

ANNUAL STOCK ASSESSMENT AND FISHERY EVALUATION REPORT: HAWAII ARCHIPELAGO FISHERY ECOSYSTEM PLAN 2024



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

The ANNUAL STOCK ASSESSMENT AND FISHERY EVALUATION REPORT for the HAWAII ARCHIPELAGO FISHERY ECOSYSTEM PLAN 2024 was drafted by the Fishery Ecosystem Plan Team. This is a collaborative effort primarily between the Western Pacific Regional Fishery Management Council (WPRFMC), National Marine Fisheries Service (NMFS) Pacific Island Fisheries Science Center (PIFSC) and Pacific Islands Regional Office (PIRO), Hawaii Division of Aquatic Resources (HDAR), American Samoa Department of Marine and Wildlife Resources (DMWR), Guam Division of Aquatic and Wildlife Resources (DAWR), and Commonwealth of the Mariana Islands (CNMI) Division of Fish and Wildlife (DFW).

This report attempts to summarize annual fishery performance looking at trends in catch, effort, and catch rates as well as provide a source document describing various projects and activities being undertaken on a local and federal level. The report also describes several ecosystem considerations including fish biomass estimates, biological indicators, protected species, habitat, climate change, and human dimensions. Information like marine spatial planning and the best scientific information available for each fishery are described. This report provides a summary of annual catches relative to the Annual Catch Limits established by the Council in collaboration with the local fishery management agencies.

Cover Image: School of akule (*Selar crumenophthalmus*). Photo by Cassandra Pardee.

A report of the Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1400, Honolulu, HI 96813

Edited by Thomas Remington (Lynker); Cassandra Pardee (Poseidon Fisheries); Joshua DeMello and Asuka Ishizaki (WPRFMC).

© Western Pacific Regional Fishery Management Council 2025.
All rights reserved.

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

ISBN 978-1-950193-55-4

This document can be cited as follows:

WPRFMC, 2025. Annual SAFE Report for the Hawaii Archipelago Fishery Ecosystem Plan 2024. T Remington, C Pardee, J DeMello, A Ishizaki (Eds.). Honolulu: Western Pacific Regional Fishery Management Council.

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

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

NMFS Pacific Islands Fisheries Science Center: Marc Nadon, Felipe Carvalho, Jenny Suter, Eva Schemmel, Kisei Tanaka, Hui Shi, Tye Kindinger, Marlowe Sabater, Robert Ahrens, Hongguang Ma, T. Todd Jones, Minling Pan, Danika Kleiber, Justin Hospital, Adam Ayers, and Kirsten Leong.

NMFS Pacific Islands Regional Office: David O'Brien, Sean Hanser, Irene Kelly, Heather Cronin, Savannah Lewis, and Keith Kamikawa.

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

This page was intentionally left blank.

EXECUTIVE SUMMARY

As part of its five-year fishery ecosystem plan (FEP) review, the Western Pacific Regional Fishery Management Council (WPRFMC; the Council) identified its annual reports as a priority for improvement. The former annual reports have been revised to meet National Standard regulatory requirements for Stock Assessment and Fishery Evaluation (SAFE) reports. The purpose of the reports is twofold: to monitor the performance of the fishery and ecosystem to assess the effectiveness of the FEP in meeting its management objectives; and to maintain the structure of the FEP living document. The reports are comprised of three chapters: Fishery Performance, Ecosystem Considerations, and Data Integration. The Council will iteratively improve the annual SAFE report as resources allow.

The Fishery Performance chapter of this report presents descriptions of Hawaiian commercial fisheries harvesting management unit species (MUS), including Deep-7 bottomfish, uku (*Aprion virescens*), and crustaceans as well as ecosystem component species (ECS). Data for precious coral MUS are not available due to data confidentiality rules associated with the low number of federal permit holders reporting harvest.

In the Fishery Performance chapter, the data collection systems for each fishery are briefly explained. The fishery statistics are organized into summary dashboard tables showcasing the values for the most recent fishing year and the percent change between short-term (10-year) and long-term (20-year) averages. Time series of fishing parameters and species catch by gear type are also provided. Bycatch summaries estimating the amount and type of releases by each fishery are also presented. Additionally, the number of federal permits and available logbook data, status determination criteria, implemented ACLs, best scientific information available, harvest extent and capacity, and administrative and regulatory actions associated with insular fisheries in the Hawaiian Archipelago are included.

For Hawaii fisheries in 2024, none of the MUS had a recent three-year average catch that exceeded their specified ACL, allowable biological catch (ABC) values, annual catch targets (ACT), or overfishing limits (OFL). Data for precious corals and deepwater shrimp were not disclosed due to data confidentiality rules that prohibit the reporting of data from less than three licensed fishers.

In 2024, the Main Hawaiian Islands (MHI) Deep-7 bottomfish fishery was generally characterized by decreasing trends in catch and effort relative to its 10- and 20-year averages (i.e., short- and long-term trends, respectively). The deep-sea handline gear type experienced declines in the number of trips and catch relative to its short- and long-term trends. This decline can likely be attributed to recent challenges associated with weather conditions, increasing shark depredation, declining fisher participation including skilled highliners, and competing fisheries. Catches of most BMUS species by deep-sea handline declined between 20%-50% relative to its 10-year and 20-year averages. The only exception in the declining trend was Lehi (*Aphareus rutilans*; 12,261 lb) catch by deep-sea handline, which had a 50% increase from the short-term average and an increase in 46% from the long-term average.

Non-deep sea handline methods catching Deep-7 bottomfish species are responsible for a much lower portion of catch but did have increases in the Catch and catch-per-unit-effort (CPUE) for all BMUS relative to short-term averages, especially notable for Kalekale (*Pristipomoides sieboldii*; 246 lb) with a 117% increase compared with the long-term trend.

An amendment to the Hawaii Archipelago FEP in early 2019 classified all non-Deep-7 bottomfish except for uku, all former coral reef ecosystem MUS, several crustacean MUS, and all mollusk and limu species as ECS (84 FR 2767, February 8, 2019). Therefore, the non-Deep-7 bottomfish fishery is solely comprised of uku (*Aprion virescens*). Total commercial catch for uku in 2024 (38,012 lb) was an all-time low for the species, over 50% lower than both its 10-year average and 20-year average, likely due to similar factors affecting the Deep-7 bottomfish fishery. In addition to the decrease in uku catch, there was a decrease in the number of licenses, trips, and individuals caught. Breaking down the fishery by gear type, all gears had decreases in catch relative to historical trends; however, CPUE for inshore handline and trolling with bait increased relative to their historical averages.

Species classified as ecosystem components do not require annual catch limits (ACLs) or accountability measures but are still regularly monitored in the annual SAFE report through a one-year snapshot of the ten most caught ECS, complete catch time series of ten prioritized ECS as identified by the State of Hawaii Department of Aquatic Resources (HDAR), as well as trophic and functional group biomass estimates from fishery independent surveys. Other existing management measures still apply to ECS.

The Hawaii coral reef ecosystem component fishery had negative trends in 2024 relative to historical averages; with the only exception being the Hawaiian Spiny Lobster which showed increases in both pounds and number of individuals caught. The most harvested ECS in 2024 were akule (*Selar crumenophthalmus*; 202,261 lb) and ‘opelu (*Decapterus macarellus*; 90,709 lb) followed by ta‘ape (*Lutjanus kasmira*; 33,563 lb), ‘U‘ū (*Myripristis* spp.; 31,831 lb), and uhu (*Scaridae* spp.; 29,504 lb). In general, all 10 prioritized ECS (as identified by DAR) had decreases in the number of licenses and the number of fishing trips taken. The number of ta‘ape caught in 2024 represented an increase relative to its 10- and 20-year trends, but pounds caught is typically a more useful metric in identifying fishery performance, and that had a declining trend for ta‘ape. In 2024, the MHI Kona crab fishery experienced increases in the number of trips (68) and catch (4,783 lb) relative to its short-term trend.

In addition to reported commercial data, the Council’s Fishery Ecosystem Plan Teams are exploring approaches to incorporate non-commercial data streams from the Hawaii Marine Recreational Fishing Survey (HMRFS) pending additional progress by several working groups.

The Hawaii annual SAFE report also presents federal logbook catch data. In Hawaii, there were three shrimp permits issued in 2024, but there were no permits issued for Non-Commercial Bottomfish, special coral reef ecosystem, precious coral, or lobsters. The reported data associated with shrimp permits are non-disclosed due to data confidentiality rules.

An Ecosystem Considerations chapter was added to the annual SAFE report following the Council’s review of its FEPs and revised management objectives. Fishery independent ecosystem survey data, fisher observations, socioeconomics, protected species, climate and oceanographic, essential fish habitat, and marine planning information are included.

Fishery independent ecosystem data were acquired through visual surveys conducted by the National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC) Ecosystem Sciences Division (ESD) under the National Coral Reef Monitoring Program (NCRMP) in the Commonwealth of the Northern Mariana Islands (CNMI), the Pacific Remote Island Area (PRIA), American Samoa, Guam, the Main Hawaiian Islands (MHI), and the Northwestern Hawaiian Islands (NWHI). This report describes mean fish biomass of functional,

taxonomic, and trophic groups for coral reefs as well as habitat condition using mean coral coverage per island for each of these locations averaged over the past ten years. However, there were no new data reported for 2020 through 2022 due to the cancellation of surveys associated with impacts from the COVID-19 pandemic. Surveys in 2024 were conducted the MHI and NWHI. Coral cover declined in Hawaii island, Oahu, and Molokai from 2018 to 2023, while fish biomass increased on Molokai and Lanai and remained relatively stable for the other MHI.

Hawaii is considered data-poor in terms of life history parameters (maximum age, asymptotic length, growth coefficient, hypothetical age at length zero, natural mortality, age and length at 50% maturity, age and length at sex transition) for both coral reef fish and bottomfish species. Available life-history parameters for eight coral reef fish species and families and six bottomfish species are presented. As of 2023, research was completed on growth for onaga (Reed et. al in press).

The socioeconomic section begins with an overview of the socioeconomic context for the region, presents relevant socioeconomic data trends including commercial pounds sold, revenues, and prices, and lists relevant socioeconomic studies from the past year. In 2024, fish prices dropped for Hawaii Deep-7 BMUS fisheries from 2023, and fuel price remained high after substantial increases observed in recent years. Across Hawaii, BMUS, the Deep-7 bottomfish complex comprised 84% of the revenue, and uku comprised 16%. The number of commercial marine licenses (CMLs) reporting BMUS sales dropped from 2023 to 2024 to 313 CMLs. In the Hawaii Deep-7 bottomfish fishery, 136,137 lb sold in 2024 for a revenue of \$1,321,839. In the uku fishery, 32,193 lb were sold for a revenue of \$242,865. There were 1,638 lb of crab sold at an for a revenue of \$17,613. For the top-ten harvested ECS in Hawaii, there were 419,701 lb sold for a revenue of \$1,788,678 in 2024, which was less than the revenue and pounds sold for the top 10 species (i.e., a different list composition) in 2023. Priority ECS in Hawaii had 99,259 lb sold for a revenue of \$465,771 in 2024, which was an increase in revenue from the priority species revenue in 2023.

The protected species section of this report summarizes information and monitors protected species interactions in fisheries managed under the Hawaii FEP using proxy indicators such as fishing effort and shifts in gear dynamics. Protected species considered include sea turtles, sea birds, marine mammals, sharks, rays, and corals, many of which are protected under the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), and/or the Migratory Bird Treaty Act (MBTA). The fisheries included in the Hawaii FEP generally have limited impacts to protected species, and currently do not have any federal observer coverage. Fishing effort and other characteristics are monitored to detect any potential change to the scale of impacts to protected species. Fishery performance data in this report indicate that there have been no notable changes in the fisheries that would affect the potential for interactions with protected species, and there is no other information that indicates that impacts to protected species have changed in recent years.

The climate and oceanic indicators section of this report includes indicators of current and changing climate and related oceanic conditions in the geographic areas for which the Council has jurisdiction. In developing this section, 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. The primary goal for selecting the indicators used in this

report was to provide fishing communities, resource managers, and businesses with climate-related situational awareness. In this context, indicators were selected to be fisheries relevant and informative, build intuition about current conditions considering changing climate, provide historical context, and recognize patterns and trends.

The trend of atmospheric concentration of carbon dioxide (CO₂) is increasing exponentially with a time series maximum at 424 ppm in 2024: The ocean is roughly 12% more acidic than it was in 1989. Over this time, pH has declined by 0.05 at a constant rate with average pH in 2023 at 8.05. The Oceanic Niño Index, which is a measure of the El Niño – Southern Oscillation (ENSO) phase, indicated a transition from El Niño conditions to a neutral state in 2024. The Pacific Decadal Oscillation (PDO) was negative in 2024. . Overall, Central Pacific tropical cyclone activity was below the 1991–2020 average in 2024. On August 19th, Hurricane Hone formed in the Central Pacific and peaked as a Category 1 hurricane with winds of 85 mph. Hone brought gusty winds and flooding rains to the Island of Hawai‘i as it passed south of the island chain. Annual mean sea surface temperature (SST) was 25.68 °C in 2024. Over the period of record, annual SST has increased at a rate of 0.016 °C yr⁻¹. After a series of stress events in 2014, 2015, and 2019, the main Hawaiian Islands experienced no coral heat stress in 2024. Annual mean chlorophyll-*a* 0.078 mg/m³ in 2024. Over the period of record, annual Chl-A has shown weak but significant decrease.

The essential fish habitat (EFH) review section of this report is required by the Hawaii Archipelago FEP and National Standard 2 guidelines, and it includes information on cumulative impacts to essential fish habitat in the U.S. Western Pacific region. The National Standard 2 guidelines also require a report on the condition of the habitat. In the 2017 and 2018 annual SAFE reports, a literature review of the life history and habitat requirements for each life stage of four reef-associated crustacean species regularly landed in U.S. Western Pacific commercial fisheries was presented. This review included information on two species of spiny lobster, (*Panulirus marginatus* and *Scyllarides squammosus*), scaly slipper lobster (*Scyllarides squammosus*), and Kona crab (*Ranina ranina*). A review of EFH for reef-associated crustaceans in the MHI and Guam was included in the 2019 report. In 2022, additional information was added on EFH models developed for uku in the MHI, providing both Level 1 (Franklin 2021) and Level 2 (Tanaka et al. 2022) data. A project initiated in 2023 is exploring a range of potential methods to effectively sample juvenile uku in nearshore habitats (Schmidt et al. 2023). Annual bottomfish surveys were successfully conducted in 2024 as part of the BFISH program. The surveys also collect important habitat-related data such as depth, temperature, and seafloor type, contributing to Essential Fish Habitat (EFH) assessments.

The marine planning section of this report monitors activities with multi-year planning horizons and begins to track the cumulative impact of established facilities. Development of the report in later years will focus on identifying appropriate data streams to report in a standardized manner. In the Hawaii Archipelago, aquaculture, alternative energy development, and military activities are those with the highest potential fisheries impact. There was notable discussion by the Council regarding the proposed NWHI fishing regulations for the Monument Expansion Area (MEA).

The Data Integration chapter of this report is under development. The chapter explores the potential association between fishery parameters for uku in the MHI and an index of the El Niño Southern Oscillation (ENSO), a measure of vorticity, and a measure of surface zonal currents. Previously, in the 2017 report, exploratory analyses were performed comparing coral reef fishery species data in the Western Pacific with precipitation, primary productivity, and sea surface

temperature. The Archipelagic Fishery Ecosystem Plan Team (Plan Team) suggested several improvements to implement to the initial evaluation, which are reflected in the preliminary analysis for uku first presented in the 2018 report. Results of the evaluation for potential fishery ecosystem relationships suggested a strong inverse relationship between uku CPUE in the MHI and the ENSO index used. Uku CPUE had a strong positive relationship with surface zonal flow. While there were some potential relationships between uku fishery parameters and vorticity, they were notably weaker than those for zonal flow. A potential explanation for these results is that increased zonal flow around the MHI could increase retention of pelagic larvae for important fisheries species, such as uku, prior to their recruitment into the fishery. In continuing with associated analyses and presentation of results for the Data Integration chapter, work may be expanded to other top species and potentially viable ecological parameters in pursuit of standardization in future report cycles.

At its May 2025 meeting, the Plan Team developed the following recommendations relevant to the Hawaii Archipelago annual SAFE report:

Regarding data collection for the fishery modules of the territorial Annual SAFE reports and the next territorial benchmark assessments, the Archipelagic Plan Team:

- Recommends the Council, in coordination with PIFSC through the Fisheries Data Collection and Research Committee, work with the jurisdictional fisheries management agencies in identifying and removing the barriers that prevent efficient and effective collection of fisheries data resulting in a decline in survey interviews and reporting of the fishery constituents affecting representativeness of data reported in the Annual SAFE Reports and future benchmark assessments
- Recommends the Council to work with PIFSC and jurisdictional fisheries management agencies in exploring the feasibility of collecting more length information to develop a rate-based monitoring in support of the Tier-6 ABC Control Rule amendment that the Council took final action on at its 202nd meeting.

TABLE OF CONTENTS

Executive Summary	v
Acronyms and Abbreviations	xviii
1 Fishery Performance	1
1.1 Deep-7 BMUS	1
1.1.1 Fishery Overview.....	1
1.1.2 Commercial Reporting.....	2
1.1.3 Management.....	2
1.1.4 Fishery Performance	3
1.1.5 Fishery Performance and CPUE by Gear Type	6
1.1.6 Bycatch Summary.....	17
1.2 <i>Aprion Virescens</i> (Uku)	21
1.2.1 Fishery Overview.....	21
1.2.2 Commercial Reporting.....	21
1.2.3 Management.....	22
1.2.4 Fishery Performance	22
1.2.5 Fishery Performance and CPUE by Gear Type	25
1.2.6 Bycatch Summary.....	29
1.3 Coral Reef Ecosystem Components	32
1.3.1 Fishery Overview.....	32
1.3.2 Commercial Reporting.....	32
1.3.3 Management.....	32
1.3.4 Most Harvested ECS.....	33
1.3.5 Bycatch Summary.....	52
1.4 Crustacean.....	53
1.4.1 Fishery Overview.....	53
1.4.2 Commercial Reporting.....	54
1.4.3 Management.....	54
1.4.4 Fishery Performance	55
1.4.5 Fishery Performance and CPUE Using Primary Gear Types	59
1.4.6 Bycatch Summary.....	63
1.5 Precious Corals Fishery	66
1.5.1 Fishery Overview.....	66
1.5.2 Fishery Performance	66
1.6 Non-Commercial Fishery Performance	67
1.6.1 Hawaii Marine Recreational Fishing Survey (HMRFS).....	67
1.6.2 Catch and Effort Estimates	67
1.7 Federal Logbook Data	68
1.7.1 Number of Federal Permit Holders.....	68
1.7.2 Summary of Catch and Effort for FEP Fisheries	69
1.8 Status Determination Criteria	72
1.8.1 Bottomfish and Crustacean Fishery	72
1.8.2 Current Stock Status	74

1.9	Overfishing Limit, Acceptable Biological Catch, and Annual Catch Limits	76
1.9.1	Brief description of the ACL process	76
1.9.2	Current OFL, ABC, ACL, and Recent Catch	77
1.10	Best Scientific Information Available	78
1.10.1	Main Hawaiian Island Deep-7 Bottomfish Fishery	78
1.10.2	Uku Fishery.....	79
1.10.3	Crustacean Fishery.....	80
1.11	Harvest Capacity and Extent.....	81
1.12	Administrative and Regulatory Actions	82
2	Ecosystem Considerations.....	83
2.1	Fisher Observations	83
2.1.1	Information from Advisory Panel Meetings.....	83
2.1.2	Information from the Annual Summit	86
2.2	Coral Reef Fish Ecosystem Parameters	87
2.2.1	Regional Reef Fish Biomass and Habitat Condition	87
2.2.2	Main Hawaiian Islands Reef Fish Biomass and Habitat Condition.....	90
2.2.3	Northwestern Hawaiian Islands Reef Fish Biomass and Habitat Condition	92
2.3	Life History and Length Derived Parameters	94
2.3.1	MHI Coral Reef Ecosystem Components Life History	94
2.3.2	MHI Bottomfish Management Unit Species Life History.....	97
2.4	Socioeconomics	100
2.4.1	Response to Previous Council Recommendations.....	101
2.4.2	Introduction.....	101
2.4.3	People Who Fish.....	103
2.4.4	Fishery Economic Performance.....	109
2.4.5	Ongoing Research and Information Collection	119
2.4.6	Relevant PIFSC Economics and Human Dimensions Publications: 2023	121
2.5	Protected Species	122
2.5.1	Indicators for Monitoring Protected Species Interactions	122
2.5.2	Status of Protected Species Interactions in the Hawaii FEP Fisheries	126
2.5.3	Identification of Emerging Issues	128
2.5.4	Identification of Research, Data, and Assessment Needs.....	130
2.6	Climate and Oceanic Indicators	130
2.6.1	Introduction.....	130
2.6.2	Response to Previous Plan Team and Council Recommendations.....	131
2.6.3	Conceptual Model.....	131
2.6.4	Selected Indicators.....	133
2.7	Essential Fish Habitat	150
2.7.1	Introduction.....	150
2.7.2	Habitat Use by MUS and Trends in Habitat Condition	153
2.7.3	Report on Review of EFH Information	156
2.7.4	EFH Levels	156
2.7.5	Ongoing Projects.....	161
2.7.6	Research and Information Needs.....	164
2.8	Marine Planning.....	165
2.8.1	Introduction.....	165

2.8.2	Response to Previous Council Recommendations.....	166
2.8.3	Marine Managed Areas Established Under FEPs.....	167
2.8.4	Fishing Activities and Facilities	170
2.8.5	Non-Fishing Activities and Facilities	171
2.8.6	Additional Considerations	173
3	Data Integration	176
3.1	Introduction.....	176
3.1.1	Potential Indicators for Insular Fisheries	176
3.1.2	Plan Team Recommendations for Section Development	176
3.1.3	Background Information.....	177
3.2	Multivariate ENSO Index	181
3.3	Surface Zonal Currents	184
4	References	187
	Appendix A: List of Species	A-1
	Hawaii Management Unit Species	A-1
	Monitored Ecosystem Component Species	A-2
	Appendix B: List of Protected Species and Designated Critical Habitat	B-1

TABLE OF TABLES

Table 1. Time series of commercial fishing reports for Deep-7 BMUS reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024.....	4
Table 2. Annual fishing parameters for the 2024 fishing year in the MHI Deep-7 bottomfish fishery compared with short-term (10-year) and long-term (20-year) averages.....	6
Table 3. DAR MHI annual Deep-7 BMUS CPUE (lb/trip) by dominant fishing methods reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024	7
Table 4a. DAR MHI annual Deep-7 catch summary by species and top gear, deep-sea handline, reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024	8
Table 4b. DAR MHI annual Deep-7 catch summary by species and top gear, deep-sea handline, reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024.....	10
Table 5. Annual fishing parameters for deep-sea handline for the 2024 fishing year in the MHI Deep-7 bottomfish fishery compared with short-term (10-year) and long-term (20-year) averages.....	12
Table 6a. DAR MHI annual Deep-7 catch summary by species for non-deep sea handline methods reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024.....	13
Table 6b. DAR MHI annual Deep-7 catch summary by species for non-deep-sea handline methods, by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024.....	15
Table 7. Annual fishing parameters for non-deep-sea handline methods for the 2024 fishing year in the MHI Deep-7 bottomfish fishery compared with short-term (10-year) and long-term (20-year) averages.....	17
Table 8. Time series of commercial fishing bycatch of Deep-7 BMUS and non-target species harvested with deep-sea handline, reported by Fishing Year from 2005-2024	19
Table 9. Time series of commercial fishing bycatch of the top 10 most caught species in the Deep-7 bottomfish fishery harvested with deep-sea handline, reported by Fishing Year over the past 10 years.....	20
Table 10. Time series of commercial fishing reports for uku by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024	23
Table 11. Annual fishing parameters for 2024 in the MHI uku fishery compared with short-term (10-year) and long-term (20-year) averages	25
Table 12. Time series of uku CPUE (lb/trip) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024	26
Table 13. Annual fishing parameters for 2024 in the MHI uku fishery by gear compared with short-term (10-year) and long-term (20-year) averages.....	29
Table 14. Time series of commercial fishing bycatch of uku and non-target species harvested with deep-sea handline, inshore handline, or casting, reported by Fishing Year from 2005-2024	30
Table 15. Time series of commercial fishing bycatch of the top 10 most caught species in the uku fishery harvested with deep-sea handline, inshore handline, or casting, reported by Fishing Year over the past 10 years.....	31
Table 16. Top ten landed species (lb) in Hawaii ECS fisheries in 2024	33
Table 17. Time series of commercial fishing reports for all ‘opihi (<i>Cellana</i> spp.; limpet) species reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024.....	34
Table 18a. Time series of commercial fishing reports for ‘ula (<i>Panulirus marginatus</i> ; Hawaiian spiny lobster) from reported by Calendar Year from 2002-2024	36

Table 18b. Time series of commercial fishing reports for ‘ula (<i>Panulirus penicillatus</i> ; green spiny lobster) from reported by Calendar Year from 2002-2024.....	37
Table 18c. Time series of commercial fishing reports for ‘ula papapa (<i>Scyllarides squammosus</i> ; scaly slipper lobster) from reported by Calendar Year from 2002-2024.....	37
Table 19. Time series of commercial fishing reports for kūmū (<i>Parupeneus porphyreus</i> ; white saddle goatfish) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024	38
Table 20. Time series of commercial fishing reports for omilu (<i>Caranx melampygus</i> ; bluefin trevally) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024	40
Table 21. Time series of commercial fishing reports for uhu (<i>Scaridae</i> spp.; parrotfish) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024	42
Table 22. Time series of commercial fishing reports for he‘e (<i>Octopus cyanea</i> ; day tako) reported by Calendar Year from 2002-2024	43
Table 23. Time series of commercial fishing reports for kala (<i>Naso</i> spp.; bluespine unicornfish, short-nosed unicornfish, whitemargin unicornfish) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024	44
Table 24. Time series of commercial fishing reports for nenu (<i>Kyphosus</i> spp.; chubs) from reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024.....	46
Table 25. Time series of commercial fishing reports for manini (<i>Acanthurus triostegus</i> ; convict tang) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024 .	47
Table 26. Time series of commercial fishing reports for ta‘ape (<i>Lutjanus kasmira</i> ; bluestripe snapper) reported by Fiscal Year from 1970-1993 and by Calendar Year from 1994-2024	49
Table 27. Annual fishing parameters for 2024 for prioritized MHI ECS designated by DAR compared with short-term (10-year) and long-term (20-year) averages.....	51
Table 28. Time series of commercial fishing bycatch of non-MUS reported by Calendar Year from 2005-2024	52
Table 29. Time series of commercial fishermen reports for the Kona crab fishery reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024	55
Table 30. Annual fishing parameters for 2024 in the MHI Kona crab fishery compared with short-term (10-year) and long-term (20-year) averages.....	57
Table 31. Time series of commercial fishermen reports for the deepwater shrimp fishery reported by Fiscal Year from 1982-1993 and by Calendar Year from 1994-2024	57
Table 32. Annual fishing parameters for 2024 in the deepwater shrimp fishery compared with short-term (10-year) and long-term (20-year) averages.....	59
Table 33. Annual Kona crab catch using Kona crab nets, reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024	59
Table 34. Annual fishing parameters for 2024 in the MHI Kona crab net fishery with short-term (10-year) and long-term (20-year) averages	61
Table 35. Annual deepwater shrimp catch using shrimp traps, reported by Fiscal Year from 1987-1993 and by Fishing Year from 1994-2024.....	61
Table 36. Annual fishing parameters for 2024 in the deepwater shrimp trap fishery compared with short-term (10-year) and long-term (20-year) averages	63
Table 37. Time series of commercial fishing bycatch of Kona crab and non-target species harvested with loop net, reported by Fishing Year from 2005-2024	64

Table 38. Time series of commercial fishing bycatch of deepwater shrimp and non-target species harvested with shrimp traps, reported by Fishing Year from 2005-2024	65
Table 39. Commercial fishing bycatch harvested with loop net in the MHI Kona crab fishery, reported for Fishing Year 2024.....	66
Table 40. Number of federal permits in Hawaii FEP fisheries.....	69
Table 41. Summary of federal logbook data for the Hawaii non-commercial bottomfish fishery.....	70
Table 42. Summary of federal logbook data for Hawaii lobster fisheries	71
Table 43. Summary of federal logbook data for the Hawaii deepwater shrimp fishery	71
Table 44. Overfishing threshold specifications for Hawaiian bottomfish and NWHI lobsters	73
Table 45. Recruitment overfishing control rule specifications for the BMUS in Hawaii	73
Table 46. Stock assessment parameters for the MHI Deep-7 bottomfish complex.....	74
Table 47. Results from 2024 stock assessment for MHI uku	75
Table 48. Stock assessment parameters for Hawaii's Kona crab stock.....	76
Table 49. Best available MSY estimates for Hawaii Crustacean MUS.....	76
Table 50. ACLs for Hawaii MUS in 2024 and three-year recent average catch (lb)	77
Table 51. Proportion of harvest capacity and extent for Hawaii MUS relative to their ACLs in 2024.....	81
Table 52. Available age, growth, and reproductive maturity information for coral reef ecosystem component species in the Hawaiian Archipelago	96
Table 53. Available age, growth, reproductive maturity, and natural mortality information for bottomfish MUS in the Hawaii Archipelago	99
Table 54. Catch disposition by fisherman self-classification	104
Table 55. Bottomfish and reef fish trip costs for small boats in Hawaii in 2014 and 2021.....	110
Table 56. Revenue structure for Hawaii BMUS.....	111
Table 57. Pounds sold, revenue, and price for Hawaii BMUS.....	113
Table 58. MHI Deep-7 bottomfish fishery economic performance measures.....	116
Table 59. Fishery economic performance standards for MHI crab and deepwater shrimp	118
Table 60. Top 10 ECS commercial landings, revenue, and price in 2024 and 2023	119
Table 61. Priority ECS commercial landings, revenue, and price in 2024 and 2023	119
Table 62. Pacific Islands Region 2024 Commercial Fishing Economic Assessment Index	120
Table 63. Pacific Islands Region 2025 Commercial Fishing Economic Assessment Index	120
Table 64. Summary of ESA consultations for Hawaii FEP Fisheries	123
Table 65. The number of oceanic whitetip shark interactions expected as calculated by the 2022 BiOp, representing the ITS, with the reported number of interactions based on the best scientific data as described above.	127
Table 66. Status of candidate ESA species, recent ESA listing processes, and post-listing activities	129
Table 67. Level of EFH available for Hawaii precious corals MUS	156
Table 68. Level of EFH information available for Hawaii bottomfish and seamount groundfish MUS.....	157
Table 69. Level of EFH information available for Hawaii Kona crab	158
Table 70. EFH and HAPC for Hawaii MUS.....	158
Table 71. MMAs established under FEP from 50 CFR § 665.....	169
Table 72. Offshore aquaculture facilities in Hawaii	170
Table 73. Alternative energy facilities and development offshore of Hawaii	171
Table 74. Military training and testing activities offshore of Hawaii	172

TABLE OF FIGURES

Figure 1. Mean coral cover (%± standard error of the mean, or SEM) per U.S. Pacific Island averaged from 2010-2023 by latitude	88
Figure 2. Mean fish biomass (g/m ² ± SEM) per U.S. Pacific Island of functional, taxonomic, and trophic groups from 2010-2024 by latitude	89
Figure 3. Mean coral cover (% ± SEM) per island of the MHI from 2010–2024 by latitude	90
Figure 4. Mean fish biomass (g/m ² ± SEM) of functional, taxonomic, and trophic groups per island of the MHI from 2010-2024	91
Figure 5. Mean coral cover (% ± SEM) per island of the NWHI from 2010–2024 by latitude ...	92
Figure 6. Mean fish biomass (g/m ² ± SEM) of functional, taxonomic, and trophic groups per island of the NWHI from 2010-2024	93
Figure 7. Settlement of the Pacific Islands, courtesy Wikimedia Commons https://commons.wikimedia.org/wiki/File:Polynesian_Migration.svg	100
Figure 8. Trends in commercial landings and revenue for Hawaii BMUS	111
Figure 9. Number of CMLs with and without sales of Hawaii MUS	112
Figure 10. Pounds sold and revenue of Deep-7 Bottomfish (adjusted to 2024 dollars)	112
Figure 11. Fish prices for Deep-7 bottomfish and uku	113
Figure 12. Trends in fishery revenue per vessel and the Gini coefficient for the MHI Deep-7 bottomfish fishery (adjusted to 2024 dollars)	115
Figure 13. Trends in fishery revenue per trip for (adjusted to 2024 dollars)	116
Figure 14. Commercial landings and revenue for MHI crab (adjusted to 2024 dollars)	117
Figure 15. Commercial landings and revenue for MHI deepwater shrimp (adjusted to 2024 dollars)	117
Figure 16. Price trends for MHI crab and deepwater shrimp (adjusted to 2024 dollars)	118
Figure 17. Indicators of change of archipelagic coastal and marine systems	132
Figure 18. Schematic diagram illustrating how indicators are connected to one another and how they vary as a result of natural climate variability	133
Figure 19. Schematic diagram illustrating how indicators are connected to one another and how they vary as a result of anthropogenic climate change	134
Figure 20. Regional spatial grids representing the scale of the climate change indicators being monitored	134
Figure 21. Monthly mean (black) and seasonally corrected (blue) atmospheric carbon dioxide at Mauna Loa Observatory, Hawaii	136
Figure 22. Time series and long-term trend of oceanic pH measured at Station ALOHA	137
Figure 23. Oceanic Niño Index from 1950–2024 El Niño periods in red, La Niña periods in blue, and neutral periods in grey	138
Figure 24. Pacific Decadal Oscillation from 1854–2024 with positive warm periods in red and negative cool periods in blue	139
Figure 25. 2024 Pacific basin tropical cyclone tracks	141
Figure 26. Storm counts (bars) and Accumulated Cyclone Energy (ACE) index values (lines) in each region of the Pacific. Both annual ACE index (black lines) and 1991–2020 average ACE index (grey lines) are shown	142
Figure 27. Sea surface temperature climatology and anomalies from 1985–2024	143
Figure 28. Coral Thermal Stress Exposure, Main Hawaiian Island Virtual Station from 2014–2024, measured in Coral Reef Watch Degree Heating Weeks	144
Figure 29. Chlorophyll- <i>a</i> and chlorophyll- <i>a</i> anomaly from 1998–2024	145

Figure 30. CMAP precipitation (top) and anomaly (bottom) across the MHI Grid with 2024 values in blue	147
Figure 31a. Sea surface height anomaly	148
Figure 31b. Quarterly maps of mean sea level anomalies during 2024.....	149
Figure 32. Monthly mean sea level without regular seasonal variability due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents.....	150
Figure 33. Substrate EFH limit of 700 m isobath around the Hawaiian Archipelago	154
Figure 34. Spatial classification of Essential Fish Habitat (EFH) for uku (<i>Aprion virescens</i>) in the Main Hawaiian Islands based on habitat suitability percentiles.	161
Figure 35. Regulated fishing areas of the Hawaii Archipelago	168
Figure 36. Map of the 12 BRFA's around the MHI; green boxes indicate those areas were opened to bottomfish fishing in 2019 and red boxes indicate areas that remained closed to bottomfish fishing at this time. All BRFA's are now open.....	174
Figure 37. CPUE for uku harvested in the MHI for four top gear types from 2002-2012	179
Figure 38. Average annual weight per fish (lb) for uku (<i>Aprion virescens</i>) harvested around the Main Hawaiian Islands from 2002-2012	180
Figure 39. Diagram showing the physical mechanisms by which the SST (shaded), OLR (contours), surface zonal and meridional winds (vectors), and sea level pressure (represented by “H” and “L”) determine the wintertime Multivariate ENSO Index (MEI) during (a) El Niño and (b) La Niña events”	182
Figure 40. Time series of the Multivariate ENSO Index (MEI) v2 from 1980-2019	183
Figure 41. Comparison of standardized MHI Deep-Set Handline CPUE and MEI.v2 with a phase lag of two years from 2002-2012 ($r = -0.729$).....	183
Figure 42. Standardized CPUE for uku from the MHI from 2002-2012 plotted against standardized MEI.v2 with a phase lag of two years	184
Figure 43. Example of eastward sea water current velocity around the MHI from 2004.....	185
Figure 44. Comparison of standardized MHI Deep-Set Handline CPUE and the average summertime zonal current with a phase lag of two years from 2002-2012 ($r = 0.748$) .	186
Figure 45. Standardized CPUE for uku from the MHI from 2002-2012 plotted against standardized average summertime zonal current with a phase lag of two years	186

ACRONYMS AND ABBREVIATIONS

Acronym	Meaning
A ₅₀	Age at 50% Maturity
AΔ ₅₀	Age at 50% Sex Reversal
ABC	Acceptable Biological Catch
ACE	Accumulated Cyclone Energy
ACL	Annual Catch Limits
ACT	Annual Catch Target
AM	Accountability Measure
APAIS	Access Point Angler Intercept Survey
AVHRR	Advanced Very High Resolution Radiometer
B	Biomass
B _{FLAG}	Reference point indicating low biomass
BiOp	Biological Opinion
BMUS	Bottomfish Management Unit Species
BOEM	Bureau of Ocean Energy Management
BRFA	Bottomfish Restricted Fishing Areas
BSIA	Best Scientific Information Available
CFEAI	Commercial Fishing Economic Assessment Index
CFR	Code of Federal Regulations
CHTS	Coastal Household Telephone Survey
CIMAR	Cooperative Institute for Marine and Atmospheric Research
CMAP	CPC Merged Analysis of Precipitation
CML	Commercial Marine License
CMLS	Commercial Marine Licensing System
CMUS	Crustacean Management Unit Species
CNMI	Commonwealth of the Northern Mariana Islands
CO-OPS	Ctr for Operational Oceanographic Products and Services
Council	Western Pacific Regional Fishery Management Council
CPC	Climate Prediction Center
CPI	Consumer Price Index
CPUE	Catch per Unit Effort
CRED	Coral Reef Ecosystem Division
CREP	Coral Reef Ecosystem Program
CREMUS	Coral Reef Ecosystem Management Unit Species
CRW	Coral Reef Watch
CSF	Community Supported Fishery
DLNR	Department of Land and Natural Resources (Hawaii)
DAR	Division of Aquatic Resources (Hawaii)
DAWR	Division of Aquatic and Wildlife Resources (Guam)
DFW	Division of Fish and Wildlife (CNMI)
DGI	Daily Growth Increments
DHW	Degree Heating Weeks
DIC	Dissolved Inorganic Carbon
DMWR	Department of Marine and Wildlife Resources (American Samoa)

Acronym	Meaning
DOD	Department of Defense
DPS	Distinct Population Segment
E	Effort
EA	Environmental Assessment
ECS	Ecosystem Component Species
EEJ	Equity and Environmental Justice
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ENSO	El Niño - Southern Oscillation
EO	Executive Order
ESA	Endangered Species Act
ESRL	Earth Systems Research Laboratory
F	Fishing Mortality
FL	Fork Length
FES	Fishing Effort Survey
FEP	Fishery Ecosystem Plan
FMP	Fishery Management Plan
FR	Federal Register
FRMD	Fisheries Research and Monitoring Division
FRS	Fishing Report System
FTP	File Transfer Protocol
Fund	Western Pacific Sustainable Fisheries Fund
GAM	Generalized Additive Model
GIS	Geographic Information System
GLM	General Linear Modeling
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
H	Harvest
HAPC	Habitat Area of Particular Concern
HDAR	Hawaii Division of Aquatic Resources
HMRFS	Hawaii Marine Recreational Fishing Survey
HOT	Hawaii Ocean Time Series (UH)
HSEMA	Hancock Seamounts Ecosystem Management Area
HSTT	Hawaii-Southern California Training and Testing
HURL	Hawaii Undersea Research Laboratory
ITEK	Indigenous and Traditional Ecological Knowledge
ITS	Incidental Take Statement
k	von Bertalanffy Growth Coefficient
L_{50}	Length at 50% Maturity
$L_{\Delta 50}$	Length at 50% Sex Reversal
L_{∞}	Asymptotic Length
L_{bar}	Mean Fish Length
L_{max}	Maximum Fish Length
LAA	Likely to Adversely Affect

Acronym	Meaning
LIDAR	Light Detection and Ranging
LOC	Letter of Concurrence
LOF	List of Fisheries
M	Natural Mortality
MBTA	Migratory Bird Treaty Act
MEI	Multivariate ENSO Index
MFMT	Maximum Fishing Mortality Threshold
MHI	Main Hawaiian Islands
MI	Mobile Invertebrates
MLCD	Marine Life Conservation District
MMA	Marine Managed Area
MMPA	Marine Mammal Protection Act
MODIS	Moderate Resolution Imaging Spectroradiometer
MPA	Marine Protected Area
MPCC	Marine Planning and Climate Change
MPCCC	MPCC Committee
MRFSS	Marine Recreational Fisheries Statistics Survey
MRIP	Marine Recreational Information Program
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MSST	Minimum Stock Size Threshold
MSU	Microwave Sounding Unit
MSY	Maximum Sustainable Yield
MUS	Management Unit Species
n	Sample Size
N _{L-W}	Sample Size for Length-Weigh Regression
NA	Not Applicable
NAF	No Active Fishery
NASA	National Aeronautics and Space Administration
NCADAC	National Climate Assessment and Development Advisory Cmte
NCDC	National Climatic Data Center
NCEI	National Centers for Environmental Information
n.d.	Non-Disclosure
NELHA	Natural Energy Laboratory of Hawaii Authority
NEPA	National Environmental and Policy Act
NLAA	Not Likely to Adversely Affect
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NS	National Standard
NWHI	Northwestern Hawaiian Islands
OEIS	Overseas Environmental Impact Statement
OFL	Overfishing Limits
OFR	Online Fishing Report system
ONI	Ocean Niño Index
OPI	OLR Precipitation Index

Acronym	Meaning
OLR	Outgoing Longwave Radiation
OTEC	Ocean Thermal Energy Conversion
OY	Optimum Yield
PCMUS	Precious Coral Management Unit Species
PDO	Pacific Decadal Oscillation
Pelagic FEP	Fishery Ecosystem Plan for the Pacific Pelagic Fisheries
PIAFA	Pacific Insular Area Fishery Agreement
PIBHMC	Pacific Islands Benthic Habitat Mapping Center
PIFSC	Pacific Island Fisheries Science Center
PIRCA	Pacific Islands Regional Climate Assessment
PIRO	Pacific Islands Regional Office
PK	Planktivorous
PMEL	Pacific Marine Environmental Laboratory
PMUS	Pelagic Management Unit Species
POES	Polar Operational Environmental Satellite
PRIA	Pacific Remote Island Area
PSE	Proportional Standard Error
RAMP	Reef Assessment and Monitoring Program
RIMPAC	Rim of the Pacific
ROD	Record of Decision
ROMS	Regional Ocean Modeling System
ROV	Remotely Operated Underwater Vehicle
RPB	Regional Planning Body
SAFE	Stock Assessment and Fishery Evaluation
SCREFP	Special Coral Reef Ecosystem Fishing Permit
SDC	Status Determination Criteria
SDM	Species Distribution Model
Secretary	Secretary of Commerce
SEEM	Social, Economic, Ecological, Management (Uncertainty)
SEIS	Supplemental Environmental Impact Statement
SFD	Sustainable Fisheries Division
SLP	Sea Level Pressure
SOEST	School of Ocean and Earth Science and Technology
SPC	Stationary Point Count
SPR	Spawning Potential Ratio
SSC	Scientific and Statistical Committee
SSM/I	Special Sensor Microwave/Imager
SST	Sea Surface Temperature
SSBPR	Spawning Stock Biomass Proxy Ratio
SWAC	Seawater Air Conditioning
t_0	Hypothetical Age at Length Zero
T_{\max}	Maximum Age
TA	Total Alkalinity
TAC	Total Allowable Catch
TALFF	Total Allowable Level of Foreign Fishing

Acronym	Meaning
TBA	To Be Assigned
TBD	To Be Determined
UFA	United Fishing Agency
UH	University of Hawaii
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
VBGF	von Bertalanffy Growth Function
WETS	Wave Energy Test Site
WPacFIN	Western Pacific Fishery Information Network
WPRFMC	Western Pacific Regional Fishery Management Council
WPSAR	Western Pacific Stock Assessment Review
WSEP	Weapon Systems Evaluation Program

1 FISHERY PERFORMANCE

1.1 DEEP-7 BMUS

1.1.1 Fishery Overview

The Deep-7 bottomfish management unit species (BMUS) group is comprised of seven deepwater bottomfish including ‘ōpakapaka (*Pristipomoides filamentosus*; pink snapper), onaga (*Etelis coruscans*; longtail snapper), ehu (*Etelis carbunculus*; ruby snapper), hapu‘upu‘u (*Epinephelus quernus*; Hawaiian grouper), kalekale (*Pristipomoides seiboldii*; Von Siebold’s snapper), gindai (*Pristipomoides zonatus*; oblique-banded snapper), and lehi (*Aphareus rutilans*; silverjaw snapper). The two most directly targeted species are ‘ōpakapaka, onaga, and ehu which together typically make up 80+% total Deep-7 catch each year. ‘Ōpakapaka in many years alone can make up approximately half of the total catch. Hapu‘upu‘u, kalekale, gindai, and lehi are primarily caught incidentally while targeting the two primary species or by some individuals who may target them specifically.

This small boat-based fishery occurs in both federal and state waters of the MHI with approximately 25% of all Deep-7 landings typically taken in state waters in recent years. Though occurring throughout the MHI, the fishery is centered around the waters of Maui Nui including Penguin Bank. The Northwest Hawaiian Island Deep-7 fishery existed up until 2009, after which the creation of the Papahānaumokuākea Marine National Monument prohibited all commercial fishing there. Deep-7 catch from the NWHI was typically less than Deep-7 catch in the MHI, although catch from the NWHI contributed just over 50% of the total Deep-7 landings in the state for brief periods.

Nearly all (~99%) combined Deep-7 BMUS are caught using deep-sea handline gear. With few exceptions, deep-sea handline gear is today largely a Deep-7-specific gear type. Though traditionally literally a “handline” gear, today most deep-sea handline fishers use electric reels due to the great depths fished and heavy lead weights. Rigging varies between fishers but commonly employs the use of heavy lead weight and multiple baited hooks fished either near the bottom or higher in the water column depending on fish behavior and species targeted. The use of palu (chum) is common in deep-sea handline fishing and is typically delivered to depth using a palu bag attached above the hooks, or methods like “make dog” (maki-dogu) in which the lead weight, baited hooks, and chum are contained in a wrapped package and deployed at a desired depth releasing the contents. Though fishing methods continue to evolve, with some fishers today using lighter modified gears to catch Deep-7 from jet skis and even kayaks, the deep-sea handline gear type remains dominant.

Demand for Deep-7 species is driven in large part by the traditional consumption of a whole red fish during the holiday season. Though Asian in origin, this practice is commonplace in local households of all ethnicities and seen by many as an essential element of gatherings during the holiday season. Many local families will consume a whole bottomfish during New Year and/or Christmas celebrations. As a result, retail price and demand both increase markedly around this time. Deep-7, especially onaga and ‘ōpakapaka, are also preferred by Hawaii’s restaurant and hotel sectors. Size preference varies between consumers, with local consumers preferring smaller fish that can be cooked whole and the hotel and restaurant industries preferring larger fish more conducive to filleting for sale as individual portions.

The State of Hawaii Department of Land and Natural Resources (DLNR), Division of Aquatic Resources (DAR) manages the deep-sea bottomfish fishery in the Main Hawaiian Islands (MHI) under a joint management arrangement with the National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) and the Western Pacific Regional Fishery Management Council (WPFMC; the Council). The three collaborating agencies coordinate management to simplify regulations for the fishing public, prevent overfishing, and manage the fishery for long-term sustainability.

1.1.2 Commercial Reporting

MHI Deep-7 bottomfish fishing reports come from two sources: paper reports received by mail, fax, or PDF copy via e-mail, and reports filed online through the Online Fishing Report system (OFR). Since federal management of the Deep-7 bottomfish fishery began in 2007, bottomfish landings have been collected on three types of fishing reports. Initially, bottomfish fishers were required to use the Monthly Fishing Report and deep-sea handline Fishing Trip Report to report their Deep-7 landings within 10 days of the end of the month. These reports were replaced by the MHI Deep-7 Bottomfish Fishing Trip Report in September 2011, after which bottomfish fishers were required to submit trip reports within five days of the trip end date. To help ensure report accuracy, Deep-7 catch reports and dealer purchase reports are compared by a fisheries database assistant, who will call the fisher or dealer to clarify any discrepancies.

1.1.3 Management

Throughout the time series of commercial fishing records, the harvest of Deep-7 bottomfish has played a significant role in Hawaii's commercial fishing industry. The management of this fishery has changed drastically over the years, going from largely open and unregulated, to today being one of the most studied and regulated fisheries in the region.

Modern day regulation of this fishery began in 1996, when the Sustainable Fisheries Act of 1996 amended the MSA including requirements that 1) fishery managers would be required to provide definition of "overfished" and "overfishing" for each managed stock, and in-turn identify those that were overfished, and 2) for the stocks identified as overfished, managers would be required to take action to restore them to target population levels within ten years. MHI populations of both ehu and onaga, with estimated spawning potential ratios at that time of less than 20%, were both listed as recruitment overfished and required immediate action from fishery managers. The Division of Aquatic Resources in 1998 introduced HAR 13-94 Bottomfish Management which included multiple measures intended to manage the fishery including gear restrictions, non-commercial bag limits, a bottomfish fishing vessel registration, a fishery control date, restrictions relating to seasons, and the creation of 19 Bottomfish Restricted Fishing Areas (BRFAs). The goal of the original 19 BRFAs was to "Restrict fishing in about 20% of the known fishing areas where spawning onaga and ehu are caught;" This being prior to management under an annual catch limit, or ACL, the BRFAs were intended to protect 20% of the ehu and onaga spawning populations by closing 20% of their estimated habitat to all harvest. In 2005, eight years after their establishment, the original 19 BRFAs were evaluated using novel bathymetric mapping technology. It was determined that the BRFAs offered protection to just 5% of ehu and onaga habitat, far below the original goal of 20%. As a result, it was decided that the BRFAs needed to be redrawn, this time to achieve a new set of goals including 1) Reduce fishing mortality of the MHI bottomfish stocks by 15%, 2) rebuild bottomfish populations within the BRFAs, and 3)

improve populations in the areas adjacent to the BRFAs via larval transport and adult spillover. In 2007, the original 19 BRFAs were replaced by the 12 BRFAs in existence today. The optimistic outlook for the 2018 benchmark stock assessment resulted in a call to open fishing access to the BRFAs. In July 2019, the DLNR Board of Land and Natural Resources (BLNR) voted to open BRFAs, C, F, J, and L, yet keep the remaining eight closed pending an analysis of fishing performance inside the newly opened BRFAs and their surrounding areas. Though the analysis proved inconclusive, the BLNR voted to immediately open all remaining BRFAs in late February 2022.

In 2005, the MHI Deep-7 fishery (then classified as overfished) began management under a Total Allowable Catch (TAC). The following year, reauthorization of the MSA mandated that all federally managed fisheries assign Annual Catch Limits (ACLs). Initially, ACLs set for the MHI Deep-7 fishery were relatively low and resulted in multiple early season closures as catch exceeded limits. In 2018, NOAA released a new benchmark stock assessment for MHI Deep-7 which found the stock much healthier than previously thought (neither overfished nor experiencing overfishing). Prior to the 2018 stock assessment, scientists at PIFSC held multiple data workshops with fishers and stakeholders which led to key improvements to data filtering, trip designations, new CPUE calculations and standardization procedures, inclusion of fishery-independent survey data, and other changes to model parameters and inputs. An ACL of 492,000 lb. was subsequently set for the MHI Deep-7 fishery.

Today, the MHI Deep-7 fishery still operates under an ACL of 492,000 lb. of mixed deep-7 commercial catch. Rules specified under HAR 13-94 Bottomfish Management are still in place, with the exception that the BRFAs are now open to commercial and non-commercial deep-7 harvest. The time series format for the Deep-7 bottomfish fishery was by the State fiscal year period (July – June) until June 1993. Prior to July 1993, the State issued and renewed the Commercial Marine License (CML) on a fiscal year basis and all licenses expired on June 30, regardless of when they were issued. During that period, each fisher received a different CML number, reducing duplicate licensee counts through June 1993. Today, all CML numbers are permanently assigned to fishers. The federal Deep-7 bottomfish fishing year (FY), defined as September through August of the following year, was established in 2007. To evaluate Deep-7 bottomfish fishing trends, the time series format was re-arranged to extend from September to August beginning in September 1993. This arrangement provides a 22-year time series trend for the Deep-7 bottomfish fishery. There is a two-month segment spanning from July 1993 through August 1993 that is defined as a separate period. The fishery continues to be co-managed by DAR, NOAA, and the Council.

1.1.4 Fishery Performance

In 1965, the Deep-7 fishery was dominated by a relatively low number of skilled highliners that consistently produced large landings (Table 1). As the availability of modernized fishing boats and equipment increased in the 1970s and 1980s, so too did the number of fishers. In 1986, fishery participation peaked at 610 registered CML holders. With the expansion of the small vessel fleet, effort and landings increased accordingly and, in 1987 catch peaked at 596,255 pounds. Following the peak and subsequent decline in catch in the late 1980s, the Deep-7 fishery had another (albeit much smaller) increase in catch peaking in 2014. There are multiple likely causes of this most recent increase in catch including the closure of the Northwest Hawaiian

Islands (NWHI) in 2009, which resulted both in certain fishers moving effort into the MHI, and increased market demand to fill the void. The economic downturn and high unemployment rate associated with the recession during that period may have also led some to enter the fishery or increase effort to offset economic losses.

In FY 2024, licenses, trips, and landings were all below their corresponding short- and long-term averages (

Table 2). The Deep-7 fishery has been in relatively steady decline since FY 2014. Factors contributing to this recent decline are numerous including increasing shark depredation, declining fisher participation including skilled highliners, competing fisheries, and changes in market demand.

Table 1. Time series of commercial fishing reports for Deep-7 BMUS reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1965	84	1,149	428	14,611	211,326
1966	92	1,059	414	11,040	181,868
1967	110	1,469	550	16,005	231,315
1968	121	1,194	524	12,945	195,039
1969	132	1,216	532	11,415	177,495
1970	139	1,150	528	8,482	158,195
1971	167	1,254	606	10,203	135,156
1972	218	1,929	831	19,833	228,375
1973	210	1,574	732	16,747	169,273
1974	264	2,163	938	23,976	225,767
1975	247	2,096	904	24,165	222,114
1976	308	2,321	1,011	26,364	258,852
1977	338	2,722	1,173	26,880	274,308
1978	434	2,657	1,539	41,381	307,628
1979	447	2,256	1,517	32,312	273,841
1980	461	2,861	1,435	35,098	244,075
1981	486	3,770	1,637	45,086	308,306
1982	450	3,909	1,630	46,873	329,436
1983	538	4,880	1,892	61,889	409,453
1984	555	4,483	1,806	55,952	345,326
1985	556	5,812	2,065	93,799	507,639
1986	610	5,823	2,285	101,469	524,726
1987	586	5,591	2,194	133,023	596,255
1988	553	6,058	2,135	138,109	575,345
1989	569	6,327	2,252	122,033	575,616
1990	531	5,258	1,948	90,745	459,215
1991	499	4,216	1,770	67,666	331,144

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1992	488	4,511	1,845	84,427	362,517
1993.1	450	3,538	1,492	62,434	260,350
1993.2	120	373	167	7,280	28,519
1994	522	3,893	1,705	85,112	317,989
1995	526	3,919	1,711	77,776	319,940
1996	518	3,980	1,745	81,391	287,138
1997	500	4,181	1,760	81,594	297,678
1998	522	4,118	1,735	83,482	288,315
1999	433	3,012	1,431	56,755	214,180
2000	498	3,935	1,700	83,429	308,128
2001	458	3,570	1,550	70,812	262,874
2002	393	2,920	1,355	56,438	217,231
2003	364	2,959	1,255	63,311	248,463
2004	333	2,669	1,145	57,588	209,475
2005	352	2,705	1,200	61,406	241,173
2006	352	2,287	1,053	46,154	193,191
2007	357	2,553	1,148	50,008	204,862
2008	351	2,354	1,027	49,397	196,347
2009	478	3,283	1,479	67,065	259,356
2010	461	2,804	1,229	56,942	209,277
2011	474	3,490	1,432	74,886	274,571
2012	480	3,109	1,529	68,060	228,026
2013	459	2,990	1,501	68,493	239,036
2014	423	3,182	1,496	90,296	311,209
2015	411	2,890	1,415	90,790	307,014
2016	372	2,348	1,194	74,536	260,732
2017	340	2,351	1,162	66,483	237,879
2018	341	2,169	1,102	59,332	236,119
2019	318	2,023	1,045	47,879	181,125
2020	334	1,843	1,000	45,903	161,713
2021	320	2,092	1,042	52,050	164,171
2022	380	2,117	1,189	57,823	189,264
2023	359	2,050	1,123	58,538	197,158
2024	284	1,595	905	43,054	151,828
10-year avg.	346	2,148	1,118	59,639	208,703
20-year avg.	382	2,512	1,214	61,455	222,206

1993.1 = Fiscal Year 1993; 1993.2 = July-August of calendar year 1993.

Table 2. Annual fishing parameters for the 2024 fishing year in the MHI Deep-7 bottomfish fishery compared with short-term (10-year) and long-term (20-year) averages

Fishery	Parameter	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Deep-7 BMUS	No. Licenses	284	↓17.9%	↓25.7%
	Trips	1,595	↓25.7%	↓36.5%
	No. Caught	43,054	↓27.8%	↓29.9%
	Lb Caught	151,828	↓27.3%	↓31.7%

1.1.5 Fishery Performance and CPUE by Gear Type

1.1.5.1 Deep-Sea Handline

Dominant use of the deep-sea handline gear type has been persistent throughout the recorded MHI Deep-7 commercial fishery (Table 3). Because the deep-sea handline catches the overwhelming majority of Deep-7 catch per year, catch trends follow closely those of the combined fishery. FY 2024 deep-sea handline catch remained below the 10- and 20-year average.

Deep-sea handline CPUE decreased markedly during the expansion of the small boat fleet in the 1970s and 1980s (Table 3). During that period, the number of fishers and trips using deep-sea handline gear increased rapidly as new technology and availability of reliable fishing vessels increased. Following the expansion of the small boat fleet, deep-sea handline CPUE has remained relatively stable though variable between years. In FY 2024, deep-sea handline CPUE was close to the 10- and 20-year averages.

Deep-sea handline catch has always been dominated predominantly by two species: ‘ōpakapaka and onaga (Tables Table 4a and 4b). And though relative contributions of each species to the entire catch has varied over time, ‘ōpakapaka characteristically has been the leader in terms of landings. Catch of the other species using deep-sea handline over time show relatively similar trends to the more commonly targeted species. This is in part due to shared trends in overall fishery participation and effort, and the fact that the lesser-caught deep-7 species (hapu‘upu‘u, lehi, kale kale, and gindai) are typical incidental catch when targeting ‘ōpakapaka, onaga, and ehu. Over the past 20 years, the average percent catch contribution by species using deep-sea handline has remained relatively stable; 47% ‘ōpakapaka, 28% onaga, 12% ehu, 5% kalekale, 3% hapu‘upu‘u, 4% lehi, and 2% gindai. In FY 2024, deep-sea handline catch was similar to the 20-year average at 50% ‘ōpakapaka, 23% onaga, 10% ehu, 6% kalekale, 2% hapu‘upu‘u, 8% lehi, and 2% gindai. With the exception of lehi, deep-sea handline landings for the deep-7 species in FY 2024 were all below their 10- and 20-year averages (Table 5).

Table 3. DAR MHI annual Deep-7 BMUS CPUE (lb/trip) by dominant fishing methods reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024

Year	Deep-Sea Handline				Non-Deep-Sea Handline Gears			
	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE
1965	73	1,067	210,197	197.00	27	89	1,129	12.69
1966	86	1,016	180,404	177.56	15	46	1,464	31.83
1967	107	1,449	231,014	159.43	7	21	301	14.33
1968	118	1,165	194,682	167.11	5	29	357	12.31
1969	128	1,175	176,988	150.63	12	46	507	11.02
1970	135	1,118	157,853	141.19	9	35	342	9.77
1971	163	1,219	134,916	110.68	18	36	240	6.67
1972	214	1,896	227,744	120.12	18	39	631	16.18
1973	201	1,537	168,976	109.94	22	38	297	7.82
1974	258	2,126	225,181	105.92	14	37	586	15.84
1975	238	2,040	219,663	107.68	39	62	2,451	39.53
1976	272	2,062	248,191	120.36	92	269	10,661	39.63
1977	290	2,263	255,123	112.74	105	461	19,185	41.62
1978	392	2,365	297,167	125.65	145	351	10,461	29.80
1979	379	1,901	259,999	136.77	187	380	13,842	36.43
1980	412	2,594	235,261	90.69	123	304	8,814	28.99
1981	456	3,459	301,726	87.23	105	342	6,580	19.24
1982	428	3,680	322,649	87.68	97	276	6,787	24.59
1983	500	4,574	401,799	87.84	142	363	7,654	21.09
1984	505	4,176	334,097	80.00	161	383	11,229	29.32
1985	538	5,682	504,875	88.86	44	138	2,764	20.03
1986	587	5,638	519,332	92.11	99	203	5,394	26.57
1987	567	5,431	586,480	107.99	65	164	9,775	59.60
1988	537	5,980	573,531	95.91	50	85	1,814	21.34
1989	541	6,229	573,247	92.03	68	107	2,369	22.14
1990	526	5,239	458,361	87.49	8	19	854	44.95
1991	492	4,198	331,017	78.85	11	21	127	6.05
1992	483	4,488	362,350	80.74	7	23	167	7.26
1993.1	445	3,525	260,249	73.83	8	13	101	7.77
1993.2	119	371	28,466	76.73	n.d.	n.d.	n.d.	n.d.
1994	515	3,871	317,685	82.07	13	25	304	12.16
1995	517	3,895	319,634	82.06	17	24	306	12.75
1996	504	3,930	286,321	72.86	34	55	816	14.84
1997	481	4,111	294,852	71.72	44	83	2,826	34.05
1998	506	4,049	286,833	70.84	35	79	1,482	18.75
1999	416	2,919	212,752	72.89	36	101	1,428	14.14

Year	Deep-Sea Handline				Non-Deep-Sea Handline Gears			
	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE
2000	492	3,886	307,460	79.12	28	50	668	13.35
2001	446	3,529	262,372	74.35	25	45	503	11.17
2002	384	2,885	216,599	75.08	22	38	632	16.63
2003	344	2,855	246,288	86.27	45	107	2,174	20.32
2004	303	2,550	206,893	81.13	48	122	2,582	21.16
2005	319	2,595	238,820	92.03	51	111	2,353	21.20
2006	323	2,176	189,873	87.26	43	111	3,318	29.89
2007	335	2,438	201,422	82.62	40	118	3,440	29.15
2008	329	2,250	191,475	85.10	34	104	4,872	46.84
2009	450	3,133	253,883	81.04	61	153	5,474	35.78
2010	422	2,679	206,891	77.23	67	128	2,386	18.64
2011	450	3,387	271,438	80.14	47	104	3,133	30.13
2012	465	3,008	226,275	75.22	32	102	1,752	17.17
2013	439	2,858	235,564	82.42	38	133	3,472	26.11
2014	404	3,069	308,472	100.51	36	114	2,737	24.01
2015	392	2,782	304,085	109.3	33	109	2,929	26.87
2016	360	2,266	259,009	114.3	23	82	1,723	21.01
2017	325	2,226	233,181	104.75	34	126	4,698	37.28
2018	328	2,075	233,562	112.56	25	94	2,557	27.21
2019	299	1,900	178,439	93.92	38	125	2,686	21.49
2020	320	1,713	159,501	93.11	26	131	2,213	16.89
2021	299	1,916	160,012	83.51	38	177	4,159	23.49
2022	360	1,974	185,612	94.03	40	143	3,653	25.54
2023	344	1,959	194,831	99.45	23	92	2,328	25.30
2024	264	1,475	147,673	100.12	29	120	4,155	34.63
10-year avg.	329	2,029	205,593	101	31	120	3,110	26
20- year avg.	361	2,394	219,004	92	38	119	3,202	27

1993.1 = Fiscal Year 1993; 1993.2 = July-August of calendar year 1993.

Table 4a. DAR MHI annual Deep-7 catch summary by species and top gear, deep-sea handline, reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024

Year	‘Ōpakapaka		Onaga		Ehu		Hapu‘upu‘u	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
1965	66	102,901	31	59,521	48	20,093	48	10,965
1966	76	70,651	34	63,965	47	17,607	49	11,863
1967	96	120,888	43	68,442	62	18,350	60	10,624
1968	97	84,164	62	69,504	68	19,871	58	11,304
1969	115	85,663	48	53,839	68	16,088	60	10,881

Year	‘Ōpakapaka		Onaga		Ehu		Hapu‘upu‘u	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
1970	114	69,538	44	43,540	62	15,870	64	19,842
1971	130	59,002	53	39,213	78	15,255	81	14,471
1972	184	117,426	71	58,673	105	21,282	112	16,659
1973	175	93,197	68	35,584	94	14,524	117	14,828
1974	220	134,838	86	43,607	113	21,113	117	14,444
1975	199	114,571	94	45,016	115	21,705	108	23,078
1976	224	101,718	118	78,684	152	28,069	140	21,236
1977	255	98,398	100	82,049	144	32,530	130	26,769
1978	345	149,538	135	66,124	191	34,385	197	27,366
1979	306	140,303	133	51,601	190	20,859	184	28,053
1980	344	147,341	161	29,889	183	15,828	182	16,984
1981	386	193,944	153	42,659	207	20,754	188	16,056
1982	369	173,764	176	65,235	232	24,088	189	20,854
1983	421	226,614	240	71,687	277	27,482	209	31,849
1984	396	153,925	240	84,615	282	35,430	208	29,010
1985	442	202,822	297	172,774	310	43,928	253	33,098
1986	481	180,087	346	195,675	371	60,969	245	27,238
1987	459	263,468	291	175,365	323	45,963	180	32,699
1988	448	301,053	275	159,975	299	43,234	197	11,094
1989	440	309,112	305	147,724	322	42,916	187	15,442
1990	419	210,224	307	143,003	312	37,720	176	14,203
1991	384	136,764	276	104,294	300	31,943	168	16,528
1992	374	173,118	253	91,813	310	31,907	167	15,136
1993.1	346	138,613	194	52,634	256	23,926	167	13,180
1993.2	85	14,511	51	5,707	60	3,059	34	1,971
1994	393	176,151	243	71,564	290	22,903	191	10,766
1995	426	178,302	236	66,199	288	26,109	228	14,932
1996	415	147,093	244	67,985	276	28,892	220	10,110
1997	377	157,591	216	59,587	263	26,598	213	13,740
1998	386	145,776	250	68,926	299	25,154	215	11,933
1999	326	101,875	199	60,611	233	19,548	179	9,737
2000	386	166,747	251	70,984	282	26,804	209	13,084
2001	339	126,788	253	63,089	272	25,603	202	15,531
2002	291	105,788	200	60,699	223	17,029	167	8,844
2003	254	127,628	188	70,487	212	15,740	142	9,483
2004	233	88,099	186	76,519	193	20,571	130	8,255
2005	249	102,303	202	87,832	208	21,890	131	10,121
2006	245	76,968	203	75,063	206	17,980	123	7,442

Year	‘Ōpakapaka		Onaga		Ehu		Hapu‘upu‘u	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
2007	271	82,489	201	80,747	224	17,713	117	5,967
2008	268	94,099	197	55,825	207	17,850	130	6,209
2009	362	133,475	245	59,827	296	24,674	168	7,808
2010	325	101,986	251	57,011	297	24,061	165	7,960
2011	369	147,813	258	67,652	306	24,191	176	7,973
2012	345	109,606	261	56,084	323	27,024	157	10,397
2013	327	98,600	246	68,314	308	31,332	156	10,366
2014	324	162,369	234	75,213	276	30,408	161	10,667
2015	309	151,223	228	78,006	271	33,080	138	9,934
2016	285	133,770	203	62,411	234	30,844	122	9,718
2017	266	133,898	173	46,100	223	24,226	127	7,714
2018	258	114,413	183	66,252	220	21,483	129	9,593
2019	210	67,256	158	60,396	218	24,948	107	6,359
2020	235	63,787	158	41,333	220	24,984	104	5,602
2021	198	57,403	157	45,309	221	29,135	91	4,065
2022	256	78,699	192	47,519	256	31,341	98	4,378
2023	267	96,956	200	46,640	245	25,524	76	3,330
2024	201	72,478	154	34,514	188	14,472	61	3,099
10-yr avg.	249	96,988	181	52,848	230	26,006	105	6,379
20-yr avg.	279	103,980	205	60,604	247	24,859	127	7,435

1993.1 = Fiscal Year 1993; 1993.2 = July-August of calendar year 1993.

Table 4b. DAR MHI annual Deep-7 catch summary by species and top gear, deep-sea handline, reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024

Year	Kalekale		Gindai		Lehi	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
1965	25	14,538	19	923	21	1,256
1966	32	13,536	20	829	20	1,953
1967	34	9,584	22	769	32	2,357
1968	31	6,870	28	754	34	2,215
1969	32	4,131	23	462	41	5,924
1970	33	5,079	34	1,437	29	2,547
1971	38	4,316	36	870	34	1,789
1972	65	8,059	50	1,237	58	4,408
1973	66	5,093	47	1,260	57	4,490
1974	64	4,860	49	1,467	67	4,852
1975	79	5,885	59	1,365	78	8,043
1976	100	7,562	59	1,076	84	9,846

Year	Kalekale		Gindai		Lehi	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
1977	96	7,590	66	1,143	81	6,644
1978	150	8,823	103	2,308	116	8,623
1979	126	6,602	89	2,505	114	10,076
1980	142	6,294	87	2,089	123	16,836
1981	152	7,377	108	1,654	143	19,282
1982	158	7,735	102	1,473	139	29,500
1983	192	14,080	138	2,321	193	27,766
1984	191	12,427	160	2,798	158	15,892
1985	237	22,171	181	4,598	201	25,484
1986	283	25,059	195	3,756	185	26,548
1987	263	28,154	144	3,328	214	37,503
1988	228	18,130	121	2,075	186	37,970
1989	219	11,053	132	1,830	230	45,170
1990	248	15,482	178	2,785	207	34,944
1991	245	18,874	189	3,644	166	18,970
1992	252	28,002	190	5,120	158	17,254
1993.1	245	16,954	153	3,765	154	11,177
1993.2	48	1,908	28	652	19	658
1994	236	20,252	176	4,062	129	11,987
1995	239	17,284	187	3,721	171	13,087
1996	266	19,561	156	3,159	134	9,523
1997	224	22,634	141	2,837	142	11,866
1998	239	23,084	176	3,260	150	8,701
1999	174	11,113	130	2,182	109	7,687
2000	217	15,973	170	3,215	149	10,654
2001	187	15,371	155	3,740	142	12,251
2002	155	11,036	134	2,308	114	10,896
2003	151	12,523	108	2,131	97	8,296
2004	127	7,584	96	2,085	73	3,779
2005	133	7,846	98	2,028	85	6,800
2006	139	5,262	97	1,516	74	5,643
2007	146	5,646	106	2,010	80	6,851
2008	126	5,320	119	2,424	106	9,748
2009	209	9,382	169	3,557	153	15,159
2010	211	7,926	157	2,677	104	5,270
2011	213	9,804	178	2,947	115	11,058
2012	221	12,187	177	3,868	104	7,109
2013	226	12,028	184	3,423	113	11,503

Year	Kalekale		Gindai		Lehi	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
2014	228	18,861	159	3,715	105	7,239
2015	222	17,623	135	2,882	130	11,338
2016	177	12,832	125	1,843	97	7,591
2017	169	10,782	121	2,130	111	8,332
2018	174	11,882	118	2,611	102	7,329
2019	169	10,184	129	3,452	79	5,844
2020	194	11,041	155	5,123	81	7,631
2021	164	11,170	146	5,573	81	7,357
2022	195	11,615	158	5,769	90	6,291
2023	196	9,967	154	5,111	96	7,304
2024	150	8,231	123	2,618	71	12,261
10-yr avg.	181	11,533	137	3,712	94	8,128
20-yr avg.	183	10,480	140	3,264	99	8,383

1993.1 = Fiscal Year 1993; 1993.2 = July-August of calendar year 1993.

Table 5. Annual fishing parameters for deep-sea handline for the 2024 fishing year in the MHI Deep-7 bottomfish fishery compared with short-term (10-year) and long-term (20-year) averages

Method	Species/ Fishery Indicator	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Deep-Sea Handline	‘Ōpaka	72,478 lb	↓25.3%	↓30.3%
	Onaga	34,514 lb	↓34.7%	↓43.0%
	Ehu	14,472 lb	↓44.4%	↓41.8%
	Hapu‘upu‘u	3,099 lb	↓51.4%	↓58.3%
	Kalekale	8,231 lb	↓28.6%	↓21.5%
	Gindai	2,618 lb	↓29.5%	↓19.8%
	Lehi	12,261 lb	↑50.8%	↑46.3%
	No. Lic.	264	↓19.8%	↓26.9%
	No. Trips	1,475	↓27.3%	↓38.4%
	Lb Caught	147,673 lb	↓28.2%	↓32.6%
	CPUE	100.1 lb/trip	↓0.9 %	↑8.8%

1.1.5.2 Non-Deep-Sea Handline Gears

The following section includes Deep-7 species that are harvested using gear types other than deep-sea handline, including both inshore handline and palu ahi. These gear types do occasionally harvest Deep-7 BMUS though they are typically not their primary targets. The inshore handline gear is intended to be a lighter tackle than the deep-sea handline. Though it is possible to catch Deep-7 with inshore handline gear, it is likely that some of the landings were made with heavier tackle gear but were reported incorrectly as inshore handline. Palu ahi is a

tuna handline gear primarily used to target yellowfin and bigeye tuna. Deep-7 BMUS are occasional bycatch for Hawai‘i Island fishers that regularly use the palu ahi method. Some of the landings may have been taken by fishers who used deep-sea handline tackle but reported it as palu ahi because of the gear definition, which also involves weights and chum on a handline. If DAR personnel suspects incorrect gear types may have been recorded, fishers are contacted for verification. The fishing reports are not amended if the fisher does not respond.

CPUE for non-deep-sea handline gears has fluctuated while staying consistently below that of deep-sea handline (

Table 2). Again, much of the catch using these gears may be incidental while target in other species, or fishers using less efficient gears to target deep-7. It is not surprising therefore that CPUE remains well-below that of the complex-specific gear. Non-deep-sea handline CPUE in FY 2024 was similar to both the 10 and 20-year averages.

The two Deep-7 species most caught with non-deep-sea handline gears are ‘ōpakapaka and lehi, both of which can be found in relatively shallower waters in comparison to the other deep-7 species (Table 6a and 6b). ‘ōpakapaka was also the most targeted of the Deep-7 species. It is likely that some of the ‘ōpakapaka caught with non-deep-sea handline gears are being targeted either with non-deep-sea handline gears or incorrectly reported deep-sea handline gear. Non-deep-sea handline gears in the past 20 years make up approximately 1% of all Deep-7 catch. Fishers continue to modify their gears to target deep-7 in different situations including from jet skis and kayaks. Total FY 2024 deep-7 landings using non-deep-sea handline gear was greater than the 10 and 20-year average (Table 7).

Table 6a. DAR MHI annual Deep-7 catch summary by species for non-deep sea handline methods reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024

Year	‘Ōpakapaka		Onaga		Ehu		Hapu‘upu‘u	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
1965	18	662	n.d.	n.d.	11	222	3	37
1966	7	756	n.d.	n.d.	7	537		
1967	3	263					n.d.	n.d.
1968	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1969	4	281	n.d.	n.d.	4	80	n.d.	n.d.
1970	3	152					n.d.	n.d.
1971	7	108	6	57	5	26	n.d.	n.d.
1972	5	428	n.d.	n.d.	3	26	5	72
1973	7	159	n.d.	n.d.	3	37	4	17
1974	8	375			n.d.	n.d.	6	181
1975	23	1,613	3	38	6	214	10	123
1976	41	3,771	18	1,550	40	3,210	38	1,163
1977	77	7,927	21	2,704	41	3,218	36	3,345
1978	68	5,104	14	381	42	1,319	29	1,241
1979	106	5,708	21	1,426	63	1,632	61	1,503
1980	54	3,715	32	1,455	36	1,170	28	726

Year	‘Ōpakapaka		Onaga		Ehu		Hapu‘upu‘u	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
1981	47	3,423	14	210	28	397	27	907
1982	29	3,964	13	710	26	348	18	826
1983	61	3,233	22	1,105	36	506	30	845
1984	65	5,382	44	1,984	36	730	36	721
1985	10	850	7	1,097	8	102	12	121
1986	38	1,770	15	851	25	930	20	325
1987	34	3,947	8	304	11	3,238	15	673
1988	14	818	6	241	6	158	11	193
1989	28	1,044	16	675	11	167	9	170
1990	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	6	454
1991							11	127
1992	n.d.	n.d.					6	118
1993.1	n.d.	n.d.					6	88
1993.2	n.d.	n.d.					n.d.	n.d.
1994	n.d.	n.d.					8	126
1995	3	45					8	144
1996	7	262			n.d.	n.d.	10	129
1997	12	360	3	20	5	576	7	785
1998	12	799	n.d.	n.d.	3	37	7	68
1999	10	164			n.d.	n.d.	n.d.	n.d.
2000	10	148			n.d.	n.d.	3	19
2001	10	110	3	37	5	104	4	53
2002	7	200	n.d.	n.d.	3	71	3	62
2003	27	1,025	4	136	8	220	7	100
2004	30	1,283	6	100	11	129	8	188
2005	22	938	3	200	8	255	5	132
2006	21	1,787	4	344	6	121	4	93
2007	23	1,459	5	169	6	447	3	468
2008	20	2,118	3	62	4	412	4	370
2009	29	2,581	8	260	13	270	7	209
2010	35	757	5	201	20	271	10	203
2011	28	1,634	4	125	14	318	8	260
2012	23	540			3	59	n.d.	n.d.
2013	26	1,417	n.d.	n.d.	3	141	3	63
2014	25	1,262	3	35	5	30	n.d.	n.d.
2015	22	1,647	3	62	5	183	n.d.	n.d.
2016	16	954	n.d.	n.d.	5	19	n.d.	n.d.
2017	23	3,288			4	126	7	182

Year	‘Ōpakapaka		Onaga		Ehu		Hapu‘upu‘u	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
2018	14	1,471	n.d.	n.d.	7	111	n.d.	n.d.
2019	24	1,259			n.d.	n.d.	4	139
2020	16	876	4	103	3	21	n.d.	n.d.
2021	23	1,725	4	49	6	151	n.d.	n.d.
2022	24	1,720	n.d.	n.d.	10	398	6	87
2023	18	814	n.d.	n.d.	4	107	n.d.	n.d.
2024	20	2,114	4	74	4	284	n.d.	n.d.
10-yr avg.	20	1,587	3	84	5	145	3	67
20-yr avg.	23	1,518	3	138	7	189	4	126

A blank cell indicates no available data; “n.d.” = non-disclosure due to data confidentiality.

1993.1 = Fiscal Year 1993; 1993.2 = July-August of calendar year 1993.

Table 6b. DAR MHI annual Deep-7 catch summary by species for non-deep-sea handline methods, reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024

Year	Kalekale		Gindai		Lehi	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
1965	8	115	n.d.	n.d.	n.d.	n.d.
1966	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1967	n.d.	n.d.			n.d.	n.d.
1968	n.d.	n.d.				
1969	n.d.	n.d.	n.d.	n.d.		
1970	n.d.	n.d.			n.d.	n.d.
1971	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1972	5	13	4	8	3	22
1973	7	13	n.d.	n.d.	n.d.	n.d.
1974	n.d.	n.d.			n.d.	n.d.
1975	7	76	4	38	10	349
1976	14	345	21	133	13	489
1977	21	1,008	16	382	18	601
1978	36	1,003	34	245	43	1,168
1979	71	1,152	33	378	58	2,043
1980	25	753	27	305	33	690
1981	22	801	22	200	27	642
1982	21	315	21	142	25	482
1983	35	922	34	332	29	711
1984	25	994	35	767	36	651
1985	12	522	n.d.	n.d.	n.d.	n.d.
1986	27	356	3	4	18	1,158

Year	Kalekale		Gindai		Lehi	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
1987	13	402	3	18	16	1,193
1988	8	129	3	6	15	269
1989	8	181	n.d.	n.d.	9	129
1990	n.d.	n.d.				
1991						
1992	n.d.	n.d.				
1993.1	n.d.	n.d.				
1993.2						
1994	3	22			n.d.	n.d.
1995	n.d.	n.d.			6	92
1996	5	32	3	62	13	253
1997	7	650	5	91	22	345
1998	5	205			15	351
1999	n.d.	n.d.	n.d.	n.d.	27	843
2000	7	129	n.d.	n.d.	16	357
2001	6	86	3	79	4	34
2002	5	113	n.d.	n.d.	6	159
2003	6	110	4	40	18	545
2004	7	51	3	66	20	765
2005	10	114	6	71	23	644
2006	9	86	n.d.	n.d.	23	874
2007	6	121	5	120	18	657
2008	10	212	3	404	20	1,295
2009	12	316	6	90	32	1,748
2010	15	160	12	64	24	731
2011	11	185	10	153	15	459
2012	7	67	n.d.	n.d.	19	1,050
2013	n.d.	n.d.	n.d.	n.d.	22	1,532
2014	5	53	n.d.	n.d.	27	1,328
2015	7	35	3	18	20	948
2016	n.d.	n.d.	n.d.	n.d.	12	597
2017	9	221	n.d.	n.d.	20	842
2018	5	22	n.d.	n.d.	16	919
2019	6	54	n.d.	n.d.	25	1,154
2020	3	25			6	92
2021	9	53	7	74	26	2,077
2022	11	181	7	172	21	895
2023	5	69	n.d.	n.d.	15	1,201

Year	Kalekale		Gindai		Lehi	
	No. License	Catch (lb)	No. License	Catch (lb)	No. License	Catch (lb)
2024	8	246	n.d.	n.d.	20	1,279
10-year avg.	7	91	3	54	19	1,105
20- year avg.	8	113	4	75	21	1,068

A blank cell indicates no available data; “n.d.” = non-disclosure due to data confidentiality.

