

# Summary Report from the 5<sup>th</sup> Annual Collaborative Climate Science Workshop, 8–10 February 2022



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## Background

In 2016 the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries) enacted the NOAA Fisheries Climate Science Strategy (Link et al. 2015) as part of its proactive approach to better track, forecast, and incorporate information on changing climate conditions into living marine resource management. Drivers and impacts of climate change vary greatly by geographic location. Therefore, the strategy is being implemented through customized Regional Action Plans for climate science (RAPs). These RAPs detail regional climate science needs and specific action items to address them. By creating action plans at the regional level, NOAA Fisheries is tailoring its response to meet specific climate challenges and forging critical partnerships at the local level. The initial RAPs were 5-year plans covering fiscal years 2017–2021 (Peterson et al. 2021).

An action item in the initial Pacific Islands Regional Action Plan for climate science (PIRAP; Polovina et al. 2016) was to convene an internal Annual Collaborative Climate Science Workshop as a forum where regional staff could keep abreast of climate-related information needs, scientific research, and data available or being developed. The first four workshops were held annually in autumn 2017–2020 (hereafter 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> Workshops, respectively). The 5<sup>th</sup> Annual Collaborative Climate Science Workshop (hereafter 5<sup>th</sup> Workshop) was held on 8–10 February 2022. All workshops were attended by staff from the NOAA Fisheries Pacific Islands Regional Office (PIRO) and Pacific Islands Fisheries Science Center (PIFSC), the NOAA National Environmental Satellite, Data, and Information Service, and the Western Pacific Regional Fishery Management Council (WPRFMC or Council), as well as by several members of WPRFMC advisory bodies. The 5<sup>th</sup> Workshop was also the first to be opened to our external climate collaborators across the region.

The goals of the 5<sup>th</sup> Workshop were to 1) introduce the second phase of the Pacific Islands Regional Action Plan for climate science, or PIRAP 2.0, and 2) develop our regional implementation strategy with a cross-disciplinary approach. PIRAP 2.0<sup>1</sup> builds on the region's initial RAP (Polovina et al. 2016). It emphasizes collaboration between regional scientists and managers. It is also structured around themes that arose during the implementation of the PIRAP. Therefore, the workshop was structured around the five PIRAP 2.0 themes:

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

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<sup>1</sup> <https://media.fisheries.noaa.gov/2022-04/PIRAP-Draft-For-Public-Comment.pdf>

Woodworth-Jefcoats P, Jacobs A, Ahrens R, Barkely H, Barlow A, Bolen L, Carvalho F, Chung A, Crigler E, DeMello J, Fitchett M, Fox M, Asuka I, Larin P, Lumsden B, Makaiiau J, McGregor M, Oliver T, O'Malley J, Richards B, Robinson S, Sabater M, Sculley M, Sweeney J, Tanaka K, Yamada Z. 2022. Draft phase two of the Pacific Islands Regional Action Plan for Climate Science—PIRAP 2.0. U.S. Dept. of Commerce, 37 p., Draft document currently in review

The first four workshop sessions had the same format: a 1-hour panel discussion followed by 45 minutes of informal conversations. The panel discussion format was selected in an effort to share information on how PIRAP 2.0 action item points of contact (POCs) are approaching their projects. The informal conversation time was included to address a leading ask from POCs: time to coordinate with their fellow POCs. The final session was open to our external climate collaborators across the region. The panel discussion was replaced by a round of 7-minute lightning talks from these collaborators. This was followed by 45 minutes of informal conversations. All sessions ended with a brief opportunity for participants to share their take-aways from the session. For more details on the agenda, please see Appendix A.

Due to the ongoing COVID-19 pandemic, the 5<sup>th</sup> Workshop was held virtually as it was in 2020. A variety of online platforms were used in an effort to make the most of the virtual setting. A climate workshop intranet site<sup>2</sup> allowed for sharing of the pre-work for the workshop, thereby enabling the full workshop to be used for conversation and collaboration. The platform WebEx hosted and recorded the panel discussions and lightning talks. The workshop used the Google platform Jamboards to solicit questions for the panel discussions, both prior to and live during the discussions. The ability to see the set of others' questions gave participants the opportunity to upvote questions that specifically interested them (Fig. 1). Informal conversations were held on Wonder<sup>3</sup> which allowed participants to select their own conversational groups and to move around freely throughout the allotted time.

