WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Pelagic Fisheries Research Plan & Implementation Strategy

February 2021 Update

I. Introduction

Fisheries for tuna, billfish, and other pelagic species in the U.S. Pacific Islands Region (Figure 1) are the largest in terms of volume and value, and include vessels using purse seine, longline, troll, and handline fishing gears. In 2017, over 20,000 metric tons of pelagic species were landed by Council-managed fisheries operating out of American Samoa, Guam, the Northern Mariana Islands, and Hawaii with a combined dock-side value of nearly $110 million. These values do not include non-commercial fishing vessels, which also harvest pelagic species including yellowfin, mahimahi, and billfish in substantial numbers, nor do they include economic revenue generated by recreational fishing within the region. Both Hawaii and Guam, for example, have sports fishing industries, as the waters off Kona are known for world class recreational blue marlin fishing. These reported catch and revenue values also do not consider the U.S.-flagged distant-water purse seine fleet of around 40 vessels responsible for landing approximately 250,000 metric tons annually from the equatorial Pacific Ocean. Several U.S. purse seine vessels homeport out of American Samoa and land their catch at the Pago Pago canneries.

A greater amount of tuna, billfish, and other pelagic species are landed in ports of the U.S. Pacific Islands than any other region in the nation. The Hawaii longline fishery consistently produces roughly 90%, 80%, and 50% of the U.S. domestic landings of bigeye, yellowfin, and swordfish, respectively. The Port of Honolulu ranks in the top 10 nationally in terms of landed fisheries value, and pelagic fisheries comprise the largest percentage of agricultural food production value in the State of Hawaii. The tuna canning industry has been the economic backbone of the American Samoa economy since the 1950s, and Pago Pago continues to be a strategic tuna port in the South Pacific.

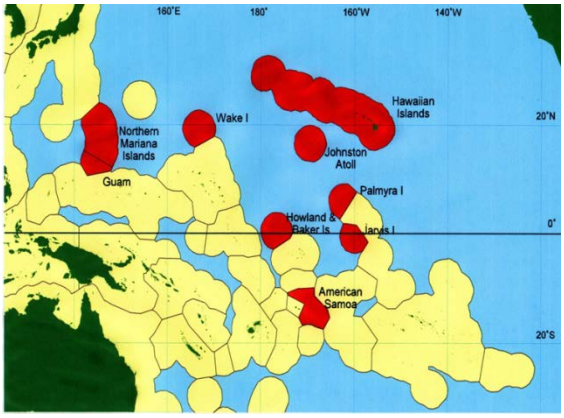


Figure 1. U.S. Pacific Islands Region

Pelagic fisheries are important to Hawaii, American Samoa, Guam, and the CNMI, not only in terms of economic revenue, but also for food security and cultural reasons. Fish have sustained indigenous populations within the region for thousands of years, and even currently, per capita consumption of seafood in the Council's region of jurisdiction is double the national average.

The Council's Pelagic Fisheries Program involves management of pelagic fisheries through the Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region (FEP). In 2009, the Pelagics FEP replaced the Council's Pelagics Fisheries Management Plan, which was first implemented in 1987. Since 1987, the Council has recommended nearly 40 amendments to the management plan and/or associated regulations (50 CFR 665 Subpart F).

Effective management of tuna, billfish, and other highly migratory species requires international cooperation. There are two tuna-RFMOs in the Pacific, the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC), covering the Western and Central Pacific Ocean (WCPO) and Eastern Pacific Ocean (EPO), respectively. The United States is a member of both commissions, and American Samoa, Guam, and the Northern Mariana Islands are Participating Territories of the WCPFC. Catch limits and other conservation and management measures set by the WCPFC and IATTC apply to U.S. pelagic fisheries including the Hawaii and American Samoa longline fisheries as well as the U.S. purse seine fleet.

Research plays a critical role in fisheries management, as stock assessments and research prioritization are major components of the Council's Pelagic Fisheries Program. From 1994 to 2012, the Council was a coordinating member of the Pelagic Fisheries Research Program (PFRP), which was funded with Congressional appropriations and administered by the University of Hawaii. The PFRP disbursed over $27 million in competitive grants to researchers around the world. Although the PFRP stopped receiving funding in 2012, the Council has continued to advocate for pelagic fisheries research through its five-year research priorities provided to NMFS as required under the MSA.

II. Purpose of the Plan

This plan outlines research categories and projects for the pelagic fisheries of the U.S. Pacific Islands Region. The plan will be used to inform the U.S. Pacific Islands Fisheries Research Program and ongoing prioritization of research funding and implementation.

III. Scope of the Research Plan

Research categories and projects identified in this plan are applicable to the U.S. Pacific Islands region and pelagic management unit species (PMUS) identified in the plan, the pelagic environment and its associated ecosystems, U.S. domestic pelagic fisheries and associated fishing communities, and internationally-managed fisheries. The plan has a five year timeframe, but can be revised at any time. Review of the plan will be conducted by the Council's advisory bodies including its Science and Statistical Committee. Major changes to the plan will be endorsed by the Council.

IV. Goals and Objectives of the Pelagics Fishery Ecosystem Plan

The Pelagics FEP contains the following four goals:

GOAL 1: Conserve and manage target and non-target stocks;
GOAL 2: Protect species and habitats of special concern;
GOAL 3: Understand and account for important ecosystem parameters and their linkages;
GOAL 4: Meet the needs of fishermen, their families, and communities.

To achieve the policy and goals of the Pacific Pelagics FEP, the Council has adopted the following objectives:

OBJECTIVE 1: Support Fishing Communities

a. Identify the various social and economic groups within the region's fishing communities and their interconnections.
b. Ensure that regulations designed to meet conservation objectives are written to be as minimally-constraining as possible.
c. Select alternatives that minimize adverse economic impacts to fishing communities when possible.
d. Eliminate regulations that are no longer necessary (i.e., eliminate access barriers).
e. Increase communication between fishery sectors.
f. Support fishery development, training and processing opportunities.
g. Support projects, programs and policies that increase sustainable fishing opportunities.

