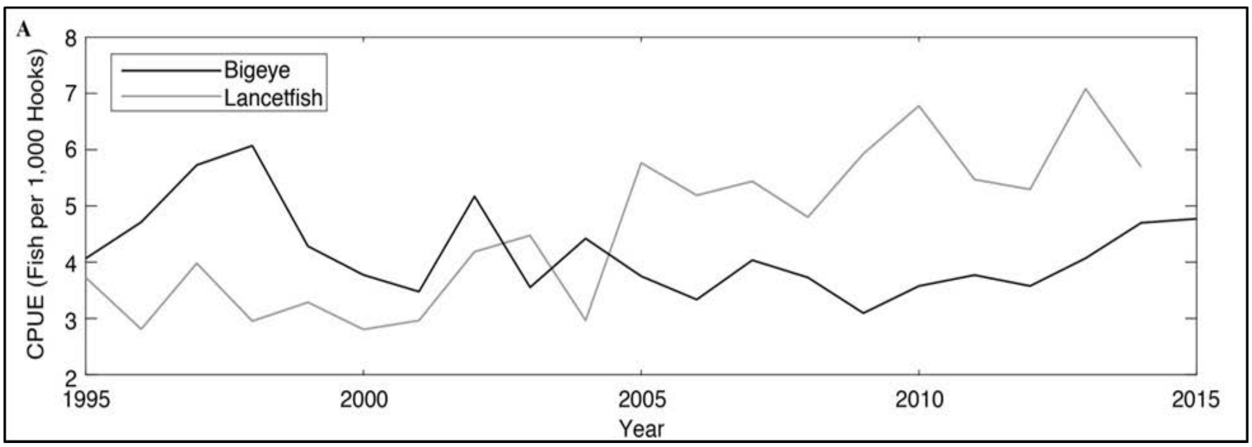


Figure 184. Annueal deep-set bigeye tuna (black) and lancetfish (gray) CPUE

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 Hawai‘i- 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 A). 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 185C).

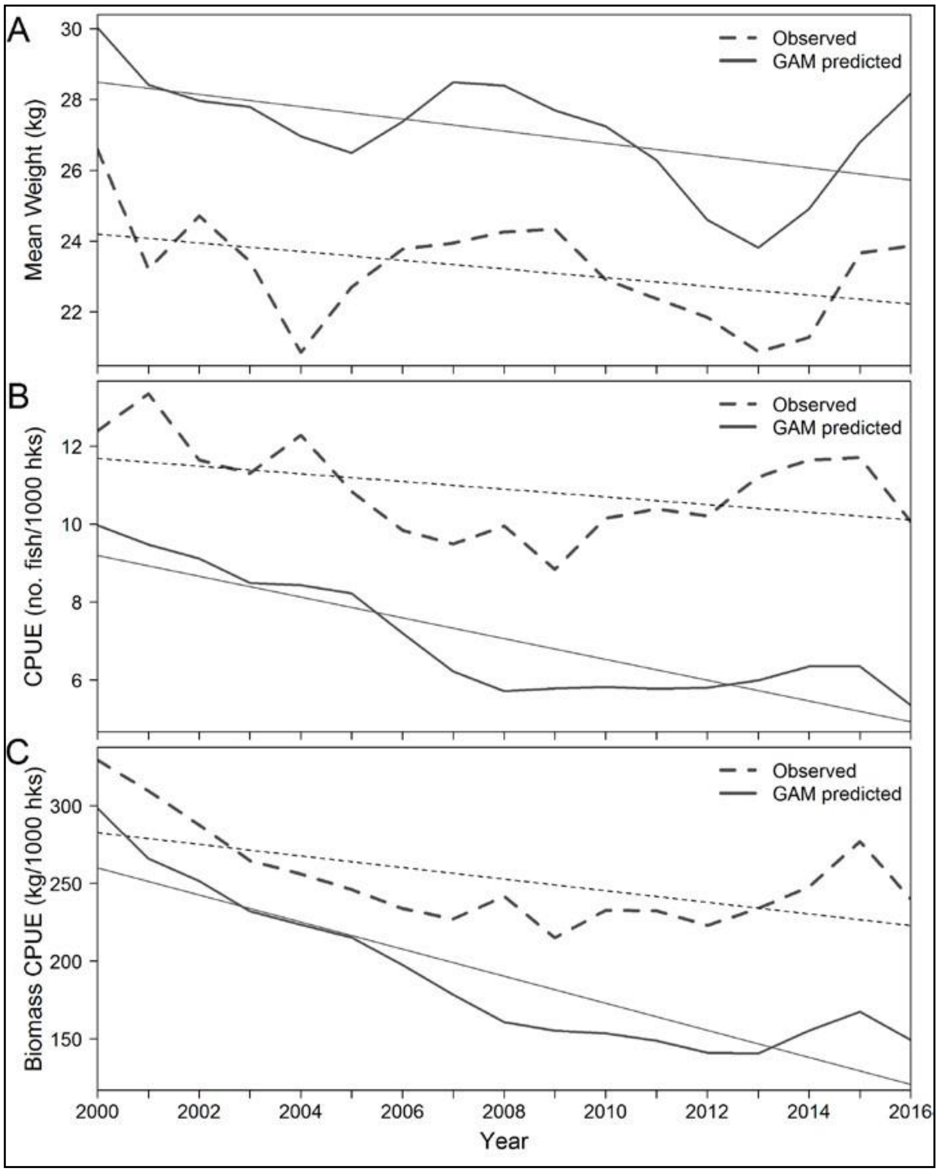


Figure 185. Mean weight (A), catch per unit effort (B), and weight per unit effort (WPUE) for all fish in the Hawai‘i-based longline fishery from dealer provided data.

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 186).

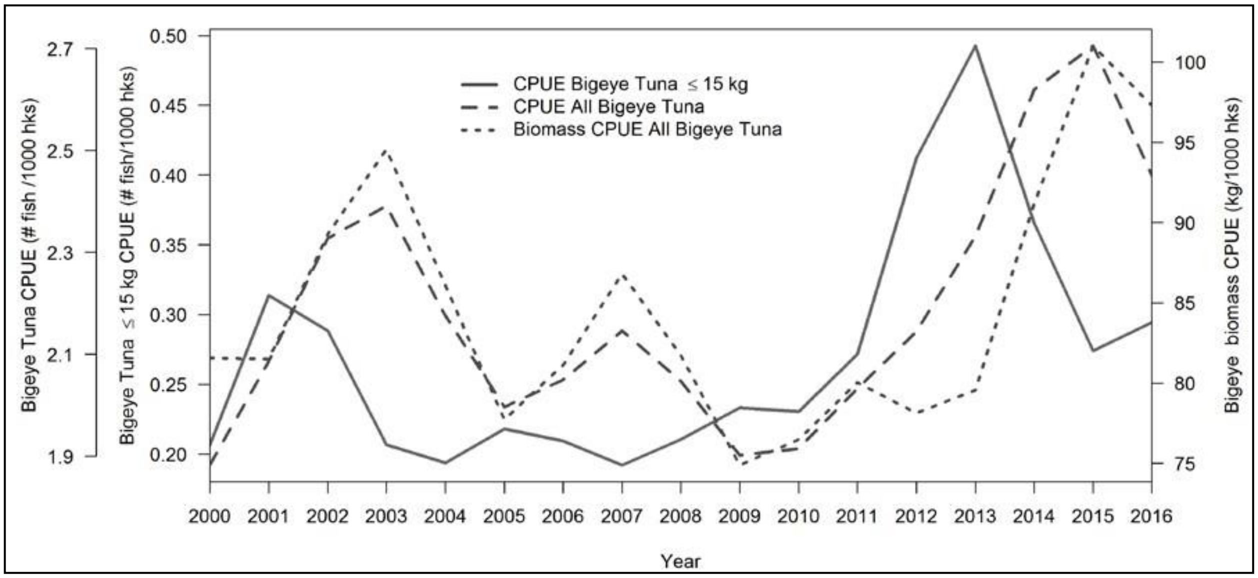


Figure 186. Temporally- and spatially-adjusted annual catch per 1000 hooks.
Note: (CPUE; dashed line), and biomass per 1000 hooks (WPUE) for all bigeye tuna and bigeye tuna 15 kg or less (solid line) from the GAM from 2000-2016.

Additional reading on the influence of environmental impacts on tuna populations can be found in Lehodey et al. (2010) and Lehodey et al. (2013).

4.2 REFERENCES

Gilman, E., Chaloupka, M., Peschon, J., and S. Ellgen, 2016. Risk factors for seabird bycatch in a pelagic longline tuna fishery. *PloS one*, *11*(5), p.e0155477.

Gilman, E., Chaloupka, M., Wiedoff, B., and J. Willson, 2014. Mitigating seabird bycatch during hauling by pelagic longline vessels. *PloS one*, *9*(1), p.e84499.

Gilman, E., Kobayashi, D., and M. Chaloupka, 2008. Reducing seabird bycatch in the Hawaii longline tuna fishery. *Endangered Species Research*, *5*(2-3), pp. 309-323.

Lehodey, P., Senina, I., Sibert, J., Bopp, L., Calmettes, B., Hampton, J., and R. Murtugudde, 2010. Preliminary forecasts of Pacific bigeye tuna population trends under the A2 IPCC scenario. *Progress in Oceanography*, *86*, pp. 302-315.

Lehodey, P., Senina, I., Calmettes, B., Hampton, J., and S. Nicol, 2013. Modelling the impact of climate change on Pacific skipjack tuna population and fisheries. *Climatic Change*, *119*, pp. 95-109.

Pan, M., 2014. Economic characteristics and management challenges of the Hawaii pelagic longline fisheries: Will a catch share program help? *Marine Policy, 44,* pp. 18–26.

Pan, M., 2015. PIFSC Internal Report IR-15-015. Issued 27 March 2015.

Pan, M., 2016. PIFSC Internal Report IR-16-018. Issued 23 November 2016.

Pan, M., Arita, S., and K. Bigelow, 2017. Cost-earnings study of the American Samoa longline fishery based on vessel operations in 2009 and recent trend of economic performance. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-17-01, 43 p. doi:10.7289/V5/AR-PIFSC-H-17-01.

This page intentionally left blank.

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
2008	208	90	111	132	84
2009	172	27	30	37	81
2010	212	31	36	38	95
2011	239	67	113	119	95
2012	262	37	71	76	93
2013	259	73	114	120	95
2014	237	97	98	126	78
2015	219	51	69	104	66
2016	196	44	56	84	67
2017	200	41	74	142	52

Table A-2. Supporting Data for Figure 2.

Year	Boats Landing All Methods	Boats Landing Longline Boats	Boats Landing Trolling
2009	48	26	10
2010	39	26	7
2011	39	24	10
2012	39	25	8
2013	22	22	13
2014	44	23	19
2015	40	21	10
2016	38	20	12
2017	27	15	8
2018	24	13	7
Average	**36**	**20**	**9**
St. Dev.	**17**	**9**	**2**

Table A-3. Supporting Data for Figure 3.

Year	**All Pelagic Species Troll Trips**	**All Pelagic Species Longline Sets**
2009	80	4,910
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	123	2,451
2017	180	2,419
2018	195	2,185
Average	**138**	**3,548**
St. Dev.	**81**	**1,927**

Table A-4. Supporting Data for Figure 4.

Year	**Total Pounds Landings Tuna**	**Total Pounds Landings Non Tuna PMUS**
2009	10,815,118	460,183
2010	10,884,642	396,168
2011	7,526,617	370,399
2012	9,375,076	335,277
2013	5,855,112	295,354
2014	4,904,315	250,446
2015	5,400,233	231,256
2016	4,581,103	218,829
2017	4,608,013	264,879
2018	3,936,100	189,285
Average	**7,375,609**	**324,734**
St. Dev.	**4,864,200**	**191,554**

Table A-5. Supporting Data for Figure 5.

Year	Commercial Landings Pounds Tuna	Commercial Landings Pounds Non Tuna PMUS
2009	10,758,143	382,117
2010	10,860,588	341,790
2011	7,511,353	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	4,573,234	97,633
2017	4,599,194	102,171
2018	3,930,015	68,465
Average	**7,344,079**	**225,291**
St. Dev.	**4,828,216**	**221,785**

Table A-6. Supporting Data for Figure 6.

Year	Estimated Yellowfin Longline Pounds	Estimated Yellowfin Trolling Pounds
2009	941,766	2,785
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	850,849	9,477
2017	1,186,805	14,023
2018	542,078	10,344
Average	**741,922**	**6,565**
St. Dev.	**282,622**	**5,345**

Table A-7. Supporting Data for Figure 7.

Year	Estimated Skipjack Longline Pounds	Estimated Skipjack Trolling Pounds
2009	390,801	2,775
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	207,970	9,801
2017	140,698	7,005
2018	147,758	8,414
Average	**269,280**	**5,595**
St. Dev.	**171,857**	**3,987**

Table A-8. Supporting Data for Figure 8.