1993.1 = Fiscal Year 1993; 1993.2 = July-August of calendar year 1993.

Table 7. Annual fishing parameters for non-deep-sea handline methods for the 2024 fishing year in the MHI Deep-7 bottomfish fishery compared with short-term (10-year) and long-term (20-year) averages

Method	Species/ Fishery Indicator	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Non-Deep-Sea Handline Methods	‘ōpakapaka	2,114 lb	↑0.1%	↑39.3%
	Onaga	74 lb	↑1.0%	↓46.1%
	Ehu	284 lb	↑1.4%	↑50.3%
	Hapu‘upu‘u	n.d.	n.d.	n.d.
	Kalekale	246 lb	↑3.0%	↑117.7%
	Gindai	n.d.	n.d.	n.d.
	Lehi	1,279 lb	↑0.1%	↑19.8%
	No. Lic.	29	↓6.5%	↓23.7%
	No. Trips	120	0	↑0.8 %
	Lb Caught	4,155 lb	↑33.6%	↑29.8%
	CPUE	34.6 lb/trip	↑33.2%	↑28.3%

“n.d.” = non-disclosure due to data confidentiality.

1.1.6 Bycatch Summary

BMUS bycatch when using deep-sea handline gear is generally low due to a lack of commercial bag limits and largely nonrestrictive one-pound commercial size limits for ‘ōpakapaka and onaga only (Table 8). Also, at the depths fished, barotrauma causes death or serious injury to most fish caught so release is often forgone to avoid waste. The increase in bycatch beginning in 2007 and peaking in 2013 is due primarily to tagging efforts by PIFSC and Pacific Islands Fisheries Group (PIFG). Tagging was performed by local fishers with CMLs, so all Deep-7 caught and released for research purposes were included in their reports. In FY 2024, percent bycatch for the Deep-7 fishery remained close to short- and long-term average values. The bycatch of non-Deep-7 when using deep-sea handline gear is consistently higher. A primary cause is that kahala (*Seriola* spp.) are frequently caught alongside Deep-7 species. Avoided by many local consumers due to their reputation for carrying ciguatera and often having parasite-laden flesh, kahala are some of the most frequently released species; despite comprising less than three percent of non-target catch using deep-sea handline, kahala make up ~60% of the releases. FY 2024 bycatch of non-BMUS using deep-sea handline was near both short- and long-term average values.

The reported species composition of bycatch using deep-sea handline is diverse, including some smaller typically shallow water associated species (Table 9). Of the most consistently released non-BMUS species using the gear type, kahala and sharks are no surprise, yet the presence of ‘ū‘ū (*Myripristis* spp.; soldierfishes) seems peculiar given that they are typically considered a target of the inshore handline fishery. While it is possible to catch ‘ū‘ū while fishing for Deep-7, in particular pa‘ū‘ū (*Myripristis chryseres*; yellowfin soldierfish), we suspect that many of these releases may be due to the fisher incorrectly classifying their inshore handline gear as deep-sea handline. Misreporting of gear type and/or species is more apparent for species on the list such as weke ‘ula (*Mulloidichthys vanicolensis*; yellowfin goatfish), moana (*Parupeneus multifasciatus*, manybar goatfish), akule, opelu, and laenihi (*Iniistius* spp. razorfishes) which are very unlikely to be caught with deep-sea handline gear.

Table 8. Time series of commercial fishing bycatch of Deep-7 BMUS and non-target species harvested with deep-sea handline, reported by Fishing Year from 2005-2024

Target Species (Deep-7 Bottomfish)							Non-Target Species (Harvested with Deep-Sea Handline)					
Year	No. Lic.	Trips	No. Reports	No. Retained	No. Released	Percent Bycatch	No. Lic.	Trips	No. Reports	No. Retained	No. Released	Percent Bycatch
2005	352	2,705	1,200	61,406	156	0.25	329	1,908	977	17,452	1,643	8.60
2006	352	2,287	1,053	46,154	55	0.12	331	1,665	856	17,284	1,214	6.56
2007	357	2,553	1,148	50,008	535	1.06	328	1,969	976	24,506	1,162	4.53
2008	351	2,354	1,027	49,397	542	1.09	330	2,008	944	29,287	2,827	8.80
2009	478	3,283	1,479	67,065	507	0.75	424	2,311	1,135	26,918	1,231	4.37
2010	461	2,802	1,229	56,942	1,102	1.90	431	2,504	1,181	40,116	1,589	3.81
2011	474	3,456	1,432	74,886	2,098	2.73	458	2,583	1,280	37,560	1,787	4.54
2012	480	3,109	1,529	68,060	1,416	2.04	446	2,199	1,203	29,859	1,537	4.90
2013	459	2,990	1,501	68,493	2,012	2.85	413	2,094	1,148	28,606	1,823	5.99
2014	423	3,182	1,496	90,296	1,474	1.61	373	2,201	1,139	31,149	1,355	4.17
2015	411	2,890	1,415	90,790	1,378	1.50	355	2,061	1,105	31,290	1,709	5.18
2016	372	2,348	1,194	74,536	733	0.97	331	1,859	993	28,023	1,430	4.86
2017	340	2,351	1,162	66,483	411	0.61	313	1,922	974	29,247	1,623	5.26
2018	341	2,169	1,102	59,332	440	0.74	331	1,660	931	25,460	2,515	8.99
2019	318	2,023	1,045	47,879	630	1.30	298	1,481	870	26,638	1,671	5.90
2020	334	1,844	1,001	45,908	211	0.46	296	1,195	753	17,540	1,340	7.10
2021	320	2,092	1,042	52,050	196	0.38	275	1,426	810	28,982	1,974	6.38
2022	380	2,117	1,189	57,823	450	0.77	299	1,228	791	18,937	718	3.65
2023	359	2,050	1,123	58,538	394	0.67	274	1,194	727	24,101	798	3.20
2024	284	1,595	905	43,054	482	1.11	211	896	572	9,174	433	4.51
10-year avg.	346	2,148	1,118	59,639	533	0.85	298	1,492	853	23,938	1,421	5.50
20-year avg.	382	2,510	1,214	61,455	761	1.14	342	1,818	968	26,106	1,519	5.57

Table 9. Time series of commercial fishing bycatch of the top 10 most caught species in the Deep-7 bottomfish fishery harvested with deep-sea handline, reported by Fishing Year over the past 10 years

Species	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
‘Ōpakapaka (<i>Pristipomoides filamentosus</i> ; pink snapper)	316	233	263	96	91	397	272	324	524	1041
Kāhala (<i>Seriola dumerili</i> , <i>S. rivoliana</i> ; amberjack)	233	336	349	794	849	843	820	874	877	969
Ehu (<i>Etelis carbunculus</i> ; ruby snapper)	135	65	80	63	68	114	83	43	97	146
Manō (<i>Selachii</i> spp.; sharks)	101	183	59	299	224	190	195	223	207	235
Hāuliuli (<i>Gempylus serpens</i> ; snake mackerel)	n.d.	n.d.	n.d.		n.d.				n.d.	88
Onaga (<i>Etelis coruscans</i> ; longtail snapper)	25	52	41	21	25	80	50	39		125
‘Ū‘ū (<i>Myripristis</i> spp.; soldierfishes)	n.d.	76	154	540	n.d.	237	438	150	n.d.	81
Ta‘ape (<i>Lutjanus kasmira</i> ; bluestripe snapper)	n.d.			49	33	54	79	127		
Uku (<i>Aprion virescens</i>), or green jobfish	7	24		123				65	41	65
Kalekale (<i>Pristipomoides seiboldii</i> ; Von Siebold’s snapper)	4	32	54						32	
‘Ōpelu Kala (<i>Naso hexacanthus</i> ; sleek unicornfish)		n.d.	n.d.	72	n.d.	n.d.				
Moana (<i>Parupeneus multifasciatus</i> , manybar goatfish)			n.d.	n.d.					31	
Akule (<i>Selar crumenophthalmus</i> ; bigeye scad)					n.d.	n.d.	627			
‘Ōpelu (<i>Decapterus macarellus</i> ; mackerel scad)						n.d.				
Ahi (<i>Thunnus albacares</i> ; yellowfin tuna)							n.d.			
Weke ‘ula (<i>Mulloidichthys vanicolensis</i> ; yellowfin goatfish)							n.d.			
Pāpā (<i>Ferdauia orthogrammus</i> ; island jack)								n.d.		
Kamanu (<i>Elagatis bipinnulata</i> ; rainbow runner)								n.d.		
Laenihi (<i>Iniistius</i> spp.; razorfishes)									n.d.	
‘Āweoweo (<i>Heteropriacanthus</i> spp.; bigeyes)										115
‘Āweoweo (<i>Cookeolus japonicus</i> ; longfin bigeye)										57
Percent of all Bycatch	90	84	86	95	83	83	87	91	85	95

A blank cell indicates the species was not part of the top ten most caught bycatch species in that year; “n.d.” = non-disclosure due to data confidentiality. Note: releases of Deep-7 BMUS, such as ‘ōpakapaka, in early parts of the time series were likely associated with a tagging research program.

1.2 *APRION VIRESCENS* (UKU)

1.2.1 Fishery Overview

The MHI fishery for uku (*Aprion virescens*; green jobfish) occurs in both federal and state waters of the MHI. In the past twenty years, about 35% of all MHI uku landings were reported in state waters. The fishery is spread across the MHI, though heavily concentrated in certain areas such as penguin bank.

Because uku occupy a wide range of habitats from shallow inshore waters to greater depths, they are targeted using a wide variety of gear types including shore-based fishing gears and spearfishing. Uku are also common incidental catch while targeting other species again due to the wide range of habitats utilized. Currently, the deep-sea handline is the primary gear used to target uku. Uku catch typically peaks around May of each year when fish congregate in their spawning aggregations. This seasonal peak is mainly driven by commercial targeting on Penguin Bank, though some fishers catch uku year-round elsewhere in relatively high numbers. Many commercial fishers view uku as an additional seasonal component of the deep-7 bottomfish fishery.

Uku are like ‘ōpakapaka, onaga, and other Deep-7 in that they are regarded highly for their firm and flavorful white flesh good for both cooking and raw consumption. Uku are not typically used to fill the seasonal demand for whole fish during the holiday season due to consumer preference for red color. The uku fishery can be driven in large part by the hotel and restaurant industries that take advantage of the low-price alternative to Deep-7 BMUS.

The State of Hawaii Department of Land and Natural Resources (DLNR), Division of Aquatic Resources (DAR) manages the uku fishery in the Main Hawaiian Islands (MHI) under a joint management arrangement with the National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) and the Western Pacific Regional Fishery Management Council (WPFMC; the Council). The three collaborating agencies coordinate management to simplify regulations for the fishing public, prevent overfishing, and manage the fishery for long-term sustainability.

1.2.2 Commercial Reporting

The collection of commercial uku fishing reports comes from two sources: paper reports received by mail, fax, or PDF copy via e-mail; and reports filed online through the OFR. Uku are reported by commercial fishers on the Monthly Fishing Report, the Net, Trap, Dive Activity Report, or the MHI Deep-7 Bottomfish Fishing Trip Report.

Like the Deep-7 fishery, the time series format for the uku fishery begins with an arrangement by the State fiscal year period (July – June) until June 1993 before being reported by calendar year. Refer to data processing procedures documented in the Deep-7 BMUS section for paper fishing reports and fishing reports filed online. Database assistants and data monitoring associates will enter the paper Monthly Fishing Report information within four weeks, and the Net, Trap, Dive Activity Report and the MHI Deep-7 Bottomfish Fishing Trip Report within two business days.

1.2.2.1 Historical Summary

Like Deep-7, MHI uku fishery landings and effort are in a state of decline following a peak in 2017. Potential causes of these declines, including the impact of the COVID-19 pandemic on landings and effort will be discussed further in Section 1.2.4. In 2024, participation, catch, and effort for the MHI uku fishery were all below their corresponding short- and long-term averages.

1.2.3 Management

Once a member of the non-Deep-7 BMUS complex, uku were previously grouped with the white/giant ulua (*Caranx ignobilis*), gunkan/black ulua (*Caranx lugubris*), butaguchi/pig-lip ulua (*Pseudocaranx dentex*), and yellowtail kalekale (*Pristipomoides auricilla*) before being removed due to the ecosystem component species (ECS) amendment to the Hawaii FEP in 2019 (84 FR 2767, February 8, 2019). In 2024, the MHI uku fishery was managed under an ACL of 295,419 lb of combined commercial and non-commercial catch. This contrasts with the MHI Deep-7 fishery which is tracked using commercial catch alone. If the MHI uku ACL is exceeded, commercial and non-commercial fishing would be closed in federal waters, while only commercial fishing would be closed in State waters. Again, this contrasts with the Deep-7 fishery in which exceedance of the ACL results in a commercial and non-commercial closure in both federal and State waters. The decision to maintain the non-commercial fishery in State waters regardless of ACL reflects the State's commitment to prioritizing non-commercial fishing opportunities in nearshore waters.

1.2.4 Fishery Performance

Commercial uku catch spiked dramatically in 1989 (Table 10). Though effort and participation also increased during the same time, local fishers have reported that the increase in catch was due to a sudden appearance of abundant adult uku into Hawaiian waters. Following the 1989 peak, catch quickly decreased to a low in 1996. Between 2003 and 2017, uku catch increased steadily likely due to multiple factors. Prior to 2010, a large proportion (occasionally the majority) of all uku landed annually in the State were caught in the NWHI. Following the NWHI closure in 2009, some fishers moved effort down into the MHI. MHI fishers also likely took advantage of the high market demand left by the void in catch. After multiple initial closures of the Deep-7 fishery due to exceedance of the ACL, some Deep-7 bottomfish fishers switched to targeting uku as an alternative, further developing the fishery. Increasing market demand, especially to supply hotels and restaurants, has also been suggested as a cause of the most recent increase in catch. Between 2003 and 2018, the average price per pound (adjusted for inflation) offered by registered dealers showed a persistent increase. Lastly, the economic downturn and increased unemployment caused by the recession starting around 2008 may have influenced new entrants into the fishery and/or more effort by existing fishers in attempts to offset economic losses.

The initial impact of the COVID-19 pandemic on the MHI uku fishery was significant as hotel and restaurant demand was almost eliminated following the lockdown in March 2020. As a result, some wholesalers limited their purchases drastically to adjust for the low demand. Unlike Deep-7, uku do not have a seasonal local demand in addition to the hotel and restaurant markets. As tourists returned to Hawaii following the easing of travel restrictions, uku wholesale prices increased. However, the fishery did not show an immediate commensurate response, with

landings remaining below pre-pandemic levels. It is likely that some fishers are targeting higher values species in lieu of uku fishing to take advantage of exceptional post-COVID prices. Additionally, as with the Deep-7 fishery, uku fishers have noted that shark depredation has been increasing in severity. Depredation can be especially bad when uku are targeted directly in high numbers, such as the fishery on Penguin Bank where a sizable proportion of MHI uku can be caught annually. The fishing community noted that depredation losses (both fish and gear) at Penguin Bank may be causing some fishers to shift effort away from targeting uku.

Effort, participation, and catch were all below short-and long-term averages in 2024 (Table 11). Again, this may be the result of both the short-term impacts of competing fisheries and frustrations stemming from shark depredation, and the long-term impacts of an aging fleet struggling to find replacement highliners.

Table 10. Time series of commercial fishing reports for uku by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1965	83	627	312	1,732	68,231
1966	84	571	278	1,297	46,816
1967	108	733	366	1,911	64,215
1968	110	571	318	1,224	52,362
1969	116	716	377	1,554	54,139
1970	125	731	394	1,576	49,794
1971	137	608	356	1,712	48,418
1972	161	761	441	1,369	54,139
1973	169	767	472	1,897	46,578
1974	235	1,040	632	3,769	72,955
1975	213	1,041	580	2,709	75,490
1976	213	934	518	2,388	69,009
1977	245	1,093	612	2,643	47,094
1978	376	1,569	1,038	4,460	94,798
1979	381	1,346	1,037	4,832	82,747
1980	362	1,488	902	5,150	63,714
1981	392	2,117	1,107	7,950	95,027
1982	384	1,994	1,107	7,664	92,871
1983	410	2,653	1,321	10,853	121,498
1984	423	2,389	1,202	12,471	141,601
1985	387	1,878	1,017	8,867	96,014
1986	307	1,346	741	4,767	67,695
1987	326	1,353	776	7,275	87,805
1988	423	2,454	1,157	14,100	185,689
1989	477	3,032	1,523	27,108	314,285
1990	454	2,205	1,267	11,720	139,387
1991	403	1,824	1,081	9,596	117,084

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1992	384	1,702	1,003	8,640	93,561
1993.1	336	1,327	798	6,080	65,925
1993.2	230	696	420	2,816	34,463
1994	355	1,457	867	5,960	73,286
1995	339	1,304	789	6,131	60,128
1996	360	1,320	887	6,234	53,346
1997	420	1,705	1,006	8,099	68,003
1998	366	1,455	890	6,992	61,147
1999	379	1,493	908	11,129	90,992
2000	383	1,546	923	10,820	83,341
2001	303	1,197	768	6,749	59,095
2002	276	1,040	671	6,788	59,347
2003	282	1,028	670	5,446	46,440
2004	319	1,291	772	8,751	76,338
2005	302	1,170	741	7,891	65,242
2006	259	1,186	673	6,852	61,152
2007	280	1,265	717	8,390	69,105
2008	318	1,486	812	11,298	92,576
2009	371	1,479	906	10,091	88,196
2010	407	1,924	1,075	13,660	121,046
2011	383	1,700	986	13,095	109,929
2012	407	1,755	1,076	13,600	116,410
2013	395	1,814	1,054	14,052	121,476
2014	379	1,679	1,004	11,687	97,003
2015	417	1,846	1,085	12,891	101,965
2016	378	1,914	1,051	15,129	118,597
2017	363	1,776	1,019	17,507	132,735
2018	287	1,236	747	10,151	75,292
2019	286	1,295	793	11,106	90,016
2020	253	1,031	626	5,952	48,038
2021	233	1,006	612	7,440	60,363
2022	235	895	570	6,724	52,973
2023	217	830	536	6,138	45,012
2024	191	691	456	4,793	38,012
10-year avg.	286	1,252	750	9,783	76,302
20-year avg.	318	1,399	827	10,423	85,258

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 11. Annual fishing parameters for 2024 in the MHI uku fishery compared with short-term (10-year) and long-term (20-year) averages

Fishery	Parameter	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Uku	No. License	191	↓33.2%	↓39.9%
	Trips	691	↓44.8%	↓50.6%
	No. Caught	4,793	↓51.0%	↓54.0%
	lb Caught	38,012	↓50.2%	↓55.4%

1.2.5 Fishery Performance and CPUE by Gear Type

The MHI uku fishery is not easy to define in terms of gear use, especially in recent years. Because of the wide range of depths and habitat types frequented by uku, they are caught both intentionally and incidentally using a wide range of gears including spearfishing and shore-based casting. Deep-sea handline has historically been the dominant gear. However, since about 1975 proportional catch using deep-sea handline gear has decreased as other gears become more commonly reported (Table 12). This may be indicative of a shift to direct targeting with unique gears and/or techniques specifically aimed at uku. Fishers moving to target uku have in some cases chosen to report as different methods. While some fishers have redefined their gear as inshore handline to reflect lighter gear weight, others have chosen to move away from the handline designation entirely and report instead with other gears, most notably casting (included in the below table as “All Other Gear Types”).

In 2024, uku were caught primarily with the deep-sea handline (64%), with inshore handline (9%), trolling with bait (14%), and other gears (13%) contributing smaller proportions of the total landings. Annual reported uku catch, participation, and effort for all four of these gears have been decreasing overtime, with 2024 values below both their short-term, and long-term averages (Table 13). CPUE in 2024 was below short- and long-term averages for deep-sea handline and “all other gears” and above short-and long-terms averages for inshore handline and trolling with bait.

Table 12. Time series of uku CPUE (lb/trip) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024

Year	Deep-Sea Handline				Inshore Handline				Troll with Bait				All Other Gear Types			
	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE
1965	74	560	66,926	119.51	10	17	822	48.35					7	51	483	9.47
1966	78	514	46,358	90.19	4	4	50	12.50					6	53	408	7.70
1967	101	683	63,303	92.68	4	5	554	110.8					9	46	358	7.78
1968	104	510	51,715	101.4	8	13	345	26.54					8	48	302	6.29
1969	107	615	52,824	85.89	3	3	24	8.00					11	98	1,291	13.17
1970	115	633	48,645	76.85	3	4	20	5.00					10	94	1,129	12.01
1971	133	548	48,038	87.66	3	4	25	6.25					5	56	355	6.34
1972	154	663	53,336	80.45	3	3	12	4.00					12	95	791	8.33
1973	161	675	45,817	67.88	8	9	47	5.22					12	83	714	8.60
1974	216	969	72,132	74.44	7	10	158	15.8					21	61	665	10.90
1975	191	947	74,325	78.48	16	23	331	14.39					24	71	834	11.75
1976	166	732	63,048	86.13	42	97	2,453	25.29					33	106	3,508	33.09
1977	187	716	36,177	50.53	60	211	7,792	36.93					49	166	3,125	18.83
1978	303	1,097	75,501	68.82	134	298	14,348	48.15					49	181	4,949	27.34
1979	248	857	67,218	78.43	211	431	12,673	29.4					26	70	2,856	40.80
1980	290	1,196	57,753	48.29	71	113	1,836	16.25					78	181	4,125	22.79
1981	338	1,763	90,177	51.15	67	110	1,198	10.89					59	247	3,652	14.79
1982	354	1,752	88,334	50.42	43	64	582	9.09					40	180	3,955	21.97
1983	368	2,451	115,347	47.06	46	67	581	8.67					56	141	5,570	39.50
1984	381	2,152	134,986	62.73	53	76	1,169	15.38					69	166	5,446	32.81
1985	361	1,785	94,464	52.92	4	4	207	51.75					33	89	1,343	15.09
1986	270	1,220	63,788	52.29	22	52	2,323	44.67					47	75	1,584	21.12
1987	247	988	61,460	62.21	91	245	11,695	47.73					53	120	14,650	122.08
1988	350	2,091	167,959	80.32	91	186	10,401	55.92					59	177	7,329	41.41

Year	Deep-Sea Handline				Inshore Handline				Troll with Bait				All Other Gear Types			
	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE
1989	424	2,667	298,435	111.9	75	162	4,532	27.98					77	209	11,318	54.15
1990	375	1,799	122,703	68.21	78	218	2,653	12.17					91	189	14,031	74.24
1991	322	1,427	103,311	72.4	106	236	4,719	20.00					75	165	9,054	54.87
1992	281	1,119	68,813	61.5	127	441	18,850	42.74					73	144	5,898	40.96
1993.1	222	808	54,507	67.46	114	354	8,286	23.41					60	166	3,132	18.87
1993.2	172	508	30,667	60.37	45	90	1,740	19.33					40	99	2,056	20.77
1994	259	1,026	59,416	57.91	93	275	11,415	41.51					74	158	2,455	15.54
1995	249	931	52,322	56.2	76	222	4,836	21.78					78	152	2,970	19.54
1996	223	743	41,024	55.21	140	400	8,612	21.53					87	179	3,710	20.73
1997	231	912	47,676	52.28	189	634	17,575	27.72					87	161	2,752	17.09
1998	224	771	44,129	57.24	146	550	14,049	25.54					69	134	2,970	22.16
1999	236	836	76,039	90.96	153	508	11,700	23.03					61	150	3,253	21.69
2000	246	914	67,280	73.61	143	485	12,948	26.7					71	148	3,113	21.03
2001	185	700	38,547	55.07	115	356	15,369	43.17					62	143	5,179	36.22
2002	176	618	44,885	72.63	81	279	9,765	35.00	9	17	404	23.74	69	127	4,294	33.81
2003	141	576	31,930	55.43	78	209	6,454	30.88	17	67	4,674	69.75	86	177	3,382	19.11
2004	155	721	56,942	78.98	94	307	7,871	25.64	23	93	7,395	79.52	86	170	4,130	24.3
2005	164	655	46,370	70.79	71	217	5,378	24.78	18	90	6,768	75.2	89	209	6,726	32.18
2006	147	665	39,997	60.15	51	230	9,554	41.54	12	76	6,171	81.2	80	216	5,430	25.14
2007	153	684	45,566	66.62	66	276	11,488	41.62	12	112	7,500	66.96	78	193	4,552	23.58
2008	177	826	63,152	76.46	84	319	12,983	40.7	17	123	10,962	89.12	95	220	5,480	24.91
2009	205	845	66,618	78.84	90	291	10,677	36.69	16	61	2,789	45.72	118	284	8,112	28.56
2010	221	1,068	83,633	78.31	100	367	17,152	46.74	31	118	5,890	49.92	135	373	14,370	38.53
2011	206	868	77,323	89.08	96	401	18,232	45.47	28	114	4,076	35.75	140	319	10,298	32.28
2012	206	767	75,310	98.19	90	409	19,789	48.38	32	147	5,793	39.41	144	435	15,518	35.67
2013	184	799	76,271	95.46	80	332	18,964	57.12	44	218	7,945	36.44	169	470	18,297	38.93

Year	Deep-Sea Handline				Inshore Handline				Troll with Bait				All Other Gear Types			
	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE	No. Lic.	Trips	Catch (lb)	CPUE
2014	163	715	56,801	79.44	67	276	12,156	44.04	45	196	8,259	42.14	167	492	19,788	40.22
2015	178	779	65,083	83.55	64	346	12,659	36.59	49	172	6,344	36.88	200	550	17,879	32.51
2016	181	822	73,362	89.25	59	308	11,518	37.39	33	222	12,721	57.3	173	565	20,997	37.16
2017	201	901	85,567	94.97	45	318	16,954	53.32	35	151	13,717	90.84	153	409	16,496	40.33
2018	138	469	34,014	72.52	34	273	17,363	63.6	28	133	7,446	55.99	140	363	16,469	45.37
2019	145	529	48,327	91.36	38	259	16,460	63.55	41	142	5,390	37.95	131	370	19,840	53.62
2020	121	410	26,454	64.52	33	227	8,112	35.73	29	108	4,132	38.26	106	286	9,340	32.66
2021	123	449	38,004	84.64	27	142	5,108	35.97	29	156	6,697	42.93	99	260	10,554	40.59
2022	137	467	35,177	75.32	23	108	7,071	65.47	24	108	3,917	36.27	74	212	6,808	32.12
2023	114	411	29,781	72.46	22	72	3,907	54.27	23	98	2,909	29.69	90	251	8,429	33.58
2024	100	357	24,472	68.55	20	65	3,290	50.62	25	94	5,195	55.27	70	175	5,055	28.88
10-yr avg.	144	559	46,018	80	37	212	10,250	50	32	138	6,847	48	124	344	13,187	38
20-yr avg.	163	674	54,561	80	58	262	11,944	46	29	132	6,731	52	123	333	12,022	35

A blank cell indicates no available data; “n.d.” = non-disclosure due to data confidentiality.

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 13. Annual fishing parameters for 2024 in the MHI uku fishery by gear compared with short-term (10-year) and long-term (20-year) averages

Method	Species/ Fishery Indicator	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Deep-Sea Handline	No. Lic.	100	↓30.6%	↓38.7%
	No. Trips	357	↓36.1%	↓47.0%
	Lb Caught	24,472 lb	↓46.8%	↓55.1%
	CPUE	68.6 lb/trip	↓14.3%	↓14.3%
Inshore Handline	No. Lic.	20	↓45.9%	↓65.5%
	No. Trips	65	↓69.3%	↓75.2%
	Lb Caught	3,290 lb	↓67.9%	↓72.5%
	CPUE	50.6 lb/trip	↑1.2%	↑10.0%
Troll with Bait	No. Lic.	25	↓21.9%	↓13.8%
	No. Trips	94	↓31.9%	↓28.8%
	Lb Caught	5,195 lb	↓24.1%	↓22.8%
	CPUE	55.3 lb/trip	↑15.1%	↑6.3%
All Other Gears	No. Lic.	70	↓43.5%	↓43.1%
	No. Trips	175	↓49.1%	↓47.4%
	Lb Caught	5,055 lb	↓61.7%	↓58.0%
	CPUE	28.9 lb/trip	↓24.0%	↓17.5%

1.2.6 Bycatch Summary

Uku percent bycatch is typically low (<2%) since the only regulation limiting commercial catch is a one-pound minimum size for spearing and sale (Table 14). Uku less than one pound can be retained for personal consumption. Percent bycatch has seen steady increase since 2002. One contributing factor is the increasing use of inshore handline gear over time. In the past ten years, inshore handline gear landed approximately 15% of the total uku catch yet contributed about 50% of all releases. Peak uku percent bycatch in 2020 is likely also the result of COVID-19 restrictions limiting market demand. Individual fishers noted that during the most restrictive lockdown periods, local dealers were drastically limiting the amount of uku they were willing to purchase per day. Percent bycatch for uku in 2024 was near short-term, and long-term averages.

In comparison to other species targeted with similar gears, uku are retained at a slightly higher rate (Table 14). This is due in part to the fact that commonly released species such as kahala and sharks are caught with similar gears and drive the non-uku bycatch rates up slightly. However, the majority of the non-target species included in the below table were caught while not targeting uku (e.g., inshore handline for akule and deep-sea handline for Deep-7). Non-uku bycatch in 2024 was below both short-term, and long-term averages.

Species composition of bycatch while using gears commonly used to target uku is dominated primarily by species caught with inshore handline (Table 15). Inshore handline is typically used to target a diverse array of smaller inshore species, and therefore sees more releases. Other top non-uku bycatch such as sharks and kahala are commonly caught using deep-sea handline, the most commonly used gear to catch uku though typically with less fish released than inshore handline. Species composition of bycatch in 2024 was typical of this set of gears.

Table 14. Time series of commercial fishing bycatch of uku and non-target species harvested with deep-sea handline, inshore handline, or casting, reported by Fishing Year from 2005-2024

Target Species (Uku)							Non-Target Species (Harvested with Deep-Sea Handline, Inshore Handline, or Casting)					
Year	No. Lic.	Trips	No. Reports	No. Retained	No. Released	Percent Bycatch	No. Lic.	Trips	No. Reports	No. Retained	No. Released	Percent Bycatch
2005	302	1,170	741	7,891	12	0.15	642	6,964	2,433	430,528	3,654	0.84
2006	259	1,186	673	6,852	27	0.39	633	7,035	2,410	554,901	3,124	0.56
2007	280	1,265	717	8,390	13	0.15	675	7,637	2,640	590,755	3,748	0.63
2008	318	1,486	812	11,298	27	0.24	823	8,288	2,910	564,609	5,908	1.04
2009	371	1,479	906	10,091	52	0.51	921	10,603	3,680	725,166	7,613	1.04
2010	407	1,924	1,075	13,660	81	0.59	893	10,157	3,618	689,383	10,223	1.46
2011	383	1,695	986	13,095	148	1.12	865	8,884	3,243	625,588	8,115	1.28
2012	407	1,754	1,076	13,600	132	0.96	903	8,857	3,475	590,003	8,135	1.36
2013	395	1,811	1,054	14,052	134	0.94	897	8,890	3,444	610,218	9,062	1.46
2014	379	1,678	1,004	11,687	169	1.43	857	8,473	3,428	604,623	10,844	1.76
2015	417	1,844	1,085	12,891	208	1.59	809	7,844	3,123	599,988	9,639	1.58
2016	378	1,908	1,051	15,129	154	1.01	736	7,085	2,850	497,687	8,243	1.63
2017	363	1,771	1,019	17,507	100	0.57	717	7,144	2,915	502,823	10,922	2.13
2018	287	1,223	747	10,151	119	1.16	651	5,752	2,428	458,744	9,759	2.08
2019	286	1,283	793	11,106	171	1.52	636	5,731	2,482	445,626	7,665	1.69
2020	253	1,026	626	5,952	147	2.41	612	4,704	2,173	414,488	6,687	1.59
2021	233	999	612	7,440	148	1.95	565	4,440	2,000	350,405	7,267	2.03
2022	235	887	570	6,724	18	0.27	606	4,802	2,157	428,105	7,171	1.65
2023	217	829	537	6,141	30	0.49	550	3,897	1,865	337,193	4,822	1.41
2024	191	691	457	4,793	65	1.34	460	3,333	1,591	327,194	4,600	1.39
10-year avg.	286	1,246	750	9,783	116	1.23	634	5,473	2,358	436,225	7,678	1.72
20-year avg.	318	1,395	827	10,423	98	0.94	723	7,026	2,743	517,403	7,360	1.43

Table 15. Time series of commercial fishing bycatch of the top 10 most caught species in the uku fishery harvested with deep-sea handline, inshore handline, or casting, reported by Fishing Year over the past 10 years

Species	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
‘Ū‘ū (<i>Myripristis</i> spp.; soldierfishes)	1,327	1,268	2,970	2,865	2,874	3,162	4,567	4,487	2,628	2,603
Akule (<i>Selar crumenophthalmus</i> ; bigeye scad)	627	932	1,106	972	427	399	769	1,052	317	
Moana (<i>Parupeneus multifasciatus</i> , manybar goatfish)	583	515	498	605	562	218	349	321	358	409
‘Ōpelu (<i>Decapterus macarellus</i> ; mackerel scad)	454	185	261		131	152	343			
Kahala (<i>Seriola dumerili</i> , <i>S. rivoliana</i> ; amberjack)	346	249	414	547	1,024	1,076	961	1,225	978	1,040
‘Ōpakapaka (<i>Pristipomoides filamentosus</i> ; pink snapper)	292	282	149	263		369	166	407	403	858
Humuhumu (<i>Balistidae</i> spp.; triggerfishes)	265	393	448	551	223				162	
Halalū (<i>Selar crumenophthalmus</i> ; juvenile bigeye scad)	136						174	264		
Ta‘ape (<i>Lutjanus kasmira</i> ; bluestripe snapper)	108	196	227	452	322	794	864	1,140	1,001	800
Manō (<i>Selachii</i> spp.; sharks)	87		209	238	268	342	244	332	302	303
Ahi (<i>Thunnus albacares</i> ; yellowfin tuna)		121								298
Ehu (<i>Etelis carbunculus</i> ; ruby snapper)		114				121				
‘Ōpelu Kala (<i>Naso hexacanthus</i> ; sleek unicornfish)			n.d.							
Uku (<i>Aprion virescens</i>), or green jobfish				148	143	167				198
Weke Nono (<i>Mulloidichthys pfluegeri</i> ; Pflueger’s goatfish)				78	131					188
‘Āweoweo (<i>Heteropriacanthus</i> spp.; bigeyes)							310	403	836	1,578
Omilu (<i>Caranx melampygus</i> ; bluefin trevally)								138	154	
Percent of all Bycatch	91	88	87	91	89	87	89	89	85	84

A blank cell indicates the species was not part of the top ten most caught bycatch species in that year; “n.d.” = non-disclosure due to data confidentiality.

1.3 CORAL REEF ECOSYSTEM COMPONENTS

1.3.1 Fishery Overview

Hawaii's inshore commercial fisheries cover a broad range of species and gear types. The top-5 gears (by landings) used to target these inshore non-MUS include gill nets, inshore handline, seine nets, spearfishing, and lift ('opelu) nets. Overwhelmingly these inshore resources are consumed locally, with exports occurring rarely. Some species such as mollusks and invertebrates are prized delicacies and fetch high retail prices. Other species like many herbivore species are often found in markets priced below imports. These species fill an important niche in Hawaii's small independent fish markets, offering fresh local fish at an affordable price.

1.3.2 Commercial Reporting

The collection of commercial ECS finfish and invertebrate fishing reports comes from two sources: paper reports received by mail, fax, or PDF copy via e-mail, and reports filed online through the OFR. The ECS are reported by commercial fishers in the Monthly Fishing Report, the Net, Trap, Dive Activity Report, or the MHI Deep-7 Bottomfish Fishing Trip Report.

Similar to the Deep-7 bottomfish, the time series format for the ECS fishery begins with an arrangement by the State fiscal year period (July – June) until June 1993 before being reported by calendar year. Refer to data processing procedures documented in the Deep-7 BMUS section for paper fishing reports and fishing reports filed online (see Section 1.1.2). Database assistants and the data monitoring associate will enter the paper Monthly Fishing Report information within four weeks, and the Net, Trap, Dive Activity Report and the MHI Deep-7 Bottomfish Fishing Trip Report within two business days.

In terms of catch parameters (pieces and pounds), the reliability of each can vary depending on the size, quantity, and collection techniques associated with each species. Pieces caught is generally seen as less accurate of a measure of catch in that some fishers have a practice of providing only a rough estimate of number or occasionally omit this information altogether. This is especially common in species that are small in size and/or caught in large quantities. Whereas counting small and/or numerous catches is time consuming, weighing is simple and ensures that dealer records (which rely on weight as a primary measure of purchase) will be similar to what is reported on fishing reports. In most cases, DAR recommends using weight over pieces as a measure of catch.

1.3.3 Management

In 2018, the Council drafted an Amendment 5 to the Hawaii Archipelago FEP that reclassified a large number of MUS as Ecosystem Component Species (ECS; WPRFMC 2018). The final rule was posted in the Federal Register in early 2019 (84 FR 2767, February 8, 2019). This amendment reduced the number of MUS from 173 species/families to 20 in the Hawaii FEP. All former coral reef ecosystem management unit species (CREMUS) were reclassified as ECS that do not require ACL specifications or accountability measures but are still to be monitored regularly to prioritize conservation and management efforts and to improve efficiency of fishery management in the region. All existing management measures, including reporting and record keeping, prohibitions, and experimental fishing regulations apply to the associated ECS.

Today, ECS are managed by the State of Hawaii as their fisheries occur almost entirely in state waters. Rules governing the take of ECS include an array of species-based size limits, bag limits, seasonal restrictions, gear restrictions, and place-based rules.

1.3.4 Most Harvested ECS

Scads including akule (*Selar crumenophthalmus*; bigeye scad) and ‘ōpelu (*Decapterus macarellus*; mackerel scad) persistently dominate Hawaii’s inshore fisheries in terms of landings. Total scad catch peaked in 1998 at 1.5 million pounds, at that time greatly exceeding other archipelagic fisheries and rivaling the MHI tuna handline fisheries in landings. Scad landings have decreased, yet still make up the majority of inshore species caught (Table 16).

The other species in the top-ten harvested ECS of 2024 reflect the diverse nature of Hawaii’s inshore fisheries. Ta‘ape (*Lutjanus kasmira*; bluestripe snapper), palani (*Acanthurus dussumieri*; eyestripe surgeonfish), weke ‘ula (*Mulloidichthys vanicolensis*; yellowfin goatfish), and kala (*Naso unicornis*, *N. brevirostris*, *N. annulatus*; unicornfishes) are primarily targeted with nets and landed in large amounts; they fetch a relatively low price at market. ‘Ū‘ū are caught with inshore handline and uhu (*Scaridae* spp.; parrotfishes) are targeted primarily by night scuba spearfishing. Both are highly prized and bring a much higher price at market than most inshore finfish species. Kuahonu (*Portunus sanguinolentus*; blood-spotted swimming crab), the only invertebrate on the list, are targeted by a small, specialized fishery but are high in value. Kahala (*Seriola dumerili*, *S. rivoliana*; amberjack) are generally low-value, but as common incidental catch in a variety of inshore and offshore fisheries can make up a sizable proportion of the non-MUS landings.

Species composition of the top-ten ECS in 2024 was typical for the combined fisheries. Species like akule, ‘ōpelu, ta‘ape, and ‘ū‘ū are persistently leaders in terms of landings. Lesser-caught species like kuahonu and kahala move in and out of the annual top-ten depending on fishery effort and highliner behavior.

Table 16. Top ten landed species (lb) in Hawaii ECS fisheries in 2024

Species	No. Licenses	Trips	Catch (lb)
Akule (<i>Selar crumenophthalmus</i> ; bigeye scad)	124	1,084	202,261
‘Ōpelu (<i>Decapterus macarellus</i> ; mackerel scad)	114	816	90,709
Ta‘ape (<i>Lutjanus kasmira</i> ; bluestripe snapper)	125	559	33,563
‘Ū‘ū (<i>Myripristis</i> spp.; soldierfishes)	101	520	31,831
Uhu (<i>Scaridae</i> spp.; parrotfishes)	30	318	29,504
Palani (<i>Acanthurus dussumieri</i> ; eyestripe surgeonfish)	34	317	24,246
Weke ‘ula (<i>Mulloidichthys vanicolensis</i> ; yellowfin goatfish)	39	157	16,823
Kala (<i>Naso unicornis</i> , <i>N. brevirostris</i> , <i>N. annulatus</i> ; unicornfishes)	30	200	14,451
Kahala (<i>Seriola dumerili</i> , <i>S. rivoliana</i> ; amberjack)	92	285	9,546
Kuahonu (<i>Portunus sanguinolentus</i> ; blood-spotted swimming crab)	n.d	n.d	n.d

1.3.4.1 Prioritized ECS

Following the shift from CREMUS to ECS, DAR selected ten ECS species for regular monitoring in SAFE reports. These prioritized ECS species are ‘opihi (*Cellana* spp.; limpets), ‘ula (*Panulirus marginatus*, *P. penicillatus*; spiny lobsters), ‘ula papapa (*Scyllarides*

squammosus; scaly slipper lobster), kūmū (*Parupeneus porphyreus*; whitesaddle goatfish), omilu (*Caranx melampygus*; bluefin trevally), uhu, he'e (*Octopus cyanea*; day octopus), kala, nenu (*Kyphosus* spp.; chubs), manini (*Acanthurus triostegus*; convict tang), and ta'ape. Time series of commercial fishing reports for these species are included in this report. These ten species are important not only commercially, but recreationally and culturally as well.

A common catch trend among inshore species in the past 20 years was a peak occurring between 2010 and 2015. This trend can be seen in a diverse array of fisheries including those using handpick, net, hook and line, and spearfishing gear types. This is thought to be in part due to the 2008 recession. In times of economic downturn and high unemployment, an increase in the number of individuals participating in these fisheries is common as some turn to commercial fishing to supplement their incomes or replace lost jobs. For many of these species, catch tracks similarly with statewide rates of unemployment. Unlike offshore boat-based fisheries, the targeting of inshore species requires minimal initial investment and therefore the greatest ease of entry. Accordingly, it is likely that the decreasing unemployment rates post-2011 influenced the declining participation, effort, and catch in many of these fisheries.

Many ECS fisheries may have been largely spared from the effects of COVID-19 restrictions since they are purchased almost entirely by locals for home consumption. Some ECS fisheries like 'opihi, kūmū, kala, manini, and ta'ape even saw increases in catch between 2019 and 2020. Job loss and economic insecurity may have driven some of this increase, though its total impact is unknown.

In 2024, 'ula (*Panulirus marginatus*) was the only ECS with landings in pounds greater than one or more of its corresponding short- and long-term averages (

Table 27). Because commercial spiny lobster harvest in the MHI is at present very limited and therefore prone to year-to-year variability, this increase likely does not suggest a major change to the overall fishery. Across all priority species and their diverse fisheries, participation and effort both continue to decrease consistently. Challenges to these small artisanal fisheries include an aging fleet, increased prevalence of cheap fresh imports, changing demographics and consumer preference, and increasing cost of operation.

Table 17. Time series of commercial fishing reports for all 'opihi (*Cellana* spp.; limpet) species reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1965	14	239	66		16,651
1966	13	171	61		13,989
1967	40	779	176		36,000
1968	26	450	112		23,185
1969	36	413	127		23,818
1970	41	392	133	1,810	20,446
1971	46	368	148	1,929	17,229
1972	44	268	117	5	16,739
1973	46	257	121	600	17,169
1974	51	351	147	66,163	19,558
1975	46	333	140	115	14,396

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1976	52	327	151	13,560	19,052
1977	60	306	157	750	13,969
1978	54	231	155	15,622	15,119
1979	51	182	158		14,146
1980	49	230	119	28	10,617
1981	36	218	87	30	7,889
1982	36	190	82	1	7,725
1983	37	190	78		6,675
1984	40	181	95	61	8,548
1985	36	285	95	151	13,512
1986	64	289	141	1,066	12,426
1987	91	563	222	200	17,949
1988	71	334	145	618	12,277
1989	68	319	143	40	11,685
1990	56	179	110		7,848
1991	58	212	114		7,680
1992	55	315	130		9,271
1993.1	39	194	87		5,672
1993.2	26	138	55		4,628
1994	42	435	137		11,444
1995	56	461	151		13,098
1996	41	371	115		12,079
1997	51	299	125	1,106	10,979
1998	50	289	128	110	13,936
1999	43	406	112		10,774
2000	31	415	103		9,950
2001	24	356	96	710	12,938
2002	32	427	105	11,300	13,373
2003	23	341	106	9,980	11,714
2004	15	193	57	2,234	8,087
2005	12	181	42	372	7,380
2006	19	143	51	7,919	10,264
2007	20	182	63	5,508	6,911
2008	27	202	67	3,692	10,530
2009	25	294	81	16,716	22,773
2010	34	340	97	16,570	26,747
2011	25	261	78	41,370	16,053
2012	28	289	96	8,750	18,377
2013	18	362	86	6,893	25,816
2014	27	333	91	10,419	22,417

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2015	17	248	82	14,126	14,211
2016	16	156	77	39,166	9,125
2017	16	198	80	72,820	11,131
2018	18	231	94	76,541	13,368
2019	20	182	91	50,631	11,018
2020	11	205	67	108,529	16,558
2021	14	222	67	108,060	16,423
2022	11	163	62	73,165	12,450
2023	10	89	29	77,892	8,565
2024	5	71	27	56,000	6,858
10-year avg.	14	177	68	67,693	11,971
20-year avg.	19	218	71	39,757	14,349

A blank cell indicates no available data; "n.d." = non-disclosure due to data confidentiality.

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 18a. Time series of commercial fishing reports for ‘ula (*Panulirus marginatus*; Hawaiian spiny lobster) from reported by Calendar Year from 2002-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2002	8	19	12	95	243
2003	24	79	46	733	1,498
2004	13	90	30	922	1,708
2005	12	31	18	134	300
2006	8	17	11	33	74
2007	7	22	12	230	506
2008	3	33	8	603	1,409
2009	12	92	27	1,331	3,067
2010	9	61	18	1,088	2,478
2011	7	57	23	735	1,691
2012	11	64	26	880	2,023
2013	3	64	14	901	2,369
2014	8	55	15	871	2,171
2015	3	8	4	79	141
2016	n.d.	n.d.	n.d.	n.d.	n.d.
2017	5	17	11	152	331
2018	n.d.	n.d.	n.d.	n.d.	n.d.
2019	3	6	4	52	106
2020	4	11	5	137	316
2021	n.d.	n.d.	n.d.	n.d.	n.d.
2022	n.d.	n.d.	n.d.	n.d.	n.d.
2023	3	14	6	146	314
2024	3	9	7	176	491

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
10-year avg.	3	11	5	126	285
20-year avg.	5	30	11	403	947

“n.d.” = non-disclosure due to data confidentiality.

Table 18b. Time series of commercial fishing reports for ‘ula (*Panulirus penicillatus*; green spiny lobster) from reported by Calendar Year from 2002-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2002	9	39	13	871	1,760
2003	20	129	48	2,912	5,906
2004	17	191	48	3,460	6,743
2005	20	296	60	5,710	11,333
2006	12	231	52	3,736	7,589
2007	14	201	52	3,722	7,682
2008	16	228	52	4,631	10,091
2009	23	281	64	5,487	11,437
2010	20	232	55	4,590	9,559
2011	18	199	50	4,370	8,902
2012	19	208	56	3,910	7,749
2013	11	185	40	4,153	8,534
2014	11	172	35	3,972	8,289
2015	10	132	36	2,834	5,742
2016	10	135	34	2,015	4,054
2017	9	165	38	2,636	5,223
2018	7	132	33	2,284	4,325
2019	7	119	27	2,057	4,098
2020	6	122	24	1,846	3,385
2021	5	75	17	1,184	1,935
2022	4	61	14	1,003	1,708
2023	7	91	16	1,407	2,638
2024	7	55	16	1013	1866
10-year avg.	7	109	26	1,828	3,497
20-year avg.	12	166	39	3,128	6,307

Table 18c. Time series of commercial fishing reports for ‘ula papapa (*Scyllarides squammosus*; scaly slipper lobster) from reported by Calendar Year from 2002-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2002	n.d.	n.d.	n.d.	n.d.	n.d.
2003					
2004					
2005					
2006	n.d.	n.d.	n.d.	n.d.	n.d.

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2007	4	9	7	76	58
2008	3	3	3	8	10
2009	n.d.	n.d.	n.d.	n.d.	n.d.
2010	6	18	11	49	58
2011	6	13	10	85	54
2012	4	12	8	51	36
2013	3	10	6	37	47
2014	n.d.	n.d.	n.d.	n.d.	n.d.
2015	3	3	3	28	40
2016	4	6	5	18	23
2017	n.d.	n.d.	n.d.	n.d.	n.d.
2018	n.d.	n.d.	n.d.	n.d.	n.d.
2019	n.d.	n.d.	n.d.	n.d.	n.d.
2020	n.d.	n.d.	n.d.	n.d.	n.d.
2021					
2022					
2023					
2024	n.d.	n.d.	n.d.	n.d.	n.d.
10-year avg.	2	2	2	56	25
20-year avg.	3	6	4	47	32

A blank cell indicates no available data; “n.d.” = non-disclosure due to data confidentiality.

Table 19. Time series of commercial fishing reports for kūmū (*Parupeneus porphyreus*; white saddle goatfish) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1965	62	700	234	1,874	12,060
1966	51	546	201	2,900	8,515
1967	62	575	216	3,826	9,599
1968	51	482	179	3,570	8,599
1969	72	649	240	3,215	8,616
1970	78	635	248	2,883	8,408
1971	96	598	270	1,649	7,205
1972	98	583	274	2,674	6,394
1973	99	617	296	2,731	8,813
1974	109	629	290	3,521	7,894
1975	88	630	255	2,585	7,033
1976	104	639	285	3,037	7,367
1977	117	887	380	2,629	10,373
1978	168	897	519	3,731	15,435
1979	163	620	488	3,133	15,429

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1980	149	810	439	2,544	13,978
1981	143	1,192	465	4,891	15,235
1982	119	980	411	3,024	10,164
1983	119	771	361	2,145	8,728
1984	143	814	386	2,074	7,150
1985	134	941	396	2,015	10,866
1986	117	719	331	1,194	6,760
1987	129	782	368	2,290	7,919
1988	121	739	316	2,164	8,288
1989	137	763	373	1,788	7,959
1990	122	616	327	1,564	5,903
1991	149	650	374	1,193	5,335
1992	118	799	343	1,746	6,943
1993.1	117	760	334	935	6,628
1993.2	79	335	159	595	2,811
1994	132	575	336	1,151	4,037
1995	151	784	391	1,174	6,246
1996	139	665	386	839	5,284
1997	131	637	367	1,127	5,118
1998	127	642	347	2,103	5,357
1999	108	560	319	1,436	4,117
2000	110	535	305	1,646	5,133
2001	104	532	276	1,648	4,539
2002	98	558	283	1,266	3,917
2003	91	364	223	1,218	2,585
2004	82	380	231	1,255	2,233
2005	71	295	181	958	2,585
2006	56	228	148	673	1,471
2007	61	315	174	971	1,759
2008	71	297	192	918	2,335
2009	111	555	305	2,612	5,483
2010	101	841	359	5,503	9,832
2011	96	665	305	6,144	9,564
2012	106	679	333	6,216	8,451
2013	102	571	287	4,499	7,179
2014	91	438	236	2,945	4,418
2015	70	276	177	1,668	2,708
2016	59	291	160	1,114	2,069
2017	61	205	133	951	1,371
2018	45	144	105	538	751

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2019	43	99	75	357	553
2020	35	127	95	629	870
2021	28	94	70	424	589
2022	30	93	71	544	751
2023	34	143	86	1,432	1,636
2024	26	98	74	725	960
10-year avg.	43	157	105	838	1,226
20-year avg.	65	323	178	1,991	3,267

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 20. Time series of commercial fishing reports for omilu (*Caranx melampygus*; bluefin trevally) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1965	26	155	75	383	3,633
1966	25	138	61	125	2,114
1967	25	109	60	463	1,851
1968	23	129	55	763	4,397
1969	32	259	81	202	6,876
1970	26	236	71	273	4,545
1971	20	161	60	410	2,912
1972	19	83	50	159	815
1973	19	76	46	35	907
1974	19	122	55	110	1,841
1975	22	118	55	62	1,263
1976	21	61	43	103	1,607
1977	28	87	59	143	1,251
1978	45	130	88	132	2,169
1979	31	57	54	65	1,243
1980	33	87	67	111	1,417
1981	57	179	123	269	2,949
1982	66	173	126	464	2,820
1983	84	247	157	717	5,135
1984	108	316	195	1,879	16,501
1985	117	333	212	850	7,341
1986	115	368	205	1,317	8,145
1987	150	560	337	1,808	12,190
1988	169	567	357	2,084	14,638
1989	160	591	369	2,235	13,604
1990	151	507	341	2,093	14,772
1991	159	405	289	1,414	9,786
1992	59	135	108	343	4,530

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1993.1	58	120	94	224	1,960
1993.2	39	64	54	114	1,319
1994	64	123	93	302	2,717
1995	70	122	104	159	1,836
1996	58	145	111	301	3,141
1997	64	128	109	277	2,422
1998	56	103	88	168	1,572
1999	47	93	71	194	1,251
2000	61	137	108	282	2,418
2001	70	154	117	354	2,504
2002	89	180	140	429	3,085
2003	102	342	231	1,321	7,590
2004	124	360	243	1,213	7,216
2005	113	338	231	1,506	9,271
2006	107	302	228	679	3,650
2007	112	394	260	953	7,402
2008	150	444	319	1,126	7,383
2009	150	456	328	1,472	7,697
2010	143	505	342	1,660	9,082
2011	146	442	302	1,074	6,857
2012	135	508	328	1,273	8,282
2013	123	400	274	965	6,470
2014	130	378	267	1,262	7,627
2015	113	356	253	1,563	6,243
2016	113	363	257	992	5,961
2017	127	396	276	1,472	8,274
2018	100	294	200	1,172	5,262
2019	96	289	203	725	4,784
2020	116	326	223	815	5,172
2021	67	213	143	473	3,422
2022	76	200	147	556	3,863
2023	80	179	150	515	2,946
2024	55	118	100	325	1,789
10-year avg.	94	273	195	861	4,772
20-year avg.	113	345	242	1,029	6,073

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 21. Time series of commercial fishing reports for uhu (*Scaridae* spp.; parrotfish) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1965	33	273	105	301	6,653
1966	20	235	94	336	6,460
1967	29	248	112	678	8,428
1968	31	199	104	531	4,572
1969	44	372	153	733	7,710
1970	43	347	163	1,320	9,012
1971	57	348	184	640	7,044
1972	45	255	126	400	3,284
1973	45	253	141	500	4,405
1974	60	263	151	541	5,215
1975	39	243	123	295	3,624
1976	59	272	159	406	9,633
1977	76	393	228	427	6,418
1978	124	598	369	955	19,775
1979	125	437	364	1,004	19,718
1980	119	586	333	1,425	22,509
1981	116	740	344	1,519	21,487
1982	96	633	316	1,099	16,782
1983	107	568	293	3,103	25,782
1984	117	620	315	3,423	27,694
1985	110	763	337	1,428	27,697
1986	124	823	359	1,991	35,171
1987	134	853	388	3,289	41,016
1988	122	865	356	3,104	44,689
1989	114	759	313	2,044	31,511
1990	75	586	250	2,284	25,999
1991	117	734	358	2,676	26,708
1992	103	964	364	5,388	36,697
1993.1	103	908	336	3,034	26,499
1993.2	79	518	206	2,290	19,382
1994	124	967	413	4,767	39,803
1995	139	1,165	479	2,817	42,036
1996	143	1,047	494	2,579	36,189
1997	131	995	451	2,731	35,968
1998	132	995	446	3,635	35,805
1999	120	952	442	4,511	35,060
2000	116	785	375	3,141	28,510
2001	113	800	386	3,819	21,786

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2002	111	885	391	4,324	31,324
2003	92	822	315	8,377	35,483
2004	84	854	340	7,762	33,279
2005	88	737	296	7,967	32,583
2006	80	637	272	7,684	31,698
2007	84	867	353	11,090	40,398
2008	90	954	371	11,445	44,937
2009	118	1,161	459	11,556	50,884
2010	108	1,441	450	17,484	71,028
2011	96	1,190	409	17,687	72,347
2012	117	1,399	462	20,301	84,442
2013	96	1,197	399	17,689	76,813
2014	89	934	348	14,190	69,929
2015	75	642	274	7,461	33,661
2016	66	585	254	6,411	26,204
2017	71	669	277	7,943	32,597
2018	57	746	247	10,487	51,615
2019	62	605	209	9,834	45,606
2020	50	549	188	9,487	43,893
2021	45	423	151	5,157	24,536
2022	47	460	174	7,534	33,518
2023	40	414	160	7,770	37,564
2024	30	318	131	6,219	29,504
10-year avg.	54	541	207	7,830	35,870
20-year avg.	75	796	294	10,770	46,688

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 22. Time series of commercial fishing reports for he'e (*Octopus cyanea*; day tako) reported by Calendar Year from 2002-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2002	9	28	12	147	341
2003	77	666	221	6,128	17,592
2004	62	749	228	5,966	19,228
2005	80	824	262	6,250	19,614
2006	75	959	277	7,134	19,284
2007	77	817	293	6,286	17,318
2008	92	962	333	10,425	29,998
2009	96	1,056	358	10,581	30,908
2010	115	1,176	392	11,216	34,089
2011	95	996	351	10,735	30,142
2012	92	1,191	405	11,969	34,602

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2013	88	1,155	413	13,436	39,206
2014	86	866	311	10,422	33,637
2015	68	737	243	10,607	32,713
2016	56	588	184	8,158	22,938
2017	60	523	205	7,264	19,893
2018	57	431	198	4,512	12,642
2019	49	367	167	4,070	11,082
2020	41	206	122	1,521	4,360
2021	38	205	101	2,299	6,922
2022	34	174	96	1,538	4,333
2023	42	172	99	1,831	5,273
2024	30	144	77	1,377	4,097
10-year avg.	48	355	149	4,319	12,430
20-year avg.	69	678	244	7,082	20,655

Table 23. Time series of commercial fishing reports for kala (*Naso* spp.; bluespine unicornfish, short-nosed unicornfish, whitemargin unicornfish) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1965	27	251	93	823	30,278
1966	20	220	60	174	26,115
1967	27	168	68	398	35,453
1968	24	160	57	423	23,886
1969	31	182	83	560	32,020
1970	40	226	108	1,114	23,954
1971	45	223	118	1,036	19,925
1972	52	189	106	703	16,421
1973	43	151	99	1,084	17,508
1974	57	166	122	1,034	20,793
1975	72	248	159	905	17,997
1976	73	233	167	1,236	13,697
1977	94	369	244	1,374	18,960
1978	103	279	226	1,143	21,775
1979	95	240	222	805	14,430
1980	90	223	174	807	10,397
1981	80	334	166	1,697	11,990
1982	86	345	179	1,515	13,525
1983	89	335	195	822	14,791
1984	92	257	171	492	11,560
1985	98	348	215	1,004	8,890

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1986	98	226	159	926	14,647
1987	86	260	177	1,217	14,644
1988	95	298	184	2,348	13,050
1989	102	345	216	864	8,912
1990	49	218	118	527	3,191
1991	91	359	194	809	8,736
1992	74	295	172	477	6,892
1993.1	73	347	183	724	7,805
1993.2	50	174	90	325	4,445
1994	84	419	229	1,332	12,945
1995	87	478	250	780	17,679
1996	102	496	270	859	15,105
1997	91	500	268	940	12,929
1998	97	497	276	1,413	15,244
1999	90	477	266	1,384	16,439
2000	74	455	223	1,912	18,115
2001	84	426	238	1,832	24,427
2002	77	516	253	2,993	20,243
2003	67	449	187	4,169	21,218
2004	59	419	177	5,074	21,855
2005	51	330	140	5,447	22,502
2006	48	329	141	5,392	21,693
2007	52	310	163	3,712	13,629
2008	55	372	169	5,022	20,227
2009	85	437	245	4,941	24,919
2010	66	578	253	8,182	33,955
2011	68	514	216	7,303	29,724
2012	69	688	247	8,559	42,464
2013	66	534	241	6,946	32,580
2014	61	480	198	6,624	30,216
2015	48	363	174	4,717	21,917
2016	41	305	140	4,056	12,665
2017	42	301	152	5,433	19,620
2018	33	208	117	2,731	10,078
2019	32	154	100	2,323	8,843
2020	31	182	110	3,149	11,302
2021	24	129	77	3,822	14,450
2022	34	185	106	8,209	21,281
2023	35	188	100	3,009	11,616
2024	30	200	96	4,191	14,451

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
10-year avg.	35	222	117	4,164	14,622
20-year avg.	49	339	159	5,188	20,907

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 24. Time series of commercial fishing reports for nenu (Kyphosus spp.; chubs) from reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1965	20	113	70	382	6,209
1966	18	97	61	299	6,908
1967	33	132	83	472	11,908
1968	24	70	49	266	2,428
1969	41	111	82	777	8,611
1970	48	120	89	558	3,088
1971	57	163	118	84	4,187
1972	53	146	105	322	4,621
1973	61	131	106	332	4,746
1974	58	175	122	658	10,553
1975	83	208	146	1,110	16,750
1976	78	227	151	971	10,433
1977	104	288	215	1,692	9,426
1978	119	292	239	1,499	10,535
1979	107	247	223	1,294	8,780
1980	84	258	177	810	13,104
1981	92	342	199	963	10,788
1982	80	428	238	2,980	19,782
1983	96	301	207	1,504	8,181
1984	116	360	241	2,223	11,282
1985	116	423	274	1,619	8,957
1986	124	412	270	2,188	10,980
1987	122	583	307	2,689	17,672
1988	109	542	278	2,483	18,445
1989	94	433	231	2,024	8,430
1990	70	310	173	1,409	6,046
1991	100	413	224	2,349	11,122
1992	80	408	221	812	15,459
1993.1	94	402	222	1,186	7,378
1993.2	57	202	107	734	3,531
1994	98	445	241	1,505	10,753
1995	100	423	259	1,293	10,872
1996	106	525	270	2,206	11,952
1997	102	484	262	2,310	7,515

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1998	97	451	243	2,824	15,503
1999	92	474	260	3,492	16,042
2000	83	400	208	1,844	9,704
2001	73	358	209	1,740	11,750
2002	84	376	223	2,018	22,627
2003	64	262	159	5,084	19,476
2004	68	312	194	5,809	19,310
2005	54	252	150	8,867	19,623
2006	59	245	150	12,651	35,621
2007	64	286	173	10,902	26,758
2008	77	334	201	8,287	21,621
2009	104	469	279	5,735	14,583
2010	79	450	240	14,410	31,690
2011	82	506	220	9,901	27,755
2012	91	571	239	7,442	31,238
2013	78	425	225	5,685	27,473
2014	84	418	221	4,664	16,638
2015	56	279	157	3,697	17,443
2016	55	258	153	3,290	10,465
2017	57	256	147	2,677	6,901
2018	44	267	129	5,135	9,677
2019	37	216	105	4,274	10,199
2020	32	210	107	3,666	9,346
2021	27	137	86	2,930	8,479
2022	28	98	72	3,023	8,092
2023	25	83	65	2,983	7,390
2024	26	98	68	2,084	6,305
10-year avg.	39	190	109	3,376	9,430
20-year avg.	58	293	159	6,115	17,365

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 25. Time series of commercial fishing reports for manini (*Acanthurus triostegus*; convict tang) reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1965	40	440	179	9,811	9,244
1966	34	316	158	11,170	7,391
1967	50	293	172	11,480	8,767
1968	41	279	171	11,559	7,046
1969	53	391	188	19,598	12,401
1970	52	372	178	15,977	9,990

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1971	79	387	209	11,860	8,527
1972	63	326	182	8,337	7,360
1973	76	424	224	11,859	9,234
1974	89	511	266	11,836	8,682
1975	86	512	246	9,382	9,463
1976	82	483	255	8,714	8,337
1977	103	575	326	6,586	10,236
1978	112	463	352	6,014	9,653
1979	103	437	338	9,687	14,440
1980	86	381	239	4,832	7,121
1981	90	404	251	6,369	15,907
1982	77	463	222	6,405	9,152
1983	86	452	253	2,294	11,091
1984	98	471	266	2,320	9,505
1985	97	533	275	1,737	9,472
1986	98	549	274	4,226	6,971
1987	94	654	299	5,374	11,042
1988	94	670	319	7,739	9,037
1989	101	705	330	8,126	12,637
1990	68	542	224	6,364	6,977
1991	93	641	294	7,595	7,667
1992	85	649	255	5,788	9,575
1993.1	89	733	265	7,803	9,286
1993.2	66	305	139	5,258	8,193
1994	98	778	303	15,968	12,923
1995	106	777	309	11,216	14,961
1996	113	1,007	367	18,570	18,331
1997	98	896	341	16,397	15,032
1998	105	754	325	19,039	13,317
1999	107	704	310	16,454	14,612
2000	86	563	247	12,943	12,152
2001	78	543	233	10,555	11,919
2002	79	591	255	18,103	15,912
2003	61	560	213	38,573	20,008
2004	61	614	230	20,445	10,057
2005	63	481	220	27,947	12,312
2006	69	539	207	20,059	9,109
2007	66	715	258	26,578	11,398
2008	70	623	272	20,623	11,602
2009	79	718	300	25,386	12,793

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2010	85	895	332	31,005	17,496
2011	76	872	296	33,450	17,746
2012	79	768	297	23,949	14,039
2013	66	744	280	28,089	15,896
2014	59	593	247	25,475	11,609
2015	65	406	205	14,261	9,152
2016	47	445	187	18,675	8,957
2017	47	406	181	23,423	10,441
2018	42	469	174	29,252	13,777
2019	40	355	149	18,498	8,725
2020	34	333	139	26,565	12,779
2021	33	308	114	21,019	8,718
2022	28	340	119	25,366	10,463
2023	30	300	114	22,455	8,930
2024	24	228	113	14,354	5,935
10-year avg.	39	359	150	21,387	9,788
20-year avg.	55	527	210	23,822	11,594

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 26. Time series of commercial fishing reports for ta'ape (*Lutjanus kasmira*; bluestripe snapper) reported by Fiscal Year from 1970-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1970	5	26	11		534
1971	30	109	57	29	1,723
1972	48	198	100	332	2,591
1973	60	249	135	862	3,749
1974	77	322	178	1,304	7,829
1975	88	353	211	1,085	9,353
1976	142	527	320	8,326	28,405
1977	201	801	436	6,853	28,541
1978	289	1,089	741	14,524	50,933
1979	320	972	845	25,672	58,175
1980	331	1,153	762	17,912	56,056
1981	299	1,448	756	20,295	80,498
1982	298	1,451	782	20,871	71,101
1983	308	1,508	799	11,078	69,225
1984	335	1,485	798	13,861	43,747
1985	364	1,748	872	12,844	50,787
1986	410	1,944	1,012	16,189	52,328
1987	372	1,629	948	13,519	55,084

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1988	417	1,908	1,037	16,970	50,894
1989	389	1,629	957	15,746	36,211
1990	400	1,635	954	17,099	43,888
1991	426	1,768	1,048	17,041	62,487
1992	343	1,865	949	19,302	74,105
1993.1	330	1,739	875	19,735	62,315
1993.2	249	991	507	11,260	30,092
1994	338	1,690	882	16,459	59,773
1995	365	1,783	951	14,943	71,781
1996	352	1,538	904	14,415	44,195
1997	365	1,983	979	23,281	85,497
1998	365	1,754	933	20,894	74,851
1999	297	1,821	841	31,734	70,073
2000	280	1,926	817	27,267	55,041
2001	240	1,593	666	17,328	47,550
2002	234	1,202	635	14,403	41,147
2003	211	1,068	541	28,194	42,130
2004	210	1,149	554	62,451	45,718
2005	176	1,033	487	45,580	39,479
2006	171	1,003	461	28,317	29,438
2007	187	1,130	529	35,662	30,281
2008	247	1,220	619	43,786	40,000
2009	274	1,392	717	49,927	38,390
2010	270	1,518	767	57,553	43,538
2011	265	1,369	693	56,221	41,261
2012	297	1,396	801	37,964	33,079
2013	269	1,394	734	38,888	33,451
2014	261	1,233	658	35,159	30,271
2015	227	1,074	582	31,077	25,823
2016	221	1,107	590	39,258	33,902
2017	241	1,247	669	60,647	37,200
2018	199	871	499	43,388	28,835
2019	178	831	465	44,856	29,583
2020	178	761	435	72,749	37,828
2021	142	703	371	62,241	30,957
2022	152	757	413	128,348	65,535
2023	144	620	363	88,207	46,170
2024	125	559	327	73,137	33,563
10-year avg.	181	853	472	64,393	36,941
20-year avg.	211	1061	559	53,649	36,430

A blank cell indicates no available data.

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 27. Annual fishing parameters for 2024 for prioritized MHI ECS designated by DAR compared with short-term (10-year) and long-term (20-year) averages

Species	Fishery Indicator	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
‘Opihi	No. Lic.	5	↓64.3%	↓73.7%
	No. Trips	71	↓59.9%	↓67.4%
	No. Caught	56,000	↓17.3%	↑40.9%
	Lb Caught	6,858 lb	↓42.7%	↓52.2%
Hawaiian Spiny Lobster	No. Lic.	3	0%	↓40%
	No. Trips	9	↓18.2%	↓70%
	No. Caught	176	↑39.7%	↓56.3%
	Lb Caught	491 lb	↑72.3%	↓48.2%
Green Spiny Lobster	No. Lic.	7	0%	↓41.7%
	No. Trips	55	↓49.5%	↓66.9%
	No. Caught	1,013	↓44.6%	↓67.6%
	Lb Caught	1,866 lb	↓46.6%	↓70.4%
Scaly Slipper Lobster	No. Lic.	n.d.	-	-
	No. Trips	n.d.	-	-
	No. Caught	n.d.	-	-
	Lb Caught	n.d.	-	-
Kūmū	No. Lic.	26	↓39.5%	↓60.0%
	No. Trips	98	↓37.6%	↓69.7%
	No. Caught	725	↓13.5%	↓63.6%
	Lb Caught	960 lb	↓21.7%	↓70.6%
Omilu	No. Lic.	55	↓41.5%	↓51.3%
	No. Trips	118	↓56.8%	↓65.8%
	No. Caught	325	↓62.3%	↓68.4%
	Lb Caught	1,789 lb	↓62.5%	↓70.5%
Uhu	No. Lic.	30	↓44.4%	↓60.0%
	No. Trips	318	↓41.2%	↓60.1%
	No. Caught	6,219	↓20.6%	↓42.3%
	Lb Caught	29,509 lb	↓17.7%	↓36.8%
He‘e (Day tako)	No. Lic.	30	↓37.5%	↓56.5%
	No. Trips	144	↓59.4%	↓78.8%
	No. Caught	1,377	↓68.1%	↓80.6%
	Lb Caught	4,097 lb	↓67.0%	↓80.2%
Kala	No. Lic.	30	↓14.3%	↓38.8%
	No. Trips	200	↓9.9%	↓41.0%
	No. Caught	4,191	↑0.6%	↓19.2%
	Lb Caught	14,451 lb	↓1.2%	↓30.9%

Species	Fishery Indicator	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Nenue	No. Lic.	26	↓33.3%	↓55.2%
	No. Trips	98	↓48.4%	↓66.6%
	No. Caught	2,084	↓38.3%	↓65.9%
	Lb Caught	6,305 lb	↓33.1%	↓63.7%
Manini	No. Lic.	24	↓38.5%	↓56.4%
	No. Trips	228	↓36.5%	↓56.7%
	No. Caught	14,354	↓32.9%	↓39.7%
	Lb Caught	5,935 lb	↓39.4%	↓48.8%
Ta‘ape	No. Lic.	125	↓30.9%	↓40.8%
	No. Trips	559	↓34.5%	↓47.3%
	No. Caught	73,137	↑13.6%	↑36.3%
	Lb Caught	33,563 lb	↓9.1%	↓7.9%

1.3.5 Bycatch Summary

Bycatch for non-MUS has been decreasing since a peak in 2007 (Table 28). This trend in non-MUS bycatch can be attributed almost entirely to the akule and ‘opelu fisheries, which since 2002 typically make up approximately 69% of all non-MUS caught each year. High reported releases by akule and ‘opelu fishers using net gear types, in particular pelagic purse seine, seine, and gill nets, have a disproportionately large influence on the total released of non-MUS. Because akule and ‘opelu are caught in large numbers with these gears, a single release event can result in up to 90,000 pieces reported as released. Fishers will occasionally do so to avoid flooding the market and/or release fish they cannot handle. While annual releases of akule and ‘opelu have ranged between 0.04% to 20.3% of catch, total bycatch rates of other non-MUS are more stable, ranging between 2.1% and 9.0%. Non-MUS bycatch was below average in 2024 largely due to proportionally low releases of akule and ‘opelu.

Table 28. Time series of commercial fishing bycatch of non-MUS reported by Calendar Year from 2005-2024

Year	No. Lic.	Trips	No. Reports	No. Retained	No. Released	Percent Bycatch
2005	862	10,081	3,155	1,068,289	167,912	13.58
2006	761	9,446	2,891	1,193,618	133,748	10.08
2007	824	10,792	3,262	2,217,897	369,774	14.29
2008	963	11,463	3,662	1,877,246	237,940	11.25
2009	1,116	13,789	4,377	1,788,814	230,382	11.41
2010	1,102	14,387	4,538	1,703,320	135,766	7.38
2011	1,028	12,632	4,084	1,736,035	99,615	5.43
2012	1,032	12,597	4,221	1,512,090	17,227	1.13
2013	980	12,225	4,077	1,503,004	43,129	2.79
2014	951	10,901	3,848	1,559,658	32,191	2.02

Year	No. Lic.	Trips	No. Reports	No. Retained	No. Released	Percent Bycatch
2015	915	10,127	3,641	1,433,792	21,683	1.49
2016	792	8,882	3,210	1,502,264	97,984	6.12
2017	802	8,719	3,261	1,417,682	21,228	1.48
2018	722	7,524	2,834	1,304,029	28,208	2.12
2019	678	7,057	2,737	1,197,640	22,769	1.87
2020	650	6,251	2,496	1,235,953	24,969	1.98
2021	600	5,605	2,187	1,128,820	21,832	1.90
2022	581	5,393	2,165	1,252,855	22,986	1.80
2023	550	4,673	1,980	1,208,903	17,707	1.44
2024	483	4,126	1,768	979,020	12,673	1.28
10-year avg.	677	6,836	2,628	1,266,096	29,204	2.15
20-year avg.	820	9,334	3,220	1,441,049	87,986	5.04

1.4 CRUSTACEAN

1.4.1 Fishery Overview

The crustacean management unit species (CMUS) include two species of deepwater shrimp (*Heterocarpus laevigatus* and *H. ensifer*) and the Kona crab (*Ranina ranina*). Despite being combined into one MUS group, these two fisheries are extremely different and should be considered distinct from each other outside of their combined CMUS designation.

1.4.1.1 Kona Crab

Kona crab are found across the MHI in habitat comprised soft sandy bottoms in which they spend nearly their entire lives burrowed. Though found at depths as great as 200 m, they are commonly fished at shallower depths allowing gear to be set and retrieved by hand. The primary gear to target Kona crab are loop nets, also known commonly in Hawaii as Kona crab nets. Kona crab nets are uniquely designed for the species. Typical crab nets used to target shallow water species are composed of a loose mesh bag inside a circular outer metal ring. This type of net must be brought to the surface “face up” to ensure that crabs within the ring are unable to exit the bag during retrieval and accordingly are fished as single units. Kona crab nets are composed of an outer metal ring, with taught, fine cotton or nylon mesh stretched over. Kona crab become entangled when their leg segments contact the mesh, securing them tightly even if the net becomes inverted. Because of this, numerous Kona crab nets can be strung together at intervals on a mainline laid along the bottom.

Fishing for Kona crab occurs both in state and federal waters of the MHI. Take of Kona crab in federal waters has varied over time from approximately 92% of landings in 1974 to today averaging about 17% of landings in the past five years (2020-2024). Of all Kona crab reported caught in federal waters, 78% have come from Penguin Bank. Capture of Kona crab in the NWHI has previously been reported though only a small percentage of the total landings reported.

Kona crabs have long been considered a delicacy in Hawaii, eaten both cooked and raw. DAR records of commercial Kona crab catch date back to the mid-1940's. Commercial landings peaked at approximately 72,000 lb in 1972, though today the fishery is comparatively dormant.

1.4.1.2 Deepwater Shrimp

The deepwater shrimp fishery is relatively new to Hawaii, with landings first appearing in commercial records in the early 1980s. As their name implies, these species are often fished at depths exceeding 300 m. Deepwater shrimp are caught exclusively with shrimp traps, a gear specifically designed for them. Deepwater shrimp traps are typically connected at intervals along a mainline laid along the bottom. Fishing for deepwater shrimp is relatively gear-intensive due to the size of the traps, amount of line required to reach necessary depths, and necessity for a vessel of adequate size equipped with a sturdy automatic hauler.

Fishing for deepwater shrimp occurs in both federal and state waters of the MHI. Approximately 86% of all reported deepwater shrimp caught are from federal waters and today the fishery operates almost entirely outside of state waters. Fishing for deepwater shrimp has occurred in the NWHI though effort was largely limited to a brief period in the early 1980s.

Deepwater shrimp are commonly known for their use in Japanese restaurants, poke shops, and fresh fish markets where they are often sold under their Japanese name amaebi. Of the two species caught, *H. laevigatus* is preferred over *H. ensifer* due to their larger size and superior food quality. Of all deepwater shrimp landings reported, 98% were *H. laevigatus*. Today, with a lack of an export market and limited local demand, the deepwater shrimp fishery in the MHI remains small in comparison to its previous size.

1.4.2 Commercial Reporting

The collection of commercial crustacean fishing reports comes from two sources: paper reports received by mail, fax, or PDF copy via e-mail; and reports filed online through the OFR. The crustacean landings are reported by commercial fishers on the Monthly Fishing Report, the Net, Trap, Dive Activity Report, or the MHI Deep-7 Bottomfish Fishing Trip Report.

Similar to the Deep-7 Bottomfish, the time series format for the crustacean fishery begins with an arrangement by the State fiscal year period (July – June) until June 1993 before being reported by calendar year. Refer to data processing procedures documented in the Deep-7 BMUS section (Section 1.1.2) for more information on paper fishing reports and fishing reports filed online. Database assistants and data monitoring associates will enter the paper Monthly Fishing Report information within four weeks, and the Net, Trap, Dive Activity Report and the MHI Deep-7 Bottomfish Fishing Trip Report within two business days.

1.4.3 Management

The MHI Kona crab fishery was managed under an ACL of 30,802 lb. in 2024. Additionally, the State imposes a suite of regulations including 4" minimum carapace length, prohibition on spearing, and May-September closed season. Individuals or businesses in Hawaii wishing to sell legally caught Kona crab during the closed season are required to obtain a Kona Crab/Lobster Closed Season Sales License issued by DAR.

The MHI deepwater shrimp fishery is managed under an ACL of 250,773 lb. In addition to compliance with State CML and associated reporting requirement, fishers are required to obtain a federal deepwater shrimp permit if fishing within the US EEZ.

1.4.4 Fishery Performance

1.4.4.1 Kona Crab

Effort and landings for the MHI Kona Crab fishery have been in a state of overall decline since the late 1990s (Table 29). The decline in effort and participation is attributed largely to both aging of the fleet as well as waning commercial interest due to the restrictiveness of previous regulations. With a minimum size and no-take on all females, fishers were reporting trips in which nearly all crab caught were released. In 2024 the State of Hawaii repealed the no-take of female Kona crab to boost interest in a commercial fishery performing well below limits of sustainability. This was accompanied by an extension of the closed season by one month to include September. Lengthening of the closed season was a fisher-driven regulatory change intended to protect female crab when they are often observed by fishers to still be berried.