OBJECTIVE 2: Prevent Overfishing on Council-managed Stocks

a. Develop status determination criteria for all stocks and stock complexes in the fisheries.
b. Monitor fisheries to understand when overfishing may be close to occurring.
c. Rebuild overfished stocks.

OBJECTIVE 3: Improve Fishery Monitoring and Data Collection

a. Increase the number of fishery ecosystem elements being monitored.
b. Improve the timeliness of data availability.
c. Improve the quantity and quality of relevant fishery data.
d. Encourage research to improve precision of data regarding protected species populations and distributions.
e. Increase research coordination between the Council, the state, and federal agencies.
f. Increase the quality and quantity of monitoring and enforcement data through improved technology.

OBJECTIVE 4: Promote Compliance

a. Understand factors that may result in non-compliance.
b. Consider ways to develop or increase buy-in from affected parties.
c. Ensure that regulations are written and implemented so as to be easy to follow and enforce.
d. Develop codes of conduct specific to individual fisheries.

OBJECTIVE 5: Reduce Bycatch and Minimize Interactions and Impacts to Protected Species to the Extent Practicable

a. Maintain minimal impacts to protected species and other bycatch species while maintaining the viability of fisheries.
b. Promote viable methods and technologies that may reduce interactions with seabirds, marine mammals, sea turtles and other protected species.
c. Encourage non-regulatory approaches to reducing protected species and bycatch impacts where necessary and appropriate.
d. Increase fishermen's knowledge about protected species issues and regulations and ways to minimize interactions.
e. Continue to work with federal and state agencies to protect relevant threatened and endangered species.
f. Improve assessment of protected species and bycatch species impacts through improvements in data collection, research and monitoring.
g. Encourage research that examines whether and to what extent bycatch is an issue in the fisheries covered by this management plan.

OBJECTIVE 6: Refine and Minimize Impacts to Essential Fish Habitat

a. Review and update EFH and HAPC designations on regular schedule (5-years) based on the best available scientific information of a higher EFH level than was used for the original designation.
b. Identify and prioritize research to: assess adverse impacts to EFH and HAPC from fishing and non-fishing activities, including, but not limited to, activities that introduce land-based pollution into the marine environment.

OBJECTIVE 7: Increase Traditional and Local Knowledge in Decision-making

a. Identify relevant indigenous and local practices and knowledge that may improve scientific inquiry regarding Council-managed fisheries.
b. Utilize cultural practitioners, concepts, and bodies in the analysis of management alternatives.
c. Utilize fishermen knowledge in the analysis of management alternatives.

OBJECTIVE 8: Consider the Implications of Spatial Management Arrangements in Council Decision-making

a. Identify and prioritize research that examines the positive and negative consequences of current no-take fishing areas to fisheries, fishery ecosystems, and fishermen, such as military installations, Monuments, and Marine Conservation Areas.
b. Consider whether the goals of any spatial-based fishing restrictions proposed in federal waters appear to be achievable.
c. Establish effective spatially-based fishing zones.
d. Remove spatial-based fishing restrictions that are no longer necessary.

OBJECTIVE 9: Consider the Implications of Climate Change in Council Decision-making

a. Identify and prioritize research that examines the effects of climate change on Council-managed fisheries and fishing communities.
b. Ensure climate change considerations are incorporated into the analysis of

management alternatives.
c. Monitor climate-change related variables via the Council's Annual Reports.
d. Engage in climate change outreach with US Pacific islands communities.

Other Identified Objectives

Additional objectives identified in the development of this plan, but not included in the Pelagics FEP, are as follows:

- Consider public health and role of domestic supply of seafood in healthy diets and initiatives to address non-communicable diseases (e.g. heart disease). Issues also to consider include effects of microplastics seafood quality and further education and outreach on methylmercury/selenium relationship.

- Support the continuation of small-scale, artisanal, subsistence and traditional fisheries and linkages to Pacific Island food security and cultural integrity.

- Support adaptive management and stock assessment that can incorporate other drivers and factors (e.g. economic, social, catchability, markets, etc.) that may influence balanced management in support of optimal yield.

- Explore and test new data collection technologies such as the use of Electronic Reporting (ER), Electronic monitoring (EM), and the use of online and mobile devices to report catch and other information.

- Improve understanding of fisheries profiles, fishing technology and capacity, and effort creep as well as how these factors influence CPUE and stock assessment.

- Promote interactive cooperative research with the fishing industry and community to identify, develop, and test bycatch mitigation and anti-depredation strategies.

- Improve data inputs to stock assessment through supporting research on:
    - Basic biology (age, growth, reproduction) of target and retained non-target species necessary for management.
    - Movement and distribution of species harvested by domestic fisheries needed for a better understanding of stock structure and connectivity.
    - Catchability, availability and changes in fishing efficiency that have a dramatic impact on CPUE indices, e.g. changes in fishing efficiency and technology, monitoring effort creep, influence of ocean productivity, oceanography, forage abundance, and vertical distribution.

V. Priority Issues

The following priority issues have been identified for focused research activities:

1) Bigeye connectivity and spatial stock structure with an emphasis on high-latitude bigeye catches by the Hawaii longline fishery in the WCPO and EPO.

2) Lack of stock assessment and indicators for incidentally-caught species, including opah, monchong, and spearfish.

3) Effects on fisheries from spatial closures and large-scale marine protected areas.

4) Shark species identification, abundance and reasons for high levels of interactions with Marianas pelagic fisheries.