Year	Estimated Wahoo Longline Pounds	Estimated Wahoo Trolling Pounds
2009	277,152	0
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	103,172	1,871
2017	109,139	747
2018	72,172	1,154
Average	**174,662**	**577**
St. Dev.	**144,943**	**816**

Table A-9. Supporting Data for Figure 9.

Year	Estimated Mahimahi Longline Pounds	Estimated Mahimahi Trolling Pounds
2009	35,151	113
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	30,506	1,373
2018	9,881	954
Average	**22,516**	**534**
St. Dev.	**17,869**	**595**

Table A-10. Supporting Data for Figure 10.

Year	Blue Marlin Longline Pounds	Blue Marlin Trolling Pounds
2009	89,085	0
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	86,325	812
2018	69,721	1,107
Average	**79,403**	**554**
St. Dev.	**13,692**	**783**

Table A-11. Supporting Data for Figure 11.

Year	Sailfish Longline Pounds	Sailfish Trolling Pounds
2009	4,538	0
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
Average	**3,120**	**0**
St. Dev.	**2,005**	**0**

Table A-12. Supporting Data for Figure 13.

Year	Longline Hook Set
2009	15,076
2010	13,184
2011	11,074
2012	12,112
2013	10,184
2014	7,667
2015	7,806
2016	6,909
2017	6,818
2018	5,952
Average	**10,514**
St. Dev.	**6,452**

Table A-13. Supporting Data for Figure 14.

Year	Bigeye Tuna Longline Pounds

2009	465,829
2010	463,890
2011	386,653
2012	408,805
2013	191,554
2014	210,869
2015	183,849
2016	157,772
2017	142,365
2018	103,391
Average	**284,610**
St. Dev.	**256,282**

Table A-14. Supporting Data for Figure 15.

Year	**Albacore Longline Pounds**
2009	9,008,539
2010	9,050,894
2011	5,482,753
2012	7,376,076
2013	4,673,320
2014	3,313,739
2015	3,937,366
2016	3,344,004
2017	3,111,826
2018	3,122,082
Average	**6,065,311**
Standard Deviation	**4,162,354**

Table A-15. Supporting Data for Figure 16.

Year	**Swordfish Longline Pounds**
2009	23,270
2010	20,437
2011	24,477

2012	26,081
2013	20,474
2014	17,736
2015	14,615
2016	12,194
2017	13,191
2018	13,434
Average	**18,352**
St. Dev.	**6,955**

Table A-16. Supporting Data for Figure 17.

Year	Release Tunas	Release Non Tuna PMUS	Release Other Pelagics	Release Sharks
2009	9,733	24,967	1,083	0
2010	16,703	23,106	1,025	0
2011	5,575	17,029	372	0
2012	6,924	23,016	911	0
2013	1,095	15,716	936	0
2014	846	11,829	393	0
2015	1,722	14,068	332	0
2016	996	10,247	126	0
2017	767	7,017	60	0
2018	910	6,726	14	0
Average	**5,322**	**15,847**	**549**	**0**
St. Dev.	**6,239**	**12,898**	**756**	**0**

Table A-17. Supporting Data for Figure 18.

Year	Alias Catch per 1000 Hooks	Monohulls Catch per 1000 Hooks
2009	0.0	14.8
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	13.6
Average	**0.0**	**14.2**
St. Dev.	**0.0**	**0.8**

Table A-18. Supporting Data for Figure 19.

Year	Troll Catch Pounds Per Hour	Effective Troll Hours
2009	26	422
2010	20	316
2011	52	708
2012	52	501
2013	27	837
2014	25	1,005
2015	16	1,022
2016	43	637
2017	14	2,161
2018	23	1,106
Average	**25**	**764**
St. Dev.	**2**	**484**

Table A-19. Supporting Data for Figure 20.

Year	Trolling Catch Rates Skipjack	Trolling Catch Rates Yellowfin Tuna
2009	11.68	14.00
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
Average	**9.61**	**12.02**
St. Dev.	**2.93**	**2.81**

Table A-20. Supporting Data for Figure 21.

Year	Trolling Catch Rates Blue Marlin	Trolling Catch Rates Mahimahi	Trolling Catch Rates Wahoo
2009	0.00	0.58	0.00
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
Average	**0.59**	**0.71**	**0.61**
St. Dev.	**0.83**	**0.18**	**0.86**

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
2008	56	164	4	160	160	5	155
2009	66	140	3	137	137	5	132
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	141	1	140
2015	68	110	1	109	102	1	101
2016	80	108	4	104	91	4	87
2017	74	121	7	114	109	3	106
Average	**71**	**133**	**4**	**129**	**124**	**4**	**120**
Std. Dev.	**6.4**	**21.8**	**2.0**	**22.4**	**22.7**	**2.0**	**22.6**

Table A-22. Supporting Data for Figure 22.

Year	Number of Fishermen Landing Pelagic Species from Commercial Receipt Invoices
2009	50
2010	40
2011	45
2012	35
2013	28
2014	21
2015	12
2016	72
2017	36
2018	40
Average	**45**

St. Dev.	**7**

Table A-23. Supporting Data for Figure 23.

Year	**Number of Trips Catching Pelagic Fish from Commercial Receipt Invoices**
2009	1,254
2010	869
2011	531
2012	1,051
2013	1,640
2014	1,227
2015	583
2016	1,123
2017	1,368
2018	1,735
Average	**1,495**
St. Dev.	**340**

Table A-24. Supporting Data for Figure 24.

Year	**Estimated Total Trolling Trips**	**Estimated Trolling Trips Non Charter**	**Estimated Trolling Trips Charter**
2009	4,129	3,940	189
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	3,375	3,357	18

Average	**3,752**	**3,649**	**104**
St. Dev.	**533**	**412**	**121**

Table A-25. Supporting Data for Figure 25.

Year	Estimated Trolling Hours Total	Estimated Trolling Hours Non Charter	Estimated Trolling Hours Charter
2009	20,921	20,336	584
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	17,537	17,453	84
Average	**19,229**	**18,895**	**334**
St. Dev.	**2,393**	**2,039**	**354**

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
2009	5.1	5.2	3.1
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	5.2	5.2	4.7
Average	**5.2**	**5.2**	**3.9**
St. Dev.	**0.1**	**0.0**	**1.1**

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
2009	378,232	299,002	75,937
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	367,473	303,333	63,219
Average	**372,853**	**301,168**	**69,578**
St. Dev.	**7,608**	**3,062**	**8,993**

Table A-28. Supporting Data for Figure 28.

Year	Estimated Total Landings Pelagic	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2009	378,232	374,526	3,705
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	367,473	365,886	1,589
Average	**372,853**	**370,206**	**2,647**
St. Dev.	**7,608**	**6,109**	**1,496**

Table A-29. Supporting Data for Figure 29.

Year	Estimated Landings Tuna PMUS	Estimated Landings Non Charter	Estimated Landings Charter
2009	299,002	296,659	2,343
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	303,333	302,160	1,173
Average	**301,168**	**299,410**	**1,758**
St. Dev.	**3,062**	**3,890**	**827**

Table A-30. Supporting Data for Figure 30.

Year	Estimated Landings Total Non Tuna PMUS	Estimated Landings Non Charter	Estimated Landings Charter
2009	75,937	74,574	1,362
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	63,219	62,829	392
Average	**69,578**	**68,702**	**877**
St. Dev.	**8,993**	**8,305**	**686**

Table A-31. Supporting Data for Figure 31.

Year	Estimated Total Landings Skipjack	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2009	268,048	266,083	1,965
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	291,854	290,681	1,173
Average	**279,951**	**278,382**	**1,569**
St. Dev.	**16,833**	**17,393**	**560**

Table A-32. Supporting Data for Figure 32.

Year	Estimated Total Landings Yellowfin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2009	26,101	26,101	0
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	9,694	9,694	0
Average	**17,898**	**17,898**	**0**
St. Dev.	**11,602**	**11,602**	**0**

Table A-33. Supporting Data for Figure 33.

Year	Estimated Total Landings Mahimahi	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2009	62,959	61,975	983
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	54,903	54,708	196
Average	**58,931**	**58,342**	**590**
St. Dev.	**5,696**	**5,139**	**556**

Table A-34. Supporting Data for Figure 34.

Year	Estimated Total Landings Wahoo	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2009	12,978	12,599	379
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	5,849	5,654	196
Average	**9,414**	**9,127**	**288**
St. Dev.	**5,041**	**4,911**	**129**

Table A-35. Supporting Data for Figure 35.

Year	Estimated Total Landings Blue Marlin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2009	0	0	0
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	2,467	2,467	0
Average	**1,234**	**1,234**	**0**
St. Dev.	**1,744**	**1,744**	**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
2009	190,796	161,778	24,284
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	208,052	189,580	12,857
2017	205,164	190,539	10,593

2018	167,754	142,977	15,470
Average	**179,275**	**152,378**	**19,877**
St. Dev.	**16,293**	**13,294**	**6,232**

Table A-37. Supporting Data for Figure 37.

Year	Commercial Purchase Landings Skipjack	Commercial Purchase Landings Yellowfin
2009	133,794	26,463
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	170,031	17,546
2017	159,701	30,579
2018	125,009	13,179
Average	**129,402**	**19,821**
St. Dev.	**6,212**	**9,393**

Table A-38. Supporting Data for Figure 38.

Year	Commercial Purchase Landings Mahimahi	Commercial Purchase Landings Wahoo	Commercial Purchase Landings Blue Marlin
2009	20,030	3,500	82
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	8,221	1,500	2,132
2017	7,876	2,072	304

2018	14,271	687	374
Average	**17,151**	**2,094**	**228**
St. Dev.	**4,072**	**1,989**	**206**

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
2009	17.9	18.2	6.3
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	20.9	20.9	18.9
Average	**19.4**	**19.6**	**12.6**
Standard Deviation	**2.1**	**1.9**	**8.9**

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
2009	12.8	13.1	3.4
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	16.6	16.6	14.0
Average	**14.7**	**14.9**	**8.7**
St. Dev.	**2.7**	**2.5**	**7.5**

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
2009	1.2	1.2	0.0
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	0.6	0.6	0.0
Average	**0.9**	**0.9**	**0.0**
St. Dev.	**0.4**	**0.4**	**0.0**

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
2009	3.0	3.0	1.7
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	3.1	3.1	2.3
Average	**3.1**	**3.1**	**2.0**
St. Dev.	**0.1**	**0.1**	**0.4**

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**
2009	0.6	0.6	0.6
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
Average	**0.5**	**0.5**	**1.5**
St. Dev.	**0.2**	**0.2**	**1.2**

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
2017	0.2	0.2	0.0
2018	0.1	0.1	0.0
Average	**0.3**	**0.3**	**0.0**
St. Dev.	**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
2009	16.0	2.8	0.1
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	7.3	1.3	1.9
2017	5.8	1.5	0.2
2018	8.2	0.4	0.2
Average	**12.1**	**1.6**	**0.1**
St. Dev.	**5.5**	**1.7**	**0.1**

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
2009	107	21	72
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	151	16	52
2017	117	22	94
2018	72	8	89
Average	**89**	**14**	**80**
St. Dev.	**24**	**10**	**12**

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
2008	96	785	406
2009	96	1,128	715
2010	96	1,128	715
2011	96	877	496
2012	96	498	274
2013	96	799	456
2014	90	964	511
2015	95	904	540
2016	96	1,128	715
2017	92	1,018	643
Average	**95**	**923**	**547**
Std. Dev.	**2.1**	**198.4**	**149.3**

Table A-48. Supporting Data for Figure 47.

Year	Estimated Trolling Boats	Upper 95 Percent	Lower 95 Percent
2009	368	468	316
2010	432	508	390
2011	454	563	396
2012	351	457	298
2013	496	588	446
2014	447	537	395
2015	372	460	326
2016	428	505	386

2017	408	473	366
2018	398	495	349
Average	**383**	**482**	**333**
Standard Deviation	**21**	**19**	**23**

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
2009	721,528	383,133	311,445
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
Average	**806,638**	**523,475**	**262,807**
Standard Deviation	**120,364**	**198,474**	**68,785**

Table A-50. Supporting Data for Figure 49.

Year	Estimated Total Landings Pelagic	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2009	721,528	667,464	54,060
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
Average	**806,638**	**753,885**	**52,752**
Standard Deviation	**120,364**	**122,218**	**1,850**

Table A-51. Supporting Data for Figure 50.

Year	Estimated Landings Tuna PMUS	Estimated Landings Non Charter	Estimated Landings Charter
2009	383,133	372,930	10,200
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
Average	**523,475**	**514,143**	**9,331**
Standard Deviation	**198,474**	**199,705**	**1,230**

Table A-52. Supporting Data for Figure 51.

