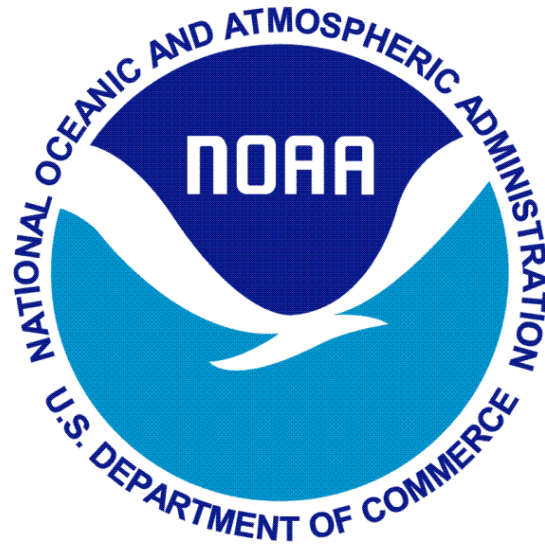


DRAFT
Pacific Islands Region
Ecosystem Based Fisheries Management
Implementation Plan
2018-2022



Contents

List of Acronyms	3
1. 5	
2. 6	
Who we are	8
3. 10	
4. 13	
5. 15	
State and Territorial Partners	16
International Fisheries Management	16
Other Federal Partners	16
6. 17	
7. 19	
8. 22	
Appendix 1: 37	
Domestic Fisheries Management	37
Resource and Ecosystem Monitoring Surveys	38
Data Management	39
Socioeconomic Research	40
Climate	40
Protected Species	42
West Hawai'i IEA and Habitat Focus Area	42
Pacific Marine National Monuments	44
Coastal and Marine Spatial Planning	45
Appendix 2: 46	

1. List of Acronyms

ABC	Acceptable Biological Catch
ACL	Annual Catch Limit
BMPs	Best Management Practices
BOEM	Bureau of Ocean Energy Management
CNMI	Commonwealth of the Northern Mariana Islands
Council	Western Pacific Regional Fishery Management Council
CRCP	NOAA Coral Reef Conservation Program
DOD	Department of Defense
EBFM	Ecosystem-based Fisheries Management
EBM	Ecosystem Based Management
EEZ	U.S. Exclusive Economic Zone
EFH	Essential Fish Habitat
ENSO	El Niño - Southern Oscillation
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESD	Ecosystem Science Division
FEP	Fishery Ecosystem Plan
FMP	Fishery Management Plan
FRMD	Fisheries Research and Monitoring Division
HFA	Habitat Focus Area
HICEAS	Hawaiian Islands Cetacean Ecosystem Assessment Survey
IAC	Inter-American Convention for the Protection and Conservation of Sea Turtles
IATTC	Inter-American Tropical Tuna Commission
IEA	Integrated Ecosystem Assessment
IFD	International Fisheries Division
ISC	International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean
LME	Large Marine Ecosystem
LEAP	Local Early Action Plan
MNM	Marine National Monument
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
NEPA	National Environmental Policy Act
NGO	Non-government Organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration (NOAA)
NOS	National Ocean Service
NPFC	North Pacific Fisheries Commission
NPS	National Park Service
OP	Observer Program
OY	Optimum Yield
PDO	Pacific Decadal Oscillation
PIFSC	NMFS Pacific Islands Fisheries Science Center
PIMPAC	Pacific Islands Marine Protected Areas Community
PIRO	NMFS Pacific Islands Regional Office

PIRPB	Pacific Islands Regional Planning Body
PRD	Protected Resources Division
PRIA	Pacific Remote Island Areas
PSD	Protected Species Division
OFL	Overfishing Limit
RAMP	Reef Assessment and Monitoring Program
REAC	Regional Ecosystem Advisory Committees
RFMO	Regional Fishery Management Organization
SAFE	Stock Assessment and Fishery Evaluation
SEEM	Social, Economic, Ecological, and Management Uncertainty
SFD	Sustainable Fisheries Division
SOD	Science Operations Division
SPC	Secretariat of the Pacific Community
SPRFMO	South Pacific Regional Fisheries Management Organization
SSC	Scientific and Statistical Committee (Council)
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WCPFC	Western and Central Pacific Fishery Commission

2. Purpose

The National Marine Fisheries Service (NMFS) released a policy¹ in May 2016, formalizing NMFS commitment to Ecosystem-based Fisheries Management (EBFM) and facilitating management of the National Oceanic and Atmospheric Administration (NOAA) trust resources in an ecosystem context. In November 2016, NMFS released the EBFM Roadmap², which outlines a national EBFM implementation strategy and establishes a framework of six Guiding Principles, each building on the next to enhance the implementation of EBFM within NMFS. These six Guiding Principles are:

1. Implement ecosystem-level planning
2. Advance our understanding of ecosystem processes
3. Prioritize vulnerabilities and risks to ecosystems and their components
4. Explore and address trade-offs within an ecosystem
5. Incorporate ecosystem considerations into management advice
6. Maintain resilient ecosystems

The EBFM Roadmap also calls for the development of regional EBFM implementation plans to identify and coordinate priority EBFM activities across NMFS science and management programs and the Regional Fishery Management Councils. This document serves as the EBFM Implementation Plan for the Pacific Islands Region (2018-2022). The goal of this regional EBFM implementation plan is to identify concrete ways in which Pacific regional marine science and management organizations can further EBFM in the near and longer term, including executing existing plans effectively and helping all the partners in the region identify high priority opportunities to meet the EBFM challenges of the future. The plan will define the long-term vision for EBFM in the region while identifying participating partners and establishing the process through which EBFM coordination will be facilitated. As a key component of the implementation plan, concrete actions to achieve EBFM guiding principles will be identified along with measurable outcomes to meet specific milestones.

Our conservation and management responsibilities spring from many mandates, the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), the Coral Reef Conservation Act (CRCA), and the National Environmental Protection Act (NEPA) among others. The Magnuson-Stevens Act also includes 10 National Standards as principles to ensure sustainable and responsible fishery management.³ NMFS defines EBFM as “a systematic approach to fisheries management in a geographically specified area that contributes to the resilience and sustainability of the ecosystem; recognizes the physical, biological, economic, and social interactions among the affected fishery-related components of the ecosystem, including humans; and seeks to optimize benefits among a diverse set of societal goals”

¹ Ecosystem-based Fisheries Management policy at: <http://www.nmfs.noaa.gov/op/pds/index.html>

² NOAA Fisheries Ecosystem-based Fisheries Management Roadmap at: <http://www.nmfs.noaa.gov/op/pds/index.html>

³ <https://www.fisheries.noaa.gov/national/laws-and-policies/national-standard-guidelines>

(EBFM Policy). This approach enables NMFS to more effectively and efficiently implement and meet these diverse mandates. More simply, EBFM can be thought of as an approach to meet our fisheries conservation and management mandates by balancing ecological well-being and human well-being through good governance.

EBFM is management of the fisheries sector under the broader goals of ecosystem-based management and acknowledges that our trust resources and associated ecosystem components do not recognize or abide by our jurisdictional boundaries; hence, we can more effectively manage and conserve these trust resources by working and managing collaboratively with our jurisdictional partner agencies. NMFS Pacific Islands Fisheries Science Center (PIFSC), NMFS Pacific Islands Regional Office (PIRO), as agents of the U.S. Government, and our primary partner the Western Pacific Fishery Regional Management Council (Council) conduct research and management in federal waters around the U.S. Pacific Islands, Hawai‘i, the Marianas Archipelago (which includes Guam and the Commonwealth of the Northern Mariana Islands (CNMI)), and American Samoa. We also collaborate on similar efforts in state and territorial waters as well as in international waters to support international fisheries treaties and protected species mandates. While EBFM considers all types of impacts to marine habitats and fishery resources, activities that impact coastal resources often originate in local waters beyond NMFS jurisdiction. We cannot implement effective EBFM without our partners in the state and territories. Together, we strive to further the goals of effective scientific research and facilitating management of resources more holistically, promoting EBFM across the Pacific Islands region.

3. Regional Context

PIFSC, PIRO, and the Council offices and staff are located primarily in Honolulu, Hawai‘i, with a few additional staff located in Guam, CNMI, and American Samoa. Our central offices in Hawai‘i are situated in the central North Pacific Ocean, with our closest neighbor the island nation of Kiribati, 2,957 km away. There are 2.3 million mi² of marine area, including the island archipelagos of Hawai‘i, American Samoa, the Mariana Islands, the island of Guam, and the Pacific Remote Island Areas (PRIAs) (see Figure 1) under our conservation and management jurisdiction as well as millions of square miles of international waters within the region. The total area of the U.S. Exclusive Economic Zone (EEZ) waters of the Pacific Islands region is roughly equal to all remaining U.S. EEZs combined.

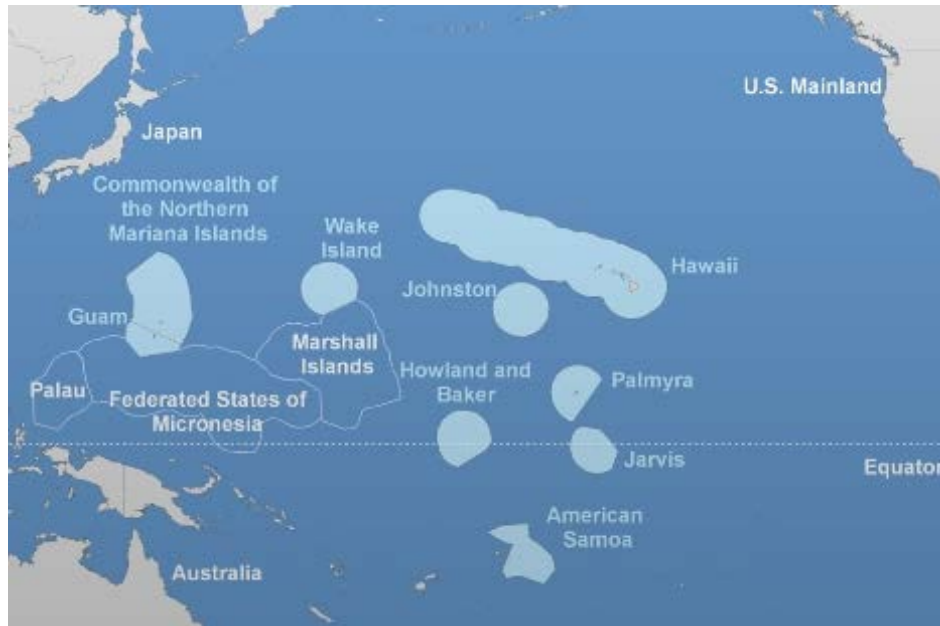


Figure 1: Map of the U.S. Exclusive Economic Zones within the U.S. Pacific Islands Region

The Pacific Islands region is comprised of dynamic and diverse nearshore and pelagic ecosystems that are unique in many ways, perform vital functions, and provide ecosystem services valued by island communities. Habitats such as coral reefs, meso-pelagic, and deep-sea communities harbor a wealth of marine life including fish, sharks, rays, sea turtles, seabirds, and marine mammals, several of which are threatened or endangered. The fisheries in the region range from nearshore crustacean, reef, and bottomfish fisheries, to wide-ranging fisheries for large highly migratory species, such as tunas and billfishes. The sessile communities, such as sponges and corals, build structures that live for centuries, providing essential habitats and supporting ecosystem functions for numerous species. Ecosystem components interact in intricate and complex ways to generate economically valuable and culturally important ecosystem goods and services. While we commonly emphasize research and management of the marine environment, a holistic approach includes the people living in the region as part of the social-ecological system. The ecosystems within the scope of the Pacific Islands region are subject to multiple stressors, and the degree of resilience and adaptability varies. We strive to provide the highest level of science-based stewardship to maintain ecosystem structure and function.