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<sup>2</sup> <https://sites.google.com/noaa.gov/pirap/cimate-workshop>  
Access requires an @noaa.gov email address.

<sup>3</sup> <https://www.wonder.me>

# Session 4: Life History and Biology (W 1 – 4pm)

Panelists (Affiliation) and PIRAP 2.0 action item(s)

**Gerry Davis (PIRO)** Develop an ecosystem model to examine and project food web and fishery sensitivity to the changing extent of the oxygen minimum zones in the central North Pacific and eastern tropical Pacific ecosystems

**Mark Fitchett (WPRFMC)** Better understand life history and how it is affected by the environment & Develop an ecosystem model to examine and project food web and fishery sensitivity to the changing extent of the oxygen minimum zones in the central North Pacific and eastern tropical Pacific ecosystems

**Joe O'Malley (PIFSC)** Better understand life history and how it is affected by the environment

**Jim Ruzicka (PIFSC)** Develop an ecosystem model to examine and project food web and fishery sensitivity to the changing extent of the oxygen minimum zones in the central North Pacific and eastern tropical Pacific ecosystems

The Jamboard contains the following questions and upvotes:

- Light blue box:** Add your questions with a new sticky!
- Yellow box:** Sounds like ocean & climate data are used in standardizing CPUE in stock assessments. Are those data yet used in adjusting vital rates, or is this what is identified as the need?
- Yellow box:** Could you explain the data needed for climate-informed life history measures and stock assessments, and then how that feeds to management? **+2**
- Green box:** Which life history and ecological processes should we prioritize for research and modeling (recruitment? migration? vertical and geographic migration?, physiological changes? diet? **+3**
- Yellow box:** How are changes in phenology being addressed? How much of an impact does this have in the tropics?
- Green box:** How can we better understand how variability in life history parameters impact non-stationarity of population dynamics of organisms and thus their management targets.... (i.e. MSST, Bmsy, MSY, **+3**
- Light blue box:** I haven't heard much about climate change impacts to protected species and their life I haven't heard much about climate change impacts to protected species and their life histories. We know that the warming trends lead to feminization of sea turtles, are there other aspects that need further
- Orange box:** How do managers use ecosystem modeling results? (asking as an ecosystem modeler) **+1**
- Light blue box:** How is this interesting information communicated out?
- Green box:** Do you see any socio-cultural, community impacts from consequences of climate change on life history related concerns?; e.g., harvest and utilization of varying life stages?
- Pink box:** Can we link egg and slick recruitment with reproduction and environmental trends? i.e. Can we collect gonad samples for an abundant species in the slicks in West Hawaii a year ahead and the year of slick tows and egg

**Figure 1. Screen capture of one of the Jamboards used during the 5<sup>th</sup> Workshop panel discussions. Questions were added, grouped, and upvoted (+1, +2, +3) anonymously by workshop participants.**

This year's workshop was punctuated by a special session on Resilient Lalo, which focused on incorporating seabird and coral stressors and thresholds into the ecosystem framework begun last year with turtles and monk seals. The Resilient Lalo project focuses on building climate resilience at Lalo/French Frigate Shoals and is a collaborative effort between NOAA, the co-managers of Papahānaumokuākea Marine National Monument (PMNM), academics, and non-governmental organizations (NGOs). A white paper led by PMNM will detail the results of the special session.



## Regional Coordination and Operations

The 5<sup>th</sup> Workshop opened with a session focused on regional coordination and operations. The directors of the Pacific Islands Fisheries Science Center and Regional Office offered opening remarks highlighting the importance of climate change in our region's work, the need to collaborate to address climate-driven challenges, and the broad reach of climate impacts in our region.

The panelists' discussion centered around a few key themes that emerged across the range of questions asked. These themes were: regional coordination at the leadership level and how staff can engage in this process, the role of climate-focused concerns in the broader range of priorities and management needs, and specific operations (e.g., Resilient Lalo, emissions reductions). These are discussed in more detail below.