Year	Estimated Total Landings Skipjack	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2009	334,568	326,186	8,381
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
Average	**472,660**	**464,799**	**7,860**
Standard Deviation	**195,291**	**196,028**	**737**

Table A-53. Supporting Data for Figure 52.

Year	Estimated Total Landings Yellowfin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2009	45,330	44,115	1,214
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
Average	**48,943**	**47,774**	**1,168**
Standard Deviation	**5,109**	**5,175**	**65**

Table A-54. Supporting Data for Figure 53.

Year	Estimated Total Landings Non Tuna PMUS	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2009	311,445	267,626	43,818
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
Average	**262,807**	**219,684**	**43,123**
Standard Deviation	**68,785**	**67,800**	**984**

Table A-55. Supporting Data for Figure 54.

Year	**Estimated Total Landings Mahimahi**	**Estimated Total Landings Non Charter**	**Estimated Total Landings Charter**
2009	146,952	124,363	22,589
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
Average	**117,885**	**100,839**	**17,046**
Standard Deviation	**41,108**	**33,269**	**7,839**

Table A-56. Supporting Data for Figure 55.

Year	**Estimated Total Landings Wahoo**	**Estimated Total Landings Non Charter**	**Estimated Total Landings Charter**
2009	130,553	121,518	9,035
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
Average	**113,294**	**101,383**	**11,911**
Standard Deviation	**24,408**	**28,475**	**4,067**

Table A-57. Supporting Data for Figure 56.

Year	**Estimated Total Landings Blue Marlin**	**Estimated Total Landings Non Charter**	**Estimated Total Landings Charter**
2009	32,549	20,354	12,194
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
Average	**28,533**	**16,554**	**11,979**
Standard Deviation	**5,680**	**5,374**	**305**

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**
2009	134,044	43,760	86,040
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	116,723	55,588	54,566
2018	94,564	52,407	37,927
Average	**114,304**	**48,084**	**61,984**
Standard Deviation	**27,917**	**6,114**	**34,021**

Table A-59. Supporting Data for Figure 58.

Year	Estimated Trolling Trips	Estimated Trolling Non Charter	Estimated Trolling Charter
2009	10,002	8,477	1,526
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
Average	**10,381**	**8,900**	**1,482**
Standard Deviation	**536**	**598**	**63**

Table A-60. Supporting Data for Figure 59.

Year	Estimated Trolling Hours Total	Estimated Trolling Hours Non Charter	Estimated Trolling Hours Charter
2009	51,060	45,805	5,255
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
Average	**52,839**	**48,047**	**4,792**
Standard Deviation	**2,515**	**3,171**	**655**

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
2009	5.1	5.4	3.4
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
Average	**5.1**	**5.4**	**3.2**
Standard Deviation	**0.0**	**0.0**	**0.3**

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
2009	14.1	14.5	10.4
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
Average	**15.2**	**15.6**	**11.2**
Standard Deviation	**1.6**	**1.5**	**1.1**

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
2009	6.6	7.1	1.6
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
Average	**8.9**	**9.6**	**1.7**

Standard Deviation	**3.3**	**3.5**	**0.1**

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
2009	0.9	1.0	0.2
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
Average	**1.0**	**1.0**	**0.3**
Standard Deviation	**0.1**	**0.0**	**0.1**

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
2009	2.9	2.7	4.3
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
Average	**2.3**	**2.1**	**3.5**
Standard Deviation	**0.9**	**0.8**	**1.1**

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
2009	2.6	2.7	1.7
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
Average	**2.2**	**2.2**	**2.6**
Standard Deviation	**0.6**	**0.8**	**1.2**

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
2009	1	0	2
2010	1	0	2
2011	0	0	0

2012	0	0	2
2013	0	0	2
2014	1	1	2
2015	1	1	2
2016	1	1	2
2017	1	1	2
2018	0	0	3
Average	**1**	**0**	**3**
Standard Deviation	**0**	**0**	**0**

Table A-68. Supporting Data for Figure 67.

Year	**Longline Transshipment Landings Total**	**Longline Transshipment Landings Bigeye Tuna**	**Longline Transshipment Landings Yellowfin Tuna**
2009	2,904	1,827	950
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	2,093	1,358	598
2016	1,314	685	567
2017	1,245	910	307
2018	1,165	918	205
Average	**2,035**	**1,373**	**578**
Standard Deviation	**1,230**	**643**	**527**

TABLES FOR SECTION 2.4: HAWAI`I

Table A-69. Supporting Data for Figure 68.

	Hawaii pelagic catch (1,000 pounds)					
Year	Tunas	Billfish	Other PMUS	PMUS Sharks	non-PMUS	Total
2009	15,555	6,063	5,226	332	20	27,263
2010	17,769	5,364	5,343	244	33	28,739
2011	19,945	6,229	4,936	190	51	31,308
2012	21,296	5,107	5,682	181	26	32,357
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	25,360	5,728	6,478	139	12	37,718
Average	**21,970.0**	**6,032.6**	**5,970.8**	**183.0**	**24.4**	**34,188.3**
SD	**3,635.7**	**686.1**	**748.6**	**62.5**	**11.4**	**4,351.4**

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
2009	18,071	3,864	2,958	1,067	298	1,005	27,263
2010	20,075	3,595	2,855	933	614	667	28,739
2011	22,796	3,465	2,966	1,129	610	342	31,308
2012	22,975	2,883	3,690	1,602	562	645	32,357
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	32,318	1,438	2,715	776	366	105	37,718
Average	**26,418.7**	**2,847.9**	**2,967.2**	**1,091.1**	**479.6**	**383.7**	**34,188.3**
SD	**5,475.3**	**775.1**	**425.6**	**246.8**	**169.2**	**317.8**	**4,351.4**

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**
2009	11,794	156	1,417	970	286	932	15,555
2010	14,140	200	1,381	818	597	633	17,769
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	22,531	188	1,473	715	358	95	25,360
Average	**18,469.6**	**157.1**	**1,528.7**	**996.0**	**467.7**	**351.0**	**21,970.0**
SD	**4,068.1**	**59.9**	**209.0**	**236.4**	**166.0**	**301.0**	**3,635.7**

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**
2009	10,769	2,820	1,278	668	0	20	15,555
2010	12,975	2,777	1,033	958	0	26	17,769
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	17,045	7,542	527	236	1	10	25,360
Average	**15,711.1**	**4,493.8**	**886.2**	**853.2**	**0.9**	**24.8**	**21,970.0**
SD	**2,881.1**	**1,738.2**	**245.7**	**582.5**	**1.0**	**17.2**	**3,635.7**

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**
2009	10,067	96	130	70	239	167	10,769
2010	11,736	143	261	212	542	81	12,975
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	16,587	108	59	29	244	17	17,045
Average	**14,815.9**	**93.7**	**195.9**	**105.0**	**396.5**	**104.1**	**15,711.1**
SD	**3,058.6**	**29.5**	**112.6**	**54.2**	**167.1**	**72.4**	**2,881.1**

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**
2009	1,014	28	964	656	46	112	2,820
2010	1,202	23	881	542	49	80	2,777
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	5,430	75	1,222	627	114	73	7,542
Average	**2,542.7**	**42.2**	**1,071.2**	**715.5**	**68.1**	**54.0**	**4,493.8**
SD	**1,683.1**	**37.1**	**139.6**	**124.6**	**31.9**	**31.0**	**1,738.2**

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
2009	298	1	303	24	1	651	1,278
2010	332	1	211	14	3	472	1,033
2011	453	1	279	17	3	101	854
2012	541	1	240	20	4	352	1,158
2013	515	0	328	22	9	235	1,115
2014	411	0	172	15	3	48	653
2015	467	1	213	11	2	28	727
2016	529	0	258	11	0	3	802
2017	485	1	214	13	0	18	732
2018	329	0	182	11	0	4	527
Average	**436.0**	**0.7**	**239.9**	**15.8**	**2.5**	**191.2**	888
SD	**89.1**	**0.4**	**51.6**	**4.8**	**2.5**	**229.4**	245

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
2009	415	31	7	214	0	1	668
2010	870	33	4	48	3	0	958
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	805
2014	423	12	7	108	0	1	577
2015	529	7	4	139	0	0	677
2016	546	2	2	52	0	0	603
2017	200	9	1	76	1	0	287
2018	184	5	3	44	0	0	236
Average	**674.2**	**20.2**	**4.6**	**152.3**	**0.5**	**1.4**	**855.8**
SD	**455.5**	**18.9**	**2.5**	**152.5**	**0.9**	**1.7**	**581.1**

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**
2009	2,087	3,552	404	14	0	6	6,063
2010	1,710	3,305	335	11	1	2	5,364
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	389	13	1	4	5,728
Average	**3,036.3**	**2,586.3**	**386.0**	**16.6**	**2.3**	**5.2**	**6,032.6**
SD	**881.6**	**735.9**	**52.2**	**3.6**	**2.0**	**2.8**	**686.1**

Table A-78. Supporting Data for Figure 77.

	Hawaii billfish catch (1,000 lbs)					
Year	**Swordfish**	**Blue marlin**	**Striped marlin**	**Spearfish**	**Other marlins**	**Total**
2009	4,020	1,162	591	261	29	6,063
2010	3,701	975	376	280	32	5,364
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	2,330	1,806	1,050	504	39	5,728
Average	**3,257.5**	**1,401.7**	**827.2**	**504.9**	**41.3**	**6,032.6**
SD	**573.9**	**342.5**	**225.5**	**165.8**	**9.5**	**686.1**

Table A-79. Supporting Data for Figure 78.

	Swordfish catch (1,000 lbs)						
Year	Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
2009	558	3,469	1	9	0	0	4,037
2010	466	3,227	1	7	0	0	3,701
2011	487	3,054	1	11	0	0	3,553
2012	567	2,567	1	14	0	1	3,150
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	1,112	1,210	1	6	0	1	2,330
Average	**719.4**	**2,530.9**	**1.2**	**10.9**	**0.2**	**0.7**	**3,263.3**
SD	**216.5**	**714.6**	**0.6**	**3.0**	**0.3**	**0.7**	**574.1**

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
2009	749	45	362	2	0	4	1,185
2010	657	18	296	2	1	1	997
2011	797	27	414	4	1	1	1,277
2012	630	26	285	4	1	4	968
2013	879	17	282	4	3	6	1,191
2014	1,160	19	318	4	5	4	1,510
2015	1,380	12	399	5	3	6	1,793
2016	1,194	28	311	5	1	2	1,562
2017	1,502	14	306	6	2	2	1,833
2018	1,462	1	335	6	0	2	1,806
Average	**1,041.0**	**20.7**	**330.8**	**4.2**	**1.8**	**3.2**	**1,412.2**
SD	**338.2**	**11.8**	**46.4**	**1.5**	**1.6**	**1.8**	**332.9**

Table A-81. Supporting Data for Figure 80.

	Striped marlin catch (1,000 lbs)						
Year	Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
2009	516	53	22	0	0	0	591
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	24	0	0	1	1,050
Average	**773.4**	**30.3**	**22.7**	**0.2**	**0.1**	**0.5**	**827.2**
SD	**227.9**	**12.9**	**6.8**	**0.3**	**0.2**	**0.5**	**225.5**

Table A-82. Supporting Data for Figure 81.

	Catch of other PMUS by gear type (1,000 lbs)						
Year	Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
2009	4,173	125	1,135	82	12	31	5,558
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	5,671	34	852	48	7	6	6,617
Average	**4,893.2**	**99.9**	**1,049.1**	**77.7**	**9.5**	**24.3**	**6,153.8**
SD	**718.7**	**29.3**	**247.9**	**22.3**	**4.6**	**12.2**	**708.6**

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
2009	1,473	1,897	498	748	610	332	5,558
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	1,074	3,039	314	1,173	878	139	6,617
Average	**1,502.2**	**2,136.8**	**492.8**	**963.3**	**875.7**	**183.0**	**6,153.8**
SD	**320.6**	**456.3**	**94.5**	**215.2**	**286.3**	**62.5**	**708.6**

Table A-84. Supporting Data for Figure 83.

	Moonfish catch (1,000 lbs)			
Year	Deep-set longline	Shallow-set longline	Other gear	Total
2009	1,891	6	0	1,897
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	3,026	13	0	3,039
Average	**2,118.5**	**18.0**	**0.3**	**2,136.7**
SD	**450.9**	**11.6**	**0.6**	**456.3**

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
2009	686	40	696	35	7	9	1,473
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	551	18	1	4	1,074
Average	**739.6**	**33.1**	**680.9**	**33.0**	**6.2**	**9.3**	**1,502.2**
SD	**150.3**	**16.8**	**166.7**	**13.1**	**4.9**	**5.5**	**320.6**

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
2009	292	2	438	12	1	3	748
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	857	1	300	13	0	1	1,173
Average	**577.7**	**1.5**	**367.1**	**13.2**	**0.9**	**2.9**	**963.3**
SD	**251.9**	**0.8**	**94.9**	**3.5**	**0.5**	**1.1**	**215.2**

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
2009	559	1	32	4	14	610
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	856	0	16	5	1	878
Average	**833.3**	**1.4**	**28.8**	**2.2**	**10.1**	**875.7**
SD	**281.5**	**1.4**	**12.3**	**2.4**	**6.5**	**286.3**

Table A-88. Supporting Data for Figure 87.

