NOAA FISHERIES

# Pacific Islands Regional Action Plan to Implement the NOAA Fisheries Climate Science Strategy Through 2024

Phoebe Woodworth-Jefcoats and Ariel Jacobs (Chairs), Rob Ahrens, Hannah Barkley, Ann Barlow, Layne Bolen, Felipe Carvalho, Anne Chung, Emily Crigler, Josh DeMello, Mark Fitchett, Mark Fox, Asuka Ishizaki, Penny Larin, Beth Lumsden, Jarad Makaiau, Michelle McGregor, Tom Oliver, Joseph O'Malley, Benjamin Richards, Stacie Robinson, Marlowe Sabater, Michelle Sculley, Matthew Seeley, Jonathan Sweeney, Kisei Tanaka, Kate Taylor, and Zach Yamada

**U.S. DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**

National Marine Fisheries Service
Pacific Islands Fisheries Science Center and Pacific Islands Regional Office

NOAA Technical Memorandum NMFS-PIFSC-142
https://doi.org/10.25923/2jjs-tx42

May 2023

# Pacific Islands Regional Action Plan to Implement the NOAA Fisheries Climate Science Strategy Through 2024

Phoebe Woodworth-Jefcoats[1] and Ariel Jacobs[2] (Chairs), Rob Ahrens[1], Hannah Barkley[1], Ann Barlow[2], Layne Bolen[2], Felipe Carvalho[1], Anne Chung[2], Emily Crigler[2], Josh DeMello[3], Mark Fitchett[3], Mark Fox[2], Asuka Ishizaki[3], Penny Larin[2], Beth Lumsden[1], Jarad Makaiau[2], Michelle McGregor[2], Tom Oliver[1], Joseph O'Malley[1], Benjamin Richards[1], Stacie Robinson[1], Marlowe Sabater[3], Michelle Sculley[1], Matthew Seeley[3], Jonathan Sweeney[1], Kisei Tanaka[1], Kate Taylor[2], and Zach Yamada[3]

[1] Pacific Islands Fisheries Science Center
National Marine Fisheries Service
1845 Wasp Boulevard
Honolulu, HI 96818

[2] Pacific Islands Regional Office
National Marine Fisheries Service
1845 Wasp Boulevard
Honolulu, HI 96818

[3] Western Pacific Regional Fisheries Management Council
1164 Bishop Street, Suite 1400
Honolulu, HI 96813

NOAA Technical Memorandum NMFS-PIFSC-142
May 2023


**U.S. Department of Commerce**
Gina Raimondo, Secretary

National Oceanic and Atmospheric Administration
Richard W. Spinrad, Ph.D., NOAA Administrator

National Marine Fisheries Service
Janet Coit, Assistant Administrator for Fisheries

**Recommended citation**

Woodworth-Jefcoats P, Jacobs A, Ahrens R, Barkley H, Barlow A, Bolen L, Carvalho F, Chung A, Crigler E, DeMello J, Fitchett M, Fox M, Asuka I, Larin P, Lumsden B, Makaiau J, McGregor M, Oliver T, O'Malley J, Richards B, Robinson S, Sabater M, Sculley M, Seeley M, Sweeney J, Tanaka K, Taylor K, Yamada Z. 2023. Pacific Islands Regional Action Plan to implement the NOAA Fisheries Climate Science Strategy Through 2024. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-PIFSC-142, 35 p. doi:10.25923/2jjs-tx42

**Copies of this report are available from**

Pacific Islands Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
1845 Wasp Boulevard, Building #176
Honolulu, Hawai‘i 96818

**Or online at**
https://repository.library.noaa.gov

# Table of Contents

## List of Figures

# Executive Summary

Changing climate and oceans are affecting the nation's valuable living marine resources and the many people, businesses, and communities that depend on them. Warming oceans, rising seas, extreme events, and acidification are impacting the structure of marine and coastal ecosystems and the distribution and abundance of species in many regions. These impacts are expected to increase and there is much at risk.

To prepare for and respond to climate impacts on marine and coastal resources, the NOAA Fisheries Climate Science Strategy (NCSS) identifies seven key objectives to increase the production, delivery, and use of climate-related information needed to fulfill the agency's mandates (e.g., fisheries management, protected resources conservation) in a changing climate. Beginning in 2016, NOAA Fisheries developed Regional Action Plans (RAPs) to implement the NCSS in each region based on each area's needs and capabilities. The NCSS 5-year Progress Report summarizes actions and accomplishments in implementing the RAPs through 2020.

The Pacific Islands Regional Action Plan (PIRAP) was developed to address the effects of climate change that are already evident across the Pacific Islands region. This updated PIRAP identifies climate-related actions to address the seven NCSS objectives and regional needs through 2024, drawing on the successes and lessons learned from carrying out the initial PIRAP from 2017 through 2021. It also seeks to align the regional response to climate change with Executive Order (EO) 13990 and EO 14008 and the actions support NOAA's effort to build a climate-ready nation. The PIRAP includes metrics to assess progress toward outcomes, and specific activities that could be undertaken with increased resources. The PIRAP actions are organized under five key areas of need (themes).

The following is a list of the five themes with associated actions and the NCSS objectives they address.

**Track Baselines and Shifting Distributions (NCSS Objectives 2-7)**

- Expand staff capacity and resources.
- Assess current conditions and track changing conditions and species ranges.
- Develop species distribution models for select pelagic species.
- Assess shifts in green sea turtle behaviors and habitat.
- Examine how changing conditions affect species distributions, fishers, and communities.
- Project future species distributions based on climate scenarios.
- Develop tools to inform future Fishery Ecosystem Plan amendments.
- Investigate ways to reduce bycatch.
- Contribute to development of climate resilient markets and policies.

**Understand Climate Impacts on Life History (NCSS Objectives 4-6)**

- Establish temporal baseline and monitoring to investigate climate impacts on life history attributes.
- Identify predictive environmental and food web attributes for incorporation into stock assessments and productivity projections.

- Examine sensitivity of food webs and fisheries to changes in the oxygen minimum zone.

**Understand Ecosystem, Habitat, and Human Interactions (NCSS Objectives 2, 5-7)**

- Expand capacity for diet studies.
- Build capacity for data collection and analyses.
- Update the Hawai‘i Ecosystem Status Report.
- Conduct Climate Vulnerability Assessments.
- Ensure environmental justice, equity, and gender representation in climate mitigation measures.
- Understand and monitor coral recovery and degradation.

**Improve Regional Coordination and Operations (NCSS Objectives 3, 6, 7)**

- Coordinate and collaborate between science and management on setting climate priorities.
- Improve regional reporting of climate variables.
- Reduce the NOAA Fisheries Pacific Island region’s carbon footprint.
- Monitor climate impacts to protected species habitat.

**Engage External Partners and Resources (NCSS Objectives 1-7)**

- Better understand the impacts of climate change through increased capacity and resources.