5) Advancing ecosystem-based fisheries management.

Figure 2. Opah landed by Hawaii longline vessels and sold in fish auction at Honolulu Harbor.
Photo: M. Goto, United Fishing Agency.

Priority Area 1: Bigeye Connectivity and Stock Structure

Bigeye is managed internationally by the WCPFC and IATTC, and separate stock assessments are conducted for the WCPO and EPO. Most of the bigeye caught in the Pacific is within the equatorial band, between 10 degrees North and 10 degrees South. In the North Pacific off of Japan and around the Hawaii Archipelago, bigeye is also caught primarily with longline and handline fishing gears. Connectivity between "high-latitude" bigeye found in the equatorial band is not well known, and understanding bigeye stock structure and movement continues to be priority for stock assessment and management.

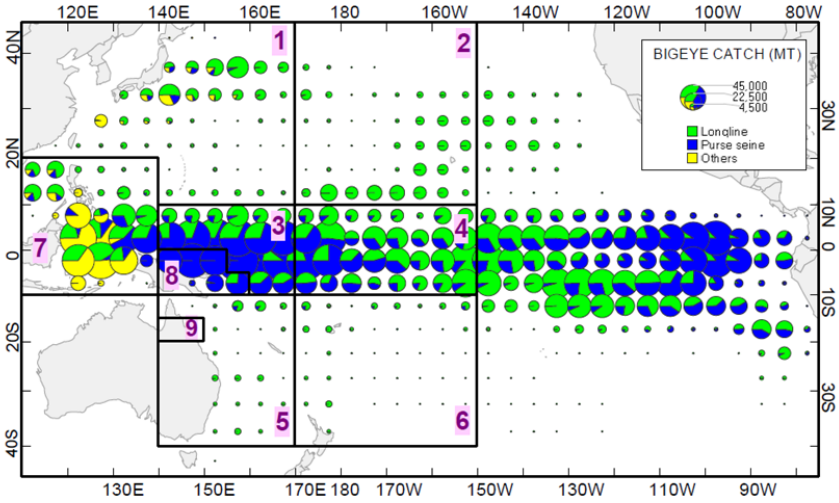


Figure 3. Distribution of bigeye catches in the Pacific Ocean (1990-2016).
Source: Williams *et al*., 2017[1]

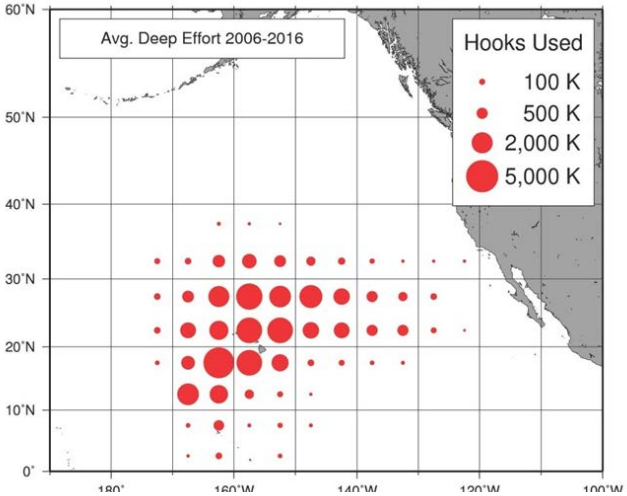


Figure 4. Spatial representation of fishing effort of the Hawaii deep-set longline fishery. Source: R. Ito, NMFS PIFSC

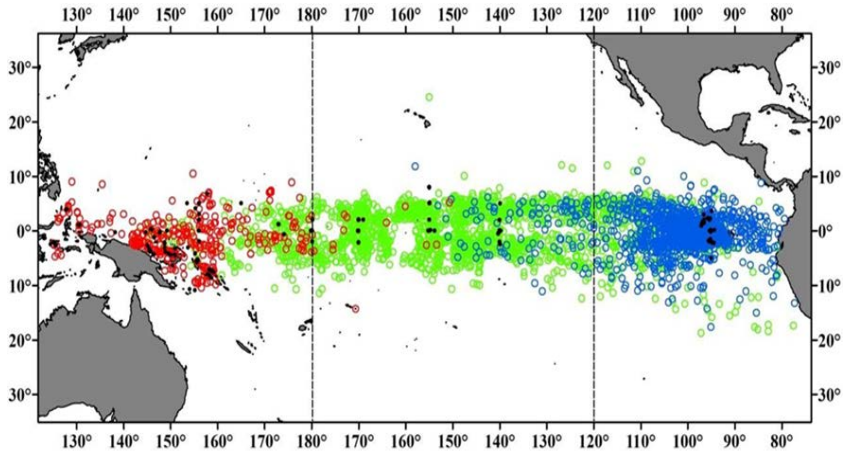


Figure 5. Bigeye mixing derived from tagging studies.
Source: Schaefer *et al*., 2015[2]

[1] Williams, P., Terawasi, P., & C. Reid. (2017). Overview of tuna fisheries in the Western and Central Pacific Ocean. WCPFC-SC13-2017/GN-WP-01.Thirteenth Regular Session of the WCPC Scientific Committee. 9-17 August 2017. Rarotonga, Cook Islands, 71.

[2] Schaefer, K., Fuller, D., Hampton, J., Caillot, S., Leroy, B., & Itano, D. (2015). Movements, dispersion, and mixing of bigeye tuna (*Thunnus obesus*) tagged and released in the equatorial Central Pacific Ocean, with conventional and archival tags. *Fisheries Research*, *161*, 336–355.

