

Regional Habitat Assessment Prioritization for Pacific Islands Stocks

Report of the Pacific Islands Habitat Assessment Prioritization
Working Group (PI-HAPWG)

**Pacific Islands Fisheries Science Center, Pacific Islands Regional Office and Western
Pacific Region Fisheries Management Council**

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Introduction

The National Marine Fisheries Service (NMFS) developed the *Habitat Assessment Improvement Plan* (HAIP; NMFS 2010) to document habitat science needs within the agency. Recommendations from this effort included the need to prioritize stocks and geographic locations that could benefit from habitat assessments and the need to identify data inadequacies for stocks and their respective habitats as relevant to information gaps identified in the HAIP. The Habitat Assessment Prioritization Working Group (HAPWG) responded to these recommendations by developing a habitat prioritization process to be carried out for stocks on a regional basis (NMFS 2011). The NMFS Southwest Region became the first to apply this prioritization process to its regional fishery stocks (NMFS 2012), followed by the Northeast Region. Subsequently, the Northwest Region convened its Regional Habitat Assessment Working Group (NW-RHAPWG) and produced a joint document with its Southwest regional counterpart addressing these two regions (Blackhart 2014), which include a number of stocks whose ranges overlap between regions. The work of these regions served as a model for the Pacific Islands prioritization as presented in this report. More detailed accounts of the rationale for and history of the HAIP and HAPWG programs can be found in these documents (NMFS 2011, 2012, Blackhart 2014).

In response to these initiatives that are part of NOAA-wide efforts to improve habitat and stock assessment science and management, the NMFS Pacific Islands Fisheries Science Center (PIFSC) embarked on an exercise intended to prioritize habitat science efforts in the Pacific Islands region. That effort began with the assembly of a Pacific Islands Habitat Assessment Prioritization Working Group (PI-HAPWG: the authors of this report) in 2014, and culminated in a final set of ratings for Pacific Islands stocks in 2016. The overall goal of the HAPWG team was to assign a relative rank to those species or species complexes and their respective habitats that would benefit from more focused research and provide justification for increased funding of habitat efforts in the future, as well as providing for more efficient use of existing resources to benefit NOAA and its trust resources. The results of this ranking effort will be used to prioritize (and in some cases determine eligibility for) habitat research funding and to support NMFS Habitat Conservation efforts, NOAA Habitat Focus Area initiatives, and perhaps, ecosystem-based fisheries management plans and policies. This report provides a summary of the PI-HAPWG stock ratings with explanations of how those values were derived and commentary on specific rating criteria and the final outcome in general.

The PI-HAPWG included representatives from both the Pacific Islands Fisheries Science Center (PIFSC) and Pacific Islands Regional Office (PIRO), as well as representatives from the Western Pacific Region Fisheries Management Council (WPRFMC). The participants have expertise in stock assessment, habitat science, ecology, essential fish habitat, and/or fisheries resources management. Since the Pacific Islands region stocks range from pelagic and demersal to shallow coral reef species, the group included experts on the pelagic, bottomfish, and coral reef fisheries. The group started with 11 members, all of whom participated in the initial ranking exercise, but final rankings were ultimately determined by only 7 participants.

U.S. Pacific Islands Stocks

Coordinators used an internal process to develop an initial list of candidate species, using a variety of national, regional, fisheries council, and local management documents, and our own expertise. We distributed this initial list that included all federally-managed Fish Stock Sustainability Index (FSSI) stocks in the region to 6 PIFSC stock assessment and/or habitat scientists, 3 PIRO scientists/managers, and 2 scientists/managers from the WPRFMC. We directed them to add or subtract to the list based on research or management priorities, and to distribute to other Pacific Islands scientists/managers they thought would like to have input. After receiving this feedback, we developed a final candidate list with 28 pelagic species, 2 pelagic genera, 1 pelagic family, 7 species of deep-water bottomfishes, 18 species of snappers, jacks and groupers, 27 species, 1 genus, and 1 family of reef fishes, and a handful of precious corals and other invertebrate species (Tables 1, 2, 3, 4). Many reef fish species were not included in this final list because they do not appear on the FSSI list, or due to lack of information and challenges associated with providing adequate rankings for the species. Many invertebrate species were also excluded because of the lack of an active commercial fishery in the region for those species. Although tunas, billfishes, and swordfish are highly migratory species, they are managed through a regional pelagic fishery ecosystem plan, in addition to international agreements, and it was agreed that they should be included in the ranking due to their ecological, social and economic importance to the region. These species, genera, and families represent stocks originally managed under 5 separate fishery management plans developed by the WPRFMC, plans that have since been superseded by 5 fishery ecosystem plans (FEPs), the Hawaii FEP, American Samoa FEP, the Marianas FEP, the Pacific Remote Island Areas (PRIA) FEP, and the Pelagics FEP.

Since the late 1970s, the WPRFMC managed fisheries throughout the Western Pacific Region through separate species-based fishery management plans (FMP) – the Bottomfish and Seamount Groundfish FMP (WPRFMC 1986a), the Crustaceans FMP (WPRFMC 1981), the Precious Corals FMP (WPRFMC 1979), the Coral Reef Ecosystems FMP (WPRFMC 2001) and the Pelagic FMP (WPRFMC 1986b). In 2009, the WPRFMC moved towards an ecosystem-based approach to fisheries management and restructured its management framework from species-based FMPs to place-based FEPs. Recognizing that a comprehensive ecosystem approach to fisheries management must be initiated through an incremental, collaborative, and adaptive management process, a multi-step approach is being used to develop and implement the FEPs. To be successful, this will require increased understanding of a range of issues including biological and trophic relationships, habitat and ecosystem indicators and models, and the ecological effects of non-fishing activities on the marine environment. This prioritization exercise should assist council efforts to allocate limited resources to understanding those habitats that are particularly critical for certain species. The Hawaii Archipelago, American Samoa, Marianas, and PRIA FEPs identify as management unit species those current management unit species known to be present in waters around the Hawaii Archipelago and incorporates all of the management provisions of the Bottomfish and Seamount Groundfish FMP, the Crustaceans FMP, the Precious Corals FMP, and the Coral Reef Ecosystems FMP that are applicable to the areas. Although pelagic fishery resources play an important role in the biological as well as the socioeconomic environment of these islands, they are managed separately through the Pacific Pelagic FEP.

Table 1. Federally-managed (FMC) pelagic marine stocks in the Pacific Islands Region.

Common Name	Species	FMC	FMP
Albacore	<i>Thunnus alalunga</i>	WPRFMC	Pelagic FEP
Bigeye scad	<i>Selar crumenophthalmus</i>	WPRFMC	Pelagic FEP
Bigeye thresher shark	<i>Alopias superciliosus</i>	WPRFMC	Pelagic FEP
Bigeye tuna	<i>Thunnus obesus</i>	WPRFMC	Pelagic FEP
Black marlin	<i>Makaira indica</i>	WPRFMC	Pelagic FEP
Blue shark	<i>Prionace glauca</i>	WPRFMC	Pelagic FEP
Common thresher shark	<i>Alopias vulpinus</i>	WPRFMC	Pelagic FEP
Diamondback squid	<i>Thysanoteuthis rhombus</i>	WPRFMC	Pelagic FEP
Dolphinfish	<i>Coryphaena hippurus</i>	WPRFMC	Pelagic FEP
Escolars	Family <i>Gempylidae</i>	WPRFMC	Pelagic FEP
Frigate mackerels	<i>Auxis</i> spp.	WPRFMC	Pelagic FEP
Indo-Pacific blue marlin	<i>Makaira mazara</i>	WPRFMC	Pelagic FEP
Kawakawa	<i>Euthynnus affinis</i>	WPRFMC	Pelagic FEP
Longfin mako shark	<i>Isurus paucus</i>	WPRFMC	Pelagic FEP
Mackerels	<i>Scomber</i> spp.	WPRFMC	Pelagic FEP
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	WPRFMC	Pelagic FEP
Opah	<i>Lampris guttatus</i>	WPRFMC	Pelagic FEP
Pacific bluefin tuna	<i>Thunnus orientalis</i>	WPRFMC	Pelagic FEP
Pacific pomfret	<i>Brama japonica</i>	WPRFMC	Pelagic FEP
Pelagic thresher shark	<i>Alopias pelagicus</i>	WPRFMC	Pelagic FEP
Purple flying squid	<i>Sthenoteuthis oualaniensis</i>	WPRFMC	Pelagic FEP
Sailfish	<i>Istiophorus platypterus</i>	WPRFMC	Pelagic FEP
Salmon shark	<i>Lamna ditropis</i>	WPRFMC	Pelagic FEP
Shortfin mako shark	<i>Isurus oxyrinchus</i>	WPRFMC	Pelagic FEP
Shortbill spearfish	<i>Tetrapturus angustirostris</i>	WPRFMC	Pelagic FEP
Sickle pomfret	<i>T. steindachneri</i> , or <i>E. illustris</i>	WPRFMC	Pelagic FEP
Silky shark	<i>Carcharhinus falciformis</i>	WPRFMC	Pelagic FEP
Skipjack tuna	<i>Katsuwonus pelamis</i>	WPRFMC	Pelagic FEP
Striped marlin	<i>Tetrapturus audax</i>	WPRFMC	Pelagic FEP
Swordfish	<i>Xiphias gladius</i>	WPRFMC	Pelagic FEP
Wahoo	<i>Acanthocybium solandri</i>	WPRFMC	Pelagic FEP
Yellowfin Tuna	<i>Thunnus albacares</i>	WPRFMC	Pelagic FEP