## Introduction

In 2016, regional staff drafted the Pacific Islands Regional Action Plan for Climate Science (PIRAP; Polovina et al. 2016). The PIRAP detailed the planned implementation of the NOAA Fisheries Climate Science Strategy (NCSS; Link et al. 2015) in the region for FY17–21. Other regions adopted plans with similar timelines. In 2020, NOAA Fisheries undertook a 5-year national synthesis of the NCSS and RAP implementation (Peterson and Griffis 2021). This synthesis highlighted both regional successes and the continued need to prioritize climate science and climate-informed living marine resource management. Furthermore, in January 2021, two executive orders that highlight the priority placed on addressing climate-related topics (Executive Order (EO) 13990 and EO 14008) were issued. These orders direct federal agencies to take immediate steps to address the cause and effects of climate change, in part by making it an "essential element" of existing and new policies. The culmination of these events makes this an ideal time to craft the next phase of RAPs.

The goals of this updated PIRAP are to continue ongoing work from the original PIRAP, identify and address new climate-related needs, and strengthen partnerships (both within NOAA and with external partners). This PIRAP places greater emphasis on linking science with management to the fullest extent possible. The goal is to adapt management actions to incorporate climate information thereby better meeting regional climate information needs. Building on the 5 years covered by the initial RAPs, this phase of action plans covers activities through FY24. This timeframe was chosen to align with other NOAA Fisheries initiatives (e.g., Integrated Ecosystem Assessment) and to allow for more realistic planning. Though this PIRAP covers only a few years, many activities included in the plan extend beyond FY24. The plan was drafted with longer-term goals in mind. These activities support NOAA's effort to build a climate-ready nation.

Staff from the Pacific Islands Regional Office and Fisheries Science Center as well as the Western Pacific Fishery Management Council drafted the updated PIRAP, working first in focused small groups and then as a whole through several draft iterations. Authors developed goals that align with both regional and national priorities and incorporate region-specific responses to the administration's request for input on how to make fisheries and protected species more climate resilient (EO 14008, Section 216 (c), 2021). Action items that could help achieve those goals were crafted under two scenarios: (1) level funding and (2) realization of the Climate, Ecosystems, and Fisheries Initiative (CEFI). Building on lessons learned from the initial PIRAP, specific metrics are assigned to each action item so that progress in implementing the NCSS in the Pacific Islands region can be quantified. Regional NOAA Fisheries staff had the opportunity to review and provide feedback on the draft goals, action items, and metrics. Public comment was also solicited and incorporated. Going forward, these action items will be considered in regional activity planning and budget allocation processes.

## Key Needs and Actions

The climate-related science and management needs are grouped into five themes:

- Baselines and Shifting Distributions
- Impacts to Life History and Biology
- Ecosystems, Habitats, and Humans
- Regional Coordination and Operations
- External Partners and Resources

The author team felt that these themes captured the region's climate-related goals. Grouping action items by theme also acknowledges the interconnected nature of the region's climate science and management needs. This section discusses each theme and its associated goals and action items. No effort was made to prioritize the five themes. The Action Items section includes a detailed list of metrics associated with each action item, as well as the NCSS objective(s) the action item addresses. The NCSS objectives represent a bottom-up approach to incorporating climate science into living marine resources management (Fig. 1). The approach begins with Objective 7 and progresses in reverse numerical order, building on previous objectives.

NCSS Objectives:

Objective 7: Build and maintain the science infrastructure needed to fulfill NOAA Fisheries mandates under changing climate conditions.

Objective 6: Track trends in ecosystems, living marine resources, and resource-dependent human communities and provide early warning of change.

Objective 5: Identify the mechanisms of climate impacts on ecosystems, living marine resources, and resource-dependent human communities.

Objective 4: Identify future states of marine, coastal, and freshwater ecosystems, living marine resources, and resource-dependent human communities in a changing climate.

Objective 3: Design adaptive decision processes that can incorporate and respond to changing climate conditions.

Objective 2: Identify robust strategies for managing living marine resources under changing climate conditions.

Objective 1: Identify appropriate, climate-informed reference points for managing marine resources.

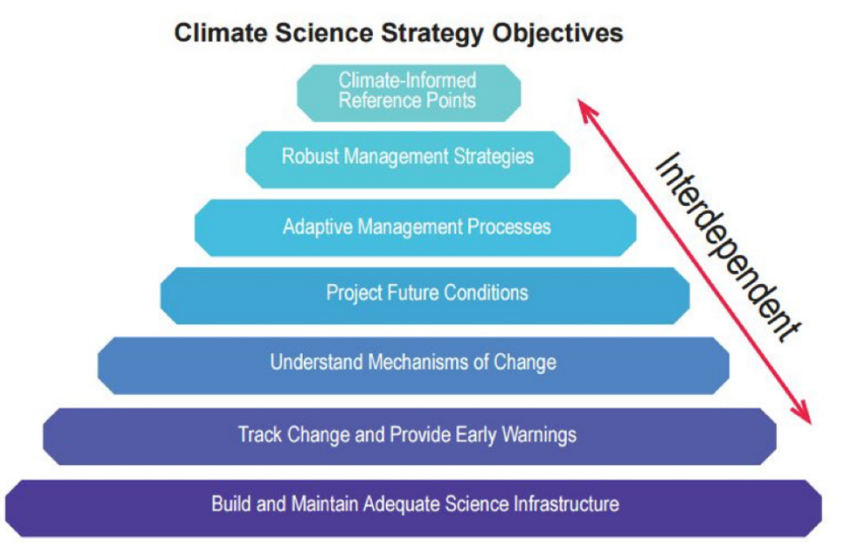


**Figure 1. Schematic figure of the bottom-up and interdependent nature of the NOAA Fisheries Climate Science Strategy objectives (from Link et al. 2015).**

## Baselines and Shifting Distributions

The top regional priority that emerged while implementing the first phase of the PIRAP was the need to establish baseline (or present-day) species distributions and understand how they may shift in the future. This is a priority for coral reef ecosystems, bottomfish, protected species, and target, non-target, and bycatch species in both pelagic and nearshore fisheries. Establishing baseline habitat and environmental conditions (i.e., climatologies) is a component of this priority. It also touches upon all seven of the NCSS objectives, as discussed below.

The first step in establishing baselines and understanding changing distributions is to assess our regional capacity for both monitoring and analyzing environmental conditions, processes, and species distributions, as well as consulting with historical documents and holders of local and traditional ecological knowledge. This assessment will note critical gaps and be used to craft a monitoring and analysis strategy with input from regional management staff to ensure it aligns with their needs. We note that, given the declining capacity for regional monitoring (Peterson and Griffiths 2021), fully implementing this strategy will require additional resources and will extend beyond the updated PIRAP's timeframe.

There are already a number of long-term time series and monitoring efforts underway in the Pacific Islands region (Peterson and Griffis 2021). Continued maintenance of these time series is included in this PIRAP. Here, we note a few specific efforts that span the region's geography and species. The first is a multi-partner effort to use telemetry data from a number of highly migratory pelagic species to construct present-day species distribution maps. These maps will then be combined with estimates of historical oceanographic conditions and with projections from earth system model output from the sixth phase of the Coupled Model Intercomparison Project (CMIP6; Eyring et al. 2016) to project future species distributions. Additionally, there are a number of ongoing efforts to monitor the effects of climate change on protected species. These include tagging and surveying sea turtles to assess shifts in behavior and/or habitat and monitoring nest incubation temperatures across the Hawaiian archipelago, continuation of

multidecadal monk seal demographic monitoring, and establishing baseline distributions of regional cetacean stocks.