	PMUS shark catch (1,000 lbs)			
Year	Deep-set longline	Shallow-set longline	Non-longline	Total
2009	294	33	5	332
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
Average	**154.4**	**24.6**	**4.0**	**183.0**
SD	**58.5**	**10.8**	**1.4**	**62.5**

Table A-89. Supporting Data for Figure 88.

	Deep-set longline		
Year	**Vessels**	**Trips**	**Sets**
2009	128	1,257	16,860
2010	123	1,211	16,152
2011	130	1,312	17,260
2012	129	1,365	18,181
2013	136	1,386	18,803
2014	140	1,355	17,831
2015	143	1,452	18,519
2016	142	1,480	19,391
2017	145	1,539	19,674
2018	143	1,641	20,977
Average	**135.9**	**1,399.8**	**18,364.8**
SD	**7.8**	**130.8**	**1434.0**

Table A-90. Supporting Data for Figure 89.

	Number of deep-set hooks by area (millions)			
Year	**Outside EEZ**	**Hawaii EEZ**	**PRIA EEZ**	**Total**
2009	24.4	12.3	1.1	37.9
2010	28.1	7.9	1.4	37.4
2011	26.4	13.7	0.9	40.9
2012	28.4	14.0	1.9	44.2
2013	32.9	12.9	1.2	47.0
2014	34.2	10.8	0.8	45.8
2015	33.0	14.3	0.3	47.6
2016	38.6	12.5	0.1	51.1
2017	40.5	13.0	0.0	53.6
2018	43.0	15.4	0.0	58.4
Average	**32.95**	**12.68**	**0.77**	**46.39**
SD	**6.25**	**2.10**	**0.65**	**6.74**

Table A-91. Supporting Data for Figure 90.

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2009	18,071	$59,513	$51,594	230.0
2010	20,075	$71,185	$63,028	234.9
2011	22,796	$77,485	$71,147	243.6
2012	22,975	$91,999	$86,520	249.5
2013	25,006	$92,070	$84,376	253.9
2014	26,615	$84,566	$78,617	257.6
2015	32,136	$97,160	$91,229	260.2
2016	31,434	$103,600	$99,190	265.3
2017	32,760	$97,927	$96,137	272.0
2018	32,318	$101,259	$101,259	277.1
Average	**26,418.7**	**$87,676.4**	**$82,309.9**	
SD	**5,475.3**	**$14,336.2**	**$16,296.6**	

Table A-92. Supporting Data for Figure 91.

	Deep-set longline CPUE (fish per 1,000 hooks)		
Year	Bigeye tuna	Yellowfin tuna	Albacore
2009	3.1	0.4	0.2
2010	3.7	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	4.8	0.4	0.2
2015	4.8	0.6	0.2
2016	4.3	0.9	0.2
2017	4.2	1.5	0.1
2018	3.7	1.1	0.1
Average	**4.01**	**0.71**	**0.33**
SD	**0.54**	**0.37**	**0.25**

Table A-93. Supporting Data for Figure 92.

	Deep-set longline CPUE (fish per 1,000 hooks)		
Year	Swordfish	Striped marlin	Blue marlin
2009	0.1	0.2	0.1
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
Average	**0.10**	**0.25**	**0.11**
SD	**0.00**	**0.08**	**0.03**

Table A-94. Supporting Data for Figure 93.

	Deep-set CPUE (fish per 1000 hooks)
Year	Blue shark
2009	1.1
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
Average	**1.26**
SD	**0.23**

Table A-95. Supporting Data for Figure 94.

	Shallow-set longline		
Year	**Vessels**	**Trips**	**Sets**
2009	28	112	1,762
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
Average	**19.5**	**74.5**	**1,200.4**
SD	**5.7**	**26.5**	**448.2**

Table A-96. Supporting Data for Figure 95.

	Number of hooks set by area (milions)			
Year	**Outside EEZ**	**Hawaii EEZ**	**PRIA EEZ**	**Total**
2009	1.4	0.3	0.0	1.7
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
Average	**1.07**	**0.19**	**0.00**	**1.26**
SD	**0.30**	**0.14**	**0.00**	**0.42**

Table A-97. Supporting Data for Figure 96.

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2009	3,864	$8,337	$6,922	230.0
2010	3,595	$7,794	$6,607	234.9
2011	3,465	$6,943	$6,105	243.6
2012	2,883	$6,526	$5,876	249.5
2013	2,345	$3,469	$3,180	253.9
2014	3,255	$4,383	$4,074	257.6
2015	2,778	$2,992	$2,810	260.2
2016	1,849	$2,596	$2,486	265.3
2017	3,007	$4,309	$4,230	272.0
2018	1,438	$1,538	$1,538	277.1
Average	**2,847.9**	**$4,888.7**	**$4,382.7**	
SD	**775.1**	**$2,355.1**	**$1,895.1**	

Table A-98. Supporting Data for Figure 97.

Year	Shallow-set longline CPUE (fish per 1,000 hooks)		
	Bigeye tuna	Yellowfin tuna	Albacore
2009	0.5	0.1	0.9
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
Average	**1.00**	**0.44**	**0.65**
SD	**0.65**	**0.57**	**0.56**

Table A-99. Supporting Data for Figure 98.

Year	Shallow-set longline CPUE (fish per 1,000 hooks)		
	Swordfish	Striped marlin	Blue marlin
2009	10.8	0.3	0.1
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
Average	**11.09**	**0.27**	**0.07**
SD	**1.20**	**0.13**	**0.05**

Table A-100. Supporting Data for Figure 99.

Year	Shallow-set CPUE (fish per 1000 hooks)
	Blue shark
2008	8.4
2009	4.8
2010	9.3
2011	5.3
2012	4.2
2013	4.9
2014	6.8
2015	10.0
2016	13.8
2017	9.0
Average	**7.65**
SD	**3.02**

Table A-101. Supporting Data for Figure 100.

Year	Fishers	Days fished
2009	1,721	29,682
2010	1,614	29,380
2011	1,676	29,231
2012	1,769	30,473
2013	1,731	26,839
2014	1,697	27,262
2015	1,626	26,580
2016	1,483	23,388
2017	1,410	21,325
2018	1,380	21,663
Average	**1,610.7**	**26,582.3**
SD	**138.8**	**3,369.1**

Table A-102. Supporting Data for Figure 101.

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2009	2,958	$5,802	$5,030	230.0
2010	2,855	$6,110	$5,410	234.9
2011	2,966	$6,280	$5,766	243.6
2012	3,690	$9,138	$8,594	249.5
2013	3,117	$8,020	$7,350	253.9
2014	3,486	$9,002	$8,368	257.6
2015	3,094	$8,268	$7,763	260.2
2016	2,582	$7,894	$7,558	265.3
2017	2,209	$6,493	$6,374	272.0
2018	2,715	$8,171	$8,171	277.1
Average	**2,967.2**	**$7,517.7**	**$7,038.5**	
SD	**425.6**	**$1,234.7**	**$1,295.7**	

Table A-103. Supporting Data for Figure 102.

MHI troll tuna CPUE (pounds per day fished)		
Year	**Yellowfin tuna**	**Skipjack tuna**
2009	32.5	10.4
2010	30.1	7.2
2011	33.6	9.6
2012	43.0	7.9
2013	40.2	12.2
2014	44.9	6.3
2015	41.2	8.0
2016	44.2	11.1
2017	44.6	10.0
2018	56.4	8.4
Average	**41.07**	**9.11**
SD	**7.65**	**1.86**

MHI troll tuna CPUE (pounds per hour fished)		
Year	**Yellowfin tuna**	**Skipjack tuna**
2009	4.9	1.6
2010	4.6	1.1
2011	5.0	1.4
2012	6.3	1.2
2013	6.0	1.8
2014	6.6	0.9
2015	6.4	1.2
2016	6.8	1.7
2017	6.9	1.6
2018	8.5	1.3
Average	**6.20**	**1.38**
SD	**1.16**	**0.28**

Table A-104. Supporting Data for Figure 103.

MHI troll marlin CPUE (pounds per day fished)		
Year	**Blue marlin**	**Striped marlin**
2009	12.3	0.7
2010	10.0	0.4
2011	14.3	1.2
2012	9.1	0.8
2013	10.6	0.7
2014	11.7	1.0
2015	14.8	0.9
2016	13.4	1.1
2017	14.4	0.7
2018	15.5	1.1
Average	**12.59**	**0.86**
SD	**2.20**	**0.25**

MHI troll marlin CPUE (pounds per hour fished)		
Year	**Blue marlin**	**Striped marlin**
2009	1.9	0.1
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
Average	**1.91**	**0.13**
SD	**0.35**	**0.04**

Table A-105. Supporting Data for Figure 104.

MHI troll mahimahi and ono CPUE (pounds per day fished)		
Year	Mahimahi	Ono (wahoo)
2009	23.5	14.8
2010	22.9	15.5
2011	22.8	10.6
2012	32.7	14.0
2013	23.9	14.8
2014	33.0	17.1
2015	27.6	15.8
2016	23.9	11.5
2017	19.5	8.7
2018	25.4	13.9
Average	**25.53**	**13.68**
SD	**4.38**	**2.59**

MHI troll mahimahi and ono CPUE (pounds per hour fished)		
Year	Mahimahi	Ono (wahoo)
2009	3.6	2.3
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
Average	**3.85**	**2.06**
SD	**0.61**	**0.38**

Table A-106. Supporting Data for Figure 105.

Year	Fishers	Days fished
2009	631	5,224
2010	560	4,414
2011	584	5,361
2012	651	6,585
2013	591	5,466
2014	556	5,097
2015	528	4,882
2016	472	4,018
2017	490	4,691
2018	428	4,022
Average	**549.1**	**4,976.0**
SD	**70.5**	**766.5**

Table A-107. Supporting Data for Figure 106.

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2009	1,067	$2,019	$1,750	230.0
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	$3,673	$3,366	253.9
2014	1,161	$3,163	$2,940	257.6
2015	1,200	$3,084	$2,896	260.2
2016	785	$2,469	$2,364	265.3
2017	975	$2,944	$2,890	272.0
2018	776	$2,493	$2,493	277.1
Average	**1,091.1**	**$2,789.2**	**$2,609.8**	
SD	**246.8**	**$582.6**	**$571.8**	

Table A-108. Supporting Data for Figure 107.

Year	MHI handline CPUE (pounds per day fished)			
	Yellowfin tuna	Albacore	Bigeye tuna	Total
2009	126.2	41.0	13.4	180.6
2010	122.7	10.5	48.5	181.7
2011	132.9	34.4	26.2	193.5
2012	118.8	84.7	21.6	225.1
2013	164.2	18.5	26.9	209.6
2014	156.9	21.2	20.9	199.0
2015	179.8	28.6	15.2	223.6
2016	137.6	13.3	23.3	174.1
2017	161.5	16.2	10.3	188.0
2018	156.0	11.1	7.3	174.3
Average	**145.66**	**27.95**	**21.35**	**194.96**
SD	**20.70**	**22.40**	**11.62**	**19.01**

Year	MHI handline CPUE (pounds per hour fished)			
	Yellowfin tuna	Albacore	Bigeye tuna	Total
2009	18.8	6.1	2.0	26.9
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	22.2	2.2	1.4	25.8
2018	23.3	1.7	1.1	26.1
Average	**20.83**	**3.98**	**3.05**	**27.86**
SD	**2.95**	**3.13**	**1.68**	**2.43**

Table A-109. Supporting Data for Figure 108.

Year	Fishers	Days fished
2009	10	195
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	217
Average	**10.2**	**308.3**
SD	**3.9**	**121.5**

Table A-110. Supporting Data for Figure 109.

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2009	298	$453	$393	230.0
2010	614	$1,389	$1,230	234.9
2011	610	$908	$834	243.6
2012	562	$1,163	$1,094	249.5
2013	831	$1,962	$1,798	253.9
2014	416	$837	$778	257.6
2015	409	$865	$812	260.2
2016	366	$964	$923	265.3
2017	323	$911	$894	272.0
2018	366	$1,055	$1,055	277.1
Average	**479.6**	**$1,050.8**	**$981.2**	
SD	**169.2**	**$400.2**	**$364.5**	

Table A-111. Supporting Data for Figure 110.

