



# WPRFMC FIVE-YEAR RESEARCH PRIORITIES UNDER THE MSRA 2020-2024

November 2019

The reauthorized Magnuson-Stevens Fishery Conservation and Management Act (MSRA), created new responsibilities and authorities for domestic regional fishery management councils and their advisory bodies. Following is the relevant MSRA text regarding the development and implementation of five-year regional research priorities by Councils.

## MSRA TEXT ON FIVE-YEAR RESEARCH PRIORITIES

Section 302 (h) Each Council shall develop, in conjunction with the scientific and statistical committee, multi-year research priorities for fisheries, fishery interactions, habitats, and other areas of research that are necessary for management purposes that shall –

- (A) establish priorities for 5-year periods;
- (B) be updated as necessary; and
- (C) be submitted to the Secretary and the regional science centers of the National Marine Fisheries Service for their consideration in developing research priorities and budgets for the region of the Council.

## HISTORY

The 2020 to 20204 MSRA Research Priorities were developed based on the management needs identified in the Council's Five Year Program Plan for 2020-2024. The research priorities are aligned with the four of the five programs of the Council: 1) Pelagic Fisheries; 2) Island Fisheries; 3) Protected Species; and 4) Communities. Underneath each program are thematic research areas related to stocks and ecosystems. The stock theme would include research and monitoring directed at the Management Unit Species and the fisheries they are harvested. The ecosystem theme is directed towards understanding the physical environment, the ecological interactions, and the integration of the ecosystem factors with the fisheries.

The process of developing the 2020-2024 research priorities involved early engagement with the Pacific Island Fisheries Science Center staff in crafting the research priorities while simultaneously aligning these research priorities with the research directions of each program at PIFSC. The product is reviewed by the PIFSC Program Leaders to ensure that the priorities are within the scope of their respective programs and enable buy-in. Any research priorities not aligned with the programs at PIFSC was identified and will be addressed through other means. The SSC reviewed the draft research priorities at its 130<sup>th</sup> meeting on October 15, 2018 and

refined the priorities further to ensure that it addressed the management needs. The revised draft has been reviewed by the Advisory Panel, Protected Species Advisory Committee, and the Social Science Planning Committee. The refined draft was provided to the Council Executive Director, PIFSC leadership team, and PIRO for their review. The revised was reviewed by the Archipelagic and the Pelagic Plan Teams and the Fishery Data Collection and Research Technical Committee in the first and second quarter of 2019. The Council took final action to accept and endorse these priorities at its 177<sup>th</sup> meeting in June 2019.

## PROCESS

The Council's five year research priority document serves as a comprehensive list of overarching research priorities to address the management need. The more specific research priorities originating from this document will be submitted to PIFSC in the first quarter of the federal fiscal year (October to December) for consideration in developing the Science Center's annual research priorities through their Annual Guidance Memo. The progress of these research priorities will be monitored through the PIFSC Director's report to the SSC and the Council. A matrix with status lines will serve as the tool to monitor which priorities are being addressed and the state of accomplishment based on the PIFSC Director's report.

## PELAGIC FISHERIES (PF) RESEARCH PRIORITIES

The Pelagic Fisheries Program is governed by the Pelagic Fisheries Ecosystem Plan and activities associated with the international fisheries management. Research priorities revolve around the domestic pelagic fisheries involving the longline and the small boat troll. These priorities also feed into the information needed for international stock assessments of tuna, bill fish and tuna-like species.

### **PF1 Understanding bigeye tuna connectivity and spatial stock structure with an emphasis on catches by the Hawaii longline fishery in the WCPO and EPO north of 10<sup>0</sup> N**

Bigeye is managed internationally by the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-America Tropical Tuna Commission (IATTC), and separate stock assessments are conducted for the Western and Central Pacific Ocean (WCPO) and Eastern Pacific Ocean (EPO). Most of the bigeye caught in the Pacific Ocean is within the equatorial band, between 10<sup>0</sup> North and 10<sup>0</sup> South, however there may also be an East/West component of the bigeye tuna's spatial connectivity in the Pacific Ocean. In the North Pacific off of Japan and around the Hawaii Archipelago, bigeye is also caught primarily with longline and handline fishing gears. Bigeye is the main target species of the Hawaii longline deep-set fishery.

**PF1.1 – Information Gap:** Connectivity between bigeye found in the equatorial band (10<sup>0</sup> N – 10<sup>0</sup> S) and higher latitudes is not well known, and understanding bigeye stock structure and movement continues to be priority for stock assessment and management. Demographics of bigeye tuna and other tuna species caught around Hawaii and United States (US) Territories are not well understood.

### **Associated Research Priorities**

- PF1.1.1** Investigate stock structure and connectivity of bigeye tuna with genetic studies or other methods;
- PF1.1.2** Conduct bio-sampling for bigeye and other tunas in US longline fisheries;
- PF1.1.3** Contribute information on bigeye tuna for age/growth estimation and maturation information within WCPO and EPO stocks;
- PF1.1.4** Determine how spatial connectivity/movement of bigeye tuna is influenced by size and/or maturity.