The Pacific Islands region has planned a number of action items to identify mechanisms of climate impacts on living marine resources and fisheries. These efforts include identifying statistical relationships between environmental data and species abundance and distribution in order to detect predictive relationships. Such approaches can be applied to both coral reef and pelagic environments. With additional resources for enhanced sampling, such methods could also be applied to bottomfish habitat in future years. This improved ecological understanding addresses not only the NCSS but also related issues such as essential fish habitat and ecosystem-based fisheries management (EBFM).

With regard to human dimensions of fisheries, action items include examining communities' vulnerability to climate change based on cultural keystone species. It will be important to engage fisheries stakeholders to share information about and solicit feedback for incorporation into federal stakeholders' climate prioritization processes. Together, these efforts can contribute to plans for building a climate-resilient fishing industry and incorporating cultural ecological practices into management.

The above science-focused actions will contribute to regional climate-informed management in several ways. In terms of adaptive management, a small working group will convene to explore risk levels and potential thresholds for targeted and protected species as well as the ecosystem. The working group will also explore incorporating environmental indicators into the Council's harvest control rules to supplement traditional stock status indicators. The harvest control rules may inform future amendments to the Council's Fishery Ecosystem Plans (FEPs).

There are also plans to investigate impacts of climate-driven shifting distributions of fishery resources and domestic and international fishing effort. These impacts may include potential social, cultural, and economic impacts by fishery sector (i.e., longline, purse seine, small boat fisheries) and regions in the western and central Pacific Ocean.

These efforts to establish baselines, identify mechanisms linking environmental conditions to species distributions, and project future change are expected to contribute to climate-informed reference points for living marine resource management. However, establishing these reference points will take longer than the PIRAP timeframe. Our first step will be to identify and prioritize species that are most likely to require adaptive management, as well as levels of acceptable risk. These climate-informed reference points can be used in the development of dynamic harvest control rules for species that require adaptive management. To maximize the efficiency of climate-informed harvest control rules, regional staff will work toward developing a fishery management decision tool that allows tracking environmental variables and ecosystem conditions to inform the Council's fishery management decisions.

Implementing this phase of the PIRAP will generate numerous scientific products to inform fishery management. These products should be designed to fit into existing fishery management frameworks where possible. New frameworks will also be explored for increased use of new scientific information as needed. Developing fishery management decision tools that use these products is essential for maximizing these scientific products.

## Impacts to Life History and Biology

Implementing the first phase of PIRAP clarified gaps in our regional understanding of how environmental conditions affect species' life history and biology. Filling these gaps is a critical step in developing climate-informed stock assessments and climate-based reference points for management.

Regional staff continue to provide life history information for deepwater snappers and grouper and coral reef and pelagic fish species for sustainable fisheries management. This also provides baseline information for a decade-plus effort to better understand how a species' life history varies according to its environment (e.g., spatial variability across its range due to temperature effects) and the ensuing impacts of a changing environment. This work includes collaborating with international partners to standardize otolith and gonad collection and analyses of life history parameters of striped marlin, blue marlin, and swordfish in the North Pacific. Regional staff are also expanding sampling efforts for bottomfish management unit species in the main Hawaiian Islands, the Mariana Islands, and American Samoa. Specifically, the 7° of latitude spanned by the Mariana Archipelago provides the opportunity to examine temperature effects on bottomfish and coral reef fishes' life history attributes as well as distinguish fishing effects from climate effects. Once sufficient data are collected, it will be possible to establish relationships, or lack thereof, between environmental conditions and life history attributes. These relationships can then be used in multiple applications: projecting demographic changes and assessing population viability, incorporation into stock assessments that are in turn used to set catch limits and contribute to resilient markets, and establishing species-specific reference points where applicable. We note that "sufficient data" is likely to be a species- and location-specific threshold and expect that work to establish biophysical relationships and incorporate them into regional management will occur beyond the timeframe of this phase of the PIRAP.

Ecosystem modeling work will examine and project food web and fishery sensitivity to expanding oxygen minimum zones (OMZs) in the central and eastern Tropical Pacific. A vertically resolved end-to-end ecosystem model will simulate fishes' interactions with regional OMZs which in turn will provide insight into possible fishery impacts of expanding OMZs.

We will also work with local fishing communities to monitor community observations of any changes in species biology over time (shifts in phenology, koas shifting to deeper waters, etc.).

## Ecosystems, Habitats, and Humans

In addition to understanding climate change effects at the species level, it is vital to understand them at the system level. This includes understanding how ecosystems and habitats will change, and how human communities will respond to those changes.

Action items which expand the science infrastructure needed to assess climate change at the system level fall into three main groups: expanding capacity for diet work in order to understand ecosystem structure and function, building capacity for local data collection, and coordinating between scientists and managers for monitoring and recovery of coral reefs. The Pacific Islands region recently hired additional laboratory staff and acquired equipment to increase the ability to conduct diet analyses by traditional and genetic approaches. As this work progresses, we will identify any further needs which may require additional resources.

Regional staff will also assess the current and needed capacity for local data collection and develop island-/territory-specific plan(s) to expand this capacity[1]. Doing so will support early identification of local climate impacts and inform place-based management of marine resources. For example, collaborative habitat restoration and research through the Habitat Focus Areas (HFA) program would increase our ability to understand and address the climate impacts in our region. Through place-based management and the inclusion of traditional ecological knowledge (TEK), we can better understand the changes the region has undergone and help inform adaptive management strategies. We can be better equipped to mitigate the impacts of climate change and ensure that the uniqueness and significance of the place is effectively managed. In addition to local data collection, staff will explore whether additional factors can or need to be included in control rules.

As monitoring regional coral reef recovery increases, scientists and managers will meet to ensure that the data collected are adequate. Planned work includes using photogrammetry and other survey techniques to track carbonate budgets and assess accretion/erosion at sites across the Pacific Islands region. These data will be downscaled to assess patterns of changing coral cover, and colony-level demographic modeling will be conducted to support federal and regional management needs.

The analyses described above will provide data for tracking change in ecosystem community composition. Additional action items to track ecosystem- and habitat-level change include updating the Hawai‘i Integrated Ecosystem Assessment’s (IEA’s) Ecosystem Status Report (ESR) and completing the marine mammal climate vulnerability assessment.

With additional funding, the Hawai‘i IEA plans to conduct a multi-platform assessment of bioslicks and their role in enhancing regional productivity. This work will also include a climate change component, projecting how the relationship between slicks and productivity will change over the coming decades.

Regional staff are working to include environmental justice, equity, and gender representation in government climate mitigation efforts, in part through diverse and culturally sensitive engagement with fishers and other regional stakeholders. Action items include investigating gender representation in socioeconomic surveys and initiating demographic collections to facilitate environmental justice/equity analyses of climate change mitigation measures. Such analyses will ensure that management measures are robust at the community level as well as the marine resource level.