Table 2. Federally-managed (FMC) non-pelagic marine stocks in the Pacific Islands Region.

Common Name	Species	FMC	FMP
Pink snapper	<i>Pristipomoides filamentosus</i>	WPRFMC	Hawaii FEP
Seabass	<i>Epinephelus quernus</i>	WPRFMC	Hawaii FEP
Oblique-banded snapper	<i>Pristipomoides zonatus</i>	WPRFMC	Hawaii FEP
Red snapper/shorttail	<i>Etelis carbunculus</i>	WPRFMC	Hawaii FEP
Von Siebolds pink snapper	<i>Pristipomoides sieboldii</i>	WPRFMC	Hawaii FEP
Red snapper/longtail	<i>Etelis coruscans</i>	WPRFMC	Hawaii FEP
Silver mouth snapper	<i>Aphareus rutilans</i>	WPRFMC	Hawaii FEP
Alfonsin	<i>Beryx splendens</i>	WPRFMC	Hawaii FEP
Amberjack	<i>Seriola dumerili</i>	WPRFMC	Hawaii FEP
Ambon emperor	<i>Lethrinus amboinensis</i>	WPRFMC	Hawaii FEP
Armorhead	<i>Pseudopentaceros wheeleri</i>	WPRFMC	Hawaii FEP
Blacktip grouper	<i>Epinephelus fasciatus</i>	WPRFMC	Hawaii FEP
Bluefin trevally	<i>Caranx melampygus</i>	WPRFMC	Hawaii FEP
Blueline snapper	<i>Lutjanus coeruleolineatus</i>	WPRFMC	Hawaii FEP
Bonefish	<i>Albula virgata/glossodonata</i>	WPRFMC	Hawaii FEP
Giant trevally/jack	<i>Caranx ignobilis</i>	WPRFMC	Hawaii FEP
Gray snapper	<i>Aprion virescens</i>	WPRFMC	Hawaii FEP
Lunartail grouper	<i>Variola louti</i>	WPRFMC	Hawaii FEP
Pacific Threadfin	<i>Polydactylus sexfilis</i>	WPRFMC	Hawaii FEP
Pelagic armorhead	<i>Pentaceros richardsoni</i>	WPRFMC	Hawaii FEP
Redgill emperor	<i>Lethrinus rubrioperculatus</i>	WPRFMC	Hawaii FEP
Thick-lipped trevally	<i>Caranx dentex</i>	WPRFMC	Hawaii FEP
Yelloweye snapper	<i>Pristipomoides flavipinnis</i>	WPRFMC	Hawaii FEP
Yellowtail kalekale/snapper	<i>Pristipomoides auricilla</i>	WPRFMC	Hawaii FEP
Gold corals	<i>Kulumanamana haumeaee</i>	WPRFMC	Hawaii FEP
Pink corals	<i>Hemicorallium laauense</i>	WPRFMC	Hawaii FEP
Red corals	<i>Pleurocorallium secundum</i>	WPRFMC	Hawaii FEP
Bamboo corals	<i>Family Isididae</i>	WPRFMC	Hawaii FEP
Black corals	<i>Antipathes griggi</i>	WPRFMC	Hawaii FEP
Deep water shrimp	<i>Heterocarpus spp.</i>	WPRFMC	Hawaii FEP
Kona crab	<i>Ranina ranina</i>	WPRFMC	Hawaii FEP
Pacific lobsters	<i>Panulirus marginatus/penicillatus</i>	WPRFMC	Hawaii FEP

Table 3. Federally-managed (FMC) reef fish marine stocks in the Pacific Islands Region.

Common Name	Species	FMC	FMP
Mackerel scad	<i>Decapterus macarellus</i>	WPRFMC	Archipelagic FEPs
Yellowstripe goatfish	<i>Mulloidichthys flavolineatus</i>	WPRFMC	Archipelagic FEPs
Whitesaddle goatfish	<i>Parupeneus porphyreus</i>	WPRFMC	Archipelagic FEPs
Yellowfin goatfish	<i>Mulloidichthys vanicolensis</i>	WPRFMC	Archipelagic FEPs
Eyestriped surgeonfish	<i>Acanthurus dussumieri</i> ()	WPRFMC	Archipelagic FEPs
Lined surgeonfish	<i>Acanthurus lineatus</i>	WPRFMC	Archipelagic FEPs
Striped surgeonfish	<i>Acanthurus lineatus</i>	WPRFMC	Archipelagic FEPs
Convict tang	<i>Acanthurus triostegus</i>	WPRFMC	Archipelagic FEPs
Bluespine unicornfish	<i>Naso unicornis</i>	WPRFMC	Archipelagic FEPs
Gray unicornfish	<i>Naso caesius</i>	WPRFMC	Archipelagic FEPs
Striped bristletooth	<i>Ctenochaetus striatus</i>	WPRFMC	Archipelagic FEPs
Bluestripe snappers	<i>Lutjanus kasmira</i>	WPRFMC	Archipelagic FEPs
Humpback red snapper	<i>Lutjanus gibbus</i>	WPRFMC	Archipelagic FEPs
Bullethead parrotfish	<i>Chlorurus spilurus</i>	WPRFMC	Archipelagic FEPs
Spectacled parrotfish	<i>Chlorurus perspicillatus</i>	WPRFMC	Archipelagic FEPs
Redlip/Ember parrotfish	<i>Scarus rubroviolaceus</i>	WPRFMC	Archipelagic FEPs
Bigscale soldierfish	<i>Myripristis berndti</i>	WPRFMC	Archipelagic FEPs
Saber squirrelfish	<i>Sargocentron spiniferum</i>	WPRFMC	Archipelagic FEPs
Striped mullet	<i>Mugil cephalus</i>	WPRFMC	Archipelagic FEPs
Honeycomb grouper	<i>Epinephelus merra</i>	WPRFMC	Archipelagic FEPs
Hexagon grouper	<i>Epinephelus hexagonatus</i>	WPRFMC	Archipelagic FEPs
Bigeye emperor	<i>Monotaxis grandoculis</i>	WPRFMC	Archipelagic FEPs
Longface	<i>Lethrinus olivaceus</i>	WPRFMC	Archipelagic FEPs
Grey reef shark	<i>Carcharhinus amblyrhynchos</i>	WPRFMC	Archipelagic FEPs
Sandbar shark	<i>Carcharhinus plumbeus</i>	WPRFMC	Archipelagic FEPs
Whitetip shark	<i>Triaenodon obesus</i>	WPRFMC	Archipelagic FEPs
Rabbitfish	Genus <i>Seganus</i>	WPRFMC	Archipelagic FEPs
Rudderfish/Chubs	<i>Centrolophus niger</i>	WPRFMC	Archipelagic FEPs
Wrasse	Family Labridae	WPRFMC	Archipelagic FEPs
Bumphead parrotfish	<i>Bolbometopon muricatum</i>	WPRFMC	Archipelagic FEPs
Humphead Wrasse	<i>Cheilinus undulatus</i>	WPRFMC	Archipelagic FEPs

*This list of reef fishes is not a comprehensive list of all of the reef fish stocks in the Western Pacific Region Fisheries area. Many of the exploited species found in American Samoa, the northern Marianas, and the Pacific Island Remote Areas were not included in this evaluation. Table 4 includes a list of some important archipelagic species that were not ranked during this exercise.