### Insight into regional coordination practices

A number of questions focused on how regional climate-related priorities are set and avenues available to shape these priorities. Panelists stressed that priorities are shaped from both the top down and the bottom up of the organizational hierarchy. Top-down processes include regular meetings between PIFSC, PIRO, and WPRFMC leadership. At these meetings, priorities are discussed as well as the specific projects planned or underway to address them. The degree of collaboration needed, or desired, between organizations is also discussed at these meetings. Decisions from these leadership meetings are passed down the supervisory chain for action.

A key component of regional leadership meetings is the discussion of topics raised by program-level staff and elevated by supervisors. Panelists stressed the importance of staff reaching out with climate-related concerns and insights. Staff actively engage in the practices of climate-informed management and climate research and have the knowledge and expertise to identify emerging issues.

Another important aspect of regional coordination that was discussed was the Council's Archipelagic and Pelagic Plan teams. PIFSC staff who participated in the workshop also chair these teams. A number of PIFSC staff serve on the Plan Teams. Plan Team meetings offer a venue for climate-related issues to be raised by multiple parties: scientists can present emerging climate science, fishers can share crucial observations, Council staff and members and other stakeholders can elevate important climate-related matters. Workshop participants were encouraged to reach out to Plan Team members with further questions and ideas.<sup>4</sup>

Finally, a key takeaway on successful regional coordination is to ensure that all the right people are in the conversation when priorities are being set. Therefore, it is incumbent on staff at all levels to think critically about the people involved in shaping and executing their climate-related work; identify gaps and reach out to colleagues and leadership to ensure they are filled.

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<sup>4</sup> Further information on Plan Team membership can be found at: <https://www.wpcouncil.org/about-us/advisory-groups/plan-teams/>

## The place of climate change among other priorities

Climate change has rapidly emerged as a top Administration priority (EO 13990, 14008). Yet, other NOAA Fisheries priorities overshadow climate work and long-identified challenges to incorporating climate information into management persist (Woodworth-Jefcoats et al. 2020). How can we, in the Pacific Islands, rise to this challenge? The panelists and workshop participants offered the following suggestions:

- Find ways to better incorporate climate change work into existing priorities. For example, a number of comments were raised about the importance of explicitly linking climate change to Ecosystem Based Fisheries Management (EBFM). Participants suggested adapting how we communicate the role of climate change in EBFM and refining our management questions to include this role. They also put forward the need to recognize and include the role climate plays in shaping habitat for developing effective management actions. Another suggestion discussed was using regional Annual Guidance Memoranda to explicitly integrate climate science into other research and management priorities.
- Reframe the way we think about risk associated with current and future climate conditions. To paraphrase one panelist, climate change is no longer a “slow burn” event; rather, it is already increasing the frequency of catastrophic events. Thus, the idea of climate change needs to include individual extreme events (marine heat waves, particularly destructive storms, etc.) as well as ongoing long-term changes.
- Adapt management processes to incorporate the dynamic nature of a changing climate into planning and rule-making. To this end, the topic of dynamic biomass reference points was discussed in relation to U.S. fisheries management based on maximum sustainable yield reference points<sup>5</sup>. At present, fisheries management typically uses reference points based on prevailing environmental conditions to assess whether fisheries resources are overfished. However, in a changing ocean environment, the application of dynamic biomass reference points along with adaptive management would build in triggers for action in response to climate-driven change. For example, one participant noted the potential for using dynamic initial biomass reference points for fisheries management instead of static equilibrium-based reference points that assume stationary environmental conditions. In this case, using dynamic reference points would help to account for the influences both natural climate variability (e.g., El Niño – Southern Oscillation, Pacific Decadal Oscillation) and anthropogenic climate change on the prevailing environmental conditions that affect stock-specific biomass reference points and ecosystem-level habitat requirements.

One participant’s takeaway from this session sums up well the challenge of integrating climate change with other priorities: “the goalposts for how we manage species may change due to climate.”

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<sup>5</sup> “Maximum sustainable yield is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological, environmental conditions and fishery technological characteristics (e.g., gear selectivity), and the distribution of catch among fleets.” From the National Standard 1 Guidelines (50 CFR § 600.310 2017).