Looking beyond the timeframe of this PIRAP, we note that energy development, aquaculture, deep-sea mineral extraction, and shoreline adaptation and mitigation will likely be topics to address at the regional level.

[1] In the Pacific Islands region, fisheries-dependent data collection for bottomfish fisheries in the territories of American Samoa, Guam, and CNMI is limited. Efforts are underway to ensure data integrity through building local capacity for data collection.

## Regional Coordination and Operations

The PIRAP authors recognize a continued need to enhance regional coordination. Action items toward this goal include annual meetings among the PIFSC, PIRO, and Council to provide top-down guidance on coordinated priorities including how climate change is incorporated into other regional initiatives. Outcomes from these meetings will be communicated to all hands (at the region level). To facilitate incorporating climate change into the region's work, the NCSS will be integrated with priority initiatives such as the Ecosystem-based Fisheries Management Road Map (NOAA Fisheries Procedure 01-120-01) and biological opinions. The Annual Collaborative Climate Workshops that began during the initial phase of the PIRAP will continue. These annual workshops brought together regional NOAA Fisheries and Council staff to ensure regional climate science evolved to meet management needs. During this phase of the PIRAP, workshops will be expanded to include climate collaborators outside of NOAA Fisheries.

This PIRAP will also continue culturally informed, place-based climate change mitigation work at Lalo/French Frigate Shoals where low-lying islets provide crucial habitat for both Hawaiian monk seals and Hawaiian green sea turtles. In addition to continuing terrestrial habitat and coastline surveys, action items include collaborating with external partners to project future conditions. Regional NOAA Fisheries staff are collaborating with other line offices, agencies, and academics to expand the breadth of species considered (e.g., seabirds, corals) and the resilience options available. Lalo/French Frigate Shoals is also a candidate location for the region's new Habitat Focus Area (HFA). If the site is designated as an HFA, work would address a range of climate change issues including coastal erosion, coral bleaching, and habitat loss. The HFA designation would also highlight multi-stakeholder approaches and inclusion of traditional ecological knowledge systems.

This PIRAP includes several action items to address our regional carbon footprint. These are divided into actions to address regional fisheries and NOAA Fisheries operations. With regard to the former, regional staff will assess the carbon emissions associated with activities under NOAA Fisheries jurisdiction in the region and, where possible, examine the potential for emissions reductions.

To address the carbon footprint of NOAA Fisheries' regional operations, an annual emissions inventory will be conducted for Pacific Islands facilities. The emissions inventory will establish a baseline of the region's emissions associated with transportation and travel, energy use in facilities and field operations, and solid waste generation. Results from the inventory will be used to craft and implement a green operations plan. It is anticipated that this operations plan will include guidance on travel, on-site vs. remote work, energy efficiency, recycling, composting, and other areas with the potential for significant emissions reductions.

## External Partners and Resources

While drafting this phase of the PIRAP, the authors identified several critical regional priorities that will need to be addressed with external partnerships and resources further described below.

- Our region faces challenges related to lack of local computational capacity and expertise which severely limits dynamical downscaling of climate model output across all domains of regional interest.

- A general lack of scientific understanding of the consequences of ocean acidification on non-coral organisms (e.g., fish, zooplankton, and cephalopods) is a source of uncertainty affecting marine ecosystems at a global scale.
- Additional research on coral reef restoration is required to direct management actions.

The Pacific Islands region is made up entirely of small islands, atolls, and reefs, nearly all of which are too small to be represented in global models. Downscaling of global models is required to capture the complex dynamic processes around islands and over coral reefs. Given that the Pacific Islands region encompasses roughly half the United States' Exclusive Economic Zone, this is a tall order. Increased monitoring and staff capacity would begin to address this need.

Expanded research on the effects of ocean acidification on non-coral species is essential, though outside the expertise of regional staff. Particularly concerning is how ocean acidification may affect pelagic fish larvae. Any negative impacts of ocean acidification to pelagic fish are expected to similarly affect the region's largest commercial fishery—a pelagic longline fishery for bigeye tuna. Furthermore, these effects are unlikely to be confined to pelagic fish, placing other regionally important bottomfish and reef fish species at risk as well.

While there are some coral reef restoration efforts underway in the region, far more research on the topic is needed. With improved understanding of the impact of restoration activities, management actions can be taken to address climate-driven coral reef declines.

Climate research needs in the Pacific Islands region cannot be met without the full participation and collaboration of a broad suite of external partners. We must continue to build relationships with academia, non-governmental organizations, and other federal entities, as well as with the Pacific Islands communities that will be impacted by climate change. Particularly, understanding the societal and cultural needs of local communities, listening to their TEK and perspectives, and incorporating these considerations into management will help build the trust that is needed to expand the capacity and accomplish these goals.

## Actions and Metrics

In response to a report from the Government Accountability Office (GAO-16-827) on the initial Regional Action Plans, the metrics used to measure success in implementing this phase of the PIRAP are selected to be concrete, quantifiable, and time-bound. Broadly, metrics fall into the following categories: reports and other publications, computational models, biophysical sampling/data collection, planning and coordination meetings between scientists and managers, and stakeholder engagement. These metrics will be used in annual progress updates to the NOAA Fisheries Science Board.

This section details the Pacific Islands region climate science action items and their associated metrics. The numbers in parentheses after each metric description indicate the NCSS objective(s) addressed by the metric. The names listed for each metric are the respective organizations' points of contact for that work.

### Theme: Baselines and Shifting Distributions

**ACTION:** Expand staff capacity and resources for establishing current conditions and species distributions and for projecting shifts in these distributions as a result of these changes. Longer-term, continue to assess capacity and resources needed to monitor conditions and species distributions and respond as needed.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Draft an internal report assessing current and needed staff capacity and resources. (*7)* | Director's Office | Directorate | Executive Director or designee |
| FY23: Fill at least 50% of the capacity and resource gaps identified in FY22. *(7)*<br>(May require additional resources.) | Director's Office | Directorate | Executive Director or designee |
| FY24: Fill 100% of the capacity and resource gaps identified in FY22. *(7)*<br>(Will require additional resources.) | Director's Office | Directorate | Executive Director or designee |

**ACTION:** Conduct regional baseline mapping, explore the use of a variety of survey platforms (ships, autonomous floats, etc.) to collect data in order to assess current conditions and species' ranges. Track changing surface and subsurface conditions and ranges (e.g., temperature, pH, $pCO_2$, nutrients, chloropigment and oxygen concentration, ocean currents and stratification, prey availability; migratory routes; species presence; data that are known to influence the vertical distribution of highly migratory species and their prey and primary production, micronekton data, and monitoring of phyto- and zooplankton size structure). Note that implementation of the sampling plan listed below will extend beyond FY24.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Draft an internal report assessing current and needed staff capacity and resources. (*7)* | Kisei Tanaka, Réka Domokos | Jarad Makaiau, Danielle Jayewardene | Mark Fitchett |
| FY23: Implement sampling plan. *(7)*<br>(Will require additional resources.) | Kisei Tanaka, Réka Domokos | Jarad Makaiau | Mark Fitchett |
| FY24: Maintain sampling plan. *(6)*<br>(Will require additional resources.) | Kisei Tanaka, Réka Domokos | Jarad Makaiau, Steve McKagan | Mark Fitchett |
| FY22–24: Work with plan teams to have the baseline mapping effort considered for inclusion in the annual Stock Assessment and Fishery Evaluation (SAFE) reports and overlay the fishery dependent information. *(6)* | Donald Kobayashi, Todd Jones | Brett Schumacher, Lynn Rassel | Mark Fitchett, Matt Seeley |
| FY23: Maintain the Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS), including standard visual surveys and towed and autonomous passive acoustic surveys . *(6)*<br>(May require additional resources.) | Erin Oleson | Danielle Jayewardene | Asuka Ishizaki |