Table 4. Select federally-managed (FMC) reef fish marine stocks in the Pacific Islands Region *not* included in prioritization due to lack of commercial fishery and/or lack of habitat information.

Common Name	Species	FMC	FMP
Hawaiian Hogfish	<i>Bodianus albotaeeniatus</i>	WPRFMC	Archipelagic FEPs
Long-nosed parrotfish	<i>Hipposcarus loniceps</i>	WPRFMC	Archipelagic FEPs
Thumb print emperor	<i>Lethrinus harak</i>	WPRFMC	Archipelagic FEPs
Orange line emperor	<i>Lethrinus obseletus</i>	WPRFMC	Archipelagic FEPs
Yellow-lipped emperor	<i>Lethrinus xanathochilus</i>	WPRFMC	Archipelagic FEPs
One spot snapper	<i>Lutjanus monostigmus</i>	WPRFMC	Archipelagic FEPs
Bigeye emperor	<i>Monotaxis grandoculus</i>	WPRFMC	Archipelagic FEPs
Yellow-lined goatfish	<i>Mulloides flavolineatus</i>	WPRFMC	Archipelagic FEPs
Pfluger's goatfish	<i>Mulloidichthys pflugeri</i>	WPRFMC	Archipelagic FEPs
Clown faced surgeonfish	<i>Naso literatus</i>	WPRFMC	Archipelagic FEPs
Yellow saddle goatfish	<i>Parupeneus cyclostomas</i>	WPRFMC	Archipelagic FEPs
Saddleback grouper	<i>Plectropomus laevis</i>	WPRFMC	Archipelagic FEPs
Tan-faced parrotfish	<i>Scarus microrhinos</i>	WPRFMC	Archipelagic FEPs
Brassy Trevally	<i>Caranx papuensis</i>	WPRFMC	Archipelagic FEPs

The term “ecosystem component species” was not introduced into NMFS’s National Standard Guidelines until after the Council took final action converting its FMPs to place-based FEPs. Although hundreds of the species included as FEP management unit species were managed as non-target species (only permit and reporting required, no size limits or catch limits, etc.), the WPRFMC adopted an ecosystem component species classification with its omnibus amendment adopting an annual catch limit (ACL) mechanism in 2012. The Council would classify species in a later amendment action. The Council is expected to take final action on this amendment sometime in 2018. EFH authorities and other stock-specific requirements only apply to species in need of conservation and management, not ecosystem component species.

The WPRFMC has determined that the Hawaii FEP boundary includes all waters and associated marine resources with EEZ waters surrounding the Hawaiian Islands (Figure 1). Although this overlaps with the boundaries of the WPRFMC’s Pacific Pelagic FEP for pelagic fisheries, the Hawaii FEP specifically manages those demersal resources and habitats associated with the federal waters of the Hawaii Archipelago.

Under the American Samoan FEP, MUS include bottomfish and seamount species, crustaceans, precious corals, and coral reef ecosystem species that are known to be present within EEZ waters around the American Samoan archipelago (Figure 2). Certain pelagic species also occur within the boundary of the American Samoa FEP, but they are managed under the WPRFMC’s Pelagic FEP.

The Marianas FEP boundary includes all waters and associated marine resources within the EEZ surrounding the Commonwealth of the Northern Mariana Islands (CNMI) and the Territory of

Guam (Figure 3). Although this overlaps with the boundaries of the WPRFMC's Pacific Pelagic FEP for pelagic fisheries, the Mariana Archipelago FEP specifically manages those demersal resources and habitats associated with the federal waters of the Mariana Archipelago.

Pacific Remote Island Area (PRIA) FEP boundaries are the Federal waters (0-200 nm) surrounding each PRIA and overlay the National Wildlife Refuge boundaries asserted by the US Fish and Wildlife Service (USFWS). This is consistent with the regulations implementing the Coral Reef Ecosystems FMP (Final Rule, 69 FR 8346, February 24, 2004) which defined the Coral Reef Ecosystems FMP regulatory area for the PRIA as the area between the shoreline and the outer boundary of the EEZ (i.e., 0-200 nm). Although the boundary of the PRIA FEP overlaps with the boundaries of the WPRFMC's Pacific Pelagic FEP for pelagic fisheries, the PRIA FEP specifically manages those demersal resources and habitats associated with the Federal waters around these island areas (Figure 4).

The Pacific Pelagic FEP encompasses all areas of pelagic fishing operations in the EEZ or on the high seas, for any domestic vessels that:

1. Fish for, possess, or transship Pacific Pelagic Management Unit Species (PMUS; see Section 1.6) within the EEZ waters of the Western Pacific Region; or
2. Land Pacific Pelagic MUS within the states, territories, commonwealths, or unincorporated U.S. island possessions of the Western Pacific Region. Although this overlaps with the boundaries of the Council's archipelagic FEPs for demersal fisheries which include the American Samoa FEP, the Marianas FEP, the Hawaii FEP, and the PRIA FEP, the Pacific Pelagic FEP specifically manages those resources and habitats associated with the pelagic ecosystem (Figure 5).

The Hawaii, American Samoa, Marianas, PRIA, and Pelagics FEPs establish the framework under which the WPRFMC will manage fishery resources, and begin the integration and implementation of ecosystem approaches to management in the Pacific Islands region. These FEPs do not establish any new fishery management regulations at this time, but rather consolidate existing fishery regulations. These FEPs contain and implement a management framework to control harvests of marine resources on the basis of available information regarding the structure and function of the ecosystem in which such harvests occur. The following Ecosystems Principles Advisory Panel guidelines were used by the WPRFMC in developing the Pacific Islands FEPs:

- The ability to predict ecosystem behavior is limited.
- Ecosystems have real thresholds and limits that, when exceeded, can affect major system restructuring.
- Once thresholds and limits have been exceeded, changes can be irreversible.
- Diversity is important to ecosystem functioning.
- Multiple scales interact within and among ecosystems.
- Components of ecosystems are linked.
- Ecosystem boundaries are open.
- Ecosystems change with time.