Priority Area 2: Stock Assessments and Indicators for Other Pelagic Species

Over 50% of the landings measured in weight of the Hawaii longline fishery are comprised of bigeye tuna followed by swordfish (13%), opah (8%) and yellowfin (6%). When considering number of fish, however, monchong, mahimahi, and spearfish comprise significant percentages (Figures 6-8). Through international cooperation, stock assessments are conducted for the major tuna and billfish stocks (i.e. swordfish, blue marlin, striped marlin). Stock assessments and stock indicators are lacking for other important species retained by the Hawaii longline fishery and marketed such as opah, monchong, and spearfish (Table 1).

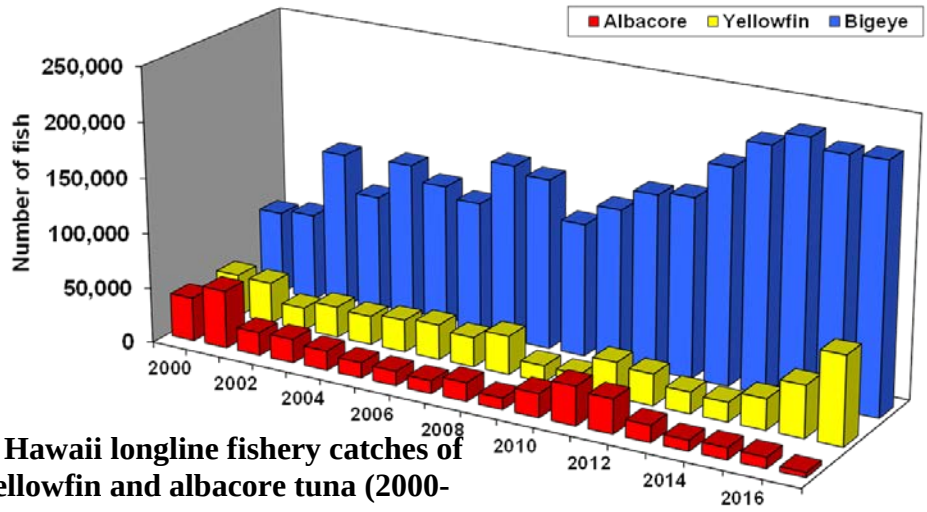


Figure 6. Hawaii longline fishery catches of bigeye, yellowfin and albacore tuna (2000-2017).
Source: R. Ito. NMFS PIFSC

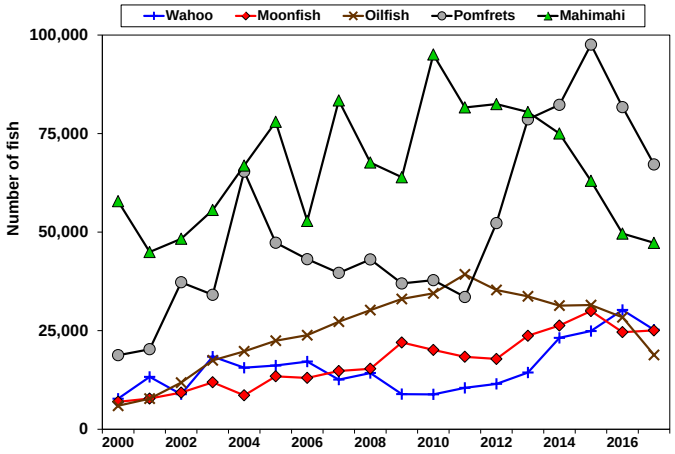


Figure 7. Hawaii longline fishery catches of wahoo, moonfish, olifish, pomfrets, and mahimahi (2000-2017).
Source: R. Ito, NMFS PIFSC

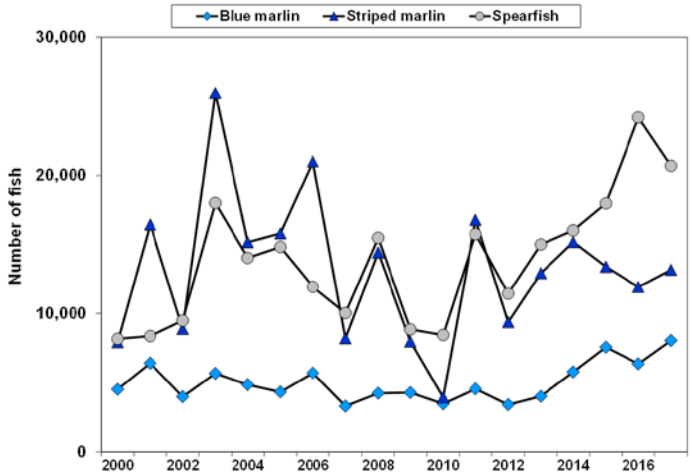


Figure 8. Hawaii longline fishery catches of blue marlin, striped marlin, and spearfish (2000-2017).
Source: R. Ito, NMFS PIFSC

Table 1: Stock Status of Pelagic Management Unit Species.