**ACTION:** Develop species distribution models for a number of pelagic species for which telemetry (bigeye tuna, yellowfin tuna, striped marlin, oceanic white-tip shark, blue shark) and survey (cetaceans) data are available. Periodic model improvement and development of additional models will extend beyond FY24 as more data become available and methodologies advance.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY23: In collaboration with the Southwest Fisheries Science Center, complete fish models, peer-reviewed paper(s), presentation(s), and meetings with appropriate Pacific Islands region (PIR) managers to share results and solicit input on the most useful application of models. *(6)* | Johanna Wren | Jarad Makaiau, Chelsey Young, Richard Hall | Mark Fitchett |
| FY24: Incorporate passive acoustic data into cetacean models. *(6)*<br>(Will require additional resources.) | Erin Oleson<br>Jason Baker | Danielle Jayewardene | Asuka Ishizaki |

**ACTION:** Assess shifts in green sea turtle behaviors and habitat use across the Hawaiian Archipelago

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22–24: Satellite tag ~12 turtles across the Hawaiian Archipelago each year. *(6)*<br>(May require additional resources.) | Camryn Allen | Irene Kelly | Asuka Ishizaki |
| FY22–24: Conduct weekly surveys of basking/nesting within Papahānaumokuākea Marine National Monument during nesting season each year. *(6)*<br>(Will require additional resources.) | Camryn Allen | Irene Kelly | Asuka Ishizaki |
| FY22–24: Assess nest incubation temperature at ~100 nests of each species across the Hawaiian Archipelago. *(6)* | Camryn Allen | Irene Kelly, Steve Kolinski | Asuka Ishizaki |

**ACTION:** Examine how changing conditions affect species distributions including commercially valuable species, non-target species, protected species, and prey, and how these shifts affect species' and communities' vulnerability to climate change. Note that much of the work encompassed in this action item builds upon other action items and will extend beyond the PIRAP timeframe.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22–24: Continue efforts to standardize fishers' observations section of the SAFE reports, engaging with local communities to document fisher/fishing community observations of changes in species biology and phenology. *(6)*<br>(With additional resources, a larger oral history/indigenous science component could be added.) | Kirsten Leong | Michelle McGregor | Matt Seeley |
| FY22–24: Examine the temporal scales and resolutions of environmental variability that can best hindcast species' spatial abundance across the PIR by, for example, decomposing remote sensing environmental variables and cross-validating each covariate's contribution to predictive skill for spatially and temporally explicit abundance. Determine taxa-specific temporal resolutions of environmental variability that provide the best predictive skills for model-based essential fish habitat delineations. Meet with appropriate PIR managers to ensure management applicability of research, peer-reviewed publication of results. Share results with appropriate PIR managers and stakeholders. *(5)* | Kisei Tanaka | Jarad Makaiau, Danielle Jayewardene, David Delaney | Mark Fitchett |
| FY22: Examine community vulnerability to climate change through impacts to cultural keystone species and climate vulnerable species. Share results with appropriate PIR managers and stakeholders via tech memo. *(5)* | Mia Iwane | Jarad Makaiau, Kate Taylor | Matt Seeley |

**ACTION:** Project future species distributions based on future climate conditions. Over the long-term (beyond FY24), periodically update these projections as underlying models improve, additional models are developed, as more data become available, and as methodologies advance.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY24: Using completed species distribution models, work with PIR managers to project future habitat and distributions of a suite of pelagic species, summarize in peer-reviewed paper, share with appropriate PIR managers. *(4)* | Phoebe Woodworth-Jefcoats | Mark Fox, Richard Hall | Josh DeMello |

**ACTION:** Investigate area-based or adaptive management tools, gear configurations, and other means to reduce the composition of non-target species relative to performance of target catch (i.e., tunas) in U.S. Pacific fisheries. Beyond FY24, continue to refine these tools as new data become available and new climate-based relationships are identified.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22–23: Continued development of the transformational EBFM project. Conversations among appropriate PIR managers, scientists, and stakeholders regarding the impact of changes in the spatial distribution of fisheries can be explored with respect to target and bycatch catches. *(2)* | Robert Ahrens | Mark Fox | Mark Fitchett |

**ACTION:** Work toward developing tools to inform future Fishery Ecosystem Plan (FEP) amendments regarding catch and/or effort controls that are more adaptive to new data and/or environmental variables, acknowledging that management benchmarks may be dynamic. Recognizing that climate change may result in non-stationary production relationships, determine if current management procedures and harvest control rules are sufficiently responsive to achieve the objectives of the Magnuson-Stevens Fishery Conservation and Management Act and current FEPs. Beyond FY24, develop an efficient science-policy framework that allows managers to respond to an increasingly rapidly changing environment in a timely manner using the Pacific Northwest as a model.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY23: Convene a small working group, in coordination with council meetings, of appropriate Pacific Islands region managers and stakeholders to determine if current management procedures are sufficiently responsive to the impacts of climate change. *(3)* | Robert Ahrens | Mark Fox | Matt Seeley |
| FY23: Should the findings of the above working group indicate concern with respect to the suitability of current management procedures, a desktop management strategy evaluation will be developed to highlight the impact of current procedures as well as a suite of potential changes to current control rules. *(3)* | Robert Ahrens | Mark Fox, Ann Barlow | Matt Seeley |
| FY24: Conduct a gap analysis to determine if any additional factors are needed to implement dynamic harvest control rules and report any findings to appropriate managers. Explore whether additional data streams can provide information that allows management to be more responsive relative to the generation-time-dependent update of the production function in a stock assessment. Share results with appropriate regional managers and stakeholders. *(3)* | Robert Ahrens | Mark Fox, Richard Hall | Matt Seeley |
| FY24: Collaborate on an FEP amendment adopting the fishery management decision framework. *(3)* | T. Todd Jones | Mark Fox | Matt Seeley |
| FY23: Develop and share with managers a table of species that requires adaptable management with respect to climate impacts, management objectives, and acceptable risk levels. *(1)* | T. Todd Jones, Charles Littnan | Mark Fox | Matt Seeley, Asuka Ishizaki |