Kona crab licenses, trips and landings in 2024 were all above their corresponding short-term averages as the fishery continues to rebound following all-time low activity in 2016 (Table 29). The increase was also likely influenced by some degree of renewed interest in the fishery caused by the repeal of the no-take of females. All four parameters in 2024 however were below their long-term average values, a reflection of the overall decline of the fishery. It remains unclear if the allowed take of female will cause the fishery to re-grow to previously seen levels. Though we have seen some indications of renewed interest, landings will likely not near those of the past unless dedicated highliners emerge.

Table 29. Time series of commercial fishermen reports for the Kona crab fishery reported by Fiscal Year from 1965-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1965	26	171	71	4,238	11,421
1966	22	179	67	3,604	10,033
1967	30	185	82	3,071	17,444
1968	25	167	71	1,764	26,419
1969	29	233	84	3,109	35,955
1970	30	197	78	2,544	35,042
1971	40	254	111	4,162	43,576
1972	41	260	102	3,042	69,331
1973	32	231	97	2,111	62,515
1974	49	211	112	7,562	40,552
1975	59	241	127	5,076	24,616
1976	59	234	136	8,568	26,577
1977	54	233	114	4,144	23,153
1978	61	243	159	5,224	31,675
1979	52	202	128	5,817	28,711
1980	42	108	67	1,920	10,390

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1981	50	157	103	6,717	17,858
1982	52	173	107	2,386	8,625
1983	53	165	105	4,204	11,206
1984	68	254	133	6,303	17,216
1985	75	349	177	6,052	21,918
1986	82	312	176	4,196	27,575
1987	71	216	126	3,781	22,024
1988	50	198	92	2,906	17,750
1989	35	142	59	916	13,116
1990	39	159	66	2,624	18,810
1991	46	172	82	1,620	23,641
1992	73	336	130	7,550	36,654
1993.1	67	312	134	4,580	25,894
1993.2	50	151	70	3,047	15,464
1994	69	254	136	3,114	19,522
1995	84	327	175	4,992	27,741
1996	85	287	156	5,191	27,689
1997	84	294	151	8,119	27,991
1998	95	309	174	7,966	31,155
1999	81	223	146	5,810	18,862
2000	63	153	105	3,415	14,144
2001	60	162	112	3,701	10,896
2002	63	196	119	6,593	12,830
2003	51	161	85	6,044	12,211
2004	50	197	85	7,441	12,297
2005	47	203	84	8,110	10,111
2006	36	154	70	5,941	6,921
2007	32	200	69	9,657	9,915
2008	38	243	84	12,076	11,396
2009	41	229	97	7,783	9,422
2010	48	222	92	8,863	10,195
2011	49	209	105	8,783	10,979
2012	36	129	77	8,138	8,212
2013	34	105	66	5,122	7,423
2014	26	75	53	1,666	2,101
2015	26	71	50	2,185	2,919
2016	17	28	26	617	758
2017	19	62	39	2,697	2,777
2018	22	63	40	2,760	2,953
2019	24	86	45	4,654	5,737

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
2020	12	60	25	3,190	4,265
2021	18	69	38	2,688	3,946
2022	19	53	31	1,941	2,533
2023	20	70	37	3,202	4,879
2024	25	68	40	4,372	4,783
10-year avg.	20	63	37	2,831	3,555
20-year avg.	29	120	58	5,222	6,111

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 30. Annual fishing parameters for 2024 in the MHI Kona crab fishery compared with short-term (10-year) and long-term (20-year) averages

Fishery	Parameters	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Kona Crab	No. License	25	↑25.0%	↓13.8%
	Trips	68	↑7.9%	↓43.3%
	No. Caught	4,372	↑54.4%	↓16.3%
	Lb Caught	4,783	↑34.5%	↓21.7%

1.4.4.2 Deepwater Shrimp

Deepwater shrimp catch has pulsed multiple times since the early 1980s, resulting from a small number of large mainland-based vessels periodically entering the fishery primarily for the purpose of export to out of State markets (Table 31). Fishing by these mainland-based vessels has not occurred since 2006, notably reducing catch. Today, the remaining Hawaii-based deepwater shrimp fishery supplies a limited amount of in-state demand and in recent years is limited to three or fewer reporting license holders. Despite the potential for high catch, the deepwater shrimp trap fishery is characterized by low participation even in years when mainland-based vessels were active. Peak CMLs active in the shrimp trap fishery occurred in 2013 with ten fishers reporting. Since the peak, participation has declined to three or fewer fishers per year. Catch (weight) has also declined primarily because of the loss of the mainland-based vessels and to a lesser extent a few Hawaii-based highliners.

Table 31. Time series of commercial fishermen reports for the deepwater shrimp fishery reported by Fiscal Year from 1982-1993 and by Calendar Year from 1994-2024

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1982	n.d.	n.d.	n.d.	n.d.	n.d.
1983	n.d.	n.d.	n.d.	n.d.	n.d.
1984	8	132	24		197,576
1985	6	111	13		60,823
1986	n.d.	n.d.	n.d.	n.d.	n.d.
1987	5	23	7	50	1,852
1988	3	44	9		12,934

Year	No. License	Trips	No. Reports	No. Caught	Catch (lb)
1989	n.d.	n.d.	n.d.	n.d.	n.d.
1990	6	88	20		343,104
1991	n.d.	n.d.	n.d.	n.d.	n.d.
1992	n.d.	n.d.	n.d.	n.d.	n.d.
1993.1	3	86	15		35,631
1993.2	3	36	10		16,531
1994	5	86	29		85,657
1995	4	140	25		70,737
1996	8	114	25	100	34,973
1997	6	52	18		22,922
1998	7	129	33		181,912
1999	5	75	24		33,644
2000	n.d.	n.d.	n.d.	n.d.	n.d.
2001	4	81	18	70	9,313
2002	3	52	15		4,202
2003	3	56	18	4,038	5,420
2004	n.d.	n.d.	n.d.	n.d.	n.d.
2005	5	178	24	130	114,789
2006	n.d.	n.d.	n.d.	n.d.	n.d.
2007	3	39	10	16,830	3,555
2008	n.d.	n.d.	n.d.	n.d.	n.d.
2009	n.d.	n.d.	n.d.	n.d.	n.d.
2010	n.d.	n.d.	n.d.	n.d.	n.d.
2011	4	69	16	46,569	8,098
2012	5	143	21	107,119	11,894
2013	10	205	36	100,832	19,383
2014	9	323	41	371,010	48,707
2015	6	200	36	148,345	28,775
2016	5	133	27	29,417	17,203
2017	3	80	10	7,510	5,984
2018	3	131	16	31,196	11,598
2019	3	196	23	18,425	12,692
2020	n.d.	n.d.	n.d.	n.d.	n.d.
2021	n.d.	n.d.	n.d.	n.d.	n.d.
2022	3	112	18	1,160	13,864
2023	3	118	24	650	24,710
2024	n.d.	n.d.	n.d.	n.d.	n.d.
10-year avg.	3	122	20	24,817	14,560
20-year avg.	4	117	19	47,476	20,473

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

A blank cell indicates no available data; "n.d." = non-disclosure due to data confidentiality.

Table 32. Annual fishing parameters for 2024 in the deepwater shrimp fishery compared with short-term (10-year) and long-term (20-year) averages

Fishery	Parameters	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Deepwater Shrimp	No. License	n.d.	-	-
	Trips	n.d.	-	-
	No. Caught	n.d.	-	-
	Lb Caught	n.d.	-	-

1.4.5 Fishery Performance and CPUE Using Primary Gear Types

1.4.5.1 Kona Crab Nets

Kona crab net CPUE spiked in the early 1970s (Table 33). Rising CPUE during that time was primarily the result of the developing Penguin Bank fishery, where Kona crab are more abundant and larger in size than many inshore fishing areas. Over time, highliner activity decreased and the fishery progressively shifted to occurring predominantly in State waters. As a result, CPUE declined. The introduction of regulations, especially the 2006 ban on the take of females also likely played a role in the persistently low CPUE in comparison to historic levels.

Kona crab net CPUE in 2024 was above both short- and long-term averages (Table 33). The immediate impact of the repeal of the female take prohibition was not apparent.

Table 33. Annual Kona crab catch using Kona crab nets, reported by Fiscal Year from 1965-1993 and by Fishing Year from 1994-2024

Year	No. Lic.	Trips	Catch (lb)	CPUE
1965	25	169	11,378	67.33
1966	21	178	10,029	56.34
1967	30	185	17,444	94.29
1968	25	167	26,419	158.2
1969	28	232	35,939	154.91
1970	29	195	35,033	179.66
1971	38	241	42,977	178.33
1972	40	259	69,328	267.68
1973	32	230	62,455	271.54
1974	49	199	39,121	196.59
1975	58	233	23,996	102.99
1976	50	203	23,195	114.26
1977	33	133	15,966	120.05
1978	60	227	28,582	125.91
1979	51	188	24,674	131.24
1980	39	100	8,162	81.62

Year	No. Lic.	Trips	Catch (lb)	CPUE
1981	47	143	12,102	84.63
1982	48	163	8,291	50.87
1983	48	146	9,009	61.71
1984	58	179	12,944	72.31
1985	71	309	20,846	67.46
1986	80	302	27,200	90.07
1987	62	158	16,310	103.23
1988	47	179	12,475	69.69
1989	32	134	11,790	87.99
1990	32	130	16,118	123.98
1991	44	161	22,789	141.55
1992	71	316	34,291	108.52
1993.1	66	309	25,305	81.89
1993.2	50	151	15,464	102.41
1994	69	253	19,472	76.96
1995	84	327	27,741	84.83
1996	83	283	27,603	97.54
1997	82	288	27,931	96.98
1998	91	299	30,639	102.47
1999	81	221	18,698	84.61
2000	62	152	14,143	93.05
2001	59	158	10,763	68.12
2002	63	196	12,830	65.46
2003	49	158	11,841	74.94
2004	48	167	12,164	72.84
2005	46	161	9,937	61.72
2006	35	128	6,749	52.73
2007	31	188	9,773	51.98
2008	36	201	10,940	54.43
2009	41	191	9,097	47.63
2010	46	178	9,913	55.69
2011	46	172	10,876	63.23
2012	35	121	7,980	65.95
2013	33	83	7,330	88.32
2014	24	59	2,029	34.38
2015	26	62	2,902	46.81
2016	16	25	745	29.80
2017	19	53	2,753	51.95
2018	20	52	2,769	53.25

Year	No. Lic.	Trips	Catch (lb)	CPUE
2019	24	71	5,688	80.11
2020	12	42	4,201	100.01
2021	17	45	3,822	84.93
2022	19	37	2,490	67.31
2023	20	57	4822	84.6
2024	24	59	4459	75.57
10-yr avg.	20	50	3465	67
20-yr avg.	29	99	5964	63

1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 34. Annual fishing parameters for 2024 in the MHI Kona crab net fishery with short-term (10-year) and long-term (20-year) averages

Method	Fishery Indicator	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Kona Crab Net	No. Lic.	24	↑20.0%	↓17.2%
	No. Trips	59	↑18.0%	↓40.4%
	Lb Caught	4,459 lb	↑28.7%	↓25.2%
	CPUE	75.6 lb/trip	↑12.8%	↑20.0%

1.4.5.2 Shrimp Traps

The shrimp trap gear code was established in 1986. Prior to then, all trap activities were reported under “miscellaneous traps.” Shrimp trap CPUE over time has, like catch, spiked periodically as a small number of mainland-based vessels returned to Hawaii to catch deepwater shrimp (Table 35). In years in which those vessels were active, CPUE saw a marked increase due to the high number of gears that the larger and more well-equipped mainland vessels could handle. The fishery being composed solely of smaller Hawaii-based vessels today explains the comparatively much lower average catch per trip.

Table 35. Annual deepwater shrimp catch using shrimp traps, reported by Fiscal Year from 1987-1993 and by Fishing Year from 1994-2024

Year	No. Lic.	Trips	Catch (lb)	CPUE
1987	4	22	1,831	83.23
1988	3	44	12,934	293.95
1989	n.d.	n.d.	n.d.	n.d.
1990	5	87	343,102	3943.7
1991	n.d.	n.d.	n.d.	n.d.
1992	n.d.	n.d.	n.d.	n.d.
1993.1	3	86	35,631	414.31

Year	No. Lic.	Trips	Catch (lb)	CPUE
1993.2	3	36	16,531	459.19
1994	5	86	85,657	996.01
1995	4	140	70,737	505.26
1996	8	114	34,973	306.78
1997	6	51	22,792	446.9
1998	7	129	181,912	1410.17
1999	5	75	33,644	448.59
2000	n.d.	n.d.	n.d.	n.d.
2001	4	81	9,313	114.98
2002	3	50	3,989	79.78
2003	3	56	5,420	96.79
2004	n.d.	n.d.	n.d.	n.d.
2005	5	178	114,789	644.88
2006	n.d.	n.d.	n.d.	n.d.
2007	n.d.	n.d.	n.d.	n.d.
2008	n.d.	n.d.	n.d.	n.d.
2009	n.d.	n.d.	n.d.	n.d.
2010	n.d.	n.d.	n.d.	n.d.
2011	4	69	8,098	117.36
2012	5	143	11,894	83.18
2013	10	205	19,383	94.55
2014	9	323	48,707	150.8
2015	6	200	28,775	143.87
2016	5	133	17,203	129.35
2017	3	80	5,984	74.80
2018	3	131	11,598	88.53
2019	3	196	12,692	64.76
2020	n.d.	n.d.	n.d.	n.d.
2021	n.d.	n.d.	n.d.	n.d.
2022	3	112	13,864	123.79
2023	3	118	24,710	209.41
2024	n.d.	n.d.	n.d.	n.d.
10-yr avg.	3	122	14,560	119
20-yr avg.	4	117	20,473	180

A blank cell indicates no available data; "n.d." = non-disclosure due to data confidentiality.
 1993.1 = Fiscal Year 1993; 1993.2 = July-December of calendar year 1993.

Table 36. Annual fishing parameters for 2024 in the deepwater shrimp trap fishery compared with short-term (10-year) and long-term (20-year) averages

Method	Fishery Indicator	2024 Value	2024 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Shrimp Trap	No. Lic.	n.d.	-	-
	No. Trips	n.d.	-	-
	Lb Caught	n.d.	-	-
	CPUE	n.d.	-	-

1.4.6 Bycatch Summary

1.4.6.1 Kona Crab

Percent bycatch for the Kona crab fishery in recent years is notably high for Hawaii fisheries due to the suite of regulations in place. MHI Kona crab populations typically (seasonal and place-based differences in sex ratio have also been noted) have a near 1:1 male to female sex ratio meaning that at minimum about half the catch would need to be released during an average trip. Considering that undersized males also need to be released, it is easy to see how fishers previously struggled to retain catch legally. It is likely that this is also influenced by significant under reporting of releases, especially early in the time series. The percentage of total Kona crab reports with zero releases (highly improbable) have been declining steadily, suggesting that fishers are progressively reporting releases more accurately. However, underreporting is still an issue today and may suggest that percent bycatch may be even higher than reflected below. In 2024, percent bycatch was below the short-term average and above the long-term average. It is yet unclear if this is due to the newly-allowed retention of females. However, the State has been receiving anecdotal reports that the regulatory change has improved retention.

Non-target species catch using Kona crab nets is extremely limited, and typically comprised almost entirely of the kuahonu crab (*P. sanguinolentus*) which also favors sandy bottoms. Unlike Kona crab, kuahonu crab are not as prone to entanglement in the mesh of Kona crab nets and can often escape capture during retrieval. Reported releases of kuahonu crab is not surprising given current regulations including a minimum size and the prohibition of the take of females carrying eggs. In 2024, non-target species catch for the Kona crab loop net fishery could not be reported due to fewer than three licensees reporting such releases (Table 37).

1.4.6.2 Deepwater Shrimp

Percent bycatch for the deepwater shrimp trap fishery is hard to determine from report data since releases can only be reported in pieces, and catch is often only reported in pounds. This results in high percent bycatch in certain years including 2024 when releases are reported (Table 38). It is likely though that target species releases are infrequent since there are no size or sex-based restrictions.

Non-target species catch in shrimp traps is not commonly reported. In many years (including 2024) non-target catch is not reported at all.

Table 37. Time series of commercial fishing bycatch of Kona crab and non-target species harvested with loop net, reported by Fishing Year from 2005-2024

Target Species (Kona Crab)							Non-Target Species (Harvested with Loop Net)					
Year	No. Lic.	Trips	No. Reports	No. Retained	No. Released	Percent Bycatch	No. Lic.	Trips	No. Reports	No. Retained	No. Released	Percent Bycatch
2005	47	203	84	8,110	1,173	12.64	3	9	6	24	0	0
2006	36	154	70	5,941	3,688	38.30	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2007	32	200	69	9,657	3,422	26.16	3	6	4	43	0	0
2008	38	243	84	12,076	1,376	10.23	3	10	10	64	6	8.57
2009	41	229	97	7,783	2,295	22.77	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2010	48	198	92	8,863	6,511	42.35	3	12	8	27	4	12.90
2011	49	189	105	8,783	7,360	45.59	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2012	36	115	77	8,138	3,716	31.35	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2013	34	97	66	5,122	7,816	60.41	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2014	26	75	53	1,666	5,576	77.00	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2015	26	71	50	2,185	7,450	77.32	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2016	17	28	26	617	1,917	75.65						
2017	19	62	39	2,697	6,947	72.03	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2018	22	63	40	2,760	12,141	81.48	3	4	4	164	748	82.02
2019	24	86	45	4,654	27,186	85.38	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2020	12	60	25	3,190	24,297	88.39	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2021	18	69	38	2,688	17,764	86.86	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2022	19	53	31	1,941	9,266	82.68	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2023	20	70	37	3,202	24,344	88.38	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2024	25	68	40	4,372	15,757	78.28	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
10-year avg.	20	63	37	2,831	14,707	81.65	1	5	3	204	222	20.99
20-year avg.	29	117	58	5,222	9,500	59.16	2	6	4	119	106	11.31

A blank cell indicates no available data; "n.d." = non-disclosure due to data confidentiality.

Table 38. Time series of commercial fishing bycatch of deepwater shrimp and non-target species harvested with shrimp traps, reported by Fishing Year from 2005-2024

Target Species (Deepwater Shrimp)							Non-Target Species (Harvested with Shrimp Traps)					
Year	No. Lic.	Trips	No. Reports	No. Retained	No. Released	Percent Bycatch	No. Lic.	Trips	No. Reports	No. Retained	No. Released	Percent Bycatch
2005	5	178	24	130	4	2.99	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2006	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.						
2007	3	39	10	16,830	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2008	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.						
2009	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.						
2010	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2011	4	69	16	46,569	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2012	5	143	21	107,119	100	0.09	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2013	10	205	36	100,832	0	0						
2014	9	323	41	371,010	34	0.01	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2015	6	200	36	148,345	310	0.21						
2016	5	133	27	29,417	3,205	9.82						
2017	3	80	10	7,510	20	0.27	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2018	3	131	16	31,196	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2019	3	196	23	18,425	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2020	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.						
2021	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2022	3	112	18	1,160	0	0						
2023	3	118	24	650	1,000	60.61						
2024	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.						
10-year avg.	3	122	20	24,817	454	7.09	1	12	4	55	0	0
20-year avg.	4	117	19	47,476	234	3.89	1	9	3	263	7	14.02

A blank cell indicates no available data; "n.d." = non-disclosure due to data confidentiality.

Table 39. Commercial fishing bycatch harvested with loop net in the MHI Kona crab fishery, reported for Fishing Year 2024

Species	Number Released	Number Released (Berried)	Number Released (Min. Size)
<i>Ranina ranina</i> ; Kona crab	524	183	15,000
<i>Portunus sanguinolentus</i> ; Kuahonu crab	n.d.	n.d.	n.d.

“n.d.” = non-disclosure due to data confidentiality.

1.5 PRECIOUS CORALS FISHERY

1.5.1 Fishery Overview

The precious coral species group is comprised of pink/red coral (*Corallium secundum*, *C. regale*, *C. laauense*), gold coral (*Gerardia* spp., *Callogorgia gilberti*, *Narella* spp., *Calyptrophora* spp.), bamboo coral (*Lepidisis olapa*, *Acanella* spp.), and black coral (*Antipathes griggi*, *A. grandis*, *A. ulex*). Throughout the entire timeseries of commercial reporting, black corals compose almost the entirety of the precious coral harvest.

Precious coral harvest occurs in both federal and State waters, though activity within 3 nm is limited. Approximately 93% of all precious coral harvest reported to DAR has occurred in or around the Auau channel.

The MHI precious coral fishery is characterized by extremely low participation that peaked at five individuals in 1987 and 1990. In the past twelve years, fewer than three individuals have reported harvest of these species. Low participation is due in part to the difficulty and danger associated with harvesting these relatively deepwater species. Diving for precious coral is the number one collection method used though inherently dangerous. The use of submersibles also occurs, though rarely and contributing a small percentage of the overall historic catch.

Precious corals have long been prized by a wide range of cultures for their use in jewelry making. In 1987, black coral was adopted as the official state “gem” of Hawaii. As their name implies, precious corals are by weight some of the highest value marine species landed in Hawaii.

1.5.2 Fishery Performance

Commercial fishery statistics for recent years are unavailable due to data confidentiality restrictions, as the number of active participants has been fewer than three since the 2011-2012 fishing year. Future reports will include data as resources and reporting confidentiality thresholds allow.

1.6 NON-COMMERCIAL FISHERY PERFORMANCE

The non-commercial data in this report is sourced from the Hawaii Division of Aquatic Resources (HDAR) Hawaii Marine Recreational Fishing Survey (HMRFS) and the NOAA Fisheries Marine Recreational Information Program's (MRIP) Fishing Effort Survey (FES). It is recommended that the non-commercial data presented here are not directly compared to the commercial data presented in Sections 1.1 through 1.5 due to inherent differences in data collection and summarization procedures. These data are presented only as a broad overview.

1.6.1 Hawaii Marine Recreational Fishing Survey (HMRFS)

HMRFS was established in 2001 in collaboration with NOAA Fisheries Marine Recreational Fisheries Statistics Survey (MRFSS). MRFSS oversight consisted of two independent and complimentary surveys: the Coastal Household Telephone Survey (CHTS) for fishing effort and the Access Point Angler Intercept Survey (APAIS) for catch rate. In 2003, the survey was expanded to all major Hawaiian Islands (i.e., Kauai, Oahu, Maui, Molokai, and Hawaii Island) and included fishing from shoreline and private boats. MRIP was then established in 2007 and replaced MRFSS to develop improved data collection and information management for monitoring US marine recreational fisheries. HMRFS is currently funded by the State of Hawaii, MRIP, and the US Fish and Wildlife Service's Sport Fish Restoration Program.

The CHTS utilized a random digit dial method to sample Hawaii households with landline phone numbers. Due to steadily decreasing numbers of households with landline phones as well as other factors, the FES was pilot tested in 2017 and eventually replaced the CHTS in 2018. The FES follows the Dillman approach for mail surveys. For every wave, or two-month period, two to three thousand households in Hawaii are randomly selected for the survey. The FES includes the initial survey mailing, a follow-up reminder (via postcard), and final mailing. Fishing data are collected from all household members, including those who did not fish.

The APAIS focuses on in-person interviews of fishers at publicly accessible locations such as public boat ramps and popular shore fishing sites. Two fishing modes, private boat and shoreline, are randomly sampled statewide. Fishing sites are weighted according to estimated fishing pressure, with higher pressure sites drawn and sampled more frequently.

1.6.2 Catch and Effort Estimates

Fishing catch and effort estimates are based upon data from HMRFS and the FES. HMRFS data include catch rate information or catch per angler trip. The catch rate is derived by multiplying the catch number of a given species with the average weight for the species for a given estimation domain (area fished and mode combination). The number of trips from the FES data is expanded to statewide estimates using current U.S. census data. Total catch is then estimated as the product of the catch rate and the number of estimated trips.

MRIP calculates estimates of catch and effort every wave for finfish only (i.e., estimates for invertebrates such as octopus, lobsters, crabs, etc., are not calculated). Unlike the commercial data where monthly catch reports are mandatory, the non-commercial data is collected through voluntary, in-person surveys that are then used to calculate estimates. The accuracy of the estimates is dependent upon the relative number of completed interviews as well as the amount of catch verified by HMRFS staff and is thus subject to much greater variability. The calculated

estimates are vulnerable to fluctuating sample sizes for a given fishery/species and are reflected in the proportional standard error (PSE) of an estimate. For example, a species that is encountered infrequently by field surveyors would yield estimates that are limited by sample size and thus may result in greater PSE values. Estimated numbers and/or weights for a given species may be absent due to less than two fish enumerated and/or weighed for a given period. Due to various sampling limitations, the accuracy of some species landing estimates can vary substantially from Wave to Wave. For more information about MRIP procedures, please visit [NOAA's website](#).

1.6.2.1 Management Unit Species

At its regular meeting in May 2024, the Council's Fishery Ecosystem Plan Teams recommended excluding HMRFS data from the 2023 annual SAFE reports as several working groups continue to make progress on improving the efficacy and representativeness of the data; Deep-7 and uku catch estimates have accordingly been removed from this document pending further developments.

1.7 FEDERAL LOGBOOK DATA

1.7.1 Number of Federal Permit Holders

In Hawaii, the following federal permits are required for fishing in the exclusive economic zone (EEZ) under the Hawaii FEP. Regulations governing fisheries under this FEP are in the Code of Federal Regulations (CFR), Title 50, Part 665.

1.7.1.1 Special Coral Reef Ecosystem Permit

Regulations require the special coral reef ecosystem fishing permit for anyone fishing for coral reef ECS in a low-use marine protected area (MPA), fishing for species on the list of Potentially Harvested Coral Reef Taxa or using fishing gear not specifically allowed in the regulations. NMFS will make an exception to this permit requirement for any person issued a permit to fish under any FEP who incidentally catches Hawaii coral reef ECS while fishing for BMUS, crustacean MUS or ECS, western Pacific pelagic MUS, precious coral, or seamount groundfish. Regulations require a transshipment permit for any receiving vessel used to land or transship potentially harvested coral reef taxa, or any coral reef ECS caught in a low-use MPA.

1.7.1.2 Main Hawaiian Islands Non-Commercial Bottomfish

Regulations require this permit for any person, including vessel owners, fishing for bottomfish MUS or ECS in the EEZ around the MHI. If the participant possesses a current State of Hawaii CML, or is a charter fishing customer, he or she is not required to have this permit.

1.7.1.3 Western Pacific Precious Coral

Regulations require this permit for anyone harvesting or landing black, bamboo, pink, red, or gold corals in the EEZ in the western Pacific. The Papahānaumokuākea Marine National Monument prohibits precious coral harvests in the monument ([71 FR 51134](#), August 29, 2006). Regulations governing this fishery are in the CFR, [Title 50, Part 665, Subpart F](#), and [Title 50, Part 404](#) (Papahānaumokuākea Marine National Monument).

1.7.1.4 Western Pacific Crustaceans Permit

Regulations require a permit for the owner of a U.S. fishing vessel used to fish for lobster or deepwater shrimp in the EEZ around American Samoa, Guam, Hawaii, and the Pacific Remote Islands Area (PRIA), and in the EEZ seaward of 3 nm of the shoreline of the CNMI.

Table 40 provides the number of permits issued to Hawaii FEP fisheries between 2015 and 2024 and longer time series of the number of permits by fishery are presented in the fishery-specific tables in Section 1.7.2.

Table 40. Number of federal permits in Hawaii FEP fisheries

Year	Special Coral Reef Ecosystem	MHI Non-Commercial Bottomfish	Precious Coral	Crustacean - Shrimp	Crustacean - Lobster
2015	0	2	1	4	2
2016	1	0	1	4	1
2017	1	1	1	6	2
2018	1	0	1	4	1
2019	0	2	1	3	1
2020	1	2	0	2	0
2021	1	0	0	3	0
2022	0	1	0	2	0
2023	0	1	0	3	0
2024	0	0	1	3	1

Source: PIRO SFD unpublished data.

1.7.2 Summary of Catch and Effort for FEP Fisheries

The Hawaii Archipelago FEP requires fishermen to obtain a federal permit to fish for certain MUS and ECS in federal waters and to report all catch and discards. While NMFS annually issues permits for various FEP fisheries, there is currently limited available data on the level of catch or effort made by federal non-longline permit holders. Determining the level of fishing activity through the required federal logbook reporting for each fishery helps establish the level of non-longline fishing occurring in federal waters to assess whether there is a continued need for active conservation and management measures (e.g., annual catch limits) for these fisheries. For each FEP fishery, the number of federal permits issued since the federal permit and logbook reporting requirements became effective as well as available catch and effort data are presented in Table 41 through Table 43.

1.7.2.1 Precious Coral

There have been less than three permittees for the precious coral fishery in recent years, so any reports received are confidential.

1.7.2.2 Non-Commercial Bottomfish

Table 41. Summary of federal logbook data for the Hawaii non-commercial bottomfish fishery

Year	No. of Federal Bottomfish Permits Issued ¹	No. of Federal Bottomfish Permits Reporting Catch	No. of Trips in MHI EEZ	Total Reported Logbook Catch (lb)		Total Reported Logbook Release/Discard (#)	
				Deep- 7 Bottomfish (MUS) from Sept 1-Aug. 31 the following year	Non-Deep-7 Bottomfish (MUS & ECS) ² from Jan. 1 to Dec. 31	Deep-7 Bottomfish (MUS) from Sept 1-Aug. 31 the following year	Non-Deep-7 Bottomfish (MUS & ECS) ² from Jan. 1 to Dec. 31
2008-09	80	4	9	182	32	0	0
2009-10	59	4	11	309	10	0	3
2010-11	22	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2011-12	18	n.d.					
2012-13	10	n.d.					
2013-14	3	n.d.					
2014-15	2	n.d.					
2015-16	0	-					
2016-17	1	n.d.					
2017-18	0	-					
2018-19	2	n.d.					
2019-20	2	n.d.					
2020-21	0	-					
2021-22	1	n.d.					
2022-23	1	n.d.					
2023-24	0	-					

¹ Source: PIRO SFD unpublished data.

² On February 8, 2019, NMFS published a final rule (84 FR 2767) to reclassify certain MUS as ecosystem component species (ECS). This rule reclassified all of the non-Deep-7 bottomfish except uku as ECS.

Notes: Federal non-commercial bottomfish permit and reporting requirements became effective on August 8, 2008 (73 FR 41296, July 18, 2008). The fishing year for “Deep-7 bottomfish” begins September 1 and ends August 31 the following year. For example, data for 2008 should include information from September 1, 2008, through August 31, 2009. The fishing year for non-Deep-7 bottomfish is the calendar year. “n.d.” = Not available due to confidentiality.

1.7.2.3 Spiny and Slipper Lobster**Table 42. Summary of federal logbook data for Hawaii lobster fisheries**

Year	No. of Federal Lobster Permits Issued ¹	No. of Federal Lobster Permits Reporting Catch in MHI	No. of Trips in MHI EEZ	Total Reported Logbook Catch (lb)		Total Reported Logbook Release/Discard (lb)	
				<i>Spiny lobster</i>	<i>Slipper lobster</i>	<i>Spiny lobster</i>	<i>Slipper lobster</i>
2004	0	-					
2005	0	-					
2006	0	-					
2007	2	n.d.					
2008	2	n.d.					
2009	3	0					
2010	0	-					
2011	0	-					
2012	0	-					
2013	2	n.d.					
2014	1	n.d.					
2015	2	n.d.					
2016	1	n.d.					
2017	2	n.d.					
2018	1	n.d.					
2019	1	n.d.					
2020	0	-					
2021	0	-					
2022	0	-					
2023	0	-					
2024	1	n.d.					

¹ Source: PIRO SFD unpublished data.**1.7.2.4 Deepwater Shrimp****Table 43. Summary of federal logbook data for the Hawaii deepwater shrimp fishery**

Year	No. of Federal Shrimp Permits Issued ¹	No. of Federal Shrimp Permits Reporting Catch ²	No. of Trips in MHI EEZ	Total Reported Logbook Shrimp MUS Catch (lb)	Total Reported Logbook Shrimp MUS Release/Discard (lb)
2009	0				
2010	0				
2011	0				
2012	0	n.d.	n.d.	n.d.	n.d.
2013	3	6	80	10,520	113
2014	7	6	61	11,676	212

Year	No. of Federal Shrimp Permits Issued ¹	No. of Federal Shrimp Permits Reporting Catch ²	No. of Trips in MHI EEZ	Total Reported Logbook Shrimp MUS Catch (lb)	Total Reported Logbook Shrimp MUS Release/Discard (lb)
2015	4	3	24	13,020	261
2016	4	3	123	39,781	7,257
2017	6	4	27	5,529	74
2018	4	n.d.	n.d.	n.d.	n.d.
2019	3	3	192	23,939	0
2020	2	n.d.	n.d.	n.d.	n.d.
2021	3	n.d.	n.d.	n.d.	n.d.
2022	2	n.d.	n.d.	n.d.	n.d.
2023	3	n.d.	n.d.	n.d.	n.d.
2024	3	n.d.	n.d.	n.d.	n.d.

¹ Source: PIRO SFD unpublished data.

² Permits are valid for one year from the date issued, so permits issued in 2021 may be valid for a part of 2022. The number of permits reporting catch can therefore be greater than the number issued that year.

Notes: Federal permit and reporting requirements for deepwater shrimp fisheries became effective on June 29, 2009 (74 FR 25650, May 29, 2009). “n.d.” = Not available due to confidentiality. Shrimp MUS = *H. laevis* and *H. ensifer*. No. of trips in MHI EEZ used permit number, gear set date to determine unique trips. Total catch and discard include both within the MHI EEZ and outside of the EEZ.

1.8 STATUS DETERMINATION CRITERIA

1.8.1 Bottomfish and Crustacean Fishery

Status determination criteria (SDC), overfishing criteria, and control rules are specified and applied to individual species within a multi-species stock whenever possible. When this is not possible, they are based on an indicator species for that multi-species stock. It is important to recognize that individual species would be affected differently based on this type of control rule, and it is important that for any given species, fishing mortality (F) does not currently exceed a level that would result in excessive depletion of that species. No indicator species are used for the bottomfish multi-species stock complexes. Instead, the control rules are applied to each stock complex as a whole.

The maximum sustainable yield (MSY) control rule is used as the maximum fishing mortality threshold (MFMT). The MFMT and minimum stock size threshold (MSST) are specified based on the recommendations of Restrepo et al. (1998) and both are dependent on the natural mortality rate (M). The value of M used to determine the reference point values is not specified in this section. The latest estimate published annually in the annual SAFE report is used, and the value is occasionally re-estimated using the best available information. The range of M among species within a stock complex is taken into consideration when estimating and choosing the M to be used for the purpose of computing the reference point values.

In addition to the thresholds MFMT and MSST, a warning reference point, B_{FLAG} , is specified at some point above the MSST to provide a trigger for consideration of management action prior to

B_{FLAG} reaching the threshold. MFMT, MSST, and B_{FLAG} are specified as indicated in Table 44. Note that the MFMT listed here only applies to Hawaiian bottomfish.

Table 44. Overfishing threshold specifications for Hawaiian bottomfish and NWHI lobsters

MFMT	MSST	B_{FLAG}
$F(B) = \frac{F_{MSY} B}{c B_{MSY}} \quad \text{for } B \leq c B_{MSY}$ $F(B) = F_{MSY} \quad \text{for } B > c B_{MSY}$	$c B_{MSY}$	B_{MSY}
where $c = \max(1-M, 0.5)$		

Standardized values of fishing effort (E) and catch-per-unit-effort (CPUE) can be used as proxies for F and B, respectively, so E_{MSY} , $CPUE_{MSY}$, and $CPUE_{FLAG}$ are used as proxies for F_{MSY} , B_{MSY} , and B_{FLAG} , respectively.

In cases where reliable estimates of $CPUE_{MSY}$ and E_{MSY} are not available, they can be estimated from catch and effort times series, standardized for all identifiable biases. $CPUE_{MSY}$ would be calculated as half of a multi-year average reference CPUE, called $CPUE_{REF}$. The multi-year reference window would be objectively positioned in time to maximize the value of $CPUE_{REF}$. E_{MSY} would be calculated using the same approach or, following Restrepo et al. (1998), by setting E_{MSY} equal to E_{AVG} , where E_{AVG} represents the long-term average effort prior to declines in CPUE. When multiple estimates are available, the more precautionary option is typically used.

Since the MSY control rule specified here applies to multi-species stock complexes, it is important to ensure that no species within the complex has a mortality rate that leads to excessive depletion. In order to accomplish this, a secondary set of reference points is specified to evaluate stock status with respect to recruitment overfishing. A secondary “recruitment overfishing” control rule is specified to control fishing mortality with respect to that status. The rule applies only to those component stocks (species) for which adequate data are available. The ratio of a current spawning stock biomass proxy ($SSBP_t$) to a given reference level ($SSBP_{REF}$) is used to determine if individual stocks are experiencing recruitment overfishing. $SSBP$ is CPUE scaled by percent mature fish in the catch. When the ratio $SSBP_t/SSBP_{REF}$, or the “SSBP ratio” ($SSBPR$) for any species drops below a certain limit ($SSBPR_{MIN}$), that species is considered to be recruitment overfished and management measures will be implemented to reduce fishing mortality on that species. The rule applies only when the SSBP ratio drops below the $SSBPR_{MIN}$, but it will continue to apply until the ratio achieves the “SSBP ratio recovery target” ($SSBPR_{TARGET}$), which is set at a level no less than $SSBPR_{MIN}$. These two reference points and their associated recruitment overfishing control rule, which prescribe a target fishing mortality rate ($F_{RO-REBUILD}$) as a function of the SSBPR, are specified as indicated in Table 45. Again, E_{MSY} is used as a proxy for F_{MSY} .

Table 45. Recruitment overfishing control rule specifications for the BMUS in Hawaii

$F_{RO-REBUILD}$	$SSBPR_{MIN}$	$SSBPR_{TARGET}$
$F(SSBPR) = 0 \quad \text{for } SSBPR \leq 0.10$ $F(SSBPR) = 0.2 F_{MSY} \quad \text{for } 0.10 < SSBPR \leq SSBPR_{MIN}$ $F(SSBPR) = 0.4 F_{MSY} \quad \text{for } SSBPR_{MIN} < SSBPR \leq SSBPR_{TARGET}$	0.20	0.30

The Council adopted a rebuilding control rule for the NWHI lobster stock, which can be found in the supplemental overfishing amendment to the Sustainable Fisheries Act omnibus amendment on the Council's website.

1.8.2 Current Stock Status

1.8.2.1 Deep-7 Bottomfish Management Unit Species Complex

Despite availability of catch and effort (from which CPUE is derived), some life history, and fishery independent information, the MHI Deep-7 BMUS complex is still considered as data moderate. The stock assessment was conducted on a subset of the population that is being actively managed because of the closure of the NWHI to commercial fishing. The assessment was also conducted on the Deep-7 species complex because the State of Hawaii designates the seven species together, and a typical bottom fishing trip is comprised primarily of these seven species.

Generally, data are only available for commercial fishing and associated CPUE by species. The new benchmark re-examined the previously used reporting ratios for determining non-commercial catch, improvements in the generation of abundance indices, updated the software used for the assessment model, and improvements in the parameterization and prior distributions. The 2024 benchmark stock assessment by PIFSC utilized a state-space surplus production model with explicit process and observation error terms (Syslo et al. 2024). Determinations of overfishing and overfished status were made by comparing current biomass and harvest rates to MSY-based reference points. As of 2023, the MHI Deep-7 bottomfish complex is not subject to overfishing and is not overfished (Table 46).

Table 46. Stock assessment parameters for the MHI Deep-7 bottomfish complex (Syslo et al. 2024)

Parameter	Value	Notes	Status
MSY for total catch	0.709 ± 0.207	Mean \pm std. error, units in million lb	
MSY for reported catch	$473,000 \pm 225,000$	Mean \pm std. error, units in lb	
H_{2023}	4.0%		
H_{MSY}	$11\% \pm 5.1\%$	Mean \pm std. error	
H/H_{CR}	0.37		No overfishing occurring
B_{2023}	11.22	Mean, units in million lb	
B_{MSY}	6.539 ± 2.476	Mean \pm std. error, units in million lb	
B/B_{MSST}	2.04		Not overfished

1.8.2.2 Uku

In 2016, 27 species of Hawaii reef fish and non-Deep-7 bottomfish were assessed by PIFSC using a length-based spawning potential ratio (SPR) method, with overfishing limits calculated as the catch level required to maintain $SPR = 0.30$ (defined as C_{30}) using either abundance from diver surveys or commercial catch estimates (Nadon 2017). Since the assessment was finalized, only one species (uku, *Aprion virescens*) remains a MUS due to the ecosystem component

amendment to the FEPs (84 FR 2767, February 8, 2019). The assessment indicated that the uku stock around Hawaii was not experiencing overfishing.

In 2020, PIFSC performed a stock assessment on only uku in the MHI using the Stock Synthesis 3.30 modeling framework, an integrated statistical catch-at-age model that fits a population model to relative abundance and size composition data in a likelihood-based statistical framework to generate maximum likelihood estimates of population parameters (Nadon et al. 2020). The assessment concluded that the MHI uku stock is not overfished and is not experiencing overfishing.

In 2024, PIFSC updated the stock assessment with data up to 2023 and used the same modeling approach as that of the benchmark assessment in 2020. There was a minor change in the modeling approach to implement correction factors for the recreational catches related to the decline of phone landlines between 2003 and 2016, as done in the recent Deep-7 assessment (Syslo et al. 2024). The assessment update concluded that as of 2023, the MHI uku stock is not overfished and the fishery is not experiencing overfishing (Nadon 2024).

Results from the uku assessment are presented in Table 47, where “SSB” refers to spawning stock biomass.

Table 47. Results from 2024 stock assessment for MHI uku (Nadon et al. 2024)

Parameter	Value	Notes	Status
MSY	111	Units mt	
F ₂₀₂₃ (age 5-30)	0.05	Units yr ⁻¹	
F _{MSY} (age 5-30)	0.14	Units yr ⁻¹	
F ₂₀₂₃ /F _{MSY}	0.36		No overfishing occurring
SSB ₂₀₂₃	995	Units mt	
SSB _{MSST}	355	Units mt	
SSB ₂₀₂₃ /SSB _{MSST}	2.8		Not overfished

1.8.2.3 Crustacean

The application of the SDCs for the crustacean MUS has only been specified for the NWHI lobster stock, which is no longer a federal MUS. The Council began the process to establish SDC for Kona crab in late 2022, and the associated final rule is expected in late 2023. Previous studies conducted in the MHI estimated the MSY for spiny lobsters at approximately 15,000 – 30,000 lobsters per year of 8.26 cm carapace length or longer (WPFMC 1983). There are insufficient data to estimate MSY values for MHI slipper lobsters. MSY for MHI deepwater shrimp has been estimated at 275,575 (Tagami and Ralston 1988).

A stock assessment model was conducted by PIFSC in 2018 for the MHI Kona crab stock in the MHI (Kapur et al. 2019). This assessment used a Bayesian state-space surplus production model to estimate parameters needed to determine stock status. Based on this, the Kona crab stock is not overfished, and overfishing is not occurring (Table 48). For crustacean MUS, the most recent MSY estimates are found in Table 49.

Table 48. Stock assessment parameters for Hawaii's Kona crab stock (Kapur et al. 2019)

Parameter	Value	Notes	Status
MSY for total catch	73,069	In lb	
MSY for reported catch	25,870	In lb	
H ₂₀₁₆	0.0081	Expressed as proportion	
H _{MSY}	0.114	Expressed as proportion	
H/H _{MSY}	0.0714		No overfishing occurring
B ₂₀₁₆	885,057	In lb	
B _{MSY}	640,489	In lb	
B ₂₀₁₆ /B _{MSY}	1.3977		Not overfished

Table 49. Best available MSY estimates for Hawaii Crustacean MUS

Fishery	Management Unit Species	MSY (lb)
Crustacean	Deepwater shrimp	275,575
	Kona crab	73,069

Sources: Deepwater shrimp (Tagami and Ralston 1988); Kona crab (Kapur et al. 2019).

1.9 OVERFISHING LIMIT, ACCEPTABLE BIOLOGICAL CATCH, AND ANNUAL CATCH LIMITS

1.9.1 Brief description of the ACL process

The Council developed a tiered system of control rules to guide the specification of ACLs and accountability measures (AMs; (WPRFMC 2011)). The process utilizes the best scientific information available (BSIA) in the form of, but not limited to, stock assessments, published papers, reports, and/or available data. Available data are categorized into the different tiers in the control rule ranging from Tier 1 (i.e., most information available, typically a stock assessment) to Tier 5 (i.e., catch-only information). The control rules are applied to the BSIA. Tiers 1 to 3 involve conducting a Risk of Overfishing Analysis (denoted by P*) to quantify the scientific uncertainties associated with the assessment to specify the Acceptable Biological Catch (ABC), lowering the MSY-based overfishing limit (OFL) to the ABC. A Social, Ecological, Economic, and Management (SEEM) Uncertainty Analysis is performed to quantify the uncertainties associated with the SEEM factors, and a buffer is used to lower the ABC to an ACL. For Tier 4, which is comprised of stocks with MSY estimates but low activity fisheries, the control rule is 91 percent of MSY. For Tier 5, which has catch-only information, the control rule is a one-third reduction in the median catch depending on a qualitative evaluation of stock status via expert opinion. ACLs may be derived from a variety of methods including the above mentioned SEEM analysis or a percentage buffer (i.e., percent reduction from ABC based on expert opinion) or the use of an annual catch target (ACT). NMFS typically implements ACLs on an annual basis, but the Council normally recommends a multi-year specification.

The AM typically implemented for Hawaii insular fisheries is a post-season AM in the form of an overage adjustment. If the recent three-year average catch for a fishery exceeded the implemented ACL, the subsequent ACL is downward adjusted by the amount of overage. A three-year average of recent catch is utilized as recommended by the Council at its 160th meeting to avoid large fluctuations in catch due to data quality and outliers. The uku and Kona crab fisheries, however, also have an in-season AM where, if the catch is projected to reach the implemented ACT, the fishery will be closed in federal waters for the remainder of the fishing year. Similarly, an in-season AM for precious coral fisheries will close individual coral beds if the ACL for that bed is projected to be reached.

1.9.2 Current OFL, ABC, ACL, and Recent Catch

The most recent implementation of OFLs, ABCs, and ACLs covers fishing years 2022–2024 for the MHI Deep-7 bottomfish stock complex (87 FR 3045, January 20, 2022), 2024–2026 for Kona crab (89 FR 37985, May 7, 2024), 2022–2025 for uku (87 FR 17195, March 28, 2022), deepwater shrimp, and precious corals (88 FR 14081, March 7, 2023). The fisheries for deep sea precious corals remain relatively dormant except for limited harvest of black corals. ACLs are no longer specified for coral reef species nor several crustacean species due to an amendment to the Hawaii FEP that reclassified many coral reef ecosystem MUS as ECS (84 FR 2767, February 9, 2019). It is also of note that the MHI Deep-7 stock complex operates based on fishing year and is still open for the 2024–2025 fishing year. Any projected exceedance of the ACT (e.g., for uku or Kona crab) will result in a federal fishery closure for the species. Note that the ACL for uku was specified both the commercial and non-commercial fishery sectors, and combined data from CML reports as well as HMRFS are presented here. The ACLs shown in Table 50 are the most recently implemented ACLs by NMFS. The CML catch for the MHI Deep-7 Bottomfish stock complex in 2024 (151,828 lb) accounted for 30.9% of its implemented ACL (492,000 lb; Table 50).

Table 50. ACLs for Hawaii MUS in 2024 and three-year recent average catch (lb)

Fishery	Management Unit Species	OFL	ABC	ACL	ACT	Catch
Bottomfish	MHI Deep-7 stock complex	558,000	508,000	492,000	-	151,828
	<i>Aprion virescens</i> (uku)	297,624	295,419	295,419	291,010	259,274
Crustacean	Deepwater shrimp	-	250,773	250,773	-	18,527
	Kona crab	33,989	30,802	30,802	25,491	4,065
Precious Coral	‘Au‘au Channel black coral	-	7,508	5,512	-	n.d.
	Makapu‘u Bed pink coral	-	3,009	2,205	-	n.d.
	Makapu‘u Bed bamboo coral	-	571	551	-	n.d.
	180 Fathom Bank pink coral	-	668	489	-	n.d.
	180 Fathom Bank bamboo coral	-	126	123	-	n.d.
	Brooks Bank pink coral	-	1,338	979	-	n.d.
	Brooks Bank bamboo coral	-	256	245	-	n.d.
	Ka‘ena Point Bed pink coral	-	201	148	-	n.d.

	Ka‘ena Point Bed bamboo coral	-	37	37	-	n.d.
	Keāhole Bed pink coral	-	201	148	-	n.d.
	Keāhole Bed bamboo coral	-	37	37	-	n.d.
	Hawaii Exploratory Area precious corals	-	2,205	2,205	-	n.d.

Notes: “n.d.” indicates that the data could not be disclosed due to issues with data confidentiality (i.e., less than three licenses reporting). “-” indicates that there is no value for the given parameter (i.e., not estimated or implemented). Catch for the MHI Deep-7 stock complex is for the 2023-2024 fishing year only, only considers CML data, and is not a three-year average. The three-year average catch value for uku is a mean from 2022 to 2024 for the sum of CML catch, HMRFS shore-based catch estimates, and HMRFS boat-based catch estimates; HMRFS estimates are known to have high uncertainty.

1.10 BEST SCIENTIFIC INFORMATION AVAILABLE

1.10.1 Main Hawaiian Island Deep-7 Bottomfish Fishery

1.10.1.1 Stock Assessment Benchmark

In 2024, PIFSC completed a benchmark stock assessment for the MHI Deep-7 bottomfish fishery (2024 stock assessment) using data through 2023 (Syslo et al. 2024). The 2024 stock assessment used a Bayesian state-space surplus production model and included several improvements, such as re-examination of previously used reporting ratios for determining non-commercial catch, refining data filtering procedures and improving the generation of abundance indices (i.e., the standardized fishery-dependent CPUE index, fishery-independent index, and single-species ‘ōpakapaka CPUE index), updating the software for the assessment model, exploring new parameterizations of the production function, and reevaluating prior distributions based on the most recent life-history information available for Deep-7 species (Syslo et al. 2024).

The 2024 assessment estimated a maximum sustainable yield (MSY) for total catch of 709,000 lb for the MHI Deep-7 bottomfish stock complex. The 2024 stock assessment also included projection results of a range of commercial catches of Deep-7 bottomfish that would produce probabilities of overfishing ranging from 0 percent to 100 percent at 1 percent intervals. If 510,000 lb of reported catch occurs from fishing years 2025-2029, there is a 50% risk of overfishing in 2029; this is the overfishing limit. The next benchmark stock assessment for the MHI Deep-7 bottomfish complex will be completed in 2030.

1.10.1.2 Stock Assessment Updates

In 2021, PIFSC completed a stock assessment update for the MHI Deep-7 bottomfish fishery using data through 2018 (Syslo et al. 2021). The 2021 stock assessment used a Bayesian state-space surplus production model and included several improvements, such as updated filtering and standardization methods for CPUE from commercial data based on a series of workshops that included input from various management, scientific, and industry participants (Yau 2018). It also incorporated a fishery-independent estimate of abundance as estimated from Richards et al. (2016).

The 2021 assessment estimates MSY for reported catch of 473,000 lb for the MHI Deep-7 bottomfish stock complex. The 2021 stock assessment also included projection results of a range

of commercial catches of Deep-7 bottomfish that would produce probabilities of overfishing ranging from 0 percent to 100 percent at 1 percent intervals. If 618,000 lb of reported catch occurs from fishing years 2021–2025, there is a 50% risk of overfishing in 2021; this is the overfishing limit. The next stock assessment update for the MHI Deep-7 bottomfish complex will be completed in 2026.

1.10.1.3 Best Available Scientific Information

National Standard 2 requires that conservation and management measures be based on the BSIA and be founded on comprehensive analyses. National Standard 2 guidelines (78 FR 43087, July 19, 2013) state that scientific information that is used to inform decision making should include an evaluation of its uncertainty and identify gaps in the information (50 CFR 600.315(a)(1)). The guidelines also recommend scientific information used to support conservation and management be peer reviewed (50 CFR 600.315(a)(6)(vii)). However, the guidelines also state that mandatory management actions should not be delayed due to limitations in the scientific information or the promise of future data collection or analysis (50 CFR 600.315(a)(6)(v)).

The PIFSC determined that the 2024 benchmark stock assessment by Syslo et al. (2024) was the BSIA. This is based on the assessment passing a Western Pacific Stock Assessment Review (WPSAR) by a three-person independent peer review panel and as accepted by the Council's SSC at its 152nd meeting on March 18-20, 2024.

1.10.2 Uku Fishery

1.10.2.1 Stock Assessment

In February 2017, PIFSC released the final species level assessment for the main Hawaiian Islands (Nadon 2017). This assessment covers 27 species of fish, one of which is uku (*Aprion virescens*). The remaining 26 species are no longer MUS.

The 2017 assessment utilized a different approach compared to the existing model used for the fishing years 2015-2018 specification. It used life history information and a length-based approach to obtain stock status based on SPR rather than MSY. When life history information is not available for a species, a data-poor approach is used to simulate life history parameters based on known relationships (Nadon and Ault 2016). Fishery independent size composition and abundance data from diver surveys were combined with fishery dependent catch estimates to calculate current fishing mortality rates (F), SPR, SPR-based sustainable fishing rates (F_{30} ; F resulting in $SPR = 30\%$), and catch levels corresponding to these sustainable rates (C_{30}). A length-based model was used to obtain mortality rates and a relatively simple age-structured population model to find the various SPR-based stock status metrics. The catch level to maintain the population at $SPR=30\%$, notated as C_{30} , was obtained by combining F_{30} estimates with current population biomass estimates derived directly from diver surveys or indirectly from the total catch. The OFL to a 50% risk of overfishing was defined as the median of the C_{30} distribution.

In May 2020, PIFSC released the final species level assessment for the main Hawaiian Islands uku stock. This assessment built off previous assessment efforts and used catch, CPUE, diver surveys, and size composition time series in the Stock Synthesis modeling framework, which is an integrated catch-at-age model.

Stock Synthesis uses observed catch, size/age composition, and relative abundance indices, such as CPUE, as inputs and incorporates the main population processes (e.g., mortality, selectivity, growth) to recreate population biomass trajectory and derived indicators of stock status to be measured against reference points in the Hawaii FEP. The 2020 assessment results differed slightly from the 2017 assessment that used a data-limited approach on mean length data only, as the 2020 assessment estimated a lower recent fishing mortality rate of approximately 0.08 versus 0.15 for the 2017 assessment. The 2020 stock assessment determined a higher OFL than the 2017 assessment based on catch-derived biomass, though the SPR-based F_{MSY} proxy used in the 2017 assessment ($F_{30} = 0.16$) is close to the F_{MSY} value estimated in the 2020 assessment (0.14).

1.10.2.2 Stock Assessment Updates

There are no stock assessment updates available for uku.

1.10.2.3 Best Scientific Information Available

The Nadon et al. (2020) assessment underwent peer review by a Western Pacific Stock Assessment Review (WPSAR) panel from February 24 to 28, 2020 (85 FR 5633, January 31, 2020). The review panel, comprised of E. Franklin, Y. Chen, and Y. Jiao, was asked to review a set of 11 Terms of Reference according to guidelines established in the WPSAR framework. The assessment author revised the draft assessment addressing the WPSAR panel comments and recommendations and presented the final stock assessment document at the 136th and 182nd meetings of the SSC and Council, respectively. PIFSC and the Council consider these assessments the BSIA for these species.

1.10.3 Crustacean Fishery

1.10.3.1 Stock Assessment Benchmark

Deepwater Shrimp: The deepwater shrimp (*Heterocarpus laevis* and *H. ensifer*) initial resource assessment was conducted in the early 1990s by Ralston and Tagami (1992). This involved depletion experiments, stratified random sampling of different habitats, and calculation of exploitable biomass using the Ricker equation (Ricker 1975). However, the value for exploitable biomass (271.4 mt/yr, or 598,328 lb/yr) as estimated by Ralston and Tagami (1992) exceeds the MSY estimate of 275,575 lb/yr from Tagami and Ralson (1988). Since then, no new estimates have been calculated for this stock.

Kona Crab: A benchmark stock assessment model was completed by PIFSC scientists in 2019 (Kapur et al. 2019). This assessment utilized a Bayesian state-space surplus production model. Based on this, the Kona crab stock is not overfished and not experiencing overfishing. PIFSC determined the Kapur et al. (2019) stock assessment to be the BSIA for Kona crabs because the assessment passed independent peer review by a WPSAR three-person panel.

1.10.3.2 Stock Assessment Updates

There are no stock assessment updates available for the crustacean MUS.

1.10.3.3 Best Scientific Information Available

To date the best available scientific information for the crustacean MUS are as follows:

- Deepwater shrimp – Tagami and Ralston (1988)
- Kona crab – Kapur et al. (2019)

1.11 HARVEST CAPACITY AND EXTENT

The MSA defines the term “optimum,” with respect to the yield from a fishery, as the amount of fish which:

- Will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems.
- Is prescribed based on the MSY from the fishery, as reduced by any relevant social, economic, or ecological factor.
- In the case of an overfished fishery, provides for rebuilding to a level consistent with producing the MSY in such fishery [50 CFR §600.310(f)(1)(i)].

Optimum yield (OY) in the bottomfish fisheries is prescribed based on the MSY from the stock assessment and the best available scientific information. In the process of specifying ACLs, social, economic, and ecological factors were considered and the uncertainties around those factors defined the management uncertainty buffer between the ABC and ACL. OY for the bottomfish MUS complex is defined to be the level of harvest equal to the ACL consistent with the goals and objectives of the FEPs and used by the Council to manage the stock.

The Council recognizes that MSY and OY are long-term values whereas the ACLs are yearly snapshots based on the level of fishing mortality at MSY (F_{MSY}). There are situations when the long-term means around MSY are lower than ACLs especially if the stock is known to be productive or relatively pristine or lightly fished. A stock can have catch levels and catch rates exceeding that of MSY over the short-term to lower the biomass to a level around the estimated MSY and still not jeopardize the stock.

The harvest extent, in this case, is defined as the level of catch harvested in a fishing year relative to the ACL or OY. The harvest capacity is the level of catch remaining in the annual catch limit that can potentially be used for the total allowable level of foreign fishing (TALFF). Table 51 summarizes the harvest extent and harvest capacity information for Hawaii in 2023 using three-year average catch.

Table 51. Proportion of harvest capacity and extent for Hawaii MUS relative to their ACLs in 2024

Fishery	Management Unit Species	ACL	Catch (lb)	Harvest Extent (%)	Harvest Capacity (%)
Bottomfish	MHI Deep-7 stock complex	492,000	151,828	30.86	69.14
	<i>Aprion virescens</i> (uku)	295,419	259,274	87.76	12.24
Crustacean	Deepwater shrimp	250,773	18,527	7.39	92.61
	Kona crab	30,802	4,065	13.20	86.80
Precious Coral	‘Au‘au Channel black coral	5,512	n.d.	NA	NA
	Makapu‘u Bed pink coral	2,205	n.d.	NA	NA
	Makapu‘u Bed bamboo coral	551	n.d.	NA	NA
	180 Fathom Bank pink coral	489	n.d.	NA	NA

Fishery	Management Unit Species	ACL	Catch (lb)	Harvest Extent (%)	Harvest Capacity (%)
	180 Fathom Bank bamboo coral	123	n.d.	NA	NA
	Brooks Bank pink coral	979	n.d.	NA	NA
	Brooks Bank bamboo coral	245	n.d.	NA	NA
	Ka‘ena Point Bed pink coral	148	n.d.	NA	NA
	Ka‘ena Point Bed bamboo coral	37	n.d.	NA	NA
	Keāhole Bed pink coral	148	n.d.	NA	NA
	Keāhole Bed bamboo coral	37	n.d.	NA	NA
	Hawaii Exploratory Area precious corals	2,205	n.d.	NA	NA

“n.d.” indicates that the data could not be disclosed due to issues with data confidentiality (i.e., less than three licenses reporting). “NA” indicates that there is no value for the given parameter (i.e., not estimated or implemented). Each catch value represents the recent three-year average except for the MHI Deep-7 stock complex, which presents the catch value only for the 2023-2024 fishing year.

1.12 ADMINISTRATIVE AND REGULATORY ACTIONS

This summary describes management actions NMFS implemented for insular fisheries in the Hawaiian Archipelago during calendar year 2024.

On April 5, 2024, NMFS published a final rule to implement the annual harvest guideline for the commercial lobster fishery in the Northwestern Hawaiian Islands (NWHI) for calendar year 2024 at zero lobsters (88 FR 23949). Harvest of NWHI lobster resources is not allowed because regulations governing the Papahānaumokuākea Marine National Monument in the NWHI prohibit the unpermitted removal of monument resources (50 CFR 404.7) and establish a zero annual harvest guideline for lobsters (50 CFR 404.10(a)).

On May 7, 2024, NMFS published a final rule to implement annual catch limits (ACLs) and accountability measures (AMs) for Main Hawaiian Islands Kona crab for fishing years 2024–2026. NMFS is implementing an ACL of 30,802 pounds (lb; 13,972 kilograms (kg)) and an annual catch target (ACT) of 25,491 lb (11,563 kg). Catch from both State and Federal waters count towards these catch limits. As an in-season AM to prevent the fishery from exceeding the ACL, NMFS will close Federal waters to commercial and non-commercial fishing for Kona crab for the remainder of the fishing year if catch reaches the ACT. As a post-season AM, if catch exceeds the ACL in a fishing year NMFS will reduce the ACT and ACL in the subsequent year by the amount of the overage.

2 ECOSYSTEM CONSIDERATIONS

2.1 FISHER OBSERVATIONS

Hawai‘i fishermen Clay Tam and Roy Morioka started the fisher observations initiative in 2020 to add traditional and local ecological knowledge, and on-the-water observations to fisheries dependent data sources to the Annual Stock Assessment and Fishery Evaluation (SAFE) reports. Fisher observations from 2020-2022 can be found in the pelagic and Archipelagic reports.

In 2023 and 2024 Fisher Observations were collected during 3 quarterly Hawai‘i advisory panel meetings. Input collected by fishers during these meetings was limited to Hawai‘i Advisory Panel members followed with an annual review meeting open to Advisory Panel members and the fishing community which was published as a data report (Ayers et al. 2024). For 2024, a total of 5 Hawai‘i Advisory Panel members attended the second quarter meeting on June 7th, and 7 Advisory Panel members attended the third and fourth quarter meetings on September 6th and December 6th, respectively. As in previous years, meeting attendance and input was limited to Hawai‘i Advisory Panel members followed with an annual review meeting open to both Advisory Panel members and the fishing community. Data gathered from the 2024 meetings is reported below.

2.1.1 Information from Advisory Panel Meetings

2.1.1.1 Hawaii Island

Second Quarter (April-June)

Bids are due for the Wailoa Small Boat Harbor channel dredging in Hilo. Ukus caught by fishers in April appeared to be about a month from spawning. Fishers also noted an exceptional amount of weke nonos (red goatfish with white stripes) around, more than previous years. Another fisher reported folks are getting out fishing, but that there’s not much enforcement presence on the Hilo side. There has been steady rain every afternoon in Kona, with a lot of moisture in the air. Kona gas prices are in the \$5/gallon range.

Third Quarter (July-September)

Some fishers were caught with lobsters carrying lots of eggs. The Kona current switched and started ripping North, but the fish disappeared with it. The rains have slowed down since second quarter (springtime) and the coffee season is beginning up in the mountains. Citrus production is down in Kona, which is something to note. Orange, lemon, tangerines all have low numbers on trees. In Hilo, dredging continues on the Wailoa Harbor and completion is expected by the end of the year. The dredgers have picked up a tremendous amount of sand, a sign of how much had accumulated.

Fourth quarter (October-December)

Dredging was completed at the Wailoa boat harbor channel. The project estimate for the dredging project came in at \$4.8 million, but the budget was only \$3.1 million. There are only a few full-time fishermen out of Honokohau harbor in Kona. The Honokohau harbor now charges \$350 to use the scale to weigh and take a picture of a fish. The lack of harbors for fishing access and safety on Hawai‘i Island is an issue. There is no harbor south after Miloli‘i / Honaunau, neither of which require a registration sticker, but your boat must be small to launch there.

Pohoiki boat ramp in the Puna region on the Southeast coast of Hawai‘i Island was filled in by the 2018 lava flows. The bottomfish are biting in Kona but the shark depredation is significant enough that it is difficult for fishers to land enough to make a profit. Another Kona fisher reported catching large weke ulas in the 6-7lb range along with consistent uku and opelu bite. Lighter winds observed in Kona in November where fishers are targeting bottomfish (areas like Kona, Kohala on the westside). Fishers reported an abundance of fish around in terms of numbers, but sharks remain a problem. One fisher reported that sharks approached their boat as soon as they put their line in the water on their last bottomfishing trip. An ice machine at the harbor should help out small boat fishermen. Fishers are reporting more DOCARE enforcement of boats, checking coolers for fish caught, Kona crab, lobsters, and trailers. Fishers felt that recent DLNR-DOCARE hires have helped increase enforcement.

2.1.1.2 Kauai

Second Quarter (April-June)

Fishers reported that non-ethanol gas prices were over \$6/gallon. The kāhala bite has been good on the inside. Commercial fishers are doing well with uku, catching a lot of fish on short fishing trips. The state of Hawai‘i is close to completing a boat ramp further up Anini stream. A community member is working with the state to put up no swimming signs by the boat ramp, since swimmers often venture into the boat channel by the reef flat area and interactions with swimmers have increased in recent years. One fisher noted harbors are full of people fishing again, for the first time in years. Kekaha boater’s association started an Instagram account to share information about their small harbor and all of the multiple users there. Near Port Allen, some thrillcraft have been running close to shore near divers/dive spots and there have been some close calls with swimmers/divers. The septic waste machine at the Port Allen boat ramp is not working, which prevented boaters from disposing of waste. Two aquaculture companies are growing limu kohu to feed to cattle to reduce their methane emissions. DOCARE officers are turning away boaters with unregistered trailers from boat ramps. One Kaua‘i fisher reported that their island’s fresh fish presentation is poor and that no one wants to buy fish from them when they catch a couple hundred pounds.

Third Quarter (July-September)

Fishing participation has been low for most of the year, with just a few charter trailers at the boat ramp. Fishers noted some type of an ocean bloom, with fish smaller than ‘oama size around. Plenty of ‘ōpelu, good ‘ōpelu bite. Two huge akule balls reported in the Kalihiwai area and Hā‘ena. ‘Oamas not very heavy, but fishers are catching them on the Kapa‘a side. Fishers are also catching big moi and lots of them. An AP member noted that a lot of fishers have gotten into catch and release, only keeping one big one and releasing the others. One Kaua‘i fisher has started bottomfishing frequently and is starting to catch a lot of bigger ehū in the 8-10lb range, which are not easy to catch. No reports of Kona crab or lobster.

Fourth quarter (October-December)

Kaua‘i fishers reported great opelu fishing with “acres and acres” inside the ledge. The kāhala bite picked back up and uku fishing has been steady. January had massive weke ulas. Great o‘opu season was great with big fish carrying lots of eggs. Mango trees were flowering already at the end of 2024, all across the westside of Kaua‘i. No reports about ika since there are not many akule net fishers around now. One Kaua‘i bottomfisher that fishes around Ni‘ihau said that all spots hold lots of fish, but nearly all of them experience heavy shark depredation, losing as

much as \$500 worth of fish or gear every trip. In terms of infrastructure, Wiliwili harbor has deferred maintenance from bumpers to no dedicated area to wash down boats, large potholes in the parking lot, and docks that need to be replaced. Maintenance issues persist at Port Allen as well, with floating docks, wash down issues (broken water lines), and lack of parking and bathroom stalls, and dredging needed. DOCARE has been enforcing trailer and boat registration. The state of Hawai'i has been working with a local landowner adjacent to Port Allen to utilize some of their vacant land for the harbor.

2.1.1.3 Maui

Third Quarter (July-September)

Commercial bottomfish catches have been good. Maui fishers are looking forward to a good opakapaka and onaga season. Boat ramp and infrastructure issues persist. The Lahaina fires [and lack of access] concentrated Lahaina boats at Ma'alaea. Uku still being caught with lots of eggs. By September, they're usually finished spawning.

Fourth quarter (October-December)

Maui is rebuilding after the fire and Lahaina is cleaned up. Thirty additional moorings have been built at Ma'alaea Harbor. Boats are surrounding humpback whales, which have just arrived from Alaska. Opakapaka fishing has been good. 2024 has been a productive fishing season in general with good weather.

2.1.1.4 Oahu

Second Quarter (April-June)

Windward O'ahu fishers noted gas prices around \$4.19/gallon at Costco.

Third Quarter (July-September)

Recreational fishing has been down for Windward O'ahu. Shorecasting has been impacted by unusual, erratic weather for summer months with high winds, low tourism, and rain. Fish catches are down – still catching all sizes – but fewer than previous years. Climate change and the economy have increased uncertainty of fishing trips. Proposed wind energy projects may affect Waimānalo, Kailua, fishing, and traditional uses. O'ahu fishers started the MOUSS work on the Penguin Banks after completing O'ahu, Maui, and Big Island. They are hoping for moderate or lighter winds in order to get some of the fishing camera work completed. PIFSC Life History program is looking for fishers to share anything uku, including otoliths, gonads.

Fourth quarter (October-December)

O'ahu fishers were pleased to see more DOCARE officers enforcing fishing regulations on the shoreline and on boats. There used to be just one DOCARE officer on O'ahu's North Shore, but now there 4-5 staff on patrol. The opelu and bottomfish bite has been good, but shark depredation has been strong. Very bad shark depredation on bottomfish in some areas, even though there was no depredation observed during the PIFSC bottomfish survey this year. There are concerns about the data when bottomfishers cannot land any fish due to shark depredation, because the sharks are not going away. Illegal/unpermitted moorings for shark tours are a hazard for boats heading out or coming back to port in low light or dark conditions. One fishing boat ran into one of the moorings and luckily another small boat was able to tow them back to port. One fisher reported that there are as many as 20 large aluminum vessels using the Haleiwa boat harbor to do shark tours. Fishers also reported that the homeless population is also a problem in

the harbor with break-ins and theft. Another fisher noted that sharks remain an issue affecting fishing productivity. Lack of trailer parking can affect safety in Windward O‘ahu, particularly during busy times. Windy conditions in early November limited the bottomfish project, but fishers on Kaua‘i and Maui were able to complete surveys. PIFG has been monitoring the UFA Auction and noted no bottomfish on the block from November 6-15th due to the rough weather conditions. One fisher felt that bottomfishing participation is declining and highliners are not being replaced when they exit the fishery. Bottomfish prices were strong end of November with double digits in red bottomfish available on the block, with kalekale and gindai also for sale.

2.1.2 Information from the Annual Summit

2.1.2.1 Social

Social issues reported by Hawai‘i fishers included fishing infrastructure issues, a lack of people fishing for bottomfish on Kaua‘i and reduced small boat fishing effort on Hawai‘i island. For fishing infrastructure, fishers referenced conflicts with tourism at Kaua‘i boat harbors over a lack of parking; the need to dredge and reopen Pohoiki and the impact that delay in dredging has had on fishers trying to launch out of Wailoa.

2.1.2.2 Economic

Economic issues described by Hawai‘i fishers included market conditions, marketing, changing consumer preferences, and a lack of markets on Kaua‘i. For market conditions, fishers described good market prices for bottomfish around Lunar New Year. Fishers also described the challenges of marketing their catch, especially if they live on an outer island and need to transit their fish to the United Fishing Agency fish auction on O‘ahu. One fisher reported that the high fuel prices make people more selective about when they go fishing.

2.1.2.3 Biological

Hawai‘i fishers reported a good year for uku and noted an abundance of bottomfish such as juvenile opakapaka. For forage fish, meeting attendees said 2024 was a good year for ‘ōpelu, moana, ‘oama, halalu, and akule. Fishers also noted some shifts in the timing in the arrival of forage fish and uku. Depredation on bottomfishing trips continued, making landing fish.

2.1.2.4 Physical/Oceanographic

Kailua-Kona fishers observed strange currents at the beginning of 2024 with ka‘u currents transitioning to more regular kohala currents later in the year. Fishers noted increases in west swell events in Kona and late south swells that coincided with uku runs on Penguin Banks. Fishers also observed windy days and heavy rainfall affecting or preventing fishing trips in 2024.

2.1.2.5 Management Uncertainty

Several fishers brought up issues with green sea turtle overpopulation, regularly witnessing large numbers basking on beaches, seeing some dead in the water, and noting depleted limu beds. Fishers also felt that new kona crab regulations and awareness of them have improved fisher behavior and compliance. One fisher felt that the state of Hawai‘i should announce spawning seasons for nearshore species and develop regulations to protect those times. Another hoped that something could be done about increasing shark populations that make landing fish difficult.

2.2 CORAL REEF FISH ECOSYSTEM PARAMETERS

2.2.1 Regional Reef Fish Biomass and Habitat Condition

Description: ‘Reef fish biomass’ is mean biomass of reef fishes per unit area derived from visual survey data between 2010 and 2024. ‘Hard Coral Cover’ is mean cover derived from benthic imagery (photoquadrats) collected by divers across the survey domain, including most sites where reef fish surveys occurred. In previous reports, this parameter stemmed from diver visual rapid assessments of coral cover. Note that no surveys were conducted in 2020 or 2021 in any region due to COVID-19.

Rationale: Reef fish biomass has been widely used as an indicator of relative ecosystem status and has repeatedly been shown to be sensitive to changes in fishing pressure, habitat quality, and oceanographic regime. Hard coral cover is an indicator of relative status of the organisms that build coral reef habitat and has been shown to be sensitive to changes in oceanographic regime, and a range of direct and indirect anthropogenic impacts. Most fundamentally, cover of hard corals has been increasingly impacted by temperature stress as a result of global heating.

Data Category: Fishery-independent

Timeframe: Triennial

Jurisdiction: American Samoa, Guam, Commonwealth of the Northern Mariana Islands (CNMI), Main Hawaiian Islands (MHI), Northwestern Hawaiian Islands (NWHI), and Pacific Remote Island Areas (PRIAs)

Spatial Scale: Regional

Data Source: Data used to generate cover and biomass estimates come from surveys conducted by the National Marine Fisheries Service (NMFS) Pacific Island Fisheries Science Center (PIFSC) Ecosystem Sciences Division (ESD) and their partners as part of the Coral Reef Conservation Program’s (CRCP) National Coral Reef Monitoring Program ([NCRMP](#)). Fish survey methods are described in detail in Ayotte et al. (2015). In brief, they involve teams of divers conducting stationary point count cylinder (SPC) surveys within a target domain of < 30 meter hard-bottom habitat at each island, stratified by depth zone and, for larger islands, by section of coastline. For consistency among islands, only data from forereef habitats are used. At each SPC, divers record the number, size, and species of all fishes within or passing through paired 15 meter-diameter cylinders over the course of a standard count procedure. Cover estimates are derived from photoquadrats collected by divers within the same survey domain, including at all the fish survey sites. Post-hoc annotation methods are described in detail in Lamirand et al. (2022).

Fish sizes and abundance are converted to biomass using standard length-to-weight conversion parameters, taken largely from [FishBase](#) and converted to biomass per unit area by dividing by the area sampled per survey. Site-level data were pooled into island-scale values by first calculating mean and variance within strata, and then calculating weighted island-scale mean and variance using the formulas given in Smith et al. (2011) with strata weighted by their respective sizes.

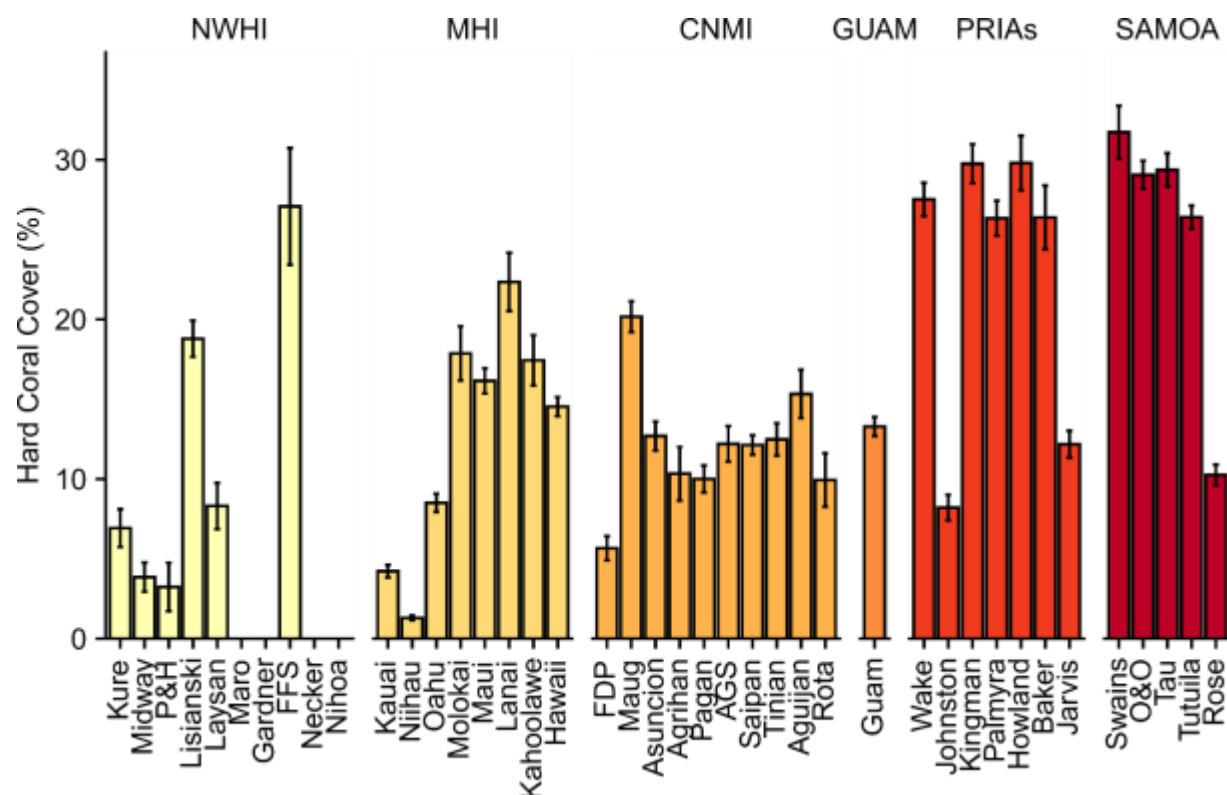


Figure 1. Mean coral cover (% ± standard error of the mean, or SEM) per U.S. Pacific Island averaged from 2010-2023 by latitude

Note: Coverage data presented here is derived from benthic imagery (photoquadrats) collected by divers across the survey domain. In previous reports, hard coral cover stemmed from diver visual assessments, which is a less rigorous method for estimating this parameter.

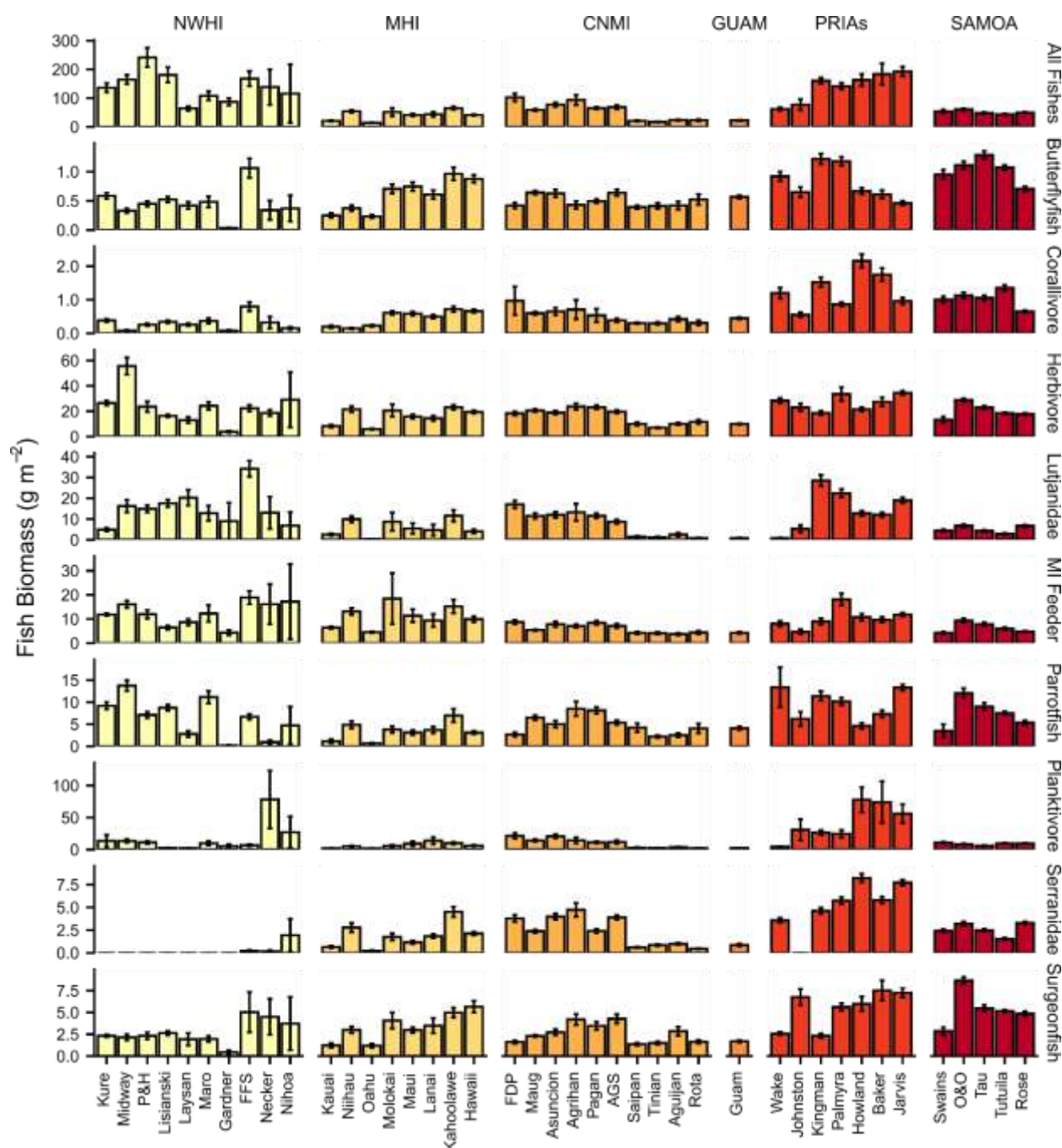


Figure 2. Mean fish biomass ($\text{g/m}^2 \pm \text{SEM}$) per U.S. Pacific Island of functional, taxonomic, and trophic groups from 2010-2024 by latitude

Note: The group ‘Serranidae’ excludes planktivorous members of that family (i.e., anthias), which can be hyper-abundant in some regions. Similarly, the bumphead parrotfish, *Bolbometopon muricatum*, has been excluded from the corallivore group. The group ‘MI Feeder’ consists of fishes that primarily feed on mobile invertebrates; ‘Butterflyfish’ are non-planktivorous butterflyfish species; and ‘Surgeonfish’ are mid-large targeted surgeonfish species.