Species	Stock	Overfishing?	Overfished?
Bigeye tuna (*Thunnus obesus)*	Western Central Pacific	No	No
	Eastern Pacific	Yes	No
Yellowfin tuna (*Thunnus albacares)*	Western Central Pacific	No	No
	Eastern Pacific	No	No
Skipjack tuna (*Katsuwonus pelamis*)	Western Central Pacific	No	No
Albacore (*Thunnus alalunga)*	North Pacific	No	No
	South Pacific	No	No
Pacific bluefin tuna (*Thunnus orientalis*)	Pacific	Yes	Yes
Swordfish *(Xiphias gladius)*	Western Central North Pacific	No	No
	Eastern Pacific	Yes	No
Striped marlin (*Kajikia audax*)	Western Central North Pacific	Yes	Yes
Blue marlin (*Makaira nigricans*)	Pacific	No	No
Blue shark (*Prionace glauca*)	North Pacific	No	No
Oceanic whitetip shark (*Carcharhinus longimanus*)	Western and Central Pacific	Yes	Yes
Shortfin mako shark (*Isurus oxyrinchus*)	North Pacific	Unknown	Unknown
Longfin mako shark (*Isurus paucus*)	North Pacific	Unknown	Unknown
Silky shark (*Carcharhinus falciformis*)	Western and Central Pacific	Yes	Yes
Common thresher shark (*Alopias vulpinus*)	North Pacific	Unknown	Unknown
Bigeye thresher shark (*Alopias superciliosus*)	North Pacific	Unknown	Unknown
Pelagic thresher shark (*Alopias pelagicus*)	North Pacific	Unknown	Unknown
Salmon shark *(Lamna ditropsis*)	North Pacific	Unknown	Unknown
Mahimahi (*Coryphaena spp*.)	Pacific	Unknown	Unknown
Wahoo (*Acanthocybium solandri*)	Pacific	Unknown	Unknown
Opah (*Lampris* spp.)	Pacific	Unknown	Unknown
Pomfret (family Bramidae)	Western Pacific	Unknown	Unknown
Black Marlin (*Istiopax indica*)	Pacific	Unknown	Unknown
Shortbill spearfish (*Tetrapturus anustirostris*)	Pacific	Unknown	Unknown
Sailfish (*Istiophorus platypterus*)	Pacific	Unknown	Unknown
Kawakawa (*Euthynnus affinis*)	Pacific	Unknown	Unknown
Oilfish (family Gympylidae)	Pacific	Unknown	Unknown
Squid	Pacific	Unknown	Unknown

Source: WPRFMC. (2018; in preparation). 2017 Annual Stock Assessment and Fishery Evaluation Report Pacific Island Pelagic Fishery Ecosystem Plan. Kingma, E., Ishizaki, A., Walker, R., Remington, T., Spalding, S. (Eds.) Western Pacific Regional Fishery Management Council. Honolulu, Hawaii 96813 USA.

Priority Area 3: Effects on Fisheries from Spatial Closures and Large-Scale Marine Protected Areas

Two of the world's largest marine protected areas are located within the U.S. EEZ of the Pacific Islands Region, and approximately 50 percent of the U.S. waters in the region are closed to commercial fishing[3]. Large-scale MPAs have displaced Hawaii longline and U.S. purse seine fishing effort into international waters, which is also fished by tuna fleets from several nations. Other spatially-managed areas within the U.S. EEZ have been established under various statutes including the MSA, the Antiquities Act, the National Marine Sanctuaries Act, and the Marine Mammal Protection Act. Council-established marine managed areas for pelagic species include Hawaii, Guam, and CNMI longline exclusion zones, American Samoa large vessel prohibited areas, and the Northwestern Hawaiian Islands protected species zone. Internationally-imposed spatially-managed areas have also been implemented by the WCPFC and IATTC, and there is an emerging United Nations convention focused on protecting and conserving biological diversity on the high seas. There also exists a need to examine and empirically quantify the effectiveness of spatially-managed areas alongside impacts associated with displaced fishing effort on target and non-target catches, protected species interactions, catch competition among fleets, fishing efficiency, and economic performance.

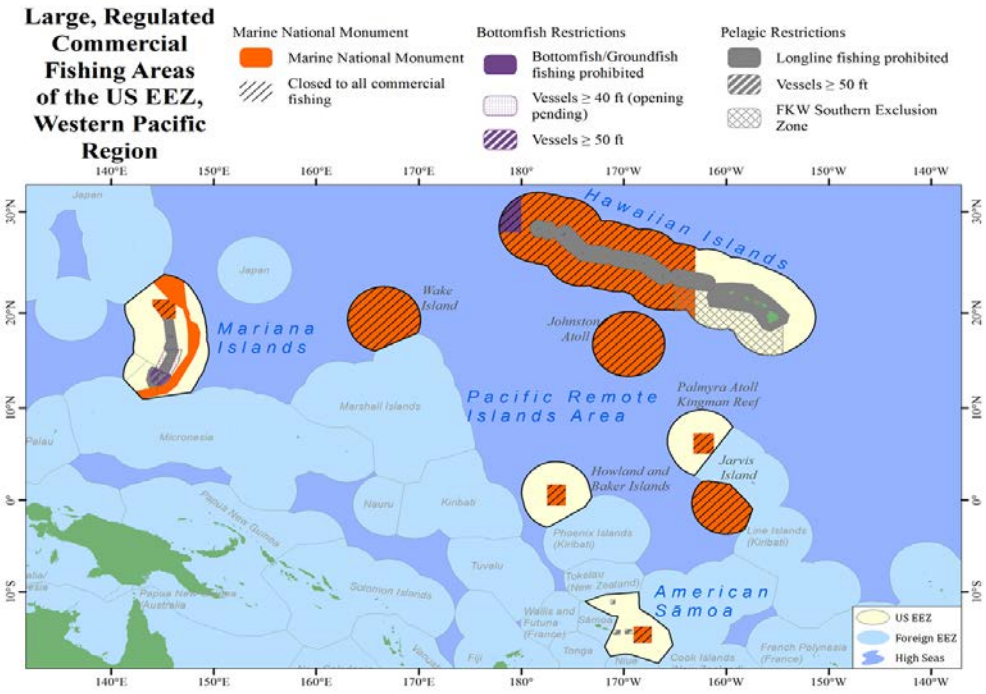


Figure 9. Map of spatially-managed areas within the U.S. Pacific Islands Region.
Source: WPRFMC

[3] 1) Papahanaumokuakea Marine National Monument; 2) Pacific Remote Islands Marine National Monument

Priority Area 4: Shark Abundance and Depredation in the Mariana Archipelago

The Mariana Archipelago stretches nearly 800 miles from north to south and lies in the sub-tropical zone of the western Pacific Ocean, just north of the core equatorial tuna fishing band within the WCPO. There has never been much industrial fishing within the Marianas, and currently, there are no pelagic longline or purse seine vessels operating in the archipelago. Pelagic species such as yellowfin, skipjack, mahimahi, and billfish are caught in small numbers by local troll vessels based in Guam and CNMI. Local fishermen regularly complain of high shark depredation during troll fishing trips. Fisheries in the Marianas do catch and land sharks, but there currently are no directed fisheries for sharks in the archipelago. Data collected from the Guam creel survey program in 2017 indicated that 40% of pelagic fishing trips surveyed reported shark interactions that included either stealing of bait or depredation of catch. To date, information is lacking on what species of sharks are interacting with the troll fisheries, and a paucity of information exists on dynamics of troll/shark interactions in the Marianas.