**ACTION:** Investigate the impacts of shifting distributions of fishery resources and fishing effort due to climate change and/or management scenarios. These may include potential social, cultural, and economic impacts by fishery sector (i.e., longline, purse seine, small boat fisheries) and regions in the western and central Pacific Ocean.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Engage international science providers through the Regional Fishery Management Organization process to identify areas of research collaboration related to shifting fishery resources. Identify resources to support domestic research into effects on U.S. fisheries. *(2)* | Emily Crigler | Alex Kahl, Rini Ghosh | Mark Fitchett |
| FY23: Explore domestic effects on U.S. fisheries from shifting resources. Collaborate with international science providers on regional analyses. *(2)* | Emily Crigler, Hing Ling Chan | Brett Schumacher Alex Kahl, Rini Ghosh | Mark Fitchett |
| FY22–FY24: Track international progress and collaborate with international partners to explore changes in stock production and access to fishery resources due to the impacts of climate change. *(2)* | Emily Crigler | Alex Kahl, Rini Ghosh | Mark Fitchett |

## Theme: Impacts to Life History and Biology

**ACTION:** Life history attributes (length-at-age, maximum age and size, somatic growth, age- and size-at maturity, natural mortality) are driven by metabolism which, in turn, is impacted by temperature. Understanding climate change impacts is dependent on establishing a temporal baseline at the appropriate spatial scale and separating fishing impacts from temperature on these attributes. Documenting spatial variability along a temperature gradient combined with dendrochronology that identifies impactful past climate events will provide insights on how climate change will affect a species' life history across its distribution. The next step after establishing a temporal baseline, includes monitoring life history attributes during periods of observed climate change and determining whether/how climate affects these attributes. Ultimately, accounting for the impacts of climate change in the estimation of life history parameters supports climate-informed stock assessments by reducing the scientific uncertainty in the assessment overall. This work is part of an ongoing, decade-plus effort to better understand life history and how it is affected by the environment. However, it is highly dependent on biological samples that are acquired on research cruises and through territorial biosampling program funding.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Establish gonad and otolith sampling plan for striped marlin, blue marlin, swordfish, and bottomfish management unit species across the main Hawaiian Islands (MHI), American Samoa (AS), Commonwealth of the Northern Mariana Islands (CNMI). *(7)* | Joseph O'Malley | Mark Fox, Jarad Makaiau | Mark Fitchett |
| FY22–24: Continue annual collection and analyses of otolith and gonad samples from North Pacific striped marlin, blue marlin, and swordfish, and MHI, AS, and Mariana Archipelago bottomfish management unit species. Continue engagement with the Pacific Islands Region Observer Program and biosampling programs in conjunction with annual cruises. *(6)* | Joseph O'Malley | Mark Fox, Jarad Makaiau | Mark Fitchett |
| FY23–24: Publish baseline life history attributes as they are determined. *(6)* | Joseph O'Malley | Mark Fox, Jarad Makaiau | Mark Fitchett |
| FY24: Publish peer-reviewed articles on any links between changing life history attributes and climate (or the lack thereof); present results to appropriate PIR managers. *(5)* | Joseph O'Malley | Mark Fox, Jarad Makaiau | Mark Fitchett |

**ACTION:** Continue to work to identify predictive environmental and food web attributes that can be incorporated into stock assessments and other productivity projections. Work toward using these climate-informed stock assessments in a management context.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Convene meeting among appropriate regional managers, stock assessment scientists, and biophysical scientists to identify candidate species and variables. *(5)* | Ryan Rykaczewski, Felipe Carvalho | Brett Schumacher | Matt Seeley |
| FY22: Explore the effects of environmental change in the main Hawaiian Islands Deep-7 bottomfish assessment. *(3, 2, 1)* | John Syslo | Brett Schumacher | Matt Seeley |
| FY22-24: Investigate the effects of environmental change on the behavior of fishing fleets and fisheries stock productivity to improve the accuracy of the territorial bottomfish stock assessments. *(3, 2, 1)* | Felipe Carvalho | Brett Schumacher | Matt Seeley |
| FY23–24: Publish results of meaningful relationships in peer-reviewed paper; share results with appropriate regional managers. *(5)* | Ryan Rykaczewski, Felipe Carvalho | Brett Schumacher | Matt Seeley |
| FY23: Integrate the effects of environmental change into age-structured stock assessment models for the North Pacific swordfish and hence the provision of climate-informed management advice in the form of reference points. *(3, 2, 1)* | Felipe Carvalho | Jarad Makaiau | Mark Fitchett |
| FY23–24: Collect tangible data and analytical components to characterize potential non-stationarity in reference points for stocks. *(1)* | Felipe Carvalho | Jarad Makaiau | Mark Fitchett |
| FY24: Conduct additional climate-informed stock assessments. *(3, 2, 1)* | Felipe Carvalho | Brett Schumacher | Matt Seeley, Mark Fitchett |
| FY24: Use nest temperature data in green sea turtle population viability assessments and others where possible. *(4)* | Camryn Allen | Irene Kelly, Steve Kolinski | Asuka Ishizaki |

**ACTION:** Examine and project food web and fishery sensitivity to the changing extent of the oxygen minimum zones (OMZs) in the central North Pacific (CNP) and eastern tropical Pacific (ETP) ecosystems. The subsurface OMZs of tropical oceanic regions play an important role in trophic connectivity between depth zones, the transport of carbon from surface waters, and the foraging environment of ecologically and economically valuable fish such as tunas and billfishes. The extent and severity of the Pacific OMZ is expected to increase as a consequence of climate change over the next century. Simulations and analyses will focus upon OMZ-driven changes in vertical distribution and diel vertical migration patterns of micronekton and upon the foraging depth range of larger, predatory fishes. Continuing work beyond this PIRAP timeframe will focus on incorporating and simulating the physiological effects of OMZ changes upon specific functional groups within the CNP and ETP models.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Develop vertically resolved end-to-end ecosystem models for the central North Pacific (CNP) and eastern tropical Pacific (ETP). *(5)* | Jim Ruzicka | Mark Fox | Mark Fitchett |
| FY23–24: Use developed models to simulate how changes in mesopelagic community composition and production and changes in diel vertical migration (DVM) patterns propagate throughout the food web and affect fisheries. Employ the ECOTRAN end-to-end model platform to run time-dynamic simulations of the CNP and ETP ecosystems under alternate OMZ and DVM scenarios; meet with appropriate regional managers while developing simulations to maximize management relevancy. *(4)* | Jim Ruzicka | Mark Fox, Gerry Davis | Mark Fitchett |
| FY24: Manuscript submitted for peer-review presenting model development and simulation results, presentation(s) to appropriate regional managers. *(4)* | Jim Ruzicka | Mark Fox, Gerry Davis | Mark Fitchett |

## Theme: Ecosystems, Habitats, and Humans

**ACTION:** Combine uncrewed systems (UxS), satellite data, aircraft hyperspectral data, and ecosystem modeling to assess the role of bioslicks in driving fisheries and ecosystem productivity across the main Hawaiian Islands (MHI).