2.2.2 Main Hawaiian Islands Reef Fish Biomass and Habitat Condition

Description: ‘Reef fish biomass’ is mean biomass of reef fishes per unit area derived from visual survey data between 2010 and 2024. ‘Hard Coral Cover’ is mean cover derived from benthic imagery (photoquadrats) collected by divers across the survey domain, including most sites where reef fish surveys occurred. In previous reports, this parameter stemmed from diver visual rapid assessments of coral cover. Note that no surveys were conducted in 2020 or 2021 in any region due to COVID-19.

Rationale: Reef fish biomass has been widely used as an indicator of relative ecosystem status and has repeatedly been shown to be sensitive to changes in fishing pressure, habitat quality, and oceanographic regime. Hard coral cover is an indicator of relative status of the organisms that build coral reef habitat and has been shown to be sensitive to changes in oceanographic regime, and a range of direct and indirect anthropogenic impacts. Most fundamentally, cover of hard corals has been increasingly impacted by temperature stress as a result of global heating.

Data Category: Fishery-independent

Timeframe: Triennial

Jurisdiction: MHI

Spatial Scale: Island

Data Source: Data are sourced from surveys conducted by NMFS PIFSC ESD and partners, as part of the Pacific NCRMP. Survey methods and sampling design, and methods to generate biomass and cover parameters are described in Section 2.2.1.

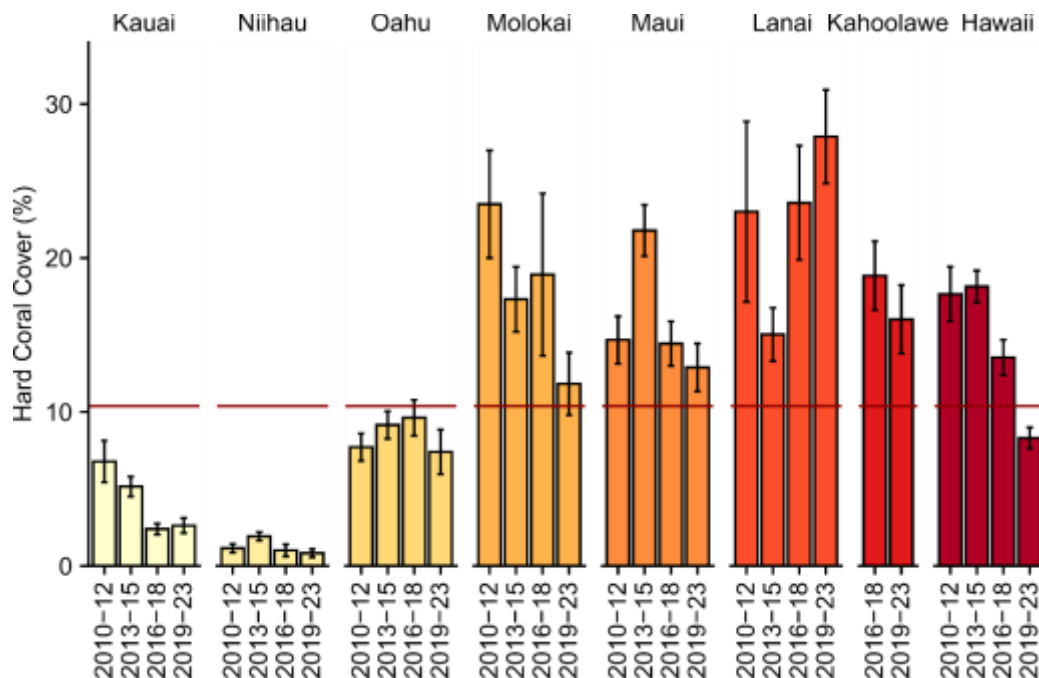


Figure 3. Mean coral cover (% \pm SEM) per island of the MHI from 2010–2024 by latitude

Note: The red horizontal line is the region-wide mean estimate for the entire time period. Coverage data presented here is derived from benthic imagery (photoquadrats) collected by divers across the survey domain. In previous reports, hard coral cover stemmed from diver visual assessments, which is a less rigorous method for estimating this parameter.

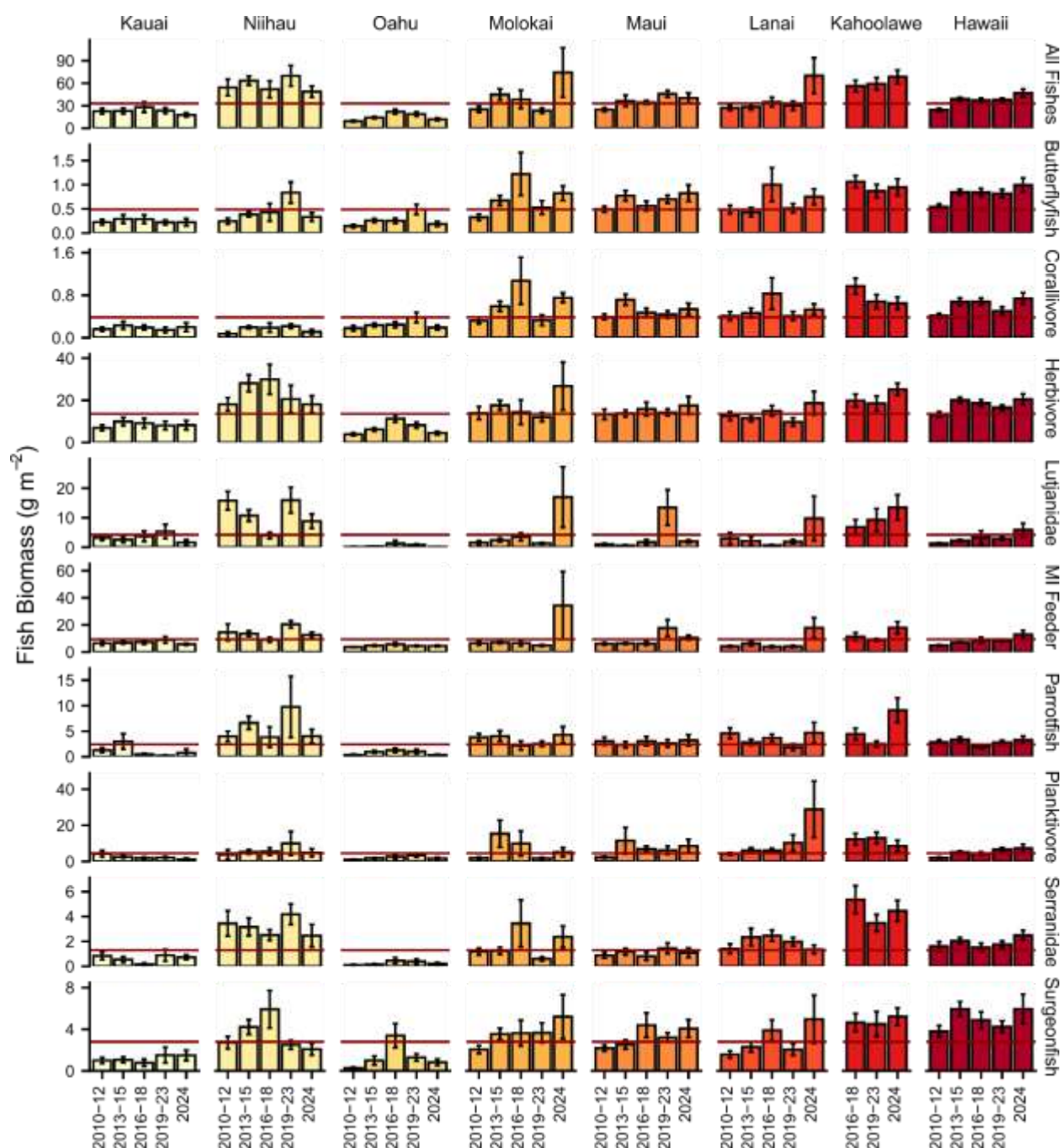


Figure 4. Mean fish biomass (g/m² ± SEM) of functional, taxonomic, and trophic groups per island of the MHI from 2010-2024

Note: The group 'Serranidae' excludes planktivorous members of that family (i.e., anthias), which can be hyper-abundant in some regions. Similarly, the bumphead parrotfish, *Bolbometopon muricatum*, has been excluded from the corallivore group. The group 'MI Feeder' consists of fishes that primarily feed on mobile invertebrates; 'Butterflyfish' are non-planktivorous butterflyfish species; and 'Surgeonfish' are mid-large targeted surgeonfish species. Red horizontal lines are the region-wide mean estimates for the entire time period.

2.2.3 Northwestern Hawaiian Islands Reef Fish Biomass and Habitat Condition

Description: ‘Reef fish biomass’ is mean biomass of reef fishes per unit area derived from visual survey data between 2010 and 2024. ‘Hard Coral Cover’ is mean cover derived from benthic imagery (photoquadrats) collected by divers across the survey domain, including most sites where reef fish surveys occurred. In previous reports, this parameter stemmed from diver visual rapid assessments of coral cover. Note that no surveys were conducted in 2020 or 2021 in any region due to COVID-19.

Rationale: Reef fish biomass has been widely used as an indicator of relative ecosystem status and has repeatedly been shown to be sensitive to changes in fishing pressure, habitat quality, and oceanographic regime. Hard coral cover is an indicator of relative status of the organisms that build coral reef habitat and has been shown to be sensitive to changes in oceanographic regime, and a range of direct and indirect anthropogenic impacts. Most fundamentally, cover of hard corals has been increasingly impacted by temperature stress as a result of global heating.

Data Category: Fishery-independent

Timeframe: Triennial

Jurisdiction: NWHI

Spatial Scale: Island

Data Source: Data are sourced from surveys conducted by NMFS PIFSC ESD and partners, as part of the Pacific NCRMP. Survey methods and sampling design, and methods to generate biomass and cover parameters are described in Section 2.2.1.

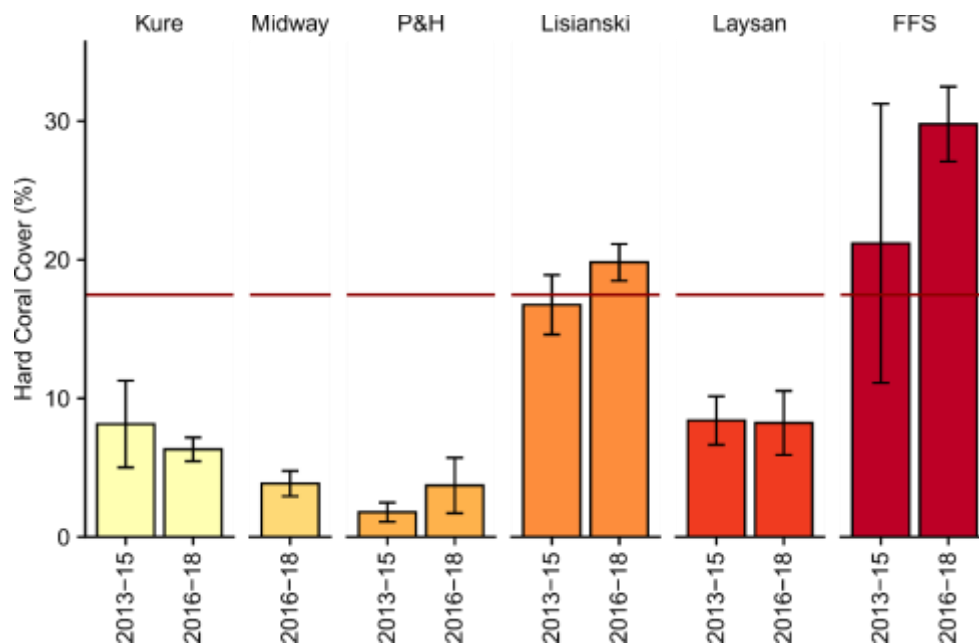


Figure 5. Mean coral cover (% ± SEM) per island of the NWHI from 2010–2024 by latitude

Note: The red horizontal line is the region-wide mean estimate for the entire time period. Coverage data presented here is derived from benthic imagery (photoquadrats) collected by divers across the survey domain. In previous reports, hard coral cover stemmed from diver visual assessments, which is a less rigorous method for estimating this parameter.

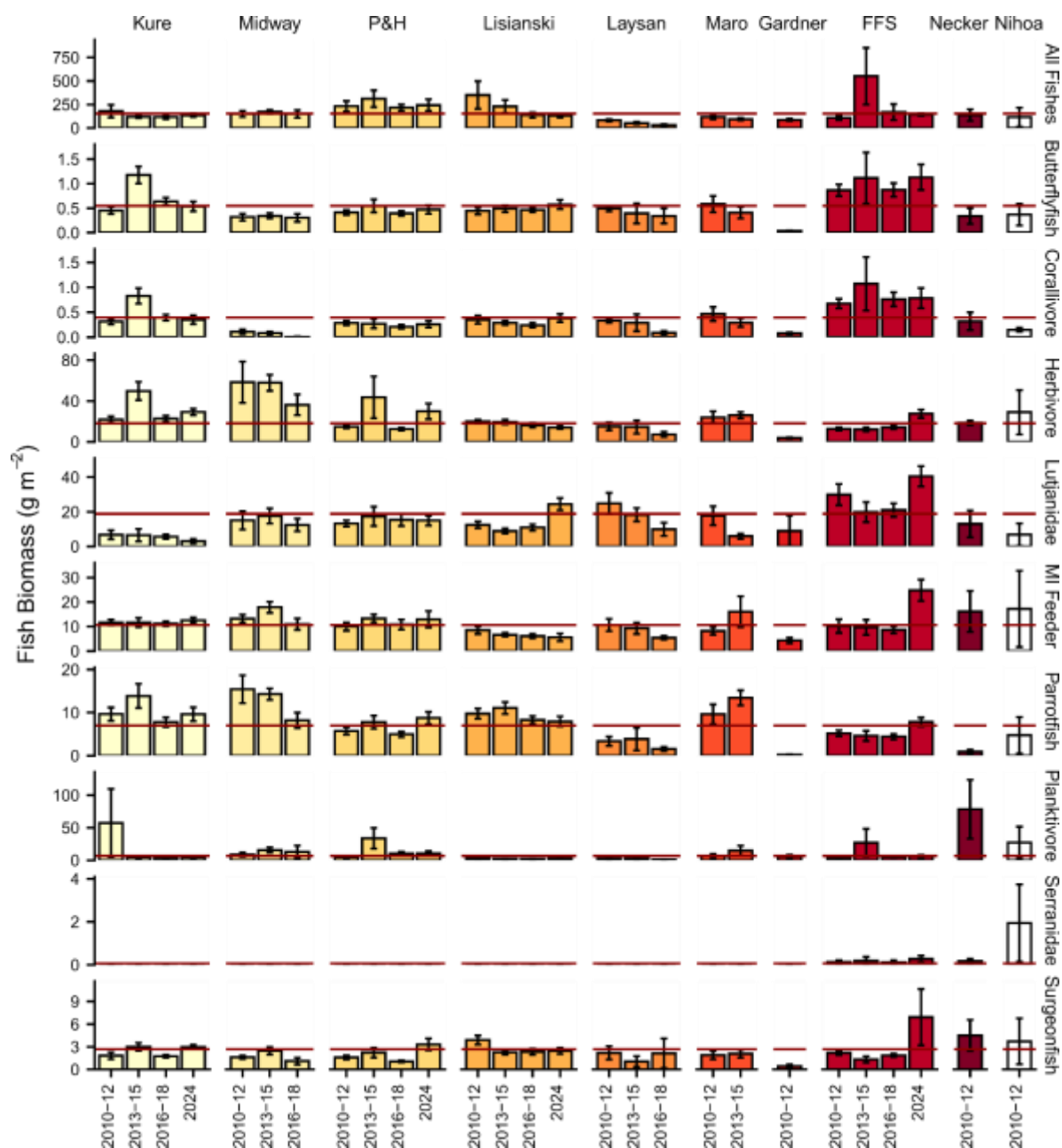


Figure 6. Mean fish biomass ($\text{g}/\text{m}^2 \pm \text{SEM}$) of functional, taxonomic, and trophic groups per island of the NWHI from 2010-2024

Note: The group ‘Serranidae’ excludes planktivorous members of that family (i.e., anthias), which can be hyper-abundant in some regions. Similarly, the bumphead parrotfish, *Bolbometopon muricatum*, has been excluded from the corallivore group. The group ‘MI Feeder’ consists of fishes that primarily feed on mobile invertebrates; ‘Butterflyfish’ are non-planktivorous butterflyfish species; and ‘Surgeonfish’ are mid-large targeted surgeonfish species. Red horizontal lines are the region-wide mean estimates for the entire time period.

2.3 LIFE HISTORY AND LENGTH DERIVED PARAMETERS

2.3.1 MHI Coral Reef Ecosystem Components Life History

2.3.1.1 Age, Growth, and Reproductive Maturity

Description: Age determination is based on counts of yearly growth marks (annuli) and/or daily growth increments (DGIs) internally visible within transversely cut, thin sections of sagittal otoliths. Validated age determination is based on several methods including an environmental signal (bomb radiocarbon ^{14}C) produced during previous atmospheric thermonuclear testing in the Pacific and incorporated into the core regions of sagittal otolith and other aragonite-based calcified structures such as hermatypic corals. This technique relies on developing a regionally based aged coral core reference series for which the rise, peak, and decline of ^{14}C values is available over the known age series of the coral core. Estimates of fish age are determined by projecting the ^{14}C otolith core values back in time from its capture date to where it intersects with the known age ^{14}C coral reference series. Fish growth is estimated by fitting the length-at-age data to a growth function, typically the von Bertalanffy growth function (VBGF). This function typically uses three coefficients (L_{∞} , k , and t_0), which together characterize the shape of the length-at-age growth relationship.

Length-at-reproductive maturity is based on the histological analyses of small tissue samples of gonad material that are typically collected along with otoliths when a fish is processed for life history studies. The gonad tissue sample is preserved, cut into five-micron sections, stained, and sealed onto a glass slide for subsequent examination. Based on standard cell structure features and developmental stages within ovaries and testes, the gender, developmental stage, and maturity status (immature or mature) is determined via microscopic evaluation. The percent of mature samples for a given length interval are assembled for each sex and these data are fitted to a three- or four-parameter logistic function to determine the best fit of these data based on statistical analyses. The mid-point of this fitted function provides an estimate of the length at which 50% of fish have achieved reproductive maturity (L_{50}). For species that undergo sex reversal (primarily female to male in the tropical Pacific region) - such as groupers and deeper-water emperors among the bottomfishes, and for parrotfish, shallow-water emperors, and wrasses among the coral reef fishes - standard histological criteria are used to determine gender and reproductive developmental stages that indicate the transitioning or completed transition from one sex to another. These data are similarly analyzed using a three or four-parameter logistic function to determine the best fit of the data based on statistical analyses. The mid-point of this fitted function provides an estimate of the length at which 50% of fish of a particular species have or are undergoing sex reversal ($L\Delta_{50}$).

Age at 50% maturity (A_{50}) and age at 50% sex reversal ($A\Delta_{50}$) can be derived by referencing the VBGF for that species and using the corresponding L_{50} and $L\Delta_{50}$ values to obtain the corresponding age value from this growth function. In studies where both age & growth and reproductive maturity are concurrently determined, estimates of A_{50} and $A\Delta_{50}$ are derived directly by fitting the percent of mature samples for each age (one-year) interval to a three- or four-parameter logistic function using statistical analyses. The mid-point of this fitted logistic function provides a direct estimate of the age at which 50% of fish of a particular species have achieved reproductive maturity (A_{50}) and sex reversal ($A\Delta_{50}$).

Data Category: Biological

Timeframe: N/A

Jurisdiction: MHI and NWHI

Spatial Scale: Archipelagic

Data Source: Sources of data are directly derived from research cruises sampling and market samples purchased from local fish vendors. Laboratory analyses and data generated from these analyses reside with the PIFSC Life History Program (LHP). Refer to the “Reference” column in Table 53 for specific details on data sources by species.

Parameter definitions:

T_{max} (maximum age) – The maximum observed age revealed from an otolith-based age determination study. T_{max} values can be derived from ages determined by annuli counts of sagittal otolith sections and/or bomb radiocarbon (^{14}C) analysis of otolith core material. Units are years.

L_{∞} (asymptotic length) – One of three coefficients of the VBGF that measures the mean maximum length at which the growth curve plateaus and no longer increases in length with increasing age. This coefficient reflects the estimated mean maximum length and not the observed maximum length. Units are centimeters.

k (growth coefficient) – One of three coefficients of the VBGF that measures the shape and steepness by which the initial portion of the growth function approaches its mean maximum length (L_{∞}).

t_0 (hypothetical age at length zero) – One of three coefficients of the VBGF whose measure is highly influenced by the other two VBGF coefficients (k and L_{∞}) and typically assumes a negative value when specimens representing early growth phases) are not available for age determination. This parameter can be fixed at 0. Units are years.

M (natural mortality) – This is a measure of the mortality rate for a fish stock and is considered to be directly related to stock productivity (i.e., high M indicates high productivity and low M indicates low stock productivity). M can be derived through use of various equations that link M to T_{max} and the VBGF coefficients (k and L_{∞}) or by calculating the value of the slope from a regression fit to a declining catch curve (regression of the natural logarithm of abundance versus age class) derived from fishing an unfished or lightly fished population.

A_{50} (age at 50% maturity) – Age at which 50% of the sampled stock under study has attained reproductive maturity. This parameter is best determined based on studies that concurrently determine both age (otolith-based age data) and reproductive maturity status (logistic function fitted to percent mature by age class with maturity determined via microscopic analyses of gonad histology preparations). A more approximate means of estimating A_{50} is to use an existing L_{50} estimate to find the corresponding age (A_{50}) from an existing VBGF curve. Units are years.

$A\Delta_{50}$ (age of sex switching) – Age at which 50% of the immature and adult females of the sampled stock under study is undergoing or has attained sex reversal. This parameter is best determined based on studies that concurrently determines both age (otolith-based age data) and reproductive sex reversal status (logistic function fitted to percent sex reversal by age class with sex reversal determined via microscopic analyses of gonad histology preparations). A more

approximate means of estimating $A\Delta_{50}$ is to use an existing $L\Delta_{50}$ estimate to find the corresponding age ($A\Delta_{50}$) from the VBGF curve. Units are years.

L_{50} (length at which 50% of a fish population are capable of spawning) – Length at which 50% of the females of a sampled stock under study has attained reproductive maturity; this is the length associated with A_{50} estimates. This parameter is derived using a logistic function to fit the percent mature data by length class with maturity status best determined via microscopic analyses of gonad histology preparations. L_{50} information is typically more available than A_{50} since L_{50} estimates do not require knowledge of age and growth. Units are centimeters.

$L\Delta_{50}$ (length of sex switching) – Length at which 50% of the immature and adult females of the sampled stock under study is undergoing or has attained sex reversal; this is the length associated with $A\Delta_{50}$ estimates. This parameter is derived using a logistic function to fit the percent sex reversal data by length class with sex reversal status best determined via microscopic analyses of gonad histology preparations. $L\Delta_{50}$ information is typically more available than $A\Delta_{50}$ since $L\Delta_{50}$ estimates do not require knowledge of age and growth. Units are centimeters.

Rationale: These nine life history parameters provide basic biological information at the species level to evaluate the productivity of a stock - an indication of the capacity of a stock to recover once it has been depleted. Currently, the assessment of coral reef ecosystem resources in Hawaii are data limited. Knowledge of these life history parameters support current efforts to characterize the resilience of these resources and also provide important biological inputs for future stock assessment efforts and enhance our understanding of the species-likely role and status as a component of the overall ecosystem. Furthermore, knowledge of life histories across species at the taxonomic level of families or among different species that are ecologically or functionally similar can provide important information on the diversity of life histories and the extent to which species can be grouped (based on similar life histories) for future multi-species assessments.

Table 52. Available age, growth, and reproductive maturity information for coral reef ecosystem component species in the Hawaiian Archipelago

Species	Age, growth, and reproductive maturity parameters									Reference
	T_{max}	L_{∞}	k	t_0	M	A_{50}	$A\Delta_{50}$	L_{50}	$L\Delta_{50}$	
<i>Acanthurus triostegus</i>								$f=16.7^d$ $m=16.3^d$		Schemmel and Friedlander (2016)
<i>Calotomus carolinus</i>	4 ^d					1.3 ^d	3.2 ^d	24 ^d	37 ^d	DeMartini et al. (2017); DeMartini and Howard (2016)
<i>Caranx melampygus</i>	24	71.8	0.20	-0.29		4.1		37.2		Pardee et al. (2021)
<i>Cellana</i> spp.										
<i>Chlorurus perspicillatus</i>	19 ^d	53.2 ^d	0.23 ^d	-1.48 ^d		3.1 ^d	7 ^d	34 ^d	46 ^d	DeMartini et al. (2017); DeMartini and Howard (2016)
<i>Chlorurus spilurus</i>	11 ^d	34.4 ^d	0.40 ^d	-0.13 ^d		1.5 ^d	4 ^d	17 ^d	27 ^d	DeMartini et al. (2017); DeMartini and Howard (2016)
<i>Kyphosus</i>										

Species	Age, growth, and reproductive maturity parameters									Reference
	T_{max}	L_{∞}	k	t_0	M	A_{50}	$A\Delta_{50}$	L_{50}	$L\Delta_{50}$	
<i>bigibbus</i>										
Lobster										
<i>Lutjanus kasmira</i>										
<i>Naso annulatus</i>										
<i>Octopus cyanea</i>										
<i>Panulirus marginatus</i> ¹		104.33-147.75 ^d	0.05-0.58 ^d					40.5 ^d		O'Malley (2009); DeMartini et al. (2005)
<i>Parupeneus porphyus</i>										
Scaridae										
<i>Scarus psittacus</i>	6 ^d	32.7 ^d	0.49 ^d	-0.01 ^d		1 ^d	2.4 ^d	14 ^d	23 ^d	DeMartini et al. (2017); DeMartini and Howard (2016)
<i>Scarus rubroviolaceus</i>	19 ^d	53.5 ^d	0.41 ^d	0.12 ^d		2.5 ^d	5 ^d	35 ^d	47 ^d	DeMartini et al. (2017); DeMartini and Howard (2016)
<i>Scyllarides squammosus</i> ²		X ^a	X ^a					51.1		O'Malley (2009); DeMartini et al. (2005)
<i>Naso unicornis</i>	54 ^d	47.8 ^d	0.44 ^d	-0.12 ^d				f=35.5 ^d m=30.1 ^d		Andrews et al. (2016); DeMartini et al. (2014)

^a signifies estimate pending further evaluation in an initiated and ongoing study.

^b signifies a preliminary estimate taken from ongoing analyses.

^c signifies an estimate documented in an unpublished report or draft manuscript.

^d signifies an estimate documented in a finalized report or published journal article (including in press).

¹ *Panulirus marginatus* growth rates (k and L_{∞}) are from a range of locations in the NWHI for both sexes.

² *Scyllarides squammosus* growth rates available for Schnute growth model but not from von Bertalanffy growth model (i.e., no k or L_{∞}).

Parameter estimates are for females unless otherwise noted (f=females, m=males). Parameters T_{max} , t_0 , A_{50} , and $A\Delta_{50}$ are in units of years; L_{∞} , L_{50} , and $L\Delta_{50}$ are in units of mm fork length (FL); k is in units of year⁻¹; X=parameter estimate too preliminary or Y=published age and growth parameter estimates based on DGI numerical integration technique and likely to be inaccurate; NA=not applicable.

2.3.2 MHI Bottomfish Management Unit Species Life History

2.3.2.1 Age, Growth, and Reproductive Maturity

Description: Age determination is based on counts of yearly growth marks (annuli) and/or DGIs internally visible within transversely cut, thin sections of sagittal otoliths. Validated age determination is based on several methods including an environmental signal (bomb radiocarbon ¹⁴C) produced during previous atmospheric thermonuclear testing in the Pacific and incorporated into the core regions of sagittal otolith and other aragonite-based calcified structures such as hermatypic corals. This technique relies on developing a regionally based aged coral core reference series for which the rise, peak, and decline of ¹⁴C values is available over the known

age series of the coral core. Estimates of fish age are determined by projecting the ^{14}C otolith core values back in time from its capture date to where it intersects with the known age ^{14}C coral reference series. Fish growth is estimated by fitting the length-at-age data to a growth function, typically a VBGF. This function typically uses three coefficients (L_{∞} , k , and t_0), which together characterize the shape of the length-at-age growth relationship.

Length-at-reproductive maturity is based on the histological analyses of small tissue samples of gonad material that are typically collected along with otoliths when a fish is processed for life history studies. The gonad tissue sample is preserved, cut into five micron sections, stained, and sealed onto a glass slide for subsequent examination. Based on standard cell structure features and developmental stages within ovaries and testes, the gender, developmental stage, and maturity status (immature or mature) is determined via microscopic evaluation. The percent of mature samples for a given length interval are assembled for each sex and these data are fitted to a three- or four-parameter logistic function to determine the best fit of these data based on statistical analyses. The mid-point of this fitted function provides an estimate of the length at which 50% of fish have achieved reproductive maturity (L_{50}). For species that undergo sex reversal (primarily female to male in the tropical Pacific region) - such as groupers and deeper-water emperors among the bottomfishes, and for parrotfish, shallow-water emperors, and wrasses among the coral reef fishes - standard histological criteria are used to determine gender and reproductive developmental stages that indicate the transitioning or completed transition from one sex to another. These data are similarly analyzed using a three or four-parameter logistic function to determine the best fit of the data based on statistical analyses. The mid-point of this fitted function provides an estimate of the length at which 50% of fish of a particular species have or are undergoing sex reversal ($L\Delta_{50}$).

Age at 50% maturity (A_{50}) and age at 50% sex reversal ($A\Delta_{50}$) can be derived by referencing the VBGF for that species and using the corresponding L_{50} and $L\Delta_{50}$ values to obtain the corresponding age value from this growth function. In studies where both age & growth and reproductive maturity are concurrently determined, estimates of A_{50} and $A\Delta_{50}$ are derived directly by fitting the percent of mature samples for each age (one-year) interval to a three- or four-parameter logistic function using statistical analyses. The mid-point of this fitted logistic function provides a direct estimate of the age at which 50% of fish of a particular species have achieved reproductive maturity (A_{50}) and sex reversal ($A\Delta_{50}$).

Data Category: Biological

Timeframe: N/A

Jurisdiction: MHI and NWHI

Spatial Scale: Archipelagic

Data Source: Sources of data are directly derived from research cruises sampling and market samples purchased from local fish vendors. Laboratory analyses and data generated from these analyses reside with the PIFSC LHP. Refer to the “Reference” column in Table 54 for specific details on data sources by species.

Parameter Definitions: Identical to Section 2.3.2.1

Parameter estimates are for females unless otherwise noted (f=females, m=males). Parameters T_{max} , t_0 , A_{50} , and $A\Delta_{50}$ are in units of years; L_{∞} , L_{50} , and $L\Delta_{50}$ are in units of mm FL; k is in units of year^{-1} ; X=parameter estimate too preliminary or Y=published age and growth parameter estimates based on DGI numerical integration technique and likely to be inaccurate; NA=not applicable.

Table 53. Available age, growth, reproductive maturity, and natural mortality information for bottomfish MUS in the Hawaii Archipelago

Species	Age, growth, and reproductive maturity parameters									Reference
	T_{max}	L_{∞}	k	t_0	M	A_{50}	$A\Delta_{50}$	L_{50}	$L\Delta_{50}$	
<i>Aphareus rutilans</i>							NA		NA	
<i>Aprion virescens</i>	27 ^d	72.78 ^d	0.31 ^d		0.24 ^d		NA	42.5-47.5 ^d	NA	Everson et al. (1989); O'Malley et al. (2021)
<i>Etelis carbunculus</i>	22 ^c	50.3 ^c	0.07 ^c				NA	23.4 ^d	NA	Nichols et al. (2019); DeMartini (2016)
<i>Etelis coruscans</i>	f=55 ^d m=51 ^d	f=87.6 ^d m=82.7 ^d	f=0.12 ^d m=0.13 ^d	f=-1.02 ^d m=-1.37 ^d		9-11 ^a	NA	65.79 ^d	NA	Reed et al. (2021); Andrews et al. (2020)
<i>Hyporthodus quernus</i>	76 ^d	0.078 ^d	95.8 ^d					58.0 ^d	89.5 ^d	Andrews et al. (2019); DeMartini et al. (2010)
<i>Pristipomoides filamentosus</i>	42 ^d	67.5 ^d	0.24 ^d	-0.29 ^d			NA	f=40.7 ^d m=43.3 ^d	NA	Andrews et al. (2012); Luers et al. (2017)
<i>Pristipomoides sieboldii</i>							NA	23.8 ^d	NA	DeMartini (2016)
<i>Pristipomoides zonatus</i>	30 ^d	42.5 ^d	0.38 ^d	-1.2 ^d			NA		NA	Andrews and Schofield (2021)

^a signifies estimate pending further evaluation in an initiated and ongoing study.^b signifies a preliminary estimate taken from ongoing analyses.^c signifies an estimate documented in an unpublished report or draft manuscript.^d signifies an estimate documented in a finalized report or published journal article (including in press)

2.4 SOCIOECONOMICS

This section outlines the pertinent economic, social, and community information available for assessing the successes and impacts of management measures or the achievements of Fishery Ecosystem Plan for the Hawaii Archipelago (WPRFMC 2009). It meets the objective “Support Fishing Communities” adopted at the 165th Council meeting; specifically, it identifies the various social and economic groups within the region’s fishing communities and their interconnections. The section begins with an overview of the socioeconomic context for the region, and then provides a summary of relevant studies and data for Hawaii, followed by summaries of relevant studies and data for each fishery within the Hawaiian archipelago.

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, to provide for their sustained participation in fisheries and to minimize adverse economic impacts, provided that these considerations do not compromise the achievement of conservation. Unlike other regions of the U.S., the settlement of the Western Pacific region was intimately tied to the sea (Figure 7), which is reflected in local culture, customs, and traditions.



Figure 7. Settlement of the Pacific Islands, courtesy 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 reflect similar importance of marine resources. Thus, fishing and seafood are integral local community ways of life. This is reflected in the amount of seafood eaten in the region in comparison to the rest of the United States, as well as the language, customs, ceremonies, and community events. It can also affect seasonality in prices of fish. Because fishing is such an integral part of the culture, it is difficult to cleanly separate commercial from non-commercial fishing, with most trips involving multiple motivations and multiple uses of the fish caught. While the economic perspective is an important consideration, fishermen report other motivations such as customary exchange as being equally, if not more, important. Due to changing economies and westernization, recruitment of younger fishermen is becoming a concern for the sustainability of fishing and fishing traditions in the region.

2.4.1 Response to Previous Council Recommendations

At its 198th meeting held in Honolulu and via web conference in March 2024, the Council accepted the 2023 Main Hawaiian Island Deep-7 bottomfish fishery benchmark stock assessment as the best scientific information available (BSIA) and directed staff to convene the P* and SEEM working groups to quantify the scientific uncertainties in the 2023 assessment to set the Acceptable Biological Catch (ABC) and the management uncertainties, respectively, and develop potential ACL alternatives for initial action at the 199th meeting in June. PIFSC SEES affiliate staff participated in the SEEM working group meeting.

At its 200th meeting held in Honolulu and via web conference in September 2024, the Council directed staff to work with NMFS Pacific Islands Fisheries Science Center (PIFSC) to strengthen the competitiveness of the Hawaii bottomfish fishery by exploring and reporting on market barriers, import competition, and market opportunities. During December 2024, PIFSC SEES staff developed a Hawaii bottomfish market snapshot presentation that provided trends in bottomfish imports, the costs of fishing, and market participation considerations and delivered this presentation to the Council's Hawaii Advisory Panel and the Fishing Industry Advisory Committee.

At its 201st meeting held in Honolulu and via web conference in December 2024, the Council directed staff to work with NMFS PIFSC on developing a consistent definition for non-commercial fishing. During December 2024, PIFSC SEES staff presented recent published research (Leong et al. 2024) titled "Aligning fisheries terminology with diverse social benefits" to all of the Council's Advisory Panel meetings held during this 201st meeting cycle. PIFSC SEES program is willing and able to work with Council staff, Advisory Panel's and the Non-Commercial Fisheries Advisory Committee to develop a consistent definition that the fishing community can use when discussing non-commercial fishing and data collection.

2.4.2 Introduction

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 ahupua'a-based management, divided the islands into large

parcels called moku, which are reflected in modern political boundaries (Census County Districts) (WPRFMC 2009; Geslani et al. 2012; Richmond and Levine 2012).

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

Today, fishing continues to play a central role in the local Hawaiian culture, diet, and economy. In 2012, an estimated 486,000 people were employed in marine-related businesses in Hawaii, with the level of commercial fishing-related employment well above the national average (Richmond et al. 2015). The Fisheries Economics of the United States (FEUS) 2022 report found an increase in sales and jobs in the commercial fishing and seafood industry in Hawaii (including the commercial harvest sector, seafood processors and dealers, seafood wholesalers and distributors, importers, and seafood retailers), when compared to the FEUS 2020 report. In 2022 commercial fishing and the seafood industry generated \$824 million in sales impacts (up from \$557 million in 2020) and approximately 10,229 full and part-time jobs that year, which is twice the number of jobs reported in the FEUS 2020 report (NMFS 2023). However, within the recreational fisheries sector there was a decrease in sales and jobs when compared to 2020. It is estimated that recreational anglers took 3.9 million fishing trips, with \$379 million in sales impacts (down from \$465 million in 2020) and 2,062 full- and part-time jobs (down from 3,929 in 2020) were generated by recreational fishing activities in the State during 2022 (NMFS 2023). Due to changes in data availability NMFS does not currently report recreational angler participation at the State level.

Seafood consumption in Hawai'i is estimated at approximately two to three times higher than the rest of the entire U.S., and Hawai'i consumes more fresh and frozen finfish while shellfish and processed seafood is consumed more across the rest of the country (Davidson et al. 2012; Geslani et al. 2012). In addition, studies have shown that seafood is eaten frequently, nearly one-third of residents ate seafood about once a week and only 3% never consumed seafood, although there is a decreasing trend in the percent of residents who consume seafood every day or a few times a week and an increase in residents who consume seafood 1-3 times a month (NCRMP 2016a; Allen et al. 2022). 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 (Davidson et al. 2012; NCRMP 2016b; Allen et al. 2022).

At the same time, local supply is inadequate to meet the high seafood demand. In 2010, 75% of all seafood consumed in the State of Hawaii was imported from either the U.S. mainland or foreign markets, and the rise in imported fish has influenced the price of local catch (Arita et al. 2011; Hospital et al. 2011). In addition, rising costs of fuel and other expenses have made it more difficult to recover trip costs (Hospital et al. 2011). A majority of commercial fishermen report selling their fish simply to recover these costs, not necessarily to make income (Hospital et al.

2011). Many describe the importance of sharing fish as a part of maintaining relationships within family or other networks as being more important than earning income from fishing (Calhoun et al. 2020).

Pelagic fish play a large role in seafood consumption, with Hawaii residents regularly consuming substantial amounts of fresh bigeye and yellowfin tuna as ‘ahi poke (bite-sized cubes of seasoned raw tuna) and ahi sashimi (sliced raw tuna). ‘Ahi is also a significant part of cultural celebrations, especially during the holiday period from late November (Thanksgiving) through late January to mid-February (Lunar New Year). Changes in bigeye regulations can have far-reaching effects not only on the fishing community in Hawai‘i 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).

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

2.4.3 People Who Fish

Hawaii includes a mix of commercial, non-commercial, and subsistence characteristics across fisheries. Archipelagic fisheries are primarily accessed via a small boat fleet and through shoreline fishing. 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, these 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) (Madge et al. 2016; Chan and Pan 2017), shoreline and boat ramp intercepts (Hospital et al. 2011; Madge et al. 2016), and vessel and angler registries (Madge et al. 2016).

The Hawaii small boat pelagic fleet was studied in 2007-2008 (hereafter, referred to as the 2008 study), following a design last utilized in 1997 (Hospital et al. 2011). Because respondents also targeted insular fish, the study is included in this report. Their work was updated in 2014 and 2021 (Chan and Pan 2017; Chan 2023) for the small boat fleet in general. All studies found that the small boat fleet is predominantly owner-operated and a male dominated activity (98% of respondents were male in all studies). The ethnic composition was predominantly Asian (45% in 2008, 41% in 2014, 38.6% in 2021) and White (23% in 2008, 26% in 2014, 26.5% in 2021), which is similar to the demographics of the State as a whole. In 2021, proportionally more Native Hawaiians and Pacific Islanders responded to the survey than are represented in the general population (18.6% vs. 10%). In addition, most respondents had a household income above \$50,000 (75% in 2008, 69% in 2014, 76% in 2021).

These studies also asked respondents to identify their motivation for fishing and allowed for multiple responses, whereas the 2014 survey had asked how they defined themselves as a fisherman. When comparing primary motivations to self-identified fisherman type, the percentage of part-time commercial fishermen decreased from 51% to 30% while the percentage

of recreational expense fishermen increased from 27% to 34% and subsistence fishermen increased from 3% to 16%, perhaps in response to the COVID-19 pandemic – the survey conducted in 2021 asked respondents about conditions and activities in 2020. When comparing all three motivations reported in 2021, recreational expense, subsistence, and part-time commercial were listed by almost half or more of respondents, whereas all other motivations were reported by fewer than 30% (Chan 2023). Different activities were then compared based on motivations.

As previously mentioned, the Hawaii small boat 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, 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. In the 2021 study, trolling was still the most common gear type, but dropped to 54%. The other answer choices were changed slightly, but the majority of remaining responses still reflected bottomfish (23%) and pelagic (14%) gear types. The 2014 and 2021 studies also asked about species composition of catch. While over 90% of the respondents reporting landing pelagic fish in the past year in both studies, about half of respondents in the 2014 study also reported they caught and landed bottomfish or reef fish. In the 2021 study 56% of respondents reported catching bottomfish while 16% reported catching reef fish. Results from the 2021 study were compared to the State of Hawaii DAR reporting system and were found to match very well. Thus, the small boat fleet includes not only a mixture of gear types, but also targets both pelagic and insular fish stocks.

Studies also examined fisher motivations and self-identification versus their commercial and non-commercial activities. 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 year. 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 54.

Table 54. Catch disposition by fisherman self-classification (from Chan and Pan 2017; Chan 2023)

	Number of respondents (n)	Caught and released (%)	Given away (%)	Consumed at home (%)	Sold (%)
All Respondents (2014)	738	5.6	13.9	15.4	65.0
<i>By Fisherman Classification:</i>					
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
All Respondents (2021)	328	3.7	12.4	14.3	69.6
<i>By Primary Motivation:</i>					
Recreational expense	98	6.5	25.4	23.0	45.1

	Number of respondents (n)	Caught and released (%)	Given away (%)	Consumed at home (%)	Sold (%)
Part-time commercial	92	4.6	13.5	12.9	69.0
Subsistence	47	2.9	23.9	28.4	44.8
Full-time commercial	34	2.7	4.8	9.5	83.0
Purely recreational	25	6.0	36.5	30.3	27.1
Cultural	4	0.9	17.9	18.7	62.5

In 2021, the average value of fish sold by all respondents was approximately \$11,913 and was seen to match well with the State of Hawaii DAR Dealer Reporting System (Chan 2023). Full-time commercial fishermen reported the highest value of fish sold (\$35,709 annually), part-time commercial fishermen reported \$8,983 annually, cultural fishermen \$19,250, recreational expenses fishermen \$3,917, subsistence fishermen \$6,382, and purely recreational fishermen reported selling \$2,939 annually. When adjusted for inflation, average annual revenue for full - and part-time commercial fishers decreased 5% and 11% respectively from 2014 values. Recreational expense revenue increased by 29%, while revenue from purely recreational fishing increased 162%, revenue from subsistence fishing increased 197%, and revenue from cultural fishing increased 338%. 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 also attempted to quantify the scale of unsold fish that was shared within community networks. For commercial fishermen, trips where no fish are sold (30.5%) were nearly equal to trips where profit was made (30.9%). In addition, 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 documented 27.3% of sales to friends, neighbors, or coworkers, which jumped to 49% in 2021 and 7.9% of sales at roadside/farmers' markets, which rose to 14% in 2021, illustrating the importance of informal markets. In addition, Table 54 also documents the importance of giving away fish for all self-classification categories, reflecting the prevalence of a gift economy. In the 2014 study, 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 Hawaii fishermen's attitudes and perceptions 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.

Madge et al. (2016) conducted a survey on the attitudes and preferences of Hawaii non-commercial fishers. Nearly all survey respondents were male (96%). Their average age was 53, and, on average, they had engaged in non-commercial saltwater fishing in Hawaii for 31 years.

The majority had household income equal to or greater than \$60,000, reported high levels of education, and reflected a large racial diversity (primarily various Asian ethnicities and White). They primarily fished via private motorboat (61%), followed by shore, including beach, pier, and bridge (38%). Offshore trolling and whipping/casting, and free-dive spearfishing were the most frequent gears reported as “always” used, and a majority of respondents reported using multiple gears on a single fishing trip.

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

NMFS and the Hawaii DAR have been collecting information on recreational fishing in Hawai‘i, administered through the Hawai‘i Marine Recreational Fishing Survey (HMRFS) (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 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 was discontinued after 2017 due to declining land line coverage. Surveyors conduct in-person intercept surveys at boat launch ramps, small boat harbors, and shoreline fishing sites. Fisher county of residence and zip code is regularly collected in the intercept surveys but has not yet been compared to the composition of the general public. As with the other surveys, this program documented a mix of gears used to catch both pelagic and insular fish. The majority of trips monitored by the on-site interviews were “pure recreational fishermen”, defined as those who do not sell their catch, with an average of nearly 60% to over 80% depending on year and island. However, they also noted that the divisions between commercial, non-commercial, and recreational are not clearly defined in Hawaii, and results suggested that the majority of catch for some categories of fishermen may be consumed by themselves or given away.

During the COVID-19 pandemic, the diversification of Hawaii fisheries and ability to adapt to shift from a national and global economy to a local one played a vital role in supporting local food systems, nutrition, food security, and community social cohesion (Kleiber et al. 2022; Smith et al. 2022).

2.4.3.1 Bottomfish

This section reviews important community contributions of the MHI bottomfish fishery (Hospital and Pan 2009; Hospital and Beavers 2011, 2012; Chan and Pan 2017; Chan 2023). For studies that examined the small boat fishery in general (Hospital et al. 2011; Chan and Pan 2017; Chan 2023), overall fisher demographics and catch disposition were summarized in Chapter 1, as bottomfish fishing is only one of the gear types used by the small boat fleet.

Economically, the MHI bottomfish fishery is much smaller scale than the large pelagic fisheries in the region, but it is comparable in terms of rich tradition and cultural significance. Bottomfish fishing was part of the culture and economy of Native Hawaiians long before European explorers ever visited the region. Native Hawaiians harvested the same species as the modern fishery, and much of the gear and techniques used today are modeled after those used by Native Hawaiians. Most of the bottomfish harvested in Hawaii are red, which is considered an auspicious color in many Asian cultures, symbolic of good luck, happiness, and prosperity. Whole red fish are sought during the winter holiday season to bring good luck for the New Year from start to finish, and for other celebrations, such as birthdays, graduations, and weddings. Many restaurants across the State of Hawaii also serve fresh bottomfish, which are sought by tourists.

The bottomfish fishery grew steadily through the 1970s and into the 1980s but experienced steady declines in the following decades. Much of the decline in domestic production has been attributed to the limited-entry management regime introduced in the early 1990s in the NWHI and reductions in fishing vessels and trips fleet-wide. In the late 1990s, research identified overfishing as a contributor to the declines, which led to establishment of spatial closure areas (bottomfish restricted fishing areas [BRFAs]), a bottomfish boat registry, and a noncommercial bag limit for Deep-7 species. Emergency closures in 2007 also resulted in a Total Allowable Catch (TAC) management regime, which set a seasonal quota for the MHI Deep-7 bottomfish. Under this system, commercial catch reports are used to determine when the quota has been reached for the season, at which both the commercial and non-commercial fisheries remain closed. This has implications for the ability of fishermen to build and maintain social and community networks throughout the year, given the cultural significance of this fishery.

In addition, in June 2006 the Northwestern Hawaiian Islands Marine National Monument was established in the NWHI, prohibiting all extractive activity and phasing out the active NWHI bottomfish fishery. This removed a source of approximately 35% of domestic bottomfish from Hawaii markets. The market has increasingly relied on imports to meet market demands, which may affect the fishery's traditional demand and supply relationships.

Overall, 45% of the MHI small boat fleet participated in the bottomfish fishery in 2014 and 77% in 2021 (Chan and Pan 2017, Chan 2023). In 2021, participants in this fishery were more likely to be Asian. The MHI bottomfish fleet is a complex mix of commercial, recreational, cultural, and subsistence fishing. The artisanal fishing behavior, cultural motivations for fishing and relative ease of market access do not align well with legal and regulatory frameworks designed for the continental U.S.

In a 2010 survey, bottomfish fishermen were asked to define what commercial fishing meant to them (Hospital and Beavers 2012). The majority of respondents agreed that selling fish for profit, earning a majority of income from fishing, and relying solely on fishing to provide income all constituted commercial fishing. However, there was less agreement on other legally established definitions, such as selling one fish, selling a portion of fish to cover trip expenses, the trade and barter of fish, or selling fish to friends and neighbors. Fishers who participated in bottomfish fisheries identified themselves as primarily part-time commercial fishermen (53% selected this category in 2014, 26.8% in 2021) and recreational expense fishermen (21% in 2014, 33.2% in 2021). Only a few self-identified as full-time commercial (11% in 2014, 12.8% in 2021), purely recreational (9% in 2014, 8.9% in 2021), subsistence (6% in 2014, 17% in 2021) or cultural (1% in 2014, 1.3% in 2021) fishermen. While fishery highliners appear to be able to regularly recover trip expenditures and make a profit from bottomfish fishing trips, they represented only 8% of

those surveyed in 2014. For a majority of participants the social and cultural motivations for bottomfish fishing outweigh economic prospects.

In 2022, an ecosystem and socioeconomic profile (ESP) was prepared for the main Hawaiian Islands uku fishery (Ayers 2022) to inform stock assessments and future research and data needs. Like many of the fisheries in the MHI, the uku fishery is characterized by multiple gear types and fishing motivations. Honolulu, North Kona, and 'Ewa census community subdivisions were most engaged in this fishery (Hospital and Leong 2021). Although it has not comprised more than 20% of landings in a given community, it is considered an important component that provides resiliency by diversifying a fishing portfolio.

2.4.3.2 Reef Fish

As described in the reef fish fishery profile (Markrich and Hawkins 2016), coral reef species have been shown by the archaeological record to be part of the customary diet of the earliest human inhabitants of the Hawaiian Islands, including the NWHI. Coral reef species also played an important role in religious beliefs and practices, extending their cultural significance beyond their value as a dietary staple. For example, some coral reef species are venerated as personal, family, or professional gods called 'aumakua. While the majority of the commercial catch comes from nearshore reef areas around the MHI, harvests of some coral reef species also occur in federal waters (e.g., around Penguin Bank).

In the 2021 small-boat cost earnings survey, fishers who participated in the coral reef fishery were more likely to be Native Hawaiian, Pacific Islander, or younger (Chan 2023).

From 2014-2015 and again in 2020, the National Coral Reef Monitoring Program (NCRMP) conducted a household telephone survey of adult residents in the MHI to better understand demographics in coral reef areas, human use of coral reef resources, and knowledge, attitudes, and perceptions of coral reefs and coral reef management. This section summarizes results of the survey (Allen et al. 2022).

In both years, just over 35% of respondents participated in fishing, while approximately 60% had never participated. However, almost all respondents reported recreational use of coral reef resources, including swimming or wading and beach recreation (approximately 80% both years), snorkeling (50-60% both years), waterside or beach camping (40-50% both years), and wave riding (over 40% both years). Gathering of marine resources was the least frequently reported, with only about 25% participating in this specific activity in 2015 and about 15% in 2020).

Of those who fished or harvested marine resources, the reason with the highest level of participation was "to feed myself and my family/household" (80.2% in 2015, 79.7% in 2020). The reason with the lowest level of participation was "to sell" (82.5% never participated in 2015, 91.1% in 2020). Other reasons with over 60% each in both years were for fun and to give extended family members and/or friends. In 2015, over 60% reported fishing or harvesting for special occasions and cultural purposes/events, which dropped to 48.2% in 2020. This indicates a substantial contribution from this fishery to local food security, as well as maintaining social or cultural connections.

The importance of culture was also evident in perceptions of value related to coral reefs. The statement that respondents agreed the most with was "Coral Reefs are important to Hawaiian culture" (about 93% both years). They also agreed strongly that healthy coral reefs attract tourists to the Hawaiian Islands and that coral reefs protect the Hawaiian Islands from erosion

and natural disasters. The statement that respondents disagreed with the most was “coral reefs are only important to fisherman, divers, and snorkelers” (76.2% in 2015 and 79.2% in 2020).

With respect to management strategies, at least half of respondents agreed with all the presented management strategies in both years, which ranged from catch limits, to gear restrictions, to enforcement, and no take zones. The exception was establishment of a non-commercial fishing license, which only 43.6% in 2020 and which respondents disagreed most in 2015 (27.2%).

In 2015, just over half of the respondents (55%) perceived their local communities as at least moderately involved in protecting and managing coral reefs. However, only about a quarter (26%) of respondents indicated moderate or higher involvement themselves. These questions were not asked in 2020.

The importance of protecting and managing coral reefs was also identified in a 2007 study on spearfishing in Hawaii (Stoffle and Allen 2012). Spearfishing was not seen as just a sport but a vehicle for learning the appropriate ways to interact with and protect the environment, including how to carry oneself as a responsible fisherman. For many, learning to spearfish was an important part of “who you are” growing up near the ocean. Fishing also was discussed as a means of providing food or extra income during times of hardship, describing the ocean as a place that people turn to in times of economic crisis. Although there is a growing segment of people who spearfish for sport, with motivations focused more on the experience of the hunt, physical activity, and the sense of achievement. Like other methods of fishing, motivations for spearfishing often cross commercial, recreational, and subsistence lines, including sharing catch with family and among cultural networks.

Overall, coral reef fish not only have a long history of cultural significance in this archipelago, but they also continue to play an important role in subsistence as well as in strengthening social networks and maintaining cultural ties.

2.4.3.3 Crustaceans

There is currently no socioeconomic information specific to the crustacean fishery. Subsequent reports will include new data as resources allow.

2.4.3.4 Precious Corals

There is currently no socioeconomic information specific to precious coral fishery. Subsequent reports will include data as resources allow.

2.4.4 Fishery Economic Performance

2.4.4.1 Costs of Fishing

Past research has documented the costs of fishing in Hawaii (Hamilton and Huffman 1997; Hospital et al. 2011; Hospital and Beavers 2012). This section presents the most recent estimates of trip-level costs of fishing for boat-based bottomfish and coral reef fishing trips in Hawaii. Fishing trip costs were collected from the 2014 Hawaii small boat survey (Chan and Pan 2017) that was updated in 2021 (Chan 2023). Fishermen were asked their fishing trip costs for the two most common gear types they used over the past year. 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 costs. Table 55 provides estimates for the cost of an average boat-based trips for the four most common gears from the

surveys conducted in 2014 and 2021. Estimates for annual fishing expenditures (fixed costs) and levels of investment in the fishery are also provided in the literature.

Table 55. Bottomfish and reef fish trip costs for small boats in Hawaii in 2014 and 2021

Trip type	Average trip costs (\$) from 2014 survey	Average trip costs (\$) from 2021 survey
Trolling	294	304
Handling for pelagic	283	304
Handling for bottomfish	253	258
Spearfishing	158	222

Data source: Pacific Islands Fisheries Science Center, <https://inport.nmfs.noaa.gov/inport/item/29820> for 2014 survey & <https://www.fisheries.noaa.gov/science-blog/hawaii-small-boat-survey-2021-summary> for 2021 survey.

2.4.4.2 Commercial Participations, Landings, Revenues, Prices

As designated by the Council, the Management Unit Species (MUS) in the Hawaii Archipelago include Deep-7 bottomfish, uku, and three species of crustaceans (Kona crab and two deep-sea shrimp species, *H. laevigatus* and *H. ensifer*). Most other non-pelagic species and non-MUS are considered Ecosystem Component Species (ECS). This section will describe trends in commercial participation, landings, revenue, and price for MUS and ECS.

2.4.4.2.1 MUS Commercial Participation, Landings, Revenues, Prices

In 2024, total revenue was \$1.56 million for all BMUS species groups (Deep-7 bottomfish and uku) from 168,329 pounds sold. Total commercial revenue and landings in 2024 dropped by 26% and 23% from 2023, respectively. Deep-7 species comprised 84% of total BMUS revenue, while the other is uku.

Figure 8 presents the revenue trend for the BMUS groups (i.e., Deep-7 bottomfish and uku). Figure 9 shows the number of fishers with BMUS sales from 2005 to 2024. The number of fishers (i.e., CML holders from the HDAR fisher reports) with BMUS landings and the number of fishers with BMUS sales (i.e., CML holders from the HDAR dealer reports) peaked at 2013, and decreased generally since then.

Figure 10 shows the pounds sold and revenue of Deep-7 bottomfish from 2005 to 2024. Commercial landings and revenue in 2024 were lower than 2023 by 24% and 30% respectively. Figure 11 presents the trend in fish price for Deep-7 and uku from 2005 to 2024. Deep-7 prices dropped in 2024 while uku price increased slightly in nominal value but decreased in adjusted value.

Supporting data for Figure 8, Figure 9, Figure 10, and Figure 11 are presented in Table 56 and Table 57. Please note that the commercial data (i.e., the number of fishers/CMLs with MUS sold, pounds sold, and revenue) were sourced from the HDAR dealer reports, while the total participation and landings were sourced from the HDAR fisher reports.

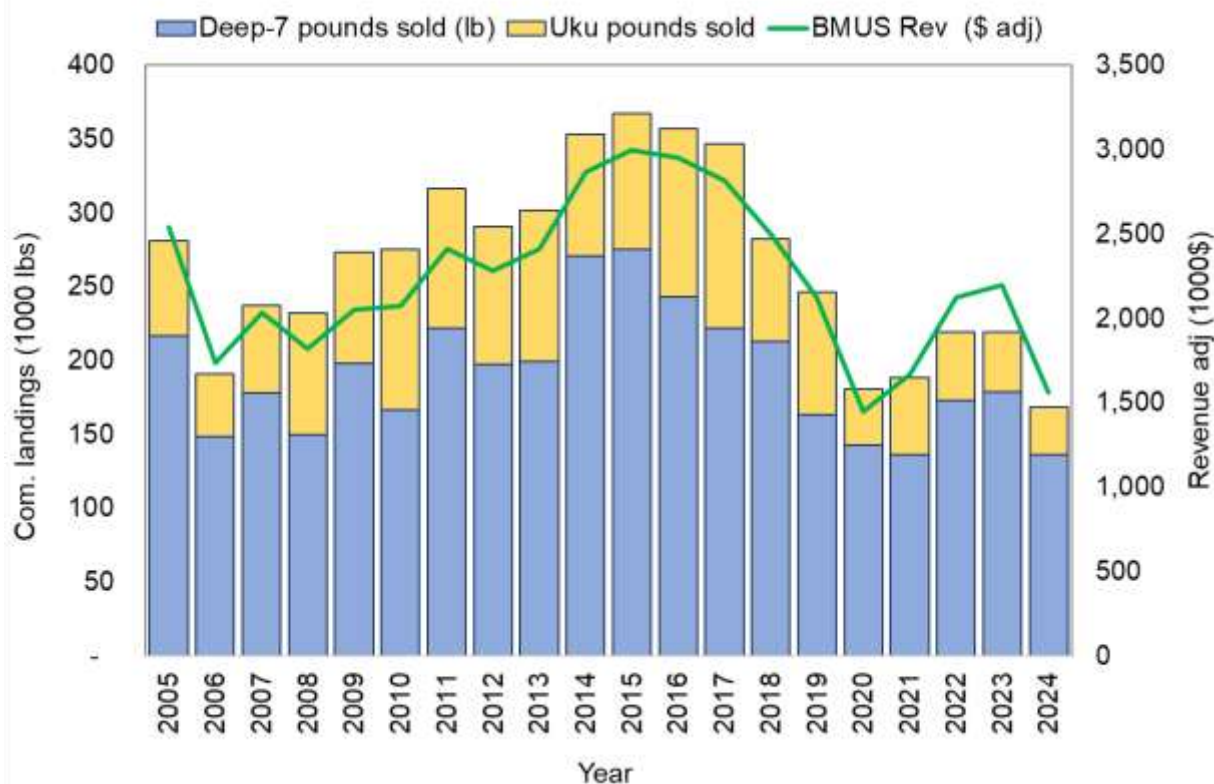


Figure 8. Trends in commercial landings and revenue for Hawaii BMUS

Table 56. Revenue structure for Hawaii BMUS

Year	Deep-7 pounds sold (lb)	Deep-7 revenue	Deep-7 revenue adj (\$)	Deep-7 price (\$/lb)	Deep-7 price adj. (\$/lb)	Uku pounds sold	Uku revenue	Uku rev adj (\$)	Uku price (\$/lb)	Uku price adj. (\$/lb)	CPI adj.
2005	216,506	1,255,543	2,159,534	5.80	9.98	64,655	220,877	220,877	3.42	5.88	1.720
2006	148,853	908,817	1,476,828	6.11	9.93	41,922	159,401	159,401	3.80	6.18	1.625
2007	178,260	1,101,407	1,707,181	6.18	9.58	59,094	212,156	212,156	3.59	5.56	1.550
2008	150,182	910,778	1,353,416	6.06	9.01	82,204	314,243	314,243	3.82	5.68	1.486
2009	197,877	1,112,317	1,645,117	5.62	8.31	75,423	273,785	273,785	3.63	5.37	1.479
2010	166,516	1,005,563	1,456,055	6.04	8.75	109,125	428,133	428,133	3.92	5.68	1.448
2011	222,204	1,309,602	1,828,204	5.89	8.22	94,056	416,641	416,641	4.43	6.18	1.396
2012	197,766	1,254,165	1,710,681	6.34	8.65	92,831	420,198	420,198	4.53	6.18	1.364
2013	199,747	1,370,325	1,836,236	6.86	9.19	102,079	430,512	430,512	4.22	5.65	1.340
2014	270,684	1,805,908	2,385,604	6.67	8.81	82,571	366,923	366,923	4.44	5.87	1.321
2015	275,262	1,867,947	2,443,275	6.79	8.88	92,063	425,310	425,310	4.62	6.04	1.308
2016	243,103	1,740,382	2,231,170	7.16	9.18	113,662	564,044	564,044	4.96	6.36	1.282
2017	221,988	1,648,485	2,062,255	7.43	9.29	124,762	602,916	602,916	4.83	6.04	1.251
2018	213,157	1,664,085	2,043,496	7.81	9.59	69,495	369,574	369,574	5.32	6.53	1.228
2019	163,509	1,339,413	1,618,011	8.19	9.89	82,753	417,937	417,937	5.05	6.10	1.208
2020	143,097	1,037,620	1,233,730	7.25	8.62	37,553	181,116	181,116	4.82	5.73	1.189
2021	136,715	1,144,356	1,311,432	8.37	9.59	52,052	311,246	311,246	5.98	6.85	1.146
2022	172,926	1,631,151	1,755,118	9.43	10.15	46,178	341,529	341,529	7.40	7.96	1.076
2023	178,594	1,804,741	1,884,150	10.11	10.55	41,068	302,431	302,431	7.36	7.68	1.044
2024	136,137	1,321,839	1,321,839	9.71	9.71	32,193	242,865	242,865	7.54	7.54	1

Data source: PIFSC FRMD from HDAR data.

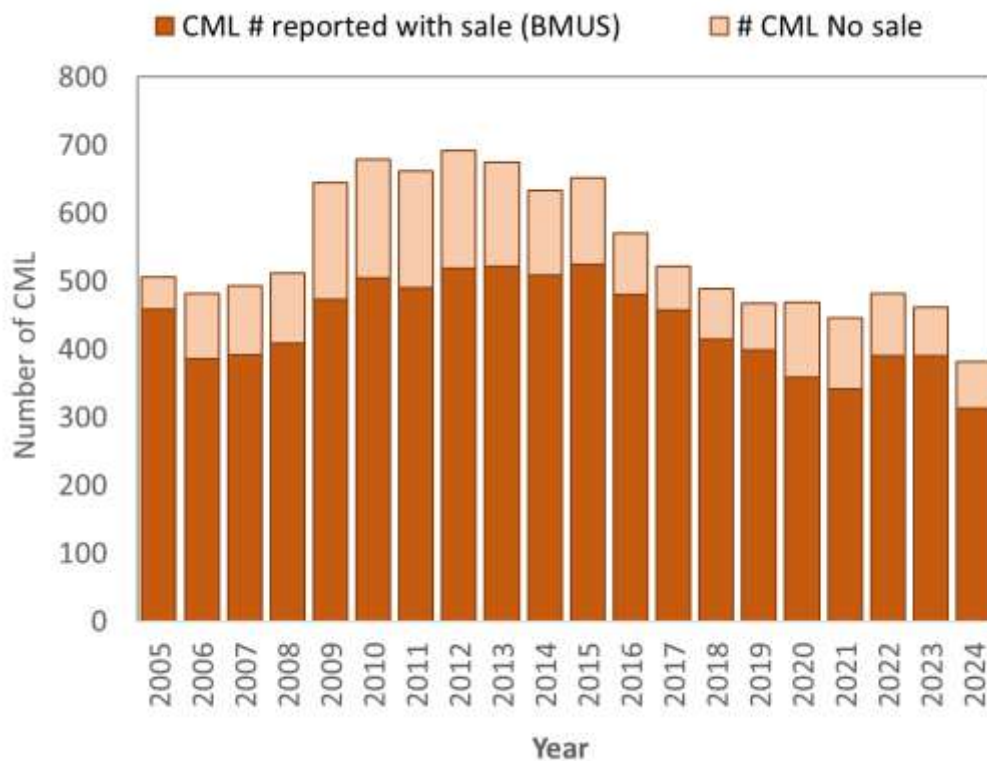


Figure 9. Number of CMLs with and without sales of Hawaii MUS

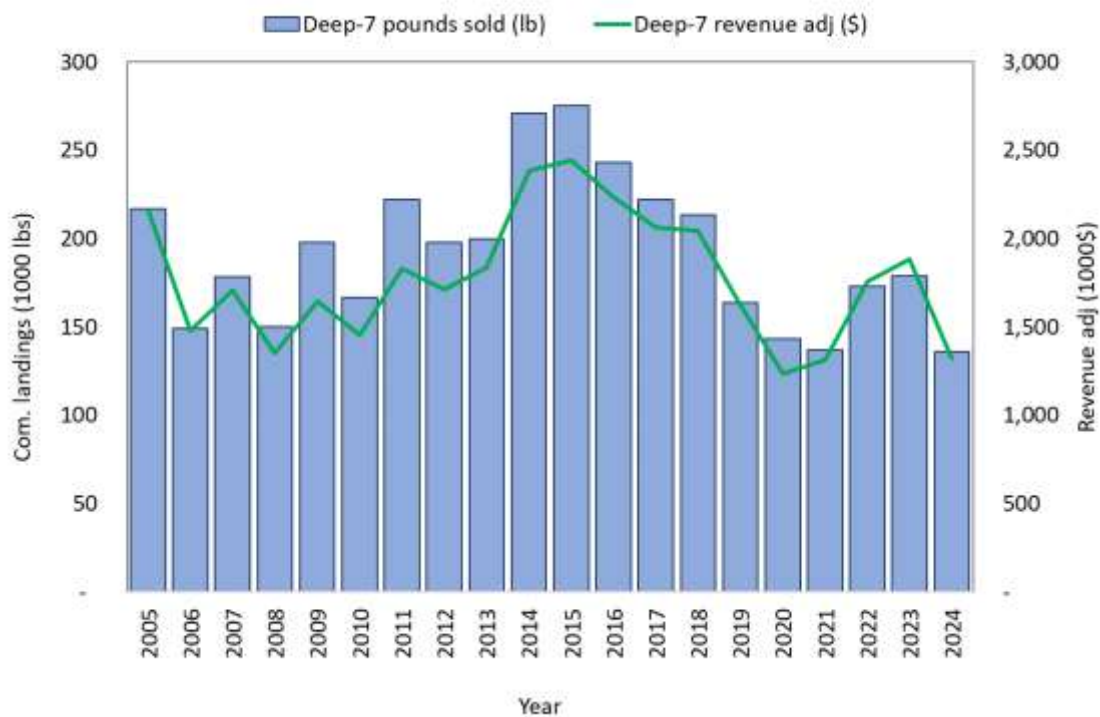


Figure 10. Pounds sold and revenue of Deep-7 Bottomfish (adjusted to 2024 dollars)

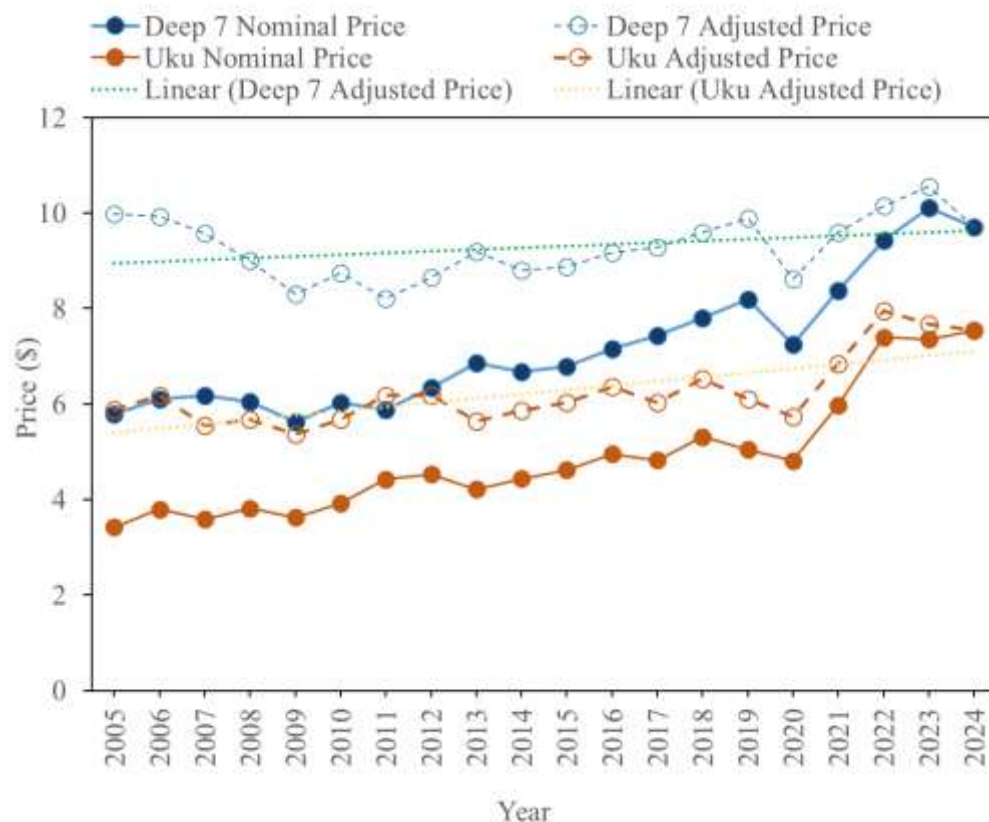


Figure 11. Fish prices for Deep-7 bottomfish and uku

Table 57. Pounds sold, revenue, and price for Hawaii BMUS

Year	Total CML # (BMUS)	CML # reported with sale (BMUS)	BMUS Pounds kept (lb)	BMUS pounds sold (lb)	% of pounds sold	BMUS Rev (\$)	BMUS Rev (\$ adj)	% Deep- 7 of total sold rev	% Uku of total sold rev	CPI adjuster
2005	506	459	306,414	281,162	92%	1,476,421	2,539,444	85%	15%	1.720
2006	482	386	254,370	190,775	75%	1,068,218	1,735,854	85%	15%	1.625
2007	493	391	273,968	237,354	87%	1,313,563	2,036,023	84%	16%	1.550
2008	512	408	288,922	232,386	80%	1,225,020	1,820,380	74%	26%	1.486
2009	645	473	347,552	273,300	79%	1,386,102	2,050,045	80%	20%	1.479
2010	679	504	330,323	275,641	83%	1,433,696	2,075,992	70%	30%	1.448
2011	661	490	384,500	316,260	82%	1,726,243	2,409,835	76%	24%	1.396
2012	692	519	344,436	290,597	84%	1,674,362	2,283,830	75%	25%	1.364
2013	675	522	360,516	301,826	84%	1,800,837	2,413,122	76%	24%	1.340
2014	633	508	408,212	353,256	87%	2,172,832	2,870,311	83%	17%	1.321
2015	651	524	408,979	367,325	90%	2,293,257	2,999,580	81%	19%	1.308
2016	570	480	379,329	356,765	94%	2,304,426	2,954,274	76%	24%	1.282
2017	522	457	370,614	346,750	94%	2,251,401	2,816,503	73%	27%	1.251
2018	489	415	311,412	282,652	91%	2,033,660	2,497,334	82%	18%	1.228
2019	467	399	271,141	246,262	91%	1,757,350	2,122,879	76%	24%	1.208
2020	469	358	209,780	180,650	86%	1,218,735	1,449,076	85%	15%	1.189
2021	446	342	224,533	188,768	84%	1,455,602	1,668,120	79%	21%	1.146
2022	481	390	242,237	219,104	90%	1,972,680	2,122,604	83%	17%	1.076
2023	461	390	242,186	219,662	91%	2,107,172	2,199,888	86%	14%	1.044
2024	382	313	189,841	168,329	89%	1,564,703	1,564,703	84%	16%	1

Data source: PIFSC FRMD from HDAR data. Inflation-adjusted use the Honolulu Consumer Price Index https://www.bls.gov/regions/west/data/consumerpriceindex_honolulu_table.pdf.

2.4.4.2.2 Deep-7 Bottomfish Economic Performance Metrics

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). PIFSC economists have used this framework to evaluate select regional fisheries; specifically, the Hawaii longline, American Samoa longline, and MHI Deep-7 bottomfish fisheries. These indicators include metrics related to catch, effort, and revenue. This section presents revenue performance metrics of: (a) total fishery revenues, (b) fishery revenue per trip, (c) the Gini coefficient, and (d) the share of Deep-7 bottomfish species as a percentage of total revenue in the MHI Deep-7 bottomfish fishery.

Data on revenue per vessel, revenue per trip, and Gini coefficients for the MHI Deep-7 bottomfish fishery include any trip that catches one or more of the Deep-7 bottomfish species in the MHI, including onaga, ehu, 'ōpakapaka, kalekale, gindai, lehi, and hapu'upu'u. 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 across these vessels, whereas a value of one represents a perfectly unequal distribution (i.e., in the case that a single vessel earns all of the revenue).

The total annual revenue for the MHI Deep-7 bottomfish fishery was estimated based on several considerations:

1. The total number of fish kept from all MHI Deep-7 fishing trips in a fishing year, as reported by fishermen (including Deep-7 species, non-Deep-7 BMUS, and all other species, e.g., pelagics).
2. Fishing years between 2002 and 2006 were defined by calendar year. Since 2007, the fishing year for the MHI Deep-7 bottomfish fishery has begun September 1 and ended August 31 of the following year, or earlier if the quota is reached before the end of the season.
3. The weight of the kept catch is estimated as the number of fish kept times the annual average whole weight per fish based on State of Hawaii marine dealer data.
4. The estimated value of the catch is estimated as the weight of the kept catch times the annual average price per pound. This measure assumes all landed fish are sold. Thus, the estimated value would be different from the sale value generated from the dealer reports.

For the MHI Deep-7 bottomfish fishery, revenue was calculated by CML because individual revenues are monitored. Multiple fishers can fish in the same vessel but report their revenue separately. Additionally, a fisher may fish in different vessels throughout the year, so revenue is attached to a CML rather than to a vessel, and the Gini coefficient effectively measures the equality of the distribution of revenue among active fishers. A Gini coefficient of 0 indicates "no difference" and 1 indicates "extremely different." Therefore, a high Gini coefficient in this fishery would imply that a small portion of fishermen account for a large share of fishery revenues. Past research demonstrates evidence of this occurring. Participants in this fishery reflect a wide range of motivations and avidity, and there is a relatively small segment of full-time commercial fishery highliners (Hospital and Beavers 2012; Chan and Pan 2017).

Trends in fishery revenue per vessel and the distribution of these revenues across vessels (i.e., Gini coefficients) are shown in Figure 12, and the trends in revenue per trip for Deep-7 and non-Deep-7 fisheries are shown in Figure 13. In Figure 12, "fishery revenues" refers to revenue for Deep-7 bottomfish species catch as well as revenue for other species (such as non-Deep-7 bottomfish, pelagics, and others) caught on the same Deep-7 fishing trip.

As shown in Figure 12, the average Gini coefficient over the past 20 years has been steady at an average of 0.74 and was 0.74 in 2024; this indicates the variation of annual revenue among vessels has been notable (i.e., Gini coefficient is closer to 1 than zero) but steady over time. When Gini coefficient was calculated, only revenue from Deep-7 landings were included.

In 2024, the average annual revenue, including Deep-7 and other species per vessel for all bottomfish trips, was \$6,506, slightly lower than 2023 by 7%. Deep-7 composed of 78% of the total revenue per vessel

In Figure 13, revenue per trip includes Deep-7 and non-Deep-7 bottomfish species, and non-bottomfish species that were caught in the same trip. Supporting data for Figure 12 and Figure 13 are provided in Table 58.

In 2024, the average annual revenue per fishing trip from all fish sold was \$1,191, which was lower than in 2023 by 2%.