Year	Offshore handline CPUE (pounds per day fished) Bigeye tuna	Yellowfin tuna	Mahimahi	Total
2009	1,270	235	38	1,542
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	1,123	526	7	1,656
Average	**1,298.5**	**251.5**	**19.0**	**1,569.1**
SD	**244.8**	**159.6**	**12.9**	**199.3**

TABLES FOR SECTION 3.1: SOCIOECONOMICS

Table A-112. Supporting Data for Figure 127. American Samoa Employment Estimates from 2008-2017[1].

Labor force status	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total Employment	17,047	16,990	14,108	18,862	18,028	14,806	16,089	17,565	17,853	17,930
Total Government	6,052	6,035	6,004	6,782	6,177	5,258	6,198	6,556	6,804	6,585
Canneries	4,633	4,861	1,562	1,553	1,815	1,827	2,108	2,500	2,759	2,843
Other/Private Sector	6,362	6,094	6,542	10,527	10,036	7,721	7,783	8,509	8,290	8,502

Table A-113. Data for Figure 128.

Year	Est. Pounds landed (million lbs.)	Est. Revenue ($million Nominal)	Est. Revenue ($million Adjusted)	Fish Price ($/lb. Nominal)	Fish Price ($/lb. Adjusted)	CPI adjustor
2009	11.3	10.8	13.2	0.95	1.17	1.23
2010	11.3	11	12.9	0.97	1.15	1.18

2011	7.9	8.9	9.7	1.13	1.24	1.09
2012	9.7	10.1	10.6	1.05	1.1	1.05
2013	6.1	6.4	6.6	1.04	1.07	1.03
2014	5.1	5.2	5.4	1.01	1.04	1.03
2015	5.6	5.7	5.9	1.02	1.06	1.04
2016	4.8	4.8	4.9	1	1.04	1.04
2017	4.8	5.1	5.2	1.05	1.07	1.02
2018	4.1	4.3	4.3	1.05	1.05	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 129.

Year	Albacore price ($/MT)	Albacore price ($/lb)	Adjusted Price ($/MT)	Adjusted Price ($/lb)	CPI adjustor
2012	3,193	1.45	3,368	1.53	1.055
2013	2,254	1.02	2,331	1.05	1.034
2014	2,707	1.23	2,780	1.26	1.027
2015	2,651	1.20	2,747	1.24	1.036
2016	2,498	1.13	2,591	1.17	1.037
2017	2,559	1.16	2,600	1.18	1.016
2018	3,086	1.40	3,086	1.40	1

Table A-115. Supporting Data for Figures 131 and 132.

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
2009	848	1,046	2,288	2,823	1,777	1.234
2010	1,065	1,254	2,416	2,846	1,592	1.178
2011	1,189	1,296	2,378	2,592	1,296	1.090
2012	1,403	1,480	2,424	2,557	1,077	1.055
2013	1,448	1,497	1,993	2,061	564	1.034
2014	1,181	1,213	1,877	1,927	714	1.027
2015	1,034	1,071	2,143	2,220	1,149	1.036
2016	947	982	2,079	2,156	1,174	1.037
2017	913	927	2,144	2,178	1,251	1.016
2018	1,034	1,034	2,360	2,360	1,326	1.000

Table A-116. Supporting Data for Figures 133 and 134.

Year	Revenue per day at sea ($/set)	Revenue per day at sea ($/set adjusted)	Revenue per vessel ($/vessel)	Revenue per vessel ($/vessel adjusted)	Gini Coefficient	CPI adjustor
2008	1307	1,640	324,557	407,320	0.35	1.255
2009	1553	1,887	413,789	502,753	0.26	1.215
2010	1682	1,949	421,250	488,229	0.28	1.159
2011	1476	1,583	371,546	398,297	0.29	1.072
2012	1658	1,721	389,816	404,629	0.34	1.038
2013	1279	1,302	289,848	295,065	0.27	1.018
2014	1279	1,293	226,453	228,944	0.42	1.011
2015	1325	1,352	274,143	279,626	0.42	1.020
2016	1303	1,330	237,792	242,786	0.49	1.021
2017	1419	1,419	313,854	313,854	0.35	1

Table A-117. Supporting Data for Figures 135 and 136.

Year	Estimated pounds caught (lb)	Estimated pounds sold (lb)	Estimated revenue ($)	Estimated revenue ($ adjusted)	% of pounds sold	Fish price ($)	Fish price ($ adjusted)	CPI adjustor
2009	5,131	3,044	3,069	3,775	59%	1.01	1.24	1.23
2010	4,471	635	635	749	14%	1.00	1.18	1.18
2011	30,848	187	187	204	1%	1.00	1.09	1.09
2012	18,380	9,800	13,294	13,959	53%	1.36	1.42	1.05
2013	16,759	6,524	8,929	9,197	39%	1.37	1.41	1.03
2014	21,377	6,828	9,661	9,951	32%	1.41	1.46	1.03
2015	11,056	5,857	12,122	12,607	53%	2.07	2.15	1.04
2016	18,617	5,838	13,340	13,874	31%	2.29	2.38	1.04
2017	23,190	9,004	24,859	25,356	39%	2.76	2.82	1.02
2018	21,659	16,219	49,262	49,262	75%	3.04	3.04	1

Table A-118. Supporting Data for Figure 137.

Year	Total trip costs ($)	Total trip costs ($) (adjusted)	Fuel cost ($)	Fuel cost ($) (adjusted)	Ice cost ($)	Ice cost ($) (adjusted)	Gear losted cost ($)	Gear losted cost ($) (adjusted)	Bait & chum cost ($)	Bait & chum cost ($) (adjusted)	CPI adjustor
2009*	-	-	-	-	-	-	-	-	-	-	1.234
2010*	-	-	-	-	-	-	-	-	-	-	1.178
2011	85	93	81	88	-	-	4	5	0	0	1.090
2012	90	95	69	73	11	12	10	10	0	0	1.055
2013	88	91	68	70	14	15	6	6	0	0	1.034
2014	69	70	59	61	5	5	2	2	2	3	1.027
2015	80	83	63	66	15	15	2	2	0	0	1.036
2016	75	78	49	51	19	20	7	7	1	1	1.037
2017	102	104	79	80	20	21	2	2	1	1	1.016
2018	118	118	98	98	16	16	4	4	1	1	1.000

Table A-119. Supporting Data for Figures 138 and 139.

Year	Estimated pounds caught (lb)	Estimated pounds sold (lb)	Estimated revenue ($)	Estimated revenue ($ adjusted)	% of pounds sold	Fish price ($)	Fish price ($ adjusted)	CPI adjustor*
2009	374,938	185,819	315,775	332,511	50%	1.70	1.79	1.053
2010	517,240	181,850	327,811	327,155	35%	1.80	1.80	0.998
2011	338,797	107,626	208,347	203,346	32%	1.94	1.89	0.976
2012	479,274	155,443	311,920	301,003	32%	2.01	1.94	0.965
2013	335,643	253,164	530,410	525,107	75%	2.10	2.07	0.990
2014	394,881	227,091	523,591	512,596	58%	2.31	2.26	0.979
2015	396,368	185,465	423,984	432,887	47%	2.29	2.33	1.021
2016	298,592	200,305	443,801	443,801	67%	2.22	2.22	1
2017	338,117	201,132	476,899	476,899	59%	2.37	2.37	1
2018	366,553	158,447	385,991	385,991	43%	2.44	2.44	1

Table A-120. Supporting Data for Figure 140.

Year	Estimated pounds caught (lb)	Estimated pounds sold (lb)	Estimated revenue ($)	Estimated revenue ($ adjusted)	% of pounds sold	Fish price ($)	Fish price ($ adjusted)	CPI adjustor*
2009	374,938	185,819	315,775	332,511	50%	1.70	1.79	1.053
2010	517,240	181,850	327,811	327,155	35%	1.80	1.80	0.998
2011	338,797	107,626	208,347	203,346	32%	1.94	1.89	0.976
2012	479,274	155,443	311,920	301,003	32%	2.01	1.94	0.965
2013	335,643	253,164	530,410	525,107	75%	2.10	2.07	0.990
2014	394,881	227,091	523,591	512,596	58%	2.31	2.26	0.979
2015	396,368	185,465	423,984	432,887	47%	2.29	2.33	1.021
2016	298,592	200,305	443,801	443,801	67%	2.22	2.22	1
2017	338,117	201,132	476,899	476,899	59%	2.37	2.37	1
2018	366,553	158,447	385,991	385,991	43%	2.44	2.44	1

Table A-121. Supporting Data for Figures 141 and 142.

Year	Estimated pounds caught (lb)	Estimated pounds sold (lb)	Estimated revenue ($)	Estimated revenue ($ adjusted)	% of pounds sold	Fish price ($)	Fish price ($ adjusted)	CPI adjustor
2009	694,577	129,800	264,989	323,287	19%	2.04	2.49	1.22
2010	721,810	219,210	452,894	538,944	30%	2.07	2.46	1.19
2011	578,793	137,807	280,131	322,151	24%	2.03	2.34	1.15
2012	394,503	113,853	236,365	262,366	29%	2.08	2.30	1.11
2013	789,168	173,064	392,273	435,423	22%	2.27	2.52	1.11
2014	744,961	116,816	232,663	255,929	16%	1.99	2.19	1.10
2015	937,728	106,471	208,623	231,571	11%	1.96	2.17	1.11
2016	865,131	95,590	204,914	215,159	11%	2.14	2.25	1.05
2017	587,091	110,154	246,396	253,789	19%	2.24	2.30	1.03
2018	877,983	90,334	216,204	216,204	10%	2.39	2.39	1.00

Table A-122. Supporting Data for Figure 143.

Year	Total trip costs ($)	Total trip costs ($) (adjusted)	Fuel cost ($)	Fuel cost ($) (adjusted)	Ice cost ($)	Ice cost ($) (adjusted)	Gear losted cost ($)	Gear losted cost ($) (adjusted)	Bait & chum cost ($)	Bait & chum cost ($) (adjusted)	CPI adjustor
2011	96	111	72	83	10	12	10	11	4	5	1.149
2012	116	129	76	84	11	13	24	27	5	5	1.114
2013	92	103	63	70	12	13	17	19	1	1	1.114
2014	101	112	64	71	11	12	22	25	4	4	1.105
2015	92	103	48	53	11	12	26	29	7	8	1.115
2016	76	80	42	44	10	11	20	21	4	4	1.052
2017	99	102	47	48	20	20	23	24	10	10	1.026
2018	112	112	63	63	19	19	18	18	13	13	1.000

Table A-123. Supporting Data for Figure 144.

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
2009	22.1	59.1	18.4	58.1	69.7	3.16	3.79	1.20
2010	23.8	72.1	19.5	69.6	82.1	3.57	4.21	1.18
2011	26.5	83.3	21.2	78.5	89.5	3.70	4.22	1.14
2012	26.1	96.5	21.3	92.4	102.6	4.34	4.82	1.11
2013	27.3	92.6	22.7	88.4	96.4	3.89	4.24	1.09
2014	29.8	87.3	23.9	82.8	89.4	3.46	3.74	1.08
2015	34.4	102.4	27.1	94.0	100.6	3.47	3.71	1.07
2016	33.1	110.7	26.3	102.1	106.2	3.88	4.04	1.04
2017	35.6	108.5	28.4	101.0	103.0	3.56	3.63	1.02
2018	33.5	109.2	26.8	102.3	102.3	3.82	3.82	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 145.

Year	Bigeye ($million)	Yellowfin ($million)	Swordfish ($million)	All others ($million)	Bigeye ($million)	Yellowfin ($million)	Swordfish ($million)	All others ($million)	CPI Adjustor
2009	38.5	3.0	7.8	9.7	46.4	3.6	9.4	11.7	1.204
2010	48.6	3.9	8.9	10.6	57.4	4.6	10.6	12.5	1.180
2011	53.4	6.3	9.3	14.4	60.7	7.1	10.5	16.4	1.137
2012	62.2	7.7	9.0	17.5	69.1	8.6	10.1	19.4	1.111
2013	63.0	6.8	8.6	14.2	68.7	7.4	9.4	15.5	1.091
2014	60.3	5.4	7.8	13.9	64.9	5.8	8.4	14.9	1.076
2015	73.2	5.9	8.2	15.1	78.0	6.2	8.8	16.1	1.065
2016	75.6	9.5	7.1	18.4	79.0	10	7.4	19.2	1.044
2017	67.7	15.9	8.5	16.4	69.0	16.2	8.6	16.7	1.019
2018	69.4	19.8	4.8	15.2	69.4	19.8	4.8	15.2	1.000

Table A-125. Supporting Data for Figure 146.