### **PF2 Conducting stock assessments and developing indicators for non-target pelagic species**

Over half of the landings of the Hawaii longline fishery are comprised of bigeye tuna, followed by swordfish (13%), opah (8%), and yellowfin (6%). However, monchong, mahimahi, and spearfish also comprise approximately 20% of landings. Through international cooperation, stock assessments are conducted for the major tuna, billfish (e.g., swordfish, blue marlin, striped marlin), and shark stocks.

**PF2.1 – Information Gap:** Stock assessments and stock indicators are lacking for other important species retained and marketed by the Hawaii longline fishery such as opah, monchong, and shortbill spearfish. The stock assessments for the non-target pelagic species need to be included and prioritized in the WPSAR Schedule.

### **Associated Research Priorities**

- PF2.1.1** Conduct catch-per-unit-effort (CPUE) standardization for non-target pelagic management unit species (PMUS) to support stock assessments for ono, mahimahi, opah, monchong, and shortbill spearfish;
- PF2.1.2** Develop status, productivity, or risk indicators for PMUS that currently lack stock assessments or have historically lacked complete landings information. Investigate available size-based indicators, if possible;
- PF2.1.3** Work with international partners to collect and develop CPUE time series and other necessary information to conduct stock assessments on non-target PMUS currently lacking stock status evaluation in the following priority: 1) opah, 2) monchong, and 3) shortbill spearfish.

### **PF3 Effects on fisheries from spatial closures and large-scale marine protected areas**

Two of the world's largest marine protected areas (MPAs) are located within the US Exclusive Economic Zone (EEZ) of the Pacific Islands Region and approximately 50% of the US waters in the region are closed to commercial fishing. Large-scale MPAs have displaced fishing effort of Hawaii longline and US purse seine vessels into international waters, which are also fished by tuna fleets of several nations. There is an emerging United Nations (UN) Law of the Sea Convention on Protecting Marine Biodiversity in areas Beyond National Jurisdiction, which may establish MPAs in international waters. This can be analyzed under a Management Strategy Evaluation (MSE) framework.

**PF3.1 – Information Gap:** There is a lack of information on the effects of large-scale MPAs on US fishing fleets in the US Pacific Islands Region.

**Associated Research Priority**

**PF3.1.1** Examine the effectiveness of closures with respect to displaced fishing effort (longline and purse seine) on target (bigeye tuna and albacore) and non-target (non-PMUS) pelagic catches, protected species (turtle, seabirds and marine mammals) interactions, catch competition among international fleets, and economic performance. Previous time-area closures may be investigated as reference cases.

**PF4 Implementation of electronic reporting in Hawaii and American Samoa longline fisheries and further development of other electronic monitoring technologies**

In 2007, regulations were promulgated under the Pelagics FEP to allow the optional use of electronic reporting (e-reporting) of fishing logbook information to NMFS (50 CFR §665.14(b)(1)). However e-reporting in Council-managed fisheries has had a slow uptake. Since 2014, the Council had been working on increasing e-reporting by the Hawaii-based longline fleet, with the main objective of improving efficiency and timeliness in fisheries data collection and quota management. The Council also conducted trials of on-board video monitoring systems in the Hawaii longline fishery in 2010, and has been collaborating with the Pacific Islands Fisheries Science Center (PIFSC) on additional video monitoring trials since 2017.

**PF4.1 – Information Gap:** There is a need to work with NMFS and fishery participants to implement more efficient and cost-effective data collection systems and ensure continued robust monitoring into the future.

**Associated Research Priorities**

**PF4.1.1** Determine the most cost-effective and cost-efficient data collection systems to potentially be employed in the Hawaii and American Samoa longline fisheries.

**PF5 Exploration of shark abundance and depredation in the Mariana Archipelago**

Local Marianas fishermen regularly complain of high shark depredation events during troll fishing trips. Data collected from the Guam creel survey program in 2017 indicated that 40% of pelagic fishing trips surveyed reported shark interactions that included either stealing bait or depredation of the catch. These levels of interactions are much higher than other areas of the Western Pacific region.

**PF5.1 – Information Gap:** Information is lacking on what species of sharks are interacting with Mariana Archipelago troll fisheries and a paucity of information exists on dynamics of troll/shark interactions in this area.

**Associated Research Priorities**

- PF5.1.1** Obtain proof of shark depredation events using video analyses or other methods to identify the sharks species involved;
- PF5.1.2** Quantify the rates of species-specific shark depredation in Guam – development of such a system would require more detailed reporting by fishery, gear, area, depth, time of day, etc., requiring significant coordination with the fishing communities. It is likely that the communities will be willing to support such efforts given their self-declared interest in these types of interactions;
- PF5.1.3** Perform geospatial mapping of shark interactions in Guam by overlaying spatial information in the catch records on maps to identify areas of high interactions – knowing what species are causing depredation across the archipelago is not sufficient, and the generation of a spatial distribution map would be advantageous for fishers looking to avoid shark interaction;
- PF5.1.4** Investigate novel ways of estimating species-specific shark abundance in Guam – while there are not many readily realized techniques to tackle this issue, more creative responses may be fostered to address concerns associated with shark depredation in the Mariana Archipelago.