Increased density in human populations, both across much of the Pacific Islands region and globally, have significantly intensified local and global threats to marine ecosystems. Development and landscape changes, along with shifting weather patterns, can lead to heightened sediment runoff and fresh water intrusion. These issues impact the nearshore environment and are likely to worsen as the region's population increases and as climate change brings shifting storm patterns and sea-level rise threatens the coastlines.

Many climate-associated changes are already occurring. Rising ocean temperatures have caused major coral bleaching and mortality events. Increasing atmospheric CO₂ is absorbed into the ocean, causing ocean acidification. Warming-induced coral bleaching and ocean acidification are already triggering significant changes in the biological communities associated with coral reefs, including mortality or decreased growth of corals and potentially significant declines in biodiversity. Local changes in reef communities can have far-reaching effects.

Effective EBFM requires linking comprehensive scientific research with management objectives. With the wealth of information available from a wide variety of sources, resource managers must work with scientists to identify the data specific to their particular needs, clearly articulate the information they require from scientists, and describe the form in which that information would be most useful. Scientific products developed in consideration of management concerns can facilitate clearer answers to specific questions. Effective implementation of an ecosystem approach requires that scientists and managers continuously communicate their needs and share information and data to successfully manage ecosystems of the U.S. Pacific Islands Region. Additionally, because many of the threats to coastal ecosystems are either land-based or the result of activities occurring shoreward of the U.S. EEZ, collaboration with the State of Hawai'i and the U.S. Territories of the Pacific and other key partners is integral to successful advancement of EBFM across the Pacific Islands region.

Historically, fisheries management has focused on management of a single species or complex. EBFM involves ecosystem considerations synthesized across diverse suites of disciplines and data streams. Giving decision makers detailed information about thresholds and tipping points, bycatch reduction options, protected species populations, climate and habitat sciences, economics, human dimensions, intra- and inter-species interactions, non-fishery activities that may affect fisheries, will facilitate the integration of these diverse efforts to achieve our region's broader EBFM goals.

Who we are

PIFSC conducts science in support of the conservation and management of living marine resources across the region and in close consultation with PIRO. Three research divisions at PIFSC; Ecosystem Sciences (ESD), Fisheries Research and Monitoring (FRMD), and Protected Species Divisions (PSD) conduct a wide range of science and research activities. ESD conducts multidisciplinary research, monitoring, and analyses of integrated environmental and living resource systems in coastal and offshore waters of the Pacific Ocean. The FRMD conducts fisheries monitoring, fisheries data management, fisheries interactions, fish life history studies, and stock assessments in support of fisheries management. PSD conducts research which provides the scientific foundation for conservation of Hawaiian monk seals, cetaceans, and sea turtles in the Pacific islands in support of the recovery and maintenance of healthy populations. In addition to these research divisions, the Science Operations Division houses the Marine National Monument (MNM) Science Program, as well as executes the logistics of field operations and advanced survey and technologies program.

PIRO is tasked with the conservation and management of living marine resources and associated habitats in the U.S. Pacific Island Region and providing guidance and support for domestic and international fisheries. These efforts are spread across five programs of PIRO; International Fisheries Division (IFD), Protected Resources Division (PRD), Habitat Conservation Division (HCD), Sustainable Fisheries Division (SFD), and Observer Program (OP). The IFD, along with the Department of State and other government agencies, negotiate and implement the provisions of international fisheries agreements for the western and central and south Pacific Ocean. PRD manages marine species protected under the ESA and the MMPA. HCD works to conserve, protect, and restore NOAA trust resources within the marine and coastal ecosystems. SFD oversees and implements fishery management plans for commercial and non-commercial domestic fisheries. The Observer Program monitors fishing efforts landings, catch and by-catch, documents interactions with protected species, and collects samples to improve stock assessments and life history research.

Established by the Fisheries Conservation and Management Act of 1976 (which after several reauthorizations is informally known as the Magnuson-Stevens Act), the Council is one of eight regional councils in the United States and has authority over fisheries in the U.S. EEZ waters seaward of the State of Hawai'i ; U.S. territories of American Samoa and Guam; the CNMI; and the U.S. Pacific remote island areas of Johnston, Midway, Palmyra and Wake Atolls; Baker, Howland and Jarvis Islands; and Kingman Reef. The Council is comprised of 16 members; 13 of whom are voting members:

- 4 area specific obligatory seats: 1 for each island area (Am. Samoa, Guam, CNMI and Hawai'i)
- 4 at large seats (can be appointed from any of the 4 areas)
- 4 local agency representatives
- 1 NMFS
- 3 federal non-voting agencies
 - U.S. Coast Guard
 - U.S. Department of State
 - U.S. Fish and Wildlife Service

The Council has the responsibility to prepare and submit to the Secretary of Commerce: fishery management/ecosystem plans and associated regulations, amendments to plans and regulations, and the specification of annual catch limits, among other requirements. The Council has several advisory bodies including the Science and Statistical Committee, Advisory Panels, FEP Plan Teams, Protected Species Advisory Committee, Marine Planning and Climate Change Committee, Fishing Industry Advisory Committee, Social Science Planning Committee, and Regional Ecosystem Advisory Committee. Each meeting of Council and its advisory bodies is listed in the Federal Register and local publications and open to public.

4. Long-term vision for and benefits of EBFM in the region

EBFM provides regional resource managers, scientists, and stakeholders with an integrated conceptual approach that ensures management of trusted species and communities are based upon sound science advice that holistically accounts for ecosystem considerations. These may include critical habitat, protected species interactions, environmental variability, ecological relationships, or socioeconomic and cultural considerations. The success of this approach will be measured by the increased number of fisheries or areas that are managed in ways that prevent overfishing (on an ecosystem basis), habitat degradation, or adverse impacts to protected species.

In 2003 when the National Marine Fisheries Service created the Pacific Islands Region, the new PIRO and PIFSC, along with the Council, collaboratively developed and drafted a “Strategic Plan for the Conservation and Management of Marine Resources in the Pacific Islands Region” (March 2004). At the heart of the plan was the establishment of the vision for “[maintaining] healthy marine ecosystems that provide for stability in fishery resources, recovery of endangered and threatened marine species, and enhanced opportunities for commercial, recreational, and cultural activities in the marine environment” in the Pacific Islands Region.

The Council, working with PIFSC and PIRO, then advanced the plan by conducting three separate multi-day Ecosystem Workshops between 2005 and 2006; the key objective was generating policy options and information needed to effectively implement EBFM in the region⁴. To this end, three themes were identified for promoting EBFM in the region. These included:

- ‘ecosystem science’ - including *biophysical* data acquisition and analysis, *models* development and application, and identification of *indicators*;
- ‘ecosystem social science’ – expanding economics, societal, and cultural data sources, *models* development and application, and identification of *indicators*;
- ‘ecosystem policy’ – in particular embracing the *Aha Moku* system for the Pacific Islands region. This is the Hawaiian system of natural resource management based on the concept of *‘ahupua`a*, the traditional land and ocean tenure system of Hawai‘i . The Aha Moku system presents an adaptive and incremental strategy; a policy for indigenous resource user groups, and framework for community and agency interaction.

Other key products from these workshops set the stage for structural change toward place-based FEPs, as well as the development of the Council’s Regional Ecosystem Advisory Committee. Today and looking ahead, this long-term vision for EBFM remains, and with it the penultimate goal of implementing conservation and management measures based on

⁴ E. Glazier (editor), 2011. “Ecosystem-based Fisheries Management in the Western Pacific.” Wiley-Blackwell.

ecosystem principles and scientific research. This implementation plan reiterates the Region's commitment to EBFM.

To achieve full implementation of EBFM for the Pacific Islands, a coordinated effort among PIFSC, PIRO, and the Council is needed to review the accomplishments and build upon the outcomes of these workshops and to identify emerging issues and management needs which will determine the science products required to address those needs. EBFM considers the task of maximizing ecosystem function and services within the jurisdiction of NMFS and beyond. This involves tradeoffs, which will require PIFSC, PIRO, and the Council, in collaboration with other partner agencies, to develop a new paradigm which shares this goal. The paradigm must shift from reactionary to proactive management based on measured changes in the ecosystem. Fisheries management frequently revolves around short-term issues emerging from fishery or policy changes. A fully implemented EBFM framework allows managers to monitor changes in the fisheries as a function of the environment and ecosystems and proactively make timely management decisions which address issues emerging from monitored parameters. This might include a transition toward ecosystem-based indicators and management thresholds that are based on synthesized information across disciplines, trophic-levels, and taxa. This complex and multifaceted approach will require substantial investment in scientific method to support the development of key indicators and application of appropriate ecosystem models and management strategy evaluations.

Transitioning from our current science and regulatory structure to EBFM will require thoughtful, clearly defined steps. The genesis of those steps can be found as recommendations in several existing strategic plans. For example:

- *Identify effective management strategies in the face of changing climate and ocean conditions and provide decision makers with the information they need for climate-ready decisions (Pacific Islands Regional Action Plan – Climate Science Strategy)*
- *Engage with our science partners to advance domestic and international conservation and management of Pacific marine resources and the ecosystems that support them. (PIRO Strategic plan 2016-2020)*
- *Consider the implications of climate change in Council decision-making by identifying and prioritizing research that examines the effects of climate change on Council-managed fisheries and ensure climate change considerations are formally incorporated into the analysis of management alternatives (Fishery Ecosystem Plans (FEPs): adopted by the Council at its 151st meeting)*
- *Improve understanding of the processes and dynamics of socio-ecological systems and the influences of climate, ecosystem, habitat, and species relationships on living marine resources to provide scientific advice to managers (draft PIFSC Science Plan 2018-2022).*

The activities currently conducted in the Pacific Islands region, such as monitoring, data gathering, modeling, assessing, reporting, and regulating that inform management and conservation of NOAA trust resources, all operate in support of EBFM. The Council and

PIRO strive to incorporate high-quality PIFSC science into actions by better formulating and evaluating management strategies and objectives and relevant research questions which will result in more relevant science and advice from PIFSC. Through full engagement in EBFM, the Regional partners will be better poised to meet our conservation and management goals and improve coordination, communication, and collaboration with our many research and stakeholder partners.

Three fundamental factors must come together when trying to understand the ecosystems to be managed: environmental, ecological, and societal. Environmental factors include abiotic physical and climate drivers, such as climate variability (including ocean acidification and sea level rise), terrestrial runoff, or dissolved oxygen levels. Ecological factors encompass trophodynamics (e.g., predator-prey interactions, food webs, and availability), regional carrying capacity, and the physico-, chemico-habitats themselves. Societal factors include stressors and impacts (such as non-commercial and commercial fishing, gear interactions, habitat degradation/destruction, marine debris, and pollution) and mitigating human engagement, such as habitat restoration efforts, conservation and stewardship of resources, or effective bycatch remediation. Additionally, people derive economic, nutritional, protective, spiritual, and cultural benefits from the ecosystem. Balancing these trade-offs through sound science and governance will reduce the risk of ecosystem degradation for future generations. An effective new management paradigm will acknowledge the importance of these three factors and incorporate them into a management framework. Likewise, science and research in each of these areas is critical to inform this framework. Its effectiveness will be evaluated throughout a continuous adaptive management cycle. Proactively considering these three factors will help shift the thinking from single-species management to an ecosystem framework.