	Bigeye price	Bigeye price adj.	Yellowfin price	Yellowfin price adj.	Swordfish price	Swordfish price adj.	CPI Adjustor
2009	3.75	4.52	2.85	3.43	1.95	2.35	1.204
2010	4.08	4.82	3.21	3.79	2.43	2.86	1.180
2011	4.26	4.84	3.03	3.44	2.63	3.00	1.137
2012	4.82	5.35	3.96	4.40	2.89	3.21	1.111
2013	4.43	4.83	4.25	4.64	3.07	3.35	1.091
2014	3.85	4.14	3.77	4.06	2.12	2.29	1.076
2015	3.85	4.10	2.99	3.18	2.46	2.62	1.065
2016	4.18	4.37	2.93	3.05	2.96	3.09	1.044
2017	3.86	3.93	2.79	2.84	2.38	2.42	1.019
2018	4.20	4.20	3.63	3.63	2.09	2.09	1

Data source: Pacific Islands Fisheries Science Center pelagic module data request.

Table A-126. Supporting Data for Figure 149.

Year	Fuel Cost ($)	Other Costs ($)	Fuel Cost adjusted ($)	Other costs adjusted	STD	CPI Adjustor
2009	10,455	10,602	12,598	12,776	6,683	1.205
2010	12,494	10,709	14,743	12,637	8,537	1.180
2011	16,378	11,719	18,621	13,325	9,792	1.137
2012	17,506	12,476	19,449	13,860	10,040	1.111
2013	16,498	12,765	17,999	13,927	11,231	1.091
2014	16,654	13,096	17,920	14,091	9,342	1.076
2015	12,425	13,456	13,232	14,331	7,928	1.065
2016	10,768	13,474	11,242	14,067	6,622	1.044
2017	10,562	13,001	10,763	13,248	8,567	1.019
2018	12,676	11,529	12,676	11,529	6,887	1

Data Source: Pan (2018 in review).

Table A-127. Supporting Data for Figure 150.

Year	Fuel Cost ($)	Other Costs ($)	Fuel Cost adjusted ($)	Other costs adjusted ($)	STD	CPI Adjustor
2009	18,508	19,109	22,302	23,027	10,393	1.205
2010	23,362	18,392	27,567	21,703	14,144	1.180
2011	35,527	20,981	40,394	23,855	13,775	1.137
2012	35,251	22,352	39,163	24,833	12,726	1.111
2013	28,820	20,919	31,443	22,823	12,213	1.091
2014	29,822	22,008	32,088	23,681	18,120	1.076
2015	20,725	21,241	22,072	22,622	10,710	1.065
2016	17,131	22,780	17,885	23,782	11,271	1.044
2017	17,259	20,325	17,587	20,711	10,920	1.019
2018	21,915	21,893	21,915	21,893	12,978	1

Data Source: Pan (2018 in review).

Table A-128. Supporting Data for Figure 151.

Year	Trip costs ($)	Trip costs adjusted ($)	Trip revenue ($)	Revenue adjusted ($)	Net revenue adjusted ($)	CPI Adjustor
2009	21,057	25,374	43,216	52,075	26,702	1.205
2010	23,204	27,380	56,194	66,309	38,928	1.180
2011	28,097	31,946	58,598	66,626	34,680	1.137
2012	29,981	33,309	68,629	76,247	42,937	1.111
2013	29,264	31,927	64,547	70,420	38,494	1.091
2014	29,750	32,011	61,565	66,244	34,233	1.076
2015	25,881	27,563	67,022	71,379	43,816	1.065
2016	24,242	25,308	77,368	80,772	55,464	1.044
2017	23,687	24,138	67,065	68,339	44,201	1.019
2018	25,329	25,329	68,345	68,345	43,016	1.000

Data Source: Pan (2018 in review).

Table A-129. Supporting Data for Figure 152.

Year	Trip costs ($)	Trip costs adjusted ($)	Trip revenue ($)	Revenue adjusted ($)	Net revenue adjusted ($)	CPI Adjustor
2009	37,617	45,329	69,182	83,364	38,035	1.205
2010	41,754	49,270	72,601	85,669	36,399	1.180
2011	56,508	64,250	103,466	117,641	53,391	1.137
2012	57,602	63,996	102,568	113,953	49,957	1.111
2013	49,739	54,265	106,305	115,979	61,713	1.091
2014	51,829	55,769	86,970	93,580	37,811	1.076
2015	41,966	44,694	78,048	83,121	38,427	1.065
2016	39,912	41,668	112,978	117,949	76,281	1.044
2017	37,584	38,298	108,788	110,855	72,557	1.019
2018	43,390	43,390	109,863	109,863	66,473	1

Data Source: Pan (2018 in review).

Table A-130. Supporting Data for Figures 153 and 154.

Year	Revenue per-day-at-sea ($)	Revenue per-day-at-sea adjusted ($)	Annual revenue per vessel ($)	Annual revenue per vessel adjusted ($)	Gini coefficient	CPI adjustor
2009	1,866	2,239	465,330	558,396	0.23	1.20
2010	2,287	2,699	581,612	686,302	0.22	1.18
2011	2,652	3,023	645,946	736,378	0.22	1.14
2012	2,943	3,267	748,340	830,657	0.19	1.11
2013	2,791	3,042	685,657	747,366	0.22	1.09
2014	2,624	2,834	623,657	673,550	0.23	1.08
2015	3,055	3,269	726,503	777,358	0.22	1.07
2016	3,269	3,400	784,913	816,310	0.21	1.04
2017	3,147	3,210	753,347	768,414	0.20	1.02
2018	3,080	3,080	755,167	755,167	0.20	1

Table A-131. Supporting Data for Figure 155.

Year	MHI troll	MHI handline	Offshore handline	Other gears
2009	2,032	801	221	115
2010	1,987	738	538	203
2011	2,006	840	462	190
2012	2,618	1,322	476	258
2013	2,386	1,079	748	274
2014	2,719	983	327	109
2015	2,391	1,007	329	123
2016	2,128	714	352	62
2017	1,802	859	294	63
2018	2,255	690	327	89

Table A-132. Supporting Data for Figures 156, 159, 160, 161, and 162.

Year	MHI troll	MHI handline	Offshore handline	Other gears	MHI handline adjusted	MHI troll adjusted	Offshore handline adjusted	Other gears adjusted	CPI adjustor
2009	6,027	2,055	506	288	7,232	2,466	607	346	1.200
2010	6,453	2,210	1,406	552	7,615	2,608	1,659	651	1.18
2011	6,862	2,488	1,330	571	7,823	2,836	1,516	651	1.14
2012	10,005	3,903	1,608	891	11,106	4,332	1,785	989	1.11
2013	8,065	3,530	1,991	760	8,791	3,848	2,170	828	1.09
2014	9,006	3,192	893	323	9,726	3,447	964	349	1.08
2015	8,228	3,118	847	356	8,804	3,336	906	381	1.07
2016	7,861	2,479	965	191	8,175	2,578	1,004	199	1.04
2017	6,501	2,948	912	217	6,631	3,007	930	221	1.02
2018	8,171	2,493	1,055	319	8,171	2,493	1,055	319	1

Table A-133. Supporting Data for Figures 157, 159, 160, 161, and 162.

Year	MHI handline	MHI troll	Offshore handline	Other gears	MHI handline adjusted	MHI troll adjusted	Offshore handline adjusted	Other gears adjusted	CPI adjustor
2009	2.57	2.97	2.29	2.50	3.08	3.56	2.75	3.00	1.20
2010	2.99	3.25	2.61	2.72	3.53	3.84	3.08	3.21	1.18
2011	2.96	3.42	2.88	3.01	3.37	3.90	3.28	3.43	1.14
2012	2.95	3.82	3.38	3.45	3.27	4.24	3.75	3.83	1.11
2013	3.27	3.38	2.66	2.77	3.56	3.68	2.90	3.02	1.09
2014	3.25	3.31	2.73	2.96	3.51	3.57	2.95	3.20	1.08
2015	3.10	3.44	2.57	2.89	3.32	3.68	2.75	3.09	1.07
2016	3.47	3.69	2.74	3.08	3.61	3.84	2.85	3.20	1.04
2017	3.43	3.61	3.10	3.44	3.50	3.68	3.16	3.51	1.02
2018	3.61	3.62	3.23	3.58	3.61	3.62	3.23	3.58	1

Data source for Tables 131, 132, 133: PIFSC & HDAR.

Table A-134. Hawaii small boat trip costs: pelagic fishing trips, 2014.

Cost Category	Troll		Pelagic Handline	
	$ per trip	% of total trip cost	$ per trip	% of total trip cost
Fuel	179.00	61%	148.66	52%
Non-fuel	112.67	39%	163.08	48%
Total cost	291.67	100%	283.72	100%

Source: PIFSC Hawaii small-boat cost-earnings data, 2014 at https://inport.nmfs.noaa.gov/inport/item/29820.

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 Hawai`i 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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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
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 Hawai`i and low level nesting on Maui and Hawai`i Islands. Occur worldwide in tropical and subtropical waters.	35 FR 8491, NMFS & USFWS 2007, Balazs et al. 1992, Katahira et al. 1994

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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 caretta*	Endangered (North Pacific DPS)	N/A	Rare in Hawai`i. 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 Hawai`i. 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 Hawai`i. 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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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
Fin Whale	*Balaenoptera physalus*	Endangered	Strategic	Infrequent sightings in Hawai`i waters. Considered rare in Hawai`i, 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 (Hawai`i 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 Hawai`i. 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 Hawai`i.	Dalebout 2003, Baird et al. 2013

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Melon-Headed Whale	*Peponocephala electra*	Not Listed	Non-strategic	Found in tropical and warm-temperate waters worldwide, found primarily in equatorial waters. Uncommon in Hawai`i.	Perryman et al. 1994, Barlow 2006, Bradford et al. 2013
Minke Whale	*Balaenoptera acutorostrata*	Not Listed	Non-strategic	Occur seasonally around Hawai`i	Barlow 2003, Rankin & Barlow 2005
North Pacific Right Whale	*Eubalaena japonica*	Endangered[a]	Strategic	Extremely rare in Hawai`i waters	35 FR 18319, 73 FR 12024, Rowntree et al. 1980, Herman et al. 1980
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 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 Hawai`i 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 Hawai`i.	Perrin et al. 2009, Baird et al. 2013, Barlow 2006, Bradford et al. 2013
Sei Whale	*Balaenoptera borealis*	Endangered	Strategic	Rare in Hawai`i. Generally found in offshore temperate waters.	35 FR 18319, Barlow 2003, Bradford et al. 2013

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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
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					

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
N/A	*Acropora globiceps*	Threatened	N/A	Not confirmed in Hawai`i 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 Hawai`i 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
N/A	*Acropora retusa*	Threatened	N/A	Not confirmed in Hawai`i 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 Hawai`i 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 Hawai`i 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 Hawai`i 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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
N/A	*Seriatopora aculeata*	Threatened	N/A	Not confirmed in Hawai`i 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 Hawai`i 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*	Not Listed	N/A	Breeding visitor	Pyle & Pyle

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
	nativitatis				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
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 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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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 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 Hawai`i and low level nesting on Maui and Hawai`i 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 Hawai`i. 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 Hawai`i. 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 Hawai`i. 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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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
Fin Whale	*Balaenoptera physalus*	Endangered	Strategic	Infrequent sightings in Hawai`i waters. Considered rare in Hawai`i, 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 (Hawai`i 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 Hawai`i. 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 Hawai`i.	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 Hawai`i.	Perryman et al. 1994, Barlow 2006, Bradford et al. 2013
Minke Whale	*Balaenoptera acutorostrata*	Not Listed	Non-strategic	Occur seasonally around Hawai`i	Barlow 2003, Rankin & Barlow 2005

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
North Pacific Right Whale	*Eubalaena japonica*	Endangered[a]	Strategic	Extremely rare in Hawai`i waters	35 FR 18319, 73 FR 12024, Rowntree et al. 1980, Herman et al. 1980
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 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 Hawai`i 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 Hawai`i.	Perrin et al. 2009, Bradford et al. 2013, Barlow 2006, Baird et al. 2013
Sei Whale	*Balaenoptera borealis*	Endangered	Strategic	Rare in Hawai`i. 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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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
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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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
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					

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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					
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 sula*	Not Listed	N/A	Resident	Craig 2005
Red-Tailed Tropicbird	*Phaethon rubricauda*	Not Listed	N/A	Resident	Craig 2005

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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
Laysan Albatross	*Phoebastria immutabilis*	Not Listed	N/A	Breed mainly in Hawai`i, 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 Hawai`i, 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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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
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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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,, Guarrige 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
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 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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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
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					

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
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
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.

REFERENCES

Andrews, K.R., Karczmarski, L., Au, W.W.L., Rickards, S.H., Vanderlip, C.A., Bowen, B.W., Grau, E.G., and Toonen, R.J., 2010. Rolling stones and stable homes: social structure, habitat diversity and population genetics of the Hawaiian spinner dolphin (*Stenella longirostris*). *Molecular Ecology*, *19*, pp. 732-748.

Awkerman, J.A., Anderson, D.J., and Whittow, G.C., 2009. Laysan Albatross (*Phoebastria immutabilis*). *In*: Rodewald, P.G. [ed.]. The Birds of North America. Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America at https://birdsna.org/Species-Account/bna/species/layalb.