## **Specific regional operations**

Two specific aspects of regional operations were covered during this session's panel discussion: Lalo Resilience and emissions reductions.

### *Lalo Resilience*

Building on the outcomes of the 3<sup>rd</sup> Workshop (Woodworth-Jefcoats et al. 2020), in January 2020 the NOAA Pacific Region Executive Board (PREB) recognized resilience work at Lalo as a priority and endorsed formation of a cross-line office working group to support these efforts. This 'Resilient Lalo' group includes PMNM co-managers, academics, and NGOs and the group focuses on identification and prioritization of ecosystems services and stressors at Lalo. Initial work in the region focused on Hawaiian monk seals and green sea turtles. It is now expanding to other ecological components such as seabirds and corals. The working group is integrating the information gathered at the 5<sup>th</sup> Workshop's special session into the existing stressor framework. This will lead to the 'Resilient Lalo' ecological resilience plan with an expected release in autumn of 2023.

### *Emissions Reductions*

One of the PIRAP 2.0 action items within this session's theme is working to reduce the carbon footprint of NOAA Fisheries' regional operations. A first step in this work is taking an inventory of our current carbon footprint (facilities, travel, fieldwork, etc.). From there, the scope for emissions reductions that is within NOAA Fisheries' control will be identified, and an emissions reduction plan will be crafted and carried out. Participants also discussed examining the carbon footprint of regional fishing operations (and this, too, is a PIRAP 2.0 action item). One participant noted that this is an area where the United States could potentially serve as a regional leader.

## **Ecosystems, Habitats, and Humans**

The panel discussion in this session focused heavily on linking science to management and how stakeholders' perspectives can be incorporated into the process. Given the panelists' areas of expertise, much of this conversation centered around coastal and coral reef examples. However, pelagic connections occurred as well. Specific areas of conversation included the science–management connection, changing management paradigms, and regionally relevant data collection and usage.

### **Connections between science and management**

The opening question in this panel discussion asked about coral work being done in the region and how it is being used by managers. Despite the somewhat specific nature of the question, the panelists offered answers that were applicable to other ecosystems and habitats. Foremost, the panelists cited regular conversations between managers and scientists. They also highlighted the benefit of both increasing and broadening communications. For example, Ecosystem Status Reports were highlighted as a trove of information that is ultimately used in applications beyond their initial purpose. Panelists also emphasized the need for collaborations that expand beyond specific mandates. To quote one panelist, “The law makes [mandates] siloed. People can make them unsiloed,” a point which ties back to the previous session’s discussion of integrating climate into other priorities.

In addition to connections between scientists and managers, panelists and participants also discussed the inclusion of stakeholders in climate-informed living marine resource management and conservation. As one panelist noted, collaboration with the community isn’t mandated but it ultimately serves to benefit both the communities and the agencies initiating the collaboration. It can also help advance equity and environmental justice. Some recent successes that were highlighted included real-time language translation services, recognition of regional oral history traditions, and scheduling public meetings at times that work for the communities in the territories whose time zones differ from Hawai‘i.

### **Changing management paradigms**

A portion of the discussion time focused on questions of habitat management, echoing some of the morning’s discussion of adaptive management. However, in this session, the conversation seemed to have an added sense of urgency. For example, one panelist noted that, in some parts of the region, baseline conditions have shifted so much that they have essentially disappeared, fundamentally changing management objectives (i.e., restoration to original conditions becomes impossible). Managing to avoid tipping points or catastrophes was also discussed, thereby changing the definition of “success” in some circumstances. Panelists also highlighted the importance of management objectives changing in response to emerging science.

This discussion also touched on the role of science in adaptive management. Specifically, the often slow speed of the scientific process was highlighted as a potential barrier to successful management in rapidly changing conditions. For example, scientific findings from only a few years past may no longer be reflective of or relevant to current conditions.

## **Regionally relevant data collection and usage**

This panel discussion also touched on PIRAP 2.0 action items to expand local capacity to collect, interpret, and act on climate data. Currently, these efforts are focused on partnering with regional academic institutions and environmental organizations. Such entities are well placed to gather ecological and other data. As the panelists noted, however, funding is a critical piece of these efforts.