To this end, PIFSC, PIRO, and the Council are working on two transformational research projects that will serve as test cases for conducting science and developing science advice with an ecosystem objective; these are: (1) Develop a framework for understanding ecosystem and operational factors influencing protected species interaction patterns in the Hawai'i and American Samoa longline fisheries and (2) develop and apply an Atlantis Ecosystem Model for the main Hawaiian Islands as a decision-support tool for EBFM.

The primary objectives of the first project are to (i) conduct an analysis examining the environmental and ecological drivers affecting the distribution and aggregation of protected species and the socioeconomic factors driving fisher behavior which ultimately determine interaction patterns/rates, (ii) develop management strategies (e.g., time-area closures, dynamic isotherm bands or depths) and social marketing tools based on the modeled environmental drivers that would reduce interaction rates, (iii) predict fisher behavior response to proposed management strategies and provide probabilities of reaching Incidental Take limits within the fishery based on choice of management strategy, and (iv) analyze the trade-offs for the fishery in operational costs (e.g., gas, time at sea) or loss of target catch for following recommended strategies to reduce protected species interactions.

The second project will provide a tool for generating science advice to marine resource managers in highly heterogeneous environments and competing societal concerns. As indicated, each island and island group in the Pacific Islands Region is unique with environmental and anthropogenic coastlines. For example, the windward and leeward coasts are very different in exposure to oceanic waters and consequently biological communities and human uses. In the Pacific, there is greater heterogeneity around the islands, but on relatively smaller spatial scales. The spatially-explicit holistic Atlantis ecosystem model will be able to inform EBFM regarding such impacts and offer management tradeoffs for consideration.

These projects represent our initial proactive foray into fully transforming the Region's operational science and management paradigm to build and support ecosystem-based management and conservation of fisheries and living marine resources. In the years going forward, we will continue to build on these initiatives until EBFM becomes the modis operandi.

5. Regional EBFM Coordination (expected outcomes and benefits)

The benefits of effective EBFM implementation will be achieved as a result of understanding and meeting the needs of our partners; delivering results in a synthesized and comprehensible fashion; collecting, analyzing, and using data to address current and future management issues; and implementing effective and adaptive management strategies. Communication will be central to achieving these anticipated outcomes and benefits. We must engage all partners to better identify strategies that are currently working or not working, what approaches might be more effective, and what science is needed to reduce the uncertainty surrounding implementation. This could also help stakeholders understand, embrace, and assist in moving toward EBFM. The Pacific Islands region has organically implemented EBFM coordination in many arenas, and these examples can serve as models for future success in achieving the six guiding principles. For additional information about any individual topic, please see Appendix 1.

Federal domestic fisheries management activity within the region derives from the legal authority under the Magnuson-Stevens Act. The Council developed, and NMFS implemented, five place-based fishery ecosystem plans (FEPs) to replace the former species-based fishery management plans (FMPs). Four of the FEPs are geographically based: the American Samoa Archipelago FEP, the Hawai'i Archipelago FEP, the Mariana Archipelago FEP, and the Pacific Remote Island Areas FEP. The fifth FEP governs pelagic fisheries operating in federal waters around the U.S. Pacific Islands and on the high seas. The FEPs establish the framework within which NMFS and the Council can integrate and implement EBFM in each of the FEP areas of the region. Each of the FEPs contain ecosystem-based objectives, such as consideration for the long-term sustainable use of marine resources; human communities; impacts to bycatch species, protected species, and habitat; and adaptive management systems to respond to environmental changes. Federal fisheries management must also be consistent

with other applicable laws, such as the ESA, MMPA, NEPA, and Water Quality Act. Integrating the requirements for these laws under the EBFM framework would allow streamlined analysis of relative impacts of fishery management measures on the resources.

Ecosystem-level advice requires ecosystem-level science created from robust data streams. PIFSC routinely conducts multiple types of **resource and ecosystem monitoring surveys** across the U.S. coral reef ecosystems under our authority. The **reef assessment and monitoring program** (RAMP) surveys provide long term data on a suite of topics; **life history surveys** collect biological samples (e.g., otoliths, gonads, and fins clips) from fishes across the Archipelagos, and operationalizing **fishery-independent surveys** develop unbiased and independent indices of abundance. PIFSC currently houses and manages an array of **data** sets that have been growing for decades. It is imperative that PIFSC and PIRO preserve long-term time series and data sets, particularly for observational data. These are fundamental to addressing future unforeseeable science and management questions. Each of these efforts contributes to scientifically robust products used in a wide range of resource management activities. Long-term data sets help us to understand the dynamic changes in the stocks, the fishery, and the environment upon which the ecosystem models can interpret and create projections for different management scenarios.

The Pacific Islands region is subject to **climate** variability on multiple temporal and spatial scales. Many changes have already been observed and are projected to increase, directly and indirectly impacting our marine ecosystems and the people and communities that depend upon them. EBFM conducted under the broad themes of basic science and research, monitoring, projecting future conditions, and adapting to persistent challenges will help the region to robustly address myriad questions and impacts while also providing effective and timely management.

Protected Species research is at the heart of monitoring, conservation, and development of solutions to minimize the bycatch or other forms of anthropogenic impact on marine mammals, sea turtles, seabirds, protected fish, and corals. This research contributes to our understanding of ecosystem process impacts on protected species and fisheries, the effects of direct and cascading trophic interactions between organisms, and cumulative pressures that pose the most risk to vulnerable resources, including factors such as climate change.

PIFSC conducts a broad range of **socioeconomic research** across the Pacific Islands region to help us more effectively understand the role of people in EBFM, both in terms of economic and societal goals and the role of communities in management. This work is increasingly utilized in ecosystem models, providing a better understanding of the links between resource management and community well-being. Social and economic information is used to evaluate the impacts of the proposed fishery management action on human communities and local economies. FEP amendments need to quantify those impacts for the fishery managers to choose the best management alternative. Social and economic information is a key element of the EBFM framework. Minimizing impact to human communities is required under the Magnuson-Stevens Act.

West Hawai‘i Integrated Ecosystem Assessment (IEA) Project works to provide sound and relevant scientific information that addresses existing and future resource management concerns in the West Hawai‘i ecosystem. This project has focused considerable effort on building local relationships to better understand management and community needs so the necessary science can be developed. A collaborative effort within **West Hawai‘i IEA and Habitat Focus Area Hawai‘i (HFA)** is working to increase the sustainability and productivity of West Hawaiian fisheries by focusing on the habitat that fish need to spawn and grow, as well as protecting the coastal resources on which communities depend. These two programs have overlapping scientific and management interests and are working together to integrate management priorities and goals into ongoing and future scientific activities.

In contrast to the small-scale IEA and HFA efforts that focus on local impacts, the **Pacific Marine National Monuments (MNM)** are large marine ecosystems situated in vast, remote, and largely uninhabited areas of the Pacific. The four marine monuments - **the Papāhānaumokuākea MNM, the Mariana Trench MNM, the Pacific Remote Islands MNM, and the Rose Atoll MNM** are managed through a collaborative effort of various federal, state, territorial, and local agencies and emphasize integrated ecosystem-based management. Because of their relative isolation from population centers in the Pacific, MNMs present a unique opportunity to advance understanding of the global pressures of climate change, marine debris, ocean acidification, and sea level rise.

The National Ocean Policy, 2010, provided a framework for all federal agencies to pursue a stewardship vision utilizing **Coastal and Marine Spatial Planning (CMSP)**. CMSP is an ecosystem-based spatial planning process for analyzing current and anticipated ocean uses and identifying areas most suitable for various activities. It involves increased coordination and collaboration across all levels of government. In the Pacific Islands region, the responsibility of implementing the National Ocean Policy falls on the Pacific Islands Regional Planning Body (PIRPB). The PIRPB plans to complete a total of four marine spatial plans for the Pacific Islands region, American Samoa, Guam and CNMI, the Pacific Remote Islands Area, and Hawai‘i .

6. Partners

The PIFSC, PIRO, and the Council work with various partners that complement the ongoing science and management activities in the Pacific Islands region. In addition to the key partners described below, we partner with the **Pacific Islands fishing communities** that fish for subsistence, cultural purposes, revenue, and leisure; **academic institutions** that conduct research and educate the next generation of scientists and managers; and **non-governmental organizations (NGOs)** that work at the grassroots level to engage the public in the marine resource issues under NMFS purview at local, national, and global scales.

State and Territorial Partners

We share responsibilities for managing marine resources with the state government agencies of Hawai‘i and the territorial government agencies of American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands (CNMI). These local partners manage marine resources within waters 0-3 nautical miles from their respective shorelines. The primary state and territorial agencies with management authority over marine resources are: **Hawai‘i’s Department of Land and Natural Resources**, including the **Division of Aquatic Resources** and **Division of Conservation and Resources Enforcement**; **Guam Department of Agriculture’s Division of Aquatic and Wildlife Resources**; **CNMI Department of Lands and Natural Resources, Division of Fish and Wildlife**; and the **American Samoa Department of Marine and Wildlife Resources**.

International Fisheries Management

U.S. pelagic longline fisheries operating in the region target highly migratory species and fish both within the U.S. EEZ and in international waters. The United States works within Regional Fisheries Management Organizations (RFMOs) to further the policies and priorities for managing domestic fisheries and conserving and managing living marine resources and ecosystems. The **Western and Central Pacific Fisheries Commission (WCPFC)** manages highly migratory species (HMS), primarily tuna and tuna-like species and other species of fish taken by vessels fishing for tunas and tuna-like species in the western Pacific Ocean. The **Inter-American Tropical Tuna Commission (IATTC)** covers the same species as the WCPFC in the eastern Pacific Ocean. These organizations have a small area of overlap. The **South Pacific Regional Fisheries Management Organization (SPRFMO)** provides fisheries management on the high seas of the South Pacific for species other than HMS. The **North Pacific Fisheries Commission (NPFC)** focuses on fisheries resources harvested in the North Pacific Ocean. Each RFMO receives advice from its scientific committee. The **Secretariat of the Pacific Community (SPC)** serves as the scientific and data service provider to the WCPFC. In addition to the SPC, the **International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC)** conducts stock assessments and research on stocks harvested in the North Pacific Ocean.

Aside from the HMS international activities, the **Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC)** provides the legal framework for countries in the Americas and the Caribbean to take actions for the benefit of sea turtles.

Other Federal Partners

We work with federal agencies external to NOAA to more effectively meet our mandates. The **Environmental Protection Agency (EPA)**; the **U.S. Army Corps of Engineers**; agencies within the **Department of the Interior (DOI)**, such as the **United States Fish and Wildlife Service (USFWS)**, the **United States Geological Survey (USGS)**, the **National Park Service (NPS)**, and the **Bureau of Ocean Energy Management (BOEM)** have missions complementary to NOAA and are effective partners in examining the ecosystem for a variety

of perspectives. With the military presence in the marine realm around the globe, the **Department of Defense (DOD)** is also a substantive partner in EBFM efforts.