## ISLAND FISHERIES (IF) RESEARCH PRIORITIES

The Island Fisheries Program is governed by the four Fisheries Ecosystem Plans for American Samoa, Marianas, Hawaii and the Pacific Remote Island Areas. Research priorities revolve around the bottomfish, coral reef, crustacean, and precious coral fisheries in these areas. The main focus of the stock theme of the research priorities is improving fishery dependent data collection to support ACL based management as well as monitoring the ecosystem component species. The research priorities for the ecosystem theme are to assess and understand the ecosystems found in federal waters and implementation of Ecosystem Based Fisheries Management.

### **IF1 Robust insular fisheries data collection to monitor catch in near-real time for annual catch limit management**

The Western Pacific region (WPR) currently does not have a robust fishery data collection system that would meet the requirements of managing their insular fisheries under an annual catch limit (ACL) for all management unit species (MUS) in its associated fishery ecosystem plan (FEP). The existing data collection implemented by the State and Territories is mostly funded through WSFR and IFA grants and is partially funded by the National Marine Fisheries Service (NMFS).

**IF1.1 – Information Gap:** There is a need to establish and modify current data collection programs geared towards collecting fishery information designed to support ACL management in near-real time as opposed to months afterward.

#### **Associated Research Priorities**

- IF1.1.1** Promote and begin development of electronic reporting and monitoring for fisheries harvesting management unit species (MUS). In areas with mandatory licensing and reporting, application of an electronic reporting system is feasible and needs to be explored. This can be done at either the fisherman and/or at the dealer level. State of Hawaii currently uses online reporting for some fisheries and is developing an online dealer report. Similar work needs to be done in the territories.
- IF1.1.2** Develop novel data collection systems to replace antiquated data collection systems using image recognition technology – the regional data collection system relied on surveys and log books account for fisheries landings for decades. Emerging technologies can be applied to fishery data collection in order to increase accuracy, timeliness and efficiency of data collection. Image recognition software is currently being tested for fishery data collection. This offers a potential solution for the inadequacies in the current data collection systems being used for federal fishery management. This would include the following projects:
- Collect fish images from existing data collection programs and through collaboration with fishing coops and auction. Create a database of images of different fish species (prioritizing MUS) with known length information.
  - Development of an image-recognition software that would utilize the pictures from the image library to identify the species and estimate length.

- Develop the hardware and process for automating the fishery data collection and apply this at the appropriate reporting level (boat, fisherman, or dealer) adapting to the situation at each area of Council jurisdiction.

## **IF2 Fishery data collection to monitor ecosystem components**

The Ecosystem Component species (ECS) will be monitored using existing fishery data collection systems that rely largely on creel intercept surveys and market reporting in the territories. These programs, however, need to be significantly improved to increase both spatial and temporal survey coverage. Associated environmental monitoring is also required to determine how the stock and fishery respond to variability in environmental conditions.

**IF2.1 – Information Gap:** There is insufficient information on participation, catch, and effort for many fishery species throughout the Pacific Island territories that can be used to produce stock assessments as well as determine and monitor ACLs.

### **Associated Research Priorities**

**IF2.1.1** Improve the existing fishery data collection systems to support monitoring of ECS, the majority of which are coral reef-associated species. If possible, apply the data collection improvements previously described for MUS to ECS;

**IF2.1.2** Develop and define objectives for target ECS reference points and/or a threshold level that would transfer an ECS back to MUS when exceeded – the Council is required to manage a stock throughout its range regardless of State/Federal jurisdictional boundaries. A majority of the ECS are found in State/Territorial waters. Indicators are needed to determine the health of these stocks that are different from the Magnuson–Stevens Fishery Conservation and Management Reauthorization Act (MSRA) or FEP requirements for managing MUS, which are mostly derived from stock assessments. Such indicators, if agreed upon by the State/Territorial agencies, will be used to determine the state of the stocks and if the stocks need to be jointly managed (using parallel rule making) by the State/Territories and the Federal agencies;

**IF2.1.3** Improve the collection and monitoring of environmental parameters (via satellite-derived imaging or in-situ logs) to generate data products that can in turn be used to monitor the impact of variability in the environmental parameters on fishery performance.

## **IF3 Identification of appropriate metrics to define optimum yield and biological reference points**

Optimum Yield (OY) has not been specified for most fisheries described as MUS in their associated FEPs. Stock assessments are only available for the bottomfish fisheries and the crustacean fisheries where information on Maximum Sustainable Yield (MSY) is present. The remaining crustacean MUS, comprised of remnants of the Northwestern Hawaiian Island (NWHI) spiny lobster fisheries that are no longer active due to the marine monument expansion, require Biological Reference Points for appropriate stock status determination.

**IF3.1 – Information Gap:** The revised National Standard 1 (NS1) guidelines provide additional guidance on the specification of OY, as there is no process to follow in terms of objectively determining the appropriate level of OY for the island fisheries in the FEPs. Additionally, the remaining crustacean MUS need Biological Reference Points.