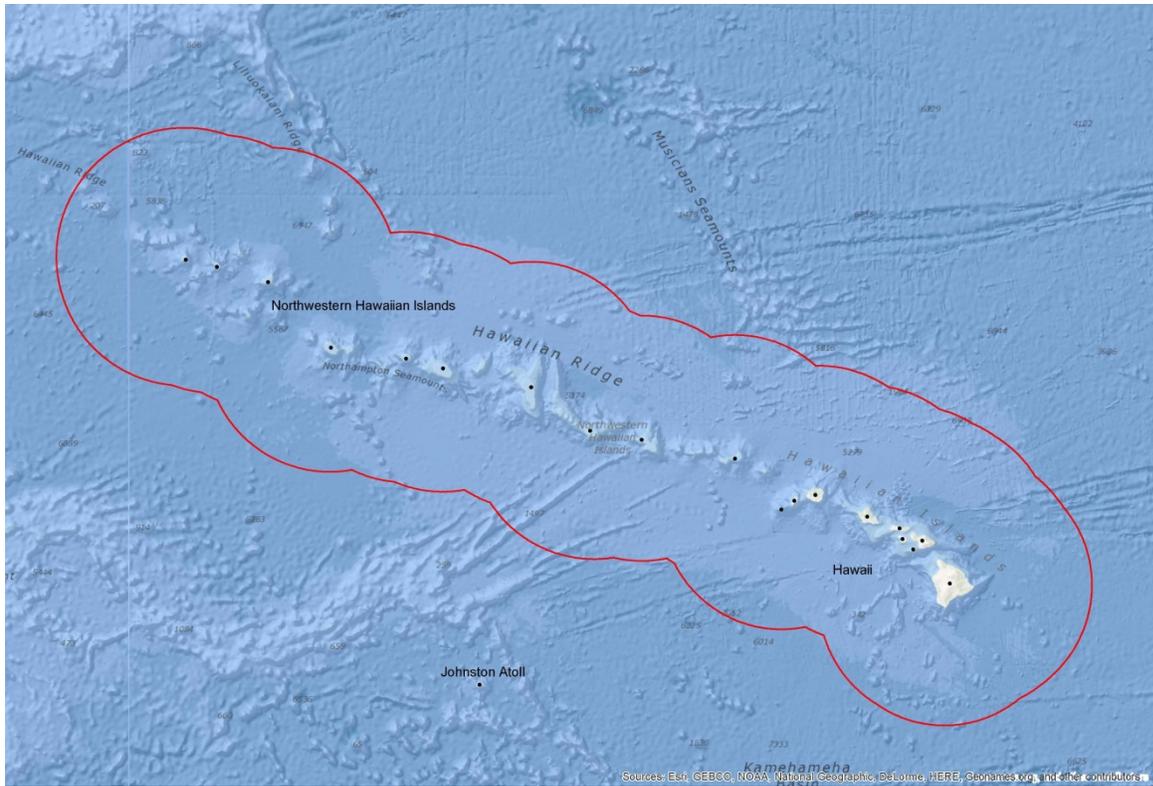


Figure 1. Map of WPRFMC Hawaii Archipelagic FEP

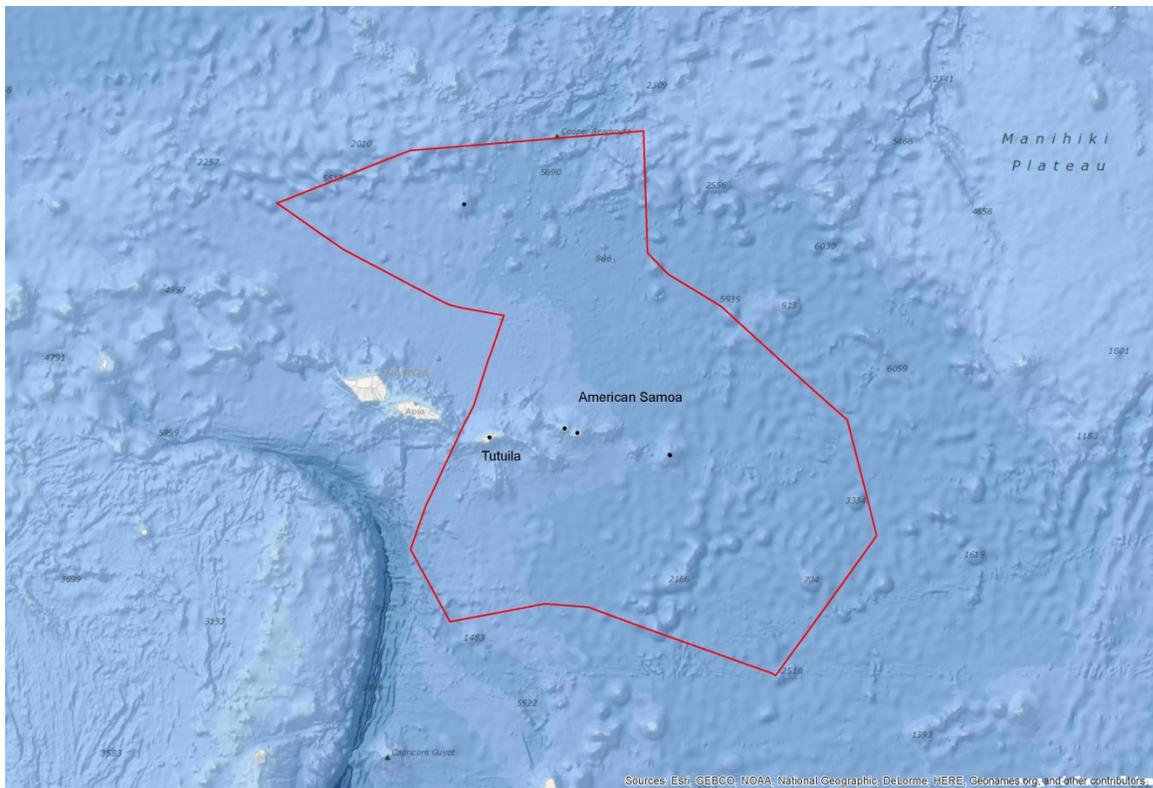


Figure 2. Map of WPRFMC American Samoa Archipelagic FEP

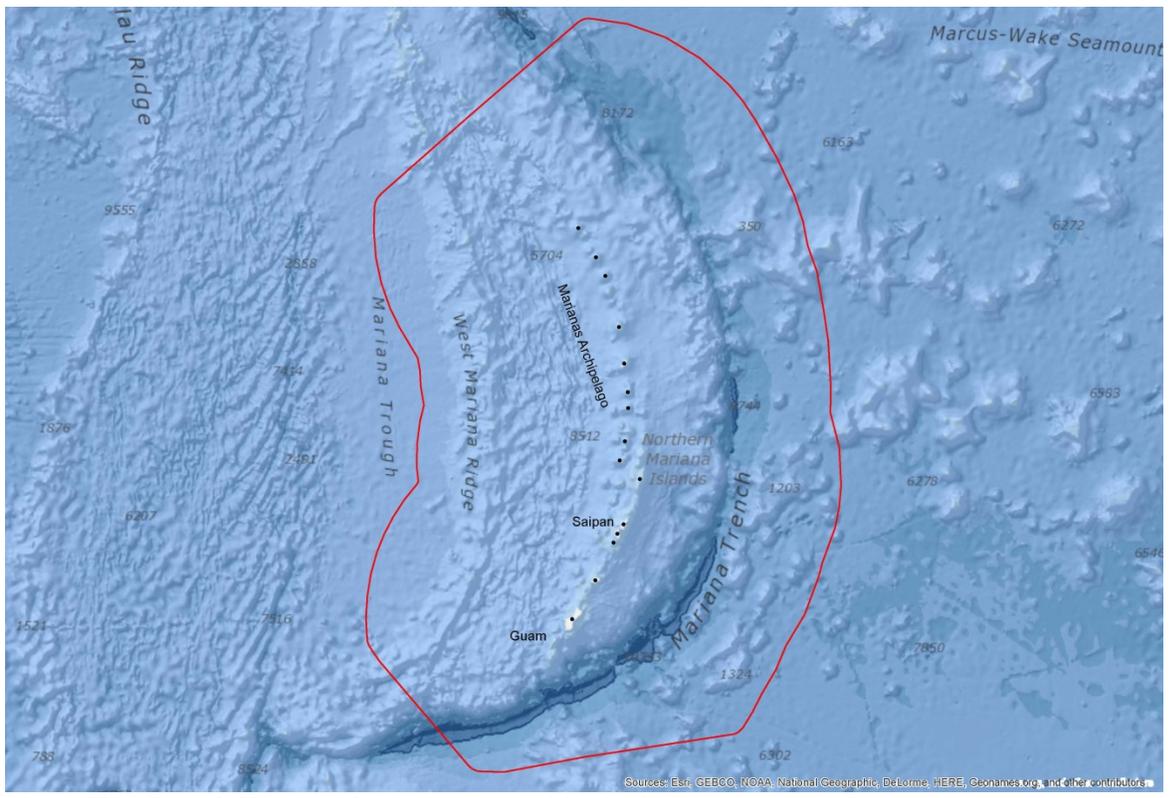


Figure 3. Map of WPRFMC Marianas Archipelagic FEP

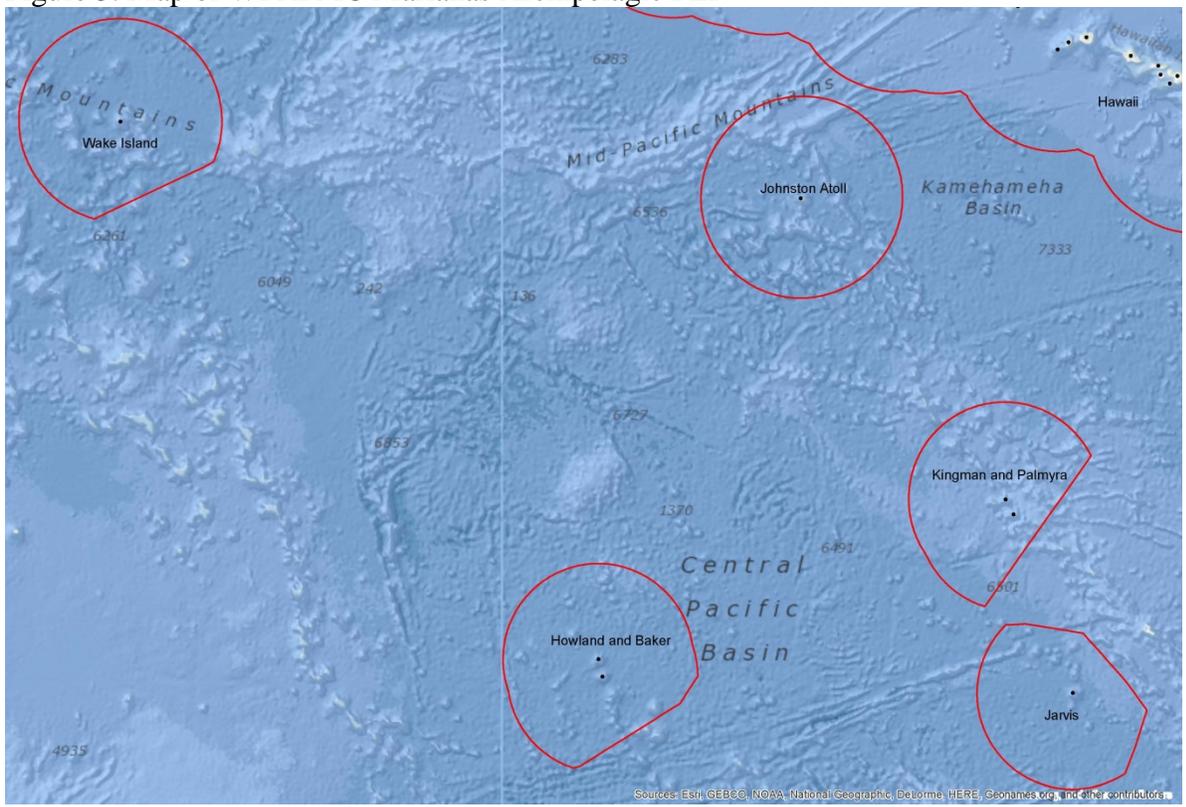


Figure 4. Map of WPRFMC Pacific Remote Island Areas FEP

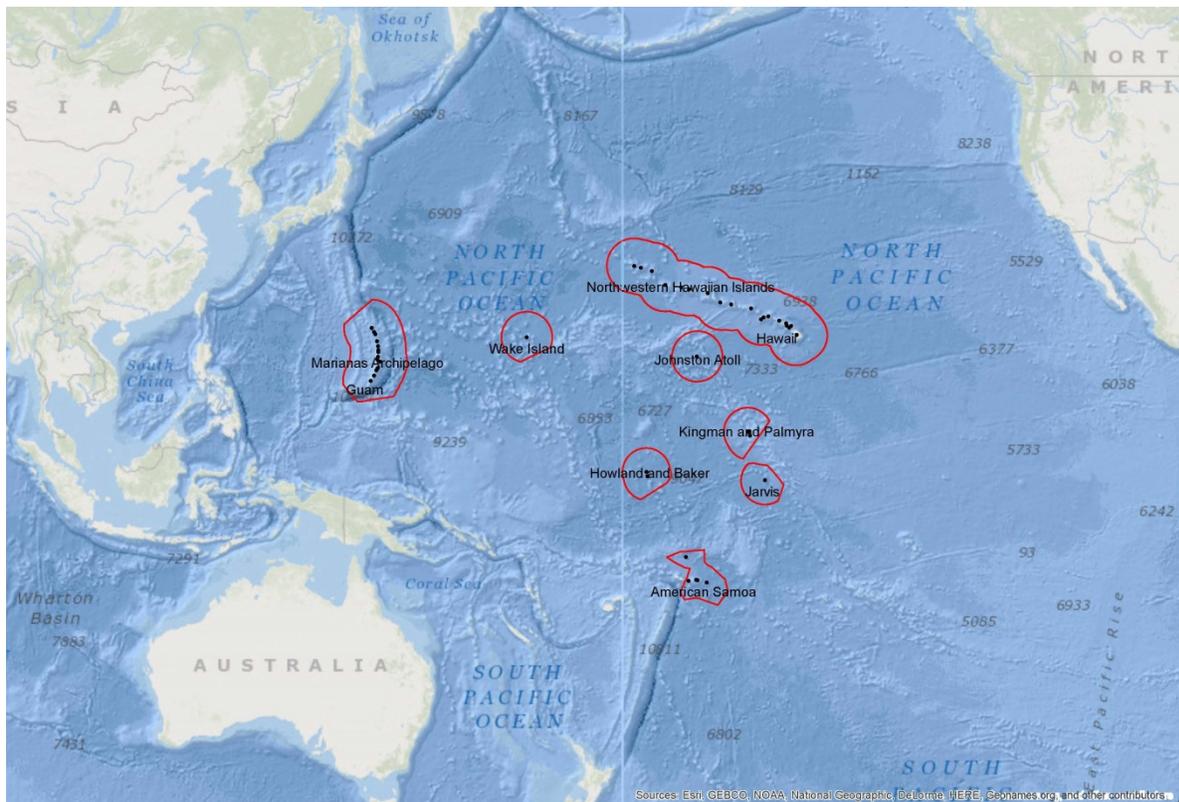


Figure 5. Map of WPRFMC Pelagics FEP

The Hawaii, American Samoa, Marianas, PRIA, and Pelagics FEPs establish the framework under which the WPRFMC will manage fishery resources, and begin the integration and implementation of ecosystem approaches to management in the Pacific Islands region. These FEPs do not establish any new fishery management regulations at this time, but rather consolidate existing fishery regulations. These FEPs contain and implement a management framework to control harvests of marine resources on the basis of available information regarding the structure and function of the ecosystem in which such harvests occur. The following Ecosystems Principles Advisory Panel guidelines were used by the WPRFMC in developing the Pacific Islands FEPs:

- The ability to predict ecosystem behavior is limited.
- Ecosystems have real thresholds and limits that, when exceeded, can affect major system restructuring.
- Once thresholds and limits have been exceeded, changes can be irreversible.
- Diversity is important to ecosystem functioning.
- Multiple scales interact within and among ecosystems.
- Components of ecosystems are linked.
- Ecosystem boundaries are open.
- Ecosystems change with time.

These FEPs discuss the key components of the various ecosystems, including an overview of the region's non-pelagic fisheries, and details how the measures contained here are consistent with the MSA and other applicable laws. The Hawaiian Archipelago FEP, in conjunction with the