In addition to NMFS, all other NOAA line offices are active in the Pacific Islands region including; **NOAA's Ocean and Atmospheric Research (OAR, the National Ocean Service (NOS), the National Environmental Satellite, Data, and Information Services (NESDIS), the National Weather Service (NWS) and NOAA's Office of Marine and Aviation Operations (OMAO)**. OAR houses the Cooperative Research Institute affiliated with the University of Hawai'i, the **Joint Institute for Marine and Atmospheric Research (JIMAR)**. This grant driven organization supports more than 50% of PIFSC staff and is a valuable partner in Pacific science. In addition to JIMAR, OAR also encapsulates the **University of Hawai'i Sea Grant College Program and the Pacific Marine and Environmental Laboratory**.

The NOS focuses on collaborative management of ecosystems and coastal resources. The **Office of National Marine Sanctuaries** oversees two Pacific Sanctuaries: the National Marine Sanctuary of American Samoa and the Hawaiian Islands Humpback Whale National Marine Sanctuary. The **Marine National Monuments Program** has four MNMs in the Pacific: Papahānaumokuākea MNM (583,000 mi²), Rose Atoll MNM (13,451 mi²), Marianas Trench MNM (95,216 mi²), and the Pacific Remote Islands MNM (232,815 mi²). The NOS Office of Coastal Management Coral Reef Conservation Program (CRCP) brings a multidisciplinary approach to understanding and conserving coral reef ecosystems. NESDIS coordinates climate science and supports the region with their Coastwatch/Oceanwatch Program that provides access to satellite oceanographic and atmospheric products. Through the OMAO, two primary support platforms, the NOAA ships *Oscar Elton Sette* and *Hi 'ialakai* serve the Pacific Islands region.

7. Engagement Strategy

Engaged and well-informed communities are the cornerstone of implementing effective EBFM. This can only be achieved through directed and concerted effort, which includes the following strategies: 1) develop and implement a comprehensive strategic communications plan for EBFM, 2) increase community participation in the fishery management processes, 3) increase community participation in project-based EBFM including habitat restoration projects, and 4) engage communities using a variety of media strategies.

1. Develop and implement a comprehensive strategic communications plan for EBFM

The first step in engaging the community is determining who is involved in EBFM for key projects. This will help us identify the desired role for the community and develop a plan targeting each segment. Attention will also be given to how different parts of the community (especially in different areas of our region) need to be engaged in different ways (e.g., traditional vs. social media, large events vs. focus groups, etc.).

2. Increase community participation in fisheries management processes

PIFSC, PIRO, and the Council provide opportunities for community participation through various meetings and events. These multiple points of engagement can provide areas in which increased community participation can be measured. The strategy for engagement under this component is to utilize existing effort more effectively to increase community participation in the fishery management process. Success for this component would be measured by an increased number of presentations and community members engaged.

For example, the Council meets at least three times a year and includes a Fishers Forum as part of each meeting. The Council process includes multiple advisory groups where fishermen and the community are involved in providing the Council with fishery management advice. The Council also utilizes its Regional Ecosystem Advisory Committees (REAC), which includes members from various federal, state, and local agencies, non-government specialists, and private businesses from each respective area to share information, as well as better integrate and coordinate ocean and coastal ecosystem management.

PIRO and PIFSC offer unique opportunities for community participation. For example, they encourage the fishing community to discuss topical issues affecting the recreational and non-commercial fishing communities through opportunistic events, such as fishing tournaments, expositions, and trade shows. PIRO, PIFSC, and the Council also engage with the community through habitat restoration projects and seek to further increase community participation in these projects.

3. Increase community participation in project-based EBFM, including habitat restoration projects

The community needs to understand EBFM in order to more effectively participate in the process. The development of new projects, in addition to the existing habitat restoration projects in the region, presents opportunities for the community to engage in EBFM in a hands-on environment. The role that these current projects play in EBFM and how the community can participate will be emphasized and/or included in future projects.

4. Engage communities through outreach and education using a variety of media strategies

It is important to note that media strategies need to be tailored to the differences between island areas, as well as the differences between stakeholder groups being targeted for messaging. For instance, TV production in Hawai'i is effective for delivering information, but radio station ads are more effective in American Samoa. Similarly, while newspaper ads help target adults, younger generations get their news through social media. Strategies on providing outreach need to cover a wide-spectrum of outlets and involve many different activities.

Interactive online data portals will help share our extensive data with academia and other stakeholders, ensuring that current scientific information is easily accessible to all. In time, our robust scientific data will be available in formats useful to both management and the broader community.

Targeting regional audiences with EBFM outreach materials will be a key component of the EBFM engagement strategy. Using local pictures/graphic elements or place names and incorporating current projects or success stories will enhance the visibility of our work, increase awareness, and build partnerships. Identifying key local community leaders to help carry the EBFM message and develop community networks and action plans promoting grassroots community-based approaches to sustainable resource management and restoration will be a crucial step to enhance community engagement. Furthermore, community engagement will need to be a two-way process for communities to continue to collaborate with management and scientists and on future monitoring projects. The community needs to have opportunities to identify assessment objectives as well as learning about the results of these assessments. The sheer size of the region presents a challenge in maintaining internal and external engagement due to intraregional time zone differences (of almost an entire day) and travel costs. Staff continue to work through these challenges with webinars and other technological tools and work with staff in American Samoa, CNMI, and Guam to promote communication with stakeholders.

8. Actions to Achieve EBFM Guiding Principles

Together, PIFSC, PIRO, and the Council have made strides in implementing many of the Guiding Principles in our day-to-day work. We will continue to work toward achieving the broader goals of EBFM by finding better ways to coordinate our efforts to incorporate ecosystem considerations in all our science and management activities. Each of the six EBFM Guiding Principles builds upon the next, with the ultimate goal of maintaining productive and resilient ecosystems. The EBFM Guiding Principles and brief descriptions of some regional actions for achieving these guiding principles follow.

1. Implement ecosystem-level planning:

PIFSC, PIRO, and the Council will engage internal and external partners throughout the region as the agency shifts its focus to management from an ecosystem perspective through an engagement strategy described in Section 6. This could result in some key benefits, such as increased coordination between climate science and management functions, increased community participation in habitat restoration projects, and improved efficacy and efficiency of science, management, and stakeholder interface, all goals within the multi-year PIRO strategic plan and PIFSC science plan. Management projects that will benefit from EBFM and research projects that will enhance EBFM need to be identified and prioritized, which can be endeavored through enhanced engagement.

The development of FEPs is another overarching EBFM goal that would meet the spirit of guiding principle #1. While our region has been managing our federal fisheries under place-based FEPs since 2010, we continually strive to improve this management framework by focusing on efforts to facilitate better communication, information sharing, and engagement with partners and stakeholders, increase our ability to integrate disparate information and understand interactions within an ecosystem context, and help inform decision-makers about

effective management strategies across jurisdictional boundaries. These activities include development, maintenance, and improvement to the Stock Assessment and Fishery Evaluation (SAFE) reports that incorporate ecological, societal, and environmental factors, and the execution of the FEPs. Providing technical assistance and enhancing capacity to strengthen science frameworks for international fisheries management also support guiding principle #1.

2. Advance our understanding of ecosystem processes:

As stated in the EBFM Road Map, “Ecosystem-level advice requires ecosystem-level science.” Numerous plans exist and are underway in the Pacific Islands region that guide the development of the tools and data streams needed to better understand Pacific ecosystems and ways in which human communities value and interact with these natural resources. The development and maintenance of robust data and data streams provide a foundation upon which good management decisions are made. Our region also continues to sustain socioeconomic, ecological, environmental, and climate observing programs to monitor status and trends of core ecosystem components and drivers influencing living marine resources and human well-being and improve integration with other regional and national programs.

PIFSC, PIRO, and the Council will continue to support, develop, and maintain a wide range of data to support ecosystem-level science and management. These efforts include biological sampling and analyses which provide requisite life history information on priority insular and pelagic species, including ecosystem considerations of spatial, temporal, and environmental effects. Efforts also include developing and using advanced technology to improve protected species population assessments and increase efficiencies and expand assessments to previously unsurveyed areas of our region. The PIFSC draft Science Plan identifies a specific goal over the next five years to conduct and disseminate research on catch and bycatch species under a framework of moving toward ecosystem-based fisheries management. Our region also continues to develop and maintain core data and information streams, while improving standardization of data collection, storage, and reporting formats to ensure timeliness, quality, and accessibility of data products.

3. Prioritize vulnerabilities and risks to ecosystems and their components:

Along with our partners, we must identify and prioritize which ecosystems warrant extra attention relative to a wide variety of risks, such as climate change and pollution. The PIFSC, PIRO, and the Council are working together develop an updated management strategy evaluation (MSE) document to prioritize vulnerabilities and risks in the Pacific pelagic and nearshore ecosystems and fisheries.

Over the next five years, our region will take numerous actions to increase scientific understanding of our MNM ecosystems and develop and implement management plans for these large marine environments. These activities would increase the scientific understanding of the areas, benefit the global community, and provide clearly defined objectives and effective management measures based on sound science. We also expect to complete activities that would help us evaluate risks to managed species, habitats, and communities. In addition to activities that support the MNM management plans, the Regional Habitat Assessment

Prioritization for Pacific Islands Stocks⁵ provides a final listing of regional priority activities. The Pacific Islands Vulnerability Assessments will analyze the vulnerability of managed fish and invertebrate stocks to climate change. Additional climate vulnerability assessments are in development for turtles, marine mammals, and coastal communities. This can help determine information gaps and improve ecosystem models to inform next generation stock and population assessments.

4. Explore and address trade-offs within an ecosystem:

The ecosystem vulnerabilities and risk assessment allow the exploration of the outcomes of management decisions in a transparent manner, including the assessment of impacts to all stakeholders. PIFSC is working to expand its capacity in the use of quantitative models and MSE style applications, including staff training and hiring. This will enhance our capability for conducting integrated social, ecological, and biophysical research and modeling to evaluate management strategies and societal tradeoffs. Staff have undergone training in management strategy evaluation, simulation modeling, and other quantitative skills to address regional priorities. These capabilities may be applied to the suite of living marine resources, managed species, and habitats in the Pacific Islands region, including the human portion of the ecosystem.

5. Incorporate ecosystem considerations into management advice:

In the Pacific Islands region, we strive to incorporate ecosystem sciences into management actions. PIFSC is working to better understand the impacts of climate change to the habitat, oceanographic processes, and marine life including (but not limited to) protected resources, fisheries, and fishing communities. Increased understanding of the ecosystem and incorporating that understanding into management advice will allow engagement across the region. In addition, stakeholders will be able to make informed decisions about how they utilize the marine environment, such as where and for which species to fish, reducing bycatch, minimizing habitat degradation, habitat improvement projects, among other practices. We are also developing the Pacific Corals Recovery Plan in which the focus of recommended recovery actions will be at the coral reef ecosystem level, rather than at the listed species level, using data and information from monitoring programs throughout the Pacific. Some of the actions which support this guiding principle would benefit our region by increasing capacity to conserve and enhance EFH as well as enhancing the effectiveness of our coral reef conservation programs. For its part, PIRO will strive to better describe the science necessary to effectively manage the marine resources in the Pacific, including how to adapt to the changing conditions occurring across the region.

6. Maintain resilient ecosystems:

Ecosystems are resilient, but they need the opportunity to return to their healthy state. PIFSC, PIRO, and the Council, along with other interested stakeholders, will work to identify adaptive management practices which will foster healthy fisheries and ecosystems, including human

⁵https://www.st.nmfs.noaa.gov/Assets/ecosystems/habitat/pdf/regionalHabitatAssessmentPrioritizationforPacificIslandsStocks_Final.pdf

communities. Understanding the processes and dynamics of socio-ecological systems and the influences that climate, ecosystem, habitat, and species relationships have on living marine resources bolsters scientific advice to inform managers. Collecting and integrating local traditional ecosystem knowledge can further enhance science-based management of marine resources. These actions will enable us to approach EBFM, which encompasses the wider community and includes a wealth of additional issues to bring into balance.