**Associated Research Priorities**

- IF3.1.1 Analyze available information to support development of appropriate biological reference points for Kona crab and deepwater shrimp stocks – the generation of additional reference points, such as optimum yield, through gathering information and/or using models would ensure compliance with NS1;
- IF3.1.2 Conduct socioeconomic fisheries research to support development of optimum yield determinations for the crustacean, bottomfish, and precious coral fisheries – because optimum yield can refer to either economic, social, or ecological sectors of a given fishery, it can be important to perform research in line with the overarching priorities for that fishery.

**IF4 Improvement of information to support stock assessments of the island fisheries management unit species**

The ECS amendment addressed issues with data-limited stocks by prompting the management of these species as components of the ecosystem rather than MUS, allowing for better focus on species prioritized for federal fisheries management. Research should focus on developing better assessments for MUS, especially those with limited baseline information.

**IF4.1 – Information Gap:** The Territorial bottomfish complexes lack baseline information on indices of abundance. There is no life history information for the Hawaii crustacean MUS.

**Associated Research Priorities**

- IF4.1.1 Implement the next generation of stock assessments for island fisheries MUS considering supporting the life history research that can be geared towards developing recruitment and growth indices as response variables to environmental change;
- IF4.1.2 Perform resource assessments on precious corals and deepwater shrimp;
- IF4.1.3 Conduct growth and recruitment research on precious corals;
- IF4.1.4 Develop estimates of unreported catch for the island crustacean fisheries in Hawaii;
- IF4.1.5 Determine life history, population dynamics, and connectivity information for island crustacean stocks;
- IF4.1.6 Develop a method to estimate MSY for the Hawaii gold coral fishery.

**IF5 Improvement of the ACL specification process**

After implementation of the ECS amendment, ACL specification was limited to six MUS. There is a need to develop stock assessments for the precious corals and deepwater shrimp remaining in this group. There is also a need to improve the existing assessments for Main Hawaii Island (MHI) deep 7 bottomfish, Territory bottomfish complexes, and Hawaii Kona crab by



incorporating climate variables (though this has been done to some extent already for the deep 7 complex). There is a need to make the ACL specification process more efficient. The score-based P\* and Social, Economic, Ecological, and Management (SEEM) analyses need significant improvements to become more objective and consistent.

**IF5.1 – Information Gap:** In order to apply ecosystem-based fisheries management to the remaining stocks in the FEP, policies should be put in place to determine the maximum and minimum harvest allowed depending on stock and oceanic productivity levels. The P\* and SEEM processes quantify the scientific and management uncertainties for the Acceptable Biological Catch (ABC) and ACL specification process. This specification must be in line with the harvest control rules and harvest control policy. There is a need to streamline these processes to simplify the harvest limit determination.

#### **Associated Research Priorities**

- IF5.1.1** Develop a comprehensive and standardized P\* process and best practices associated with this new process –there are potential issues with the P\* process utilizing values from previous years’ assessments instead of re-calculating them at the start of a new process each year. This may eventually lead to the continual increase of P\* to the point that it would represent a “perfect” value, despite it being impossible to have a truly flawless assessment.
- IF5.1.2** Develop a comprehensive and standardized SEEM process – the Council is currently revising the SEEM process to be more wide-ranging and robust.

#### **IF6 Refinement of the descriptions of essential fish habitat and habitat areas of particular concern in the FEPs**

The MSRA requires the Council to designate essential fish habitat (EFH) and habitat areas of particular concern (HAPC) for all species included in the FEPs. These designations are defined for the four life stages of each species (i.e., egg, larval, post-larval, and adult), and are required to be reviewed and revised, if needed, every five years. Once designated, all activities undertaken by a federal agency must consult with NMFS to minimize impacts to areas designated as EFH and HAPC. The Council requests a model-based approach in predicting distribution of MUS based on multiple habitat-related variables. There exists a notable overlap here with priorities categorized under the Ecosystem theme.

**IF6.1 – Information Gap:** Basic distribution maps for precious corals, deepwater shrimp, and Kona crab are limited. There exists limited information for level 2 EFH (i.e., abundance per habitat level) for MHI deep 7 bottomfish, territory bottomfish, and non-deep 7 bottomfish. There is a need to develop predictive models for species occurrence in a given area. Understanding and quantifying non-fishing impacts to habitat is needed to improve the designation and delineation of EFH and HAPC as defined in the Council’s FEPs.

#### **Associated Research Priorities**

- IF6.1.1** Develop distribution maps for the remaining MUS;

- IF6.1.2** Explore the Modular Optical Underwater Survey System (MOUSS) data set (see Misa et al. 2013) along with habitat maps (i.e., bathymetry, hardness, and slope) for potential to support EFH descriptions for bottomfish;
- IF6.1.3** Develop a predictive model to inform level 2 EFH descriptions for the remaining MUS. The development of a predictive mapping capability that can provide EFH information previously unavailable would be ideal for completing such analyses on the species level due to scarcity of direct species observations in inaccessible areas.