Figure 10. Shark depredation in waters offshore of Guam.
Photo: J. Borja, Guam fisherman

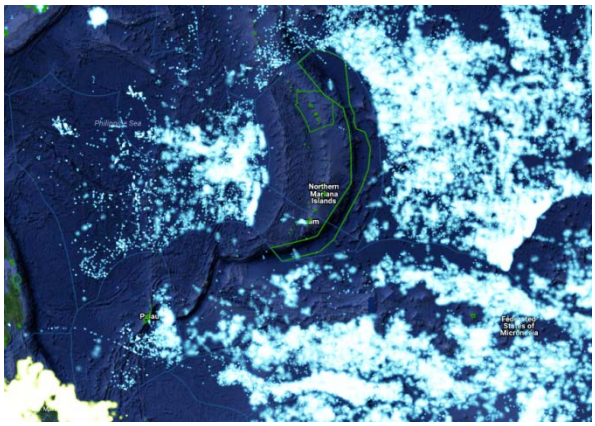
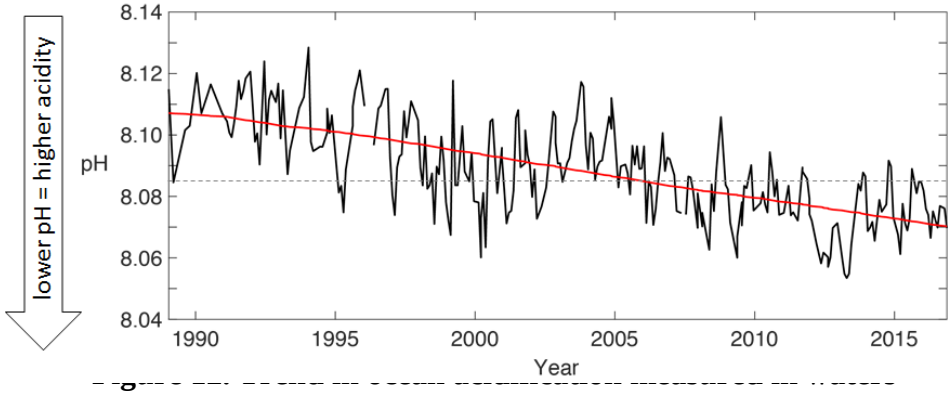


Figure 11. Industrial-scale fishing effort adjacent to the U.S. EEZ around the Mariana Archipelago (November 2017 through April 2018).
Source: Global Fishing Watch

Priority Area 5: Advancing Ecosystem-based Fisheries Management

The Council transitioned to Fisheries Ecosystem Plans in 2009 and recognizes that effective ecosystem-based fisheries management will require appropriate management objectives and an increased understanding of a range of social and scientific issues including, biological and trophic relationships, ecosystem indicators and models, and the ecological effects of non-fishing activities on the marine environment. Future fishery management actions are anticipated to utilize this information as it becomes available, and adaptive management will be used to further advance the implementation of ecosystem science and principles.

From a marine ecosystem management perspective, the boundary of a pelagic ecosystem cannot be readily defined and depends on many factors, including life history characteristics, habitat requirements, geographic ranges, and interdependence of fish and other marine resources. Additionally, processes that affect and influence the abundance and distribution of natural resources, such as environmental cycles, extreme natural events, and acute or chronic anthropogenic impacts must also be considered (Figure 12). Serious considerations must also be given to social, economic, and political constraints. The Pelagic FEP is subject to multinational political constraints due to the highly migratory nature of pelagic species, such as tunas, whose stocks move between the high seas and the EEZs of multiple nations. The overall goal of the Pacific Pelagic FEP is to establish a framework under which the Council will improve its abilities to realize the goals of the MSA through the incorporation of ecosystem science and principles.



offshore of the Hawaiian Archipelago at Station Aloha (1989-2017).

Source: P. Woodworth-Jefcoats, NMFS PIFSC

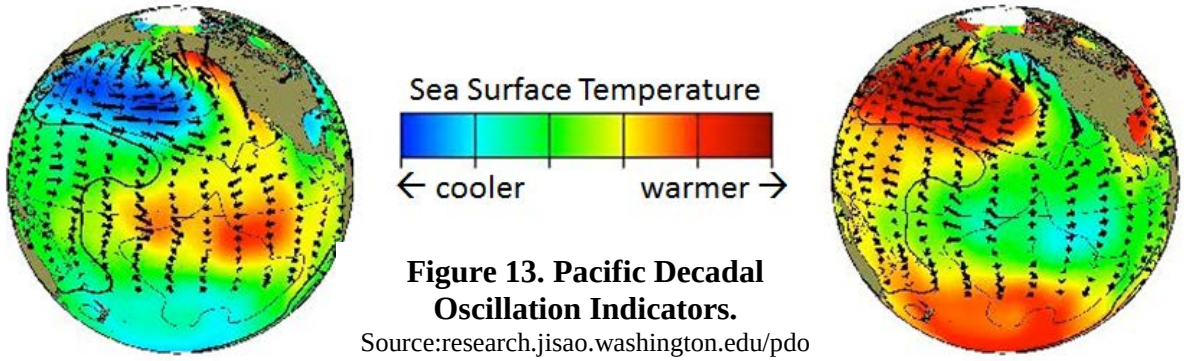


Figure 13. Pacific Decadal Oscillation Indicators.