9. Road Map Actions and Milestones

The EBFM Road Map provides some action items that could help achieve the guiding principles; these actions are identified as short-term, medium-term, long-term, or continuing. While some actions described in the Road Map will be implemented at the national level, they are not included here. Some specific actions that our region intends to carry out over the 2018-2022 period are included in the following table. These milestones are a list of science and management actions being undertaken or proposed primarily in the near term and link the national road map actions to our regional milestones. Although these actions will result in sound science and management decisions, they have not been planned and implemented with full consideration of EBFM.

Road Map #	Road Map Action items	Timing	Associated Milestone(s)
Guiding Principle 1: Implement ecosystem-level planning			
1a: Engagement Strategy - goal is engagement strategy for each region			
1a2	Develop National and Regional EBFM engagement strategies	Short	<p>EBFM team will host an EBFM Workshop to identify ecosystem-related information and monitoring needs, the science products available or in development that can address these needs, management needs, and the gaps.</p> <p>PIFSC, PIRO, and the Council work with the state, territories, and key partners to both coordinate and conduct outreach by engaging our constituents and helping them to understand the role they play in the ecosystem. See section 5.</p> <p>The Pacific Islands regional communications team will develop materials that include local information and will be disseminated to partners and others for further regional distribution.</p> <p>Identify key local leaders that can help build ties to the local communities and stakeholders.</p>

1a3	Develop best practices where there are overlapping jurisdictions	Continuing	The Council will continue to improve the Regional Ecosystem Advisory Committee (PIFSC and PIRO are members) to best engage local agency partners in addressing ecosystem issues in the Pacific Islands region. This is crucial to effectively implement EBFM approaches as the majority of the fishing mortality for non-pelagic fishery resources in the Pacific Islands region is occurring in state/territorial waters.
1a5	NOAA Fisheries supports any Ecosystem Plan Development Teams, Ecosystem Committees (or equivalent groups) that councils establish	Continuing	PIFSC and PIRO staff serve on Council plan teams, all of which operate in support of the FEPs. PIRO and PIFSC staff will participate in the Council's REAC.
1b: FEPs - goal to assist in development for most of 12 Large Marine Ecosystems (LMEs)			
1b1	Establish FEP Coordinator/Analyst for each NOAA Fisheries Regional Office and in appropriate Headquarters Office	Mid	Each PIRO Sustainable Fisheries policy analyst, working with his/her Council-staff counterpart with oversight for each FEP (Pelagic, Hawai'i, American Samoa, Marianas, and PRIA) acts as the FEP coordinators for his or her respective plans. PIFSC will work with appropriate entities to develop meaningful LMEs in the Pacific.

1b3	Assist councils, Commissions, RFMOs, and other bodies as requested, in their development of new, or revision of existing FEPs or other fisheries plans	Continuing	<p>PIRO staff work to ensure that conservation and management measures agreed to in international fora, specifically WCPFC and SPRFMO, are implemented domestically, as necessary, in U.S. regulations. In so doing, the NEPA analyses for the development of such regulations continues to incorporate relevant ecosystem indicators as identified by the scientific community. PIRO staff advises PIFSC or the scientific community on any additional ecosystem information needed and at the appropriate scale to be useful for analyses. Additionally, PIFSC leads the U.S. Science Delegation to the WCPFC. PIFSC staff collect, analyze, and submit the fisheries statistics and annual reports to the WCPFC and conduct stock assessments. PIFSC also collaborates with the Southwest Fisheries Science Center to provide fisheries data to report to the IATTC.</p> <p>PIFSC and PIRO assist Council in their work with existing FEPs to include ecosystem considerations in the analysis of amendments to the FEPs. Implement the FEP revision with the revised goals and objectives approved by the Council at its 165th Meeting and transition to the living document approach</p>
-----	--------------------------------------------------------------------------------------------------------------------------------------------------------	------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Guiding Principle 2: Advance our understanding of ecosystem processes			
2a1	Advance resources to conduct EBFM	Continuing	<p>PIFSC, working with the National Advanced Sampling Technology working group, is exploring the utility of next generation camera designs, operationalizing the fishery independent survey, conducting AUV studies, and building an optical spectrometer as well as working to standardize the associated data streams.</p> <p>PIFSC, PIRO, and the Council continue to develop the capabilities for electronic reporting and monitoring in the federally managed fisheries, improving quantity, quality, and timeliness of catch and bycatch data for EBFM and its incorporation into fisheries regulation.</p> <p>The Council is developing a framework to deal with sea turtle interactions in the Hawai‘i shallow set longline fishery. This is an integration of information and model implementation using Turtle Watch and the PIRO Observer Program to initiate near-real time reporting of interaction at the turtle hotspots to avoid sea turtle contact.</p>
2a3	Conduct biennial EBFM Science & Management Conference	Mid	The West Hawai‘i IEA Symposium is held every 3 years.

2a4	Develop and maintain core data and information streams	Short - Continuing	<p>PIFSC staff will make all non-confidential PIFSC data queryable and available to the public both online in the NOAA archives and in recurring reports, such as Fisheries of the United States and Fisheries of the Western Pacific. Robust associated metadata will accompany the delivery of data.</p> <p>PIFSC will continue to collect a wide variety of core oceanographic data, ranging from those collected on oceanographic research cruises to multi-decadal monitoring, e.g., SST, chlorophyll, PAR, wind, SSH and currents, eddy kinetic energy, salinity, and the merged ocean color dataset, see <i>Pacific Islands Regional Action Plan - NOAA Fisheries Climate Science Strategy</i>.</p> <p>Based on a PIRO management need, PIFSC and PIRO will be developing an assessment of coral connectivity within the Pacific Monuments islands and associated Archipelagos. A few studies have been conducted of coral connectivity between Johnston Atoll and the NWHI but are lacking between the other Pacific remote islands and proximate archipelagos.</p> <p>PIRO will conduct ocean acidification studies at Rose Atoll, locations within the Pacific Remote Islands, and continue ongoing research at Maug to better understand coral resilience and recovery with respect to climate change impacts.</p>
2b2	Establish routine, regular, and dynamic reporting of ecosystem status reports for each large marine ecosystem	Mid	<p>The Council is developing the Data Integration Chapter of the SAFE Report that summarizes ecosystem effects on fisheries dynamics. The summaries will be on a dynamic interactive online platform that describes both the environment and the fisheries.</p>
<p>Guiding Principle 3: Prioritize vulnerabilities and risks of ecosystems and their components</p>			
<p>3a: Eco-level risk assessment - goal is to evaluate majority of main risks, including Climate Change, for most of our 12 LMEs</p>			

3a1	Conduct Systematic Risk Assessments for relevant NOAA regional ecosystems	Long	<p>PIFSC is working to conduct systematic assessments of climate impacts in three important ways in 2018. PIFSC will complete two reports: 1) <i>Pacific Island Climate Fish Vulnerability Assessment</i> and the 2) <i>Climate Change Vulnerability Analysis Report for Coral Reef Ecosystems</i> and continue implementation of the <i>Pacific Islands Regional Action Plan - NOAA Fisheries Climate Science Strategy</i>.</p> <p>Scientists will prepare an Environmental Sensitivity Index for the Mariana Trench MNM Islands Unit and will conduct a vulnerability assessment to understand potential climate change scenarios in the Mariana Trench MNM. These and many other efforts will be articulated in the final Marianas Trench MNM Science Plan anticipated to be published in 2018.</p> <p>Staff will conduct scientific research in support of the Papahānaumokuākea MNM Management Plan. NOAA will continue monitoring shallow and deep water habitats and characterize the different types and spatial distributions to protect ecological integrity and inform management efforts. Scientists will measure connectivity and genetic diversity of key species, analyze historical impacts of reef growth at Midway Atoll to facilitate restoration of natural reef building, survey distributions and populations of known invasive species at regular intervals, and support research on invasive species detection and the effect of invasive species on native ecosystems. NOAA will continue to collect, analyze, and input research, monitoring, and bathymetric data into appropriate databases to inform management.</p>
-----	---------------------------------------------------------------------------	------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

3a2	Explore protocols for conducting regional habitat risk assessments for those areas known to serve important ecological functions for multiple species groups or those that will be especially vulnerable or important in the face of climate change	Mid	<p>Scientists will evaluate effects of contamination in terrestrial and nearshore areas from shoreline dumps at French Frigate Shoals and at Kure, Midway, and Pearl and Hermes atolls and prioritize cleanup action based on risk assessments to support the Papahānaumokuākea MNM Management Plan.</p> <p>Mariana Trench MNM Management team is developing protocols to prevent marine debris from U.S. fishing fleets that fish in the CNMI and Guam EEZs and partner with them for removal incentives.</p>
3a3	Ensure more integrated, systematic, risk assessments, which could be used to coordinate regional NEPA analyses	Long	Complete final PIFSC environmental assessment/incidental take authorization for fisheries and ecosystem research
3b: Managed species, habitats & communities risk assessment – goal is to evaluate risk to managed species			
3b1	Ensure that factors which impact 800+ U.S. managed species are being considered	Continuing	<p>The Pacific Islands Vulnerability Assessment project is implementing a tool for rapidly assessing the vulnerability of 83 marine taxa to the impacts of climate change. This collaborative project utilizes expert knowledge, literature review, and climate projection models to assess the relative vulnerability of marine species. This research: 1) provides a relative climate vulnerability ranking across species; 2) identifies key attributes/factors that drive this vulnerability; and 3) identifies key data gaps in understanding and mitigating climate change impacts to living marine resources.</p>

3b2	Conduct Habitat Assessment Prioritization for all NOAA Fisheries regions	Mid	<p>PIRO and PIFSC will complete the Mariana Trench MNM Management and Science Plans and support the development of the Pacific Remote Islands Marine National Monument (PRIMNM) draft management plan. These plans will direct scientists to collect available spatial data and characterize the distribution of various habitats and geological features, and describe physical, chemical, and biological resources and processes, communities, and environments to support management of these resources.</p> <p>PIRO - Priority Watershed Projects in the Manell-Gues Watershed, Guam watershed, and reef restoration efforts will improve habitat for hundreds of fish and coral species and the largest aggregation of ESA-listed sea turtles documented in Guam's waters, while improving important local fishing grounds and building community resilience to climate change impacts.</p> <p>PIFSC scientists continue working with Territorial and other partners to conduct populations studies for marine mammals and threatened and endangered species, to continue to assess coral reef communities and other benthic habitats in the Monuments, to acquire baseline data about fishery populations, and to monitor impacts of authorized Monument activities via the use of remote surveillance technologies. NOAA has already completed priority activities identified in the draft Mariana Trench MNM management plan to identify vector pathways and assess spatial and temporal water vessel traffic patterns.</p> <p>The <i>Regional Habitat Assessment Prioritization for Pacific Islands Stocks</i>, which developed a habitat assessment prioritization process to be carried out for regional fish stocks, was finalized in 2018.</p>
-----	--------------------------------------------------------------------------	-----	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