**IF7 Non-fishing impacts on essential fish habitats and habitat areas of particular concern**

The MSRA requires the Council to designate EFH and HAPC for all species included in the management plan. These designations are defined for the four life stages of each species (i.e., egg, larval, post-larval, and adult), and are required to be reviewed and revised, if needed, every five years. Once designated, all activities undertaken by a federal agency must consult with NMFS to minimize impacts to areas designated as EFH and HAPC. There exists a notable overlap here with priorities categorized under the Stock theme.

**IF7.1 – Information Gap:** Understanding and quantifying non-fishing impacts to habitat is needed to improve the designation and delineation of EFH and HAPC as defined in the Council’s FEPs.

**Associated Research Priorities**

- IF7.1.1** Conduct studies for the different habitats known to be EFH, and develop thresholds at the level an EFH is no longer essential to the MUS – categorize different areas and develop EFH maps of areas possessing different threshold levels.

**IF8 Implementing ecosystem-based fisheries management in the island fisheries**

Fishery management decisions have required ecosystem considerations since the 1990s. A majority of the island fisheries are in a data-limited situation, causing the development of single species assessments to inform management to be challenging. In order to implement ecosystem-based fisheries management (EBFM) in the island fisheries, the Council needs a comprehensive understanding of island fisheries ecosystem dynamics in the Western Pacific. Only by understanding the linkages between different ecosystems under federal jurisdiction and the dynamics of the stocks that inhabit those ecosystems will the Council be able to implement EBFM. There is interest in developing a fishery decision-making tool that would take into account the status of a representative stock (from an available stock assessment) and ecosystem information (including social and economic information), not dissimilar approaches utilized by a management strategy evaluation (MSE).

**IF8.1 – Information Gap:** Ecosystem based fisheries management is such a broad clause. Operationalizing EBFM would be difficult unless there is a complete understanding of the

linkages between the federal and state resources and the dynamics of the environment affecting both areas.

#### **Associated Research Priorities**

- IF8.1.1** Developing the overarching objectives for ecosystem-based fisheries management;
- IF8.1.2** Investigate the connectivity of deep- and shallow-water ecosystems through movements and larval recruitment
- IF8.1.3** Increase the understanding of island ecosystem circulation by developing more fine-scale ocean and coastal modeling;
- IF8.1.4** Investigate the utility of e-DNA to analyze species distribution;
- IF8.1.5** Apply the Integrated Environmental Assessment (IEA) on an island-wide scale or on the regional scale at which the Council operates;
- IF8.1.6** Increase support for the development of fishery management decision-making tools that incorporate ecosystem processes and environmental changes (short- and long-term), such as Atlantis ecosystem models;
- IF8.1.7** Perform trophic analyses and diet studies to understand species-specific dynamics – this would also provide information on bioenergetics for Atlantis modeling;
- IF8.1.8** Acquire funding support to provide data streams at appropriate spatial and temporal scales to inform ecosystem-scale reference points.

#### **IF9 Assessment of deep water ecosystems**

The Pacific islands are characterized by having deep-sloping ecosystems. Federal waters typically lack the shallow continental shelf areas, but are instead comprised of mesophotic reefs, pinnacles, offshore banks, and deep precious coral beds. These resources are poorly mapped, and assessments on the status of the resource are limited.

**IF9.1 – Information Gap:** The region lacks a comprehensive map that describes the distribution of the different MUS present. The Council also lacks baseline information on the state and extent of these habitats utilized by MUS throughout their life history.

#### **Associated Research Priorities**

- IF9.1.1** Develop maps of mesophotic and deepwater bank habitats to generate a comprehensive list of federal banks and mesophotic reefs. Multi-beam mapping systems are available, but there are no staff resources or capabilities to run the program at \$1.3 million per year. The Ocean Foundation has a mega-yacht that can do high resolution mapping, however;
- IF9.1.2** Develop a deep reef assessment and monitoring program (RAMP), conduct a comprehensive resource survey on the deep reef habitat, utilize technology-based optics including autonomous underwater vehicles (AUVs), and conduct mesophotic diving for shallower habitats;
- IF9.1.3** Generate predictive mapping of deep coral resources and improve bottom current modeling using annotated videos of precious coral beds and in situ observation by deploying sensors and loggers – predictive mapping can be performed by using

models by the Bureau of Ocean Energy (BOEM), though the flow models (important driver to predictive mapping) need to be improved

## PROTECTED SPECIES (PS) RESEARCH PRIORITIES

The Protected Species section deals with scientific research needed to reduce bycatch impacts on protected species and to ensure FEP compliance with statutory requirements such as the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA). Improving the accuracy of protected species stock assessments as well as bycatch estimates are major priorities being addressed in this section, as are research contributing to the development of technological solutions to protected species bycatch.