Another panelist highlighted the unique data needs in our region, particularly when it comes to social data. Currently, NOAA Fisheries relies on social indicators to assess social vulnerability of geographic communities. These indicators largely rely on annual American Community Survey (ACS) data. However, there are two main challenges with their application to regional communities. First, some of the indicators derived from these data carry different meanings in our region than they do in the continental United States. For example, low rental costs are associated with poorer and more vulnerable neighborhoods, but in much of American Samoa people do not pay rent at all. In this case, low cost of housing could be better interpreted as an indicator of community cohesion rather than vulnerability. The second challenge is that comparable secondary data often aren't available in our region. In the territories, the annual ACS data are not available, which results in relying on decadal Census data. Similarly, other social data that may be available through other governmental agencies or the private sector, are simply not collected in the territories. Bio-cultural and place-based approaches were discussed as possible ways to address climate-related management concerns that regional fishing communities are facing.

Tying back to scientist–manager connections, panelists offered several ideas for extending the reach of existing regional practices. Panelists suggested using the West Hawai'i Integrated Ecosystem Assessment (IEA) as a model for how to approach assessment of other regional ecosystems. Likewise, the data in the Council's Stock Assessment and Fishery Evaluation (SAFE) reports was highlighted as being useful beyond that document's primary purpose. More specifically, the disparate approaches for monitoring and projecting conditions in data poor and data rich regional reef ecosystems were offered as an example that could be extended to other regional ecosystems. Finally, panelists discussed the potential benefit of producing different information products that serve different purposes and audiences (e.g., fellow scientists vs. public vs. managers vs. industry).

## **Impacts to Life History and Biology**

The panel discussion on impacts to life history and biology coalesced around two central themes: data and uncertainty, and communication and stakeholder engagement. These topics are discussed below.

### **Data and Uncertainty**

This discussion opened with panelists briefly describing the data they use and need for regional life history, ecosystem modeling, and fisheries management work. Much of the same data are needed for all approaches: basic life history estimates (growth rates, age/size at maturity, etc.) and stock recruitment relationships. Behavior data, such as foraging, were also touched on as important but as a somewhat lower priority given the labor-intensive nature of collecting such data and the breadth of species for which the region is responsible. Panelists also described new efforts to better standardize data collection and analysis practices across the region (e.g., PIFSC International Billfish Biological Sampling program and the Territorial Bio-sampling Prioritization Plan). This is particularly relevant in the pelagic realm, where species are targeted by different international fisheries at different life stages, thereby yielding very different samples from which to conduct life history work. Panelists also highlighted the difficulties in acquiring adequate bottomfish and pelagic fish samples.

Beyond the species-specific data needed, all panelists and several participants noted the critical need for complementary environmental data. Temperature data are needed at the depths at which bottomfish species live and are caught. Likewise, pelagic temperature and oxygen data are needed for depths at which protected and management unit species and their prey live. While surface observations and modeled data are readily available, empirical data at depths inaccessible to satellite remote observation remain sparse. Several PIRAP 2.0 action items are poised to help address these gaps, specifically action items to assess regional environmental and ecosystem gaps and to develop and implement activities to fill them.

Discussion of data paucity led panelists to discuss the uncertainty in evaluation of current species and ecosystem status and projected future status in which data gaps often results. Regional management practices incorporate mechanisms to deal with the existing uncertainty in life history parameters. These include the P\* and social, economic, ecological management (SEEM) approaches. The uncertainty evaluation through P\* and SEEM are semi-quantitative. We need to have a more robust way of accounting for uncertainties through a risk-assessment framework that uses the past, present, and projected future state of the ecosystem as input parameters. However, as one panelist noted, climate change makes it increasingly difficult to accurately project future conditions, potentially making precautionary approaches more appropriate. Another panelist noted that uncertainty can result in very broad management measures, whereas greater availability of data can be used to craft more specific and effective management measures. There was also discussion of the role that ecosystem models can play by both bounding uncertainty and by projecting over a range of potential future scenarios.