3b3	Conduct Fishing Community vulnerability assessments for all NOAA Fisheries regions	Short	Climate vulnerability assessments are in development for turtles and marine mammals. PIFSC scientists are also conducting vulnerability studies of coastal communities, in the context of both commercial and non-commercial fisheries, to climate change and in general.
Guiding Principle 4: Explore and address trade-offs within an ecosystem			
4a: Modeling Trade-Offs-goal is to have sufficient analytical capacity to evaluate a full range of tradeoffs			
4a1	Assess and bolster ecosystem and Living Marine Resources (LMR) modeling needs in each Fisheries Science Center (FSC)	Short-Mid	<p>The federal MSE position for the Pacific will be filled in 2018. In addition to the full-time position, PIFSC created an intense MSE focused training available to all assessment scientists in January 2018, to increase MSE capacity at the Center.</p> <p>PIFSC capacity will be complemented by the development and application of new modeling tools for assessing data-poor species, an open access user-friendly data-moderate model, and for a new meta-population analysis model.</p>
4a2	Development of an EBFM analytical toolbox that includes ecosystem modeling tools and best practices, data-poor qualitative and semi-quantitative tools, and related decision tools	Mid	Council is working with PIFSC and PIRO to develop a framework for improving understanding of ecosystem factors influencing protected species interactions in the Hawai'i longline fisheries, stemming from SAFE report review recommendations. Continue and expand this effort to address improved management of protected species interactions in fisheries.
4a4	Establish suitable review venues and deliberative bodies for ecosystem models and associated information in each FSC region	Mid	<p>The Western Pacific Stock Assessment Review Framework provides a review process for any ecosystem models developed by PIFSC used for management purposes.</p> <p>For ecosystem work outside the scope of management, PIFSC uses the skills of the Center for Independent Experts to provide robust peer review.</p>
4b: MSEs - goal is to have MSEs that cover most of our 12 LMEs and Fisheries			

4b1	Develop functional system-level MSEs	Mid	Using the main Hawaiian Islands Atlantis model, simulations will give an understanding of how fisheries and protected resources will shift, assuming data on thermal tolerance and other physiological limitations is available. Apply identified management strategies of interest and use an estimation model to evaluate ecosystem impacts.
Guiding Principle 5: Incorporate ecosystem considerations into management advice			
5a: Eco-Level Reference Points - goal is to establish and use Ecosystem Level Reference Points			
5b: Ecosystem considerations for LMRs - goal is to appropriately include ecosystem factors in crafting advice for managed species			
5b1	Develop and track fishery stock status indices that denote when ecosystem considerations are used	Mid	<p>PIFSC staff are working toward understanding how the pelagic fleets, particularly the Hawai‘i longline fleet, change fishing practices in response to a shifting climate and how that changing climate impacts the ecology of the commercially exploited fish.</p> <p>Council and PIFSC continues to develop ecosystem indicators for the annual SAFE reports, which are revised and refined annually.</p>
5b2	Support consistent and effective implementation of the NS1 guidelines, which includes guidance on incorporating ecosystem information into stock management	Mid-Continuing	<p>PIFSC staff continues to conduct all assessments of living marine resources in the U.S. exclusive economic zone in the Central and Western Pacific, including protected (marine mammals, sharks, and turtles) and commercially exploited (finfish and crustaceans) species. PIFSC plans to incorporate ecosystem level information into each of these assessments, as robust parameters are available, to test the measurable impact. This will allow scientists and managers to more clearly understand the sensitivity of stocks to those considerations.</p> <p>Council staff continues to convene a working group that conducts the P* Analysis and SEEM Analysis (Social, Economic, Ecological, and Management Uncertainty) for stocks in the FEPs that PIFSC assessed. Included in these analyses are characterizations of uncertainties from ecological and stock dynamics brought about by changing climate and ecosystems. The Council will be working on</p>

			improving this process using a more structured and quantitative approach to support management of the fish stocks.
5b3	Identify best practices for incorporating ecosystem considerations into management decisions	Short-Mid	<p>PIFSC will complete the Annual Update Report for West Hawai‘i IEA Ecosystem Status and Trends Report.</p> <p>PIRO will assess the effectiveness of local reef-to-ridge watershed conservation and implementation of Best Management Practices (BMPs). In addition, PIRO will provide training of local resource staff to assist in the biological surveys and help build local capacity in managing the reefs for the key watersheds.</p> <p>Council, PIFSC, and PIRO complete annual SAFE Reports for American Samoa, Marianas, and Hawai‘i , and Pelagic species that includes the Ecosystem Consideration Chapter and the Data Integration Chapter.</p>
5c: Integrated Advice for other Management Considerations - goal is to systematically evaluate advice provided across multiple species within an ecosystem			

5c1	Explore protocols for considering ecosystem-level information in EFH reviews, identifying ecosystem-level habitat areas of particular concern, and setting habitat conservation objectives and/or indicators	Short	<p>The Council, PIFSC, and PIRO will collaborate on improvements for the 5 year Essential Fish Habitat reviews. Included in this effort is the development of a species occurrence predictor model for level 1 and 2 EFH definitions.</p> <p>PIFSC will examine oceanic white tip shark use of their coastal habitat, model the critical habitat of false killer whales, and the nesting behaviors of marine turtles nesting in remote island areas.</p> <p>PIFSC will report on reef condition indicators, examine hierarchical drivers of reef fish assemblages, analyze and report on reef fish survey data, and conduct a vulnerability assessment of reef fishes.</p> <p>PIFSC staff will execute the coral reef cruise to American Samoa, the life history cruise to the Marianas, and plan the next three years of the reef assessment monitoring program (RAMP).</p>
5c2	Finalize and implement National Bycatch Reduction Strategy	Short	<p>PIRO and PIFSC staff provide the annual statistical updates to the national bycatch report, as well as the data summaries and trend analyses for various fisheries and taxa based on the latest years of data. Tiering off the National Bycatch Reduction Strategy, PIFSC, PIRO, and the Council will collaborate to develop a Regional Implementation Plan.</p>
5c3	Evaluate ecosystem effects of offshore aquaculture	Long	<p>PIRO, in coordination with the Council, is developing a draft Programmatic Environmental Impact Statement (PEIS) to analyze the potential environmental impacts of implementing a Pacific Islands Region aquaculture management program. As the PIRO aquaculture program moves forward with developing the PEIS and the framework for managing the aquaculture program, key ecosystem considerations will be incorporated into the analyses of environmental effects as well as in the implementation of the program.</p> <p>Throughout the process of developing this program, PIRO and Council will work with industry and research partners to identify, develop, evaluate, and transfer appropriate offshore aquaculture technologies.</p>

5c5	Review long-term protected species recovery and rebuilding plans to ensure they account for the potential effects of near-term and long-term climate change, particularly relating to alterations to food web structure	Long	<p>The Hawaiian Islands Cetacean Ecosystem Assessment Survey (HICEAS) is the first step in understanding the myriad species and their associated ecosystem dependency. Though the cruise was in 2017, the research to delve into the nuances of the data, ranging from acoustics to species density, will be explored for many years and contribute to long term conservation planning.</p> <p>PIFSC staff will continue to work toward understanding the ecology of the critically endangered Hawaiian monk seal. PIFSC staff will examine the causes and consequences of disease, impacts of birth order and toxins, examine links between oceanic productivity and juvenile seal survival, evaluate the efficacy of translocations between subpopulations, and evaluate and strive to improve outcomes of rehabilitation and release efforts, and assist PIRO with the development of recovery plans with the best available science.</p> <p>PIFSC staff are exploring marine turtles’ use of their nearshore habitats and how they are impacted by change.</p> <p>PIRO is developing the Pacific Corals Recovery Plan which uses an ecosystem-based approach to recovery planning, meaning that the focus of the recommended recovery activities will be at the coral reef ecosystem level instead of the listed species level. The intent is to provide benefits to both listed and unlisted coral species (and other reef species) that are part of the same coral reef ecosystem. The Recovery Plan will incorporate data and information from coral monitoring programs around the Pacific, including PIFSC (for U.S. waters), the Micronesia Coral Reef Monitoring Program, and the Great Barrier Reef Monitoring Program. Since the trophic effects of fishing are among the five major threats to listed corals, the Recovery Plan will include actions to address that threat, which could benefit reef fish.</p>
-----	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

			<p>PIRO’s draft Pacific Corals Critical Habitat rule is based on “essential features” of the habitat for listed corals, which include hard substrate and suitable water quality. The essential features are applicable to all reef corals, so critical habitat protects habitat for all reef corals within the designated areas, whether listed coral colonies are present or not. The critical habitat rule will incorporate data and information from PIFSC/CREP’s monitoring reports and substrate maps. The coral reef critical habitat could potentially benefit coral reef fish stocks via additional protection of coral reef habitat.</p>
6b1	Explore community health and well-being socioeconomic metrics	Mid	<p>PIRO is studying social adaptive capacity related to climate impacts among fishing communities at five sites in Micronesia (in Guam and the Federated States of Micronesia). The project examines vulnerability based on dependency on fisheries and other livelihoods, conditions of essential resources, and their adaptive capacity to changes in those categories. Additionally, through our partnership with PIMPAC, the team is applying a tool called LEAP (Local Early Action Plan) which is a community-based climate vulnerability, adaptation, and resource management planning tool for use in coastal and island communities.</p> <p>PIFSC socioeconomic group is developing a conceptual model for understanding the role of cultural values in the context of an ecosystem (and within the West Hawai‘i IEA as an application).</p> <p>PIRO will implement the Guam Community Coral Reef Monitoring Program to provide support for coral reef conservation efforts on Guam by facilitating consistent, meaningful exchange of information between the community and resource managers; collaborate with local partners to facilitate community participation in pilot coral reef restoration projects; and continue to build capacity for socioeconomic</p>

			monitoring on Guam and in the region to support coral reef conservation.
6b3	Track community health, well-being, and vulnerability socio-economic metrics	Mid-continual	<p>PIFSC social scientists are developing a technical memo which describes the construction of social indicators of fishing community vulnerability and resilience specific to the PIR.</p> <p>PIFSC social scientists are collecting secondary data back to 2006 to be used to develop time series of social indicators to track community health over time.</p>

Appendix 1: Regional EBFM Coordination Details

Below are more details of the examples from Section 4 that highlight regional EBFM coordination and have been successful.

Domestic Fisheries Management

Using its authority under the Magnuson-Stevens Act, the Council developed, and NMFS implemented, five species-based FMPs. In 2009, the Council reorganized the management provisions of these five FMPs into five place-based fishery ecosystem plans (FEP). Four of the FEPs are geographically-based: the American Samoa Archipelago FEP, the Hawai'i Archipelago FEP, the Mariana Archipelago FEP, and the Pacific Remote Island Areas FEP. The fifth FEP governs pelagic fisheries operating in federal waters surrounding the U.S. Pacific Islands and on the high seas. The FEPs consolidate management provisions to address marine resources and user groups as integrated components within the archipelago-based units of management. This transition from species-based FMPs to place-based FEPs is an important first step in establishing the framework in which NMFS and the Council can begin the integration and implementation of EBFM in each of the FEP areas of the PIR.

Comprehensive ecosystem approach to fisheries management must be initiated through an incremental, collaborative, and adaptive management process. To further the goal of EBFM, NMFS and the Council have incorporated ecosystem-based management objectives into each FEP and established procedures by which the best scientific information available from stock assessments, SAFE Reports, and other sources, can be considered in developing conservation and management measures, including the specification of annual catch limits (ACL) and accountability measures.