### **PS1 Improving information base for managing protected species interactions in fisheries managed under the Council's FEPs**

Collection of scientific data, improvement of stock assessments, and evaluation of fishery impacts are integral to meeting the MSRA mandate for the Council's FEPs to be consistent with other applicable laws such as the ESA and the Marine Mammal Protection Act (MMPA). The best scientific information available (BSIA) on protected species is needed in developing management and conservation measures, amending the FEP, and monitoring fisheries under the FEP annual reports. Accurate characterization and quantification of impacts are critical in managing protected species interactions in fisheries. Equally important are scientifically robust and frequent stock assessments to determine the status of stocks that may be affected by fishing activities.

#### *Improving Information Base: Cross-cutting Management Needs*

**PS1.1 – Information Gap:** Develop robust stock assessments and stock designations for species listed in the Endangered Species Act (ESA) as well as non-ESA marine mammals and seabirds to support evaluation of fishery impacts on protected species populations.

#### **Associated Research Priorities**

- PS1.1.1** Enhance data collection for identifying population stock structure, including genetic structure studies;
- PS1.1.2** Improve understanding of life history of protected species (especially data-limited life stages);
- PS1.1.3** Establish or continue standard surveys for population abundance (including indices of abundance or other indicators, if applicable);
- PS1.1.4** Develop new analytical approaches and expand surveys areas to develop population assessments beyond existing survey areas or life stages. Examples include:
- Analytical approaches for using habitat associations in estimating abundance of marine mammals outside of EEZ;
  - Expanding in-water surveys to estimate foraging ground abundance for sea turtles;
  - Conducting targeted surveys outside of the EEZ for trans-boundary cetacean stocks.
- PS1.1.5** Improve data collection on habitat use and habitat requirements, including identification of foraging and breeding areas for protected species.

**PS1.2 – Information Gap:** Improve evaluation of impacts on protected species populations from FEP fisheries.

**Associated Research Priorities**

- PS1.2.1** Improve data collection to estimate species-specific demographic parameters of protected species that are captured in the fishery;
- PS1.2.2** Improve species-specific estimates of post-hooking mortality rates;
- PS1.2.3** Improve genetic assignments of protected species captured in the fishery to assess impacts to DPS/stocks;
- PS1.2.4** Conduct studies to assess extent of prey overlap between protected species and fisheries;
- PS1.2.5** Conduct studies to evaluate link between trends in population abundance and interactions to determine whether population trends may be a predictor in future interaction levels;
- PS1.2.6** Improve bycatch estimates in non-US fisheries that have interactions with protected species that are observed in the FEP fisheries.

***Improving Information Base: Pelagic Longline Management Needs***

**PS1.3 – Information Gap:** Supplement data collection for protected species interactions where standard observer program data collection for the Hawaii and American Samoa longline fishery is inadequate to assess patterns and trends.

**Associated Research Priorities**

- PS1.3.1** Develop electronic monitoring capabilities to improve species identification, characteristics of the animal involved in the interaction (e.g., size), and interaction outcomes (e.g., release condition, gear remaining, handling practices) for protected species interactions in the longline fisheries;
- PS1.3.2** Increase tagging efforts on protected species that interact with the longline fishery to improve data on habitat use and to assess post-hooking mortality (not a priority for marine mammals due to difficulty of tagging post-hooking);
- PS1.3.3** Improve data collection on depredation of catch and bait in longline fisheries by marine mammals and sharks (e.g., assessing empty hooks during a haul);
- PS1.3.4** Conduct periodic evaluation of observer program data forms, data collection protocols, and training procedures.

**PS1.4 – Information Gap:** Evaluate factors driving protected species interaction patterns and trends (including depredation) for Hawaii and American Samoa longline fisheries.

**Associated Research Priorities**

- PS1.4.1** Collect fishery-dependent and independent data to better understand habitat use of protected species;
- PS1.4.2** Improve understanding of socioeconomic factors affecting fishery operations;
- PS1.4.3** Understand changes in oceanographic conditions and climate factors (and their impact on habitat use and fishery operations):

- Specific information need - higher resolution oceanographic data at depths;
- PS1.4.4** Conduct studies to assess overlap between fisheries and protected species habitat;
- PS1.4.5** Conduct studies to improve understanding of factors influencing protected species attraction to fishing vessels and/or gear.

***Improving Information Base: Island and Pelagic Small Boat Fisheries Management Needs***

**PS1.5 – Information Gap:** Improve monitoring of protected species interaction patterns and trends in FEP island fisheries.

**Associated Research Priorities**

- PS1.5.1** Conduct research to improve data on fishing effort and distribution to evaluate overlap between fisheries and protected species:
  - Estimate gear-specific interaction rates for pelagic small boat fisheries;
- PS1.5.2** Improve fishery-dependent data collection, including coordination with State/Territories to increase specificity of data reporting and revise reporting forms to improve data for assessing levels of protected species interactions. There exists a notable overlap here with priorities categorized under the Stock theme. Specific activities may include:
  - Devise standard language and codes for species identifications (e.g., using FAO 3-alpha codes).
  - Develop platforms for simple, timely, efficient, and accurate reporting;
  - Create a species identification application for protected species (including basic biological information about the species and population status) to improve accuracy of reports;
- PS1.5.3** Conduct risk assessment of fishing gear or fisheries to identify priorities for data collection (e.g., desk-top study to identify fisheries that have high priority for data collection improvements and assess feasibility for implementing improvements);
- PS1.5.4** Improve understanding of protected species interactions with aquaculture facilities and operations.