Council's American Samoa Archipelago, Mariana Archipelago, PRIA, and Pacific Pelagic FEPs, incorporates by reference and replaces the Council's existing Bottomfish and Seamount Groundfish, Crustaceans, Precious Corals, Coral Reef Ecosystems and Pelagics Fishery Management Plans (and their amendments) and reorganizes their associated regulations into a place-based structure aligned with the FEPs. In addition, under the Archipelagic FEPs, the organizational structure for developing and implementing FEPs explicitly incorporates community input and local knowledge into the management process.

Future fishery management actions are anticipated to incorporate additional information as it becomes available. An adaptive management approach will be used to further advance the implementation of ecosystem science and principles. Such actions would be taken in accordance with the Magnuson-Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, the Endangered Species Act, the Marine Mammal Protection Act, and other applicable laws and statutes.

All of these FEPs are designed to move the WPRFMC toward a process that uses ecosystem-based analysis and consideration of the interactions among marine organisms and their environment to enhance marine resources management. This PI-HAPWG ranking exercise may help the WPRFMC operationalize their FEP management efforts by providing a list of species that will benefit most from habitat and place-based management, while recognizing that even ecosystem-based management processes will continue to depend on the use of single-species models and management measures (Mace 2004). At the least, these rankings will enable the Council and Pacific Islands Regional Office to recognize those species that are most likely to have the greatest dependence on spatially-constrained habitats relative to population dynamics.