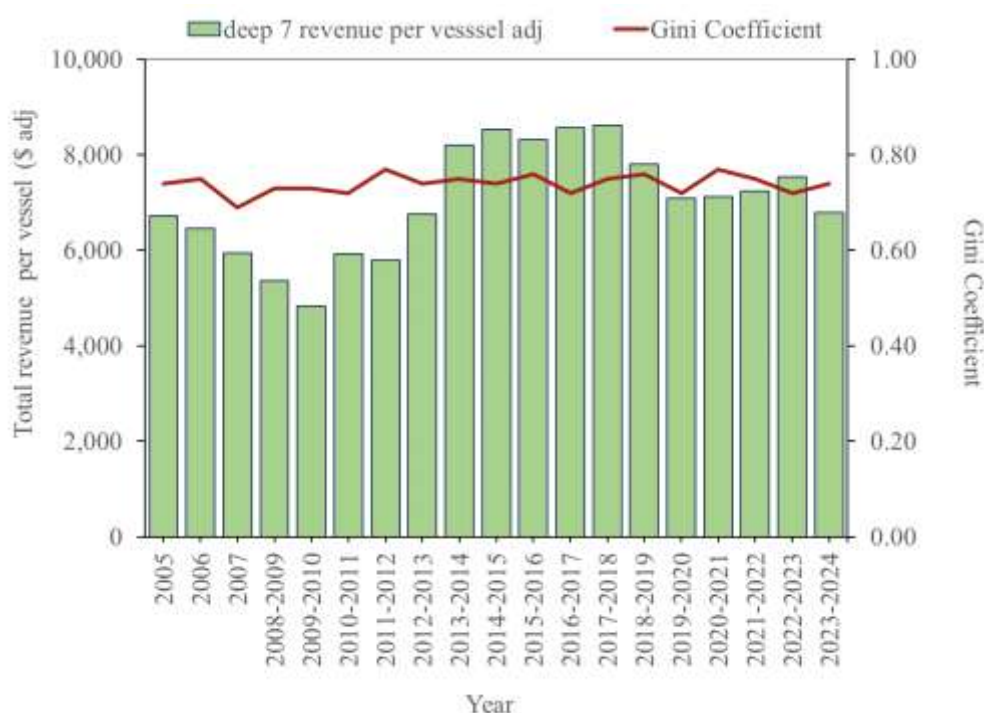


Figure 12. Trends in fishery revenue per vessel and the Gini coefficient for the MHI Deep-7 bottomfish fishery (adjusted to 2024 dollars)

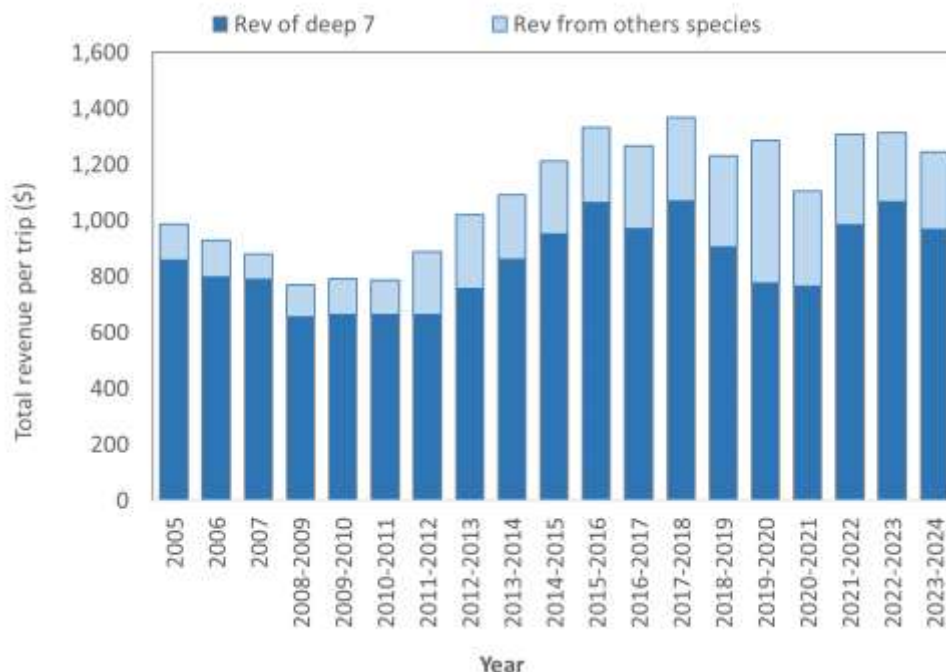


Figure 13. Trends in fishery revenue per trip for (adjusted to 2024 dollars)

Table 58. MHI Deep-7 bottomfish fishery economic performance measures

Year	Total revenue per vessel (\$)	Total revenue per vessel (\$ adj)	Total deep7 revenue per vessel adj. (\$)	Gini Coefficient	Deep-7 revenue per trip (\$)	Deep-7 revenue per trip adj. (\$)	Non-deep 7 revenue per trip (\$)	Non-deep 7 revenue per trip adj. (\$)	Total bottomfish revenue per trip (\$, adj.)	% of deep-7 in trip revenue	CPI adjustor
2005	3,908	6,350	3,397	0.74	499	811	75	122	574	87%	1.625
2006	3,976	6,162	3,419	0.75	492	762	80	124	572	86%	1.550
2007	3,833	5,696	3,440	0.69	510	758	58	87	568	90%	1.486
2008-2009	3,611	5,340	3,070	0.73	441	652	78	115	518	85%	1.479
2009-2010	3,261	4,722	2,729	0.73	448	648	87	126	535	84%	1.448
2010-2011	4,092	5,712	3,457	0.72	458	640	84	117	543	84%	1.396
2011-2012	4,151	5,662	3,104	0.77	475	649	160	219	636	75%	1.364
2012-2013	4,951	6,634	3,668	0.74	554	742	194	260	748	74%	1.340
2013-2014	6,117	8,081	4,828	0.75	642	848	171	227	813	79%	1.321
2014-2015	6,456	8,444	5,070	0.74	720	942	197	257	917	79%	1.308
2015-2016	6,353	8,144	5,070	0.76	812	1,041	205	263	1,018	80%	1.282
2016-2017	6,680	8,356	5,113	0.72	757	947	232	290	989	77%	1.251
2017-2018	6,886	8,456	5,384	0.75	855	1,049	238	293	1,093	78%	1.228
2018-2019	6,355	7,677	4,667	0.76	737	890	267	322	1,003	73%	1.208
2019-2020	5,871	6,981	3,538	0.72	642	763	423	503	1,065	60%	1.189
2020-2021	5,988	6,862	4,148	0.77	643	737	285	327	929	69%	1.146
2021-2022	6,319	6,799	4,756	0.75	858	923	282	303	1,140	75%	1.076
2022-2023	7,005	7,313	5,694	0.72	991	1,034	228	238	1,219	81%	1.044
2023-2024	6,506	6,506	5,064	0.74	927	927	264	264	1,191	78%	1

Note: Inflation-adjusted revenue (in 2021 dollars) used the Honolulu Consumer Price Index (CPI-U)

https://www.bls.gov/regions/west/data/consumerpriceindex_honolulu_table.pdf Source: PIFSC Socioeconomics Program: Fishery Economic Performance Measures. Pacific Islands Fisheries Science Center, Tier 1 data request, <https://inport.nmfs.noaa.gov/inport/item/46097>

2.4.4.2.3 Hawaii Crab and Shrimp Economic Performance

Figure 14 presents the revenue trend of crab in Hawaii. In 2024, total revenue from crab was \$17,613 from the commercial landings of 1,638 pounds. Commercial landings and revenue of crab dropped significantly since 2014. Figure 15 presents the revenue trend of shrimps in Hawaii. Data for some data (i.e., 2005-2010, 2022, and 2024) were not available due to the number of active fishers or dealers were lower than 2 for those years. Supporting data for Figure 14, Figure 15, and Figure 16 are presented in Table 59.

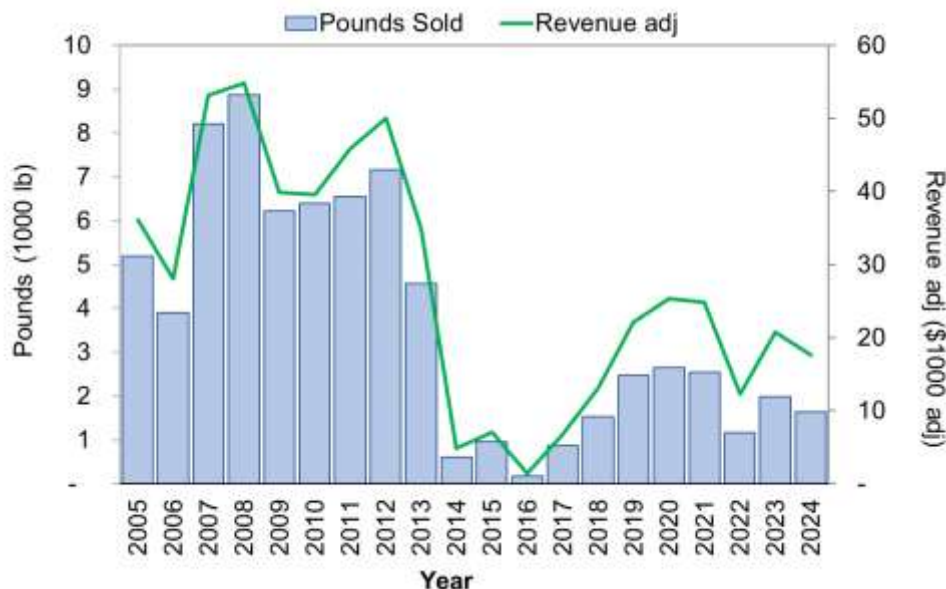


Figure 14. Commercial landings and revenue for MHI crab (adjusted to 2024 dollars)

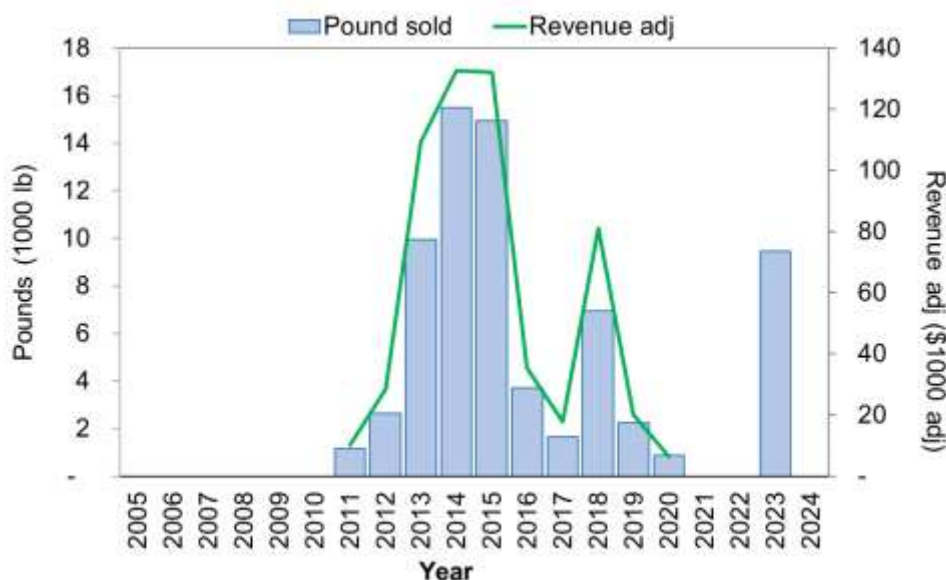


Figure 15. Commercial landings and revenue for MHI deepwater shrimp (adjusted to 2024 dollars)

*Data of 2005-2010, 2022, and 2024 were not available due to number of fishers or dealers less than 3

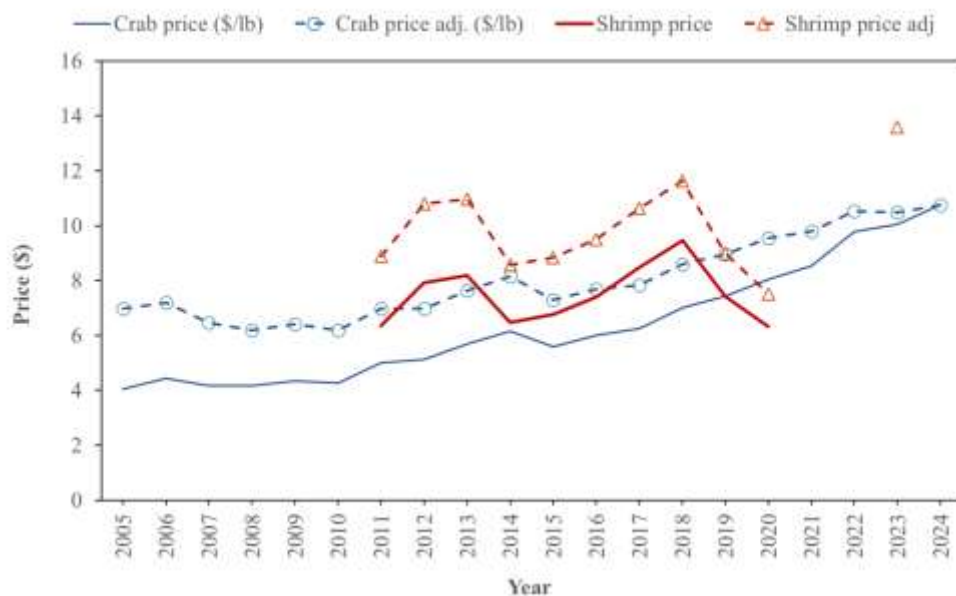


Figure 16. Price trends for MHI crab and deepwater shrimp (adjusted to 2024 dollars)

Table 59. Fishery economic performance standards for MHI crab and deepwater shrimp

Year	Total Crus. pounds sold	Crab pounds sold (lb)	Crab % sold to kept	Crab revenue (\$)	Crab revenue adj (\$)	Crab price (\$/lb)	Crab price adj. (\$/lb)	Shrimp pounds sold	Shrimp Rev (\$)	Shrimp rev adj (\$)	Shrimp price (\$/lb)	Shrimp price adj. (\$/lb)	CPI adjustor
2005	5,275	5,191	51%	21,006	36,130	4.05	6.97	84	756	1,300	9.00	15.48	1.720
2006	3,904	3,899	56%	17,263	28,052	4.43	7.20	5	30	49	5.82	9.46	1.625
2007	8,633	8,216	83%	34,292	53,153	4.17	6.46	417	2,333	3,616	5.60	8.68	1.550
2008	9,029	8,868	78%	36,887	54,814	4.16	6.18	160	659	979	4.11	6.11	1.486
2009	6,463	6,228	66%	26,948	39,856	4.33	6.40	235	393	581	1.68	2.48	1.479
2010	6,546	6,403	63%	27,342	39,591	4.27	6.18	143	215	311	1.50	2.17	1.448
2011	7,717	6,561	60%	32,823	45,821	5.00	6.98	1,156	7,347	10,256	6.36	8.88	1.396
2012	9,808	7,161	87%	36,655	49,997	5.12	6.98	2,646	20,947	28,572	7.92	10.80	1.364
2013	14,513	4,563	61%	25,989	34,825	5.70	7.64	9,949	81,450	109,143	8.19	10.97	1.340
2014	16,082	602	29%	3,708	4,898	6.16	8.14	15,480	100,288	132,480	6.48	8.56	1.321
2015	15,913	966	33%	5,389	7,049	5.58	7.30	14,947	101,063	132,190	6.76	8.84	1.308
2016	3,892	177	23%	1,059	1,358	6.00	7.69	3,715	27,495	35,249	7.40	9.49	1.282
2017	2,541	876	32%	5,477	6,852	6.26	7.83	1,665	14,132	17,679	8.49	10.62	1.251
2018	8,487	1,530	52%	10,713	13,156	7.00	8.60	6,957	65,897	80,922	9.47	11.63	1.228
2019	4,697	2,468	43%	18,312	22,121	7.42	8.96	2,229	16,574	20,021	7.44	8.99	1.208
2020	3,521	2,656	62%	21,329	25,360	8.03	9.55	865	5,466	6,499	6.32	7.51	1.189
2021	3,169	2,537	64%	21,653	24,814	8.54	9.79	633	4,228	4,845	6.68	7.66	1.146
2022	3,685	1,172	46%	11,459	12,330	9.78	10.52	2,513	36,167	38,916	14.39	15.48	1.076
2023	11,424	1,981	41%	19,889	20,764	10.04	10.48	9,444	122,994	128,406	13.02	13.59	1.044
2024	7,275	1,638	34%	17,613	17,613	10.75	10.75	n.d.	n.d.	n.d.	n.d.	n.d.	1

2.4.4.2.4 Hawaii Ecosystem Component Species

This section highlights the top 10 ecosystem component species (ECS) sorted by landings and the priority ECS (i.e., those identified as priority by the local fishery management agency, 10 priority species in Hawaii) caught by small boats or shoreline fishing. Please note that the commercial data (the number of fishers/CML with MUS sold, pounds sold, and revenue) were sourced from the HDAR dealer reporting system, and the total participation and landings were

sourced from the HDAR fisher reporting system. In some cases, the pounds sold may be higher than pounds kept due to discrepancies between the two data collection systems.

Table 60 shows the total commercial landings and revenue of the top 10 ECS in Hawaii in 2023 and 2024. The total pounds sold of the top 10 species/species groups in 2024 was 0.46 million pounds valued at \$1.79million, slightly higher than 2023. Bigeye scad (akule) was the most sold species of the top 10, comprising 46% of the total revenue in 2023. In addition, the ten fish species defined as priority species for Hawaii are shown in Table 61. The total revenue of the 10 priority species was roughly 0.46 million dollars from 100 thousand pounds sold in 2024, slightly lower by 1%. Parrotfish (uhu) was the leading species in landings and revenue among the 10 priority species.

Table 60. Top 10 ECS commercial landings, revenue, and price in 2024 and 2023

Common names	2024							2023				
	# of Fishers	Pounds Kept	Pounds Sold	% of sold	Revenue (\$)	% total rev	Price \$/lb	Common names	Pounds Kept	Pounds Sold	Revenue (\$)	Price \$/lb
Bigeye Scad	124	202,261	193,832	96%	822,340	46%	4.24	Bigeye Scad	259,325	232,973	943,555	4.05
Mackerel Scad	114	90,709	81,025	89%	325,447	18%	4.02	Mackerel Scad	99,411	89,415	354,348	3.96
Bluestripe Snapper	125	33,563	31,039	92%	87,089	5%	2.81	Bluestripe Snapper	46,170	25,778	71,918	2.79
Squirrelfish (Myripristi)	101	31,831	29,717	93%	182,482	10%	6.14	Parrotfish (Misc.)	37,220	16,965	103,870	6.12
Parrotfish (Misc.)	28	29,387	26,751	91%	167,193	9%	6.25	Squirrelfish (Myripristi)	26,994	22,646	137,199	6.06
Eyestripe Surgeonfish	34	24,246	21,256	88%	65,252	4%	3.07	Eyestripe Surgeonfish	22,283	19,643	57,569	2.93
Yellowfin Goatfish	39	16,823	15,331	91%	68,344	4%	4.46	Yellowfin Goatfish	18,760	15,069	65,855	4.37
Unicornfish	30	14,451	14,358	99%	43,048	2%	3.00	White Crab	13,528	7,010	43,381	6.19
Amberjack	92	9,546	3,039	32%	6,163	0%	2.03	Unicornfish	11,616	12,673	35,979	2.84
White Crab	1	7,795	3,353	43%	21,320	1%	6.36	Bonefish	10,404	9,836	23,421	2.38
Sum		460,612	419,701	91%	1,788,678		4.26	Sum	545,711	452,008	1,837,095	3.37

Table 61. Priority ECS commercial landings, revenue, and price in 2024 and 2023

Common Name	2024							2023						
	# of Fishers	Pounds Kept	Pounds Sold	Revenue (\$)	% sold	Price \$/lb		# of Fishers	Pounds Kept	Pounds Sold	Revenue (\$)	% sold	Price \$/lb	
Bluestripe snapper	125	33,563	31,039	87,089	92%	2.81		144	46,170	25,778	71,918	56%	2.79	
Parrotfish	30	29,504	29,208	182,405	99%	6.25		40	37,564	32,495	188,252	87%	5.79	
Whitemargin unicornfish	30	14,451	14,358	43,048	99%	3.00		35	11,616	12,673	35,979	109%	2.84	
Limpet	5	6,858	6,403	61,397	93%	9.59		30	8,930	6,173	26,328	69%	4.27	
Brown chub	26	6,305	7,070	22,350	112%	3.16		25	7,390	7,740	19,611	105%	2.53	
Convict tang	24	5,935	4,142	19,896	70%	4.80		10	8,565	6,385	59,238	75%	9.28	
Day octopus	30	4,097	3,890	28,520	95%	7.33		8	2,952	260	2,989	9%	11.48	
Lobster	8	2,436	1,116	3,123	46%	2.80		42	5,273	6,251	30,914	119%	4.95	
Bluefin trevally	55	1,789	1,089	3,919	61%	3.60		80	2,946	1,280	4,442	43%	3.47	
White saddle goatfish	26	960	944	14,024	98%	14.86		34	1,636	1,406	21,404	86%	15.23	
Total		105,898	99,259	465,771	94%	4.69			133,042	100,441	461,075	75%	4.59	

2.4.5 Ongoing Research and Information Collection

PIFSC reports annually 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 2024. Entries for Hawaii insular 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 62. Pacific Islands Region 2024 Commercial Fishing Economic Assessment Index

	2024 CFEAI				
	2024 Reporting Year (1/2024-12/2024)				
	Data			Assessment	
Pacific Islands Fisheries	Fishing Revenue Most Recent Year	Operating Cost Most Recent Year	Fixed Cost Most Recent Year	Returns Above Operating Costs (Quasi Rent) Assessment Most Recent Year	Profit Assessment Most Recent Year
HI Longline	2024	2024	2023	2024	2024
ASam Longline	2024	2024	2016	2024	2019
HI Offshore Handline	2024	2021	2021	2019	2019
HI Small Boat (pelagic)	2024	2021	2021	2023	2023
HI Small Boat (bottomfish)	2024	2021	2021	2023	2023
HI Small Boat (reef)	2024	2021	2021	2023	2023
Guam Small boat	2024	2024	2019	2024	
CNMI Small boat	2024	2024	2019	2025	
ASam Small boat	2024	2024	2021	2023	

PIFSC also generates projections for upcoming fiscal years, and the table below provides the projected CFEAI report for 2025 (*all projected activities and analyses are subject to funding*).

Table 63. Pacific Islands Region 2025 Commercial Fishing Economic Assessment Index

	2025 Projected CFEAI				
	2025 Reporting Year (1/2025-12/2025)				
	Data			Assessment	
Pacific Islands Fisheries	Fishing Revenue Most Recent Year	Operating Cost Most Recent Year	Fixed Cost Most Recent Year	Returns Above Operating Costs (Quasi Rent) Assessment Most Recent Year	Profit Assessment Most Recent Year
HI Longline	2025	2025	2023	2025	2024
ASam Longline	2025	2025	2016	2025	2019
HI Offshore Handline	2025	2021	2021	2019	2019
HI Small Boat (pelagic)	2025	2021	2021	2023	2023
HI Small Boat (bottomfish)	2025	2021	2021	2023	2023
HI Small Boat (reef)	2025	2021	2021	2023	2023
Guam Small boat	2025	2025	2025	2024	
CNMI Small boat	2025	2025	2025	2025	
ASam Small boat	2025	2025	2021	2023	

PIFSC will continue to collect and monitor annual community social indicators (Kleiber et al. 2018; Hospital and Leong 2021) for Hawaii fishing communities, in accordance with a national framework (Jepson and Colburn 2013).

2.4.6 Relevant PIFSC Economics and Human Dimensions Publications: 2023

Publication	MSRA priority
Advani S, JK. O'Hara, SM. Shoffler, P Pinto da Silva, J Agar, J Arnett, L Brislen, M Cutler, A Harley, J Hospital, K Norman, E Ragland, D Squires, B Stoffle, M Szymkowiak, AJ Vega-Labiosa, JS. Stoll. 2024. Estimating the scope, scale, and contribution of direct seafood marketing to the United States seafood sector. <i>Marine Policy</i> 165, 106188. https://doi.org/10.1016/j.marpol.2024.106188	HC1.1.4
Ayers A, Leong K, Hospital J, Tam C, Morioka R. 2024. 2023 Hawaii fisher observations data summary and analysis. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-24-09, 30 p. https://doi.org/10.25923/yyfz-a677	HC3.1.1 HC3.1.3 HC2.1.4 PF1
Chan HL, Cai J, Leung P. 2024. Aquaculture production and diversification: What causes what? <i>Aquaculture</i> 583, 740626. https://doi.org/10.1016/j.aquaculture.2024.740626	PF4
Fisk JJ, Leong KM, Berl REW, Long JW, Landon AC, Adams MM, Hankins DL, Williams CK, Lake FK, Salerno J. 2024. Evolving wildlife management cultures of governance through Indigenous Knowledges and perspectives. <i>Journal of Wildlife Management</i> . https://doi.org/10.1002/jwmg.22584	HC2.1.4 HC3.1
Ingram, R. J., Leong, K. M., Nakachi, A., & Gove, J. M. (2024). Dimensions of cultural ecosystem service contributions to human well-being in marine environments. <i>Ecosystems and People</i> , 20(1). https://doi.org/10.1080/26395916.2024.2378155	HC2.1.1 HC2.1.4 HC3.1
Kleiber D, Terry J, Elliot S, Selgrath, J, et al. 2024. NOAA and Demographic Data Collection. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-163, 77 p. https://doi.org/10.25923/kw71-b226	HC1.2.1
Konrad L, Levine A, Leong KM, Koethe F. 2024. Understanding perceptions that drive conflict over the endangered Hawaiian monk seal. <i>Front. Conserv. Sci.</i> https://doi.org/10.3389/fcosc.2024.1394063	HC2.2 HC2.2.2
Leong KM, Ingram RJ, Kleiber D, Long SH, Mastitski A, Norman K, Weng C, Wise S 2024. Aligning fisheries terminology with diverse social benefits <i>Marine Policy</i> , 170,106377. https://doi.org/10.1016/j.marpol.2024.106377	HC1.1.2 HC1.1.4
Leong KM, Gramza AR, Duberstein JN, Bryson C, Amlin A. 2024. Using applied social science disciplines to implement creative outdoor cat management solutions and avoid the trap of one-size-fits-all policies. <i>Conservation Biology</i> . 39(1) https://doi.org/10.1111/cobi.14321	HC2.2.2 HC3.1.4

Publication	MSRA priority
Leong KM, Quiocho K, Blacklow A, Rosa S, Kleiber D, Winter KB, Long KS, Puniwai N, Poe MR. 2024. Relational research to elevate cultural dimensions of marine organisms in Hawai‘i. <i>Ecology and Society</i> 29 (4):30. https://doi.org/10.5751/ES-15573-290430	HC2.1.1 HC2.1.4 HC3.1
Perng L, Leong K, Weijerman M, Oleson K. 2024. A multi-decadal assessment of social thresholds and outcomes in marine social-ecological systems in Hawai‘i. <i>Marine Policy</i> , 163, 106141. https://doi.org/10.1016/j.marpol.2024.106141	HC2.1
Wallmo K, Kleiber D, Tomberlin D, Woodworth-Jefcoats P and Oliver T (2024) The Diversity of Science Behind U.S. Seafood. <i>Front. Young Minds</i> . 12:1331893. https://doi.org/10.3389/frym.2024.1331893	HC1.1

2.5 PROTECTED SPECIES

This section of the report summarizes information on protected species interactions in fisheries managed under the Hawaii 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), the Marine Mammal Protection Act (MMPA), and/or the Migratory Bird Treaty Act (MBTA). A list of protected species found in or near Hawaii waters and a list of critical habitat designations in the Pacific Ocean are included in Appendix B.

2.5.1 Indicators for Monitoring Protected Species Interactions

This report monitors the status of protected species interactions in the Hawaii FEP fisheries using proxy indicators such as fishing effort and changes in gear types, as these fisheries do not have observer coverage. Creel surveys and logbook programs are not expected to provide reliable data about protected species interactions. Discussion of protected species interactions is focused on fishing operations in federal waters and associated transit through State waters.

2.5.1.1 FEP Conservation Measures

No specific regulations are in place to mitigate protected species interactions in the bottomfish, precious coral, coral reef ecosystem and crustacean fisheries currently active and managed under this FEP. Destructive gear such as bottom trawls, bottom gillnets, explosives, and poisons are prohibited under this FEP, and these prohibitions benefit protected species by preventing potential interactions with non-selective fishing gear.

The original crustacean Fishery Management Plan (FMP) and subsequent amendments included measures to minimize potential impacts of the Northwestern Hawaiian Islands (NWHI) component of the spiny lobster fishery to Hawaiian monk seals, such as specification of trap gear design and prohibition of nets. The Bottomfish and Seamount Groundfish FMP began requiring protected species workshops for the NWHI bottomfish fishery participants in 1988. These fisheries are no longer active due to the issuance of Executive Orders 13178 and 13196 and the

subsequent Presidential Proclamations 8031 and 8112, which closed the fisheries within 50 nm around the NWHI.

2.5.1.2 ESA Consultations

Hawaii FEP fisheries are covered under the following consultations under section 7 of the ESA, through which NMFS has determined that these fisheries are not likely to jeopardize or adversely affect any ESA-listed species or critical habitat in the Hawaii Archipelago (Table 64).

Table 64. Summary of ESA consultations for Hawaii FEP Fisheries

Fishery	Consultation Date	Consultation Type^a	Outcome^b	Species
All Fisheries	3/1/2016	LOC	NLAA	Hawaiian monk seal critical habitat
Bottomfish	3/18/2008	BiOp	LAA, non-jeopardy	Green sea turtle
			NLAA	Loggerhead sea turtle, leatherback sea turtle, olive ridley sea turtle, hawksbill sea turtle, humpback whale, blue whale, fin whale, northern right whale, sei whale, sperm whale, Hawaiian monk seal
	8/7/2013	BiOp modification	NLAA	False killer whale (MHI insular DPS)
	8/26/2022	BiOp	LAA, non-jeopardy	Oceanic whitetip shark
			NLAA	Giant manta ray, chambered nautilus, MHI false killer whale critical habitat
Coral Reef Ecosystem	5/22/2002	LOC (USFWS)	NLAA	Green, hawksbill, leatherback, loggerhead, and olive ridley turtles, Newell's shearwater, short-tailed albatross, Laysan duck, Laysan finch, Nihoa finch, Nihoa millerbird, Micronesian megapode, 6 terrestrial plants
	12/5/2013	LOC	NLAA	Loggerhead sea turtle (North Pacific DPS), leatherback sea turtle, olive ridley sea turtle, green sea turtle, hawksbill sea turtle, humpback whale, blue whale, fin whale, North Pacific right whale, sei whale, sperm whale, Hawaiian monk seal, false killer whale (MHI insular DPS)
	9/18/2018	No effect memo	No effect	Oceanic whitetip shark, giant manta ray

Fishery	Consultation Date	Consultation Type ^a	Outcome ^b	Species
Coral Reef Ecosystem (Kona Kampachi Special Coral Reef Ecosystem Fishing Permit only)	9/19/2013	LOC (USFWS)	NLAA	Short-tailed albatross, Hawaiian petrel, Newell's shearwater
	9/25/2013	LOC	NLAA	Loggerhead sea turtle (North Pacific DPS), leatherback sea turtle, olive ridley sea turtle, green sea turtle, hawksbill sea turtle, humpback whale, blue whale, fin whale, North Pacific right whale, sei whale, sperm whale, Hawaiian monk seal, false killer whale (MHI insular DPS)
Crustacean	12/5/2013	LOC	NLAA	Loggerhead sea turtle (North Pacific DPS), leatherback sea turtle, olive ridley sea turtle, green sea turtle, hawksbill sea turtle, humpback whale, blue whale, fin whale, North Pacific right whale, sei whale, sperm whale, Hawaiian monk seal, false killer whale (MHI insular DPS)
	9/18/2018	No effect memo	No effect	Oceanic whitetip shark, giant manta ray, MHI false killer whale critical habitat
Precious Coral	12/5/2013	LOC	NLAA	Loggerhead sea turtle (North Pacific DPS), leatherback sea turtle, olive ridley sea turtle, green sea turtle, hawksbill sea turtle, humpback whale, blue whale, fin whale, North Pacific right whale, sei whale, sperm whale, Hawaiian monk seal, false killer whale (MHI insular DPS)
	9/18/2018	No effect memo	No effect	Oceanic whitetip shark, giant manta ray, MHI false killer whale critical habitat

^a BiOp = Biological Opinion; LOC = Letter of Concurrence.

^b LAA = likely to adversely affect; NLAA = not likely to adversely affect.

2.5.1.2.1 Bottomfish Fishery

In a March 18, 2008 Biological Opinion (BiOp) covering MHI bottomfish fishery, NMFS determined that the MHI bottomfish fishery is likely to adversely affect but not likely to jeopardize the green sea turtle and included an incidental take statement (ITS) of two animals killed per year from collisions with bottomfish vessels. In the 2008 BiOp, NMFS also concluded that the fishery is not likely to adversely affect any four other sea turtle species (loggerhead, leatherback, olive ridley, and hawksbill turtles) and seven marine mammal species (humpback, blue, fin, Northern right whale, sei and sperm whales, and the Hawaiian monk seal).

In 2013, NMFS re-initiated consultation under ESA in response to listing of the MHI insular false killer whale distinct population segment (DPS) under the ESA. In a modification to the 2008 BiOp dated August 7, 2013, NMFS determined that commercial and non-commercial bottomfish fisheries in the MHI are not likely to adversely affect MHI insular false killer whale because of the spatial separation between the species and bottomfish fishing activities, the low likelihood of collisions, and the lack of observed or reported fishery interactions were among other reasons. NMFS also concluded that all previous determinations in the 2008 BiOp for other ESA-listed species and critical habitat remained valid.

In August 2015, NMFS revised the Hawaiian monk seal critical habitat in the NWHI and designated new critical habitat in the MHI. In an informal consultation completed on March 1, 2016, NMFS concluded that the Hawaii bottomfish fishery is not likely to adversely affect monk seal critical habitat.

On August 26, 2022, NMFS completed a new BiOp that was initiated in response to the ESA listings of the oceanic whitetip shark, giant manta ray and chambered nautilus, and designation of MHI insular false killer whale critical habitat. This BiOp did not re-evaluate species previously consulted on because NMFS determined that reinitiation was not triggered for those species based on a Biological Evaluation dated February 1, 2019. NMFS determined that the MHI bottomfish fishery is not likely to adversely affect giant manta rays, chambered nautilus, or MHI insular false killer whale critical habitat. For oceanic whitetip sharks, NMFS determined that the continued operation of MHI bottomfish activities is likely to adversely affect the threatened sharks but are not likely to jeopardize their continued existence. The MHI bottomfish fishery does incidentally take oceanic whitetip sharks, and to monitor the amount of take, NMFS established an Incidental Take Statement (ITS) of two interactions over any five consecutive calendar years. If the ITS is exceeded, NMFS will reinitiate formal consultation.

2.5.1.2.2 Crustacean Fishery

In an informal consultation completed on December 5, 2013, NMFS concluded that the Hawaii crustacean fisheries are not likely to affect five sea turtle species (North Pacific loggerhead DPS, leatherback, olive ridley, green, and hawksbill turtles) and eight marine mammal species (humpback, blue, fin, North Pacific right whale, sei, and sperm whales, MHI insular false killer whale DPS and the Hawaiian monk seal). In an informal consultation completed on March 1, 2016, NMFS concluded that the Hawaii crustacean fishery is not likely to adversely affect monk seal critical habitat.

On September 18, 2018, NMFS concluded the Hawaii crustacean fishery will have no effect on the oceanic whitetip shark, giant manta ray, and MHI false killer whale critical habitat.

2.5.1.2.3 Coral Reef Ecosystem Fishery

On May 22, 2002, the USFWS concurred with the determination of NMFS that the activities conducted under the Coral Reef Ecosystems FMP are not likely to adversely affect ESA-listed species under USFWS's exclusive jurisdiction (i.e., seabirds) and ESA-listed species shared with NMFS (i.e., sea turtles).

In an informal consultation completed on December 5, 2013, NMFS concluded that the Hawaii coral reef ecosystem fisheries are not likely to affect five sea turtle species (North Pacific loggerhead DPS, leatherback, olive ridley, green, and hawksbill turtles) and eight marine mammal species (humpback, blue, fin, Northern right, sei, and sperm whales, MHI insular DPS

false killer whales and the Hawaiian monk seal). In an informal consultation completed on March 1, 2016, NMFS concluded that the Hawaii coral reef ecosystem fishery is not likely to adversely affect monk seal critical habitat.

On September 18, 2018, NMFS concluded the Hawaii coral reef ecosystem fishery will have no effect on the oceanic whitetip shark and giant manta ray.

2.5.1.2.4 Precious Coral Fishery

In an informal consultation completed on December 5, 2013, NMFS concluded that the Hawaii precious coral fisheries are not likely to affect five sea turtle species (North Pacific loggerhead DPS, leatherback, olive ridley, green, and hawksbill turtles) and eight marine mammal species (humpback, blue, fin, North Pacific right, sei, and sperm whales, MHI insular false killer whale DPS and the Hawaiian monk seal). In an informal consultation completed on March 1, 2016, NMFS concluded that the Hawaii precious coral fishery is not likely to adversely affect monk seal critical habitat.

On September 18, 2018, NMFS concluded the Hawaii precious coral fishery will have no effect on the oceanic whitetip shark, giant manta ray, and MHI false killer whale critical habitat.

2.5.1.3 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 2024 LOF (89 FR 12257, February 16, 2024), the bottomfish (HI bottomfish handline), precious coral (HI black coral diving), coral fish (HI spearfishing), and crustacean (HI crab trap, lobster trap, shrimp trap, crab net, Kona crab loop net, lobster diving) fisheries are classified as Category III fisheries (i.e., a remote likelihood of or no known incidental mortality and serious injury of marine mammals).

2.5.2 Status of Protected Species Interactions in the Hawaii FEP Fisheries

2.5.2.1 Bottomfish Fishery

2.5.2.1.1 Sea Turtle, Marine Mammal, and Seabird Interactions

Fisheries operating under the Hawaii FEP currently do not have federal observers on board. The NWHI component of the bottomfish fishery had observer coverage from 1990 to 1993 and 2003 to 2005. The NWHI observer program reported several interactions with non-ESA-listed seabirds during that time, and no interactions with marine mammals or sea turtles (Nitta 1999; WPRFMC 2018).

To date, there have been no reported interactions between MHI bottomfish fisheries and ESA-listed species of sea turtles, marine mammals, and seabirds. Furthermore, the commercial and non-commercial bottomfish fisheries in the MHI are not known to have the potential for a large and adverse effect on non-ESA-listed marine mammals. Although these species of marine mammals occur in the Exclusive Economic Zone (EEZ) waters where the fisheries operate and depredation of bait or catch by dolphins (primarily bottlenose dolphins) occurs (Kobayashi and Kawamoto 1995), there have been no observed or reported takes of marine mammals by the bottomfish fishery.

The 2008 BiOp included an ITS of two green turtle mortalities per year from collisions with

bottomfish vessels. There have not been any reported or observed collisions of bottomfish vessels with green turtles, and data are not available to attribute stranded turtle mortality to collisions with bottomfish vessels. However, the BiOp analysis to determine the estimated level of take from vessel collisions was based on an estimated 71,800 bottomfish fishing trips per year. The total annual number of commercial and non-commercial bottomfish fishing trips since 2008 has been less than 3,500 per year. Therefore, the potential for collisions with bottomfish vessels is substantially lower than was estimated in the 2008 BiOp.

Based on fishing effort and other characteristics described in Chapter 1 of this report, no notable changes have been observed in the fishery. There is no other information to indicate that impacts to sea turtle, marine mammal, and seabird species from this fishery have changed in recent years.

2.5.2.1.2 Elasmobranch Interactions

As described in Section 2.5.1.2, the 2022 Biological Opinion established an ITS for oceanic whitetip sharks of two interactions over any five consecutive calendar years in the MHI bottomfish fishery. Between 2000 and 2017, the Hawaii commercial catch database for bottomfish reported 23 sharks under the single “whitetip sharks” reporting code, thus interactions with “whitetip sharks” could be either oceanic whitetip sharks or whitetip reef sharks. Based on area fished, the catch composition associated with the captured sharks, and the size of the shark, it was determined that only four were likely oceanic whitetip sharks interactions with the MHI bottomfish fishery. Beginning in 2019, the Hawaii DAR CML began using a separate species code to differentiate between oceanic whitetip sharks and whitetip sharks. There have been no reported interactions with oceanic whitetip sharks in the CML data for the MHI bottomfish fishery in the last five years (since 2018).

Table 65. The number of oceanic whitetip shark interactions expected as calculated by the 2022 BiOp, representing the ITS, with the reported number of interactions based on the best scientific data as described above.

ITS	Reported number in the last five consecutive calendar years
2	0

Notwithstanding the sparsity of data and potential for species misidentification in self-reported data, available information indicates that oceanic whitetip shark captures in the MHI bottomfish fishery are rare. Sharks generally do not experience barotrauma when brought up from depth, and fishermen in Hawaii bottomfish fisheries tend to release hooked sharks alive by cutting their hook leaders (WPRFMC 2007). However, quantitative estimates of post-release mortality are not available.

A federal observer program monitored the Northwestern Hawaiian Islands (NWHI) bottomfish fishery from October 2003 to April 2006. Observer data from that period reported five interactions with oceanic whitetip sharks. However, a recent review of these data by the NMFS Observer Program indicated that species identification for these records is uncertain and some or all of these interactions could have been whitetip reef sharks (NMFS 2019). Additionally, the characteristics of the NWHI bottomfish fishery, which ceased operations in 2011 pursuant to the presidential proclamation establishing the Papahānaumokuākea Marine National Monument, differ from the MHI bottomfish fishery that operates today. The NWHI bottomfish fishery was

comprised of larger vessels than those in the MHI due to the distance to the fishing grounds and was conducted solely by commercial fishermen using heavier gear than those used in the MHI.

Cooperative research fishing surveys conducted by Kendall Enterprise Incorporated and Pacific Islands Fisheries Group as part of the MHI Bottomfish Fishery-Independent Survey contract local Deep-7 commercial fishermen to collect data using a standardized traditional fishing method (Kendall Enterprise Inc 2014). In the 2016 to 2017 surveys comprising 814 fishing samples (each sample being 30 minutes in duration) and 2,545 records of fish catch, three whitetip reef sharks and no oceanic whitetip sharks were recorded (NMFS 2019).

In addition to the bottomfish surveys, PIFSC researchers have conducted limited bottomfish fishing in the Pacific Islands region for life history research and fishery-independent survey purposes. Each research cruise may land a maximum of 1,200 kg of bottomfish. There have been seven such cruises in the Main Hawaiian Islands since 2007. However, there are no records of researchers catching oceanic whitetip sharks while conducting these activities (NMFS 2019).

There are no records of giant manta ray incidental captures or entanglements in the federally managed bottomfish fisheries in Hawaii.

2.5.2.2 Crustacean, Coral Reef, and Precious Coral Fisheries

There are no observer data available for the crustacean, coral reef, or precious coral fisheries operating under the Hawaii FEP. However, based on current ESA consultations, these fisheries are not expected to interact with any ESA-listed species in federal waters around the Hawaii Archipelago. NMFS has also concluded that the Hawaii crustacean, coral reef, and precious coral commercial fisheries will not affect marine mammals in any manner not considered or authorized under the MMPA.

In 1986, one Hawaiian monk seal died as a result of entanglement with a bridle rope from a lobster trap. There have been no other reports of protected species interactions with any of these fisheries since then (WPRFMC 2009, 2023).

Based on fishing effort and other characteristics described in Chapter 1 of this report, no notable changes have been observed in these fisheries. There is no other information to indicate that impacts to protected species from this fishery have changed in recent years.

2.5.3 Identification of Emerging Issues

Table 66 summarizes current candidate ESA species, recent listing status, and post-listing activity (critical habitat designation and recovery plan development). Impacts from FEP-managed fisheries on any new listings and critical habitat designations will be considered in future versions of this report.

Table 66. Status of candidate ESA species, recent ESA listing processes, and post-listing activities

Species		Listing Process			Post-Listing Activity	
Common Name	Scientific Name	90-Day Finding	12-Month Finding / Proposed Rule	Final Rule	Critical Habitat/Other	Recovery Plan
Oceanic Whitetip Shark	<i>Carcharhinus longimanus</i>	Positive (81 FR 1376, 1/12/2016)	Warranted, threatened (81 FR 96304, 12/29/2016)	Listed as threatened (83 FR 4153, 1/30/18)	<u>Critical habitat:</u> Designation not prudent; no areas within US jurisdiction that meet definition of critical habitat (85 FR 12898, 3/5/2020) <u>Other:</u> Protective regulations under ESA 4(d) proposed (89 FR 41917, 5/14/2024)	Final Recovery Plan published July 11, 2024 (89 FR 56865)
Giant Manta Ray	<i>Manta birostris</i>	Positive (81 FR 8874, 2/23/2016)	Warranted, threatened (82 FRN 3694, 1/12/2017)	Listed as threatened (83 FR 2916, 1/22/18)	<u>Critical habitat:</u> Designation not prudent; no areas within US jurisdiction that meet definition of critical habitat (84 FR 66652, 12/5/2019)	Draft Recovery Plan published October 15, 2024 (89 FR 82991)
False Killer Whale (MHI Insular DPS)	<i>Pseudorca crassidens</i>	Positive (75 FR 316, 1/5/2010)	Warranted, endangered (75 FR 70169, 11/17/2010)	Listed as endangered (77 FR 70915, 11/28/2012)	<u>Critical habitat:</u> Designated in waters from the 45 m depth contour to the 3,200 m depth contour around the MHI from Niihau east to Hawaii (83 FR 35062, 07/24/2018)	Final Recovery Plan published November 3, 2021 (85 FR 60615)
Green Sea Turtle	<i>Chelonia mydas</i>	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)	Critical habitat proposed (88 FR 46572, 07/19/2023)	TBA

Species		Listing Process			Post-Listing Activity	
Common Name	Scientific Name	90-Day Finding	12-Month Finding / Proposed Rule	Final Rule	Critical Habitat/Other	Recovery Plan
Giant Clams	<i>Hippopus hippopus</i> , <i>H. porcellanus</i> , <i>Tridacna squamosina</i> , <i>T. derasa</i> , <i>T. gigas</i> , <i>T. Squamosa</i> , and <i>T. tevoroa</i>	Positive for 7 species (82 FR 28946, 06/26/2017)	Warranted; endangered for 5 species, threatened for 1 species, threatened due to similarity in appearance for 4 species (89 FR 60498, 7/25/24)	TBA	Protective regulations under ESA 4(d) proposed for <i>H. hippopus</i> (89 FR 60498, 7/25/24)	N/A

2.5.4 Identification of Research, Data, and Assessment Needs

The following research, data, and assessment needs for insular fisheries were identified by the Council's Plan Team:

- Improve species identification of commercial and non-commercial fisheries data (e.g., outreach, use FAO species codes) to improve understanding of potential protected species impacts.
- Define and evaluate innovative approaches to derive robust estimates of protected species interactions in insular fisheries.
- Conduct genetic and telemetry research to improve understanding of population structure and movement patterns for listed elasmobranchs.
- Estimates of post release survival for incidental protected species.

2.6 CLIMATE AND OCEANIC INDICATORS

2.6.1 Introduction

Over the past several years, the Council has incorporated climate change into the overall management of the fisheries over which it has jurisdiction. This 2024 annual SAFE report includes a now standard chapter on indicators of climate and oceanic conditions in the Western Pacific region. These indicators reflect 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 Hawaii as well as fishing industry representatives and local communities in those jurisdictions.

In 2013, the Council began restructuring its Marine Protected Area/Coastal and Marine Spatial Planning Committee to include a focus on climate change, and the committee was renamed as the Marine Planning and Climate Change Committee (MPCCC). 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 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:

- To identify and prioritize research that examines the effects of climate change on Council-managed fisheries and fishing communities.
- To ensure climate change considerations are incorporated into the analysis of management alternatives.
- To monitor climate change related variables via the Council's Annual Reports.
- 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. 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.

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.

2.6.2 Response to Previous Plan Team and Council Recommendations

There were no Council recommendations relevant to the climate and oceanic indicators section of the annual SAFE report for the Hawaii Archipelago in 2024.

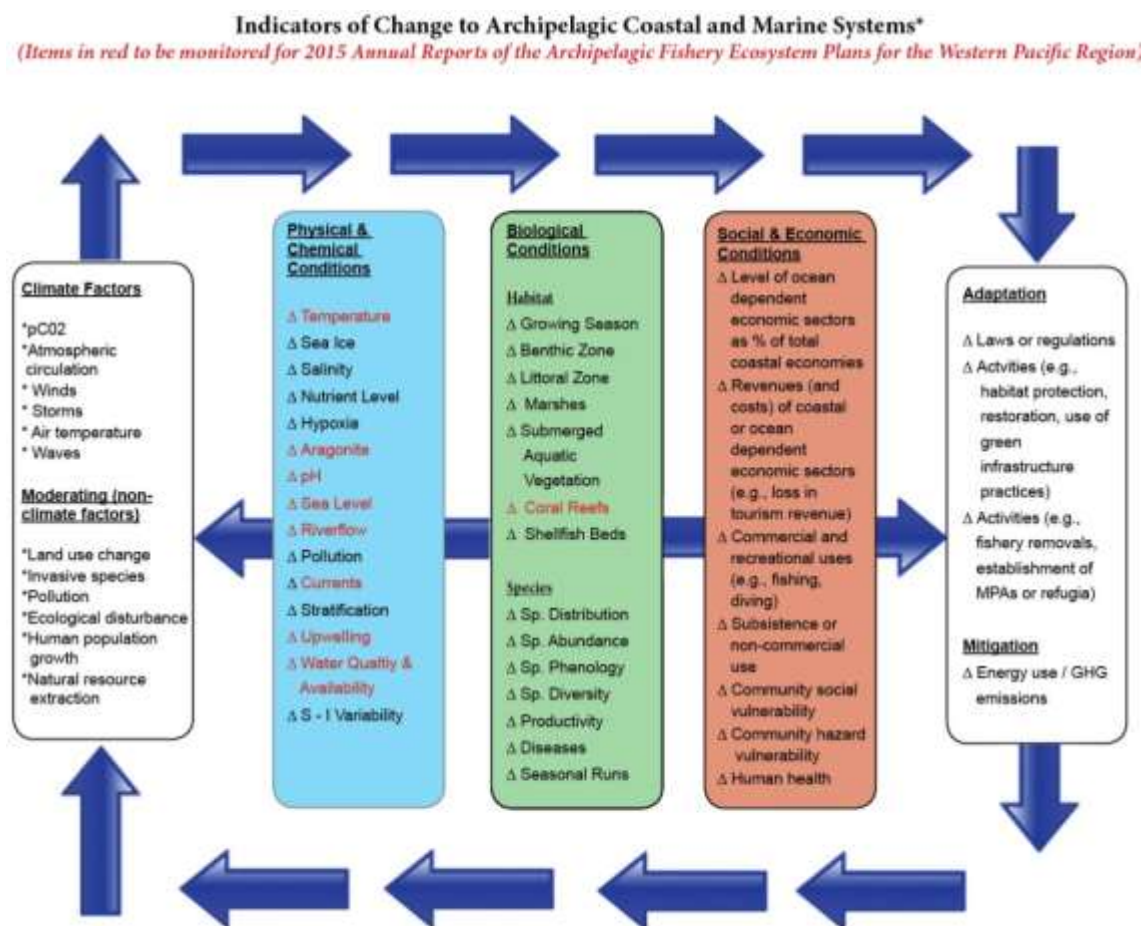
2.6.3 Conceptual Model

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 (PIRCA) 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 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 17).

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.



*Adapted from National Climate Assessment and Development Advisory Committee, February 2014, National Climate Indicators System Report, B-59.

Figure 17. Indicators of change of archipelagic coastal and marine systems; conceptual model

2.6.4 Selected Indicators

The primary goal for selecting the indicators used in this (and future reports) is to provide fisheries-related communities, resource managers, and businesses with climate-related situational awareness. In this context, Indicators were selected to:

- Be fisheries relevant and informative;
- Build intuition about current conditions in light of changing climate;
- Provide historical context; and
- Recognize patterns and trends.

In this context, this section includes the following climate and oceanic indicators:

- Atmospheric concentration of carbon dioxide (CO₂)
- Oceanic pH at Station ALOHA;
- Oceanic Niño Index (ONI);
- Pacific Decadal Oscillation (PDO);
- Tropical cyclones;
- Sea surface temperature (SST);
- Coral thermal stress exposure
- Chlorophyll-a
- Rainfall
- Sea level (Sea surface height)

Figure 18 and Figure 19 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.

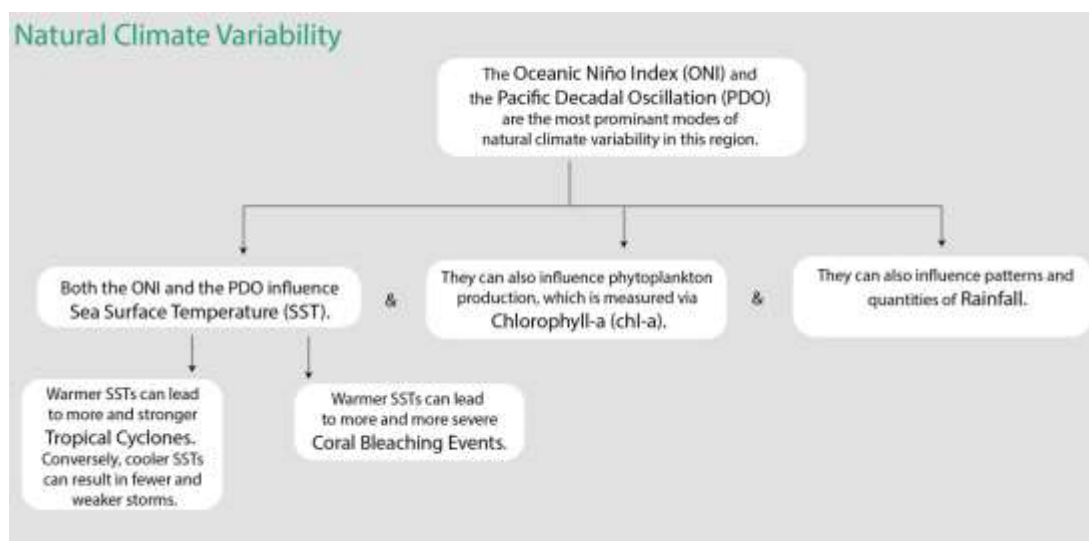


Figure 18. Schematic diagram illustrating how indicators are connected to one another and how they vary as a result of natural climate variability

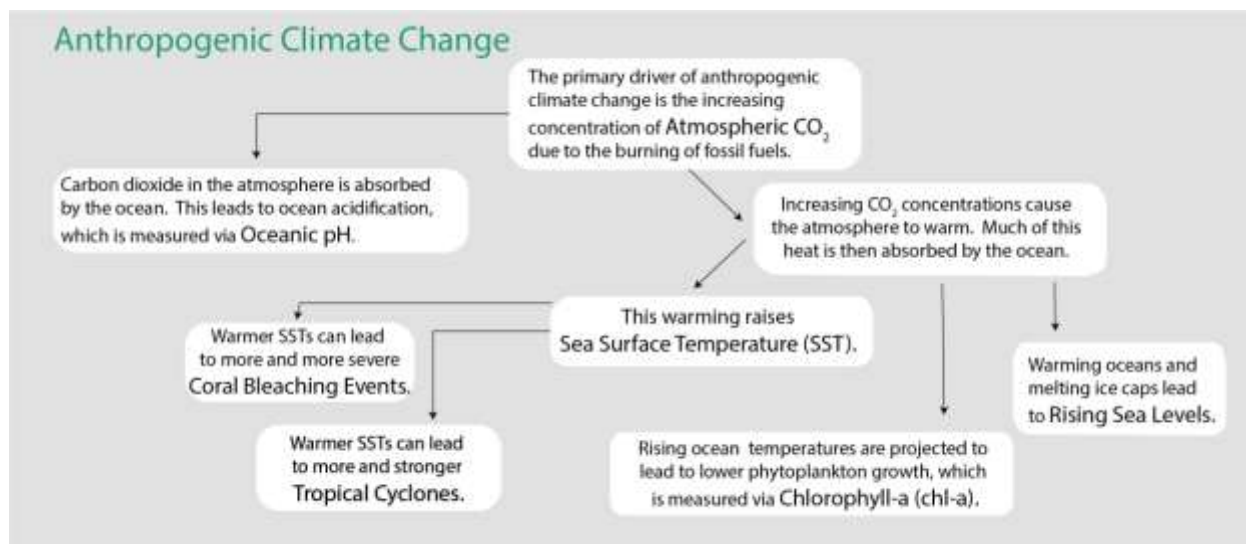


Figure 19. Schematic diagram illustrating how indicators are connected to one another and how they vary as a result of anthropogenic climate change

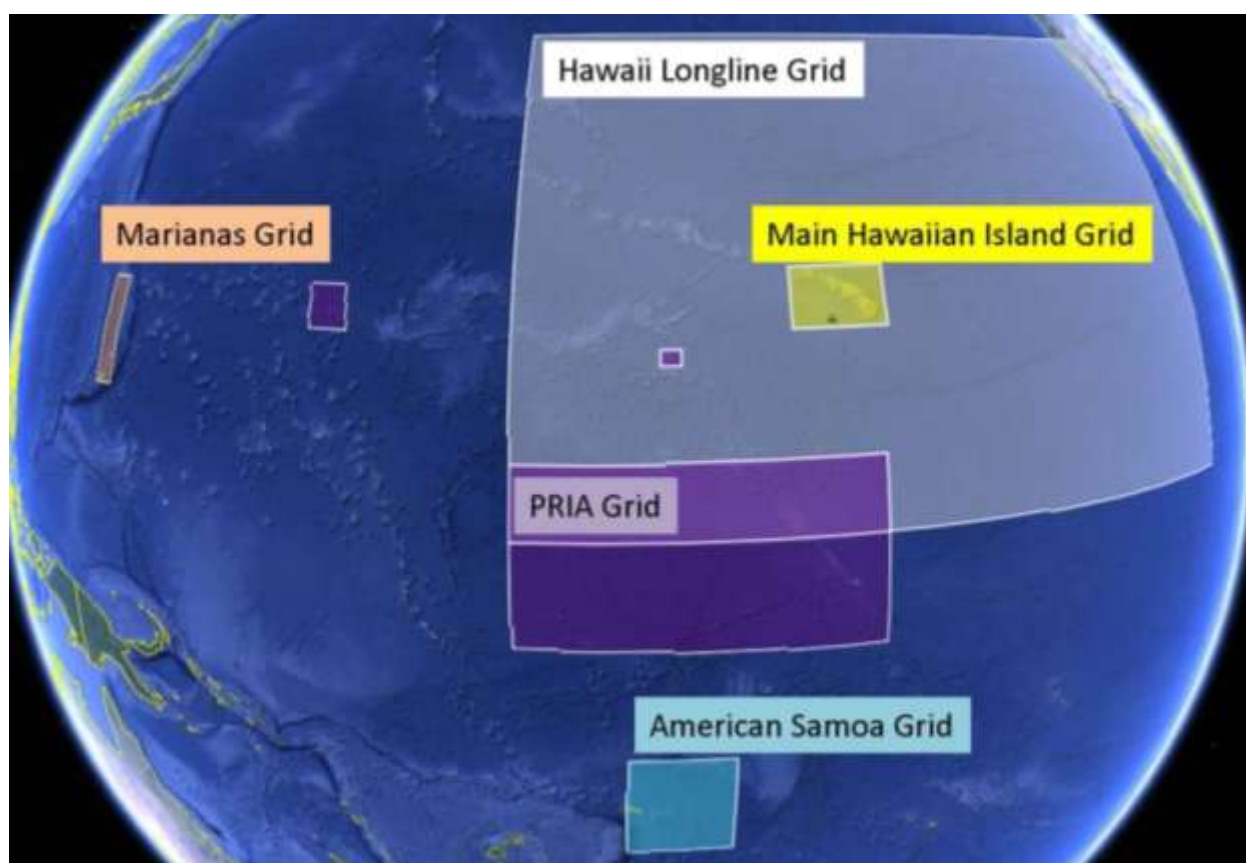


Figure 20. Regional spatial grids representing the scale of the climate change indicators being monitored

2.6.4.1 Atmospheric Concentration of Carbon Dioxide at Mauna Loa

Rationale: Atmospheric carbon dioxide (CO₂) 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 CO₂ is increasing exponentially. This means that atmospheric CO₂ is increasing more quickly over time. In 2024, the annual mean concentration of CO₂ was 424.61 ppm. This is the highest annual value recorded. This year also saw the highest monthly value, which was 426.91 ppm. In 1959, the first year full of the time series, the atmospheric concentration of CO₂ was 316 ppm. The annual mean passed 350 ppm in 1988, and 400 ppm in 2015.

Description: Monthly mean atmospheric CO₂ 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 CO₂ 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 CO₂ is removed from the atmosphere. In the winter (outside the growing season), respiration exceeds photosynthesis, and CO₂ 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. Note that due to the eruption of the Mauna Loa Volcano, measurements from Mauna Loa Observatory were suspended as of 29 November 2022. Observations from December 2022 to 4 July 2023 are from a site at the Maunakea Observatories, approximately 21 miles north of the Mauna Loa Observatory. Mauna Loa observations resumed in July 2023.

Measurement Platform: *In-situ* station.

Data available at: <https://gml.noaa.gov/ccgg/trends/data.html>.

Sourced from: Keeling et al. (1976), Thoning et al. (1989), and NOAA (2025a). Graphics produced in part using Stawitz and Li (2025).

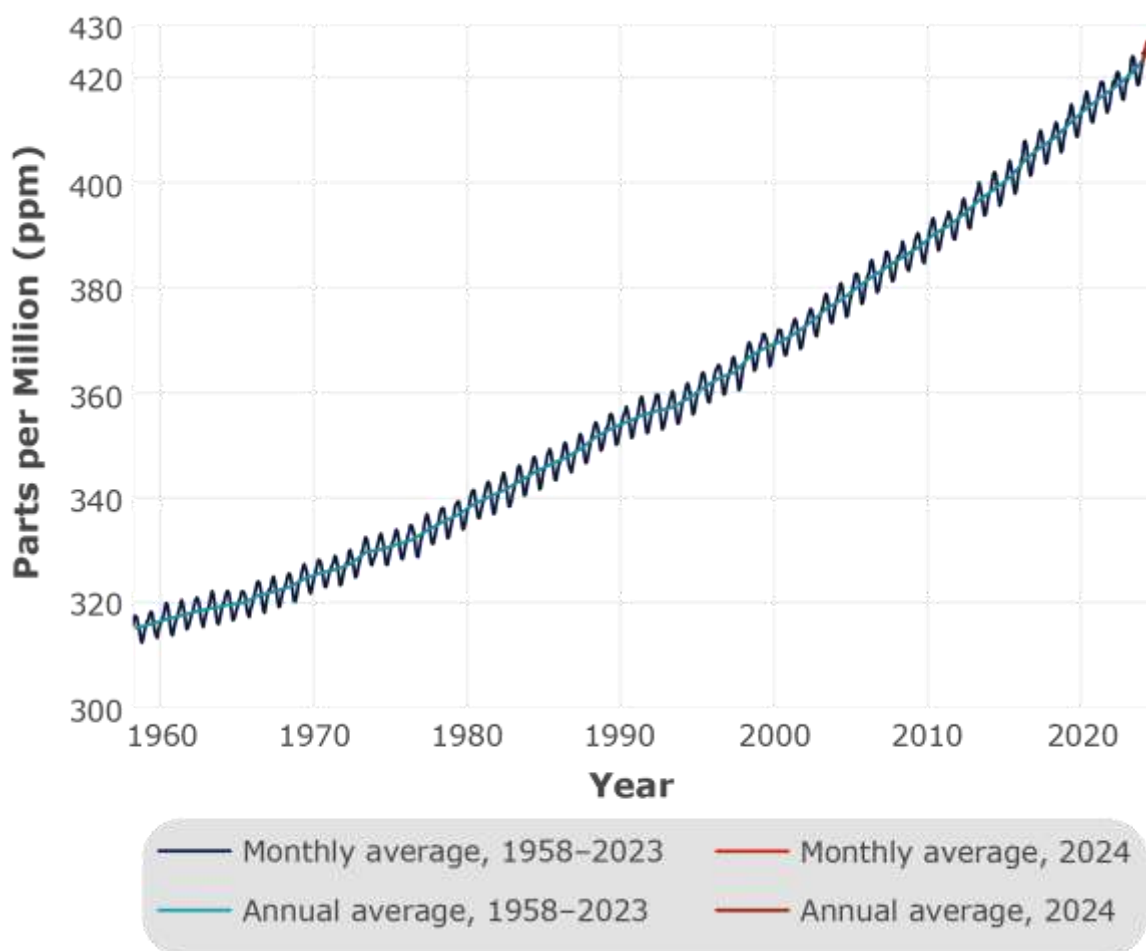


Figure 21. Monthly mean (black) and seasonally corrected (blue) atmospheric carbon dioxide at Mauna Loa Observatory, Hawaii

2.6.4.2 Oceanic pH

Rationale: Oceanic pH is a measure of how greenhouse gas emissions have already affected 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 12.2% more acidic than it was over 30 years ago at the start of this time series. Over this time, pH has declined by 0.05 at a constant rate. In 2023, the most recent year for which data are available, the average pH was 8.05. This year also saw a time series minimum of 8.026. Additionally, for the 8th year, small variations seen over the course of the year are outside the range seen in the first year of the time series. The highest pH value reported for the most recent year (8.063) is lower than the lowest pH value reported in the first year of the time series (8.083).

Description: Trends in surface (5 m) pH at Station ALOHA, north of Oahu (22.75°N, 158°W), are collected by the Hawai‘i Ocean Time-Series (HOT) from October 1988 to 2023 (2024 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 CO₂ and the amount of CO₂ absorbed is captured through measurements of DIC. The multi-decadal time series at Station ALOHA represents the best available documentation of the significant downward trend in oceanic pH since the time series began in 1988. Oceanic pH varies over both time and space, though the conditions at Station ALOHA are considered broadly representative of those across the Western and Central Pacific’s pelagic fishing grounds.

Timeframe: Monthly.

Region/Location: Station ALOHA: 22.75°N, 158°W.

Measurement Platform: *In-situ* station.

Data available at: <https://hahana.soest.hawaii.edu/hot/hot-dogs/bseries.html>.

Sourced from: Fabry et al. (2008), Feely et al. (2016), and the Hawai‘i Ocean Time-Series as described in Karl and Lukas (1996) and on its website (HOT 2025) using the methodology provided by Zeebe and Wolf-Gladrow (2001). Graphics produced in part using Stawitz and Li (2025).

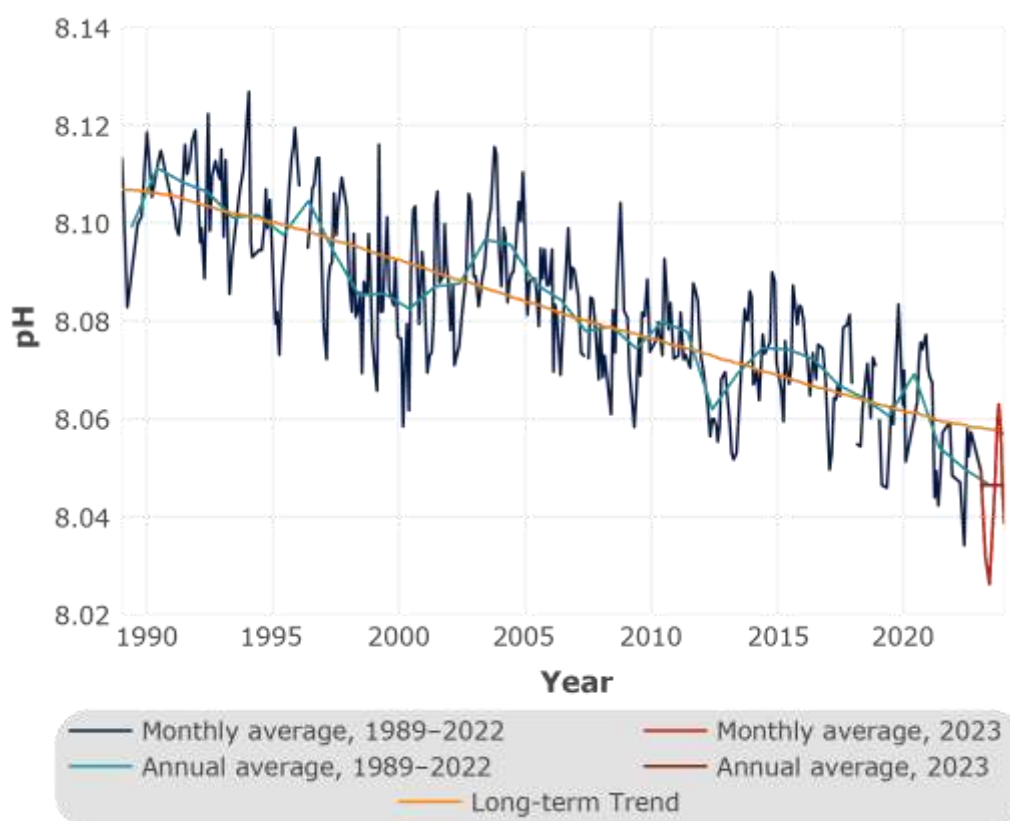


Figure 22. Time series and long-term trend of oceanic pH measured at Station ALOHA

2.6.4.3 Oceanic Niño Index

Rationale: The El Niño – Southern Oscillation (ENSO) cycle is known to have impacts on Pacific fisheries including tuna fisheries. The Oceanic Niño Index (ONI) focuses on ocean temperature, which has the most direct effect on these fisheries.

Status: The Oceanic Niño Index (ONI) indicated a transition from El Niño to neutral conditions in 2024. In 2024, the ONI ranged from -0.53 to 1.78. This is within the range of values previously observed in the time series.

Description: The three-month running mean (referred to as a season) of satellite remotely-sensed sea surface temperature (SST) anomalies in the Niño 3.4 region (5°S – 5°N, 120° – 170°W). The ONI is a measure of the 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: Three-month running mean.

Region/Location: Niño 3.4 region, 5°S – 5°N, 120° – 170°W.

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

Data available at: <https://www.cpc.ncep.noaa.gov/data/indices/oni.ascii.txt>.

Sourced from: NOAA CPC (2025). Graphics produced in part using Stawitz and Li (2025).

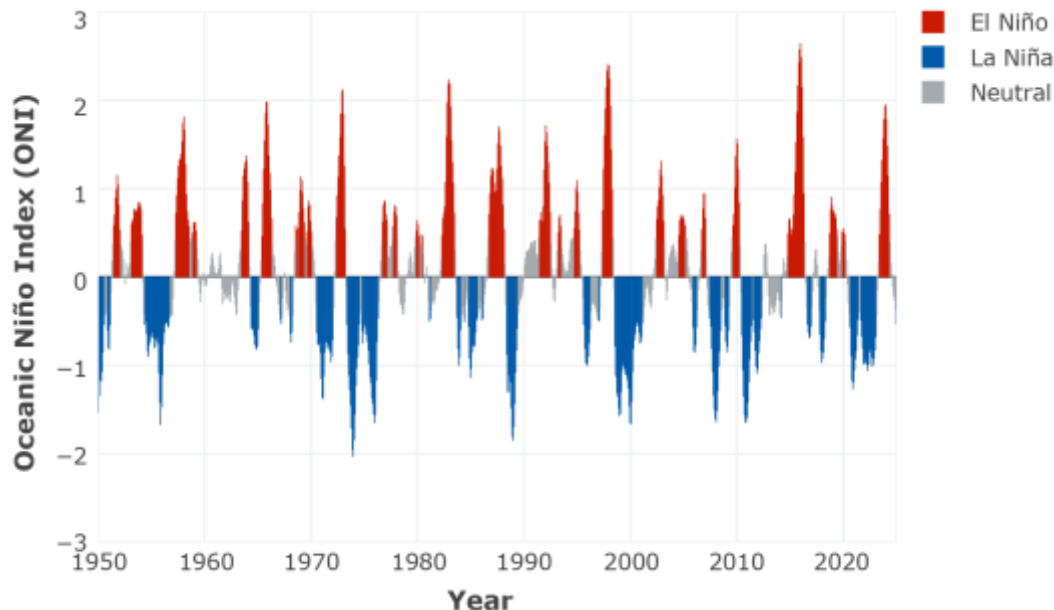


Figure 23. Oceanic Niño Index from 1950–2024 El Niño periods in red, La Niña periods in blue, and neutral periods in grey

2.6.4.4 Pacific Decadal Oscillation

Rationale: The Pacific Decadal Oscillation (PDO) was initially named by fisheries scientist Steven Hare in 1996 while researching connections between Alaska salmon production cycles and Pacific climate. Like ENSO, the PDO reflects changes between periods of persistently warm or persistently cool ocean temperatures, but over a period of 20 to 30 years (versus six to 18 months for ENSO events). The climatic fingerprints of the PDO are most visible in the Northeastern Pacific, but secondary signatures exist in the tropics.

Status: The PDO was negative in 2024. The index ranged from -3.04 to -1.07 over the course of the year. This is within the range of values previously observed in the time series.

Description: The PDO is often described as a long-lived El Niño-like pattern of Pacific climate variability. As seen with the better-known ENSO, extremes in the PDO pattern are marked by widespread variations in the Pacific Basin and the North American climate. In parallel with the ENSO phenomenon, the extreme cases of the PDO have been classified as either warm or cool, as defined by ocean temperature anomalies in the northeast and tropical Pacific Ocean. When SST is below average in the [central] North Pacific and warm along the North American coast, and when sea level pressures are below average in the North Pacific, the PDO has a positive value. When the climate patterns are reversed, with warm SST anomalies in the interior and cool SST anomalies along the North American coast, or above average sea level pressures over the North Pacific, the PDO has a negative value. Description inserted from NOAA (2025b).

Timeframe: Monthly.

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

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

Data available at: <https://psl.noaa.gov/pdo/>.

Sourced from: NOAA (2025b), Mantua (1997), and Newman (2016). Graphics produced in part using Stawitz and Li (2025).

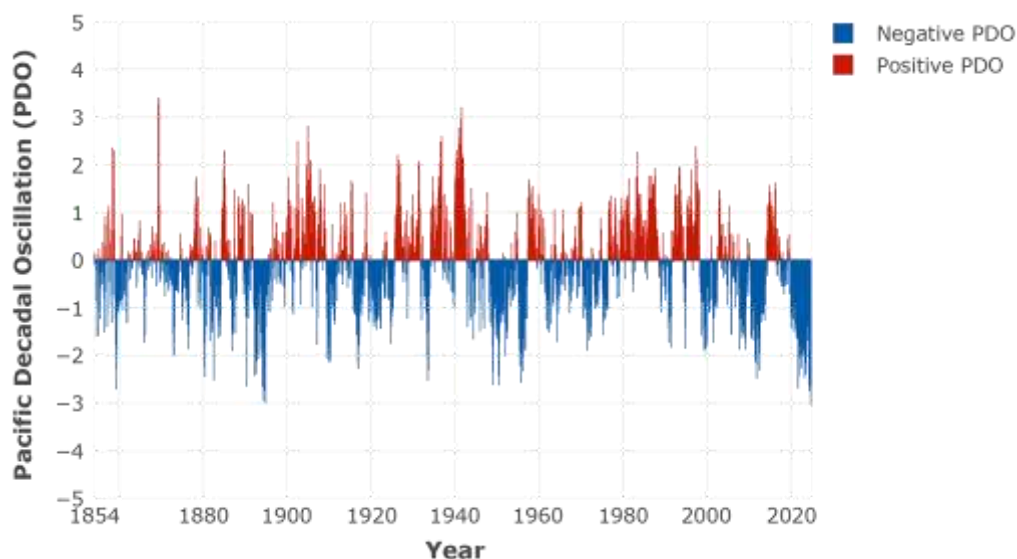


Figure 24. Pacific Decadal Oscillation from 1854–2024 with positive warm periods in red and negative cool periods in blue

2.6.4.5 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. Tropical cyclone activity was below the 1991–2020 average in the Eastern Pacific in 2024. There were 13 named storms, 4 of which were hurricanes. There were 3 major hurricanes (category 3 or higher). Accumulated Cyclone Energy (ACE) was about 67% the 1991–2020 average in the Eastern North Pacific. In addition to season totals, early season tropical cyclone activity and ACE were at a record low in 2024, with this being only the second year in this time series with no activity in June. Portions of this summary inserted from <https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202406> and <https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202413>.

Central North Pacific. Early season tropical cyclone activity and ACE were at a record low in 2024 in the Central North Pacific, with this being only the second year in this time series with no activity in June. On August 19th, Hurricane Hone formed in the Central Pacific and peaked as a Category 1 hurricane with winds of 85 mph. Hone brought gusty winds and flooding rains to the Island of Hawai‘i as it passed south of the island chain. Overall, Central Pacific tropical cyclone activity was below the 1991–2020 average in 2024. There were 2 named storms, both hurricanes, though neither became a major hurricane. On average (1991–2020), the central Pacific sees four named storms, two hurricanes, and one major hurricane each year. The 2024 ACE index was well below the 1991–2020 average. Portions of this summary inserted from <https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202406>, <https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202407>, and <https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202408>.

Western North Pacific. Early season tropical cyclone activity and ACE were at a record low in 2024. However, this changed in November, when four named storms were simultaneously active. This was the first instance of four simultaneous named storms in the West Pacific during the month of November. Overall, though, storm activity was near average. The Western Pacific saw 23 named storms in 2024. Of these storms, 15 were typhoons, and 9 became major typhoons. These counts were all close to average (1991–2020), although ACE was only about 67% the long-term average. Since 1980, the number of named storms and typhoons has decreased slightly at a rate of about 1 storm per decade and the total number of storms has decreased at a rate of about 2 storms per decade. Portions of the summary inserted from <https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202406> and <https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202411>.

South Pacific. South Pacific tropical cyclone activity was roughly average in 2024. There were 11 named storms, 4 of which became cyclones and 2 major cyclones. The 2024 ACE was less than the 1991–2020 average.

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 which is a way of monitoring the frequency, strength, and duration of tropical cyclones based on wind speed measurements.

The annual frequency of storms passing through each basin is tracked and Figure 25 shows the representative breakdown of Saffir-Simpson hurricane categories.

Every cyclone has an ACE Index value, which is a number based on the maximum wind speed measured at six-hourly intervals over the entire time that the cyclone is classified as at least a tropical storm (wind speed of at least 34 knots; 39 mph). Therefore, a storm's ACE Index value accounts for both strength and duration. Figure 26 shows the ACE values for each hurricane/typhoon season and has a horizontal line representing the average annual ACE value.

Timeframe: Annual.

Region/Location:

Eastern North Pacific: east of 140° W, north of the equator.

Central North Pacific: 180° - 140° W, north of the equator.

Western North Pacific: west of 180°, north of the equator.

South Pacific: south of the equator.

Measurement Platform: Satellite.

Data available at: <https://www.ncei.noaa.gov/data/international-best-track-archive-for-climate-stewardship-ibtracs/v04r01/access/csv/>.

Sourced from: Knapp et al. (2010), Knapp et al. (2018), and NOAA (2025c).

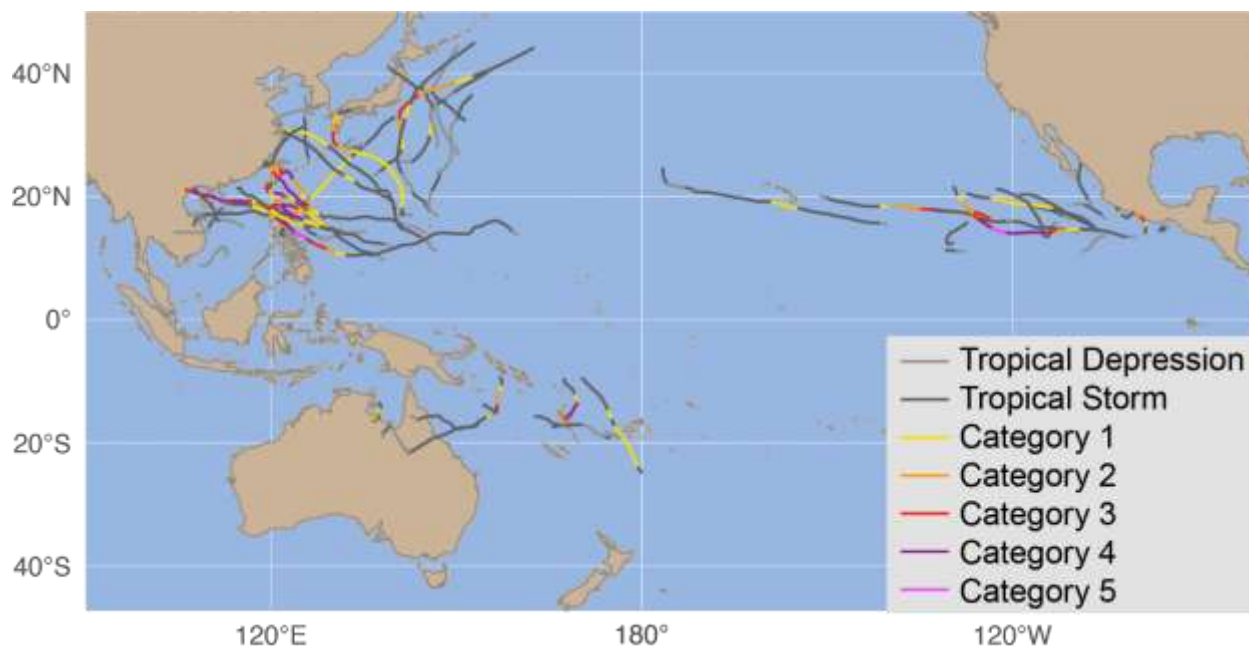


Figure 25. 2024 Pacific basin tropical cyclone tracks

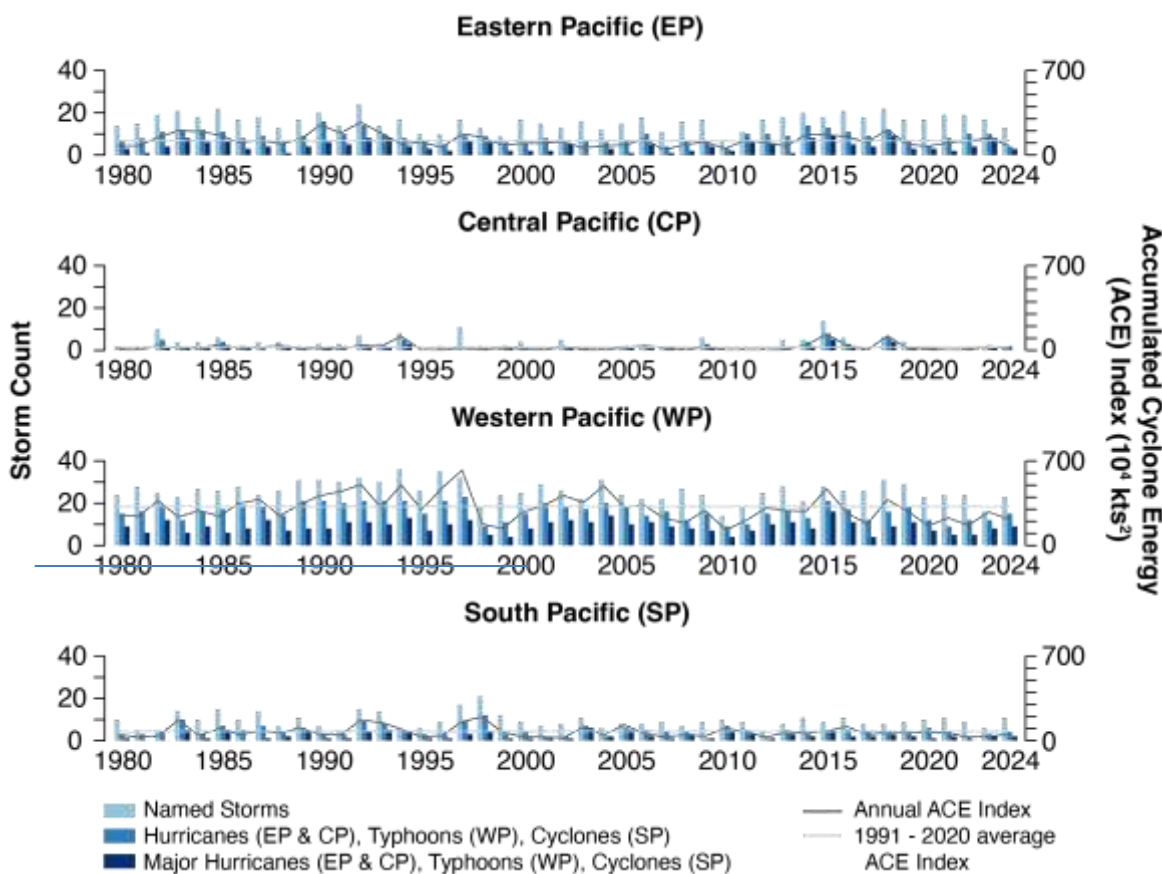


Figure 26. Storm counts (bars) and Accumulated Cyclone Energy (ACE) index values (lines) in each region of the Pacific. Both annual ACE index (black lines) and 1991–2020 average ACE index (grey lines) are shown

2.6.4.6 Sea Surface Temperature & Anomaly

Rationale: Sea surface temperature (SST) is one of the most directly observable existing measures for tracking increasing ocean temperatures. SST varies in response to natural climate cycles such as 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 25.68 °C in 2024. Over the period of record, annual SST has increased at a rate of 0.016 °C yr⁻¹. Monthly SST values in 2024 ranged from 24.14 – 27.14 °C, within the range of temperatures seen (23.28 – 28.47 °C) over the previous years of the time series (1985-2023). The annual anomaly was 0.24 °C hotter than the reference (1985-2009) climatology, with pockets of cooler waters east of and near the southern tip of the island of Hawai'i.