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Secure resources from Requests for Proposals to undertake sampling and research. *(7)*<br>(Will require additional resources.) | Jamison Gove | Jarad Makaiau | Matt Seeley |
| FY23: Use satellite remotely sensed data to assess slicks within 50 nm of each of the main Hawaiian Islands, expanding out to the full EEZ as computational power allows. *(6)*<br>(Will require additional resources.) | Jamison Gove | Jarad Makaiau, Ann Barlow | Matt Seeley |
| FY23: Examine relationship(s) between bioslicks and food web productivity, publish results in peer-reviewed paper, share results with appropriate PIR managers. *(5)*<br>(Will require additional resources.) | Jamison Gove | Jarad Makaiau, Ann Barlow | Matt Seeley |
| FY23–24: Where possible, use identified relationships between bioslicks and food web productivity to project future regional productivity, peer-review paper, and presentations to appropriate PIR managers. *(4)*<br>(Will require additional resources.) | Jamison Gove | Jarad Makaiau, Ann Barlow | Matt Seeley |

**ACTION:** Expand capacity for regular diet studies for managed, protected, frequently bycaught, cultural keystone, and other species of interest. Beyond FY24, continue to assess needed capacity for diet work and respond when necessary.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Draft an internal report assessing current and needed staff capacity and resources. *(7)* | Jonathan Whitney | Mark Fox | Asuka Ishizaki |
| FY23: Fill at least 50% of the capacity and resource gaps identified in FY22. *(7)*<br>(May require additional resources.) | Jonathan Whitney | Mark Fox | Asuka Ishizaki |
| FY24: Fill 100% of the capacity and resource gaps identified in FY22. *(7)*<br>(May require additional resources.) | Jonathan Whitney | Mark Fox | Asuka Ishizaki |

**ACTION:** Build local capacity for data collection and analysis of climate-relevant data streams to support early identification of local climate impacts.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Assess current capacity and draft island-/territory-specific reef and slope fishery management plan(s) to expand capacity. *(7)* | Frank Parrish | Mark Fox | Joshua DeMello |
| FY22–24: Conduct baseline work that moves toward developing tools in the next iteration of PIRAP, coordination between appropriate PIR managers, scientists, and stakeholders. *(7)* | T. Todd Jones | Fatima Sauafea-Leau | Joshua DeMello |
| FY23–24: Implement plan to expand capacity thereby beginning and maintaining data collection. *(6)*<br>(May require additional resources.) | T. Todd Jones | Mark Fox | Joshua DeMello |

**ACTION:** Update the Ecosystem Status Report (ESR). This report expands the geographic scope of the previous efforts and describes the status and trends of marine ecosystems in the main Hawaiian Islands. Sections within the ESR include *Human Connections, Small-Boat Commercial Fishers, Coral Reefs and Reef Fish, Climate and Ocean, Human Impacts,* and *Vulnerability of Coral Reefs to Climate Change.*

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Complete report. *(6, 4)* | Jamison Gove | Gerry Davis, Lani Watson (OHC), | Matt Seeley |

**ACTION:** Conduct Climate Vulnerability Assessments. Use climate-informed vulnerability assessments in a management context, noting that this will likely not be possible until after the PIRAP timeframe.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Contribute to marine mammal climate vulnerability assessments; publish results in a NOAA tech memo. *(6)* | Jason Baker, Erin Oleson | Krista Graham | NA |
| FY22: Present results of the marine mammal climate vulnerability assessments at the 24th Biennial Conference on the Biology of Marine Mammals. *(6)* | Jason Baker, Erin Oleson | Krista Graham | NA |
| FY22–24: Track communities' vulnerability to climate change. *(6)* | Kirsten Leong | Michelle McGregor, Fatima Saufea-Leau | Asuka Ishizaki |
| FY23: Complete updated Climate Vulnerability of Coral Reefs report. *(6, 4)* | Jamison Gove | Gerry Davis, Steve Kolinski | Asuka Ishizaki |

**ACTION:** Ensure environmental justice, equity, and gender representation in government climate mitigation measures. This work will continue beyond FY24.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Investigate gender representation in socio-economic surveys and summarize findings; share results with appropriate PIR managers and stakeholders. *(2)* | Danika Kleiber | Mark Fox, Michelle McGregor | Asuka Ishizaki |
| FY23: Initiate demographic data collections to facilitate environmental justice/equity analyses of climate change mitigation measures. *(2)* | Danika Kleiber | Mark Fox, Michelle McGregor | Asuka Ishizaki |
| FY24: Maintain demographic data collections to facilitate environmental justice/equity analyses of climate change mitigation measures. *(2)* | Danika Kleiber | Mark Fox, Michelle McGregor | Asuka Ishizaki |

**ACTION:** Monitor and improve understanding of coral recovery and degradation. Beyond FY24, incorporate this information into management where possible.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22–24: Meet at least quarterly with appropriate PIR managers to ensure research aligns with management needs. *(7)* | Frank Parrish | Gerry Davis | Matt Seeley |
| FY22–24: Use photogrammetry and other survey techniques to track carbonate budgets and assess accretion/erosion balance at 20 sites each year across western and central Pacific reefs, work with appropriate PIR managers and stakeholders to incorporate into management products. *(6)* | Hannah Barkley | Kaipo Perez | Joshua DeMello |
| FY22–24: Use photogrammetry to track coral reef structural change and fish habitat at 100 sites each year across central Pacific reefs, share results with appropriate PIR managers and stakeholders. *(6)* | Thomas Oliver | David Delaney | Joshua DeMello |
| FY22–23: Spatially refine (i.e., downscale) ecological coral reef trends from > 300 sites across central Pacific reefs, reporting trends at the smallest scale that is statistically responsible. Engaging with appropriate PIR managers and stakeholders. *(6)* | Thomas Oliver | Gerry Davis, Lani Watson (OHC), Lance Smith, Steve McKagan, Steve Kolinski | Joshua DeMello |
| FY22–24: Conduct colony-level demographic modeling at 30 sites across the Central Pacific. *(4)* | Thomas Oliver | Gerry Davis, Lani Watson (OHC), Lance Smith | Joshua DeMello |

## Theme: Regional Coordination and Operations

**ACTION:** Ensure higher-level collaboration between science and management on setting climate priorities in order to provide top-down guidance on issues coordinated among the Science Center, Regional Office, and the Council. Include streamlining how climate change is incorporated in other regional initiatives (e.g., Ecosystem-based Fishery Management, Biological Opinions).

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22–24: Convene annual meetings among PIFSC, PIRO, and Council directorates to coordinate climate-related priorities and needs; conduct additional coordination meetings between PIRO and PIFSC throughout the year. *(7)* | Director's Office | Directorate | Executive Director |
| FY22–24: Oversee all-hands communication of decisions made at above coordination meetings. *(7)* | Director's Office | Directorate | Executive Director |
| FY22–24: Crosswalk NCSS and PIRAP with regional initiatives that include a climate-related element. *(7)* | Director's Office | Directorate | Executive Director |
| FY22–24: Hold an annual collaborative climate workshop to bring together regional scientists and managers. *(7)* | Phoebe Woodworth-Jefcoats | Ann Barlow, Kate Taylor | Matt Seeley, Mark Fitchett |
| FY24: Conduct tabletop scenario planning exercise to determine "no regrets" strategies under different potential futures; write summary meeting report. *(2)* | Kirsten Leong | Mark Fox | Josh DeMello |
| FY22-24: Develop a state- and territory-specific fisheries stakeholder engagement process to solicit and incorporate localized needs into regional climate research prioritization and management objectives, including a feedback process that improves transparency. *(6, 3, 2)* | Mia Iwane | Mark Fox | Matt Seeley |