**PS2 Minimizing fishery impacts on protected species through development of mitigation measures and implementation of regulatory and non-regulatory measures while minimizing socioeconomic impacts and providing incentives to fishing communities.**

Minimizing protected species interactions and associated mortality is central to the objectives of the Council’s FEPs and the MSRA. Research and development of bycatch mitigation measures are needed where protected species interactions are identified as a concern in fisheries managed under the Council’s FEP. Mitigation measures may be implemented through regulatory or non-regulatory mechanisms, and may include outreach and training to fishermen.

***Minimizing Fishery Impacts: Pelagic Longline Management Needs***

**PS2.1 – Information Gap:** Review and evaluate effectiveness of existing protected species management measures in the Hawaii and American Samoa longline fisheries

### **Associated Research Priorities**

- PS2.1.1** Conduct tagging projects to evaluate effect of trailing gear (especially with respect to shark non-retention measures);
- PS2.2.2** Evaluate recommendations for handling practices;
- PS2.2.3** Evaluate mitigation measure effectiveness and alternatives;
- PS2.2.4** Evaluate gear configuration requirements.

**PS2.2 – Information Gap:** Develop and test new gear, methods, and tools (including non-gear measures to reduce interactions, such as trip limits) to both reduce interaction with protected species and evaluate their efficacy and practicality in the Hawaii and American Samoa longline fisheries.

### **Associated Research Priorities**

- PS2.2.1** Continue research on deterrent devices (e.g., marine mammal depredation deterrent devices, seabird deterrents);
- PS2.2.2** Conduct research to improve understanding of mechanism of interactions (e.g., mechanism of how sea turtles are hooked);
- PS2.2.3** Develop tools for interaction avoidance and other non-gear mitigation approaches utilizing information on interaction patterns and drivers (e.g., TurtleWatch, trip limits);
- PS2.2.4** Conduct outreach and training for successful implementation of gear, methods, and tools;
- PS2.2.5** Evaluate cross-taxa impacts of bycatch mitigation measures (for both gear and non-gear measures; e.g., effort displacement from avoiding interactions with one species).

**PS2.3 – Information Gap:** Develop and test tools and approaches to reduce post-hooking mortality of protected species.

### **Associated Research Priorities**

- PS2.3.1** Conduct research to improve post-hooking mortality rates (e.g., understanding effects of trailing gear on post-hooking mortality rates);
- PS2.3.2** Identify best practices for handling and release to improve post-hooking survival;
- PS2.3.1** Conduct research to evaluate how gear responds to interactions (e.g., weak hooks in combination with branchline strength).

**PS2.4 – Information Gap:** Evaluate socioeconomic impacts of mitigation measures.

### **Associated Research Priorities**

- PS2.4.1** Perform a cost-benefit analysis of new gear and methods for reducing protected species interactions.



*Minimizing Fishery Impacts: Island and Pelagic Small Boat Fisheries Management Needs*

**Associated Research Priorities**

- PS2.4.2** Develop and test new gear, methods, and tools to reduce interactions with protected species:
- Conduct social science studies to assess fishery participants' knowledge, attitude, and behavior toward protected species and assess extent of fishery interactions to inform development of suitable tools for minimizing interactions;
  - Conduct socioeconomic studies to evaluate potential for effective implementation of mitigation measures;
- PS2.4.3** Develop and test tools to reduce post-hooking mortality of protected species;
- PS2.4.4** Evaluate socioeconomic impacts of mitigation measures.

## HUMAN COMMUNITIES (HC) RESEARCH PRIORITIES

The Human Communities section addresses the socio-cultural and economic needs (the human dimensions) inherent in regional fisheries management. The MSA requires that the Council consider the importance of fishery resources to fishing communities, as well as to use social and economic data to support the specification of Optimum Yield. In addition, the MSA finds that the Pacific Insular Areas have unique social and historical characteristics. Finally, the WPRFMC's process to specify annual catch limits requires assessing relevant social and economic factors and their importance to the fishery.

### **HC1 Socioeconomic characterization of regional fisheries, markets, and fishing communities**

Effective conservation and management of natural resources is largely driven by governing the people who interact with those resources. The people are a major part of the ecosystem, and the Council is required to assess potential social and economic impacts of all proposed management actions on fishing and broader communities that depend on those resources. The Council generally lacks basic information on socioeconomic drivers in the domestic fisheries, markets, and fishing communities needed to conduct socioeconomic impact analysis. Information is needed on the costs of fishing, fisher effort and participation, relative proportionality of commercial and non-commercial catch for stock assessments, understanding product flow through market and non-market distribution networks and relative impacts, and related changes in user groups from management actions.