Note that from the top to bottom in Figure 27, panels show climatological SST (1985-2009), 2024 SST anomaly, time series of monthly mean SST, and time series of monthly SST anomaly.

Description: Satellite remotely-sensed monthly sea surface temperature (SST) is averaged across the Main Hawaiian Island Grid (18.5° – 22.5°N, 161° – 154°W). A time series of monthly mean SST averaged over the Main Hawaiian Island region is presented. Additionally, spatial climatology and anomalies are shown.

Timeframe: 1985-2024, Monthly.

Region/Location: Main Hawaiian Island Grid (18.5° – 22.5°N, 161° – 154°W).

Measurement Platform: Satellite.

Sourced from: NOAA OceanWatch (2025a).

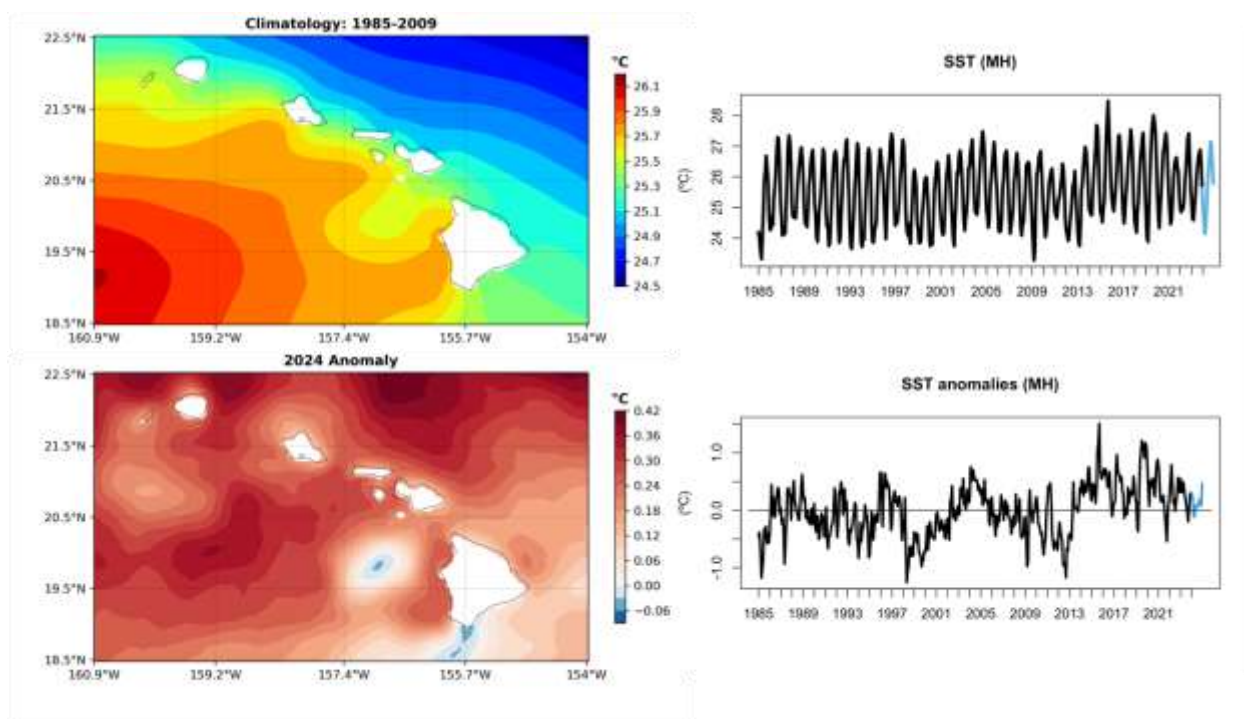


Figure 27. Sea surface temperature climatology and anomalies from 1985–2024

2.6.4.7 Coral Thermal Stress Exposure: Degree Heating Weeks

Rationale: Degree heating weeks are one of the most widely used metrics for assessing exposure to coral bleaching-relevant thermal stress.

Status: After a series of stress events in 2014, 2015, and 2019, the main Hawaiian Islands experienced no coral heat stress in 2024.

Description: Here we present a metric of exposure to thermal stress that is relevant to coral bleaching. Degree Heating Weeks (DHW) measure time and temperature above a reference ‘summer maximum’, presented as rolling sum weekly thermal anomalies over a 12-week period. Higher DHW measures imply a greater likelihood of mass coral bleaching or mortality from thermal stress.

The NOAA Coral Reef Watch program uses satellite data to provide current reef environmental conditions to quickly identify areas at risk for [coral bleaching](#). Bleaching is the process by which corals lose the symbiotic algae that give them their distinctive colors. If a coral is severely bleached, disease and death become likely.

The NOAA Coral Reef Watch (CRW) daily 5-km satellite coral bleaching Degree Heating Week (DHW) product presented here shows accumulated heat stress, which can lead to coral bleaching and death. The scale goes from 0 to 20 °C-weeks. The DHW product accumulates the instantaneous bleaching heat stress (measured by Coral Bleaching HotSpots) during the most-recent 12-week period. It is directly related to the timing and intensity of coral bleaching. Significant coral bleaching usually occurs when DHW values reach 4 °C-weeks. By the time DHW values reach 8 °C-weeks, widespread bleaching is likely and significant mortality can be expected (NOAA Coral Reef Watch 2024).

Timeframe: 2014–2024, daily data.

Region/Location: Global.

Sourced from: NOAA Coral Reef Watch (2024).

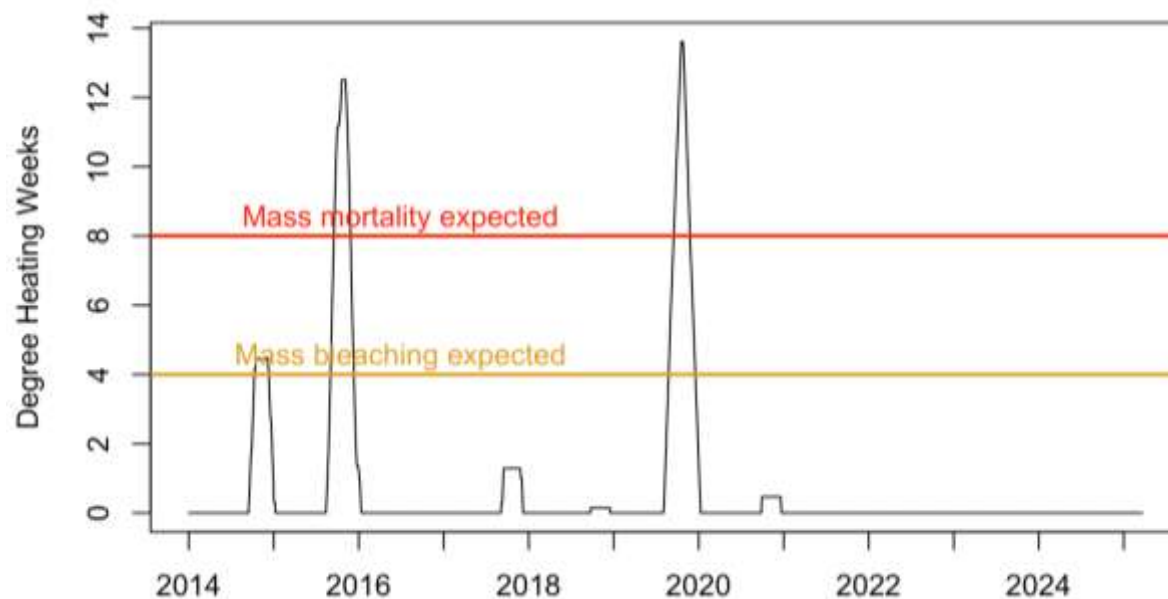


Figure 28. Coral Thermal Stress Exposure, Main Hawaiian Island Virtual Station from 2014–2024, measured in Coral Reef Watch Degree Heating Weeks

2.6.4.8 Chlorophyll-*a* and Anomaly

Rationale: Chlorophyll-*a* (Chl-A) is one of the most directly observable measures we have for tracking increasing ocean productivity.

Status: Annual mean Chl-A was 0.078 mg/m^3 in 2024. Over the period of record, annual Chl-A has shown weak but significant linear decrease at a rate of $0.00022 \text{ mg/m}^3/\text{year}$. Monthly Chl-A values in 2024 ranged from $0.066\text{--}0.092 \text{ mg/m}^3$, within the range of Chl-A concentrations seen ($0.057\text{--}0.121 \text{ mg/m}^3$) over the previous years of the time series (1998-2023). The annual anomaly was 0.0036 mg/m^3 lower than the reference (1998-2009) climatological values.

Description: Chlorophyll-*a* concentration from 1998-2024, derived from the ESA Ocean Color Climate Change Initiative dataset, v6.0. A monthly climatology was generated across the entire period to provide an anomaly time series. An annual anomaly was generated in reference to the 1998-2009 climatology to provide a 2024 spatial anomaly.

ESA Ocean Color Climate Change Initiative dataset is a merged dataset, combining data from SeaWiFS, MODIS-Aqua, MERIS, and VIIRS to provide a homogeneous time-series of ocean color. Data was accessed from the OceanWatch Central Pacific portal.

Timeframe: 1998–2024, daily data available, monthly means shown.

Region/Location: Global.

Measurement Platform: SeaWiFS, MODIS-Aqua, MERIS, and VIIRS.

Sourced from: NOAA OceanWatch (2025b).

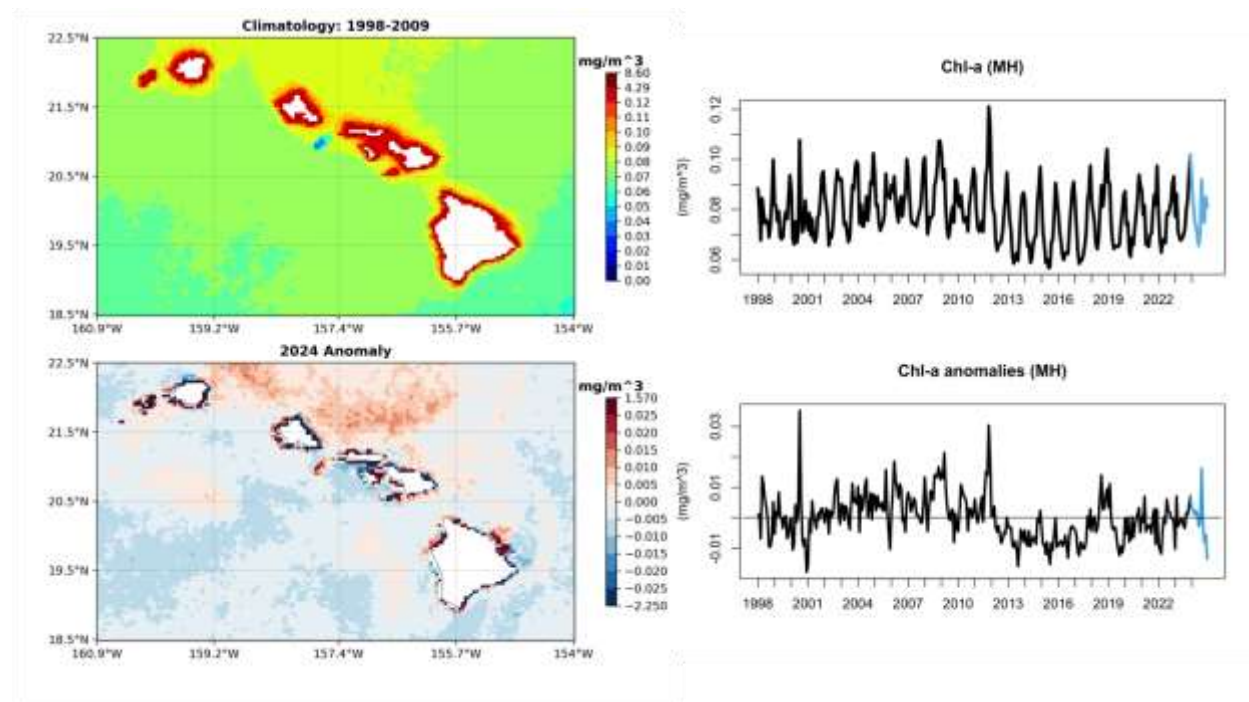


Figure 29. Chlorophyll-*a* and chlorophyll-*a* anomaly from 1998–2024

2.6.4.9 Rainfall

Rationale: Rainfall may have substantive effects on the nearshore environment and is a potentially important co-variate with the landings of particular stocks.

Description: The CPC Merged Analysis of Precipitation (CMAP) is a technique which produces pentad and monthly analyses of global precipitation in which observations from rain gauges are merged with precipitation estimates from several satellite-based algorithms, such as infrared and microwave (NOAA 2002). The analyses are on a 2.5 x 2.5-degree latitude/longitude grid and extend back to 1979. CMAP Precipitation data are provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their website at <https://www.esrl.noaa.gov/psd/>. The data are comparable (but should not be confused with) similarly combined analyses by the Global Precipitation Climatology Project described in Huffman et al. (1997).

It is important to note that the input data sources to make these analyses are not constant throughout the period of record. For example, SSM/I (passive microwave - scattering and emission) data became available in July 1987; prior to that the only microwave-derived estimates available are from the MSU algorithm (Spencer 1993) which is emission-based thus precipitation estimates are available only over oceanic areas. Furthermore, high temporal resolution IR data from geostationary satellites (every 3-hr) became available during 1986; prior to that, estimates from the OPI technique (Xie and Arkin 1997) are used based on OLR from orbiting satellites.

The merging technique is thoroughly described in Xie and Arkin (1997). Briefly, the methodology is a two-step process. First, the random error is reduced by linearly combining the satellite estimates using the maximum likelihood method, in which case the linear combination coefficients are inversely proportional to the square of the local random error of the individual data sources. Over global land areas the random error is defined for each time period and grid location by comparing the data source with the rain gauge analysis over the surrounding area. Over oceans, the random error is defined by comparing the data sources with the rain gauge observations over the Pacific atolls. Bias is reduced when the data sources are blended in the second step using the blending technique of Reynolds (1988).

Timeframe: Monthly.

Region/Location: Global.

Measurement Platform: *In-situ* station gauges and satellite data.

Sourced from: NOAA ESRL (2024).

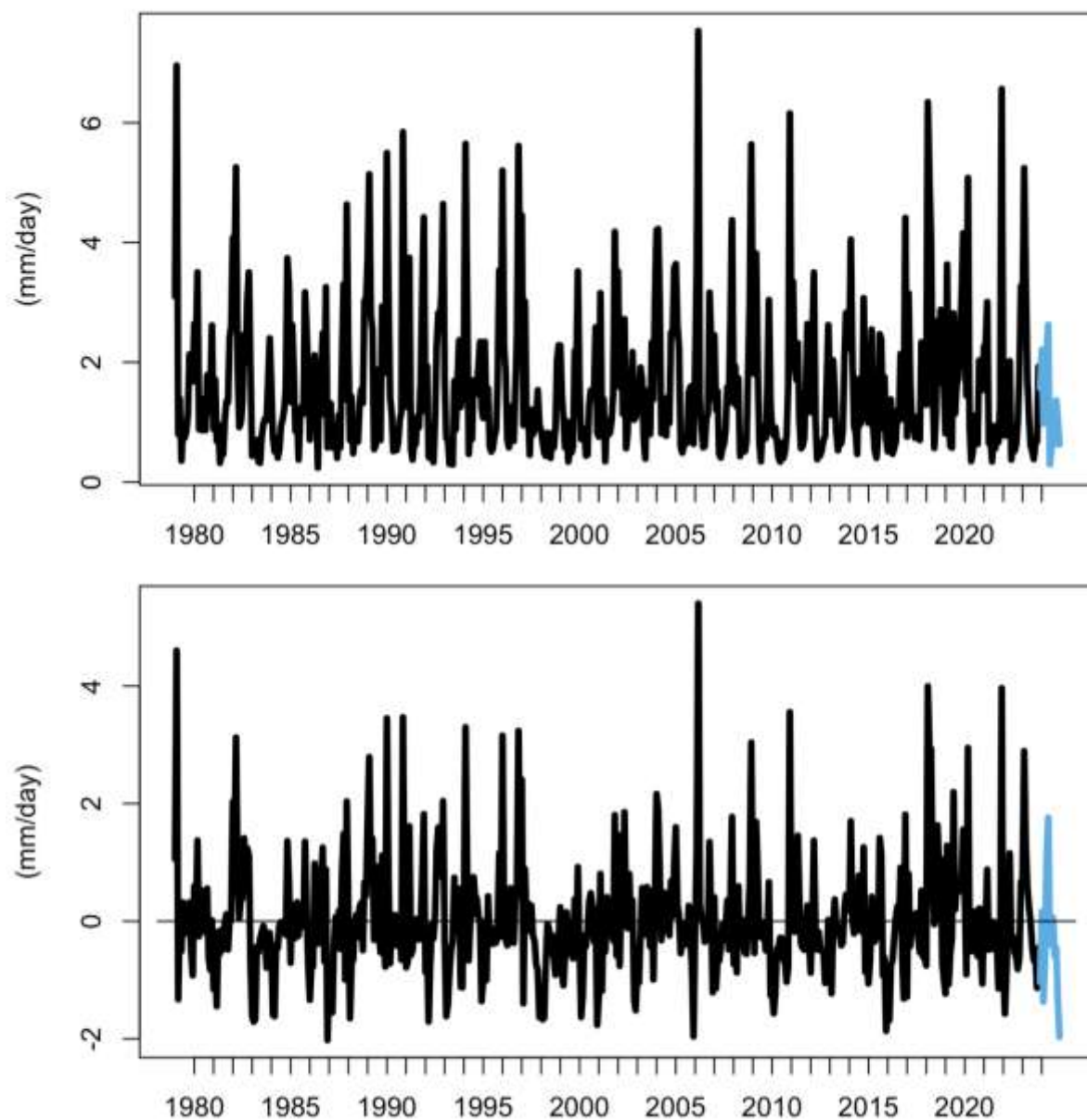


Figure 30. CMAP precipitation (top) and anomaly (bottom) across the MHI Grid with 2024 values in blue

2.6.4.10 Sea Level (Sea Surface Height and Anomaly)

Rationale: Coastal: Rising sea levels can result in a number of coastal impacts, including inundation of infrastructure, increased damage resulting from storm-driven waves and flooding, and saltwater intrusion into freshwater supplies.

Description: Monthly mean sea level time series of local and basin-wide sea surface height and sea surface height anomalies, including extremes.

Timeframe: Monthly.

Region/Location: Observations from selected sites within the Hawaiian Archipelago.

Measurement Platform: Satellite and *in situ* tide gauges.

Sourced from: Aviso (2024), NOAA CoastWatch (2024), and NOAA (2025d).

2.6.4.10.1 Basin-Wide Perspective

This image of the mean sea level anomaly for January 2024 compared to 1993-2020 climatology from satellite altimetry shows the peak of the 2024 El Niño conditions across the Pacific Basin. The image captures the fact that sea level is higher in the Eastern and Central Pacific and lower in the Western Pacific (this basin-wide perspective provides a context for the location-specific sea level/sea surface height images that follow).

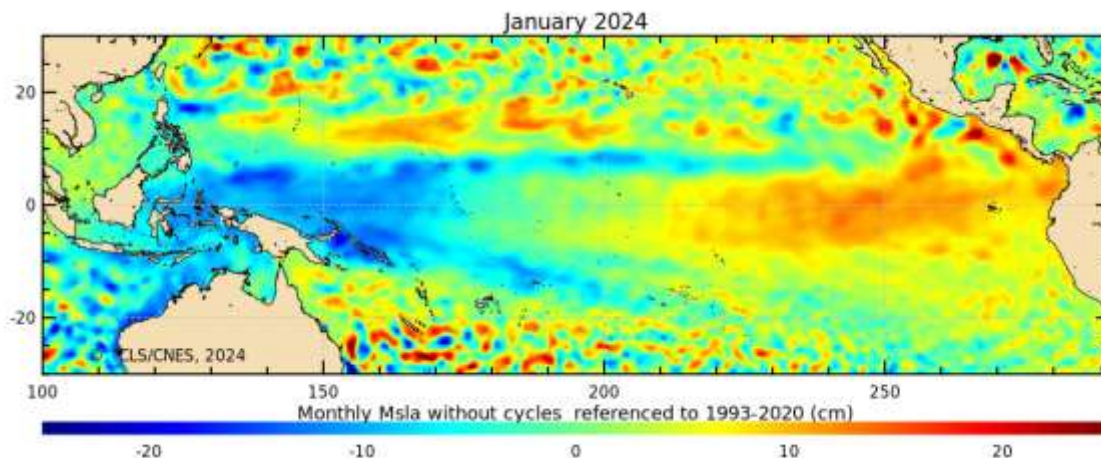


Figure 31a. Sea surface height anomaly

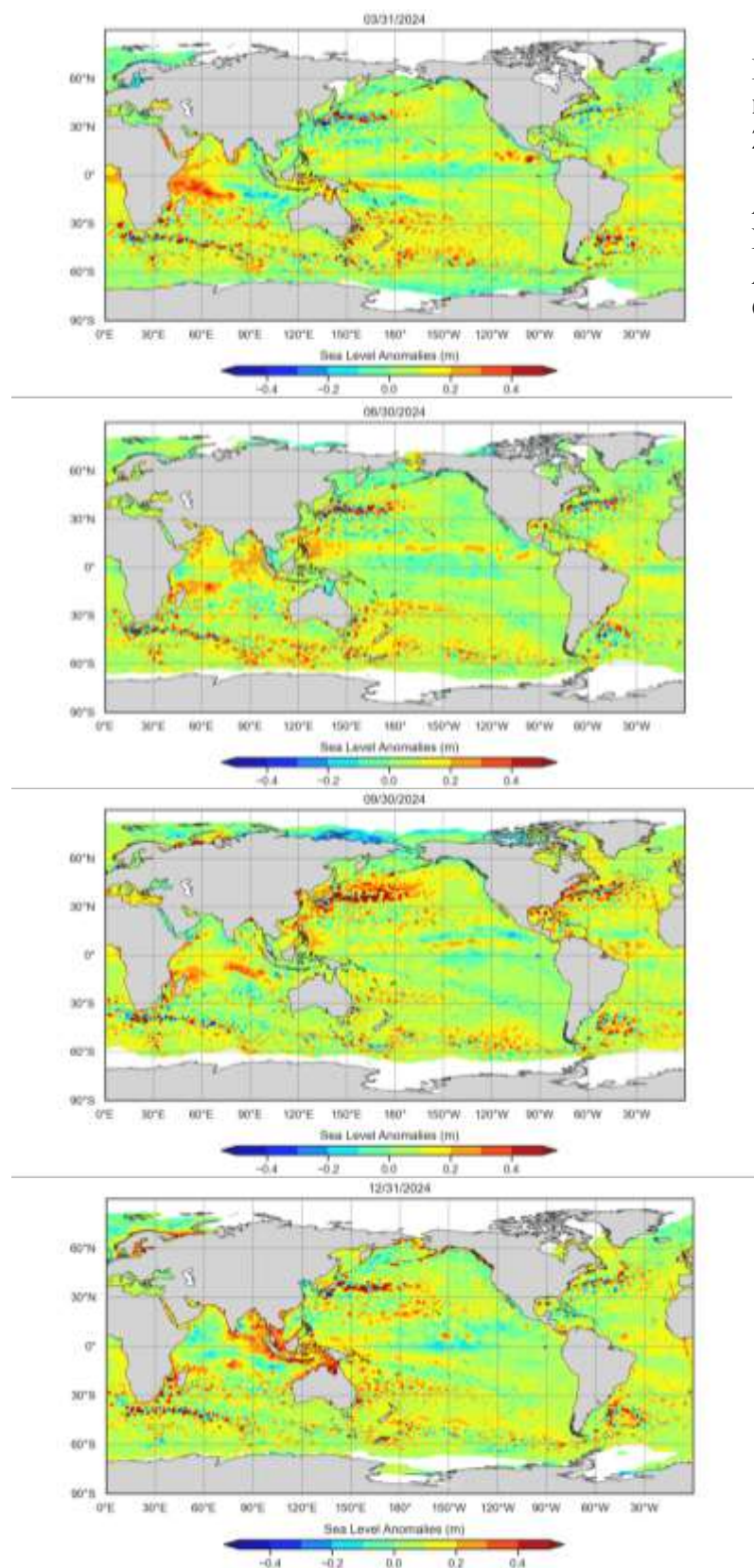


Figure 31b. Quarterly maps of mean sea level anomalies during 2024

Altimetry data are provided by the NOAA Laboratory for Satellite Altimetry, accessed from NOAA CoastWatch (2024).

2.6.4.10.2 Local Sea Level

These time-series from *in situ* tide gauges provide a perspective on sea level trends within each Archipelago (Tide Station Time Series from NOAA Center for Operational Oceanographic Products and Services, or CO-OPS).

The following figures and descriptive paragraphs were inserted from the NOAA Tides and Currents website. Figure 32 shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95% confidence interval. The plotted values are relative to the most recent [Mean Sea Level datum established by CO-OPS](#). The calculated trends for all stations are available as a table in millimeters/year and in feet/century. If present, solid vertical lines indicate times of any major earthquakes in the vicinity of the station and dashed vertical lines bracket any periods of questionable data or datum shift.

The relative sea level trend is 1.56 millimeters/year with a 95% confidence interval of ± 0.20 mm/yr based on monthly mean sea level data from 1905 to 2024, which is equivalent to a change of 0.51 feet in 100 years.

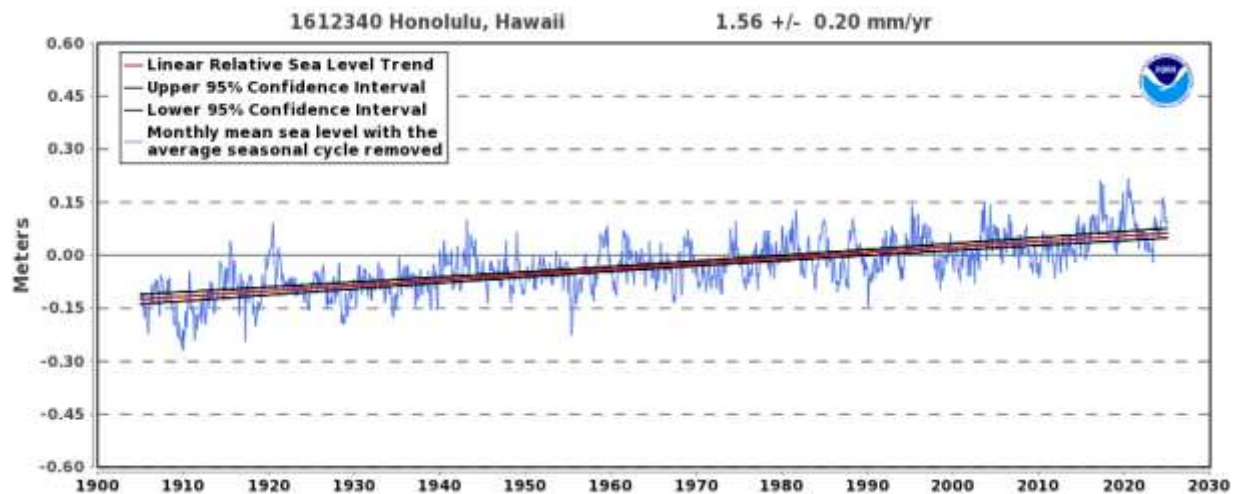


Figure 32. Monthly mean sea level without regular seasonal variability due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents

2.7 ESSENTIAL FISH HABITAT

2.7.1 Introduction

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) includes provisions concerning the identification and conservation of essential fish habitat (EFH) and, under the EFH final rule, habitat areas of particular concern (HAPC) (50 Code of Federal Regulations [CFR] 600.815). The MSA defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” HAPC are those areas of EFH identified pursuant to 50 CFR 600.815(a)(8), and meeting one or more of the following considerations: (1) ecological function provided by the habitat is important; (2) habitat is sensitive to human-induced environmental degradation; (3) development activities are, or will be, stressing the habitat type; or (4) the habitat type is rare.

NMFS and the regional fishery management councils must describe and identify EFH in fishery management plans (FMPs) or fishery ecosystem plans (FEPs), minimize to the extent practicable the adverse effects of fishing on EFH, and identify other actions to encourage the conservation and enhancement of EFH. Federal agencies that authorize, fund, or undertake actions that may adversely affect EFH must consult with NMFS, and NMFS must provide conservation recommendations to federal and State agencies regarding actions that would adversely affect EFH. Councils also have the authority to comment on federal or State agency actions that would adversely affect the habitat, including EFH, of managed species. Fishery management actions must be evaluated for impacts to all EFH and HAPC in the area of effect and not just the EFH and HAPC for the fishery to which the management action applies.

The EFH Final Rule strongly recommends regional fishery management councils and NMFS to conduct a review and revision of the EFH components of FMPs every five years (600.815(a)(10)). The Council's FEPs state that new EFH information should be reviewed, as necessary, during preparation of the annual reports by the Plan Teams. Additionally, the EFH Final Rule states "Councils should report on their review of EFH information as part of the annual Stock Assessment and Fishery Evaluation (SAFE) report prepared pursuant to §600.315(e)." The habitat portion of the annual SAFE report is designed to meet the FEP requirements and EFH Final Rule guidelines regarding EFH reviews.

National Standard 2 guidelines recommend that the SAFE report summarize the best scientific information available concerning the past, present, and possible future condition of EFH described by the FEPs.

2.7.1.1 EFH Information

The EFH components of FMPs include the description and identification of EFH, lists of prey species and locations for each managed species, and optionally, HAPC. Impact-oriented components of FMPs include federal fishing activities that may adversely affect EFH, non-federal fishing activities that may adversely affect EFH, non-fishing activities that may adversely affect EFH, conservation and enhancement recommendations, and a cumulative impacts analysis on EFH. The last two components include the research and information needs section, which feeds into the Council's Five-Year Research Priorities, and the EFH update procedure, which is described in the FEP but implemented in the annual SAFE report.

The Council has described EFH for five management unit species (MUS) under its management authority, some of which are no longer MUS: pelagic (PMUS), bottomfish (BMUS), crustaceans (CMUS), former coral reef ecosystem (CREMUS), and precious corals (PCMUS). The Hawaii FEP describes EFH for the BMUS, CMUS, and PCMUS.

EFH reviews of the biological components, including the description and identification of EFH, lists of prey species and locations, and HAPC, consist of three to four parts:

- Updated species descriptions, which can be found appended to the SAFE report. These can be used to directly update the FEP;
- Updated EFH levels of information tables, which can be found in this Section 2.7.4;
- Updated research and information needs, which can be found in Section 2.7.5. These can be used to directly update the FEP; and

- An analysis that distinguishes EFH from all potential habitats used by the species, which is the basis for an options paper for the Council. This part is developed if enough information exists to refine EFH.

2.7.1.2 Habitat Objectives of FEP

The habitat objective of the FEP is to refine EFH and minimize impacts to EFH, with the following sub-objectives:

- Review EFH and HAPC designations every five years based on the best available scientific information and update such designations based on the best available scientific information, when available; and
- 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 marine environment.

The annual report has reviewed the precious coral EFH components, crustacean EFH components, and non-fishing impacts components, resetting the five-year timeline for review. The Council's support of non-fishing activities research is monitored through the program plan and five-year research priorities, not the annual report.

2.7.1.3 Response to Previous Council Recommendations

At its 198th meeting in March 2024, the Council received updates related to habitat management, including NMFS's ongoing efforts to revise ESA-designated critical habitat for listed coral species in the Western Pacific. Although distinct from EFH under the Magnuson-Stevens Act, these designations raised concerns among territorial representatives about potential impacts on access, development, and local fisheries. NMFS noted that public comments, including those from territorial governors, would be addressed in the final rule. The Council also heard from PIFSC about the January 2024 Uku Ecosystem-Based Fishery Management Data Summit, which focused on integrating new ecological data and modeling tools to inform future stock assessments and potential EFH updates. These efforts reflect the Council's continued commitment to refining EFH using best scientific information available while balancing regional management priorities and community needs.

At its 199th meeting in June 2024, the Council did not adopt any new revisions specific to essential fish habitat. Instead, it focused on broader fisheries management issues—such as finalizing the Terms of Reference for the Uku Update Stock Assessment, advancing sanctuary proposals, and enhancing enforcement measures—while reaffirming its commitment to incorporating updated scientific data in future habitat management decisions to ensure that any subsequent EFH updates reflect the best available science and support local fishing communities.

At its 200th meeting in 2024, Marlowe explained on page 11 that NMFS and PIRO will not only prepare NEPA compliance documents but also conduct consultations on essential fish habitat (EFH) and protected resources to ensure that environmental impacts—especially those associated with offshore wind leases—are appropriately characterized and mitigated. This discussion, found in the second paragraph of page 11, underscores the Council's commitment to integrating updated EFH considerations into broader resource management and regulatory processes,

ensuring that the best available science is applied while balancing development and conservation priorities

2.7.2 Habitat Use by MUS and Trends in Habitat Condition

The Main Hawaiian Islands (MHI) are part of the Hawaiian Archipelago, an isolated island chain in the central North Pacific Ocean extending approximately 1,500 miles northwest from Hawai‘i Island to Kure Atoll. The MHI include the larger, mountainous high islands of Hawai‘i, Maui, Lāna‘i, Moloka‘i, Kaho‘olawe, O‘ahu, Kaua‘i, and Ni‘ihau. These islands are geologically younger than the low-lying Northwestern Hawaiian Islands (NWHI), having formed as the Pacific Plate moved over a volcanic hotspot. Hawai‘i Island, the youngest, is approximately 400,000 years old, while Kure Atoll is estimated at 28 million years old. The highest point in the archipelago is Mauna Kea at 13,800 feet.

The MHI experience a tropical climate with significant variation due to elevation and wind exposure. Easterly trade winds bring most rainfall to windward coasts, while leeward areas tend to be drier. Coral reef habitats are more extensive in the MHI than in the NWHI, largely due to their younger geological age and greater availability of fringing reef structure. Although the islands rise steeply from the deep ocean, some areas—such as Penguin Bank between O‘ahu and Moloka‘i—provide relatively shallow habitat for demersal species.

Essential Fish Habitat (EFH) for managed unit species (MUS) in the MHI includes all bottom substrate from the shoreline to the 700 m isobath (Tanaka 2022). The water column is also designated as EFH from the shoreline to the 700 m isobath, and from the 700 m isobath to the outer boundary of the U.S. Exclusive Economic Zone (EEZ), EFH includes the water column to a depth of 400 m.

The coral reef ecosystems in the MHI have been subject to long-term monitoring through NOAA’s Pacific Islands Fisheries Science Center (PIFSC). Beginning in 2002, biennial surveys were conducted by the Coral Reef Ecosystem Division (CRED), later transitioned to the Coral Reef Ecosystem Program (CREP), and now under the Archipelagic Research Program (ARP) within the Ecosystem Sciences Division. In 2024, a new National Coral Reef Monitoring Program (NCRMP) survey was conducted in the MHI, providing updated data on reef fish communities, including abundance data for uku (*Aprion virescens*), a key managed bottomfish species. This new data stream contributes to ongoing EFH assessments by enhancing our knowledge of uku population trends and reef-associated habitat use in shallow waters (0–30 m).

These recent data complement earlier EFH modeling work conducted by PIFSC in 2021, which developed statistical species distribution models (SDMs) using uku survey data from 2010–2019 (Tanaka 2022). These models analyzed spatiotemporal patterns in abundance and distribution using generalized linear mixed models that accounted for spatial autocorrelation and environmental covariates. The study found that uku density shifts were driven more by a combination of static (e.g., depth) and dynamic (e.g., surface wind variability) oceanographic variables, while chlorophyll-a and SST were less informative. High variability in the geographic center of gravity of uku was observed, particularly around O‘ahu and Moloka‘i, with localized density changes around Maui and Hawai‘i Island. These results demonstrated the importance of using spatiotemporal modeling to understand the behavior of highly mobile species and guide EFH refinement.

In parallel, the Council supported a separate modeling effort by Franklin (2021) that used fishery-independent data and boosted regression tree SDMs to define EFH for sub-adult and adult uku. Separate models were built for shallow (0–30 m) and deep (30–300 m) habitats using diver survey data and stereo-video camera arrays, respectively. Slope orientation, depth, and wave height were strong predictors in shallow models, while depth was dominant in deeper waters. Maps produced from this work delineated areas of “basic EFH,” “hot spots,” and “core EFH,” with “core EFH” representing the most critical habitat. These model results underwent formal review at a WPSAR Panel meeting held July 12–14, 2022 and were accepted as the best scientific information available (BSIA) with some caveats.

Together, the addition of 2024 NCRMP field data and earlier modeling efforts significantly enhance the EFH knowledge base for uku in the MHI. These resources will support improved spatial planning, stock assessments, and habitat-based management under the Hawai‘i Fishery Ecosystem Plan (FEP).

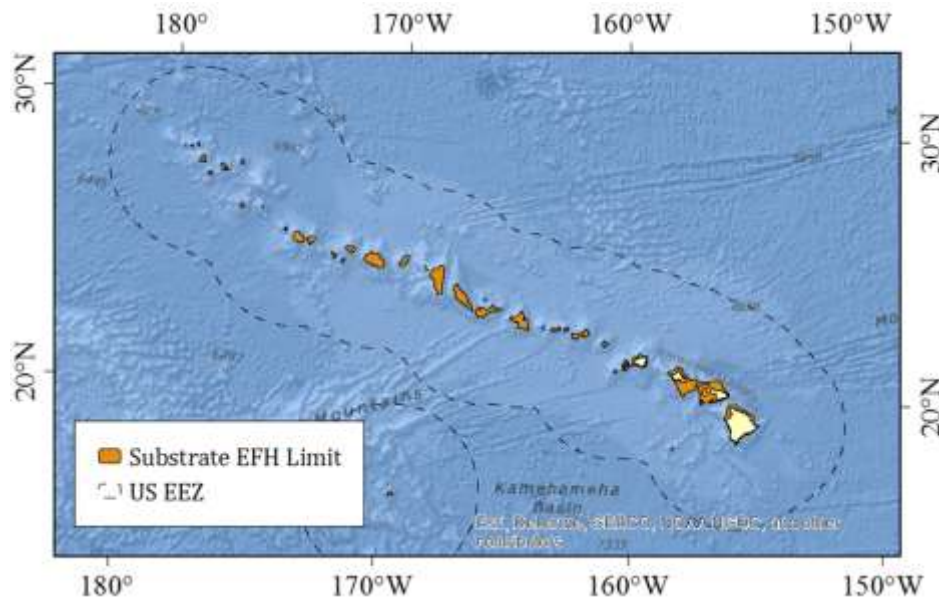


Figure 33. Substrate EFH limit of 700 m isobath around the Hawaiian Archipelago (from GMRT; Ryan et al. 2009)

2.7.2.1 Habitat Mapping

No new habitat mapping was conducted in 2024.

2.7.2.2 Benthic Habitat

EFH for juvenile and adult life stages of Kona crab extends from the shoreline to the 100 m isobath (64 FR 19067, April 19, 1999). All benthic habitat is considered EFH for crustacean species (64 FR 19067, April 19, 1999). Juvenile and adult bottomfish EFH extends from the shoreline to the 400 m isobath (64 FR 19067, April 19, 1999), and juvenile and adult deepwater shrimp habitat extends from the 300 m isobath to the 700 m isobath (73 FR 70603, November 21, 2008).

2.7.2.2.1 NCRMP Indicators

Benthic percent cover of coral, macroalgae, and crustose coralline algae are surveyed as part of NOAA's National Coral Reef Monitoring Program (NCRMP), led by the PIFSC Ecosystem Sciences Division (ESD). A comprehensive NCRMP survey was successfully carried out in the Main Hawaiian Islands (MHI) in 2024 by the Archipelagic Research Program (ARP), generating a new stream of EFH-relevant data for the region (see Section 2.2). This survey employed randomized, fishery-independent reef fish sampling in shallow waters from 0–30 m depth, collecting updated information on reef fish community structure and benthic habitat condition—key indicators for supporting future Essential Fish Habitat (EFH) assessments. NMFS continues to anticipate a future NCRMP survey in the Northwestern Hawaiian Islands (NWHI), pending planning and resource availability.

2.7.2.3 Oceanography, Water Quality, and Other Environmental Data

For larval stages of all species except deepwater shrimp, the water column is considered EFH from the shoreline to the EEZ. Crustacean species have egg and larval EFH designated to a depth of 150 m, and bottomfish to a depth of 400 m. Please refer to the Climate and Oceanic Indicator section (Section 2.6) for additional information on oceanography and water quality. While no substantial field-based oceanographic research was conducted in 2024, satellite and buoy data continued to be collected and archived. The PIFSC Ecosystem Sciences Division maintains the Environmental Data Summary (EDS), an advanced data integration tool developed in R, which enables users to supplement in situ biological observations with external gridded environmental data. The EDS interfaces with NOAA CoastWatch and OceanWatch datasets through the ERDDAP server protocol, allowing users to download, filter, and extract large volumes of spatial and temporal data based on user-defined parameters. In 2024, the EDS was updated to include the latest satellite-derived datasets, further improving its utility for EFH-related research and environmental assessments. The environmental data summarized at individual survey sites aid scientists in understanding how oceanographic variability influences habitat use by managed species. Originally summarized for the National Coral Reef Monitoring Program (NCRMP) Rapid Ecological Assessment (REA) sites from 2000 to 2020 across 57 islands, the EDS was expanded in 2024 to support finer-scale spatiotemporal analysis and integration of additional data types—including wave and wind fields, remote sensing imagery, modeled oceanographic variables (e.g., from Regional Ocean Modeling Systems), and socioeconomic data such as human density. These enhancements strengthen the EDS as a key tool in ongoing EFH reviews and climate-informed habitat assessments.

2.7.3 Report on Review of EFH Information

There were no EFH reviews for Hawaii completed in 2024.

2.7.4 EFH Levels

NMFS guidelines codified at 50 C.F.R. § 600.815 recommend Councils organize data used to describe and identify EFH into the following four levels:

- Level 1: Distribution data are available for some or all portions of the geographic range of the species.
- Level 2: Habitat-related densities of the species are available.
- Level 3: Growth, reproduction, or survival rates within habitats are available.
- Level 4: Production rates by habitat are available.

The Council adopted a fifth level, denoted Level 0, for situations in which there is no information available about the geographic extent of a particular managed species' life stage. The existing level of data for individual MUS in each fishery are presented in tables per fishery.

The Hawaii Undersea Research Laboratory (HURL) is a center operating under the School of Ocean and Earth Sciences and Technology (SOEST) at the University of Hawai'i (UH) and NOAA's Office of Ocean Exploration and Research. The unique deep-sea research operation runs the Pisces IV and V manned submersibles and remotely operated vehicles (ROVs) for investigating the undersea environment through hypothesis driven projects that address gaps in knowledge or scientific needs. HURL maintains a comprehensive video database, which includes biological and substrate data extracted from their dive video archives. Submersible and ROV data are collected from depths deeper than 40 m. Observations from the HURL video archives are considered Level 1 EFH information for deeper bottomfish and precious coral species which exist in the database though cannot be considered to observe absence of species. Survey effort is low compared to the range of species observed.

2.7.4.1 Precious Corals

No new data relevant to precious coral EFH were collected in 2024, but the Council is currently in the process of defining new EFH for precious coral MUS (see Section 2.7.1.3). EFH for precious corals was originally designated in Amendment 4 to the Precious Corals FMP (64 FR 19067, April 19, 1999), using the level of data found in Table 67.

Table 67. Level of EFH available for Hawaii precious corals MUS

Species	Pelagic Phase (Larval Stage)	Benthic Phase	Source(s)
Pink Coral (<i>Corallium</i>)			
<i>Pleurocorallium secundum</i> (prev. <i>Corallium secundum</i>)	0	1	Figueroa and Baco (2014); HURL Database
<i>Hemicorallium laauense</i> (prev. <i>C. laauense</i>)	0	1	HURL Database
Gold Coral			
<i>Kulamanamana haumea</i> (prev. <i>Gerardia</i> spp.)	0	1	Sinniger et al. (2013); HURL Database

Species	Pelagic Phase (Larval Stage)	Benthic Phase	Source(s)
Bamboo Coral			
<i>Acanella</i> spp.	0	1	HURL Database
Black Coral			
<i>Antipathes griggi</i> (prev. <i>Antipathes dichotoma</i>)	0	1	Opresko (2009); HURL Database
<i>A. grandis</i>	0	1	HURL Database
<i>Myriopathes ulex</i> (prev. <i>A. ulex</i>)	0	1	Opresko (2009); HURL Database

2.7.4.2 Bottomfish and Seamount Groundfish

New data relevant to bottomfish EFH were collected in 2024 through the continued implementation of the Bottomfish Fishery-Independent Survey in Hawai‘i (BFISH), which included species-specific abundance and environmental data across 750 survey grids (Richards et al. 2016). These data are expected to support refinement of Deep-7 bottomfish EFH through habitat-use models and improved spatial resolution. Previously, in 2023, no new EFH-specific analyses were completed; however, the Council and its Scientific and Statistical Committee (SSC) reviewed and endorsed updated EFH models for uku (*Aprion virescens*), a key bottomfish species. Based on these outputs, the Council recommended revising uku EFH in the Hawai‘i Fishery Ecosystem Plan (FEP). EFH for bottomfish and seamount groundfish was originally designated in Amendment 6 to the Bottomfish and Seamount Groundfish FMP (64 FR 19067, April 19, 1999). The levels of information presented in Table 68 have not changed since the most recent formal review. However, recent and ongoing data collection from BFISH and other survey efforts are likely to improve EFH definitions in future amendments. To analyze the potential effects of a proposed fishery management action on EFH, one must consider all designated EFH, although research examining depth and habitat requirements for many species remains limited. Prior observational studies using baited cameras in the MHI (limited to 300 m depth) found that *Etelis* spp. are more abundant at depths of 210–300 m, while *Pristipomoides* spp. are more abundant between 90–270 m (Merritt et al. 2011; Misa 2012). PIFSC (2021) also concluded that *Lethrinidae* spp. tend to occupy shallower depths than *Pristipomoides*, which in turn are shallower than *Etelis*, though overlap exists between these groups. New data from the 2024 BFISH effort will be evaluated for its potential to refine these depth-based distributions and inform habitat-specific abundance modeling in future EFH updates.

Table 68. Level of EFH information available for Hawaii bottomfish and seamount groundfish MUS

Life History Stage	Eggs	Larvae	Juvenile	Adult
<i>Aphareus rutilans</i> (red snapper/silvermouth)	0	0	0	1
<i>Aprion virescens</i> (gray snapper/jobfish)	0	0	1	1-2
<i>Epinephelus quernus</i> (sea bass)	0	0	1	1
<i>Etelis carbunculus</i> (red snapper)	0	0	1	1
<i>E. coruscans</i> (red snapper)	0	0	1	1
<i>Pristipomoides filamentosus</i> (pink snapper)	0	0	1	1
<i>P. sieboldii</i> (pink snapper)	0	0	1	1
<i>P. zonatus</i> (snapper)	0	0	0	1

Life History Stage	Eggs	Larvae	Juvenile	Adult
<i>Beryx splendens</i> (alfonsin)	0	1	2	2
<i>Hyperoglyphe japonica</i> (ratfish/butterfish)	0	0	0	1
<i>Pseudopentaceros richardsoni</i> (armorhead)	0	1	1	3

2.7.4.3 Crustaceans

No new data relevant to crustacean EFH were collected in 2024. EFH for crustaceans was originally designated in Amendment 10 to the Crustaceans FMP (64 FR 19067, April 19, 1999). EFH definitions were also approved for deepwater shrimp through an amendment to the Crustaceans FMP in 2008 (73 FR 70603, November 21, 2008).

Table 69. Level of EFH information available for Hawaii Kona crab

Life History Stage	Eggs	Larvae	Juvenile	Adult
Kona crab (<i>Ranina ranina</i>)	1	0	1	1-2

Table 70. EFH and HAPC for Hawaii MUS

MUS	Species Complex	EFH	HAPC
Bottomfish and Seamount Groundfish	Shallow-water species (0–50 fm): uku (<i>Aprion virescens</i>)	<p>Eggs and larvae: the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 240 m.</p> <p>Juvenile/adults: the water column and all bottom habitat extending from the shoreline to a depth of 240 m. The EFH for subadult and adult stages is now derived from model-based presence-absence (EFH level 1) and abundance (level 2) data, as per Franklin (2021) and Tanaka et al. (2022). For depths of 0-30 m, EFH is based on Tanaka's EFH level 2 model output, while for depths of 30-240 m, it is based on Franklin's EFH model output.</p>	<p>Ka'ena Point</p> <p>Kane'ohe</p> <p>Makapu'u Point</p> <p>Penguin Bank</p> <p>Pailolo Channel</p> <p>North Kaho'olawe</p> <p>Hilo</p>

MUS	Species Complex	EFH	HAPC
	Deep-water species (50–200 fm): ehu (<i>Etelis carbunculus</i>), onaga (<i>E. coruscans</i>), ‘ōpakapaka (<i>Pristipomoides filamentosus</i>), kalekale (<i>P. sieboldii</i>), gindai (<i>P. zonatus</i>), hapu‘upu‘u (<i>Epinephelus quernus</i>), lehi (<i>Aphareus rutilans</i>)	Eggs and larvae: the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 280–400 m depending on species. Juvenile/adults: the water column and all bottom habitat extending from the shoreline to a depth of 400 meters (200 fm).	
	Seamount groundfish species (50–200 fm): armorhead (<i>Pentaceros wheeleri</i>), ratfish/butterfish (<i>Hyperoglyphe japonica</i>), alfonsin (<i>Beryx splendens</i>)	Eggs and larvae: the (epipelagic zone) water column down to a depth of 600 m in waters within the EEZ west of 180° W and north of 28° N. Juvenile/adults: all EEZ waters and bottom habitat between 120 and 600 m in waters within the EEZ west of 180° W and north of 28° N.	Depths between 0 and 600 encompassing the Hancock Seamount summits and slopes. Post-settlement and sub-adult/adult HAPC depth ranges between 120 and 600 m.
Crustaceans	Kona crab (<i>Ranina ranina</i>)	Eggs and larvae: the water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m (75 fm). Juvenile/adults: all of the bottom habitat from the shoreline to a depth of 100 m (50 fm).	All banks in the NWHI with summits less than or equal to 30 m (15 fathoms) from the surface.

MUS	Species Complex	EFH	HAPC
	Deepwater shrimp (<i>Heterocarpus</i> spp.)	<p>Eggs and larvae: the water column and associated outer reef slopes between 550 and 700 m.</p> <p>Juvenile/adults: the outer reef slopes at depths between 300-700 m.</p>	No HAPC designated for deepwater shrimp.
Precious Corals	<p>Deep-water precious corals (150–750 fm): Pink coral (<i>Pleurocorallium secundum</i>), red coral (<i>Hemicorallium laauense</i>), gold coral (<i>Kulamanamana haumea</i>), bamboo coral (<i>Acanella</i> spp.)</p> <p>Shallow-water precious corals (10-50 fm): Black coral (<i>Antipathes griggi</i>), black coral (<i>Antipathes grandis</i>), black coral (<i>Myriopathes ulex</i>)</p>	<p>EFH for precious corals is confined to six known precious coral beds located off Keāhole Point, Makapu‘u, Ka‘ena Point, Wespac bed, Brooks Bank, and 180 Fathom Bank.</p> <p>EFH has also been designated for three beds known for black corals in the MHI between Milolii and South Point on the Big Island, the ‘Au‘au Channel, and the southern border of Kauai.</p>	<p>Includes the Makapu‘u bed, Wespac bed, Brooks Banks bed.</p> <p>For black corals, the ‘Au‘au Channel has been identified as HAPC.</p>

Source: WPRFMC (2009) and WPRFMC (2018).

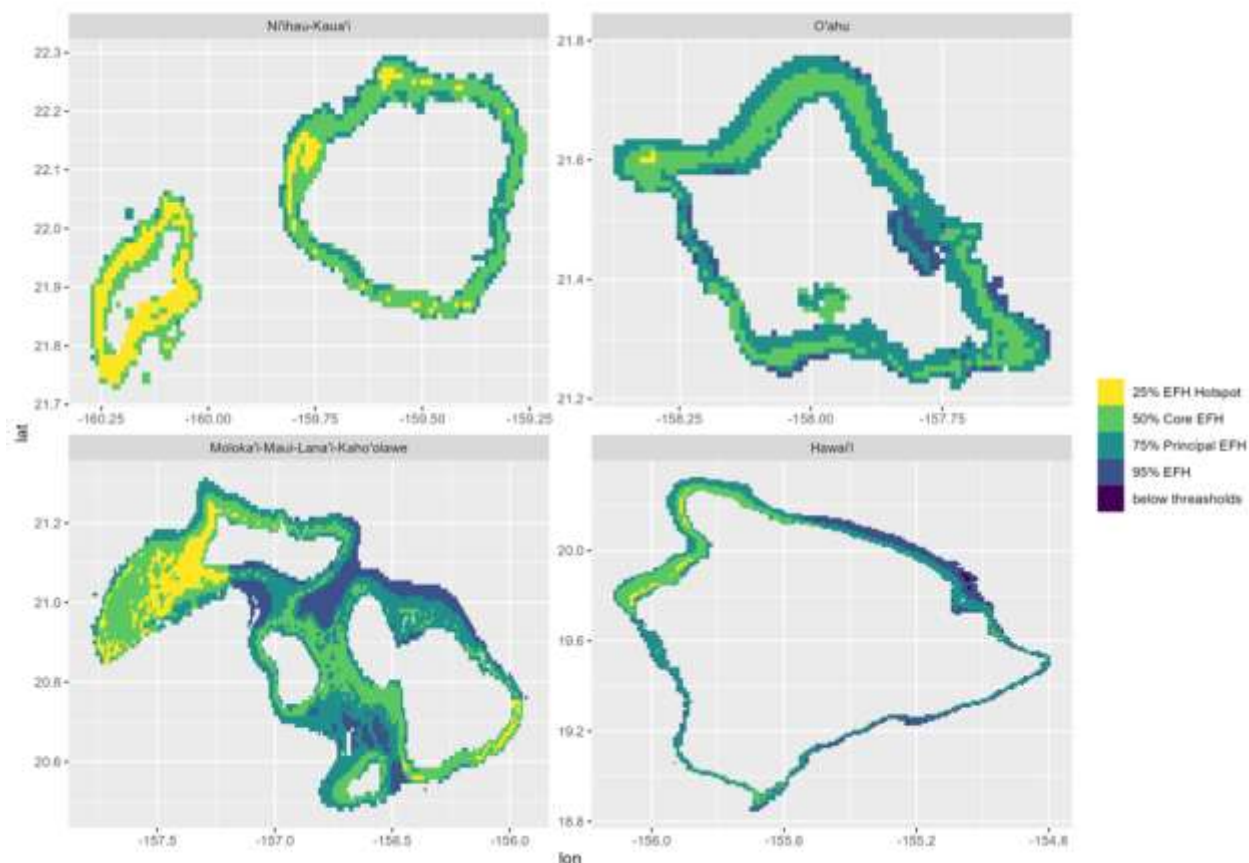


Figure 34. Spatial classification of Essential Fish Habitat (EFH) for uku (*Aprion virescens*) in the Main Hawaiian Islands based on habitat suitability percentiles. Values represent the averaged predictions from two independent habitat models developed by Franklin (2021) and Tanaka et al. (2022). The map shows relative EFH importance: 25% EFH Hotspot (yellow), 50% Core EFH (green), 75% Principal EFH (blue-green), and 95% EFH (dark blue). Areas shown in purple fall below EFH thresholds. This integrated map supports refinement of EFH designations using multiple best scientific information available (BSIA) sources.

2.7.5 Ongoing Projects

2.7.5.1 Enhancing reef resilience through process investigations

This project is a set of process investigations focused on revealing differential resilience to habitat stressors by describing interacting trends in coral populations, reef structure, and their ecological and physical forcing. In 2020, this project included improving quality control and access to environmental data collected by the coral program over the last 20 years, and in future years will examine reef-scale coral cover change, drivers of juvenile coral density, drivers of change in reef structure, drivers of complexity, carbonate budgets, and *in-situ* temperatures relative to benthic changes. Efforts are beginning to link habitat structural complexity/rugosity (quantified from Structure-from-Motion models across the MHI) to fish composition and abundance. This work is ongoing (POC; Thomas Oliver; thomas.oliver@noaa.gov).

2.7.5.2 Assessing impacts of Hawaii's 2019 coral bleaching event on coral recovery

Research is being conducted to identify which reefs and coral taxa in Hawaii are especially resilient to bleaching and what the potential long term impacts of bleaching are at the colony and reef-level by identifying resilient coral communities following multiple bleaching events, automating bleaching quantification, and tracking colonies over time to investigate growth and mortality in years prior, during, and following bleaching. This work is ongoing.

2.7.5.3 Understanding importance of nearshore habitats for MUS

The primary goal of this research is to refine the understanding of how inshore habitats, including coral reefs, contribute to the productivity of MUS fisheries and/or ESA listed species, focusing particularly on those MUS that are primarily caught in federal waters and certain key coral reef fishes that are classified as ECS. The quantitative information linking offshore and nearshore habitats can be applied to the Council's efforts to refine existing BMUS designations. Most of these nearshore and laboratory research efforts are designed to bridge a key life history stage data gap, and feed into an essential fish habitat modeling effort described later.

Another project is assessing larval uku (*Aprion virescens*) habitat use in nearshore and offshore of Hawaii. Uku is the only shallow bottomfish stock in Hawaii within the BMUS complex. EFH for uku is currently broadly designated from the shoreline to offshore down to 240 meters deep, and more information is needed on connectivity from offshore to nearshore to refine EFH designations. This study will assess uku habitat and prey base utilization in nearshore and offshore ecosystems. This effort will include lab work for processing (i.e., sorting, identifying, and measuring) larval uku from a backlog of existing wet-archived ichthyoplankton samples from nearshore and offshore ecosystems along Oahu and Hawaii Island. Through this work, PIFSC plans to quantify the connectivity of uku from offshore to nearshore, including the presence/absence of larval uku in the nearshore coral reef ecosystem, to assist with potential future habitat models and refining Hawaii EFH and HAPC. Though hampered by the COVID restrictions, this work has continued and a technical memorandum should be finalized in 2025.

Another project in 2025 is to explore a series of potential sampling methods to target juvenile uku in nearshore habitats. This project leverages results of a previous EFH Refine funded desktop review of the early life history of uku. That review found fewer than 300 larval and pelagic juvenile uku (3-30 mm) were collected in the Main Hawaiian Islands between 1967 and 2012. Furthermore, the review revealed that juvenile uku between 3-9 cm in length (~30-90 days old) have yet to be recorded anywhere in the Pacific. We concluded that the nearshore waters have been insufficiently sampled to model or predict uku presence at this early life stage. As an initial investigation, the focus will be on areas in or near a harbor with proximity to a deep sand channel. EFH consultations are most common in harbors and nearshore environments, making it an important target habitat, while the focus on sand channels is based on information gathered during the aforementioned larval uku study. Light traps and sabiki fishing rigs will be tested.

2.7.5.4 Predicting the impacts of climate change on 'opelu koas

Koas are temporally and spatially ephemeral habitats for 'opelu (*Decapterus macarellus*), also known as the mackerel scad. The 'opelu koa work will explore the environmental factors that characterize these aggregation sites, as well as what drives CPUE, abundance, and catchability. 'Opelu are important forage species in the coastal pelagic ecosystem and are an important fishery in Hawaii. To further investigate what factors may drive changes in catch, compilation of

remotely sensed and modeled data products, small-boat field surveys, and interviews will be conducted with ‘opelu fishermen since there is a long history of ‘opelu fishing in Hawaii. Information from the fishermen interviews assist in parameterizing planned field work. Koas serve as an important subset of the overall pelagic habitat for ‘opelu, and this work will further the understanding of the definition, function, and criticalities of these small areas for this species. This work was interrupted by the COVID-19 pandemic but is ongoing.

2.7.5.5 Bottomfish fishery independent surveys (BFISH)

Annual bottomfish surveys were successfully conducted in both 2023 and 2024 as part of the BFISH program, which provides species-specific abundance information for key Deep-7 bottomfish species throughout the Main Hawaiian Islands (MHI). The surveys also collect important habitat-related data such as depth, temperature, and seafloor type, contributing to Essential Fish Habitat (EFH) assessments. In 2021, the BFISH survey design was expanded from 500 to 750 survey grids to evaluate optimal sampling intensity in relation to specific precision targets. Detailed temperature and depth sampling were also expanded by equipping both camera gear and hook-and-line sampling gear with temperature/depth recorders. In 2023, the survey successfully sampled 375 fishing grids and 125 camera grids. In 2024, survey operations continued with comparable spatial coverage and enhanced integration of environmental data collection, supporting continued refinement of Deep-7 EFH. These datasets can be applied using spatial modeling methods previously outlined by Oyafuso (2017) and Moore (2013) to inform the distribution and habitat preferences of Deep-7 species. This work is critical for updating EFH designations and improving the spatial resolution of habitat-use predictions in bottomfish management. Ongoing monitoring updates, including quarterly summaries, are available in reports such as Richards (2022) and subsequent annual releases.

2.7.5.6 Sampling juvenile uku nearshore

A project initiated in 2023 is exploring a range of potential methods to effectively sample juvenile uku in nearshore habitats (Schmidt et al. 2023). This work builds on findings from a prior EFH Refine-funded desktop review of uku early life history, which identified a major data gap: fewer than 300 larval and pelagic juvenile uku (3–30 mm) had been collected in the MHI between 1967 and 2012, and no records existed for juvenile uku in the 3–9 cm range (~30–90 days old) anywhere in the Pacific. PIFSC scientists concluded that nearshore waters have been insufficiently sampled to adequately model or predict juvenile uku presence.

As an initial step, the current project is focused on areas in or near harbors with deep sand channels, where EFH consultations are frequently concentrated. Light traps and sabiki rigs are being tested in these environments based on guidance from the earlier desktop review and hypotheses regarding juvenile habitat preferences.

Complementing these efforts, PIFSC's Ecosystem Sciences Division significantly expanded its ichthyoplankton sampling across the region in 2023–2024 to better understand the distribution, habitat, and early life stages of managed species like uku. Using a 6' IKMT net system deployed during nighttime hours aboard the NOAA Ship Oscar Elton Sette, scientists collected 88 ichthyoplankton tows across the Hawaiian EEZ during the 2023 Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS), from west of Hōlanikū (Kure Atoll) to South Point, Hawai‘i Island. In spring 2024, 24 additional tows were completed around Maui Nui on the BFISH R&D cruise, followed by 70 more tows across the Papahānaumokuākea Marine National

Monument during the NCRMP summer survey. These large-scale sampling efforts align with the spawning periods for uku and other BMUS and PMUS (e.g., marlins, tunas, ono, deep-7 snappers), and provide valuable insights into larval distribution, early-stage habitat use, and inter-island connectivity—critical inputs for refining EFH definitions and informing future stock assessment models.

2.7.6 Research and Information Needs

Based, in part, on the information provided in the tables above the Council identified the following scientific data which are needed to more effectively address the EFH provisions:

2.7.6.1 All FMP Fisheries

- Distribution of early life history stages (eggs and larvae) of MUS by habitat.
- Juvenile habitat (including physical, chemical, and biological features that determine suitable juvenile habitat).
- Food habits (feeding depth, major prey species etc.).
- Habitat-related densities for all MUS life history stages.
- Growth, reproduction, and survival rates for MUS within habitats.

2.7.6.2 Bottomfish Fishery

- Inventory of marine habitats in the EEZ of the Western Pacific region.
- Data to obtain a better SPR estimate for American Samoa's bottomfish complex.
- Baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/NMI deep-water and shallow water bottomfish complexes.
- High resolution maps of bottom topography/currents/water masses/primary productivity.
- Habitat utilization patterns for different life history stages and species.

2.7.6.3 Crustaceans Fishery

- Identification of post-larval settlement habitat of all CMUS.
- Identification of "source/sink" relationships in the NWHI and other regions (i.e., relationships between spawning sites settlement using circulation models, genetic techniques, etc.).
- Establish baseline parameters (CPUE) for the Guam/Northern Marinas crustacean populations.
- Research to determine habitat related densities for all CMUS life history stages in American Samoa, Guam, Hawaii, and CNMI.
- High resolution mapping of bottom topography, bathymetry, currents, substrate types, algal beds, and habitat relief.

2.7.6.4 Precious Coral Fishery

- Statistically sound estimates of distribution, abundance, and condition of precious corals throughout the MHI. Targeted surveys of areas that meet the depth and hardness criteria could provide very accurate estimates.

- Environmental conditions necessary for precious coral settlement, growth, and reproduction. The same surveys used for abundance and distribution could collect these data as well.
- Quantitative measures of growth and productivity.
- Taxonomic investigations to ascertain if the *H. laauense* that is commonly observed between 200- and 600-meters depth is the same species as those *H. laauense* observed below 1,000 meters in depth.
- Continuous backscatter or LIDAR data in depths shallower than 60 m.

2.8 MARINE PLANNING

2.8.1 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. Efforts by the Western Pacific Regional Fishery Management Council (the Council) to formalize incorporation of marine planning in its actions began in response to Executive Order (EO) 13547, *Stewardship of the Ocean, Our Coasts, and the Great Lakes*. EO 13158, *Marine Protected Areas*, proposes that agencies strengthen the management, protection, and conservation of existing marine protected areas (MPAs), develop a national system of MPAs representing diverse ecosystems, and avoid causing harm to MPAs through federal activities. MPAs, or marine managed areas (MMAs), are one tool used in fisheries management and marine planning.

At its 165th meeting in March 2016, in Honolulu, Hawaii, the Council approved the following objective for the FEPs: To consider the implications of spatial management arrangements in Council decision-making. The following sub-objectives apply:

- 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 Restricted Fishing Areas (BRFAs), military installations, NWHI restrictions, and Marine Life Conservation Districts (MLCDs).
- Establish effective spatially based fishing zones.
- Consider modifying or removing spatial-based fishing restrictions that are no longer necessary or effective in meeting their management objectives.
- As needed, periodically evaluate the management effectiveness of existing spatial-based fishing zones in federal waters.

To monitor implementation of this objective, this annual report includes the Council's spatially based fishing restrictions and MMAs, the goals associated with those, and the most recent evaluation. Council research needs 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 and facilities that may contribute to cumulative impact. The National Marine Fisheries Service

(NMFS) is responsible for NEPA compliance, and the Council must assess the environmental effects of ocean activities for the EFH cumulative impacts section of the FEP.

2.8.2 Response to Previous Council Recommendations

At its 194th meeting in March 2023, regarding the NWHI fishing regulations for the Monument Expansion Area (MEA), the Council stressed the importance of allowing cost recovery for fishing in the MEA in order for the community to participate in the fishery. Native Hawaiians are at the top of several socioeconomic indicators including the highest rates of poverty, unemployment, negative health conditions, lowest home ownership, etc. A decision to disallow cost recovery, including sales will continue to disenfranchise the Native Hawaiian community. The Council believes that limited cost recovery may be conducted on a small scale within the community consistent with Proclamation 9478's prohibition on commercial fishing. We further believe that the Council's recommended prohibition on commercial gear and comprehensive process for applying and approving requests for NH subsistence practice permits will provide effective safeguards against commercial fishing. The distance from the Main Hawaiian Islands to the MEA requires a large cost for fuel, bait, ice, food and other fishing needs may prohibit fishers from participating in Native Hawaiian cultural and traditional fishing practices in the MEA. Cost recovery allows for the disadvantaged communities to participate in cultural and traditional fishing practices by promoting equity amongst fishers as directed by Executive Order 13985 in particular for Asian American, Native Hawaiian and Pacific Island (AANHPI) communities as directed in Executive Order 14031. The Council also acknowledges the comments of an independent cultural working group and that other Native Hawaiian groups have commented at the Council's recent public meetings with a differing opinion. Nevertheless, to achieve resolution on this issue the Council amended its 193rd Council meeting recommendation as follows:

- Revised the Disposition of Native Hawaiian Subsistence Practices Catch section to read:
 - Disposition of Native Hawaiian Subsistence Practices Catch: Bottomfish MUS and Pelagic MUS legally caught by an individual holding a valid MEA Native Hawaiian Subsistence Practices fishing permit may bring catch back to the main Hawaiian Islands for consumption, including community sharing, barter and trade. Additionally, permittees may request NMFS consider the ability to recover costs through sale of catch associated with the trip to the MEA.
- Revised the Native Hawaiian Subsistence Practices Fishing Permit Application Process section to read:
 - Native Hawaiian Subsistence Practices Fishing Permit Application Process: An applicant for a Native Hawaiian Subsistence Practices Permit must complete and submit an application to NMFS that includes, but is not limited to a statement describing the objectives of the fishing activity for which a permit is needed, including a general description of the expected disposition of the resources harvested under the permit. If cost recovery is requested through sale, the application must include estimated costs for fuel and ice, and other trip costs to make a trip from the main Hawaiian Islands to the MEA along with a statement explaining why cost recovery is necessary for the intended action.

- If an application contains all of the required information, NMFS will forward copies of the application to the Council, the USFWS, the ONMS, the Office of Hawaiian Affairs (OHA), and the Chair of the Hawaii Department of Land and Natural Resources. The Council may consult with any of its Federal Advisory Committee Act (5 U.S.C. App. 2) exempt advisory bodies established pursuant to Section 302(g) of the Magnuson Stevens Act to provide comments on the application. NMFS will also make the permit application available for public review for no less than 30 days.
- Within 30 days following receipt of a complete application, NMFS will consult with the Council through its Executive Director, and the USFWS, NOAA Office of National Marine Sanctuaries (ONMS), Office of Hawaiian Affairs (OHA), and the Chair of the Hawaii Department of Land and Natural Resources (DLNR) concerning the permit application and will receive their recommendations for approval or disapproval of the application.
- In addition, to provide EEJ for Hawaii communities to participate in Native Hawaiian fishing practices in the MEA, applications for funding through Western Pacific Community Demonstration Projects (CDPP) and Community Development Plans (CDP) under the authority of MSA section 305(i) are to be submitted in accordance with 67 FR 18512 (April 16, 2002) and this action. The Council requested NMFS provide funding to support the approval of such grants. This could provide communities seeking to access the MEA the funding needed to assist with costs for their trip.

At its 195th meeting in June 2023, regarding the NWHI MEA, the Council noted that the ONMS' letter of May 31, 2023, rejecting the Council's cost-recovery provision in the permitting process simply referred to its February 22, 2023 letter for disapproval rationale. However, the latter is unclear on exactly how the Council's recommendation is inconsistent with Goal 4 and Objectives 3, 5, and 6 because sale can be denied by NMFS after consultation with monument management partners. On February 14, 2024, the Council responded to ONMS and the intent of its recommendation and requested ONMS provide a more detailed explanation of how the recommendation is inconsistent with each goal and objective.

2.8.3 Marine Managed Areas Established Under FEPs

Council-established MMAs were compiled in Table 71 from 50 CFR § 665, Western Pacific Fisheries, the Federal Register, and Council amendment documents. Regulated fishing areas of Hawaii, including the Papahānaumokuākea Marine National Monument, are shown in Figure 35.

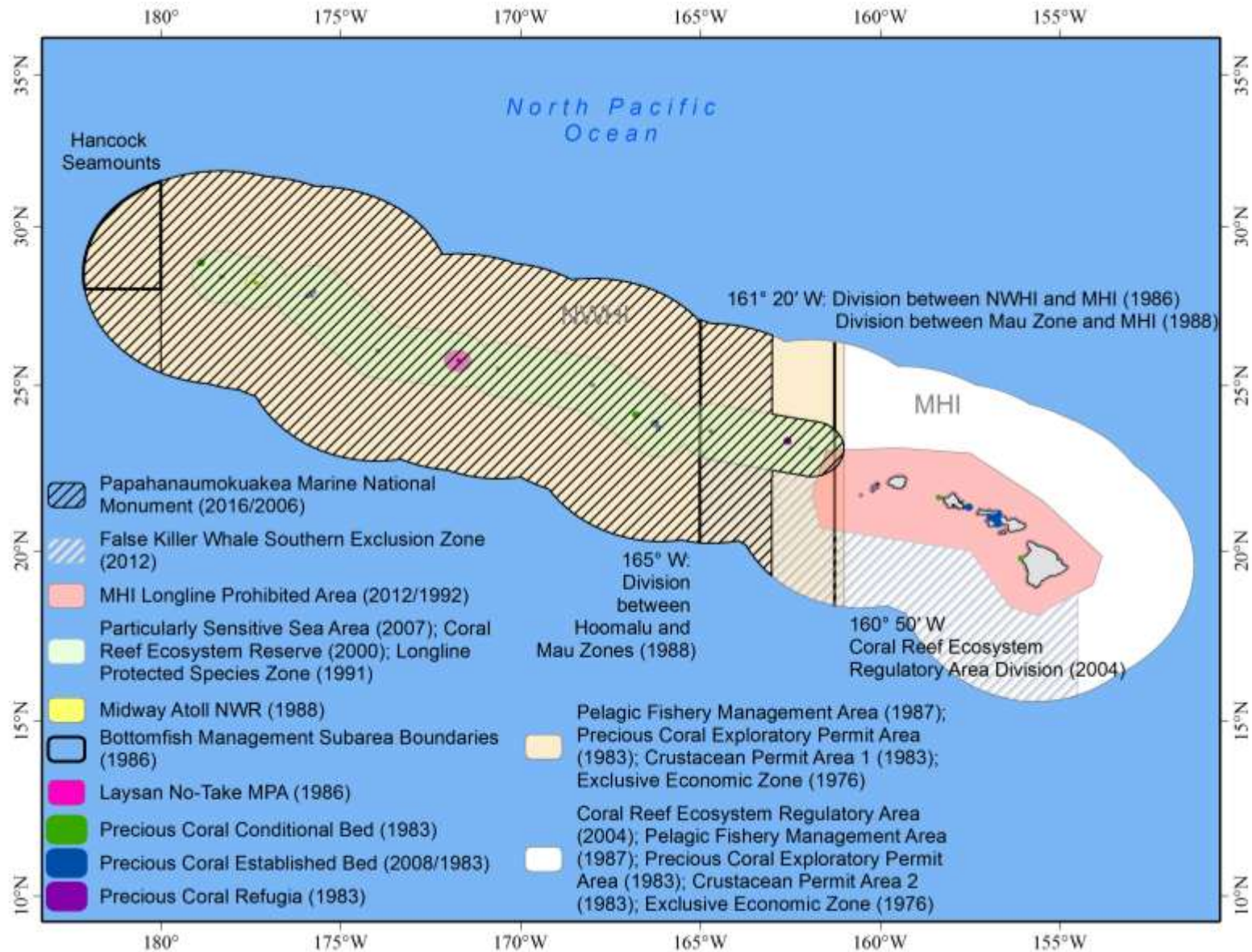


Figure 35. Regulated fishing areas of the Hawaii Archipelago

Table 71. MMAs established under FEP from 50 CFR § 665

Name	FEP	Island	50 CFR/FR/ Amendment Reference	Marine Area (km ²)	Fishing Restriction	Goals	Most Recent Evaluation	Review Deadline
Pelagic Restrictions								
NWHI Longline Protected Species Zone	Pelagic (Hawaii)	NWHI	665.806(a)(1) 56 FR 52214 76 FR 37288 Pelagic FMP Am. 3	351,514.0	Longline fishing prohibited	Prevent longline interaction with monk seals	1991	-
MHI Longline Prohibited Area	Pelagic (Hawaii)	MHI	665.806(a)(2) 57 FR 7661 77 FR 71286 Pelagic FMP Am. 5	248,682.4	Longline fishing prohibited	Prevent gear conflicts between longline vessels and troll/handline vessels	1992	-
Bottomfish Restrictions								
Hancock Seamounts Ecosystem Management Area (HSEMA)	Hawaii Archipelago	NW of Midway Island	HSEMA: 665.209 75 FR 52921 84 FR 2772 Moratorium: 51 FR 27413 Bottomfish FMP	60,826.8	Moratorium	The intent of the continued moratorium is to facilitate rebuilding of the armorhead stock, and the intent of the ecosystem management area is to facilitate research on armorhead and other seamount groundfish	2010	-
Precious Coral Permit Areas								
Keāhole Point	Hawaii Archipelago	Hawaii Island	665.261(2)(i) 73 FR 47098 84 FR 2773 Precious Corals FMP Am. 7	2.7	Fishing by permit only	Manage harvest	2008	-
Ka'ena Point	Hawaii Archipelago	Oahu	665.261(2)(ii) 73 FR 47098 84 FR 2773 Precious Corals FMP Am. 7	2.7	Fishing by permit only	Manage harvest	2008	-
Makapu'u	Hawaii Archipelago	Oahu	665.261(1)(i) 73 FR 47098 84 FR 2773 Precious Corals FMP Am. 7	43.15	Fishing by permit only	Manage harvest	2008	-
Brooks Bank	Hawaii Archipelago	NWHI	665.261(2)(iii) 73 FR 47098 84 FR 2773 Precious Corals FMP Am. 7	43.15	Fishing by permit only	Manage harvest	2008	-
180 Fathom Bank	Hawaii Archipelago	NWHI	665.261(2)(iv) 73 FR 47098 84 FR 2773 Precious Corals FMP Am. 7	43.15	Fishing by permit only	Manage harvest	2008	-

Name	FEP	Island	50 CFR/FR/ Amendment Reference	Marine Area (km ²)	Fishing Restriction	Goals	Most Recent Evaluation	Review Deadline
Westpac Bed	Hawaii Archipelago	NWHI	665.261(3) 73 FR 47098 84 FR 2773 Precious Corals FMP Am. 7	43.15	Fishing prohibited	Manage harvest	2008	-
'Au'au Channel	Hawaii Archipelago	Maui Nui	665.261(1)(ii) 73 FR 47098 84 FR 2773 Precious Corals FMP Am. 7	728.42	Fishing by permit only	Harvest quota for black coral of 5,000 kg every two years for federal and State waters	2008	-

2.8.4 Fishing Activities and Facilities

2.8.4.1 Aquaculture Facilities

Hawaii had one offshore aquaculture facility recently operational in federal waters from 2020-2021. The permit process was started by Kampachi Farms (now known as Ocean Era) in 2016, but the associated Special Coral Reef Ecosystem Fishing Permit (SCREFP) was transferred to Forever Oceans in 2017 (see Table 72). A new nearshore aquaculture operation in the waters off of Ewa Beach, Oahu, by Ocean Era is currently in the pre-consultation stage, and a preliminary environmental review was made to resource management agencies for evaluation in March 2021. The aquaculture farm will be situated off of Ewa Beach, Oahu, and will aim to cultivate nenuke (*Kyphosus vaigiensis*), moi (*Polydactylus sexifilis*), ogo (*Gracilari* sp.), *Sargassum*, and sea grapes (*Caulerpa* sp.).