Each FEP requires the Council's Scientific and Statistical Committee (SSC) to set an acceptable biological catch (ABC) for each fishery. The ABC is the maximum catch at which the probability or risk of overfishing (P^*) is less than 50 percent and accounts for scientific uncertainty in the estimates of the overfishing limit (OFL) and other scientific uncertainties. These may include, but are not limited to, uncertainty in data and models, stock status, stock productivity and susceptibility, recruitment variability, trends in population variables, and other factors determined relevant by the SSC. Each FEP includes a qualitative process by which the P^* value may be reduced below 50 percent.

Each FEP also requires the Council to set an ACL for each fishery that cannot exceed the ABC. This process includes methods by which the ACL may be reduced from the ABC based on social, economic, and ecological considerations or management uncertainty (SEEM). An ACL set below the ABC further reduces the probability that actual catch will exceed the OFL and result in overfishing and can also account for other ecosystem level considerations.

Another fisheries management action currently under consideration that would fall under EBFM is re-classification of some stocks in the FEPs as ecosystem component species. Ecosystem component species are stocks generally not targeted in federal fisheries under the

jurisdiction of the Council but are included in the FEPs to achieve ecosystem-based fishery management objectives. This action would enable us to ensure resources are focused on those stocks that need conservation and management in federal waters, while retaining ecosystem component species in the FEP for monitoring, allowing implementation of additional measures that are needed for these species.

EBFM works only if the fisheries science conducted is used by resource managers. One of the primary challenges to EBFM in the PIR is that many of the threats to coastal ecosystems are either land-based or the result of activities occurring shoreward of the U.S. EEZ. Therefore, collaboration with the state and territories of the PIR will be integral to successfully advance EBFM.

Resource and Ecosystem Monitoring Surveys

In the Pacific Islands region, the U.S. coral reef ecosystems of the Hawaiian Archipelago, the Mariana Archipelago, and the American Samoa Archipelago, along with the associated PRIA are routinely surveyed during integrated and interdisciplinary Pacific Reef Assessment and Monitoring Program (Pacific RAMP) research cruises. These ecosystem surveys provide long-term status and trend data on the abundance, diversity, size, and distribution of reef fishes, corals, and benthic communities and habitats, as well as the dynamic ocean environments that these resources occupy. Since its inception in 2000, Pacific RAMP has established baseline ecosystem assessments and initiated long-term monitoring of spatial patterns and temporal trends that integrate biological observations of trust resources with changing water quality, environmental, and oceanographic conditions. In particular, these ecosystem surveys include observations to document the influences of ocean warming and acidification on coral reef ecosystems. The consistent use of comparable methods across diverse habitats, environmental conditions, and stressors from human activities reveal spatial and temporal patterns and support an unprecedented ability to understand ecosystem processes that enable development of ecosystem models that can be used to support management strategy evaluation. Each outlined effort contributes to scientifically robust PIFSC products used in management.

The Life History Program surveys collect biological samples (e.g., otoliths, gonads, and fins clips) from coral reef fishes, deep-slope snappers and groupers, and pelagic fishes in the Hawai'i, Mariana, and Samoa Archipelagos. These samples allow estimation of detailed life history and population dynamic information, such as length-at-age, growth, maturity, and mortality. Not only are these used as direct inputs into quantitative stock assessments, but also increase our understanding of how these parameters vary among species, along fishing pressure gradients, and temporally and spatially provide insights into fishery production, ecological theory, and environmental variability.

Most stock assessments require reliable time-series of catches, fishing effort, and life history demographics to estimate stock abundance trends and evaluate sustainability benchmarks. These assessments rely on fishery-dependent data, such as fishermen and vendor reporting. PIFSC is moving toward operationalizing fishery-independent surveys which are specifically

designed to develop unbiased and independent indices of abundance. They advance our ability to capture fishery-independent estimates of stocks and augment and improve the robustness of assessments, the science upon which fishery management decisions are based. Once fully operational, this technology could be used in the U.S. Pacific Territories to gather fisheries independent data on data poor stocks.

Data Management

Ecosystem-level advice requires ecosystem-level science created from robust data streams. PIFSC currently houses and manages an array of data sets that have been growing for decades. It is imperative that PIFSC and PIRO preserve long-term time series and data sets, particularly for observational data. These are fundamental to addressing future unforeseeable science and management questions. Existing information streams, even those currently perceived to have less utility, may ultimately allow scientists to answer much needed management questions in a more informed manner. Long-term data support our understanding of ecosystems and our ability to conduct EBFM will arise from these data.

PIRO and PIFSC continue to manage the regulatory, legal, and planning information necessary to fulfill our mandated authorities for the conservation and management of fisheries, listed species, and marine habitats in the Pacific. This information includes the data collected on the monitoring and assessments of marine resources in the region, the permitting and monitoring of the domestic commercial fishing industry, the spatial data generated for habitat and species protection, spatial data regarding fishery footprints, and analyses of impacts of proposed management actions and other information related to management and planning for U.S. and international fisheries and habitat conservation.

We are working on improving data accessibility for the public, beyond what is required under the U.S. government's 2013 initiative to expand access to the results of federally-funded research. One endeavor is the development of a pilot web-based data portal for PIFSC data streams. This data portal will include user-interactive data analytics tools that generate data visualizations and numerical summaries based on non-confidential data summaries from on-going historic and episodic data collection projects. Current data streams in the pilot version include (a) fishery performance indicators, (b) economic monitoring programs, (c) socioeconomic data supporting regional SAFE reports, (d) trends in State of Hawai'i commercial fishing and community engagement at various geographic scales, (e) National Report submissions to Regional Fishery Management Organizations (RFMO), including spatio-temporal maps of catch and effort, and (f) links to fishing community snapshot tools and community social vulnerability indicators. This project establishes a viable open source framework to allow greater access and provide value-added visualizations to core regional data streams for fishery managers, members of the fishing community, and the general public. Once this web portal is finalized and made publicly available, resource managers will be given the opportunity to provide feedback on data or output needed to enhance effectiveness of this tool for management purposes.

Socioeconomic Research

The PIFSC conducts a broad range of socioeconomic research across the Pacific Islands region in support of NOAA goals of sustainable fisheries and habitat and protected resource conservation. These efforts help us more effectively understand the role of people in EBFM, both in terms of economic and societal goals, and the role of communities in management. For example, we have developed Community Social Vulnerability Indicators for the fishing communities in American Samoa, Hawai'i, Guam, and CNMI. We are also building a time series of data points to enable the development of recent historical trends in key indicators of social well-being. These indicators are beginning to be used in socio-ecological assessments as well, which examine coral reef resilience and social vulnerability.

Additionally, PIFSC social scientists are developing a suite of tools to address socio-economic concerns within the region. Some efforts include a conceptual model for understanding the role of cultural values in the context of an ecosystem applied within the West Hawai'i IEA; a study to better understand social adaptive capacities of fishing communities to changing climate; research on the importance of fishing to culture in American Samoa; and working with PIRO, PIFSC, and other local and international conservation organizations to conduct and evaluate socioeconomic monitoring. The goal of the study is to better understand the links between resource management and community well-being. Approaches such as interdisciplinary collaboration, bio-cultural indicators, and stakeholder engagement in identifying research topics are receiving more emphasis as an improved holistic integrated method for monitoring with respect to EBFM.

Climate

The Pacific Islands region is subject to climate variability and change on multiple temporal and spatial scales. Temperature, wind, currents, sea level, coral reef bleaching, and ocean acidification are all impacted by natural climate variability modes such as El Niño - Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). The persistent increase in greenhouse gases which drives climate change and ocean acidification can have greater negative effects, resulting in physical, chemical, and biological impacts to the marine ecosystems and trust resources of the Pacific Islands region. Many of these changes have already been observed and are projected to increase, directly and indirectly impacting our marine ecosystems and the people and communities that depend upon them. NMFS Climate Science Strategy - Pacific Islands Regional Action Plan⁶ specifies several key actions that PIFSC, PIRO, and the Council can take over the next five years to enhance our ability to both assess and understand our changing climate:

- Maintain and enhance ongoing monitoring programs for insular and pelagic ecosystems, sea turtles, cetaceans, and monk seals, and analyze these data to detect climate impacts.

⁶ https://www.pifsc.noaa.gov/do/pacific_islands_regional_action_plan.php

- Update surveys of fishing community economics, vulnerability, adaptive capacity, and resilience.
- Develop and incorporate climate indicators and information into Fisheries Ecosystem Status Reports under the Fisheries Ecosystem Plans.
- Incorporate climate information into billfish, tuna, and bottomfish stock assessments and coral reef fish annual catch limits.
- Incorporate climate change information into designations of protected species critical habitat, recovery planning, and National Environmental Policy Act (NEPA) and ESA analyses.

The first annual Pacific Islands Climate Science Workshop was held in 2017⁷ and identified climate-related information needs, the science products available or in development that can address these needs, and the existing gaps among PIFSC, PIRO, and the Council. The common thread at the workshop was adaptive capacity, including questions on how the climate is going to change, and the extents to which the ecosystems and communities have resilience and adaptive capacity to climate impacts. Looking beyond protected and managed species, social adaptive capacity was a significant concern. The information needed to address these, and other questions fell into four broad themes:

- Basic science and research: better understanding of population segments and stocks, as well as species' life history rates and parameters, diet studies, process studies, and an improved understanding of intermediate trophic levels. This basic information is needed for a number of both protected and commercially valuable species before we can begin to understand how they might be impacted by climate change and their potential adaptive capacity.
- Monitoring: the need for consistent, high-quality, long-term monitoring that establishes baseline conditions and identifies trends. Partnering and data sharing are essential for maintaining time series across the Pacific Islands region.
- Projecting future conditions: the need for robust projections of future conditions reaches into nearly every question raised at the workshop. These projections are needed for a host of variables (productivity, temperature, acidity, sea level, etc.) to determine habitat shifts, risk to critical infrastructure, and stock movement. These projections enable regional managers to be proactive instead of reactive.
- Persistent Challenges: though there are many persistent challenges, effective communication among stakeholders, managers, and scientists is a recurring theme. Managing living marine resources in a changing environment will inevitably involve tradeoffs.

Some additional climate related considerations that were not specifically highlighted in the workshop report but are, nevertheless, important to examine include:

⁷Summary Report from the First Annual Collaborative Climate Science Workshop
<https://repository.library.noaa.gov/view/noaa/17123>

- Better understanding of social vulnerability, dependency of fisheries resources, sensitivity of the social systems to climate impacts, and social adaptive capacities for long-term human development.
- Deciding how to balance trade-offs depends, in part, on understanding how stakeholders value different resources. Communication has the potential to increase trust among scientists, managers, and stakeholders.

Monitoring and research must be done strategically to help guide management decisions. In the Pacific Islands region, information on changing conditions or habitat loss and its impacts on NOAA trust resources and communities who are dependent on them for various ecosystem services, is vital. Coordination between PIFSC and PIRO on how and where the emphasis of effort will be placed will be important.

Protected Species

Protected species research and management is an important component of EBFM. The science programs within PIFSC continue to advance the understanding of ecosystem processes on protected species and fisheries, as well as the effects of direct and trophic interactions between protected species and fisheries. Understanding these processes will require a multidisciplinary approach to study and analyze data on diet, predator-prey interactions and other trophodynamics, ecosystem productivity, habitat attributes and use, influence of oceanography and climate change, and threats to protected species. PIFSC has already begun the process of implementing EBFM by taking a number of actions including: assessment of our protected species stocks through the Protected Species Stock Assessment Improvement Plan (PR-SAIP); the monitoring, conservation, and development of solutions to minimize the bycatch or other forms of anthropogenic impact of marine mammals, sea turtles, seabirds, protected fish, corals, and sponges; and studying individual and cumulative pressures that pose the most risk to vulnerable resources including factors such as climate change.