**HC1.1 – Information Gap:** Understanding and incorporating economic and social science into fishery management.

#### **Associated Research Priorities**

- HC1.1.1** Understand the costs of fishing, fisher effort (nominal and spatial) and/or participation;
- HC1.1.2** Improving estimations of the relative proportionality of commercial and noncommercial catch for stock assessment purposes;
- HC1.1.3** Understand product flow, price determination, demand structure (price flexibilities), consumer preferences, and non-market fish distribution relationships with formal markets (fish flow);
- HC1.1.4** Characterize and analyzing labor supply focusing on fishing and processing labor, its source, composition, alternative employment opportunities, and related issues;
- HC1.1.5** Monitor community engagement, reliance, and dependence on fishery resources;
- HC1.1.6** Evaluate effects of management actions, alternatives and governance on fisher behavior, markets, and communities;
- HC1.1.7** Explore the feasibility of establishing a regional long-term socioeconomic monitoring program;
- HC1.1.8** Establish and monitor demographic and socioeconomic characterizations of regional fishery participants;

**HC1.1.9** Design and implement socioeconomic surveys with consideration for how results could support regional comparisons and understanding of trends in fishery and ecosystem knowledge, attitude, and perceptions.

**HC1.2 – Information Gap:** Understanding and incorporating non-commercial fishing dimensions into fishery management.

**Associated Research Priorities**

**HC1.2.1** Characterizing non-commercial vessels, participants, motivations, catch and effort;

**HC1.2.2** Measure attributes of fisheries and fishing outcomes (e.g., non-market valuation);

**HC1.2.3** Perform comparative analyses of data from different sampling designs such as fishing panels, general household surveys, and targeted fishing community surveys to inform participant characterizations.

**HC2 Integrating social, ecological, and biophysical research efforts to inform ecosystem-based fisheries management**

One of the Council’s guiding principles is to “promote an ecosystem approach in fisheries management.” Fishery development in this area includes effectuating EBFM for remaining FEP stocks in order to develop harvest control rules and harvest control policies that support the ACL specification process.

**HC2.1 – Information Gap:** Understanding and incorporating EBFM in the Western Pacific region.

**Associated Research Priorities**

**HC2.1.1** Support studies to expand understanding of ecosystem service valuation (non-market values; non-economic considerations), human well-being (seafood safety, security), equity and gender issues, and other intangible benefits;

**HC2.1.2** Inspect integrated social, ecological, and biophysical research efforts to inform EBFM;

**HC2.1.3** Develop narratives of socioeconomic and ecological considerations associated with trends in fishery performance (e.g., Annual SAFE Report – Data Integration Chapters);

**HC2.1.4** Perform coupled modeling of environmental and socioeconomic parameters (e.g., using the Atlantis ecological model);

**HC2.2 – Information Gap:** Understanding impacts of climate change and other large-scale changes resulting in an uncertain future for fisheries and fishing communities for adaptive management.

**Associated Research Priorities**

**HC2.2.1** Develop robust indicators to examine community resilience, risk perception, and adaptive management;

- HC2.2.2 Generate attributes of island communities, including local knowledge and traditional practices, that may help them be resilient when exposed to change;
- HC2.2.3 Determine the cultural importance of and community reliance on species vulnerable to effects of climate change.

**HC3 Understanding the roles of indigenous and cultural fishing and other social drivers in the current management system**

The Western Pacific region is host to native Hawaiians, Samoans, Chamorro, and Refaluwasch as indigenous peoples to their respective island areas. Each of these ethnicities has an associated culture and rights that need to be considered in policy development. Recent legal battles have resulted in the Council needing to take into account the relationships between the indigenous people of the Western Pacific region and the US in fishery policy development.

**HC3.1 – Information Gap:** Recognizing the importance of island cultures and traditional fishing practices.

**Associated Research Priorities**

- HC3.1.1 Examine interactions between culture and contemporary fisheries to understand relevant dimensions of fishing;
- HC3.1.2 Assess the human dimensions of US Pacific Marine managed areas regarding procedural and distributive justices, transferred economic, social and ecological effects and safety;
- HC3.1.3 Describe dimensions of fishing at appropriate cultural scales (island, fishery, community, etc.);
- HC3.1.4 Identify cultural keystone species at appropriate scales (island, fishery, community, etc.);
- HC3.1.5 Perform focused research on attributes of culture (examples such as: materials, fishing practice, identity, motivation, governance, distribution, etc.) to ensure appropriate consideration in future Council actions.

**HC3.2 – Information Gap:** Understanding the importance of social drivers impacting management.

**Associated Research Priorities**

- HC3.2.1 Examine interactions between culture and contemporary fisheries to understand relevant dimensions of fishing;
- HC3.2.2 Research the science of compliance within regional fishery regulations and best practices with applications to commercial and non-commercial catch reporting and behavior (commercial marine licenses [CMLs], fish sales, closed areas, bag and size limits, etc.) and protected species interactions (turtles, monk seals, cetaceans, ESA-listed species, etc.);
- HC3.2.3 Design effective management interventions that align behavior with conservation goals;
- HC3.2.4 Evaluate effectiveness of management intervention and strategic communication processes.