Table 72. Offshore aquaculture facilities in Hawaii

Name	Size	Location	Species	Status
Forever Oceans, transferred from Kampachi Farms (now known as Ocean Era)	Shape: Cylindrical Height: 33 ft. Diameter: 39 ft. Volume: 36,600 ft ³	5.5 nautical miles (nm) west of Keauhou Bay and 7 nm south-southwest of Kailua Bay, off the west coast of Hawaii Island 19° 33' N, 156° 04' W. Mooring scope is 10,400-foot radius.	<i>Seriola rivoliana</i>	On July 6, 2016, NMFS authorized SCREFP for culture and harvest of 30,000 kampachi over two years on July 6, 2016. Array broke loose from mooring and empty net pen sank in 12,000 feet of water on Dec. 12, 2016. The mooring was redeployed under guidance from the U.S. Army Corps of Engineers (USACE) in late 2018 and stocked with the first cohort of 10,000 fish in early 2019. On March 30, 2017, NMFS authorized transfer of the two-year SCREFP from Ocean Era to Forever Oceans and the permit was renewed in 2019.

Name	Size	Location	Species	Status
				Forever Oceans' most recent SCREFP expired in December 2021, and there are currently no ongoing, in-water operations.

Additionally, the [Final Programmatic Environmental Impact Statement \(DPEIS\) for an aquaculture management program in the Pacific Islands](#) was published in 2022. The Council is amending their FEPs to create a permitting program for offshore aquaculture, applicable to the entire Pacific Islands Region. Relatedly, the State of Hawaii is interested in developing a pre-permitted demonstration/pilot area for offshore aquaculture technologies at their NELHA facility.

2.8.5 Non-Fishing Activities and Facilities

The following section includes activities or facilities associated with known uses and predicted future uses. The Plan Team will update this section as new facilities are proposed and/or built. Due to the sheer volume of ocean activities and the annual frequency of this report, only major activities on multi-year planning cycles are tracked. 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.

2.8.5.1 Alternative Energy Facilities

Hawaii previously had four proposed wind energy facilities of commercial interest nominated by the Bureau of Ocean Energy Management (BOEM) in its Call Areas northwest and south of Oahu, all of which were in the area identification and environmental assessment stage of the leasing process (Progression Energy 2015), but these projects were disengaged around 2018 (BOEM 2017). In December 2020, BOEM put out a new call for recommendations on environmental studies regarding offshore wind facilities, and the Hawaii State Energy Office is facilitating and providing input on studies that could be conducted to mitigate impacts on various resources, including aquatic. In October 2021, the National Renewable Energy Laboratory published a study providing estimates of the Levelized Cost of Energy of offshore wind in the region surrounding Oahu and investigates related topics relevant to planning for offshore wind (Shields et al. 2021). In December 2022, the Pacific Northwest National Laboratory deployed a floating scientific research buoy stationed approximately 15 miles east of Oahu to collect accurate offshore wind resource, meteorological, and oceanographic data in Hawaii. There are several other alternative energy projects also being tracked in this report ().

Table 73).

Table 73. Alternative energy facilities and development offshore of Hawaii

Name	Type	Location	Impact to Fisheries	Stage of Development	Source
Makai Ocean Engineering, Inc., Natural Energy Laboratory of Hawaii	120 kW Ocean Thermal Energy Conversion (OTEC)	Ke'ahole, North Kona, West Hawaii	Intake	120 kW OTEC operational; Final EA for 1 MW OTEC Site using existing infrastructure submitted July 2012 and finalizing	NELHA Energy Projects

Name	Type	Location	Impact to Fisheries	Stage of Development	Source
Authority (NELHA)	Test Site/ 1 MW OTEC Test Site			lease negotiations currently; HEPA Exemption List memo Dec. 27, 2016.	Final Environmental Assessment, NELHA, July 2012
Honolulu Sea Water Air Conditioning (SWAC)	SWAC	4 miles S of Kaka'ako, Oahu	Benthic impacts; intake	USACE Record of Decision (ROD) signed in 2015. In 2018, HSWAC and the State of Hawaii finalized an agreement to provide seawater air conditioning for eight State buildings. Construction was planned to start in late 2019 or, but the operation was shut down in late 2020 due to increasing costs.	Final Environmental Assessment, June 2014 West Hawaii Today
Marine Corps Base Hawaii Wave Energy Test Site (WETS)	Shallow-and Deep-Water Wave Energy	1, 2 and 2.5 km N of Mokapu, Oahu	Hazard to navigation	Shallow and deep water wave energy units operational starting mid-2015. In 2021, deployments were planned for the C-Power 2 kW SeaRay, the Oscilla Triton-C, and the Ocean Energy 500 kW OE35.	Final Environmental Assessment, NAVFAC PAC, January 2014 Tethys The Maritime Executive
BOEM, US DOE Wind Energy Technologies Office (WETO), Pacific Northwest National Laboratory (PNNL)	Lidar Buoy	15 miles east of Oahu	Hazard to navigation	In December 2022, PNNL and WETO deployed the lidar buoy and set to retrieve it in January 2024	PNNL Lidar Buoy Program

2.8.5.2 Military Training and Testing Activities and Impacts

The Department of Defense (DOD) major planning activities in the region are summarized in Table 74.

Table 74. Military training and testing activities offshore of Hawaii

Action	Description	Phase	Impacts
Rim of the Pacific (RIMPAC) Exercise	Multinational, sea control/power projection fleet exercise that has been performed biennially and is currently headquartered in Pearl Harbor, Hawaii.	RIMPAC Programmatic EA developed in 2002 and a Supplemental Programmatic EA was finalized in 2006 (71 FR 31170). Biennial exercises continue through	Programmatic Environmental Assessment, June 2002 U.S. Pacific Fleet

Action	Description	Phase	Impacts
	RIMPAC exercise locations are present throughout the State of Hawaii.	the present, with the most recent occurring in Summer 2022.	
Hawaii-Southern California Training and Testing (HSTT)	Increased naval testing and training activities, including the use of active sonar and explosives	Record of Decision (ROD) available in December 2018 to conduct training and testing activities as identified in Alternative 1 of the HSTT Final Environmental Impact Statement (EIS)/Overseas EIS (OEIS) published in October 2018 (83 FR 66255). NMFS implemented regulations regarding to the incidental take of marine mammals in the HSTT area in July 2020 (85 FR 41780).	The 2018 HSTT EIS/OEIS predicts impacts to access and habitat impact similar to previous analysis in the 2013 HSTT EIS/OEIS .
Long Range Strike Weapon Systems Evaluation Program (WSEP)	Conduct operational evaluations of Long-Range Strike weapons and other munitions as part of Long-Range Strike WSEP operations at the Pacific Missile Range Facility at Kauai, Hawaii.	Comment period closed Feb. 6, 2017, and final rule on Aug. 22, 2017, for NMFS authorization to take marine mammals incidental to conducting munitions testing for their Long-Range Strike Weapons Systems Evaluation Program (LRS WSEP) over the course of five years, from August 21, 2017 through August 22, 2022 (82 FR 1702 ; 82 FR 39684).	Access – closures during training. Final Environmental Assessment October 2016 NMFS Biological Opinion August 2017
Naval Special Operations Training in the State of Hawaii	Small-unit maritime training activities for naval special operations personnel.	Draft EA released in October 2018. Public comment period through Dec. 10, 2018 was extended to Jan. 7, 2019. Final EA released May 2021.	Access. Draft Environmental Assessment 2018 Final Environmental Assessment 2021

2.8.6 Additional Considerations

2.8.6.1 State of Hawaii Initiatives

The State of Hawaii has several initiatives ongoing, including its [Holomua Initiative](#) and its [Ocean Resource Management Plan](#), which was most recently updated in 2020 (Hawaii Office of Planning 2020). Interested parties are encouraged to provide input and track the progress of these plans.

2.8.6.2 Bottomfish Restricted Fishing Areas (BRFAs)

In 1997, in response to a federal stock assessment indicating that certain species of the MHI bottomfish stock complex were in danger of being overfished, DAR developed a bottomfish management plan, which included the creation of 19 bottomfish restricted fishing areas (BRFAs)

where bottomfish fishing was prohibited. These BRFA s were enacted in 1998. The MHI BRFA s are situated in both State and federal waters. Upon review in 2005, it was determined that the BRFA system did not protect an adequate amount of preferred habitat for bottomfish, so a new system was created in 2007 with 12 BRFA s (Figure 36) with the objective of reducing fishing mortality of MHI bottomfish stocks, rebuilding bottomfish populations on habitats within the BRFA s, and improving bottomfish populations in adjacent fishing areas (Drazen et al. 2014). In 2019, four of the 12 BRFA s were opened: BRFA C (Poipu, Kauai), BRFA F (Penguin Banks), BRFA J (Hana, Maui), and BRFA L (Leleiwi, Hawaii Island) (Figure 36).

On February 25, 2022, the Hawaii Board of Land and Natural Resources (BLNR) approved the reopening of all BRFA s such that registered bottomfish vessels are now allowed to fish for Deep-7 bottomfish in all previously closed BRFA s. During deliberations, representatives from DAR suggested that, because the Deep-7 bottomfish complex is being fished at sustainable levels according to the 2021 stock assessment update (Syslo et al. 2021), DAR is comfortable in taking an adaptive management approach to co-management of the Hawaii bottomfish fishery by opening the BRFA s and relying on other existing conservation and management measures to sustain the fishery.

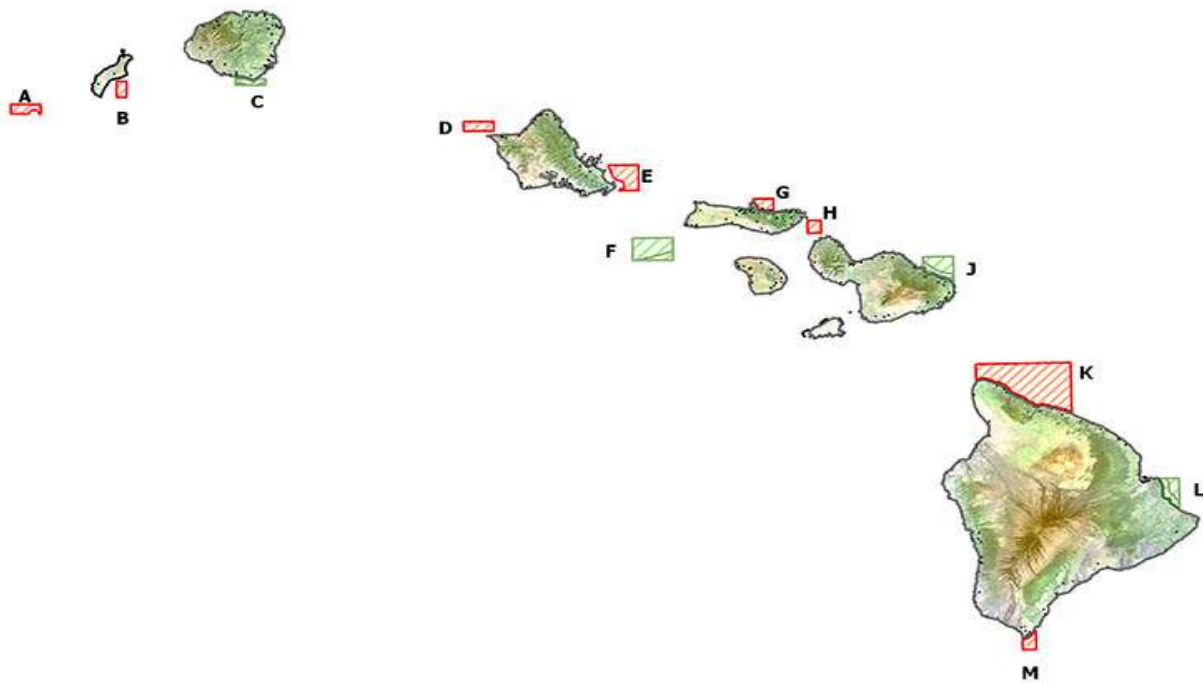


Figure 36. Map of the 12 BRFA s around the MHI; green boxes indicate those areas were opened to bottomfish fishing in 2019 and red boxes indicate areas that remained closed to bottomfish fishing at this time. All BRFA s are now open (from DAR 2021)

2.8.6.3 NWHI National Marine Sanctuary Nomination

On November 19, 2021, NOAA published a Notice of Intent (NOI) to initiate the sanctuary designation process for the Northwestern Hawaiian Island National Marine Sanctuary. On December 8, 2021, the State of Hawaii published its EIS preparation notice. In November 2022,

the Council held public meetings on the islands of Kaua'i, Maui, Hawaii (Hilo and Kona), Moloka'i, and Oahu to solicit input from the community on alternatives for allowing non-commercial fishing and Native Hawaiian practices in the MEA, including a definition for subsistence fishing and options for including customary exchange. In general, participants commented that fishing should be allowed in the NWHI and that the opportunity for Native Hawaiians to fish should be provided. Participants commented that due to the distance and expense that fishing in the MEA would entail, the only persons likely to fish in that area would be rich people with large boards that could afford to go there. There was support to allow for commercial fishing, non-commercial fishing, and Native Hawaiian subsistence fishing. Cost recovery was also support by most participants as a means for providing the ability for fishermen to access the area.

At its March 2023 meeting, the Council finalized its recommended fishing regulations for the Monument Expansion Area from 50-200 miles around the NWHI. The regulations would allow for federal permitting and reporting of non-commercial fishing and Native Hawaiian subsistence fishing practices and prohibit commercial fishing. The Council stressed the importance of allowing limited cost recovery for Native Hawaiian subsistence fishing practices in the MEA in order for the community to participate in regulated fishing practices under Proclamation 9478.

On March 1, 2024, NOAA published request for public comment on the proposed rule, notification of availability of the draft environmental impact statement (EIS) and draft management plan for the proposed Papahānumokuākea Marine National Sanctuary (89 FR 42, March 1, 2024). The alternatives analyzed in the EIS include 1) No Action do not establish a sanctuary; 2) non-commercial fishing would be permitted under NMFS and the sanctuary boundary would extend to 200 nm; 3) Sanctuary boundary would be limited to the existing monument, non-commercial fishing is permitted if it meets the scope of the sanctuary; and 4) the sanctuary boundary is extended from 0-200 nm but does not include the USFWS National Wildlife Refuges; noncommercial fishing would be permitted under NMFS. In April 2024, NOAA held public meetings virtually and in-person on O'ahu (Honolulu, Kaneohe, and Waianae), Kaua'i (Waimea and Hanalei), Hawai'i Island (Hilo and Kona), Maui, and Moloka'i to solicit comments on the draft EIS. In response to the request for public comment, the Council provided that the No Action alternative for the proposed rule was appropriate for the area and that the designation of a national marine sanctuary is unwarranted.

3 DATA INTEGRATION

3.1 INTRODUCTION

3.1.1 Potential Indicators for Insular Fisheries

The purpose of this section of the annual Stock Assessment and Fishery Evaluation (SAFE) report is to identify and evaluate potential fishery ecosystem relationships between fishery parameters and ecosystem variables to assess how changes in the ecosystem affect fisheries in the Main Hawaiian Islands (MHI) and across the Western Pacific region. Fishery ecosystem relationships are those associations between various fishery-dependent data measures (e.g., catch, catch-per-unit-effort [CPUE]) and other environmental attributes (e.g., wind, sea surface temperature [SST], currents, etc.) that may contribute to observed trends or act as potential indicators of the status of prominent stocks in the fishery. These analyses represent a first step in a sequence of exploratory analyses that will be utilized to inform new assessments of in determining ecological factors that may be useful to monitor in the context of ecosystem-based fisheries management going forward.

In late 2016, staff from the Council, National Marine Fisheries Service (NMFS), Pacific Islands Fisheries Science Center (PIFSC), Pacific Islands Regional Offices (PIRO), and other fishery resource professionals held a SAFE Report Data Integration Workshop to identify potential fishery ecosystem relationships relevant to local policy in the Western Pacific region and determine appropriate methods to analyze them. Among the ranked potential relationships were bottomfish catch/CPUE and eddy features as well as bottomfish catch/CPUE and surface current, speed, and direction. This chapter reflects exploratory analyses in search of these potential fishery ecosystem relationships.

For the 2017 report, exploratory analyses were performed comparing coral reef fishery species data in the Western Pacific with precipitation, primary productivity, and SST. The Archipelagic Fishery Ecosystem Plan (FEP) Team (Plan Team) suggested several improvements to implement to the initial evaluation, which are reflected in the following preliminary analysis for uku first presented in the 2018 report. The results are prefaced by the Plan Team recommendations for ongoing development and improvement of the Data Integration chapter. Then, the chapter includes brief descriptions of past work on fishery ecosystem relationship assessment in the U.S. Western Pacific, followed by initial evaluations of relationships between uku and ENSO as well as surface zonal currents. The evaluations completed were exploratory in nature and were used as initial analyses to know which comparisons may hold more utility going forward. In subsequent years, this chapter will be updated with analyses through the SAFE report process to include more of the described climate change indicators from Section 2.6.4, and as the strength of certain fishery ecosystem relationships relevant to advancing ecosystem-based fishery management are determined.

3.1.2 Plan Team Recommendations for Section Development

At the Plan Team meeting held on April 30th and May 1st, 2018, participants were presented preliminary data integration results on comparisons between coral reef species and various climate indicators. The Plan Team provided detailed recommendations to support the ongoing development of the data integration section of the Archipelagic annual SAFE report. These

suggestions, both general and specific, will continue to be implemented in the coming years to ensure that more refined analyses comprise the data integration section.

Plan Team participants recommended that:

- CPUE data should be standardized and calculated in a more robust fashion, measuring the average catch per unit effort rate over the course of a year to analyze variance.
- Analyses of fishery performance data against environmental variables should focus on dominant gear types rather than the entirety of the fishery or other gear aggregates;
- There should be additional phase lag implemented in the analyses;
- Local knowledge of fishery dynamics, especially pertaining to shifting gear preferences, should be utilized. Changes in dynamics that may have impacted observed fishery trends over the course of available time series, both discreetly and long-term for taxa-specific and general changes should be emphasized; and
- Spatial specificity and precision should be increased for analyses of environmental variables in relation to areas commonly fished.

The analyses presented in this chapter reflect a thoughtful re-approaching to data integration evaluations. Data from 2002 to 2012 were utilized because all data products had consistent coverage within this range. Additional data can be added to either time series as they are made available. Moving forward, incorporating Plan Team recommendations into the annual SAFE report will mark the beginning of a standardized process to implement current data integration analyses on an annual basis. Doing so will promote more proactive management action with respect to ecosystem-based fishery management objectives.

3.1.3 Background Information

Fishery Ecosystem Relationships

There is growing concern that the effects of increased variability in environmental and ecological parameters attributed to climate change may impact fish stocks and the fisheries that harvest them. A recent meta-analysis looking at 235 populations of 124 species of fish nationwide recently suggested that the maximum sustainable yield of fish species has generally declined over the last 80 years in response to ocean warming (Free et al. 2019). In addition to impacts from gradual warming, changes in storm frequency and intensity associated with climate change also threaten fisheries worldwide by disrupting fishing effort and infrastructure of coastal communities, and these impacts are likely to be realized in a more immediate manner (Sainsbury et al. 2018).

In response to elevated awareness of potential impacts to fish stocks and their associated fisheries, there have been increased efforts by scientific researchers to understand how a changing environment may influence commercially important fishery species. Richards et al. (2012) performed a study on a range of environmental factors that could potentially affect the distribution of large-bodied coral reef fish in Mariana Archipelago. Large-bodied reef fish were determined to typically be at the greatest risk of overfishing, and their distribution in the region was shown to be negatively associated with human population density. Additionally, depth, sea surface temperature (SST), and distance to deepwater were identified as important environmental factors to large-bodied coral reef fish, whereas topographic complexity, benthic habitat structure, and benthic cover had little association with reef fish distribution in the Mariana Archipelago.

Kitiona et al. (2016) completed a study of the impacts climate and ecosystem change on coral reefs fish stocks of American Samoa using climate and oceanic indicators (see Section 2.6.4). The evaluation of environmental variables showed that certain climate parameters (e.g., SST anomaly, sea level height, precipitation, and tropical storm days) are likely linked to fishery performance. It has also noted that larger natural disturbances in recent decades, such as cyclones and tsunamis, negatively impacted reef fish assemblages and lowered CPUE of reef fish in American Samoa (Ochavillo 2012).

Little information exists on the larval and juvenile life stages of bottomfish in the MHI, though the larvae and juveniles are typically found in very different habitats than their adult counterparts (Moffitt 2006). Larvae in the MHI exhibit a high degree of self-recruitment and connectivity, and the presence of zonal currents may play a part in influencing larval transport and connectivity (Wren et al. 2016). In addition, mesoscale eddies are thought to play a major role in retention of larvae and recruitment for fish stocks around the MHI, and parrotfish in the MHI likely utilize eddies to retain larvae near their settling grounds (Lobel and Robinson 1986; Lobel 1989; Wren and Kobayashi 2016; Shulzitski et al. 2017). Another project evaluating larval fish assemblages in association with water masses and mesoscale dynamics that govern them suggested that larval assemblages depend on species-based interactions between their spawning strategies and these processes (León-Chávez et al. 2010). Similarly, a study on the impact of mesoscale eddies on the migration of Japanese eel larvae found that there was a negative relationship between the eel recruitment index and the eddy index subtropical countercurrent, indicating that eddies play some sort of role in migration of the species (Chang et al. 2017).

Uku and its Fishery in the Main Hawaiian Islands

The green jobfish (*Aprion virescens*), known as uku in Hawaii, is a non-Deep-7 bottomfish that inhabits deep lagoons, channels, and inshore reefs from the surface down to about 100-135 m (Haight et al. 1993a; Asher et al. 2017). It is among the most common roving predatory marine species in the MHI (Asher et al. 2017). The most recent stock assessment of uku in the MHI was done by Nadon (2017), where it was suggested that population abundance appeared to be increasing from 2003 to 2016.

Uku reach sexual maturity during the spring and summer before spawning until fall or early winter; they begin spawning in May before their peak in June (Everson et al. 1989). The green jobfish are generally known to aggregate in shallower waters, such as those above Penguin Banks, during summer months for spawning purposes and are caught during daylight hours (Haight et al. 1993a, 1993b). The timing of their spawning aggregations may also be associated with increases in SST and/or day length to ensure ideal conditions for their larvae (Walsh 1987). It has been found that areas active with spawning during the summer had prolonged absences of the species from October to April due to seasonal migrations (Meyer et al. 2007).

Unsurprisingly, around the MHI, the majority of uku are typically caught over Penguin Banks during the summer, as are typically targeted when they aggregate for spawning (Everson et al. 1989; Parke 2007).

Uku size at 50 percent sexual maturity for females is 425-475 mm fork length (FL), and the smallest uku with vitellogenic (stage II) ovaries during spawning was just 429 mm (Everson et al. 1989; Haight et al. 1993a). The slope of the logistic curve fit to size at sexual maturity data for uku was relatively steep, suggesting that uku grow rapidly and quickly recruit into the fishery

(Everson et al. 1989). Uku congregate around the MHI in expected 1:1 sex ratio, and likely release multiple egg batches over the course of a spawning season (Everson et al. 1989).

Uku are harvested by a wide range of gear types, including deep- and shallow-set (i.e., inshore) handlining, cast netting, and trolling. Deep-set handline was primarily focused on for this data integration assessment due to the amount of consistent data available and its apparent dominance in the MHI uku fishery. There was generally more structural variability apparent in handline trips, as the fishermen should catch uku with handline if that is what they are targeting due to the gear's high selectivity. Of all gear types that are used to harvest uku, the deep-set handline consistently had the highest CPUE of the four gears considered by nearly an order of magnitude; however, while CPUE for deep-set handline trended downwards over the course of the time series, the CPUE for inshore handline, cast netting, and trolling with lures slightly increased over the same period (Figure 37). Trolling (with lure) to harvest uku had the second-highest CPUE for several years of the CPUE time series, but this gear type was not taken further in the assessment because there is no good understanding of trolling effort for uku; troll fishers are usually targeting pelagic species and are not reporting “zero” catch on trips where there is no uku catch.

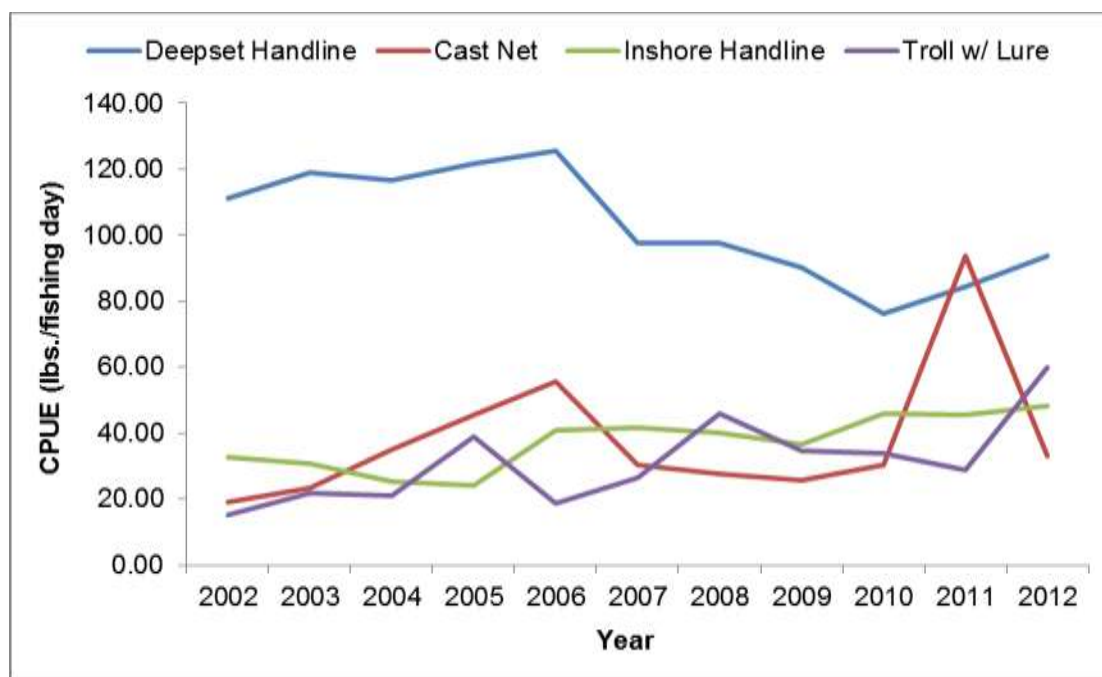


Figure 37. CPUE for uku harvested in the MHI for four top gear types from 2002-2012

The annual average weight per fish from 2002 to 2012 was 8.59 pounds, ranging from 8.25 pounds in 2008 to 8.94 pounds in 2014 (Figure 38). These results agree well with the annual average weight-per-fish determined by Moffitt et al. (2005). Using a weight-to-length conversion for uku (Sundberg and Underkoffler 2011) it was determined that the average length per fish was roughly 63 to 65 cm Total Length (TL). From there, a length-to-age curve was utilized (O'Malley et al. 2016) to estimate the approximate age that uku individuals recruit into the fishery around the MHI to be about two years. It is reasonable to infer that the CPUE data analyzed here is comprised mostly of fish that recruited into the fishery at two years of age.

Though Sundberg and Underkoffler (2011) suggested that an uku of eight to nine pounds is likely 63 to 65 cm TL, Everson et al. (1989) noted that uku of such size in the main Hawaiian

Islands were 95 percent mature, indicating that the uku may have recruited to the fishery earlier as well. For uku, it was determined that 100 percent maturity was reached by the 50 cm size classes, but it is important to note that disparities in size and at sexual maturity between areas may reflect differences in resource utilization and growth allocation (Everson et al. 1989). Uku have been found to be homogenously dispersed across all available depth and habitat strata with significant regional differences no matter the depth strata or inclusion of habitat (Asher et al. 2017).

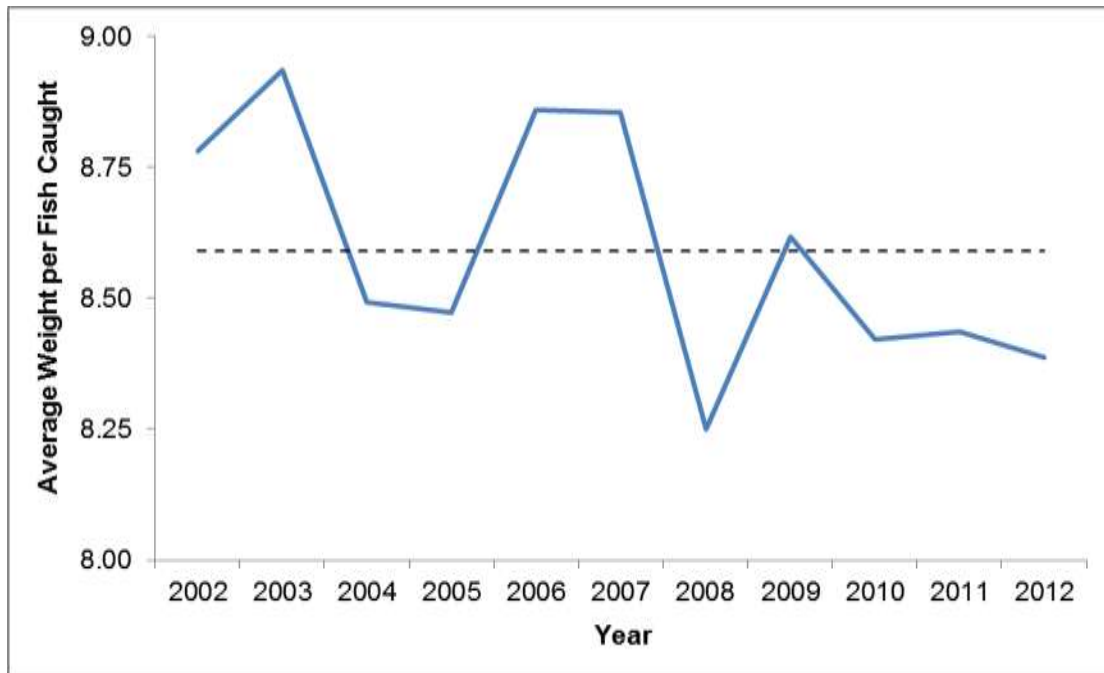


Figure 38. Average annual weight per fish (lb) for uku (*Aprion virescens*) harvested around the Main Hawaiian Islands from 2002-2012

3.2 MULTIVARIATE ENSO INDEX

The El Niño Southern Oscillation (ENSO) is Earth's strongest interannual climate fluctuation and is the most important and representative phenomenon in the ocean-atmosphere system on these time scales (Wolter and Timlin 2011; Mazzarella et al. 2013). To measure the response of the uku fishery to interannual environmental shifts, such as those due to ENSO, data were drawn from a relatively recent index that utilizes an ensemble approach and has become the leading ENSO index called the Multivariate ENSO Index Version 2 (MEI.v2). The MEI utilizes five different environmental parameters across the tropical Pacific Ocean to derive its value: SST, sea level pressure (SLP), surface zonal winds, surface meridional winds, and outgoing longwave radiation (OLR; NOAA 2019). Notable environmental features during the typical peak of ENSO during late Fall/early Winter are anomalously warm SST across the east-central equatorial Pacific, anomalously low SLP over the eastern tropical Pacific, reduction of tropical Pacific easterly trade winds, and increased OLR over the Western Pacific (Figure 39; NOAA 2019). In MEI.v2, the measures of SST, SLP, and surface zonal and meridional winds are obtained from the JRA-55 global atmospheric reanalysis by the Japan Meteorological Agency (Kobayashi et al. 2015), while the measures of OLR were gathered from the NOAA Climate Data Record of Monthly OLR (Lee 2018). While there are positive MEI values every few years, the last several major ENSO events occurred in 1983, 1998, and 2016 (Figure 40; NOAA 2019).

The CPUE (catch in pounds per fishing trip/day) and environmental data were standardized by both average and standard deviation so the time series would be comparable, and all covariates would have equitability. Phase lag was incorporated from one to six years. The correlation coefficient for the comparison between standardized uku CPUE from the MHI and the standardized MEI.v2 was -0.729 (Figure 41) and the coefficient of determination (R^2) was 0.53 (Figure 42), indicating a strong inverse relationship between the variables. The covariates suggest that as the MEI.v2 increases, uku CPUE in the MHI decreases, and vice versa.

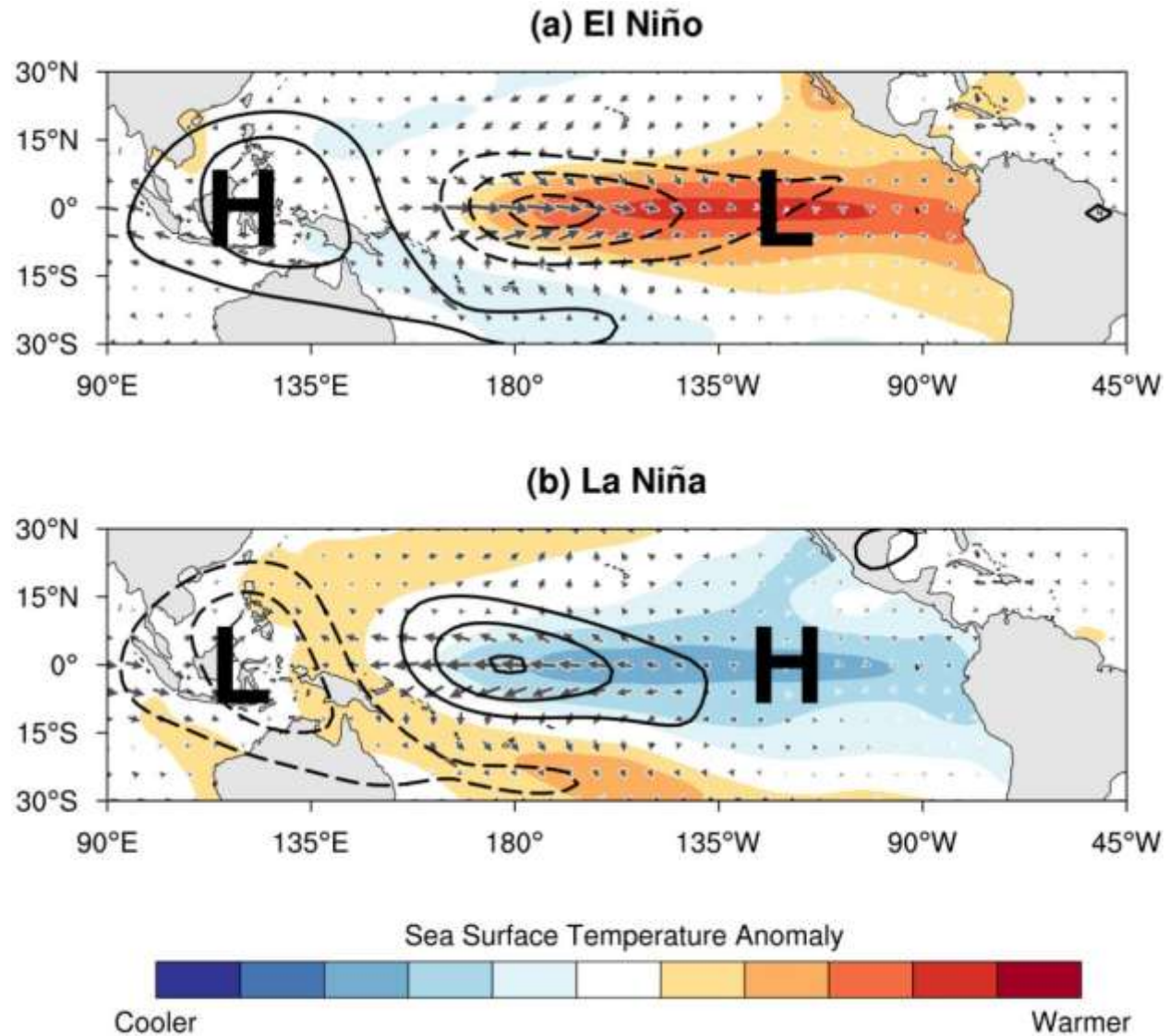


Figure 39. Diagram showing the physical mechanisms by which the SST (shaded), OLR (contours), surface zonal and meridional winds (vectors), and sea level pressure (represented by “H” and “L”) determine the wintertime Multivariate ENSO Index (MEI) during (a) El Niño and (b) La Niña events” (NOAA 2019)

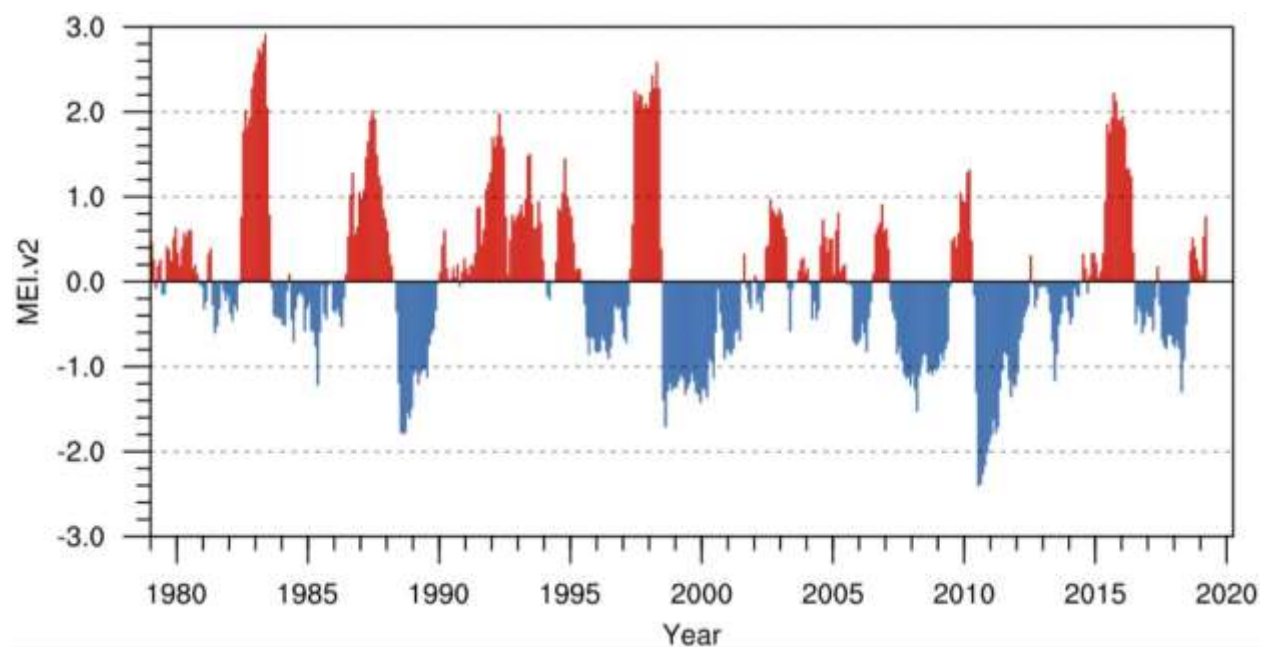


Figure 40. Time series of the Multivariate ENSO Index (MEI) v2 from 1980-2019

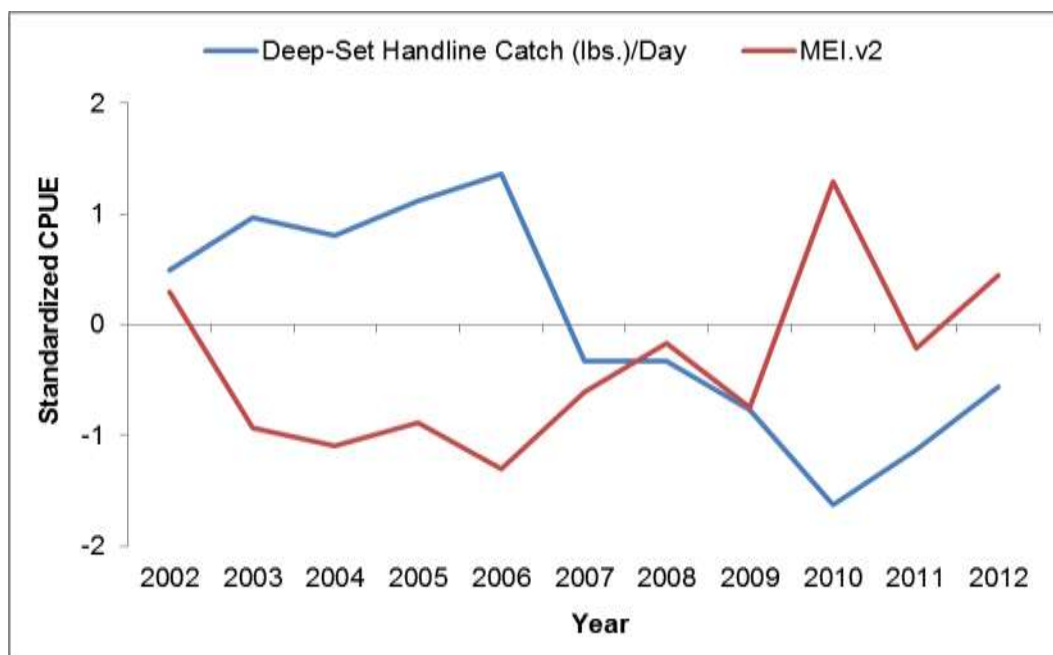


Figure 41. Comparison of standardized MHI Deep-Set Handline CPUE and MEI.v2 with a phase lag of two years from 2002-2012 ($r = -0.729$)

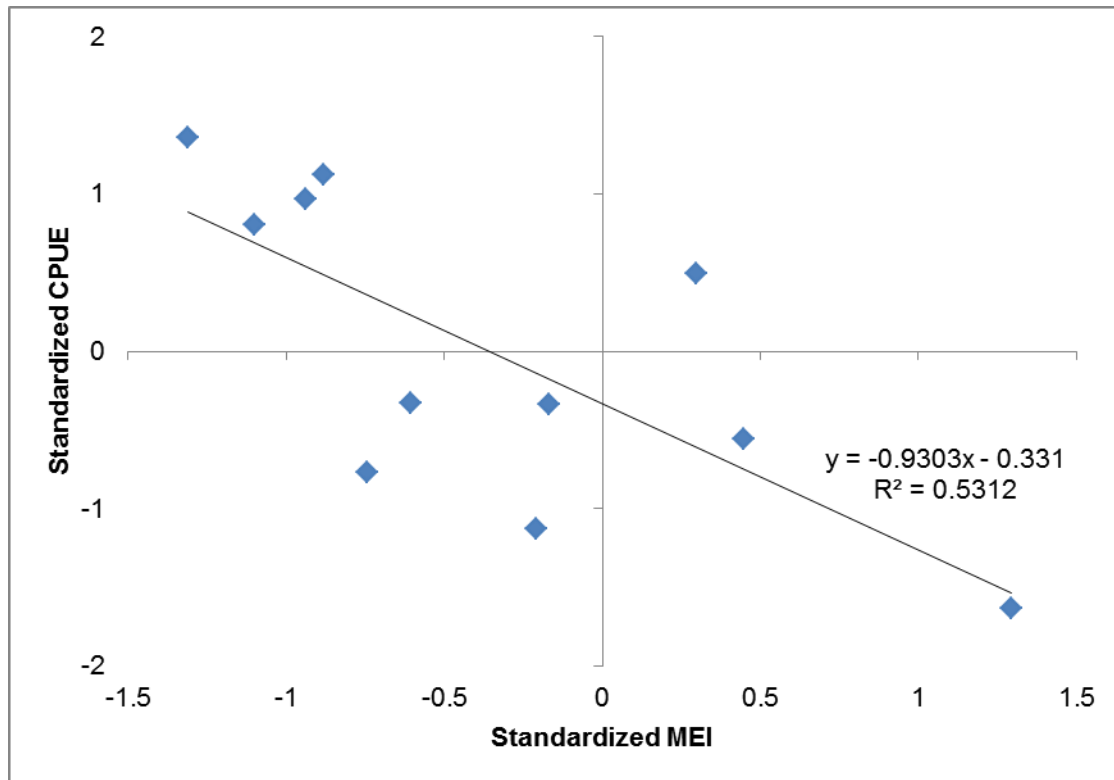


Figure 42. Standardized CPUE for uku from the MHI from 2002-2012 plotted against standardized MEI.v2 with a phase lag of two years

3.3 SURFACE ZONAL CURRENTS

The surface circulation in the tropical Pacific Ocean is complex and undergoes a large amount of short- and long-term variability due to both shifts in major winds as well as thermohaline structure of surrounding water masses. It has been suggested in the past that the current flow near the MHI is responsible for the variability in larval assemblages and distribution in the area (Miller 1974). Given the vital role zonal flow plays in vorticity, it was inferred that the parameter itself may possess some sort of fishery ecosystem relationship with uku, whose spawning assemblages are known to congregate in shallow waters above Penguin Banks during the summer months (Haight et al. 1993a, 1993b). A summary of surface zonal currents and vorticity in the waters surrounding the MHI from 2004 is depicted in Figure 43. One of the major surface currents in this region, the North Equatorial Current, was also analyzed for the purposes of this study, with moderate relationships between NEC flow with a phase lag of two years and uku CPUE ($r = 0.304$).

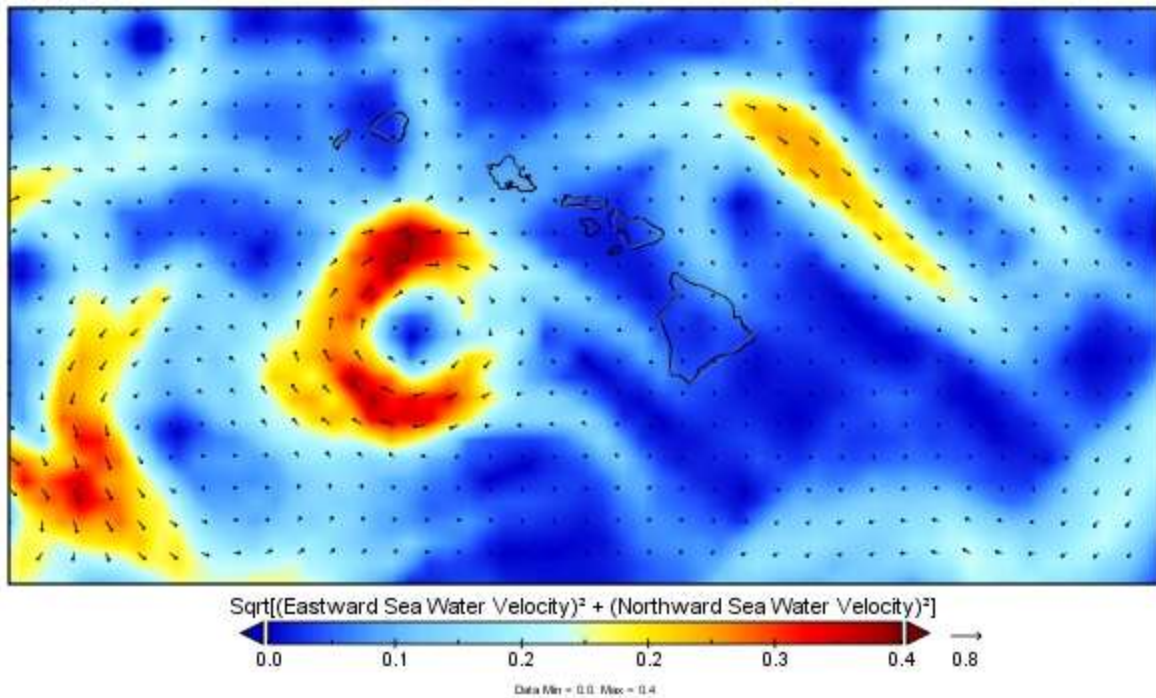


Figure 43. Example of eastward sea water current velocity around the MHI from 2004

Similar to comparisons with the MEI.v2, both CPUE (catch in pounds per fishing trip/day) and environmental data were standardized by both average and standard deviation so the time series would be comparable, and all covariates would have equitability. Phase lag was incorporated from one to six years. The correlation coefficient for the comparison between standardized uku CPUE from the MHI and the standardized average summertime zonal current flow in the same area was 0.748 (Figure 44) and the coefficient of determination (R^2) was approximately 0.56 (Figure 45), indicating a strong relationship between the variables. The covariates suggest that as the average summertime zonal current increases, uku CPUE in the MHI also increases.

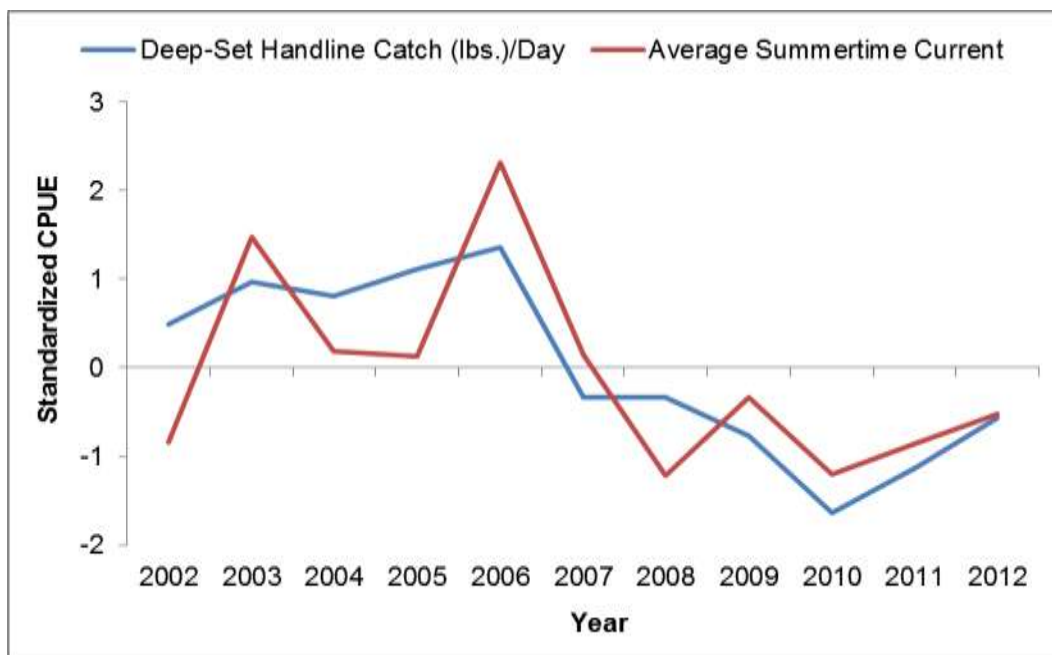


Figure 44. Comparison of standardized MHI Deep-Set Handline CPUE and the average summertime zonal current with a phase lag of two years from 2002-2012 ($r = 0.748$)

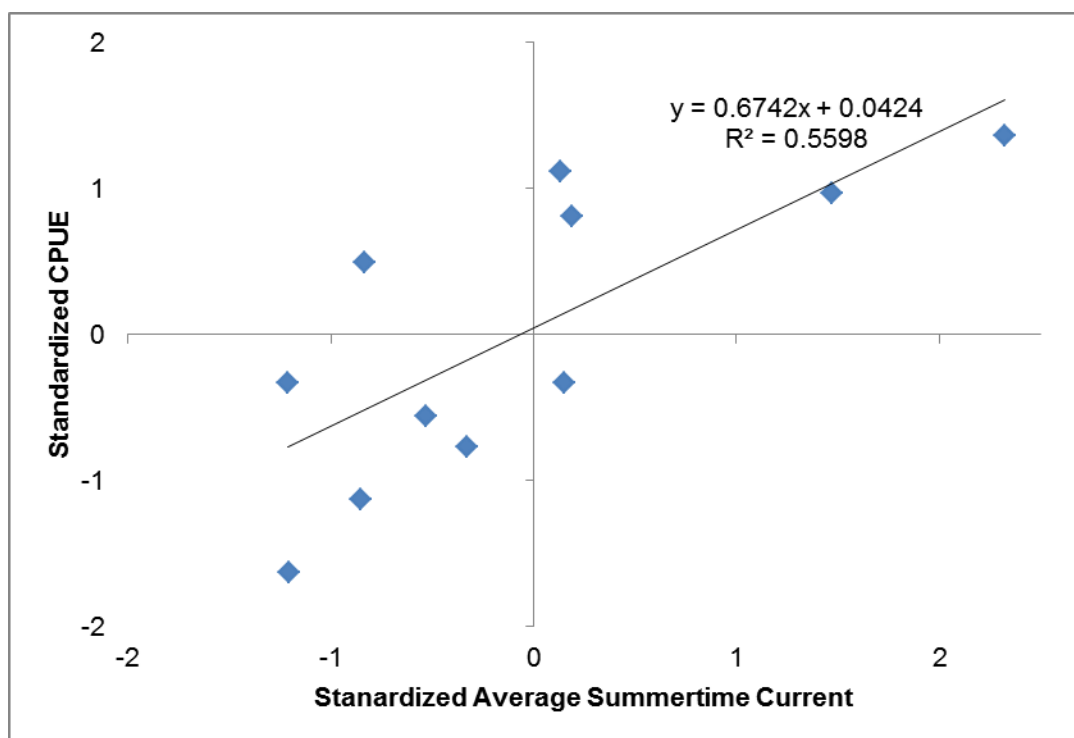


Figure 45. Standardized CPUE for uku from the MHI from 2002-2012 plotted against standardized average summertime zonal current with a phase lag of two years

4 REFERENCES

- Allen, M., C. Fleming, B. Zito, S. Gonyo, S. Regan, and E. Towle. 2022. National Coral Reef Monitoring Program Socioeconomic Monitoring Component: Summary Findings for Hawai'i, 2020. Page U.S. Dep. Commerce, NOAA Technical Memorandum CRCP.
- 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. H-08-04.
- Andrews, A. H., J. Brodziak, E. E. DeMartini, and E. Cruz. 2020. Long-lived life history for onaga *Etelis coruscans* in the Hawaiian Islands. *Marine and Freshwater Research* 72(6):848–859.
- Andrews, A. H., E. E. DeMartini, J. Brodziak, R. S. Nichols, and R. L. Humphreys. 2012. A long-lived life history for a tropical, deepwater snapper (*Pristipomoides filamentosus*): bomb radiocarbon and lead–radium dating as extensions of daily increment analyses in otoliths. *Canadian Journal of Fisheries and Aquatic Sciences* 69(11):1850–1869.
- Andrews, A. H., E. E. DeMartini, J. Brodziak, R. S. Nichols, and R. L. Humphreys. 2019. Growth and longevity of Hawaiian grouper (*Hyporthodus quernus*) — input for management and conservation of a large, slow-growing grouper. *Canadian Journal of Fisheries and Aquatic Sciences* 76:1874–1884.
- Andrews, A. H., E. E. DeMartini, J. A. Eble, B. M. Taylor, D. C. Lou, and R. L. Humphreys. 2016. Age and growth of bluespine unicornfish (*Naso unicornis*): A half-century life-span for a keystone browser, with a novel approach to bomb radiocarbon dating in the Hawaiian Islands. *Canadian Journal of Fisheries and Aquatic Sciences* 73(10):1575–1586.
- Andrews, A. H., and T. R. Scofield. 2021. Early overcounting in otoliths: a case study of age and growth for gindai (*Pristipomoides zonatus*) using bomb ¹⁴C dating. *Fisheries and Aquatic Sciences* 24(1):53–62.
- Arita, S., M. Pan, J. Hospital, and P. S. Leung. 2011. Contribution, linkages, and impacts of the fisheries sector to Hawaii's economy: a social accounting matrix analysis. . SOEST Publication 11-01, JIMAR Contribution 11-373.
- Asher, J., I. D. Williams, and E. S. Harvey. 2017. An Assessment of Mobile Predator Populations along shallow and Mesophotic Depth Gradients in the Hawaiian Archipelago. *Scientific Reports* 7:3905.
- Aviso. 2024. ENSO Maps. Ocean Bulletin, Centre National D'études Spatiales. https://bulletin.aviso.altimetry.fr/html/produits/indic/enso/welcome_uk.php.
- Ayers, A. 2022. Ecosystem & Socioeconomic Profile of uku (*Aprion virescens*) in the main Hawaiian Islands.
- Ayers, A., and K. Leong. 2020. Stories of Conservation Success: Results of Interviews with Hawaii Longline Fishers. H-20-11.
- Ayers, A., K. Leong, J. Hospital, C. Tam, and R. Morioka. 2024. 2023 Hawai'i fisher observations data summary and analysis. DR-24-09.
- Ayotte, P., K. McCoy, A. Heenan, I. Williams, and J. Zamzow. 2015. Coral Reef Ecosystem Division standard operating procedures: data collection for Rapid Ecological Assessment fish surveys. H-15-07.
- BOEM. 2017. Hawaii Activities. <https://www.boem.gov/renewable-energy/state-activities/hawaii-activities>.

- Brinson, A. A., E. M. Thunberg, and K. Farrow. 2015. The Economic Performance of U. S. NonCatch Share Programs. NMFS-F/SPO-150.
- Calhoun, S., K. Leong, and J. Hospital. 2020. Hawai'i bottomfish heritage project: traditions and fishery development. NMFS-PIFSC-97.
- Chan, H. L. 2023. Economic Contributions of U. S. Commercial Fisheries in American Samoa. NOAA-TM-NMFS-PIFSC-151.
- Chan, H. L., and M. Pan. 2017. Economic and Social Characteristics of the Hawaii Small Boat Fishery 2014. NOAA-TM-NMFS-PIFSC-63.
- Chang, Y. L., Y. Miyazawa, and M. Beguer-Pon. 2017. The dynamical impact of mesoscale eddies on migration of Japanese eel larvae. PLOS ONE 12(3):e0172501.
- Davidson, K., M. Pan, W. Hu, 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):136–154.
- DeMartini, E., A. Andrews, K. Howard, B. Taylor, D. Lou, and M. Donovan. 2017. Comparative growth, age at maturity and sex change and longevity of Hawaiian parrotfishes with bomb radiocarbon validation. Canadian Journal of Fisheries and Aquatic Sciences 15(51):1–31.
- DeMartini, E. E. 2016. Body size at sexual maturity in the eteline snappers *Etelis carbunculus* and *Pristipomoides sieboldii*: subregional comparisons between the main and north-western Hawaiian Islands. Marine and Freshwater Research 68:1178–1186.
- DeMartini, E. E., A. R. Everson, and R. S. Nichols. 2010. Estimates of body sizes at maturation and at sex change, and the spawning seasonality and sex ratio of the endemic Hawaiian grouper (*Hyporthodus quernus*, F. Epinephelidae). Fishery Bulletin 109:123–134.
- DeMartini, E. E., and K. G. Howard. 2016. Comparisons of body sizes at sexual maturity and at sex change in the parrotfishes of Hawaii: input needed for management regulations and stock assessments. Journal of Fish Biology 88(2):523–541.
- DeMartini, E. E., M. L. McCracken, R. B. Moffitt, and J. A. Wetherall. 2005. Relative pleopod length as an indicator of size at sexual maturity in slipper (*Scyllarides squammosus*) and spiny Hawaiian (*Panulirus marginatus*) lobsters. Fishery Bulletin 103(1):23–33.
- DeMartini, E., R. Langston, and J. Eble. 2014. Spawning seasonality and body sizes at sexual maturity in the bluespine unicornfish, *Naso unicornis* (Acanthuridae). Ichthyological Research 61:243–251.
- Drazen, J. C., V. Moriwake, D. Sackett, and C. Demarke. 2014. Evaluating the effectiveness of restricted fishing areas for improving the bottomfish fishery in the Main Hawaiian Islands. State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources, Honolulu.
- Everson, A., H. Williams, and B. Ito. 1989. Maturation and Reproduction in Two Hawaiian Eteline Snappers, *Aprion virescens*, and *Onaga*, *Etelis coruscans*. Fishery Bulletin 87(4):877–888.
- Fabry, V. J., B. A. Seibel, R. A. Feely, and J. C. Orr. 2008. Impacts of ocean acidification on marine fauna and ecosystem processes. ICES Journal of Marine Science 65(3):414–432.
- Feely, R. A., S. R. Alin, B. Carter, N. Bednarsek, B. Hales, F. Chan, T. M. Hill, B. Gaylord, E. Sanford, R. H. Byrne, C. L. Sabine, D. Greeley, and L. Juranek. 2016. Chemical and biological impacts of ocean acidification along the west coast of North America. Estuarine, Coastal and Shelf Science 183:260–270.
- Figueroa, D. F., and A. R. Baco. 2014. Complete mitochondrial genomes elucidate phylogenetic relationships of the deep-sea octocoral families Coralliidae and Paragorgiidae. Deep Sea

- Research Part II: Topical Studies in Oceanography 99:83–91.
- Franklin, E. C. 2021. Model-based Essential Fish Habitat Definitions for the Uku Aprion virescens in the Main Hawaiian Islands. Western Pacific Regional Fishery Management Council, Honolulu.
- Free, C. M., J. T. Thorson, M. L. Pinsky, K. L. Oken, J. Wiedenmann, and O. P. Jensen. 2019. Impacts of historical warming on marine fisheries production. *Science* 363(6430):979–983.
- Geslani, C., M. Loke, B. Takenaka, and P. S. Leung. 2012. Hawaii's seafood consumption and its supply sources. . SOEST Publication 12-01, JIMAR Contribution 12-0379.
- Haight, W. R., D. R. Kobayashi, and K. E. Kawamoto. 1993a. Biology and Management of Deepwater Snappers of the Hawaiian Archipelago. *Marine Fisheries Review* 55(2):20–27.
- Haight, W. R., J. D. Parrish, and T. A. Hayes. 1993b. Feeding Ecology of Deepwater Lutjanid Snappers at Penguin Bank, Hawaii. *Transactions of the American Fisheries Society* 122:328–347.
- Hamilton, M. S., and S. W. Huffman. 1997. Cost-earnings study of Hawaii's small boat fishery. SOEST Publication 97-06, JIMAR Contribution 97-314.
- Hawaii Office of Planning. 2020. 2020 Ocean Resources Management Plan: Coastal Zone Management Mauka to Makai.
- Hospital, J., and C. Beavers. 2011. Management of the main Hawaiian Islands bottomfish fishery: fishers' attitudes, perceptions, and comments. H-11-06.
- Hospital, J., and C. Beavers. 2012. Economic and social characteristics of bottomfish fishing in the main Hawaiian Islands. H-12-01.
- Hospital, J., S. S. Bruce, and M. Pan. 2011. Economic and social characteristics of the Hawaii small boat pelagic fishery. H-11-01.
- Hospital, J., and K. Leong. 2021. Community Participation in Hawai'i Commercial Fisheries. NOAA-TM-NMFS-PIFSC-119.
- Hospital, J., and M. Pan. 2009. Demand for Hawaii bottomfish revisited: incorporating economics into total allowable catch management. NOAA-TM-NMFS-PIFSC-20.
- HOT. 2025. Hawaii Ocean Time Series Data Organization & Graphical System (HOT-DOGS). <https://hahana.soest.hawaii.edu/hot/hot-dogs/bseries.html>.
- Huffman, G. J., R. F. Adler, P. Arkin, A. Chang, R. Ferraro, A. Gruber, J. Janowiak, A. McNab, B. Rudolf, and U. Schneider. 1997. The global precipitation climatology project (GPCP) combined precipitation dataset. *Bulletin of the American Meteorological Society* 78(1):5–20.
- Jepson, M., and L. Colburn. 2013. Development of Social Indicators of Fishing Community Vulnerability and Resilience in the U.S. Southeast and Northeast Regions. NMFS-F/SPO-129.
- Kapur, M. R., M. D. Fitchett, A. J. Yau, and F. Carvalho. 2019. 2018 Benchmark Stock Assessment of Main Hawaiian Islands Kona Crab. NMFS-PIFSC-77.
- Karl, D. M., and R. Lukas. 1996. The Hawaii Ocean Time-series program: Background, rationale and field implementation. *Deep-Sea Research Part II: Topical Studies in Oceanography* 43:129–156.
- Keeling, C. D., R. B. Bacastow, A. E. Bainbridge, C. A. Ekdahl, P. R. Guenther, and L. S. Waterman. 1976. Atmospheric carbon dioxide variations at Mauna Loa Observatory, Hawaii. *Tellus* 28:538–551.
- Kendall Enterprise Inc. 2014. Advancing bottomfish assessment in the Pacific Islands region. Pacific Island Fisheries Science Center, Honolulu.

- Kitiona, F., S. Spalding, and M. Sabater. 2016. The impacts of climate change on coastal fisheries in American Samoa. University of Hawaii, Hilo.
- Kleiber, D., M. Iwane, K. Kamikawa, K. Leong, and J. Hospital. 2022. Pacific Islands Region Fisheries and COVID-19: Impacts and adaptations. NOAA-TM-NMFS-PIFSC-130.
- Kleiber, D., D. Kotowicz, and J. Hospital. 2018. Applying national community social vulnerability indicators to fishing communities in the Pacific Island region. Page U. S. Dep. of Commer., NOAA Tech. Memo. NOAA-TM-NMFS-PIFSC-65.
- Knapp, K. R., H. J. Diamond, J. P. Kossin, M. C. Kruk, and C. J. Schreck. 2018. International Best Track Archive for Climate Stewardship (IBTrACS) Project, Version 4.
- Knapp, K. R., M. C. Kruk, D. H. Levinson, H. J. Diamond, 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* 91:363–376.
- Kobayashi, D., and K. Kawamoto. 1995. Evaluation of shark, dolphin, and monk seal interactions with NWHI bottomfishing activity: A comparison of two time periods and an estimate of economic impacts. *Fisheries Research* 23:11–22.
- Kobayashi, S., Y. Ota, Y. Harada, A. Ebita, M. Moriya, H. Onoda, K. Onogi, H. Kamahori, C. Kobayashi, H. Endo, K. Miyaoka, and K. Takahashi. 2015. The JRA-55 Reanalysis: general specifications and basic characteristics. *Journal of the Meteorological Society of Japan* 93:5–48.
- Lamirand, M., P. Lozada-Misa, B. Vargas-Ángel, C. Couch, B. D. Schumacher, and M. Winston. 2022. Analysis of benthic survey images via CoralNet: A summary of standard operating procedures and guidelines. H-22-03.
- Lee, H. T. 2018. NOAA Climate Data Record (RCD) of Monthly Outgoing Longwave Radiation (OLR), Version 2.7. .
- León-Chávez, C. A., L. Sánchez-Velasco, E. Beier, M. F. Lavín, V. M. Godínez, and J. Färber-Lorda. 2010. Larval fish assemblages and circulation in the Eastern Tropical Pacific in autumn and winter. *Journal of Plankton Research* 32(4):397–410.
- Leong, K. M., R. J. Ingram, D. Kleiber, S. H. Long, A. Mastitski, K. Norman, C. Weng, and S. Wise. 2024. Aligning fisheries terminology with diverse social benefits. *Marine Policy* 170:106377.
- Lobel, P. S. 1989. Ocean current variability and the spawning season of Hawaiian reef fishes. *Environmental Biology of Fishes* 24(3):161–171.
- Lobel, P. S., and A. R. Robinson. 1986. Transport and entrapment of fish larvae by ocean mesoscale eddies and currents in Hawaiian waters. *Deep Sea Research Part A. Oceanographic Research Papers* 33:483–500.
- Luers, M. A., E. E. DeMartini, and R. L. Humphreys. 2017. Seasonality, sex ratio, spawning frequency and sexual maturity of the opakapaka *Pristipomoides filamentosus* (Perciformes: Lutjanidae) from the Main Hawaiian Islands: fundamental input to size-at-retention regulations. *Marine and Freshwater Research* 69(2):325–335.
- Ma, H., and T. K. Ogawa. 2016. Hawaii Marine Recreational Fishing Survey: A Summary of Current Sampling, Estimation, and Data Analyses. NOAAAPPENDIX ATMNMFS-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., NOAAAPPENDIX ATM-NMFS-PIFSC-58.
- Mantua, N. J., S. R. Hare, Y. Zhang, J. M. Wallace, and R. C. R. C. Francis. 1997. A Pacific

- Interdecadal Climate Oscillation with Impacts on Salmon Production. *Bulletin of the American Meteorological Society* 78:1069–1079.
- Markrich, M., and C. Hawkins. 2016. Fishing Fleets and Fishery Profiles: Management – Vessels – Gear – Economics. Page Pacific Islands Fishery Monographs No. 5. Western Pacific Regional Fishery Management Council, Honolulu.
- Mazzarella, A., A. Giuliacci, and N. Scafetta. 2013. Quantifying the Multivariate ENSO Index (MEI) Coupling to CO₂ Concentration and to the Length of Day Variations. *Theoretical and Applied Chemistry* 111(3):601–607.
- Merritt, D., M. K. Donovan, C. Kelley, L. Waterhouse, M. Parke, K. Wong, and J. C. Drazen. 2011. BotCam: a baited camera system for nonextractive monitoring of bottomfish species. *Fishery Bulletin* 109(1):56–67.
- Meyer, C. G., Y. P. Papastamatiou, and K. N. Holland. 2007. Seasonal, diel, and tidal movements of green jobfish (*Aprion virescens*, Lutjanidae) at remote Hawaiian atolls: implications for marine protected area design. *Marine Biology* 151(6):2133–2143.
- Miller, J. M. 1974. Nearshore Distribution of Hawaiian Marine Fish Larvae: Effects of Water Quality, Turbidity and Currents. Page in J. Blaxter, editor. *The Early Life History of Fish*. Springer, Berlin.
- Misa, W. 2012. Establishing Species-Habitat Associations for 4 Eteline Snappers Using a Baited Stereo-Video Camera System. Honolulu HI.
- Moffitt, R. B. 2006. Biological data and stock assessment methodologies for deep-slope bottomfish resources in the Hawaiian archipelago. Pages 301–308 *Deep Sea 2003: Conference on the governance and management of deep-sea fisheries*. Conference poster papers and workshop papers.
- Moffitt, R. B., D. R. Kobayashi, and G. T. DiNardo. 2005. Status of the Hawaiian Bottomfish Stocks, 2004. NOAA-TM-NMFS-PIFSC-60.
- Moore, C. H., J. C. Drazen, and C. Kelley. 2013. Deepwater marine protected areas of the main Hawaiian Islands: Establishing baselines for commercially valuable bottomfish populations. *Marine Ecology Progress Series* 476:167–183.
- Nadon, M. O. 2017. Stock assessment of the coral reef fishes of Hawaii, 2016. NOAA Technical Memorandum, NMFS-PIFSC-60. Honolulu HI.
- Nadon, M. O. 2024. Stock assessment of Uku (*Aprion virescens*) in Hawai‘i, 2024 update. NMFS-PIFSC-171.
- Nadon, M. O., and J. S. Ault. 2016. A stepwise stochastic simulation approach to estimate life history parameters for data-poor fisheries. *Canadian Journal of Fisheries and Aquatic Sciences* 73:1–11.
- Nadon, M. O., M. Sculley, and F. Carvalho. 2020. Stock Assessment of Uku (*Aprion virescens*) in Hawaii, 2020.
- NCRMP. 2016a. Socioeconomic Monitoring for Hawaii. Page Updated.
- NCRMP. 2016b. National Coral Reef Monitoring Program Socioeconomic Monitoring for Hawaii.
- Newman, M., M. A. Alexander, T. R. Ault, K. M. Cobb, C. Deser, E. Di Lorenzo, N. J. Mantua, A. J. Miller, S. Minobe, H. Nakamura, N. Schneider, D. J. Vimont, A. S. Phillips, J. D. Scott, and C. A. Smith. 2016. The Pacific Decadal Oscillation, Revisited. *Journal of Climate* 29(12):4399–4427.
- Nichols, R. S., E. E. DeMartini, A. H. Andrews, J. C. Drazen, and E. C. Franklin. 2019. An Archipelagic Understanding of the Sex-Specific Variation in Growth and Length

- Distribution of a Tropical Deepwater Snapper, *Etelis carbunculus*. University of Hawai'i at Manoa.
- 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.
- NMFS. 2019. Biological Evaluation: Potential Effects of Main Hawaiian Islands Bottomfish Fisheries on the Oceanic Whitetip Shark, Giant Manta Ray, and Critical Habitat of the Main Hawaiian Islands Insular False Killer Whale Distinct Population Segment. NMFS Pacific Islands Regional Office, Honolulu.
- NMFS. 2023. Fisheries Economics of the United States 2020. NMFS-F/SPO-236.
- NOAA. 2019, April 5. Multivariate ENSO Index Version 2 (MEI.v2). <https://www.esrl.noaa.gov/psd/enso/mei/>.
- NOAA. 2025a. Trends in Atmospheric Carbon Dioxide. <https://gml.noaa.gov/ccgg/trends/data.html>.
- NOAA. 2025b. Pacific Decadal Oscillation (PDO). <https://psl.noaa.gov/pdo/>.
- NOAA. 2025c. NOAA's International Best Track Archive for Climate Stewardship (IBTrACS) data. . <https://www.ncei.noaa.gov/data/international-best-track-archive-for-climate-stewardship-ibtracs/v04r00/access/csv/>.
- NOAA. 2025d. NCEP Global Ocean Data Assimilation System (GODAS).
- NOAA Climate Prediction Center (CPC). 2025. Oceanic Niño Index. <https://www.cpc.ncep.noaa.gov/data/indices/oni.ascii.txt>.
- NOAA CoastWatch. 2024. Sea level Anomaly and Geostrophic Currents, multi-mission, global, optimal interpolation, gridded. . <https://coastwatch.noaa.gov/cwn/products/sea-level-anomaly-and-geostrophic-currents-multi-mission-global-optimal-interpolation.html>.
- NOAA Coral Reef Watch. 2024. Hawaii 5 km Regional Virtual Station Time Series Graphs.
- NOAA ESRL. 2024. CMAP Precipitation. <https://psl.noaa.gov/data/gridded/>.
- NOAA OceanWatch. 2025a. Sea Surface Temperature, Coral Reef Watch, CoralTemp, v3.1 - Monthly, 1985-present. . https://oceanwatch.pifsc.noaa.gov/erddap/griddap/CRW_sst_v3_1_monthly.html.
- NOAA OceanWatch. 2025b. Chlorophyll a concentration, ESA OC CCI - Monthly, 1997-2023 v6.0. <https://oceanwatch.pifsc.noaa.gov/erddap/griddap/esa-cci-chla-monthly-v6-0.html>.
- O'Malley, J. M. 2009. Spatial and temporal variability in growth of Hawaiian spiny lobsters in the Northwestern Hawaiian Islands. *Marine and Coastal Fisheries* 1:325–342.
- O'Malley, J. M., B. M. Taylor, and A. H. Andrews. 2016. Feasibility of Ageing Hawaiian Archipelago Uku (*Aprion virescens*). H-16-06.
- O'Malley, J. M., C. B. Wakefield, M. J. Kinney, and S. J. Newman. 2021. Markedly similar growth and longevity of Green Jobfish over an expansive geographic range between the Hawaiian Archipelago and the eastern Indian Ocean. *Marine and Coastal Fisheries* 13(3):253–262.
- Ochavillo, D. 2012. Coral Reef Fishery Assessment in American Samoa. Department of Marine and Wildlife Resources, Pago Pago.
- Opresko, D. M. 2009. A New Name for the Hawaiian Antipatharian Coral Formerly Known as *Antipathes dichotoma* (Cnidaria: Anthozoa: Antipatharia) 1. *Pacific Science* 63(2):277–292.
- Oyafuso, Z. S., J. C. Drazen, C. H. Moore, and E. C. Franklin. 2017. Habitat-based species distribution modelling of the Hawaiian deepwater snapper-grouper complex. *Fisheries Research* 195:19–27.

- Pan, M. 2014. Economic characteristics and management challenges of the Hawaii pelagic longline fisheries: Will a catch share program help? *Marine Policy* 44:18–26.
- Pardee, C., J. Wiley, and S. Springer. 2021. Age, growth and maturity for two highly targeted jack species: *Caranx ignobilis* and *Caranx melampygus*. *Journal of Fish Biology* 99(4):1247–1255.
- Parke, M. 2007. Linking Hawaii Fisherman Reported Commercial Bottomfish Catch Data to Potential Bottomfish Habitat and Proposed Restricted Fishing Areas using GIS and Spatial Analysis. NOAA-TM-NMFS-PIFSC-11.
- PIFSC. 2021. Indo-Pacific Snapper, Emperor, Jack, and Grouper Age, Growth, Mortality, Maturity, and Habitat Review and Recommendations for Use in Stock Assessments and Management. IR-21-010, Honolulu.
- Progression Energy. 2015. Unsolicited Application for a Section 585 Commercial Wind Lease on the Outer Continental Shelf Offshore of the South Coast of Oahu.
- Ralston, S., and D. T. Tagami. 1992. An assessment of the exploitable biomass of *Heterocarpus laevis* in the main Hawaiian Islands. Part I: Trapping surveys, depletion experiment, and length structure. *Fishery Bulletin* 90(3):494–504.
- Reed, E. M., N. J. Brown-Peterson, E. E. DeMartini, and A. Andrews. 2021. Reproductive characteristics of Longtailed Red Snapper (*Onaga, Etelis coruscans*) in the Main Hawaiian Islands.
- Restrepo, V. R., G. G. Thompson, P. M. Mace, W. L. Gabriel, L. L. Low, A. D. MacCall, R. D. Methot, J. E. Powers, B. L. Taylor, P. R. Wade, and J. F. Witzig. 1998. Technical Guidance on the use of precautionary approaches to implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act. NOAA-TM-NMGS-F/SPO-31.
- Reynolds, R. W. 1988. A real-time global sea surface temperature analysis. *Journal of Climate* 1(1):75–87.
- Richards, B. L., S. G. Smith, and J. S. Ault. 2022. Annual Report: 2020 Fall Bottomfish Fishery-Independent Survey in Hawai‘i. NOAA-TM-PIFSC-125.
- Richards, B. L., I. D. Williams, O. J. Vetter, and G. J. Williams. 2012. Environmental factors affecting large-bodied coral reef fish assemblages in the Mariana Archipelago. *PLoS ONE* 7(2):e31374.
- Richards, B., S. Smith, J. Ault, G. DiNardo, D. Kobayashi, R. Domokos, J. Anderson, W. Misa, L. Giuseffi, A. Rollo, D. Merritt, J. Drazen, M. Clarke, and C. Tam. 2016. Design and Implementation of a Bottomfish Fishery-independent Survey in the Main Hawaiian Islands. NOAA-TMNMFS-PIFSC-53.
- Richmond, L., D. Kotowicz, and J. Hospital. 2015. Monitoring socioeconomic impacts of Hawai‘i’s 2010 bigeye tuna closure: Complexities of local management in a global fishery. *Ocean and Coastal Management* 106:87–96.
- Richmond, L., and A. Levine. 2012. Institutional analysis of community-based marine resource management initiatives in Hawai‘i and American Samoa. NMFS-PIFSC-35, Honolulu.
- Ricker, W. 1975. Computation and interpretation of biological statistics of fish populations.
- Ryan, W. B. F., S. M. Carbotte, J. O. Coplan, S. O’Hara, A. Melkonian, R. Arko, R. A. Weissel, V. Ferrini, A. Goodwillie, F. Nitsche, J. Bonczkowski, and R. Zemsky. 2009. Global Multi-Resolution Topography synthesis. *Geochemistry, Geophysics, Geosystems* 10:Q03014.
- Sainsbury, N. C., M. J. Genner, G. R. Saville, J. K. Pinnegar, C. K. O’Neill, S. D. Simpson, and R. A. Turner. 2018. Changing storminess and global capture fisheries. *Nature Climate*

- Change 8(8):655–659.
- Schemmel, E., A. M. Friedlander, P. Andrade, K. Keakealani, L. M. Castro, C. Wiggins, B. A. Wilcox, Y. Yasutake, and J. N. Kittinger. 2016. The codevelopment of coastal fisheries monitoring methods to support local management. *Ecology and Society* 21(4).
- Schmidt, A. L., J. L. Whitney, J. Suca, and K. Tanaka. 2023. NOAA Fisheries Larval ecology of *Aprion virescens*: a review from historical data . TM-PIFSC-145.
- Shields, M., P. Duffy, W. Musial, M. Laurienti, D. Heimiller, R. Spencer, and M. Optis. 2021. The Cost and Feasibility of Floating Offshore Wind Energy in the O`ahu Region. . National Renewable Energy Laboratory, Golden, CO.
- Shulzitski, K., S. Sponaugle, M. Hauff, K. D. Walter, E. K. D'Alessandro, and R. K. Cowen. 2017. Patterns in larval reef fish distributions and assemblages, with implications for local retention in mesoscale eddies. *Canadian Journal of Fisheries and Aquatic Sciences* 75(2):180–192.
- Sinniger, F., O. V Ocana, and A. R. Baco. 2013. Diversity of Zoanthids (Anthozoa: Hexacorallia) on Hawaiian seamounts: description of the Hawaiian gold coral and additional zoanthids. *PloS one* 8(1):e52607.
- Smith, S. G., J. S. Ault, J. A. Bohnsack, D. E. Harper, J. Luo, and D. B. McClellan. 2011. Multispecies survey design for assessing reef-fish stocks, spatially explicit management performance, and ecosystem condition. *Fisheries Research* 109(1):29–41.
- Smith, S. L., S. Cook, A. Golden, M. A. Iwane, D. Kleiber, K. M. Leong, A. Mastitski, L. Richmond, M. Szymkowiak, and S. Wise. 2022. Review of adaptations of U. S. Commercial Fisheries in response to the COVID-19 pandemic using the Resist-Accept-Direct (RAD) framework. *Fisheries Management and Ecology* 29:439–455.
- Spencer, R. W. 1993. Global oceanic precipitation from the MSU during 1979-91 and comparisons to other climatologies. *Journal of Climate* 6(7):1301–1326.
- Stawitz, C., and B. Li. 2025. nmfspalette: A Color Palette for NOAA Fisheries. R package.
- Stoffle, B. W., and S. D. Allen. 2012. The Sociocultural Importance of Spearfishing In Hawaii.
- Sundberg, M., and K. Underkoffler. 2011. Size composition and length-weight data for bottomfish and pelagic species sampled at the United Fishing Agency Fish Auction in Honolulu, Hawaii from October 2007 to December 2009. H-11-04.
- Syslo, J., J. Brodziak, and F. Carvalho. 2021. Stock assessment update for the main Hawaiian Islands deep 7 bottomfish complex in 2021, with catch projections through 2025. NMFS-PIFSC-118.
- Syslo, J., M. Oshima, H. Ma, N. Ducharme-Barth, M. Nadon, and F. Carvalho. 2024. Benchmark stock assessment for the main Hawaiian Islands Deep 7 bottomfish complex in 2024 with catch projections through 2029. NOAA-TM-NMFS-PIFSC-157.
- Tagami, D. T., and S. Ralston. 1988. An assessment of exploitable biomass and projection of maximum sustainable yield for *Heterocarpus laevigatus* in the Hawaiian Islands. H-88-14.
- Tanaka, K. 2022. Spatiotemporal Assessment of *Aprion Virescens* Density in Shallow Main Hawaiian Islands Waters, 2010-2019.
- Thoning, K. W., P. P. Tans, 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* 94:8549–8565.
- Walsh, W. J. 1987. Patterns of recruitment and spawning in Hawaiian reef fishes. *Environmental Biology of Fishes* 18(4):257–276.
- Wolter, K., and M. S. Timlin. 2011. El Niño/Southern Oscillation Behaviour since 1871 as

- Diagnosed in an Extended Multivariate ENSO Index (MEI.ext). *International Journal of Climatology* 31(7):1074–1087.
- WPRFMC. 2007. Amendment 14 to the Fishery Management Plan for Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region, including a final supplemental environmental impact statement, regulatory impact review, and an initial regulatory flexibility analysis. Western Pacific Regional Fishery Management Council, Honolulu.
- WPRFMC. 2009. Fishery Ecosystem Plan for the Hawaii Archipelago. Western Pacific Regional Fishery Management Council, Honolulu.
- WPRFMC. 2011. Omnibus Amendment for the Western Pacific Region to Establish a Process for Specifying Annual Catch Limits and Accountability Measures. Western Pacific Regional Fishery Management Council, Honolulu.
- WPRFMC. 2018. Amendment 5 to the Fishery Ecosystem Plan for the Hawaii Archipelago – Ecosystem Components. Western Pacific Regional Fishery Management Council, RIN 0648-BH63, Honolulu.
- WPRFMC. 2023. Annual SAFE Report for the Hawaii Archipelago Fishery Ecosystem Plan 2022. . Page A. I. T Remington J DeMello, editor. Western Pacific Regional Fishery Management Council, Honolulu.
- Wren, J. L. K., and D. R. Kobayashi. 2016. Exploration of the “larval pool”: development and ground-truthing of a larval transport model off leeward Hawai`i. *PeerJ* 4:e1636.
- Wren, J. L. K., D. R. Kobayashi, Y. Jia, and R. J. Toonen. 2016. Modeled Population Connectivity across the Hawaiian Archipelago. *PLoS ONE* 11(12):e0167626.
- Xie, P., and P. A. Arkin. 1997. Global precipitation: A 17-year monthly analysis based on gauge observations, satellite estimates, and numerical model outputs. *Bulletin of the American Meteorological Society* 78(11):2539–2558.
- Yau, A. 2018. Report from Hawaii bottomfish commercial fishery data workshops, 2015-2016. NMFS-PIFSC-68.
- Zeebe, R. E., and D. A. Wolf-Gladrow. 2001. CO₂ in Seawater Systems: Equilibrium, Kinetics, Isotopes. https://www.soest.hawaii.edu/oceanography/faculty/zeebe_files/CO2_System_in_Seawater/csys.html.