Source:research.jisao.washington.edu/pdo

Positive phase

Negative phase

VI. Research Plan Categories and Projects

This plan includes the following research categories:

- Biology, Life History, Stock Structure, and Connectivity
- Stock Assessment and Stock Status Indicators
- Ecosystem Considerations and Indicators
- Economics and Human Communities
- Fisheries Interactions and Management

Where appropriate, the plan incorporate themes and projects identified by the PFRP[4], the Council's five-year research priorities[5], workshops convened by the Council[6], and other relevant sources. Projects identified within categories are listed in priority order.

[4] Sibert, J., McCreary, S., and Poncelet, E. (2005). Pacific Ocean Connections: priorities for pelagic fisheries research in the 21st century. *Report of PFRP Research Priorities Workshop*. 16-18 November 2005. Honolulu.
[5] WPRFMC. (2013). Five-year Research Priorities under the MSRA. Western Pacific Regional Fishery Management Council. Honolulu, HI.
[6] WPRFMC. (2014). Report of the Workshop on Pacific Bigeye Movement and Distribution. April 22-24, 2014. Western Pacific Regional Fishery Management Council. Honolulu, HI.

Research Category A: Biology, Life History, Stock Structure and Connectivity

A: Biology, Life History, and Connectivity			
Theme	**Project**	**Priority Area(s)**	**Implementation Strategy**
Life History	A1: Conduct biosampling of pelagic species with a focus bigeye tuna, opah, monchong, and spearfish sub-regional age and growth estimation, genetics, maturity, and stock structure to inform stock assessments.	**1, 2**	
	A2: Support research to improve understanding of reproduction including spatial differences in size and age at maturity, spawning seasons, spawning locations, fecundity, with particular focus on bigeye tuna.	**1,2,3,4,5**	
Connectivity	A3: Examine regional differences in behavior of bigeye and other PMUS that influence both vertical and horizontal movement	**1, 5**	
	A4: Incorporate the influence of size and maturity on movement studies	**1,2,5**	
	A5: Support development of new tags and tools to examine movement and motivations for fish movement.	**3,4,5**	

	A6: Investigate stock structure and connectivity of PMUS species using electronic tagging, genetic studies, stable isotope, trace elements, gene tagging or other analytical methods with priority on bigeye and South Pacific albacore tuna.	**1,2, 3,5**	

Research Category B. Stock Assessment and Stock Status Indicators

B: Stock Assessment and Stock Status Indicators			
Theme	**Project**	**Priority Area(s)**	**Implementation Strategy**
CPUE Standardization	B1: Conduct CPUE standardization for non-target PMUS to support stock assessments for opah, monchong, and shortbill spearfish.	**2**	**In progress**
Stock Assessment and Stock Status Indicators	B2: Conduct Productivity Susceptibility Assessments using stock status indicators for PMUS that currently lack stock assessments.	**2**	
	B3. Work with international partners to collect and develop CPUE time series and other necessary information to conduct stock assessments on PMUS currently lacking stock status evaluation and in the following priority: 1) opah, 2) monchong, 3) shortbill spearfish.	**2**	

Research Category C. Ecosystem Consideration and Indicators

C. Ecosystem Considerations and Indicators			
Theme	**Project**	**Priority Area(s)**	**Implementation Strategy**
Trophic Interactions and Food Webs	C1: Conduct regular field surveys of the pelagic environment to assess plankton abundance and composition and where appropriate develop and utilize trophic models to characterize dynamics of the ecosystem relevant to key stocks and variations in trophic structure related to fishing.	**5**	**Current PIFSC and UH cruise work may be collecting pertinent information. This will need a longer timeline and heavy support from NOAA and funding for shipboard activities**
	C2: Examine effects of large predator removals to trophic levels and food webs.	**5**	**Flag for Ryan R…. Top-down dynamics have been well studied with sharks. This could be a desk study in absence of immediate assistance**
	C3: Assess the relative importance of epi-pelagic and meso-pelagic prey organisms on trophic structure (e.g. several species of squid are poorly understood).	**5**	
Indicators	C4: Monitor variation in oceanographic conditions and linkages to stock distribution, connectivity, recruitment, and catchability, availability, selectivity, and seasonality.	**5**	
	C5: Develop a suite of science-based	**5**	

	indicators and operational metrics related to ecosystem condition in support ecosystem-based fisheries management.		
	C6: Determine the influence of meso-scale oceanographic features (e.g. fronts, eddies, upwelling) on fisheries and ecosystems.	**5**	
Climate Change Impacts	C7: Evaluate the impacts on PMUS due to changes in various oceanographic conditions (temperature, oxygen, salinity, pH, currents, stratification, frontal zone locations, etc.) that are induced by a warming planet and greenhouse gas emissions.	**5**	
	C8: Conduct simulations using models to predict the distribution of key tuna stocks as a result of changing conditions	**5**	
	C9: Support investigations of early life history strategies of PMUS to inform ecosystem-based fisheries management.	**1,2,5**	