Backus, R.H., Springer, S., and Arnold, E.L., 1956. A contribution to the natural history of the white tip shark, *Pferdumiops kmgimunus* (Poey). *Deep-Sea Research*, *3*, pp. 178-188.

Baird, R.W., McSweeney, D.J., Bane, C., Barlow, J., Salden, D.R., Antoine, L.R.K., LeDuc, R.G. and Webster, D.L., 2006. Killer Whales in Hawaiian Waters: Information on Population Identity and Feeding Habits. *Pacific Science*, *60*(4), pp. 523-530.

Baird, R.W., Gorgone, A.M., McSweeney, D.J., Ligon, A.D., Deakos, M.H., Webster, D.L., Schorr, G.S., Martien, K.K., Salden, D.R., and Mahaffy, S.D., 2009. Population structure of island-associated dolphins: Evidence from photo-identification of common bottlenose dolphins (*Tursiops truncatus*) in the main Hawaiian Islands. *Marine Mammal Science*, *25*, pp. 251-274.

Baird, R.W., Webster, D.L., Aschettino, J.M., Schorr, G.S. and McSweeney, D.J., 2013. Odontocete cetaceans around the main Hawaiian Islands: Habitat use and relative abundance from small-boat sighting surveys. *Aquatic Mammals*, *39*(3), 253 pp.

Baker J.D., Harting, A.L., Wurth, T.A., and Johanos, T.C., 2011. Dramatic shifts in Hawaiian monk seal distribution predicted from divergent regional trends. *Marine Mammal Science*, *27*(1), pp. 78–93.

Balazs, G.H. 1979. Loggerhead turtle recovered from a tiger shark at Kure Atoll. *'Elepaio*, *39*(12), pp. 45-47.

Balazs, G.H 1982. Status of sea turtles in the central Pacific Ocean. *In:* Bjorndal, K.A. [ed.]. Biology and Conservation of Sea Turtles. *Smithsonian Institution Scholarly Press*, Washington, D.C., 583 pp.

Balazs, G.H., Craig, P., Winton, B.R. and Miya, R.K., 1994. Satellite telemetry of green turtles nesting at French Frigate Shoals, Hawaii, and Rose Atoll, American Samoa. *In:* Bjorndal, K.A., Bolten, A.B., Johnson, D.A., and Eliazar, P.J. [eds.]. Proceedings of the fourteenth annual symposium on sea turtle biology and conservation.

Balazs, G.H., Hirth, H., Kawamoto, P., Nitta, E., Ogren, L., Wass, R., and Wetherall, J., 1992. Interim Recovery Plan for Hawaiian Sea Turtles. Honolulu Lab, Southwest Fisheries

Science Center, National Marine Fisheries Service, NOAA, Honolulu, HI 96822-2396. Southwest Fisheries Science Center Administrative Report H-92-01. 76 pp.

Barlow, J., 2003. Preliminary Estimates of the Abundance of Cetaceans along the U.S. West Coast, 1991-2001. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center.

Barlow, J., 2006. Cetacean abundance in Hawaiian waters estimated from a summer/fall survey in 2002. *Marine Mammal Science*, *22*(2), pp. 446-464.

Baum, J., Clarke, S., Domingo, A., Ducrocq, M., Lamónaca, A.F., Gaibor, N., Graham, R., Jorgensen, S., Kotas, J.E., Medina, E., Martinez-Ortiz, J., Monzini Taccone di Sitizano, J., Morales, M.R., Navarro, S.S., Pérez-Jiménez, J.C., Ruiz, C., Smith, W., Valenti, S.V. and Vooren, C.M., 2007. *Sphyrna lewini*. The IUCN Red List of Threatened Species 2007: e.T39385A10190088. Downloaded on 21 Feb 2017.

Baum, J.K., Medina, E., Musick, J.A., and Smale, M., 2006. *Carcharhinus longimanus*. *In*: IUCN 2007. 2007 IUCN Red List of Threatened Species.

Bester, C., 2011. Species Profile: Scalloped Hammerhead. Florida Museum of Natural History. http://www.flmnh.ufl.edu/fish/Gallery/Descript/Schammer/ScallopedHammerhead.html.

BirdLife International, 2017. Species factsheet: *Phoebastria albatrus*. Downloaded from http://www.birdlife.org on 02/04/2017.

Bonfil, R., Clarke, S., Nakano, H., Camhi, M.D., Pikitch, E.K. and Babcock, E.A., 2008. The biology and ecology of the oceanic whitetip shark, *Carcharhinus longimanus*. *In*: Camhi, M.D., Pikitch, E.K., and Babcock, E.A. [eds.]. Sharks of the Open Ocean: Biology, Fisheries, and Conservation, pp.128-139.

Bradford, A.L., Oleson, E.M., Baird, R.W., Boggs, C.H., Forney, K.A., and Young, N.C., 2015. Revised stock boundaries for false killer whales (*Pseudorca crassidens*) in Hawaiian waters. NOAA Tech. Memo. NMFS-PIFSC-47.

Bradford. A.L., K.A. Forney, E.M. Oleson, and J. Barlow. 2013. Line-transect abundance estimates of cetaceans in the Hawaiian EEZ. PIFSC Working Paper WP-13-004.

Brownell, J. R. L., W. A. Walker, and K. A. Forney. 1999. Pacific white-sided dolphin, *Lagenorhynchus obliquidens* Gill, 1865. *In*: Ridgeway, S.H., and Harrison, R. [eds.]. Handbook of marine mammals: the second book of dolphins and the porpoises. *Academic Press*, San Diego, CA.

Brueggeman, J.J., Green, G.A., Balcomb, K.C., Bowlby, C.E., Grotefendt, R.A., Briggs, K.T., Bonnell, M.L., Ford, R.G., Varoujean, D.H., Heinemann, D.and Chapman D.G., 1990. Oregon-Washington Marine Mammal and Seabird Survey: Information synthesis and hypothesis formulation. U.S. Department of the Interior, OCS Study MMS 89-0030.

Caldwell, D.K. and Caldwell, M.C., 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville, 1838)/dwarf sperm whale *Kogia simus* (Owen, 1866). Handbook of marine mammals, *4*, pp. 235-260.

Childerhouse, S., J. Jackson, C. S. Baker, N. Gales, P. J. Clapham, and R. L. Brownell, Jr., 2008. *Megaptera novaeangliae*, Oceania subpopulation. IUCN Red List of Threatened Species http://www.iucnredlist.org/details/132832.

CITES (2016) Consideration of proposals for amendment of Appendices I and II: Nautilidae Convention on International Trade in Endangered Species of Wild Fauna and Flora; Seventeenth meeting of the Conference of the Parties; 24 September – 5 October 2016, Johannesburg, South Africa

Cliffton, K., Cornejo, D.O., and Felger, R.S., 1982. Sea turtles of the Pacific coast of Mexico. *In:* Bjorndal, K.A. [ed.]. Biology and Conservation of Sea Turtles. Smithsonian Inst. Press, Washington, D.C., 583 pp.

Compagno, L.J.V., 1984. FAO Species Catalogue. Vol. 4. Sharks of the World. An Annotated and Illustrated Catalogue of Shark Species Known to Date. Carcharhiniformes. FAO Fish Synop 124, Vol. 4, Part 2.

Craig, P., 2005. Natural history guide to American Samoa. National Park of American Samoa, Department of Marine and Wildlife Resources, American Samoa Community College.

Dalebout, M.L., Baker, C.S., Anderson, R.C., Best, P.B., Cockcroft, V.G., Hinsz, H.L., Peddemors, V. and Pitman, R.L., 2003. Appearance, distribution, and genetic distinctiveness of Longman's beaked whale, *Indopacetus pacificus*. *Marine Mammal Science*, *19*(3), pp. 421-461.

Dewar, H., Mous, P., Domeier, M., Muljadi, A., Pet, J., and Whitty, J., 2008. Movements and site fidelity of the giant manta ray, *Manta birostris*, in the Komodo Marine Park, Indonesia. *Marine Biology*, *155*, pp. 121-133.

Dodd, C.K., 1990. *Caretta caretta* (Linnaeus) Loggerhead Sea Turtle. Catalogue of American *Amphibians and Reptiles*, pp. 483.1-483.7.

Eckert, K.L., B.P. Wallace, J.G. Frazier, S.A. Eckert, and P.C.H. Pritchard. 2012. Synopsis of the biological data on the leatherback sea turtle (*Dermochelys coriacea*). U.S. Department of Interior, Fish and Wildlife Service, Biological Technical Publication BTP-R4015-2012, Washington, D.C.

Fleischer, L.A., 1987. Guadalupe fur seal, *Arctocephalus townsendi*. *In*: Croxall, J.P. and Gentry R.L. [eds.]. Status, biology, and ecology of fur seals. National Oceanic and Atmospheric Association, Technical Report, National Marine Fisheries Service 51, pp. 1-212.

Gallo-Reynoso, J.P., Figueroa-Carranza, A.L. and Le Boeuf, B.J., 2008. Foraging behavior of lactating Guadalupe fur seal females. *In*: Lorenzo, C., Espinoza, E., and Ortega, J. [eds.].

Avances en el Estudio de los Mamíferos de México. *Publicaciones Especiales*, *2*, pp. 595-614.

Garrigue, C., Franklin, T., Russell, K., Burns, D., Poole, M., Paton, D., Hauser, N., Oremus, M., Constantine, R., Childerhouse, S., Mattila, D., Gibbs, N., Franklin, W., Robbins, J., Clapham, P., and Baker, C.S., 2007. First assessment of interchange of humpback whales between Oceania and the east coast of Australia. International Whaling Commission, Anchorage, Alaska. SC/59/SH15.

Gelatt, T., Ream, R., and Johnson, D., 2015. *Callorhinus ursinus*. The IUCN Red List of Threatened Species 2015:e.T3590A45224953. Available at http://www.iucnredlist.org/details/3590/0.

Grant, G.S. 1994. Juvenile leatherback turtle caught by longline fishing in American Samoa. *Marine Turtle Newsletter*, *66*, pp. 3-5.

Hall, J., 1979. A survey of cetaceans of Prince William Sound and adjacent waters - their numbers and seasonal movements. Unpubl. rep. to Alaska Outer Continental Shelf Environmental Assessment Programs. NOAA OCSEAP Juneau Project Office, Juneau, AK. 37 pp.

Hamilton, T.A., Redfern, J.V., Barlow, J., Balance, L.T., Gerrodette, T., Holt, R.S., Forney, K.A., and Taylor, B.L., 2009. Atlas of cetacean sightings for Southwest Fisheries Science Center Cetacean and Ecosystem Surveys: 1986-2005. U.S. Dep. of Commerce, NOAA Technical Memorandum, NOAA-TM-NMFSSWFSC-440. 70 pp.

Herman, L.M. and Antinoja, R.C., 1977. Humpback whales in the Hawaiian breeding waters: Population and pod characteristics. *Scientific Reports of the Whales Research Institute*, *29*, pp. 59-85.

Herman, L. M., C. S. Baker, P. H. Forestell, and R. C. Antinoja. 1980. Right whale, *Balaena glacialis*, sightings near Hawaii: a clue to the wintering grounds? *Marine Ecology Progress Series*, 2, pp. 271-275.

Heyning, J.E. 1989. Cuvier's beaked whale, *Ziphius cavirostris* (Cuvier, 1823). pp. 289-308. *In*: S.H. Ridgway and R. Harrison (eds.) Handbook of Marine Mammals. Vol. 4. River Dolphins and the Larger Toothed Whales. *Academic Press*, London and San Diego. 442 pp.

Hill, M.C., Oleson, E.M., and Andrews, K.R., 2010. New island-associated stocks for Hawaiian spinner dolphins (*Stenella longirostris longirostris*): Rationale and new stock boundaries. Pacific Islands Fisheries Science Center Admin Report H-10-04, 12 pp.

Johnston, D.W., Robbins, J., Chapla, M.E., Mattila, D.K. and Andrews, K.R., 2008. Diversity, Johnston, D.W., Robbins, J., Chapla, M.E., Mattila, D.K. and Andrews, K.R., 2008. Diversity, habitat associations and stock structure of odontocete cetaceans in the waters of American Samoa, 2003-2006. *Journal of Cetacean Research and Management*, *10*(1), pp. 59-66.

Karczmarski, L., Würsig, B., Gailey, G., Larson, K.W., and Vanderlip, C., 2005. Spinner dolphins in a remote Hawaiian atoll: social grouping and population structure. *Behavioral Ecology*, *16*, pp. 675-685.

Karl, S.A. and Bowen, B.W., 1999. Evolutionary significant units versus geopolitical taxonomy: molecular systematics of an endangered sea turtle (genus *Chelonia*). *Conservation Biology*, *13*, pp. 990–999.