**ACTION:** Improve the regional reporting of climate variables through the Archipelagic and Pelagic Plan Team's annual Stock Assessment and Fishery Evaluation Reports. The Ecosystem Consideration Chapter of the report includes the state of the environment to which the stock is exposed and where fishery operations take place. The purpose of this action is to enhance the selection, reporting, and communication of the climate variables to fishery managers and fishing communities. Regulations require these reports be published on June 30 of each year, and the information from the report must be processed for fishery management use.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22: Convene meeting of the Archipelagic and Pelagic Plan Teams to discuss ways to incorporate the climate information in Council management decisions noting that the final decision on actions rests with the Plan Teams. *(6, 3)* | Donald Kobayashi, Todd Jones | Lynn Rassel, Brett Schumacher | Matt Seeley, Mark Fitchett |
| FY23: Develop fishery management framework that will incorporate climate information in the Council's conservation and management measures. *(6, 3)* | Marlowe Sabater | Brett Schumacher | Matt Seeley, Mark Fitchett |
| FY24: Finalize potential amendments. *(6, 3)* | Donald Kobayashi, T. Todd Jones, Marlowe Sabater | Directorate, Jonathan Brown | Matt Seeley, Mark Fitchett |

**ACTION:** Reduce the NOAA Fisheries Pacific Island region's carbon footprint.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22–24: In partnership with the Inouye Regional Center Facility Management Board, complete annual emissions inventories for PIR facilities and operations. Note those emissions which are within NOAA Fisheries' control and those which are not. The emissions inventory is the first step in taking a baseline on the region's use of cars and travel, use of energy in offices and other facilities, and reduction of waste with on-site recycling and composting as well as water conservation. *(7)* | Phoebe Woodworth-Jefcoats | Directorate | NA |
| FY22: Develop a green operations plan with the goal of reducing our region's carbon footprint, including through both PIR facilities as well as travel/remote work. The plan will directly address those elements of the region's carbon footprint which are within NOAA Fisheries' control; include partnership strategies for those elements which are not. *(7)* | Phoebe Woodworth-Jefcoats | Directorate | NA |
| FY23: Implement green operations plan. *(7)* | Director's Office | Directorate | NA |
| FY24: Evaluate and refine green operations plan as needed. | Phoebe Woodworth-Jefcoats | Directorate | NA |
| FY24: Estimate carbon emissions associated with activities under NOAA Fisheries jurisdiction in the PIR and, where possible, examine potential for emissions reductions. Share results in a peer-reviewed publication with the fishing industry and with appropriate PIR managers. | Hing Ling Chan | Jarad Makaiau | Matt Seeley Mark Fitchett |

**ACTION:** Monitor climate impacts to protected species habitat at Lalo/French Frigate Shoals (FFS). Habitat loss is a concern there as small low-lying islets provide crucial habitat, especially for breeding, to both Hawaiian monk seals and Hawaiian green sea turtles.

| METRICS | PIFSC | PIRO | COUNCIL |
|---|---|---|---|
| FY22–24: Conduct climate-focused restoration work and research in coordination with co-managers to tackle issues of coastal erosion, storm damage, coral bleaching, and habitat loss. This may include coastal surveying at Lalo that incorporates marine environmental parameters, and species of interest, such as corals and seabirds, as well as use of quality LIDAR. *(6)*<br>(May require additional resources.) | Jason Baker | Irene Kelly, Ann Barlow | Asuka Ishizaki |
| FY22–24: Participate in a broad workshop to assess management next steps for Lalo that will include National Environmental Satellite, Data, and Information Service, Office of National Marine Sanctuaries, Fish and Wildlife Service, Office of Hawaiian Affairs, and State of Hawai‘i, in addition to PIFSC and PIRO for NOAA Fisheries. *(6)* | Jason Baker | Irene Kelly, Ann Barlow | Asuka Ishizaki |
| FY22–24: Hawaiian Monk Seal Research Program (HMSRP) team will survey monk seal populations each year (these surveys will occur on the terrestrial portion of seal habitat) at FFS as well as throughout the Northwestern and main Hawaiian Islands. *(6)* | Jason Baker | Jamie Thomton | Asuka Ishizaki |
| FY23: HMSRP will identify appropriate partners and model/simulation methods, complete simulation of future conditions (in collaboration with external partners), share results in peer-reviewed publication and in presentation(s) to appropriate PIR managers. *(4)*<br>(Will require additional resources.) | Jason Baker | Jamie Thomton | Asuka Ishizaki |
| FY22–24: Designation of FFS as a new Habitat Focus Areas (HFA). New HFAs will be chosen within the Pacific Islands region with the goal of solving habitat degradation problems through increased NOAA collaboration and work with partners. An HFS designation at FFS within the next year would bring a climate focus, tackling issues of coastal erosion, storm damage, coral bleaching, and habitat loss. *(3, 2, 1)* | Jason Baker | Ann Barlow, Lani Watson (OHC), Irene Kelly, Lance Smith | Asuka Ishizaki |

## Acknowledgments

We thank K. McCoy and R. Rykaczewski for support during PIRAP author team meetings and J. Coyle for expeditious and thorough editing.

## Literature Cited


Executive Order Number 13990, 86 FR 7037 (7037-7043), 2021. https://www.federalregister.gov/documents/2021/01/25/2021-01765/protecting-public-health-and-the-environment-and-restoring-science-to-tackle-the-climate-crisis

Executive Order Number 14008, 86 FR 7619 (7619-7633), §216c, 2021. https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad

Eyring V, Bony S, Meehl GA, Senior CA, Stevens B, Stouffer RJ, Taylor KE. 2016. Overview of the coupled model intercomparison project phase 6 (CMIP6) experimental design and organization. Geosci. Model Dev. 9, 1937–1958. doi: 10.5194/gmd-9-1937-2016

GAO-16-827, 2016, United States Government Accountability Office Report to Congressional Requestors, Federal Fisheries Management: Additional Actions Could Advance Efforts to Incorporate Climate Information into Management Decisions. https://www.gao.gov/assets/gao-16-827.pdf

Link JS, Griffis R, Busch S. (Editors). 2015. NOAA Fisheries Climate Science Strategy. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-F/SPO-155, 70 p.

NOAA Fisheries Procedure 01-120-01, Ecosystem-Based Fishery Management Road Map. 2018. https://www.fisheries.noaa.gov/resource/document/ecosystem-based-fisheries-management-road-map

Peterson J, Griffis R. (Editors). 2021. NOAA Fisheries Climate Science Strategy Five-Year Progress Report. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-F/SPO-228, 157p

Polovina J, Dreflak K, Baker J, Bloom S, Brooke S, Chan V, Ellgen S, Golden D, Hospital J, Van Houtan K, et al. 2016. Pacific Islands Fisheries Science Center Pacific Islands Regional Action Plan -- NOAA Fisheries Climate Science Strategy. U.S. Dep. Commer., NOAA Tech Memo., NOAA-TM-NMFS-PIFSC-49, 33p. doi:10.7289/V5/TM-PIFSC-59.