West Hawai'i IEA and Habitat Focus Area

The West Hawai'i Integrated Ecosystem Assessment (IEA) Project's overarching goal is to provide sound and relevant scientific information that addresses existing and future resource management concerns in West Hawai'i. The area contains a diverse group of marine species in a highly productive marine ecosystem that supports myriad ecosystem services important to the local community, including eco-tourism, aquaculture, non-commercial, recreational fishing, and commercial aquarium fish collection. Since its inception, the West Hawai'i IEA has focused considerable efforts on building relationships with state, federal, and non-governmental organizations and engaging local community organizations to better understand management and community needs. Much of our current understanding is synthesized in the West Hawai'i Integrated Ecosystem Assessment Status and Trends report. The report examines a suite of 29 indicators: social (e.g., population, tourism), biological (e.g., coral reef, benthic community), climate (e.g., sea level rise, Pacific Decadal Oscillation), and ocean (e.g., wave forcing, rainfall) to explore ecosystem effects of changes in the environment, policy options, and management strategies. An IEA considers interactions among ecosystem components and recognizes that human activities should be guided using collaborative,

interdisciplinary, and adaptive methods. In doing so, the IEA framework recognizes that an understanding of the whole, not simply the individual components, is necessary to conserve marine ecosystems and the services they deliver.

NMFS is working with our partners to increase the sustainability and productivity of fisheries by focusing on the habitat that fish need to spawn and grow, as well as protecting the coastal resources on which communities depend. The West Hawai'i Habitat Focus Area (HFA) was selected in 2013 because of its unique coastal ecosystems, known threats to these ecosystems, multiple ongoing conservation efforts, and the strong foundation of partnerships and community involvement. The unique ecosystems include an extensive fringing coral reef supporting federally managed fish and protected species. Threats include nutrient discharge to coral reefs from cesspools and fertilizers, sediment runoff from large areas of bare land, overharvesting, and climate change. To help manage these threats, the West Hawai'i HFA developed the following objectives: improve coral health through the reduction of the delivery of land-based pollutants, such as sediments and nutrients; reduce vulnerability of communities and natural resources to the localized effects of climate change; ensure that communities are informed and contribute to the sustainable use and restoration of natural resources; and provide better management tools and easily accessible information to promote informed decisions.

The West Hawai'i HFA and IEA have overlapping scientific and management interests and are working together to integrate management priorities and goals into ongoing and future scientific activities. Three key examples highlight the collaborative efforts between the West Hawai'i HFA and West Hawai'i IEA to support Ecosystem Based Management (EBM) in the region:

- (1) *Assessing Coral Reef Resilience and Vulnerability to Climate Change*: Understanding the ecosystem's vulnerability to climate change combines reef resilience and projections of future climate disturbances, such as coral bleaching. As such, it allows resource managers to make informed and targeted management decisions that take into account both present-day and future impacts to ecosystem health.
- (2) *Assessing the impact of local stressors and evaluating management strategies for Puakō's coral reef ecosystem*: The HFA and IEA are collaborating to better understand local stressors and ultimately provide a suite of management options and associated trade-offs to the state and local community. By demonstrating the likelihood of outcomes from a range of potential management options, these collaborative efforts provide an important decision-support tool that can inform the natural resource management decision process at Puakō.
- (3) *Assessing water quality and coral reef health near two resorts in the West Hawai'i HFA*: The HFA, IEA, and their partners at the Nature Conservancy and University of Hawai'i at Hilo are currently synthesizing data and results to determine how each watershed and marine ecosystem functions while working to ultimately provide management recommendations to private and public resource managers.

The West Hawai'i HFA and IEA programs are committed to working together to support ecosystem-based management. Upcoming strategic planning efforts for the respective

programs will identify opportunities for collaboration to leverage resources, build synergy, and maximize the impact of programmatic efforts in the region.

Pacific Marine National Monuments

In contrast to the small-scale IEA and Habitat Blueprint efforts that focus on local impacts, the Pacific MNMs are large marine ecosystems designated under the Antiquities Act of 1906⁸ to preserve “objects of historic or scientific interest.” These monuments are situated in vast, remote, and largely uninhabited areas of the Pacific. The four marine monuments - the Papāhānaumokuākea MNM, the Marianas Trench MNM, the Pacific Remote Islands MNM, and the Rose Atoll MNM - combine to encompass over 3 million square kilometers, which are managed through a collaborative effort of various federal, state, territorial, and local agencies. The MNMs emphasize integrated ecosystem-based management by ensuring traditional access by indigenous persons for culturally significant subsistence, cultural and religious uses within the monuments. They also provide opportunities to learn about coral reef ecosystems or related marine resources. Commercial fishing is prohibited in the monuments.

An emphasis on ecosystem exploration and research in the MNMs serves to expand our understanding of the physical, chemical, and biological ocean processes, social connections to the environments, the abundance and distribution of marine resources, and the geologic features within these sites. Monuments designation presents a need and opportunity to advance our understanding of the global pressures of climate change, marine debris, ocean acidification, and sea level rise without the confounding influences of local stressors, such as overfishing and land-based sources of pollution.

The Monuments are, in general, less impacted by immediate anthropogenic stressors, such as run-off and non-marine debris, due to their isolation and protection. Thus, these areas serve an important role as refugia for many commercially important fisheries species, for several endangered and threatened species, and for the associated habitats. But, this isolation can only provide a certain level of protection from threats correlated with climate change and marine debris. A major on-going issue that will continue to impact effective management and research of the Monuments is the distances of these remote areas from population centers, which complicates monitoring and enforcement of the fishing and access prohibitions and makes effective research extremely costly and labor intensive. Additionally, the vulnerability of these relatively pristine habitats and largely endemic marine life to global climate change, invasive species introduction, and marine debris accumulation threatens the sensitive balance of the various ecosystems which the Monuments were designated to protect.

⁸ The Antiquities Act of 1906, (Pub.Law 59–209), is an act signed into law by Theodore Roosevelt and gives the President of the United States the authority to, by presidential proclamation, create national monuments from federal lands to protect significant natural, cultural, or scientific features.

Coastal and Marine Spatial Planning

NMFS recognizes that EBFM, as part of the larger strategic goal of EBM, can assist the agency in better meeting its mandates to sustainably manage the nation's living marine resources. The National Ocean Policy, 2010, provided a framework for all federal agencies to pursue the stewardship vision of the Policy utilizing Coastal and Marine Spatial Planning (CMSP). CMSP is an ecosystem-based spatial planning process for analyzing current and anticipated ocean uses and identifying areas most suitable for various activities. It involves increased coordination and collaboration across all levels of government, leading to a more efficient, streamlined, and certain decision-making process.

In the Pacific Islands region, the responsibility of implementing the National Ocean Policy falls on the Pacific Islands Regional Planning Body (PIRPB). The PIRPB was established in 2013 and consists of 17 members from federal, state, and territorial agencies, as well as the regional fishery management council. The PIRPB plans to complete a total of five CMS plans for the Pacific Islands region: American Samoa, Guam, CNMI, the Pacific Remote Islands Area, and Hawai'i. In January of 2018, the first draft of the marine spatial plan for American Samoa was completed, and in October 2017, it kicked off its planning efforts in Guam and CNMI.

The PIRPB is also developing a data portal and mapping interface; tools that will allow all users, including government, project proposers, and stakeholders to utilize the same data and to review project efficacy through the same lens. It will also allow better integration of future human uses of our ocean environment with the goals of EBM through overlapping important ecosystem layers with current and proposed use layers. For example, it will allow overlapping turtle nesting beaches with proposed new boat ramp locations.

Appendix 2: Links to Ongoing Projects Supporting EBFM

A. Climate

NOAA Fisheries Climate Science Strategy:

<https://doi.org/10.7289/V5/AR-PIFSC-H-18-01>

Pacific Islands Regional Action Plan: NOAA Fisheries Climate Science Strategy:

https://www.pifsc.noaa.gov/library/pubs/tech/NOAA_Tech_Memo_PIFSC_59.pdf

Pacific Islands Regional Action Plan for Climate Science:

https://www.pifsc.noaa.gov/do/pacific_islands_regional_action_plan.php

B. Fisheries

Fishery Ecosystem Plans (American Samoa FEP, Hawai‘i FEP, Marianas FEP, Pacific Remote Islands Area FEP, Pelagic FEP):

<http://www.wpcouncil.org/fishery-plans-policies-reports/current-fishery-ecosystem-plans-sorted-by-island-areas/>

Stock Assessment and Fishery Evaluation (SAFE Reports):

<http://www.wpcouncil.org/fishery-plans-policies-reports/fishery-reports-2/>

National Saltwater Recreational Fisheries Policy–Pacific Islands Region Implementation Plan:

<https://repository.library.noaa.gov/view/noaa/17055>

C. Habitat

West Hawai‘i IEA program overview:

<https://www.integratedecosystemassessment.noaa.gov/regions/pacific-islands/index.html>

West Hawai‘i IEA Status and Trends Report (2016):

https://www.integratedecosystemassessment.noaa.gov/Assets/iea/gulf/documents/West_Hawai_i_IEA_Ecosystem_Trends_and_Status_Report.pdf

West Hawai‘i IEA Three Year workplan (FY2016-FY2018):

<https://www.integratedecosystemassessment.noaa.gov/Assets/iea/gulf/documents/regional-work-plans/NOAA-IEA-Work-Plan-West-Hawaii.pdf>

West Hawai‘i HFA program overview:

<https://www.habitatblueprint.noaa.gov/habitat-focus-areas/west-hawaii/>

West Hawai‘i HFA Implementation Plan:

<https://www.habitatblueprint.noaa.gov/wp-content/uploads/2016/10/West-Hawaii-HFA-Implementation-Plan.pdf>

Manell-Geus HFA:

<https://www.habitatblueprint.noaa.gov/habitat-focus-areas/manell-geus-guam/>

Papahānaumokuākea MNM Plan:

<https://www.papahanaumokuakea.gov/management/mp.html>

The NOAA Sentinel Site Program:

<https://oceanservice.noaa.gov/sentinelsites/hawaii.html>

The Coral Reef Conservation Program:

<https://coralreef.noaa.gov/welcome.html>

Coral Reef Resilience to Climate Change in Guam in 2016:

https://www.coris.noaa.gov/activities/guam_coral_resilience/

Pacific Island Managed and Protected Area Community tools and other guidebooks:

<http://www.pimpac.org/activities.php?pg2=2&pg3=8>

D. Protected Resources

Protected Species: Coral Listing and Recovery Plan:

http://www.fpir.noaa.gov/PRD/prd_coral.html

False Killer Whale Take Reduction Plan overview:

http://www.fpir.noaa.gov/PRD/prd_FKW_take_reduction_team.html

Recovery Plan for Hawaiian Monk Seals:

<http://www.nmfs.noaa.gov/pr/pdfs/recovery/hawaiianmonkseal.pdf>

Recovery Plan for U.S. Pacific Population of the Green Sea Turtle:

http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_green_pacific.pdf

E. Ocean Planning

Pacific Islands Regional Planning Body:

<https://pacificislandsrpb.org/>