Katahira, L.K., C.M. Forbes, A.H. Kikuta, G.H. Balazs, and M. Bingham. 1994. Recent findings and management of hawksbill turtle nesting beaches in Hawaii. *In:* Bjorndal, K.A, Bolton, A.B., Johnson, D.A., and Eliazar, P.J. [eds.], Proc. of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-351, 323 pp.

Klimley, A.P., 1993. Highly directional swimming by scalloped hammerhead sharks, *Sphyrna lewini*, and subsurface irradiance, temperature, bathymetry, and geomagnetic field. *Marine Biology*, *117*(1), pp. 1-22.

Kolinski, S.P., Parker, D.M., Ilo, L.I., and Ruak, J.K, 2001. An assessment of sea turtles and their marine and terrestrial habitats at Saipan, Commonwealth of the Northern Mariana Islands. *Micronesica*, 34, pp. 55-72.

Le Boeuf, B.J., Crocker, D.E., Costa, D.P., Blackwell, S.B., Webb, P.M. and Houser, D.S. 2000. Foraging ecology of northern elephant seals. *Ecological Monographs*, *70*(3), pp. 353-382.

Lee, T. 1993. Summary of cetacean survey data collected between the years of 1974 and 1985. NOAA Tech.Mem. NMFS 181, 184 pp.

Leatherwood, J.S. and Dahlheim, M.E., 1978. Worldwide distribution of pilot whales and killer whales. Naval Ocean System Center Technical Report 443, pp. 1-39.

Leatherwood, S., Reeves, R.R., Perrin, W.F., and Evans, W.E. 1982. Whales, dolphins, and porpoises of the North Pacific and adjacent arctic waters. NOAA Tech. Rep. NMFS Circ. No. 444.

Mallory M.L., Hatch, S.A., and Nettleship, D.N. 2012. Northern Fulmar (*Fulmarus glacialis*). *In*: Rodewald, P.G. [ed.]. The Birds of North America. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America at https://birdsna.org/Species-Account/bna/species/norful.

Marshall, A., L.J.V. Compagno, and M.B. Bennett. 2009. Redescription of the genus Manta with resurrection of *Manta alfredi* (Krefft, 1868) (Chondrichthyes; Myliobatoidei; Mobulidae). *Zootaxa*, *2301*, pp. 1-28.

Marshall, A., Bennett, M.B., Kodja, G., Hinojosa-Alvarez, S., Galvan-Magana, F., Harding, M., Stevens, G., and Kashiwagi, T., 2011. *Manta birostris*. The IUCN Red List of Threatened Species 2011: e.T198921A9108067.

Martien, K.K., Baird, R.W., Hedrick, N.M., Gorgone, A.M., Thieleking, J.L., McSweeney, D.J., Robertson, K.M. and Webster, D.L. 2012. Population structure of island-associated dolphins: Evidence from mitochondrial and microsatellite markers for common bottlenose dolphins (*Tursiops truncatus*) around the main Hawaiian Islands. *Marine Mammal Science*, 25(3), pp. 208-232.

McSweeney, D.J., Baird, R.W., and Mahaffy, S.D., 2007. Site fidelity, associations and movements of Cuvier's (*Ziphius cavirostris*) and Blainville's (*Mesoplodon densirostris*) beaked whales off the island of Hawai'i. *Marine Mammal Science*, 23, pp. 666-687.

McSweeney, D.J., Baird, R.W., Mahaffy, S.D., Webster, D.L., and Schorr, G.S. 2009. Site fidelity and association patterns of a rare species: Pygmy killer whales (*Feresa attenuata*) in the main Hawaiian Islands. *Marine Mammal Science*, 25, pp. 557-572.

Mead, J.G., 1989. Beaked whales of the genus *Mesoplodon*. *In*: Ridgeway, S.H. & Harrison, R. [eds.]. Handbook of marine mammals. Volume 4. River dolphins and the larger toothed whales. Academic Press Ltd: London, 452 pp.

Mitchell, E., 1975. Report on the meeting on smaller cetaceans, Montreal, April 1-11, 1974. *Journal of the Fisheries Research Board of Canada*, *32*(7), pp. 914-916

Mobley, J.R. Jr., Spitz, S.S., Forney, K.A., Grotenfendt, R., and Forestell, P.H., 2000. Distribution and abundance of odontocete species in Hawaiian waters: preliminary results of 1993-98 aerial surveys. Southwest Fisheries Science Center Administrative Report LJ-00–14C. La Jolla, CA 92037. 26 pp.

Nagorsen, D., 1985. *Kogia simus*. *Mammalian Species*, *239*, pp. 1-6.

NMFS and USFWS, 1998. Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle (*Dermochelys coriacea*). National Marine Fisheries Service, Silver Spring, MD. 77 pp.

NMFS and USFWS, 2007. Hawksbill Sea Turtle (*Eretmochelys imbricata*) 5-Year Review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, Maryland, and U.S. Fish and Wildlife Service Jacksonville, Florida. 90 pp.

Norris, K.S. and Dohl, T.P., 1980. Behavior of the Hawaiian spinner dolphin, *Stenella longirostris*. *Fisheries Bulletin*, *77*, pp. 821-849.

Norris, K.S., B. Würsig, B., Wells, R.S., and Würsig, M., 1994. The Hawaiian Spinner Dolphin. *University of California Press,* 408 pp.

Northrop, J., Cummings, W.C., and Morrison, M.F. 1971. Underwater 20-Hz signals recorded near Midway Island. *Journal of the Acoustical Society of America*, 49, pp. 1909-1910.

Oleson, E.M., Boggs, C.H., Forney, K.A., Hanson, M.B., Kobayashi, D.R., Taylor, B.L., Wade, P.R., and Ylitalo, G.M., 2010. Status Review of Hawaiian Insular False Killer Whales (*Pseudorca crassidens*) under the Endangered Species Act. U.S. Dep. Commer. NOAA Tech Memo., NOAA-TM-NMFS-PIFSC-22. 140 pp.

Oleson, E.M., Baird, R.W., Martien, K.K., and Taylor, B.L., 2013. Island-associated stocks of odontocetes in the main Hawaiian Islands: A synthesis of available information to facilitate evaluation of stock structure. PIFSC Working Paper WP-13-003. 41 pp.

Olson, P.A., Ensor, P., Olavarria, C., Bott, N., Constantine, R., Weir, J., Childerhouse, S., van der Linde, M., Schmitt, N., Miller, B.S. and Double, M.C., 2015. New Zealand Blue Whales: Residency, Morphology, and Feeding Behavior of a Little-Known Population. *Pacific Science*, *69*(4), pp. 477-485.

Perrin, W.F., Wursig, B., and Thewissen J.G.M. [eds.], 2009. Encyclopedia of marine mammals. *Academic Press*.

Perryman, W.L., Au, D.W.K., Leatherwood, S., and Jefferson, T.A., 1994. Melon-headed whale *Peponocephala electra* Gray, 1846. *In*: Ridgway, S.H. and Harrison, R. [eds.]. Handbook of Marine Mammals, Volume 5. The first book of dolphins. *Academic Press*, London, U.K.

Pitman, R.L. 1990. Pelagic distribution and biology of sea turtles in the eastern tropical Pacific. *In*: Richardson, T.H., Richardson, J.I., and Donnelly, M. [eds.]. Proc. of the Tenth Annual Workshop on Sea Turtle Biology and Conservation. U.S. Dep. of Comm., NOAA Tech. Memo. NMFS-SEFC-278. 286 pp.

Pyle, R.L., and Pyle, P., 2009. The Birds of the Hawaiian Islands: Occurrence, History, Distribution, and Status. B.P. Bishop Museum, Honolulu, Hawaii. Version 1 (31 December 2009). Accessed from http://hbs.bishopmuseum.org/birds/rlp-monograph.

Rankin, S. and Barlow, J., 2005. Source of the North Pacific "boing" sound attributed to minke whales. *Journal of the Acoustical Society of America*, *118*(5), pp. 3346-3335

Reeves, R.R., Leatherwood, S., Stone, G.S., and Eldredge, L.G., 1999. Marine Mammals in the Area Served by the South Pacific Regional Environment Program. Report of the South Pacific Regional Environment Program (P.O. Box 240, Apia, Samoa). 48 pp.

Reeves, R.R., Leatherwood, S., and Baird, R.W., 2009. Evidence of a possible decline since 1989 in false killer whales (*Pseudorca crassidens*) around the main Hawaiian Islands. *Pacific Science*, *63*(2), pp. 253–261.

Rice, D.W., 1960. Distribution of the bottle-nosed dolphin in the leeward Hawaiian Islands. *Journal of Mammalogy*, *41*(3), pp. 407-408.

Rice, D. W., and A. A. Wolman. 1984. Humpback whale census in Hawaiian waters—February 1977. *In:* Norris, K.S., and Reeves, R.R. (eds.). Report on a workshop on problems related to humpback whales (*Megaptera novaeangliae*) in Hawaii. Final report to the Marine Mammal Commission, U.S. Department of Commerce, NTIS PB-280-794.

Ross, G.J.B. and Leatherwood, S., 1994. Pygmy killer whale *Feresa attenuata* (Gray, 1874). Handbook of Marine Mammals, Volume 5, pp. 387-404.

Rowntree, V., Darling, J., Silber, G., and M. Ferrari, M., 1980. Rare sighting of a right whale (*Eubalaena glacialis*) in Hawaii. *Canadian Journal of Zoology*, *58*, pp. 308-312.

Sanches, J.G., 1991. Catálogo dos principais peixes marinhos da República de Guiné-Bissau. Publicações avulsas do I.N.I.P. No. 16. 429 pp. as cited in Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 pp.

Schorr, G.S., Baird, R.W., Hanson, M.B., Webster, D.L., McSweeney, D.J., and Andrews, R.D., 2009. Movements of satellite-tagged Blainville's beaked whales off the island of Hawai'i. *Endangered Species Research*, *10*, pp. 203-213.

Schulze-Haugen, M. and Kohler, N.E. [eds.], 2003. Guide to Sharks, Tunas, & Billfishes of the U.S. Atlantic and Gulf of Mexico. RI Sea Grant/National Marine Fisheries Service.

Shallenberger, E.W., 1981. The status of Hawaiian cetaceans. Marine Mammal Commission Report No. MMC–77/23 (NTIS PB82–109398).

Stafford, K.M., Nieukirk, S.L., and Fox, C.G., 2001. Geographic and seasonal variation of blue whale calls in the North Pacific. *Journal of Cetacean Research and Management*, *3*, pp. 65-76.

Strasburg, D.W., 1958. Distribution, abundance, and habits of pelagic sharks in the central Pacific Ocean. *Fishery Bulletin*, *138*(58), pp. 335-361.

Thompson, P.O., and Friedl, W.A., 1982. A long-term study of low frequency sounds from several species of whales off Oahu, Hawaii. *Cetology*, *45*, pp. 1-19.

Tuato'o-Bartley, N., Morrell, T.E., and Craig, P., 1993. Status of sea turtles in American Samoa in 1991. *Pacific Science*, *47*(3), pp. 215-221.

Utzurrum, R., 2002. Sea turtle conservation in American Samoa. *In:* Kinan, I. [ed.]. Proceedings of the western Pacific sea turtle cooperative research and management workshop.

Veron, J.E.N., 2014. Results of an update of the Corals of the World Information Base for the Listing Determination of 66 Coral Species under the Endangered Species Act. Report to the Western Pacific Regional Fishery Management Council, Honolulu, Hawaii.

Wolman, A.A. and Jurasz, C.M., 1977. Humpback whales in Hawaii: Vessel Census, 1976. *Marine Fisheries Review*, *39*(7), pp. 1-5.

APPENDIX C: LIST OF PLAN TEAM MEMBERS

Member; Title	Plan Team Role
Keith Bigelow; NMFS PIFSC	Chair, Pelagics
Paul Bartram; Akala Products Inc.	Pelagics
Russel Ito; NMFS PIFSC	Pelagics
Ashley Tomita; NMFS PIFSC	Pelagics
Kirsten Leong; NMFS PIFSC	Human Dimensions
Minling Pan; NMFS PIFSC	Economics
T. Todd Jones; NMFS PIFSC	Protected Species
Emily Crigler; NMFS PIRO	International Fisheries
Josh Lee; NMFS PIRO	Sustainable Fisheries
Michael Fujimoto; Hawai`i Division of Aquatic Resources	Hawaii
Tepora Lavatai; A.S. Dept. of Marine & Wildlife Resources	American Samoa
William Dunn; CNMI Division of Fish & Wildlife	Marianas
Brent Tibbatts; Guam Division of Aquatic & Wildlife Resources	Guam
Phoebe Woodworth-Jefcoats; NMFS PIFSC	Climate
John Marra; NOAA Climatic Information Services Branch	Climate
Stefanie Dukes, NMFS PIFSC	Ex-Officio
Reginald Kokubun; Hawai`i Division of Aquatic Resources	Ex-Officio