Data Sources

FSSI species list:

http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/historical_fssi_stocks.pdf

Fisheries of the United States 2015:

<http://www.st.nmfs.noaa.gov/Assets/commercial/fus/fus14/documents/FUS2014.pdf>

WPRFMC Former Fishery Management Plans:

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WPRFMC Fishery Ecosystem Plans:

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Scoring Approach

Coordinators used an internal process to develop an initial list of candidate species, using a variety of national, regional, fisheries council, and local management documents, and our own expertise. The initial list was finalized after additions/subtractions by 6 PIFSC stock assessment and/or habitat scientists, 3 PIRO scientists/managers, 2 scientists/managers from the WPRFMC, and other Pacific Islands scientists/managers. After applying the HAPWG filters, the FEP stock is listed in the FSSI or is a regional FMC priority, a habitat assessment is likely to benefit stock assessment, and/or a habitat assessment is likely to inform EFH science, a final candidate list was developed with 9 pelagic species, 7 species of deep-water bottomfishes, 12 species of snappers, jacks and groupers, 24 species, 1 genus, and 2 families of reef fishes, and a handful of precious corals and other invertebrates (refer to Tables 1, 2, 3, 4). Many reef fish species, especially those found in the territories/commonwealth or remote areas of the Pacific Islands were not included in this final list because they do not appear on the FSSI list, are primarily under state or territorial jurisdiction, or lack the necessary scientific information needed to provide justifiable rankings for the species. Many invertebrate species were also excluded because of the lack of an active commercial fishery in the region for those species. Although tunas, billfishes, and swordfish are highly migratory species, they are managed through a regional pelagic fishery ecosystem plan, in addition to international agreements, and it was agreed that they should be included in the ranking due to their ecological, social and economic importance to the region.

The Pacific Islands does not have comprehensive prioritized lists for assessments of all FSSI stocks, but does have a schedule for different fisheries. Certain stocks are more frequently assessed due to concerns regarding fishing pressure, uncertainties associated with population estimates, management priorities, etc. Over the last ten years, the PIFSC has assessed more than thirty stocks, including multiple assessments of the main Hawaiian Islands (MHI) deep-water bottomfishes. The PIFSC has assessed 24 species of reef fishes, three non-deep seven bottomfishes, and deep-water bottomfishes in the U.S. territories and commonwealth. The PIFSC also cooperates with international regulatory bodies on regularly-scheduled stock assessments of pelagic tunas, billfishes, and sharks. Recently, the WPRFMC adopted an ecosystem component species amendment that will attempt to reduce the management unit species list to those that are of management concern and for which data are available; ecosystem component species will be managed separately from those in need of conservation and management. While the HAPWG process will provide some prioritization for stocks that are particularly dependent on certain habitats, it remains uncertain whether these stocks will be prioritized for future assessments by the WPRFMC, PIFSC and PIRO through their normal Western Pacific Stock Assessment Review (WPSAR) process. Therefore, we passed all FSSI-listed species through this filter.

In retrospect, this filter was not useful, as we were not able to evaluate it prior to the more detailed analysis for the scorable criteria. As the Pacific Islands Fisheries Science Center (PIFSC) has not performed EFH reviews and updated EFH documents for all managed species on a regular basis, employment of this filter was problematic, as it would have precluded many important stocks. Therefore, the PI-HAPWG decided to pass all FSSI-listed stocks and allow the HAPWG detailed scoring process to provide values for prioritization.

We chose to place all stocks on an equal footing with regard to evaluation. We did not attempt to perform within-FMP comparisons first, as did the Southwest or Northwest Regional Habitat Assessment Prioritization Working Groups (NMFS 2012, Blackhart 2014). Most Pacific Island stocks are not aggregated into multi-stock FMPs, but are instead treated as part of regional ecosystem plans. We did not have issues that the west coast working groups had with comparison of diadromous with fully marine species. Thus, stock-by-stock comparison regardless of FEP for the entire suite of Pacific Islands stocks made more sense.

We sent this final list out to the original group, providing instructions on how to go through the scoring process. We received 3 partially-completed scoresheets back, with 7 others preferring to meet in person to iteratively go through the scoring process. Following a period of research of existing records and documents, the authors convened our only face-to-face conference, clarified the rubrics for each criterion, developed individual stock scores, and arrived at both the scoring approaches and scores by consensus to complete the scoring process and to ensure that all participants could support the final scores and the intent of the process. This was done by rating all stocks for each criterion one at a time. As recommended by the HAPWG, scoring was split into two separate lists to support the main objectives outlined in the HAIP: priorities for habitat science supporting stock assessments (Stock Assessment Theme), and priorities for EFH science (EFH Science Theme). No weighting factors were applied to any criteria categories. Once final scores for each theme were calculated, eligible stocks were sorted into high/medium/low priority categories.

Scored Criteria

Common Scorable Criterion: Fishery Status

HAPWG Scoring Rubric:

Score	Rubric
5	Stock is overfished, approaching an overfished condition, experiencing overfishing, or is in a rebuilding or recovery plan.
3	Stock is below 80% of B_{MSY} .
2	Stock is fully exploited (i.e. $F_{MSY} \geq F_C \geq 0.75 * F_{MSY}$, or $ABC \geq Total\ Catch \geq 0.75 * ABC$ if no F_{MSY} available).
1	Stock status is unknown, but credible information exists to suggest that the stock is at risk or vulnerable to overexploitation.
0	Stock is not overfished, not approaching an overfished condition, not experiencing overfishing, or otherwise showing any evidence of overexploitation. Or, if stock status is unknown, evidence does not suggest that the stock is vulnerable to overexploitation.

Pacific Islands Application: This criterion was relatively easy for the PI-HAPWG to score, as the rubrics were clear and unambiguous and the information to rate stocks was generally available. Status scores were based on the most recent assessments. The PI_HAPWG utilized the 0 values here since there was a strong feeling among raters that even when the status of many stocks might be unknown, there was no evidence that the stocks are particularly vulnerable to overexploitation.

Common Scorable Criterion: Regional FMC Priority

HAPWG Scoring Rubric:

Score	Rubric
5	Research is identified for a stock by the regional FMC to address a pressing issue and satisfy the Federal requirements of the MSA.
3	Research is identified for a stock by the regional FMC to address ongoing needs of fishery management.
1	Research is identified for a stock by the regional FMC; however, it is not of immediate concern or necessary to manage a Federal fishery.

Pacific Islands Application: In agreement with other regional prioritization efforts (Blackhart 2015), the PI-HAPWG removed the word “Research” from the name of this criterion in recognition of the fact that FMC priorities are not driven exclusively by research needs. Following the NE region example, we eliminated the words “to maintain existing” with regard to fisheries management, as models are often changed or improved incrementally beyond simple maintenance, but not necessarily addressing urgent needs. Stocks were assigned values based on expert knowledge of WPRFMC, PIFSC, and PIRO scientists who participate in WPRFMC meetings.

Common Scorable Criterion: Habitat Disturbance, Vulnerability, and Rarity

HAPWG Scoring Rubric:

Additive Points	Rubric
+1	A large portion of the habitat of a fish stock is disturbed due to fishing activities or other direct anthropogenic events.
+1	A large portion of the habitat of a fish stock is disturbed due to non-fishing anthropogenic activities as a result of natural disasters, and indirect anthropogenic events.
+1	The habitat of a life stage of a fish stock is vulnerable to disturbance based on a location that is accessible or heavily used, resulting in impacts to habitat.
+1	The habitat of a fish stock is vulnerable or slow to recover from disturbance.
+1	The habitat of a fish stock is demonstrably rare.

Pacific Islands Application: The Pacific Islands did not feel the need to adopt any wording changes for this criterion, primarily because our fishing industry does not engage in commercial practices that would substantially alter or degrade fishery habitats. On the other hand, many of our habitats are vulnerable to natural disasters (floods, sedimentation events, hurricanes, etc.) as well as anthropogenic impacts (groundings, oil spills, etc.). Our working group agreed that the cause of the disturbance was not relevant to rating the level of disturbance or vulnerability of the habitat. Reef fishes and other near-shore species were generally given the highest ratings in this category, with pelagic fishes receiving lower scores.