Research Category D: Economics and Human Communities

D: Economics and Human Communities			
Theme	**Project**	**Priority Area(s)**	**Implementation Strategy**
Human Communities	D1. Identify key socioeconomic factors that influence participation and effort in regional commercial and non-commercial pelagic fisheries to better understand and predict future trends.	**3, 5**	**Need to consult with PIFSC Socioeconomics Program and WPRFMC Social Science Planning Committee**
	D2: Examine relationships between culture and contemporary pelagic fisheries for improved knowledge of locally-relevant dimensions of fishing.	**3, 5**	
	D3. Determine social drivers of human behavior that affect compliance in regional fisheries and design effective management interventions that align behavior with conservation goals, (e.g. mitigating protected species interactions, responses to management actions, catch reporting, etc.)	**3, 5**	
	D4: Develop indicators to examine community resilience and risk perceptions for considering potential impacts of climate change (or other large-scale changes that result in an uncertain future) on pelagic fisheries,	**3, 5**	

	fishing communities, and human well-being.		
	D5: Assess the human dimensions of U.S. Pacific marine managed areas and regional fisheries management, especially elements of procedural justice, transferred economic, social, and ecological effects, food security, equity and gender issues, and safety at sea.	**3, 5**	**Need to consult with PIFSC Socioeconomics Program and WPRFMC Social Science Planning Committee**
Seafood Markets	D6. Explore pelagic species market distribution (sources and flows) in both formal and informal markets to understand contributions of Hawaii fish to domestic and international markets, as well as the role of directly imported or via interstate commerce channels of pelagic product in Hawaii's seafood markets.	**5**	
	D7. Investigate consumer preferences for Hawaii seafood product attributes to include (but not limited to); source and quality (local vs. import and/or fishing gear), labeling, species substitution patterns, health benefits, safety, etc.	**5**	
Fishery Profiles	D8: Conduct socioeconomic surveys of regional commercial and non-commercial fisheries, communities, and supporting industries.	**5**	**Need to consult with PIFSC Socioeconomics Program and WPRFMC Social Science Planning Committee**
	D9. Collect oral histories, archival	**5**	

	photos, and artifacts to document the history and traditions for regional pelagic fisheries.		
Applied Economics	D10: Utilize applied economic and bio-economic models to evaluate management measures, future scenarios, and associated trade-offs including effort displacement, profitability, economic efficiency, and transferred effects.	**3, 5**	**Need to consult with PIFSC Socioeconomics Program and WPRFMC Social Science Planning Committee**
	D11: Design empirical models of price determination and demand structure to better understand and predict pelagic market dynamics.	**5**	
	D12: Estimate non-market values associated with regional pelagic fisheries.	**5**	

Research Category E: Fisheries Interactions and Management

E: Fisheries Interactions and Management			
Theme	**Project**	**Priority Area(s)**	**Implementation Strategy**
Fisheries Data	E1: Research new and innovative methods for pelagic fisheries data including electronic monitoring and reporting systems for vessels and observers including systems with species recognition ability and automatic length/weight measurement.	**2,5**	**ER Regulatory Amendment to Final Rule**
Bycatch and Depredation	E7: Conduct studies on shark abundance, movement, and seasonality of sharks in the Marianas Archipelago.	**4**	
	E2: Conduct research on gear mitigation measures that reduce bycatch and/or reduce post-release mortality.	**5**	
	E3: Conduct research on catch and bait depredation on fishing gear and explore mitigation strategies.	**5**	
	E4: Conduct research on gear mitigation measures that promote greater selectivity in purse seine fisheries (for example echo sounder buoys on drifting FADs to discern between yellowfin, bigeye, and skipjack and size of fish).	**5**	
	E5: Investigate mitigation and catch	**5**	

	reduction strategies for bigeye tuna taken in the tropical purse seine fisheries.		
	E6: Evaluate post hooking mortality of bycatch species for those listed under the ESA and MMPA.	**5**	
	E8: Assess bycatch reduction strategies and trade-offs in longline and purse seine fisheries.	**5**	
Spatial Management	E9: Develop frameworks for identifying real-time temporal/spatial hotspots and evaluate potential for implementation as management measures.	**3,5**	
	E10: Conduct empirical studies to evaluate the effectiveness of large-scale MPAs including no-take areas, commercial fishing prohibitions or gear prohibitions including abundance of key species, spillover, and nursery areas.	**3**	
	E11: Conduct tagging research to evaluate movement of PMUS in and out of large-scale MPAs.	**3,4,5**	
	E12: Examine the effect of drifting and anchored FADs on the movement of PMUS including residency, aggregation times, size of aggregations and vulnerability to fishing.	**1,5**	
	E13: Evaluate spatial management and effects on catch, effort displacement, revenue, and cost.	**3,5**	
Fisheries	E14: Evaluate gear competition and interaction between longline, purse seine,	**5**	

Interactions	troll, and other pelagic fisheries and effects on catch rates.		
	E15: Investigate the concept of local depletion and impact to domestic fisheries of Hawaii and the territories, particularly for the albacore fishery of American Samoa.	**5**	**PIFSC and Council have strategizing group on this, going into 2021 Commission Meeting**
	E16: Identify indicators and metrics that could be used to assess impacts of offshore aquaculture operations on PMUS including displacement, aggregation, predation, and habitat degradation.	**5**	
Non-fishery related Impacts	E17: Conduct studies on the effects of non-fishery stressors on PMUS including plastics in marine environment, pollution, ocean noise, seabed mining, etc.	**5**	
Decision tools	E18: Explore the feasibility of Management Strategy Evaluation for pelagic fisheries of the region with regards to: - Longline catch vs effort restrictions. - Fishery interactions (e.g. purse seine and longline). - Role of catchability, availability and movement of pelagic resources.	**3,5**	

	- Characterizing uncertainty and identifying measures that are robust to uncertainty. - Addressing fishing capacity and market competition between scales of domestic pelagic fisheries. - Evaluating the value of existing/new data collection processes in achieving management aims (value of information, cost/benefit analyses). - Rights-based management alternatives including catch shares.		