APPENDIX A: LIST OF SPECIES**HAWAII MANAGEMENT UNIT SPECIES****1. MHI Deep-7 Bottomfish Multi-Species Stock Complex (FSSI)**

DAR Species Code	Species Name	Scientific Name
19	pink snapper (‘ōpakapaka)	<i>Pristipomoides filamentosus</i>
22	longtail snapper (onaga)	<i>Etelis coruscans</i>
21	squirrelfish snapper (ehu)	<i>Etelis carbunculus</i>
15	sea bass (hapu‘upu‘u)	<i>Epinephelus quernus</i>
97	snapper (gindai)	<i>Pristipomoides zonatus</i>
17	pink snapper (kalekale)	<i>Pristipomoides sieboldii</i>
58	silver jaw jobfish (lehi)	<i>Aphareus rutilans</i>

2. MHI Non-Deep-7 Bottomfish Multi-Species Stock Complex (non-FSSI)

DAR Species Code	Species Name	Scientific Name
20	gray jobfish (uku)	<i>Aprion virescens</i>

3. Seamount groundfish Complex (non-FSSI)

DAR Species Code	Species Name	Scientific Name
140	Armorhead	<i>Pentaceros wheeleri</i>
141	Alfonsin	<i>Beryx splendens</i>
None	Ratfish/butterfish	<i>Hyperoglyphe japonica</i>

4. Crustacean deep-water shrimp Complex (non-FSSI)

DAR Species Code	Species Name	Scientific Name
708	deepwater shrimp	<i>Heterocarpus</i> spp.

709	deepwater shrimp (ensifer)	<i>Heterocarpus</i> spp.
-----	----------------------------	--------------------------

5. Crustacean Kona crab Complex (non-FSSI)

DAR Species Code	Species Name	Scientific Name
701	Kona crab	<i>Ranina ranina</i>

6. 'Au'au Channel Black Coral Complex (non-FSSI)

DAR Species Code	Species Name	Scientific Name
860	Black Coral	<i>Antipathes griggi</i>
860	Black Coral	<i>Antipathes grandis</i>
860	Black Coral	<i>Myriopathes ulex</i>

7. Precious corals on identified and exploratory beds (non-FSSI)

DAR Species Code	Species Name	Scientific Name
871	Pink coral	<i>Pleurocorallium secundum</i>
873	Red coral	<i>Hemicorallium laauense</i>
881	Gold Coral	<i>Kulamanamana haumea</i> (prev. <i>Gerardia</i> spp.)
892	Bamboo coral	<i>Acanella</i> spp.

MONITORED ECOSYSTEM COMPONENT SPECIES

1. Species Selected for Monitoring by DLNR-DAR

DAR Species Code	Species Name	Scientific Name
18	bluefin trevally (omilu)	<i>Caranx melampygus</i>
47	whitemargin unicornfish (kala)	<i>Naso annulatus</i>
52	whitesaddle goatfish (kūmū)	<i>Parupeneus porphyus</i>
64	convict tang (manini)	<i>Acanthurus triostegus</i>

DAR Species Code	Species Name	Scientific Name
74	brown chub (nenu)	<i>Kyphosus bigibbus</i>
87/88/96	parrotfish (uhu)	Scaridae
114	bluestripe snapper (ta‘ape)	<i>Lutjanus kasmira</i>
716/717/718	lobster	Miscellaneous
724	limpets (‘opihi)	<i>Cellana</i> spp.
726	day octopus (day tako)	<i>Octopus cyanea</i>

2. Species Monitored by Trophic, Taxonomic, and Functional Groups

The species presented in Section 2.1 are displayed according to both trophic level and functional group as an effort to foster continued monitoring of ecosystem component species that are no longer categorized as management unit species. These species are monitored according to their ecosystem function as opposed to individually. Monitoring based on these factors allows for a broader outlook on the ecological composition of fish communities in areas of the Western Pacific. For trophic groupings, “H” stands for “Herbivore”, “Cor” stands for “Corallivore”, “PK” stands for “Planktivore”, “MI” stands for “Mobile Invertebrate Feeder”, “SI” stands for “Sessile-Invertebrate Feeder”, “Om” stands for “Omnivore”, and “Pisc” stands for “Piscivore”.

Family	Scientific Name	Trophic Group	Functional Group
Acanthuridae	<i>Naso lituratus</i>	H	Browsing Surgeons
Acanthuridae	<i>Naso tonganus</i>	H	Browsing Surgeons
Acanthuridae	<i>Naso unicornis</i>	H	Browsing Surgeons
Acanthuridae	<i>Naso brachycentron</i>	H	Browsing Surgeons
Acanthuridae	<i>Ctenochaetus cyanocheilus</i>	H	Mid-Large Target Surgeons
Acanthuridae	<i>Ctenochaetus strigosus</i>	H	Mid-Large Target Surgeons
Acanthuridae	<i>Acanthurus nigroris</i>	H	Mid-Large Target Surgeons
Acanthuridae	<i>Ctenochaetus hawaiiensis</i>	H	Mid-Large Target Surgeons
Acanthuridae	<i>Ctenochaetus striatus</i>	H	Mid-Large Target Surgeons
Acanthuridae	<i>Ctenochaetus marginatus</i>	H	Mid-Large Target Surgeons
Acanthuridae	<i>Acanthurus lineatus</i>	H	Mid-Large Target Surgeons
Acanthuridae	<i>Acanthurus blochii</i>	H	Mid-Large Target Surgeons
Acanthuridae	<i>Acanthurus dussumieri</i>	H	Mid-Large Target Surgeons
Acanthuridae	<i>Acanthurus xanthopterus</i>	H	Mid-Large Target Surgeons
Chaetodontidae	<i>Chaetodon flavocoronatus</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon multicinctus</i>	Cor	Non-PK Butterflyfish

Family	Scientific Name	Trophic Group	Functional Group
Chaetodontidae	<i>Chaetodon punctatofasciatus</i>	MI	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon mertensii</i>	H	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon citrinellus</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon pelewensis</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon lunulatus</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon melannotus</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon rafflesii</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon ulietensis</i>	MI	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon fremblii</i>	SI	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon quadrimaculatus</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon meyeri</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon reticulatus</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon trifascialis</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Heniochus chrysostomus</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon bennetti</i>	MI	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon tinkeri</i>	SI	Non-PK Butterflyfish
Chaetodontidae	<i>Heniochus varius</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon ornatissimus</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon unimaculatus</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon lunula</i>	SI	Non-PK Butterflyfish
Chaetodontidae	<i>Forcipiger longirostris</i>	MI	Non-PK Butterflyfish
Chaetodontidae	<i>Forcipiger flavissimus</i>	SI	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon ephippium</i>	MI	Non-PK Butterflyfish
Chaetodontidae	<i>Heniochus monoceros</i>	MI	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon auriga</i>	SI	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon vagabundus</i>	SI	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon semeion</i>	H	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodontidae</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Heniochus singularius</i>	Cor	Non-PK Butterflyfish
Chaetodontidae	<i>Chaetodon lineolatus</i>	SI	Non-PK Butterflyfish
Caracanthidae	<i>Caracanthus typicus</i>	MI	No Group
Gobiidae	<i>Eviota</i> sp.	MI	No Group
Pomacentridae	<i>Chrysiptera traceyi</i>	H	No Group
Apogonidae	<i>Ostorhinchus luteus</i>	Pk	No Group
Caracanthidae	<i>Caracanthus maculatus</i>	MI	No Group
Pseudochromidae	<i>Pseudochromis jamesi</i>	MI	No Group

Family	Scientific Name	Trophic Group	Functional Group
Pomacentridae	<i>Chromis acares</i>	Pk	No Group
Serranidae	<i>Luzonichthys whitleyi</i>	Pk	No Group
Pomacentridae	<i>Pomachromis guamensis</i>	Pk	No Group
Pomacentridae	<i>Pomachromis richardsoni</i>	Pk	No Group
Gobiidae	<i>Fusigobius duospilus</i>	MI	No Group
Pomacentridae	<i>Plectroglyphidodon imparipennis</i>	MI	No Group
Microdesmidae	<i>Nemateleotris helfrichi</i>	Pk	No Group
Pomacentridae	<i>Chromis leucura</i>	Pk	No Group
Syngnathidae	<i>Doryrhamphus excisus</i>	Pk	No Group
Pomacentridae	<i>Pomacentrus coelestis</i>	Pk	No Group
Clupeidae	<i>Spratelloides delicatulus</i>	Pk	No Group
Pomacentridae	<i>Chrysiptera biocellata</i>	H	No Group
Pseudochromidae	<i>Pictichromis porphyreus</i>	MI	No Group
Pomacanthidae	<i>Centropyge fisheri</i>	H	No Group
Cirrhitidae	<i>Cirrhitops hubbardi</i>	MI	No Group
Gobiidae	<i>Amblyeleotris fasciata</i>	Pk	No Group
Pomacentridae	<i>Chromis lepidolepis</i>	Pk	No Group
Pomacentridae	<i>Chromis margaritifer</i>	Pk	No Group
Pomacentridae	<i>Chromis ternatensis</i>	Pk	No Group
Pomacentridae	<i>Chromis viridis</i>	Pk	No Group
Pomacentridae	<i>Chrysiptera cyanea</i>	Pk	No Group
Pomacentridae	<i>Dascyllus aruanus</i>	Pk	No Group
Pomacentridae	<i>Dascyllus reticulatus</i>	Pk	No Group
Engraulidae	<i>Encrasicholina purpurea</i>	Pk	No Group
Pomacentridae	<i>Neopomacentrus metallicus</i>	Pk	No Group
Pomacentridae	<i>Chromis amboinensis</i>	H	No Group
Pomacentridae	<i>Chromis iomelas</i>	H	No Group
Pomacentridae	<i>Chrysiptera glauca</i>	H	No Group
Pomacentridae	<i>Chrysiptera taupou</i>	H	No Group
Labridae	<i>Labroides pectoralis</i>	MI	No Group
Labridae	<i>Pseudocheilinus hexataenia</i>	MI	No Group
Labridae	<i>Pseudocheilinus tetrataenia</i>	MI	No Group
Scorpaenidae	<i>Sebastapistes cyanostigma</i>	MI	No Group
Labridae	<i>Wetmorella nigropinnata</i>	MI	No Group
Pseudochromidae	<i>Pseudochromis</i> sp.	MI	No Group
Monacanthidae	<i>Pervagor marginalis</i>	Om	No Group

Family	Scientific Name	Trophic Group	Functional Group
Pomacentridae	<i>Chromis alpha</i>	Pk	No Group
Pomacentridae	<i>Plectroglyphidodon phoenixensis</i>	H	No Group
Gobiidae	<i>Amblyeleotris guttata</i>	Pk	No Group
Atherinidae	<i>Atherinomorus insularum</i>	Pk	No Group
Pomacentridae	<i>Chromis caudalis</i>	Pk	No Group
Pomacentridae	<i>Chromis hanui</i>	Pk	No Group
Labridae	<i>Cirrhilabrus katherinae</i>	Pk	No Group
Microdesmidae	<i>Nemateleotris magnifica</i>	Pk	No Group
Apogonidae	<i>Ostorhinchus angustatus</i>	Pk	No Group
Serranidae	<i>Pseudanthias bartlettorum</i>	Pk	No Group
Tetraodontidae	<i>Canthigaster jactator</i>	H	No Group
Tetraodontidae	<i>Canthigaster janthinoptera</i>	H	No Group
Tetraodontidae	<i>Canthigaster valentini</i>	H	No Group
Pomacanthidae	<i>Centropyge shepardi</i>	H	No Group
Pomacentridae	<i>Chrysiptera brownriggii</i>	H	No Group
Monacanthidae	<i>Oxymonacanthus longirostris</i>	Cor	No Group
Cirrhitidae	<i>Amblycirrhitus bimacula</i>	MI	No Group
Cirrhitidae	<i>Cirrhitichthys falco</i>	MI	No Group
Labridae	<i>Labroides rubrolabiatus</i>	MI	No Group
Cirrhitidae	<i>Neocirrhites armatus</i>	MI	No Group
Labridae	<i>Pseudojuloides splendens</i>	MI	No Group
Apogonidae	<i>Ostorhinchus novemfasciatus</i>	Pk	No Group
Labridae	<i>Pteragogus cryptus</i>	MI	No Group
Scorpaenidae	<i>Sebastapistes</i> sp.	Pisc	No Group
Scorpaenidae	<i>Taenianotus triacanthus</i>	Pisc	No Group
Pomacentridae	<i>Amphiprion perideraion</i>	Pk	No Group
Pomacentridae	<i>Chromis fumea</i>	Pk	No Group
Labridae	<i>Cirrhilabrus jordani</i>	Pk	No Group
Blenniidae	<i>Ecsenius bicolor</i>	Pk	No Group
Blenniidae	<i>Ecsenius midas</i>	Pk	No Group
Blenniidae	<i>Ecsenius opsifrontalis</i>	Pk	No Group
Pomacentridae	<i>Lepidozygus tapeinosoma</i>	Pk	No Group
Blenniidae	<i>Meiacanthus atrodorsalis</i>	Pk	No Group
Apogonidae	<i>Ostorhinchus apogonoides</i>	Pk	No Group

Family	Scientific Name	Trophic Group	Functional Group
Pomacentridae	<i>Plectroglyphidodon lacrymatus</i>	Pk	No Group
Pomacentridae	<i>Pomacentrus brachialis</i>	Pk	No Group
Pomacentridae	<i>Pomacentrus nigriradiatus</i>	Pk	No Group
Pomacentridae	<i>Pomacentrus philippinus</i>	Pk	No Group
Pomacentridae	<i>Pomacentrus vaiuli</i>	Pk	No Group
Serranidae	<i>Pseudanthias dispar</i>	Pk	No Group
Serranidae	<i>Pseudanthias hawaiiensis</i>	Pk	No Group
Tetraodontidae	<i>Canthigaster bennetti</i>	H	No Group
Pomacanthidae	<i>Centropyge bispinosa</i>	H	No Group
Pomacanthidae	<i>Centropyge heraldi</i>	H	No Group
Pomacanthidae	<i>Centropyge loricula</i>	H	No Group
Blenniidae	<i>Cirripectes obscurus</i>	H	No Group
Blenniidae	<i>Cirripectes polyzona</i>	H	No Group
Blenniidae	<i>Cirripectes sp.</i>	H	No Group
Blenniidae	<i>Cirripectes springeri</i>	H	No Group
Blenniidae	<i>Cirripectes stigmaticus</i>	H	No Group
Blenniidae	<i>Cirripectes variolosus</i>	H	No Group
Callionymidae	<i>Callionymidae</i>	MI	No Group
Labridae	<i>Labroides phthirophagus</i>	MI	No Group
Pomacanthidae	<i>Paracentropyge multifasciata</i>	MI	No Group
Blenniidae	<i>Plagiotremus ewaensis</i>	MI	No Group
Blenniidae	<i>Plagiotremus goslinei</i>	MI	No Group
Scorpaenidae	<i>Sebastapistes coniota</i>	MI	No Group
Monacanthidae	<i>Pervagor melanocephalus</i>	Om	No Group
Blenniidae	<i>Plagiotremus laudandus</i>	Par	No Group
Blenniidae	<i>Plagiotremus rhinorhynchos</i>	Par	No Group
Blenniidae	<i>Plagiotremus tapeinosoma</i>	Par	No Group
Labridae	<i>Pseudocheilinus ocellatus</i>	MI	No Group
Pomacanthidae	<i>Centropyge flavissima & vroliki</i>	H	No Group
Pomacentridae	<i>Amblyglyphidodon curacao</i>	Om	No Group
Pomacentridae	<i>Amphiprion melanopus</i>	Pk	No Group
Pomacentridae	<i>Chromis agilis</i>	Pk	No Group
Gobiidae	<i>Istigobius sp.</i>	Pk	No Group
Pomacentridae	<i>Pomacentrus pavo</i>	Pk	No Group

Family	Scientific Name	Trophic Group	Functional Group
Apogonidae	<i>Pristiapogon fraenatus</i>	Pk	No Group
Tetraodontidae	<i>Canthigaster epilampra</i>	H	No Group
Tetraodontidae	<i>Canthigaster solandri</i>	H	No Group
Blenniidae	<i>Cirripectes vanderbilti</i>	H	No Group
Pomacentridae	<i>Stegastes albifasciatus</i>	H	No Group
Pomacentridae	<i>Stegastes aureus</i>	H	No Group
Pomacentridae	<i>Stegastes marginatus</i>	H	No Group
Pomacentridae	<i>Plectroglyphidodon dickii</i>	Cor	No Group
Cirrhitidae	<i>Paracirrhites xanthus</i>	MI	No Group
Monacanthidae	<i>Paraluteres prionurus</i>	MI	No Group
Microdesmidae	<i>Microdesmidae</i>	Pk	No Group
Scorpaenidae	<i>Sebastapistes ballieui</i>	MI	No Group
Apogonidae	<i>Apogon kallopterus</i>	Pk	No Group
Pomacentridae	<i>Chromis weberi</i>	Pk	No Group
Labridae	<i>Cirrhilabrus exquisitus</i>	Pk	No Group
Syngnathidae	<i>Corythoichthys flavofasciatus</i>	Pk	No Group
Pomacentridae	<i>Dascyllus albisella</i>	Pk	No Group
Microdesmidae	<i>Gunnellichthys curiosus</i>	Pk	No Group
Apogonidae	<i>Pristiapogon kallopterus</i>	Pk	No Group
Serranidae	<i>Pseudanthias olivaceus</i>	Pk	No Group
Ptereleotridae	<i>Ptereleotris heteroptera</i>	Pk	No Group
Ptereleotridae	<i>Ptereleotris zebra</i>	Pk	No Group
Pomacanthidae	<i>Centropyge vrolikii</i>	H	No Group
Pomacentridae	<i>Plectroglyphidodon leucozonus</i>	H	No Group
Pomacentridae	<i>Plectroglyphidodon johnstonianus</i>	Cor	No Group
Labridae	<i>Anampses melanurus</i>	MI	No Group
Apogonidae	<i>Cheilodipterus quinquelineatus</i>	MI	No Group
Cirrhitidae	<i>Cirrhitichthys oxycephalus</i>	MI	No Group
Cirrhitidae	<i>Cirrhitops fasciatus</i>	MI	No Group
Labridae	<i>Halichoeres biocellatus</i>	MI	No Group
Labridae	<i>Labroides dimidiatus</i>	MI	No Group
Labridae	<i>Labropsis micronesica</i>	MI	No Group
Labridae	<i>Macropharyngodon negrosensis</i>	MI	No Group

Family	Scientific Name	Trophic Group	Functional Group
Labridae	<i>Pseudojuloides cerasinus</i>	MI	No Group
Labridae	<i>Pseudojuloides polynesica</i>	MI	No Group
Blenniidae	<i>Aspidontus taeniatus</i>	Par	No Group
Tetraodontidae	<i>Torquigener randalli</i>	MI	No Group
Pomacentridae	<i>Plectroglyphidodon sindonis</i>	H	No Group
Pomacanthidae	<i>Centropyge potteri</i>	H	No Group
Cirrhitidae	<i>Oxycirrhites typus</i>	Pk	No Group
Serranidae	<i>Pseudanthias bicolor</i>	Pk	No Group
Ptereleotridae	<i>Ptereleotris microlepis</i>	Pk	No Group
Pomacentridae	<i>Stegastes lividus</i>	H	No Group
Labridae	<i>Cirrhilabrus punctatus</i>	MI	No Group
Labridae	<i>Halichoeres margaritaceus</i>	MI	No Group
Labridae	<i>Pseudojuloides atavai</i>	MI	No Group
Holocentridae	<i>Sargocentron punctatissimum</i>	MI	No Group
Monacanthidae	<i>Pervagor janthinosoma</i>	Om	No Group
Pomacentridae	<i>Amphiprion clarkii</i>	Pk	No Group
Serranidae	<i>Anthias</i> sp.	Pk	No Group
Blenniidae	<i>Blenniella chrysospilos</i>	Pk	No Group
Chaetodontidae	<i>Chaetodon kleinii</i>	Pk	No Group
Pomacentridae	<i>Dascyllus trimaculatus</i>	Pk	No Group
Apogonidae	<i>Ostorhinchus maculiferus</i>	Pk	No Group
Serranidae	<i>Pseudanthias cooperi</i>	Pk	No Group
Gobiidae	<i>Amblygobius phalaena</i>	H	No Group
Tetraodontidae	<i>Canthigaster amboinensis</i>	H	No Group
Tetraodontidae	<i>Canthigaster coronata</i>	H	No Group
Pomacanthidae	<i>Centropyge flavissima</i>	H	No Group
Pomacentridae	<i>Stegastes nigricans</i>	H	No Group
Labridae	<i>Halichoeres melanurus</i>	MI	No Group
Labridae	<i>Halichoeres melasmapomus</i>	MI	No Group
Labridae	<i>Labroides bicolor</i>	MI	No Group
Labridae	<i>Labropsis xanthonota</i>	MI	No Group
Cirrhitidae	<i>Paracirrhites arcatus</i>	MI	No Group
Labridae	<i>Pseudocheilinus evanidus</i>	MI	No Group
Labridae	<i>Pseudocheilinus octotaenia</i>	MI	No Group
Monacanthidae	<i>Pervagor aspricaudus</i>	Om	No Group
Ostraciidae	<i>Lactoria fornasini</i>	SI	No Group

Family	Scientific Name	Trophic Group	Functional Group
Labridae	<i>Pseudojuloides</i> sp.	MI	No Group
Pomacentridae	<i>Abudefduf sexfasciatus</i>	Pk	No Group
Pomacentridae	<i>Chromis vanderbilti</i>	Pk	No Group
Pomacentridae	<i>Chromis xanthura</i>	Pk	No Group
Labridae	<i>Cirrhilabrus</i> sp.	Pk	No Group
Pomacanthidae	<i>Genicanthus watanabei</i>	Pk	No Group
Labridae	<i>Thalassoma amblycephalum</i>	Pk	No Group
Pomacanthidae	<i>Centropyge bicolor</i>	H	No Group
Serranidae	<i>Belonoperca chabanaudi</i>	MI	No Group
Labridae	<i>Coris centralis</i>	MI	No Group
Labridae	<i>Halichoeres ornatissimus</i>	MI	No Group
Malacanthidae	<i>Hoplolatilus starcki</i>	MI	No Group
Labridae	<i>Macropharyngodon meleagris</i>	MI	No Group
Labridae	<i>Oxycheilinus bimaculatus</i>	MI	No Group
Labridae	<i>Pteragogus enneacanthus</i>	MI	No Group
Labridae	<i>Stethojulis balteata</i>	MI	No Group
Labridae	<i>Stethojulis strigiventer</i>	MI	No Group
Labridae	<i>Stethojulis trilineata</i>	MI	No Group
Pomacentridae	<i>Stegastes</i> sp.	H	No Group
Apogonidae	<i>Apogon</i> sp.	Pk	No Group
Apogonidae	<i>Apogonidae</i>	Pk	No Group
Chaetodontidae	<i>Chaetodon miliaris</i>	Pk	No Group
Pomacentridae	<i>Dascyllus auripinnis</i>	Pk	No Group
Labridae	<i>Pseudocoris yamashiroi</i>	Pk	No Group
Labridae	<i>Stethojulis bandanensis</i>	Pk	No Group
Monacanthidae	<i>Cantherhines verecundus</i>	H	No Group
Pomacanthidae	<i>Centropyge interrupta</i>	H	No Group
Pomacentridae	<i>Stegastes fasciolatus</i>	H	No Group
Blenniidae	<i>Exallias brevis</i>	Cor	No Group
Labridae	<i>Labrichthys unilineatus</i>	Cor	No Group
Labridae	<i>Halichoeres prosopeion</i>	MI	No Group
Labridae	<i>Macropharyngodon geoffroy</i>	MI	No Group
Gobiidae	<i>Valenciennea strigata</i>	MI	No Group
Ostraciidae	<i>Ostracion whitleyi</i>	SI	No Group
Scorpaenidae	<i>Dendrochirus barberi</i>	MI	No Group
Blenniidae	<i>Blenniidae</i>	Pk	No Group

Family	Scientific Name	Trophic Group	Functional Group
Synodontidae	<i>Synodus binotatus</i>	Pisc	No Group
Pomacentridae	<i>Amphiprion chrysopterus</i>	Pk	No Group
Serranidae	<i>Pseudanthias pascalus</i>	Pk	No Group
Acanthuridae	<i>Ctenochaetus flavicauda</i>	H	No Group
Labridae	<i>Cheilinus oxycephalus</i>	MI	No Group
Holocentridae	<i>Sargocentron diadema</i>	MI	No Group
Holocentridae	<i>Sargocentron xantherythrum</i>	MI	No Group
Labridae	<i>Thalassoma quinquevittatum</i>	MI	No Group
Labridae	<i>Iniistius umbrilatus</i>	MI	No Group
Labridae	<i>Thalassoma</i> sp.	MI	No Group
Pomacentridae	<i>Pomacentridae</i>	Om	No Group
Pomacentridae	<i>Abudefduf notatus</i>	Pk	No Group
Chaetodontidae	<i>Hemitaurichthys polylepis</i>	Pk	No Group
Ptereleotridae	<i>Ptereleotris evides</i>	Pk	No Group
Labridae	<i>Anampses twistii</i>	MI	No Group
Apogonidae	<i>Cheilodipterus</i> sp.	MI	No Group
Labridae	<i>Cymolutes lecluse</i>	MI	No Group
Labridae	<i>Halichoeres hartzfeldii</i>	MI	No Group
Labridae	<i>Halichoeres marginatus</i>	MI	No Group
Pinguipedidae	<i>Parapercis clathrata</i>	MI	No Group
Pinguipedidae	<i>Parapercis schauinslandii</i>	MI	No Group
Labridae	<i>Choerodon jordani</i>	Om	No Group
Monacanthidae	<i>Pervagor</i> sp.	Om	No Group
Monacanthidae	<i>Pervagor spilosoma</i>	Om	No Group
Pomacanthidae	<i>Apolemichthys arcuatus</i>	SI	No Group
Holocentridae	<i>Neoniphon argenteus</i>	MI	No Group
Apogonidae	<i>Cheilodipterus artus</i>	MI	No Group
Pomacentridae	<i>Chromis ovalis</i>	Pk	No Group
Labridae	<i>Bodianus mesothorax</i>	MI	No Group
Pinguipedidae	<i>Parapercis millepunctata</i>	MI	No Group
Labridae	<i>Halichoeres</i> sp.	MI	No Group
Serranidae	<i>Cephalopholis leopardus</i>	Pisc	No Group
Apogonidae	<i>Cheilodipterus macrodon</i>	Pisc	No Group
Pomacentridae	<i>Abudefduf vaiensis</i>	Pk	No Group
Chaetodontidae	<i>Heniochus diphreutes</i>	Pk	No Group
Holocentridae	<i>Myripristis vittata</i>	Pk	No Group

Family	Scientific Name	Trophic Group	Functional Group
Caesionidae	<i>Pterocaesio trilineata</i>	Pk	No Group
Labridae	<i>Thalassoma hardwicke</i>	Pk	No Group
Monacanthidae	<i>Cantherhines sandwichiensis</i>	H	No Group
Tetraodontidae	<i>Canthigaster rivulata</i>	H	No Group
Acanthuridae	<i>Zebrasoma flavescens</i>	H	No Group
Acanthuridae	<i>Zebrasoma scopas</i>	H	No Group
Monacanthidae	<i>Amanses scopas</i>	Cor	No Group
Labridae	<i>Anampses chrysocephalus</i>	MI	No Group
Labridae	<i>Anampses sp.</i>	MI	No Group
Labridae	<i>Bodianus axillaris</i>	MI	No Group
Labridae	<i>Bodianus prognathus</i>	MI	No Group
Labridae	<i>Coris dorsomacula</i>	MI	No Group
Labridae	<i>Coris venusta</i>	MI	No Group
Labridae	<i>Cymolutes praetextatus</i>	MI	No Group
Labridae	<i>Pseudocoris aurantiofasciata</i>	MI	No Group
Labridae	<i>Pseudocoris heteroptera</i>	MI	No Group
Scorpaenidae	<i>Pterois antennata</i>	MI	No Group
Holocentridae	<i>Sargocentron microstoma</i>	MI	No Group
Labridae	<i>Thalassoma janssenii</i>	MI	No Group
Nemipteridae	<i>Scolopsis lineata</i>	Om	No Group
Zanclidae	<i>Zanclus cornutus</i>	SI	No Group
Labridae	<i>Bodianus anthioides</i>	Pk	No Group
Chaetodontidae	<i>Hemitaurichthys thompsoni</i>	Pk	No Group
Acanthuridae	<i>Zebrasoma rostratum</i>	H	No Group
Kuhliidae	<i>Kuhlia sandvicensis</i>	Pk	No Group
Scorpaenidae	<i>Pterois sphex</i>	Pisc	No Group
Synodontidae	<i>Synodontidae</i>	Pisc	No Group
Pomacentridae	<i>Chromis verater</i>	Pk	No Group
Pempheridae	<i>Pempheridae</i>	Pk	No Group
Serranidae	<i>Pseudanthias thompsoni</i>	Pk	No Group
Balistidae	<i>Xanthichthys auromarginatus</i>	Pk	No Group
Acanthuridae	<i>Ctenochaetus binotatus</i>	H	No Group
Labridae	<i>Anampses meleagrides</i>	MI	No Group
Labridae	<i>Iniistius aneitensis</i>	MI	No Group
Mullidae	<i>Parupeneus chrysonemus</i>	MI	No Group

Family	Scientific Name	Trophic Group	Functional Group
Balistidae	<i>Sufflamen chrysopterum</i>	MI	No Group
Cirrhitidae	<i>Paracirrhites forsteri</i>	Pisc	No Group
Synodontidae	<i>Saurida gracilis</i>	Pisc	No Group
Holocentridae	<i>Myripristis kuntee</i>	Pk	No Group
Pempheridae	<i>Pempheris oualensis</i>	Pk	No Group
Pomacentridae	<i>Abudefduf septemfasciatus</i>	H	No Group
Acanthuridae	<i>Acanthurus nigricans</i>	H	No Group
Acanthuridae	<i>Acanthurus nigrofasciatus</i>	H	No Group
Holocentridae	<i>Neoniphon aurolineatus</i>	MI	No Group
Pinguipedidae	<i>Parapercis</i> sp.	MI	No Group
Labridae	<i>Bodianus sanguineus</i>	Om	No Group
Synodontidae	<i>Synodus dermatogenys</i>	Pisc	No Group
Synodontidae	<i>Synodus variegatus</i>	Pisc	No Group
Pomacentridae	<i>Abudefduf sordidus</i>	H	No Group
Holocentridae	<i>Myripristis earlei</i>	MI	No Group
Pomacentridae	<i>Abudefduf abdominalis</i>	Pk	No Group
Pomacanthidae	<i>Genicanthus personatus</i>	Pk	No Group
Chaetodontidae	<i>Heniochus acuminatus</i>	Pk	No Group
Holocentridae	<i>Myripristis chryseres</i>	Pk	No Group
Holocentridae	<i>Myripristis woodsi</i>	Pk	No Group
Labridae	<i>Thalassoma lunare</i>	Pk	No Group
Acanthuridae	<i>Acanthurus achilles</i>	H	No Group
Acanthuridae	<i>Acanthurus achilles & nigricans</i>	H	No Group
Acanthuridae	<i>Acanthurus leucopareius</i>	H	No Group
Acanthuridae	<i>Acanthurus pyroferus</i>	H	No Group
Monacanthidae	<i>Cantherhines pardalis</i>	H	No Group
Labridae	<i>Bodianus diana</i>	MI	No Group
Balistidae	<i>Rhinecanthus rectangulus</i>	MI	No Group
Holocentridae	<i>Sargocentron caudimaculatum</i>	MI	No Group
Holocentridae	<i>Sargocentron ensifer</i>	MI	No Group
Labridae	<i>Thalassoma duperrey & quinquevittatum</i>	MI	No Group
Labridae	<i>Thalassoma lutescens</i>	MI	No Group
Pomacanthidae	<i>Apolemichthys griffisi</i>	SI	No Group
Pomacanthidae	<i>Apolemichthys trimaculatus</i>	SI	No Group

Family	Scientific Name	Trophic Group	Functional Group
Pomacanthidae	<i>Apolemichthys xanthopunctatus</i>	SI	No Group
Pomacanthidae	<i>Pygoplites diacanthus</i>	SI	No Group
Serranidae	<i>Epinephelus hexagonatus</i>	Pisc	No Group
Acanthuridae	<i>Acanthurus nubilus</i>	Pk	No Group
Muraenidae	<i>Gymnothorax melatremus</i>	MI	No Group
Labridae	<i>Pseudodax moluccanus</i>	MI	No Group
Labridae	<i>Thalassoma duperrey</i>	MI	No Group
Acanthuridae	<i>Acanthurus triostegus</i>	H	No Group
Serranidae	<i>Grammistes sexlineatus</i>	MI	No Group
Labridae	<i>Halichoeres hortulanus</i>	MI	No Group
Labridae	<i>Halichoeres trimaculatus</i>	MI	No Group
Serranidae	<i>Cephalopholis urodeta</i>	Pisc	No Group
Cirrhitidae	<i>Paracirrhites hemistictus</i>	Pisc	No Group
Acanthuridae	<i>Acanthurus thompsoni</i>	Pk	No Group
Siganidae	<i>Siganus spinus</i>	H	No Group
Balistidae	<i>Rhinecanthus lunula</i>	MI	No Group
Balistidae	<i>Sufflamen bursa</i>	MI	No Group
Ostraciidae	<i>Ostracion meleagris</i>	SI	No Group
Acanthuridae	<i>Acanthurus guttatus</i>	H	No Group
Cirrhitidae	<i>Cirrhitidae</i>	MI	No Group
Serranidae	<i>Cephalopholis spiloparaea</i>	Pisc	No Group
Labridae	<i>Oxycheilinus digramma</i>	Pisc	No Group
Scorpaenidae	<i>Scorpaenopsis diabolus</i>	Pisc	No Group
Scorpaenidae	<i>Scorpaenopsis</i> sp.	Pisc	No Group
Synodontidae	<i>Synodus ulae</i>	Pisc	No Group
Caesionidae	<i>Caesio lunaris</i>	Pk	No Group
Balistidae	<i>Canthidermis maculata</i>	Pk	No Group
Hemiramphidae	<i>Hyporhamphus acutus</i>	Pk	No Group
Caesionidae	<i>Pterocaesio lativittata</i>	Pk	No Group
Caesionidae	<i>Pterocaesio tile</i>	Pk	No Group
Carangidae	<i>Selar crumenophthalmus</i>	Pk	No Group
Balistidae	<i>Xanthichthys mento</i>	Pk	No Group
Acanthuridae	<i>Ctenochaetus</i> sp.	H	No Group
Acanthuridae	<i>Naso thynnoides</i>	H	No Group
Balistidae	<i>Balistapus undulatus</i>	MI	No Group
Cirrhitidae	<i>Cirrhitus pinnulatus</i>	MI	No Group

Family	Scientific Name	Trophic Group	Functional Group
Labridae	<i>Coris ballieui</i>	MI	No Group
Lethrinidae	<i>Gnathodentex aureolineatus</i>	MI	No Group
Malacanthidae	<i>Malacanthus brevirostris</i>	MI	No Group
Mullidae	<i>Mulloidichthys mimicus</i>	MI	No Group
Holocentridae	<i>Myripristis violacea</i>	MI	No Group
Labridae	<i>Novaculichthys taeniourus</i>	MI	No Group
Balistidae	<i>Rhinecanthus aculeatus</i>	MI	No Group
Synodontidae	<i>Saurida flamma</i>	Pisc	No Group
Acanthuridae	<i>Paracanthurus hepatus</i>	Pk	No Group
Caesionidae	<i>Caesionidae</i>	Pk	No Group
Holocentridae	<i>Holocentridae</i>	MI	No Group
Priacanthidae	<i>Heteropriacanthus carolinus</i>	Pk	No Group
Holocentridae	<i>Myripristis adusta</i>	Pk	No Group
Holocentridae	<i>Myripristis amaena</i>	Pk	No Group
Labridae	<i>Cheilinus chlorourus</i>	MI	No Group
Labridae	<i>Gomphosus varius</i>	MI	No Group
Lethrinidae	<i>Lethrinus harak</i>	MI	No Group
Holocentridae	<i>Neonippon sammara</i>	MI	No Group
Serranidae	<i>Epinephelus melanostigma</i>	Pisc	No Group
Serranidae	<i>Epinephelus merra</i>	Pisc	No Group
Holocentridae	<i>Myripristis berndti</i>	Pk	No Group
Priacanthidae	<i>Priacanthus hamrur</i>	Pk	No Group
Priacanthidae	<i>Priacanthus meeki</i>	Pk	No Group
Acanthuridae	<i>Acanthurus albipectoralis</i>	H	No Group
Tetraodontidae	<i>Arothron nigropunctatus</i>	Cor	No Group
Mullidae	<i>Parupeneus insularis</i>	MI	No Group
Mullidae	<i>Parupeneus pleurostigma</i>	MI	No Group
Holocentridae	<i>Sargocentron tiere</i>	MI	No Group
Labridae	<i>Thalassoma trilobatum</i>	MI	No Group
Mullidae	<i>Upeneus taeniopterus</i>	MI	No Group
Balistidae	<i>Melichthys vidua</i>	H	No Group
Serranidae	<i>Epinephelus spilotoceps</i>	Pisc	No Group
Lutjanidae	<i>Lutjanus semicinctus</i>	Pisc	No Group
Serranidae	<i>Pogonoperca punctata</i>	Pisc	No Group
Caesionidae	<i>Caesio caeruleaurea</i>	Pk	No Group
Carangidae	<i>Decapterus macarellus</i>	Pk	No Group

Family	Scientific Name	Trophic Group	Functional Group
Holocentridae	<i>Myripristinae</i>	Pk	No Group
Caesionidae	<i>Pterocaesio marri</i>	Pk	No Group
Balistidae	<i>Xanthichthys caeruleolineatus</i>	Pk	No Group
Labridae	<i>Iniistius pavo</i>	MI	No Group
Holocentridae	<i>Neoniphon opercularis</i>	MI	No Group
Holocentridae	<i>Neoniphon</i> sp.	MI	No Group
Mullidae	<i>Parupeneus crassilabris</i>	MI	No Group
Labridae	<i>Anampses cuvier</i>	MI	No Group
Labridae	<i>Cheilinus fasciatus</i>	MI	No Group
Siganidae	<i>Siganus punctatus</i>	H	No Group
Gobiidae	<i>Gobiidae</i>	MI	No Group
Scorpaenidae	<i>Pterois volitans</i>	Pisc	No Group
Balistidae	<i>Melichthys niger</i>	Pk	No Group
Priacanthidae	<i>Priacanthus</i> sp.	Pk	No Group
Monacanthidae	<i>Monacanthidae</i>	H	No Group
Siganidae	<i>Siganidae</i>	H	No Group
Diodontidae	<i>Diodon holocanthus</i>	MI	No Group
Mullidae	<i>Mulloidichthys vanicolensis</i>	MI	No Group
Mullidae	<i>Parupeneus multifasciatus</i>	MI	No Group
Balistidae	<i>Sufflamen fraenatum</i>	MI	No Group
Monacanthidae	<i>Cantherhines dumerilii</i>	Om	No Group
Pomacanthidae	<i>Pomacanthus imperator</i>	SI	No Group
Lethrinidae	<i>Lethrinus rubrioperculatus</i>	MI	No Group
Caesionidae	<i>Caesio teres</i>	Pk	No Group
Balistidae	<i>Odonus niger</i>	Pk	No Group
Acanthuridae	<i>Acanthurus nigricauda</i>	H	No Group
Acanthuridae	<i>Acanthurus olivaceus</i>	H	No Group
Acanthuridae	<i>Zebrasoma veliferum</i>	H	No Group
Labridae	<i>Bodianus loxozonus</i>	MI	No Group
Labridae	<i>Coris gaimard</i>	MI	No Group
Labridae	<i>Hologymnosus annulatus</i>	MI	No Group
Labridae	<i>Hologymnosus doliatus</i>	MI	No Group
Mullidae	<i>Mulloidichthys flavolineatus</i>	MI	No Group
Acanthuridae	<i>Acanthurus maculiceps</i>	H	No Group
Kyphosidae	<i>Kyphosus hawaiiensis</i>	H	No Group
Cheilodactylidae	<i>Cheilodactylus vittatus</i>	SI	No Group

Family	Scientific Name	Trophic Group	Functional Group
Ostraciidae	<i>Ostraciidae</i>	SI	No Group
Siganidae	<i>Siganus argenteus</i>	H	No Group
Labridae	<i>Anampses caeruleopunctatus</i>	MI	No Group
Serranidae	<i>Epinephelus fasciatus</i>	Pisc	No Group
Labridae	<i>Thalassoma ballieui</i>	MI	No Group
Labridae	<i>Thalassoma purpureum</i>	MI	No Group
Serranidae	<i>Cephalopholis miniata</i>	Pisc	No Group
Hemiramphidae	<i>Hemiramphidae</i>	Pk	No Group
Acanthuridae	<i>Acanthurus leucocheilus</i>	H	No Group
Ostraciidae	<i>Ostracion cubicus</i>	H	No Group
Bothidae	<i>Bothus mancus</i>	MI	No Group
Labridae	<i>Cheilinus</i> sp.	MI	No Group
Labridae	<i>Cheilinus trilobatus</i>	MI	No Group
Malacanthidae	<i>Malacanthus latovittatus</i>	MI	No Group
Labridae	<i>Oxycheilinus unifasciatus</i>	Pisc	No Group
Labridae	<i>Oxycheilinus</i> sp.	MI	No Group
Serranidae	<i>Epinephelus retouti</i>	Pisc	No Group
Mullidae	<i>Mulloidichthys pfluegeri</i>	MI	No Group
Serranidae	<i>Cephalopholis sexmaculata</i>	Pisc	No Group
Serranidae	<i>Cephalopholis sonnerati</i>	Pisc	No Group
Serranidae	<i>Gracila albomarginata</i>	Pisc	No Group
Mullidae	<i>Parupeneus cyclostomus</i>	Pisc	No Group
Belonidae	<i>Platybelone argalus</i>	Pisc	No Group
Acanthuridae	<i>Acanthurus mata</i>	Pk	No Group
Tetraodontidae	<i>Arothron meleagris</i>	Cor	No Group
Balistidae	<i>Balistoides conspicillum</i>	MI	No Group
Labridae	<i>Hemigymnus fasciatus</i>	MI	No Group
Lethrinidae	<i>Lethrinus obsoletus</i>	MI	No Group
Mullidae	<i>Mullidae</i>	MI	No Group
Mullidae	<i>Parupeneus barberinus</i>	MI	No Group
Holocentridae	<i>Sargocentron</i> sp.	MI	No Group
Ephippidae	<i>Platax orbicularis</i>	Om	No Group
Serranidae	<i>Epinephelus macrospilos</i>	Pisc	No Group
Scorpaenidae	<i>Scorpaenopsis cacopsis</i>	Pisc	No Group
Kyphosidae	<i>Kyphosus cinerascens</i>	H	No Group
Labridae	<i>Cheilio inermis</i>	MI	No Group

Family	Scientific Name	Trophic Group	Functional Group
Mullidae	<i>Parupeneus porphyreus</i>	MI	No Group
Serranidae	<i>Epinephelus socialis</i>	Pisc	No Group
Tetraodontidae	<i>Arothron hispidus</i>	MI	No Group
Holocentridae	<i>Sargocentron spiniferum</i>	MI	No Group
Carangidae	<i>Trachinotus bailloni</i>	Pisc	No Group
Labridae	<i>Epibulus insidiator</i>	MI	No Group
Serranidae	<i>Epinephelus howlandi</i>	Pisc	No Group
Labridae	<i>Bodianus albotaeniatus</i>	MI	No Group
Labridae	<i>Bodianus bilunulatus</i>	MI	No Group
Acanthuridae	<i>Acanthurus</i> sp.	H	No Group
Serranidae	<i>Aethaloperca rogaa</i>	Pisc	No Group
Serranidae	<i>Anyperodon leucogrammicus</i>	Pisc	No Group
Serranidae	<i>Cephalopholis argus</i>	Pisc	No Group
Serranidae	<i>Cephalopholis</i> sp.	Pisc	No Group
Serranidae	<i>Epinephelus maculatus</i>	Pisc	No Group
Holocentridae	<i>Myripristis murdjan</i>	Pk	No Group
Acanthuridae	<i>Naso brevirostris</i>	Pk	No Group
Acanthuridae	<i>Naso maculatus</i>	Pk	No Group
Acanthuridae	<i>Naso vlamingii</i>	Pk	No Group
Kyphosidae	<i>Kyphosus vaigiensis</i>	H	No Group
Muraenidae	<i>Gymnothorax eurostus</i>	MI	No Group
Labridae	<i>Hemigymnus melapterus</i>	MI	No Group
Balistidae	<i>Pseudobalistes flavimarginatus</i>	MI	No Group
Lethrinidae	<i>Lethrinus xanthochilus</i>	Pisc	No Group
Acanthuridae	<i>Naso caesi</i>	Pk	No Group
Lethrinidae	<i>Monotaxis grandoculis</i>	MI	No Group
Serranidae	<i>Variola albimarginata</i>	Pisc	No Group
Labridae	<i>Coris flavovittata</i>	MI	No Group
Tetraodontidae	<i>Arothron mappa</i>	Om	No Group
Carangidae	<i>Carangoides ferdau</i>	Pisc	No Group
Carangidae	<i>Carangoides orthogrammus</i>	Pisc	No Group
Carangidae	<i>Scomberoides lysan</i>	Pisc	No Group
Acanthuridae	<i>Acanthuridae</i>	H	No Group
Lethrinidae	<i>Lethrinus amboinensis</i>	MI	No Group
Lethrinidae	<i>Lethrinus erythracanthus</i>	MI	No Group

Family	Scientific Name	Trophic Group	Functional Group
Ephippidae	<i>Platax teira</i>	Om	No Group
Serranidae	<i>Plectropomus areolatus</i>	Pisc	No Group
Carangidae	<i>Gnathanodon speciosus</i>	Pisc	No Group
Serranidae	<i>Epinephelus polyphekadion</i>	Pisc	No Group
Serranidae	<i>Epinephelus tauvina</i>	Pisc	No Group
Muraenidae	<i>Gymnothorax breedeni</i>	Pisc	No Group
Acanthuridae	<i>Naso hexacanthus</i>	Pk	No Group
Acanthuridae	<i>Naso</i> sp.	Pk	No Group
Kyphosidae	<i>Kyphosus sandwicensis</i>	H	No Group
Kyphosidae	<i>Kyphosus</i> sp.	H	No Group
Balistidae	<i>Balistidae</i>	MI	No Group
Balistidae	<i>Balistoides viridescens</i>	MI	No Group
Muraenidae	<i>Echidna nebulosa</i>	MI	No Group
Haemulidae	<i>Plectorhinchus gibbosus</i>	MI	No Group
Balistidae	<i>Balistes polylepis</i>	MI	No Group
Tetraodontidae	<i>Tetraodontidae</i>	MI	No Group
Monacanthidae	<i>Aluterus scriptus</i>	Om	No Group
Ophichthidae	<i>Myrichthys magnificus</i>	MI	No Group
Aulostomidae	<i>Aulostomus chinensis</i>	Pisc	No Group
Muraenidae	<i>Enchelycore pardalis</i>	Pisc	No Group
Sphyrinae	<i>Sphyrina helleri</i>	Pisc	No Group
Muraenidae	<i>Gymnothorax rueppelliae</i>	MI	No Group
Oplegnathidae	<i>Oplegnathus fasciatus</i>	MI	No Group
Serranidae	<i>Variola louti</i>	Pisc	No Group
Haemulidae	<i>Plectorhinchus picus</i>	MI	No Group
Haemulidae	<i>Plectorhinchus vittatus</i>	MI	No Group
Lethrinidae	<i>Lethrinidae</i>	MI	No Group
Lethrinidae	<i>Lethrinus</i> sp.	MI	No Group
Oplegnathidae	<i>Oplegnathus punctatus</i>	MI	No Group
Carangidae	<i>Caranx papuensis</i>	Pisc	No Group
Muraenidae	<i>Gymnothorax steindachneri</i>	Pisc	No Group
Diodontidae	<i>Diodon hystrix</i>	MI	No Group
Labridae	<i>Labridae</i>	MI	No Group
Belonidae	<i>Belonidae</i>	Pisc	No Group
Carangidae	<i>Caranx lugubris</i>	Pisc	No Group
Carangidae	<i>Caranx sexfasciatus</i>	Pisc	No Group

Family	Scientific Name	Trophic Group	Functional Group
Scombridae	<i>Euthynnus affinis</i>	Pisc	No Group
Scombridae	<i>Grammatorcynus bilineatus</i>	Pisc	No Group
Lethrinidae	<i>Lethrinus olivaceus</i>	Pisc	No Group
Acanthuridae	<i>Naso annulatus</i>	Pk	No Group
Ophidiidae	<i>Brotula multibarbata</i>	MI	No Group
Dasyatidae	<i>Urogymnus granulatus</i>	MI	No Group
Scombridae	<i>Sarda orientalis</i>	Pisc	No Group
Congridae	<i>Congridae</i>	Pisc	No Group
Congridae	<i>Heterocongrinae</i>	Pisc	No Group
Scombridae	<i>Katsuwonus pelamis</i>	Pisc	No Group
Echeneidae	<i>Echeneis naucrates</i>	Pk	No Group
Carangidae	<i>Trachinotus blochii</i>	MI	No Group
Carangidae	<i>Caranx melampygus</i>	Pisc	No Group
Muraenidae	<i>Gymnothorax meleagris</i>	Pisc	No Group
Tetraodontidae	<i>Arothron stellatus</i>	Cor	No Group
Labridae	<i>Coris aygula</i>	MI	No Group
Carangidae	<i>Pseudocaranx dentex</i>	Pisc	No Group
Muraenidae	<i>Scuticaria tigrina</i>	Pisc	No Group
Serranidae	<i>Plectropomus laevis</i>	Pisc	No Group
Serranidae	<i>Epinephelus</i> sp.	Pisc	No Group
Serranidae	<i>Serranidae</i>	Pisc	No Group
Belonidae	<i>Tylosurus crocodilus</i>	Pisc	No Group
Carangidae	<i>Alectis ciliaris</i>	Pisc	No Group
Muraenidae	<i>Enchelynassa canina</i>	Pisc	No Group
Muraenidae	<i>Gymnothorax undulatus</i>	Pisc	No Group
Muraenidae	<i>Gymnomuraena zebra</i>	MI	No Group
Carangidae	<i>Carangidae</i>	Pisc	No Group
Fistulariidae	<i>Fistularia commersonii</i>	Pisc	No Group
Carangidae	<i>Caranx ignobilis</i>	Pisc	No Group
Carangidae	<i>Caranx</i> sp.	Pisc	No Group
Sphyraenidae	<i>Sphyraena genie</i>	Pisc	No Group
Carangidae	<i>Elagatis bipinnulata</i>	Pisc	No Group
Chanidae	<i>Chanos chanos</i>	H	No Group
Dasyatidae	<i>Taeniurops meyeri</i>	MI	No Group
Dasyatidae	<i>Dasyatidae</i>	MI	No Group
Carangidae	<i>Seriola dumerili</i>	Pisc	No Group

Family	Scientific Name	Trophic Group	Functional Group
Carcharhinidae	<i>Carcharhinus melanopterus</i>	Pisc	No Group
Sphyrnidae	<i>Sphyrna barracuda</i>	Pisc	No Group
Scombridae	<i>Thunnus albacares</i>	Pisc	No Group
Carcharhinidae	<i>Triaenodon obesus</i>	Pisc	No Group
Labridae	<i>Cheilinus undulatus</i>	MI	No Group
Carcharhinidae	<i>Carcharhinus amblyrhynchos</i>	Pisc	No Group
Muraenidae	<i>Gymnothorax flavimarginatus</i>	Pisc	No Group
Scombridae	<i>Scombridae</i>	Pisc	No Group
Scombridae	<i>Gymnosarda unicolor</i>	Pisc	No Group
Muraenidae	<i>Muraenidae</i>	Pisc	No Group
Carcharhinidae	<i>Carcharhinus limbatus</i>	Pisc	No Group
Muraenidae	<i>Gymnothorax javanicus</i>	Pisc	No Group
Muraenidae	<i>Gymnothorax</i> sp.	Pisc	No Group
Ginglymostomatidae	<i>Nebrius ferrugineus</i>	Pisc	No Group
Myliobatidae	<i>Aetobatus ocellatus</i>	MI	No Group
Carcharhinidae	<i>Carcharhinus galapagensis</i>	Pisc	No Group
Sphyrnidae	<i>Sphyrna lewini</i>	Pisc	No Group
Sphyrnidae	<i>Sphyrnidae</i>	Pisc	No Group
Myliobatidae	<i>Mobula</i> sp.	Pk	No Group
Scaridae	<i>Scarus fuscocaudalis</i>	H	Parrotfish
Scaridae	<i>Calotomus zonarchus</i>	H	Parrotfish
Scaridae	<i>Chlorurus japanensis</i>	H	Parrotfish
Scaridae	<i>Scarus globiceps</i>	H	Parrotfish
Scaridae	<i>Scarus spinus</i>	H	Parrotfish
Scaridae	<i>Scarus psittacus</i>	H	Parrotfish
Scaridae	<i>Scarus dubius</i>	H	Parrotfish
Scaridae	<i>Scarus oviceps</i>	H	Parrotfish
Scaridae	<i>Scarus schlegeli</i>	H	Parrotfish
Scaridae	<i>Chlorurus spilurus</i>	H	Parrotfish
Scaridae	<i>Scarus niger</i>	H	Parrotfish
Scaridae	<i>Scarus festivus</i>	H	Parrotfish
Scaridae	<i>Scarus frenatus</i>	H	Parrotfish
Scaridae	<i>Chlorurus frontalis</i>	H	Parrotfish
Scaridae	<i>Scarus dimidiatus</i>	H	Parrotfish
Scaridae	<i>Calotomus carolinus</i>	H	Parrotfish

Family	Scientific Name	Trophic Group	Functional Group
Scaridae	<i>Scarus forsteni</i>	H	Parrotfish
Scaridae	<i>Scarus tricolor</i>	H	Parrotfish
Scaridae	<i>Scarus xanthopleura</i>	H	Parrotfish
Scaridae	<i>Hipposcarus longiceps</i>	H	Parrotfish
Scaridae	<i>Scarus altipinnis</i>	H	Parrotfish
Scaridae	<i>Chlorurus perspicillatus</i>	H	Parrotfish
Scaridae	<i>Scaridae</i>	H	Parrotfish
Scaridae	<i>Scarus rubroviolaceus</i>	H	Parrotfish
Scaridae	<i>Chlorurus microrhinos</i>	H	Parrotfish
Scaridae	<i>Cetoscarus ocellatus</i>	H	Parrotfish
Scaridae	<i>Scarus ghobban</i>	H	Parrotfish
Scaridae	<i>Chlorurus</i> sp.	H	Parrotfish
Scaridae	<i>Scarus</i> sp.	H	Parrotfish
Scaridae	<i>Bolbometopon muricatum</i>	Cor	Parrotfish
Lutjanidae	<i>Lutjanus fulvus</i>	MI	Snappers
Lutjanidae	<i>Lutjanus kasmira</i>	MI	Snappers
Lutjanidae	<i>Lutjanus gibbus</i>	MI	Snappers
Lutjanidae	<i>Lutjanus monostigma</i>	Pisc	Snappers
Lutjanidae	<i>Macolor macularis</i>	Pk	Snappers
Lutjanidae	<i>Aphareus furca</i>	Pisc	Snappers
Lutjanidae	<i>Macolor niger</i>	Pk	Snappers
Lutjanidae	<i>Macolor</i> sp.	Pk	Snappers
Lutjanidae	<i>Lutjanus bohar</i>	Pisc	Snappers
Lutjanidae	<i>Lutjanus argentimaculatus</i>	MI	Snappers
Lutjanidae	<i>Aprion virescens</i>	Pisc	Snappers

APPENDIX B: LIST OF PROTECTED SPECIES AND DESIGNATED CRITICAL HABITAT

Table B-1. Protected species found or reasonably believed to be found near or in Hawaii waters

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Seabirds					
Laysan Albatross	<i>Phoebastria immutabilis</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Black-Footed Albatross	<i>Phoebastria nigripes</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Short-Tailed Albatross	<i>Phoebastria albatrus</i>	Endangered	N/A	Breeding visitor in the NWHI	35 FR 8495, 65 FR 46643, Pyle & Pyle 2009
Northern Fulmar	<i>Fulmarus glacialis</i>	Not Listed	N/A	Winter resident	Pyle & Pyle 2009
Kermadec Petrel	<i>Pterodroma neglecta</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Herald Petrel	<i>Pterodroma arminjoniana</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Murphy's Petrel	<i>Pterodroma ultima</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Mottled Petrel	<i>Pterodroma inexpectata</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Juan Fernandez Petrel	<i>Pterodroma externa</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Hawaiian Petrel	<i>Pterodroma sandwichensis</i> (<i>Pterodroma phaeopygia sandwichensis</i>)	Endangered	N/A	Breeding visitor in the MHI	32 FR 4001, Pyle & Pyle 2009
White-Necked Petrel	<i>Pterodroma cervicalis</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Bonin Petrel	<i>Pterodroma hypoleuca</i>	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
Black-Winged Petrel	<i>Pterodroma nigripennis</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Cook Petrel	<i>Pterodroma cookii</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Stejneger Petrel	<i>Pterodroma longirostris</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Pycroft Petrel	<i>Pterodroma pycrofti</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Bulwer's Petrel	<i>Bulweria bulwerii</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Flesh-Footed Shearwater	<i>Ardenna carneipes</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Wedge-Tailed Shearwater	<i>Ardenna pacifica</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Buller's Shearwater	<i>Ardenna bulleri</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Sooty Shearwater	<i>Ardenna grisea</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Short-Tailed Shearwater	<i>Ardenna tenuirostris</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Christmas Shearwater	<i>Puffinus nativitatis</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Newell's Shearwater	<i>Puffinus newelli</i> (<i>Puffinus auricularis newelli</i>)	Threatened	N/A	Breeding visitor	40 FR 44149, Pyle & Pyle 2009
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Leach's Storm-Petrel	<i>Oceanodroma leucorhoa</i>	Not Listed	N/A	Winter resident	Pyle & Pyle 2009
Band-Rumped Storm-Petrel	<i>Oceanodroma castro</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Tristram Storm-Petrel	<i>Oceanodroma tristrami</i>	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
White-Tailed Tropicbird	<i>Phaethon lepturus</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Red-Tailed Tropicbird	<i>Phaethon rubricauda</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Masked Booby	<i>Sula dactylatra</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Brown Booby	<i>Sula leucogaster</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Red-Footed Booby	<i>Sula sula</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Great Frigatebird	<i>Fregata minor</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Lesser Frigatebird	<i>Fregata ariel</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Laughing Gull	<i>Leucophaeus atricilla</i>	Not Listed	N/A	Winter resident in the MHI	Pyle & Pyle 2009
Franklin Gull	<i>Leucophaeus pipixcan</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Ring-Billed Gull	<i>Larus delawarensis</i>	Not Listed	N/A	Winter resident in the MHI	Pyle & Pyle 2009
Herring Gull	<i>Larus argentatus</i>	Not Listed	N/A	Winter resident in the NWHI	Pyle & Pyle 2009
Slaty-Backed Gull	<i>Larus schistisagus</i>	Not Listed	N/A	Winter resident in the NWHI	Pyle & Pyle 2009
Glaucous-Winged Gull	<i>Larus glaucescens</i>	Not Listed	N/A	Winter resident	Pyle & Pyle 2009
Brown Noddy	<i>Anous stolidus</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Black Noddy	<i>Anous minutus</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Blue-Gray Noddy	<i>Procelsterna cerulea</i>	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
White Tern	<i>Gygis alba</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Sooty Tern	<i>Onychoprion fuscatus</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Gray-Backed Tern	<i>Onychoprion lunatus</i>	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Little Tern	<i>Sternula albifrons</i>	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
Least Tern	<i>Sternula antillarum</i>	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
Arctic Tern	<i>Sterna paradisaea</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
South Polar Skua	<i>Stercorarius maccormicki</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Pomarine Jaeger	<i>Stercorarius pomarinus</i>	Not Listed	N/A	Winter resident in the MHI	Pyle & Pyle 2009
Parasitic Jaeger	<i>Stercorarius parasiticus</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Long-Tailed Jaeger	<i>Stercorarius longicaudus</i>	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Sea turtles					
Green Sea Turtle	<i>Chelonia mydas</i>	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	<i>Chelonia mydas</i>	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 DSLF fishery.	43 FR 32800, 81 FR 20057, WPRFMC 2009, Clifton et al. 1982, Karl & Bowen 1999
Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Endangered ^a	N/A	Small population foraging around Hawaii and low level nesting on Maui and Hawaii Islands. Occur worldwide in tropical and subtropical waters.	35 FR 8491, NMFS & USFWS 2007, Balazs et al. 1992, Katahira et al. 1994
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	Endangered ^a	N/A	Not common in Hawai'i. Occur worldwide in tropical, subtropical, and subpolar waters.	35 FR 8491, Eckert et al. 2012
Loggerhead Sea Turtle	<i>Caretta caretta</i>	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

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Olive Ridley Sea Turtle	<i>Lepidochelys olivacea</i>	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	<i>Mesoplodon densirostris</i>	Not Listed	Non-strategic	Uncommon in Hawaiian waters. Possible separate nearshore and pelagic stocks.	McSweeney et al. 2007, Schorr et al. 2009, Baird et al. 2013
Blue Whale	<i>Balaenoptera musculus</i>	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	<i>Tursiops truncatus</i>	Not Listed	Non-strategic	Common in both inshore shallow waters and offshore deep waters. Evidence for five different populations associated with different island groups and depths.	Baird et al. 2009, Martien et al 2012
Bryde's Whale	<i>Balaenoptera edeni</i>	Not Listed	Unknown	Common in Hawaiian Islands.	Bradford et al. 2013
Common Dolphin	<i>Delphinus delphis</i>	Not Listed	N/A	Found worldwide in temperate and subtropical seas.	Perrin et al. 2009
Cuvier's Beaked Whale	<i>Ziphius cavirostris</i>	Not Listed	Non-strategic	Occur year round in Hawaiian waters. Possible separate nearshore and pelagic stocks. Nearshore stock found up to 67 km from shore.	McSweeney et al. 2007, Baird et al. 2013
Dall's Porpoise	<i>Phocoenoides dalli</i>	Not Listed	Non-strategic	Range across the entire north Pacific Ocean.	Hall 1979
Dwarf Sperm Whale	<i>Kogia sima</i>	Not Listed	Non-strategic	Possible resident population. Most common in waters between 500 m and 1,000 m in depth.	Baird et al. 2013

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
False Killer Whale	<i>Pseudorca crassidens</i>	Endangered (MHI Insular DPS)	Strategic	Found in waters within a modified 72 km radius around the MHI. Range overlaps with those of two other stocks around Kauai/Niihau. Population declining.	77 FR 70915, Bradford et al. 2015, Baird 2009, Reeves et al. 2009, Oleson et al. 2010
False Killer Whale	<i>Pseudorca crassidens</i>	Not Listed	Non-strategic	Two stocks with overlapping ranges around Kauai/Niihau: 1) the Northwestern Hawaiian Islands stock, which includes animals inhabiting waters within the Papahānaumokuākea Marine National Monument and to the east around Kauai, and 2) the Hawaii pelagic stock, which includes false killer whales inhabiting waters greater than 11 km from the main Hawaiian Islands, including adjacent high seas waters. Little known about these stocks.	Bradford et al. 2015
Fin Whale	<i>Balaenoptera physalus</i>	Endangered	Strategic	Infrequent sightings in Hawaii 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	<i>Lagenodelphis hosei</i>	Not Listed	Non-strategic	Distributed worldwide in tropical waters. Rare in Hawaiian waters.	Perrin et al. 2009, Baird et al. 2013, Bradford et al. 2013, Barlow 2006
Hawaiian Monk Seal	<i>Neomonachus schauinslandi</i>	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 et al. 2011

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Humpback Whale	<i>Megaptera novaeangliae</i>	Delisted Due to Recovery (Hawaii DPS)	Strategic	Migrate through the archipelago and breed during the winter. Common during winter months when they are generally found within the 100 m isobath.	35 FR 18319, 81 FR 62259, Childerhouse et al. 2008, Wolman & Jurasz 1976, Herman & Antinaja 1977, Rice & Wolman 1978
Killer Whale	<i>Orcinus orca</i>	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	<i>Indopacetus pacificus</i>	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	<i>Peponocephala electra</i>	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	<i>Balaenoptera acutorostrata</i>	Not Listed	Non-strategic	Occur seasonally around Hawai'i.	Barlow 2003, Rankin & Barlow 2005
Pantropical Spotted dolphin	<i>Stenella attenuata</i>	Not Listed	Non-strategic	Common and abundant throughout the Hawaiian archipelago, including nearshore. Three stocks found in Hawaiian Islands.	Baird et al. 2013
Pygmy Killer Whale	<i>Feresa attenuata</i>	Not Listed	Non-strategic	Small resident population.	McSweeney et al. 2009
Pygmy Sperm Whale	<i>Kogia breviceps</i>	Not Listed	Non-strategic	Rare, found in nearshore waters.	Baird et al. 2013
Risso's Dolphin	<i>Grampus griseus</i>	Not Listed	Non-strategic	Found in tropical to warm-temperate waters worldwide. Uncommon in Hawai'i.	Perrin et al. 2009
Rough-Toothed Dolphin	<i>Steno bredanensis</i>	Not Listed	Non-strategic	Found in tropical to warm-temperate waters worldwide. Present throughout Hawaii and in offshore waters.	Perrin et al. 2009, Baird et al. 2013, Barlow 2006, Bradford et al. 2013
Sei Whale	<i>Balaenoptera borealis</i>	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	<i>Globicephala macrorhynchus</i>	Not Listed	Non-strategic	Commonly observed around MHI and present around NWHI.	Shallenberger 1981, Bradford et al. 2013, Baird et al. 2013

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Sperm Whale	<i>Physeter macrocephalus</i>	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, Barlow 2006, Lee 1993, Rice 1960, Mobley et al. 2000, Shallenberger 1981
Spinner Dolphin	<i>Stenella longirostris</i>	Not Listed	Non-strategic	Occur in shallow protected bays during the day, feed offshore at night. Four stocks associated with island groups.	Karczmarski 2005, Norris & Dohl 1980, Hill et al. 2010, Norris et al. 1994, Andrews et al. 2010
Striped Dolphin	<i>Stenella coeruleoalba</i>	Not Listed	Non-strategic	Found in tropical to warm-temperate waters throughout the world	Perrin et al. 2009
Elasmobranchs					
Giant manta ray	<i>Manta birostris</i>	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	<i>Carcharhinus longimanus</i>	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	<i>Sphyrna lewini</i>	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	<i>Sphyrna lewini</i>	Threatened (Indo-West Pacific DPS)	N/A	Occur over continental and insular shelves, and adjacent deep waters, but is 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

^a These species have critical habitat designated under the ESA. See Table B-2.

Table B-2. ESA-listed species' critical habitat in the Pacific Ocean^a

Common Name	Scientific Name	ESA Listing Status	Critical Habitat	References
Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Endangered	None in the Pacific Ocean.	63 FR 46693
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	Endangered	Approximately 16,910 square miles (43,798 square km) stretching along the California coast from Point Arena to Point Arguello east	77 FR 4170

			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.	
Hawaiian Monk Seal	<i>Neomonachus schauinslandi</i>	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	<i>Eubalaena japonica</i>	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*). *Molec Ecol* 19:732-748.
- Backus, R.H., S. Springer and E.L. Arnold Jr. 1956. A contribution to the natural history of the white-tip shark, *Pterolamiops longimanus* (Poey). *Deep-Sea Res* 3: 178-188.
- Baird, R. W., D. J. McSweeney, C. Bane, et al. 2006. Killer whales in Hawaiian waters: Information on population identity and feeding habits. *Pac Sci* 60:523–530.
- Baird, R.W., A.M. Gorgone, D.J. McSweeney, A.D. Ligon, M.H. Deakos, D.L. Webster, G.S. Schorr, K.K. Martien, D.R. Salden, and S.D. Mahaffy. 2009. Population structure of island-associated dolphins: Evidence from photo-identification of common bottlenose dolphins (*Tursiops truncatus*) in the main Hawaiian Islands. *Mar Mamm Sci* 25:251-274.
- Baird, R.W., D.L. Webster, J.M. Aschettino, G.S. Schorr, D.J. McSweeney. 2013. Odontocete cetaceans around the main Hawaiian Islands: Habitat use and relative abundance from small-boat sighting surveys. *Aquat Mamm* 39:253-269
- Baker J.D., A. L. Harting, T. A. Wurth, and T. C. Johanos. 2011. Dramatic shifts in Hawaiian monk seal distribution predicted from divergent regional trends. *Mar Mamm Sci* 27(1): 78–93.
- 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 Inst. Press, Washington, D.C. 583 pp.
- Balazs, G.H. 1979. Loggerhead turtle recovered from a tiger shark at Kure Atoll. *'Elepaio* 39(12):45-47.

- Balazs, G.H., H. Hirth, P. Kawamoto, E. Nitta, L. Ogren, R. Wass, and J. Wetherall. 1992. Interim Recovery Plan for Hawaiian Sea Turtles. Honolulu Lab., Southwest Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Southwest Fish. Sci. Cent. Admin. Rep. H-92-01. 76 pp.
- Barlow, J. 2003. Cetacean abundance in Hawaiian waters during summer/fall 2002. Admin. Rep. LJ-03-13. Southwest Fisheries Science Center, National Marine Fisheries Service, 8604 La Jolla Shores Drive, La Jolla, CA 92037.
- Barlow, J. 2006. Cetacean abundance in Hawaiian waters estimated from a summer/fall survey in 2002. *Mar Mamm Sci* 22(2): 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.
- Bester, C. 2011. Species Profile: Scalloped Hammerhead. Florida Museum of Natural History. <http://www.flmnh.ufl.edu/fish/Gallery/Descript/Schammer/ScallopedHammerhead.html>.
- 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., E.M. Oleson, R.W. Baird, C.H. Boggs, K.A. Forney, and N.C. Young. 2015. Revised stock boundaries for false killer whales (*Pseudorca crassidens*) in Hawaiian waters. U.S Dep. Comm. NOAA Tech Memo., NOAA-TM-NMFS-PIFSC-47. 29p.
- 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.
- 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>).
- 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.
- Dalebout, M. L., G. J. B. Ross, C. S. Baker, R. C. Anderson, P. B. Best, V. G. Cockcroft, H. L. Hinsz, V. Peddemors and R. L. Pitman. 2003. Appearance, distribution and genetic distinctiveness of Longman's beaked whale, *Indopacetus pacificus*. *Mar Mamm Sci* 19:421-461.
- Dewar, H., P. Mous, M. Domeier, A. Muljadi, J. Pet, and J. Whitty. 2008. Movements and site Wdelity of the giant manta ray, *Manta birostris*, in the Komodo Marine Park, Indonesia. *Mar Biol* 155:121-133.

- Dodd, C.K. 1990. *Caretta caretta* (Linnaeus) Loggerhead Sea Turtle. Catalogue of American Amphibians and Reptiles 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.
- 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., J.V. Redfern, J. Barlow, L.T. Balance, T. Gerrodette, R.S. Holt, K.A. Forney, and B.L. Taylor. 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-NMFSWFSC-440. 70 pp.
- Herman, L. M. and R. C. Antinaja, 1977. Humpback whales in the Hawaiian breeding waters: Population and pod characteristics. Sci Rep Whales Res Inst 29:59-85.
- Hill, M.C., E.M. Oleson, and K.R. Andrews. 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, 12pp.
- Karczmarski L, Würsig B, Gailey G, Larson KW, and Vanderlip C. 2005. Spinner dolphins in a remote Hawaiian atoll: social grouping and population structure. Behav Ecol 16: 675-685.
- Karl SA and Bowen BW. 1999. Evolutionary significant units versus geopolitical taxonomy: molecular systematics of an endangered sea turtle (genus *Chelonia*). Conserv Biol 13:990–999.
- 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. Mar Biol 117(1):1-22.
- Kolinski, S. P., D. M. Parker, L. I. Ilo, and J. K. Ruak. 2001. An assessment of sea turtles and their marine and terrestrial habitats at Saipan, Commonwealth of the Northern Mariana Islands. Micronesica 34:55–72.
- Lee, T. 1993. Summary of cetacean survey data collected between the years of 1974 and 1985. NOAA Tech.Mem. NMFS 181, 184pp.
- 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 2301:1-28.

- Marshall, A., M.B. Bennett, G. Kodja, S. Hinojosa-Alvarez, F. Galvan-Magana, M. Harding, G. Stevens, and T. Kashiwagi. 2011. *Manta birostris*. The IUCN Red List of Threatened Species 2011: e.T198921A9108067.
- Martien, K.K., R.W. Baird, N.M. Hedrick, A.M. Gorgone, J.L. Thieleking, D.J. McSweeney, K. Robertson, and D.L. Webster. 2012. Population structure of island-associated dolphins: evidence from mitochondrial and microsatellite markers for common bottlenose dolphins (*Tursiops truncatus*) around the main Hawaiian Islands. *Mar Mamm Sci* 28(3): E208-E332.
- McSweeney, D. J., Baird, R. W., & 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. *Mar Mamm Sci* 23:666-687.
- 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. *Mar Mamm Sci* 25:557-572.
- Mitchell, E. D. 1975. Report on the meeting on small cetaceans, Montreal, April 1-11, 1974. *J Fish Res Bd Can* 32:914-916.
- Mobley, J. R., Jr, S. S. Spitz, K. A. Forney, R. A. Grotefendt, and P. H. Forestall. 2000. Distribution and abundance of odontocete species in Hawaiian waters: preliminary results of 1993-98 aerial surveys Admin. Rep. LJ-00-14C. Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA 92038. 26 pp.
- National Marine Fisheries Service and U.S. Fish and Wildlife Service. 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 T. P. Dohl. 1980. Behavior of the Hawaiian spinner dolphin, *Stenella longirostris*. *Fish Bull* 77:821-849.
- Norris, K. S., B. Würsig, R. S. Wells, and M. Würsig. 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. *J Acoust Soc Am* 49:1909-10.
- Oleson, E.M., C.H. Boggs, K.A. Forney, M.B. Hanson, D.R. Kobayashi, B.L. Taylor, P.R. Wade, and G.M. Ylitalo. 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.
- Perrin, W.F., Würsig, B., and Thewissen J.G.M. [eds.]. 2009. Encyclopedia of marine mammals. Academic Press.
- Perryman, W. L., D. W. K. Au, S. Leatherwood and T. A. Jefferson. 1994. Melon-headed whale *Peponocephala electra* Gray, 1846. In: S. H. Ridgway and R. Harrison [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 P. Pyle. 2009. The Birds of the Hawaiian Islands: Occurrence, History, Distribution, and Status. B.P. Bishop Museum, Honolulu, HI, U.S.A. Version 1 (31 December 2009) <http://hbs.bishopmuseum.org/birds/rlp-monograph>
- Rankin, S. and J. Barlow. 2005. Source of the North Pacific “boing” sound attributed to minke whales. *J Acous Soc Am* 118(5):3346-335.
- Reeves, R.R., S. Leatherwood, and R.W. Baird. 2009. Evidence of a possible decline since 1989 in false killer whales (*Pseudorca crassidens*) around the main Hawaiian Islands. *Pac Sci* 63(2): 253–261.
- Rice, D. W. 1960. Distribution of the bottle-nosed dolphin in the leeward Hawaiian Islands. *J Mamm* 41:407- 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.
- Sanches, J.G. 1991. Catálogo dos principais peixes marinhos da República de Guiné-Bissau. Publicações avulsas do I.N.I.P. No. 16. *In*: Froese, R. and Pauly, D. [Eds.]. 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., & Andrews, R. D. 2009. Movements of satellite-tagged Blainville’s beaked whales off the island of Hawai‘i. *Endang Spec Res* 10:203-213.
- Schmidt AL, Whitney JL, Suca J, Tanaka K. 2023. NOAA Fisheries Larval ecology of *Aprion virescens*: a review from historical data NOAA Tech. Memo. TM-PIFSC-145, 71 p. <https://doi.org/10.25923/aevx-hr06>.
- 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. Final report to U.S. Marine Mammal Commission. MMC- 77/23, 79pp.
- Stafford, K.M., S.L. Nieuwirth and C.G. Fox. 2001. Geographic and seasonal variation of blue whale calls in the North Pacific. *J Cet Res Mgmt* 3:65–76.
- Strasburg, D. 1958. Distribution, abundance, and habits of pelagic sharks in the Central Pacific Ocean. *Fish Bull* 138(58):335-361.
- Thompson, P. O., and W. A. Friedl. 1982. A long-term study of low frequency sounds from several species of whales off Oahu, Hawaii. *Cetology* 45:1–19.

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.

Wolman, A. A. and Jurasz, C.M. 1977. Humpback whales in Hawaii: Vessel Census, 1976. Mar Fish Rev 39(7):1-5.