Common Scorable Criterion: Habitat Dependence

HAPWG Scoring Rubric:

Score	Rubric
5	There is quantitative evidence that vital rates and productivity of a stock are dependent on particular physical habitat(s).
3	There is a measurable difference, attributable to physical habitat quality and/or quantity, in a stock's density, population size, and/or an individual's condition factor.
1	While uncertainty exists due to poor or conflicting data, there is a reasonable expectation for a measurable difference, attributable to physical habitat quality and/or quantity, in a stock's density, population size, and/or an individual's condition factor.

Pacific Islands Application: It seemed obvious to our group that all stocks are dependent on certain habitats, whether the habitats are measured by some type of benthic characteristics or oceanographic conditions. We gave higher scores to those stocks that were more directly dependent on hard substrates (reef fishes and deep-water bottomfishes), but have insufficient quantitative evidence to assign a score of five to any species. All pelagic species received a score of 1, as did deep-water corals due to lack of data.

Common Scorable Criterion: Ecological Importance

HAPWG Scoring Rubric:

Additive Points	Rubric	Category
+1	The stock is an important predator. Based on current data from the region, the stock consumes a high number of species (top quartile) and is abundant (top two quartiles) compared to other predators at that life stage.	1
+1	The stock is important prey. Based on current data from the region, the stock occurs in diets of a high number of species (top quartile) compared to other prey at that life stage.	2
+1	The stock has a high biomass. The stock currently has a high (top quartile) biomass in the best available metric, within the region of interest, and at a particular life stage.	3
+1	The stock is a habitat-altering species. It is known to create, modify, or maintain habitat functions.	4
+1	Evidence exists that in the region of interest the stock was historically abundant, or an important predator, prey, or ecosystem engineer.	5

Pacific Islands Application:

Category 1 – For this category, the Pacific Islands considered stocks that were both important predators and relatively abundant. None of the predatory fish on our list are particularly rare, and tend to have higher population numbers and broad diets.

Category 2 – The PI-HAPWG determined that a stock must be abundant to be considered for a positive score in this category. Apex predators were not considered important prey.

Category 3 – Current unfished biomass of stocks within the top quartile of biomass was used to assign a positive value in this category.

Category 4 – Only two of our reef fishes were assigned as a habitat-altering fish stock. This category was scored on the basis of expert opinion. Abundance was not considered.

Category 5 – The limited amount of data relating to historical importance constrained our group from adding points to most species. A few species that were known to be of particular historical abundance (primarily prey species) were given a positive score.

Common Scorable Criterion: Economics, Social, and Management Value

HAPWG Scoring Rubric:

Additive Points	Rubric	Category
+1	The economic impacts of the commercial industry for this stock are in the top quartile (25%) of FMP stocks in the region.	1
+1	The economic impacts of recreational fishing for this stock are in the top quartile (25%) of FMP stocks in the region.	2
+1	The commercial fishery for the stock has high resource management importance.	3
+1	The recreational fishery for the stock has high resource management importance.	4
+1	The stock has high social value such as cultural importance or strong localized effects on community viability, or is necessary for subsistence.	5

Pacific Islands Application:

CATEGORY 1 (ECONOMIC IMPACTS OF COMMERCIAL FISHERY): Scores in this category were based on 2008-2012 total estimated value stated in WPFRC annual reports. Across all FEPs, stocks with total value in excess of \$500,000 were awarded a point in this category.

Category 2 – This category was scored on the basis of expert opinion, reflecting a lack of relevant data. Where relevant catch data were available, a point was awarded to the top quartile of stocks based on their contribution to Hawaii’s recreational catch. Most reef fish stocks received a point in this category due to the economic importance to local communities, and the wide variety of targeted species throughout different Pacific Island communities.

Category 3 – This category was scored on the basis of expert opinion. Most deep water bottomfish and many reef fish received values of 1 for this category. Only those stocks that were considered underutilized did not receive a point. Many of our pelagic fish, especially our tuna species, also scored a one in this rating.

Category 4 – This category was scored on the basis of expert opinion. All stocks that had been subject to time or area closures or catch limits (whether federal or state) received values of 1 here.

Category 5 – This category was scored on the basis of expert opinion. Values of 1 were given to any stocks that had social importance, both recreationally and commercially targeted, especially for particular ethnic celebrations. For groundfish and reef fish, points were assigned to any targeted stocks that communities have relied on over time. All commonly targeted reef stocks received points due to high social value and cultural importance.

Theme-Specific Filter Criterion: Habitat Assessment Likely to Benefit Stock Assessment

HAPWG Scoring Rubric: To pass this filter for further consideration, a stock must be likely to be assessed in the next 5 years, or be in the top quartile of stocks in the Stock Assessment Prioritization. Additionally, the stock’s assessment must be likely to benefit from a habitat assessment [as described in the HAPWG].

Pacific Islands Application: When considering this filter for the Stock Assessment Theme, the PI-RHAPWG followed the example of the SW-RHAPWG and omitted the phrase “or be in the top quartile of stocks in the Stock Assessment Prioritization” from scoring rubric language. Because our region has adopted Fishery Ecosystem Plans for all its fish stocks, it is likely that all stocks will not be assessed individually, but as components of their respective ecosystems. Therefore, this filter was applied to only eliminate species that are basically not targeted by any fishery. All stock assessments of the fish on our prioritization list likely would benefit from a habitat assessment, even our pelagic fisheries, given the certain prospect of climate variation in the major convergence zones.

Theme-Specific Scorable Criterion: Benefits of a Habitat Assessment to Stock Assessment

HAPWG Scoring Rubric:

Score	Rubric
5	A habitat assessment for this stock is likely to result in an SAIP Level 5 stock assessment, an HAIP Tier 3 habitat assessment, or improve performance within an existing SAIP Level 5 or HAIP Tier 3 assessment.
4	A habitat assessment for this stock is likely to improve survey efficiency or efficacy, reduce sampling variability, or improve the analysis of fishery catch per unit of effort (CPUE) data that are likely to be used in a stock assessment.
1	A habitat assessment would provide new opportunities to develop stock assessment modeling or survey techniques that incorporate the relationships between habitat and population processes or data variability.

Pacific Islands Application: As with the SW- RHAPWG (NMFS 2012), the PI-RHAPWG found no stocks meeting the highest score category (5) within this criterion and the distinctions between rubric scores 4 and 1 were somewhat subjective. With the exception of pelagic species, all other fish species were assigned a score of 4 because all of the reef and deep-water species would benefit from better survey efficacy and reduced sampling variability.

Theme-Specific Filter Criterion: Habitat Assessment Likely to Inform EFH Science

HAPWG Scoring Rubric: To pass this filter for further consideration, a habitat assessment for the stock must be likely to be conducted within a region’s Essential Fish Habitat (EFH) 5-year review schedule. In addition, the habitat assessment for this stock must be likely to define EFH, refine EFH, or improve the understanding of adverse effects of fishing or non-fishing activities on EFH.

Pacific Islands Application: As the Pacific Islands Fisheries Science Center (PIFSC) has only performed EFH reviews and updated EFH documents for a handful of managed species on an irregular basis, the PI-RHAPWG has responded by passing any FSSI-listed stocks that could benefit from a habitat assessment into the HAPWG scoring process to provide values for prioritization.

Theme-Specific Scorable Criterion: Habitat Assessment Likely to Advance EFH Level of Knowledge

HAPWG Scoring Rubric:

Score	Rubric
5	A habitat assessment would likely provide an initial definition of EFH.
4	A habitat assessment would likely provide an increase in information sufficient to increase between EFH levels of knowledge.
1	A habitat assessment would likely provide an increase in information within the existing EFH level of knowledge.

Pacific Islands Application: We agreed with the SW- and NW-RHAPWGs (Blackhart 2015) regarding wording changes for this criterion. Here, as with the previous scorable criterion, there were no rating values of 5. All Pacific Island stocks have at least an initial EFH definition on large geographic scales, even if those scales make a delineation of the EFH almost useless for management purposes. EFH designations for all federally-managed species in our region are either level 1 (presence only) or level 2 (relative abundance). EFH levels for most of our stocks would increase with habitat assessment that could narrow the scales and parameters of habitat definitions, hence all stocks received values of 4.

Weighting

The PI-RHAPWG did not see any need for pre-assignment of weighting factors. Final scores are thus simple sums of scorable criterion values.

Priority Categories

The PI-HAPWG considered different approaches (e.g. percentage, break points, etc.) for creating prioritization classes, but ultimately simply divided the scores into thirds. The two lower priority categories had 5 point spreads, with the highest priority category having a 6 point spread. The group decided this approach had a more inclusive high priority category.

Table 5. Pacific Islands stock prioritization for Stock Assessment (SA) theme. Shading indicates priority category assignments: white – High, lighter gray – Medium, darker gray – Low.

Stock	SA Score	Priority Category	Stock	SA Score	Priority Category
Redlip/Ember parrotfish	29	High	Rudderfish/chubs	22	Medium
Bluespine unicornfish	29	High	Striped marlin	22	Medium
Whitesaddle goatfish	27	High	Yellowstripe goatfish	22	Medium
Pink snapper	26	High	Yellowfin goatfish	22	Medium
Red snapper/longtailed snapper	26	High	Pacific lobsters	22	Medium
Bigeye emperor	26	High	Pacific threadfin	21	Medium
Convict tang	26	High	Redgill emperor	21	Medium
Eyestriped surgeonfish	26	High	Seabass	21	Medium
Gray unicornfish	26	High	Deepwater shrimp	21	Medium
Kona crab	26	High	Ambon emperor	19	Medium
Striped bristletooth	25	High	Blacktip Grouper	19	Medium
Spectacled parrotfish	25	High	Gray snapper	19	Medium
Pink (von Siebold's) snapper	25	High	Bigeye scad	18	Low
Bullethead parrotfish	24	High	Blacktip grouper	18	Low
Bumphead parrotfish	24	High	Lunartail grouper	18	Low
Humpback red snapper	24	High	Bluefin tuna	18	Low
Humphead wrasse	24	High	Albacore	17	Low
Longface	24	High	Dolphinfish	17	Low
Mackeral scad	24	High	Yellowfin tuna	17	Low
Oblique-banded snapper	24	High	Skipjack tuna	16	Low
Rabbitfish	24	High	Swordfish	16	Low
Red shorttail snapper	24	High	Amberjack	17	Low
Silverjaw jobfish	24	High	Yelloweye snapper	16	Low
Striped surgeonfish	24	High	Yellowtail snapper	16	Low
Wrasse	24	High	Bluespotted grouper	16	Low
Bonefish	23	Medium	Opah (moonfish)	15	Low
Saber squirrelfish	23	Medium	Gold corals	14	Low
Striped mullet	23	Medium	Red corals	14	Low
Honeycomb grouper	23	Medium	Pink corals	14	Low
Hexagon grouper	23	Medium	Bamboo corals	14	Low
Bigeye tuna	22	Medium	Black corals	14	Low
Bigscale soldierfish	22	Medium	Grey reef shark	-	
Bluefin trevally	22	Medium	Sandbar shark	-	
Bluestripe snappers	22	Medium	Whitetip shark	-	
Giant trevally/jack	22	Medium			

Table 6. Pacific Islands stock prioritization results for Essential Fish Habitat (EFH) theme. Shading indicates priority category assignments: white – High, lighter gray – Medium, darker gray – Low.

Stock	SA Score	Priority Category
Redlip/Ember parrotfish	30	High
Bluespine unicornfish	30	High
Bigeye emperor	27	High
Eyestriped surgeonfish	27	High
Whitesaddle goatfish	27	High
Convict tang	26	High
Gray unicornfish	26	High
Kona crab	26	High
Pink snapper	26	High
Red snapper/longtailed snapper	26	High
Spectacled parrotfish	26	High
Striped bristletooth	26	High
Bigeye tuna	25	High
Bullethead parrotfish	25	High
Humpback red snapper	25	High
Longface	25	High
Pink (Von Siebold's) snapper	25	High
Bumphead parrotfish	24	High
Humphead wrasse	24	High
Oblique-banded snapper	24	High
Red shorttail snapper	24	High
Giant trevally jack	24	High
Mackerel scad	24	High
Rabbitfish	24	High
Silverjaw jobfish	24	High
Striped marlin	24	High
Striped surgeonfish	24	High
Wrasse	24	High
Bluefin trevally	23	Medium
Bonefish	23	Medium
Honeycomb grouper	23	Medium
Hexagon grouper	23	Medium
Saber squirrelfish	23	Medium

Stock	SA Score	Priority Category
Striped mullet	23	Medium
Bluefin tuna	22	Medium
Bluestripe snappers	22	Medium
Bigscale soldierfish	22	Medium
Rudderfish/chubs	22	Medium
Yellowstripe goatfish	22	Medium
Yellowfin goatfish	22	Medium
Pacific lobsters	22	Medium
Bigeye scad	21	Medium
Deepwater shrimp	21	Medium
Pacific threadfin	21	Medium
Seabass	21	Medium
Albacore tuna	20	Medium
Dolphinfish	20	Low
Yellowfin tuna	20	Medium
Gray snapper	20	Low
Ambon emperor	19	Low
Blacktip grouper	19	Low
Lunartail grouper	19	Low
Redgill emperor	19	Low
Skipjack tuna	19	Low
Swordfish	19	Low
Opah (moonfish)	18	Low
Amberjack	17	Low
Grey reef shark	17	Low
Sandbar shark	17	Low
Whitetip shark	17	Low
Yelloweye snapper	17	Low
Yellowtail snapper	17	Low
Gold corals	15	Low
Red and pink corals	15	Low
Bamboo corals	15	Low
Black corals	14	Low

Observations and Lessons

As seen in other regions, the species, order, and scores of the stocks that were ranked in the high category and the upper part of the medium category are nearly identical when comparing prioritization rankings in the Stock Assessment (SA; Table 5) and Essential Fish Habitat (EFH; Table 6) lists. The current design of the HAPWG prioritization scheme lends itself to this type of outcome due to the large number of common scorable criteria. Using these metrics, species whose stock assessments would benefit from better habitat information would also see an improvement in their EFH science from this same information. Although there is some divergence in order and scores in the medium priority and low priority stocks, this reflects the high and low values assigned to the unshared SA and EFH criteria (Benefits to Stock Assessment and Likelihood of Advancing EFH Information), especially for those species that were assigned very low scores using shared criteria values. The unshared criteria values of either 1 or 4, with no intermediate values result in a *de facto* weighting effect for these criteria that is evident for lower priority. The SA benefit criteria value of “1” was a major reason many of the pelagic stocks did not rank in the high priority category. This does not reflect any major impediment to using the ranking process, but rather the lack of information that would allow stock assessors to better incorporate habitat into pelagic stock assessments.

The ranking exercise did not produce any surprising results, and it is clear that those species that are most reliant on delineable substrates are going to be ranked higher than those that do not. High value, heavily targeted nearshore species of reef fish and deep-water bottomfish dominate the high ranked category. While pelagic fishes constitute the bulk of the commercial fishery landings in the Pacific Islands, reef fishes and deep-water bottomfishes constitute important components of local markets, and are heavily targeted by large recreational and subsistence fishing communities. It has been estimated that these communities catch the majority of these reef and demersal fishes, but definitive data are unavailable.

Conclusion

In addition to providing a basis for prioritizing habitat research, the HAPWG process has proved valuable in highlighting the need for better data regarding habitat and the critical role improved habitat science could play in improving both stock assessments and EFH determinations. As incorporating habitat into stock assessment and ecosystem-based fisheries management remains a goal within NMFS, the HAPWG process needs to be ongoing, with periodic updates to refine stock prioritization decisions based on more specific habitat-species dependencies. The current HAPWG ranking process has shortcomings, but these are primarily due to a lack of information that clarifies habitat-species interactions, particularly in regards to life history and productivity. We need to continue improving both habitat data information and the ranking process over time.

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