### **Communication and Stakeholder Engagement**

Panelists also discussed their communications strategies. Scientific communications are usually targeted to a range of specific audiences. Specific informational products are used to share

information with the public (e.g., 1-pager handouts for territorial fishermen describing bio-sampling efforts, interactive museum displays to teach children about marine food webs). The recent American Samoa bottomfish data workshop was another stakeholder communication effort that was highlighted not only in this discussion but throughout the workshop. Scientists also engage in routine conversations with PIRO and participate in Council processes and advisory bodies. And, peer-reviewed publications share specific scientific results with fellow scientists.

Communicating management strategies uses similar approaches to communicating scientific concepts. Managers on the panel highlighted many of the same strategies, especially frequent communication with scientists. The necessity of such conversations was captured by one panelist's remark that, "If I don't know about the science, then it doesn't get used in management and that's a tragedy." The bottom-up nature of the Council was also noted as a structure that promotes communication among stakeholders, managers, and scientists; members from all three communities are present on the Council and its advisory bodies as are people from all the region's territories.

Incorporation of stakeholder knowledge was also discussed. Panelists noted that climate change will affect some groups and communities much more heavily than others, potentially disrupting both industry and cultural practices. As such, panelists noted the importance of engaging with community stakeholders to ensure that traditional life history knowledge is given equal weight in management. Furthermore, climate change has the potential to affect species' life history, which could result in changes to local fisheries and the communities and industries which they support.

## Baselines and Shifting Distributions

This session opened with a brief discussion of the major regional data gaps as they related to establishing baselines of present conditions. Multiple panelists noted the need for three-dimensional oceanographic data, a gap highlighted in other sessions as well. Not only would these data shed light on species' habitats and the relationships between the environment and ecosystem composition, but they would also provide valuable insight into operational characteristics of fishing gear. Panelists also noted the need for fishery-independent observations that range from target species distribution to species' size composition to the composition and distribution of mid-trophic-level prey.

While the theme for this session was baselines and shifting distributions, a considerable amount of the discussion covered adaptive and dynamic management. Specific aspects of management that were discussed were implementing risk management, acting despite the absence of needed data, and working with fishers to ensure their deep ecological knowledge is reflected in management decisions.

### Risk management

Discussion of risk management flowed from the status quo through future goals to steps that could be taken to move from the former to the latter. Risk management frameworks currently in place were discussed as primarily being qualitative. The goal, specifically with respect to climate-related baselines and shifting distributions, is to move to a point where risk management can be more data-driven. Panelists identified several gaps that could be filled to move in that direction. These included incorporating real- or near-real-time observations from fishers on the water, drawing from existing climate vulnerability assessments (e.g., Giddens et al. In review<sup>6</sup>, Gove and Maynard 2019, Kleiber et al. 2018, Marrack and Gove 2019), and filling observation voids for specific species and geographic locations.

The panelists also discussed shifting distributions in relation to tipping points, or changes from which there is no return. In this conversation, panelists saw climate-related tipping points as being outside our control and, in some cases, potentially passed. Examples included ocean temperature, oxygen concentration, and pH. Thresholds that are under the influence of our management frameworks were discussed in more detail by the panelists and participants. A potential tipping point in Eastern Tropical Pacific fishing behavior was discussed, with decadal increases in purse seine fishing effort and associated increases in fishing mortality on juvenile tuna potentially harming adult tuna populations through reductions in yield per recruit and population spawning potential. Participants also offered examples from the past, such as predictions that tipping points for overfishing American lobster in the Gulf of Maine had been passed only to be proven incorrect when lobster predators were overfished and warmer waters improved lobster growth and reproductive success. Among all panelists there was a sense that any tipping points would likely only be visible after they were passed.

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<sup>6</sup> Giddens J, Kobayashi DR, Mukai GNM, Asher J, Birkeland C, Fitchett MD, Hixon M, Hutchinson M, Mundy B, O'Malley J, Sabater M, Scott M, Stahl J, Toonen R, Trianni M, Woodworth-Jefcoats PA, Wren JLK, Nelson M. 2022. Assessing the vulnerability of marine life to climate-change in the Pacific Islands Region. In Review.



## **Moving ahead with the data at hand**

According to a consensus among the panelists, regardless of existing data gaps, management frameworks need to move forward with the data at hand. To this end, panelists highlighted examples from other regions that could serve as goals for our region. Frameworks from the data-rich Northeast and Alaska regions were cited here. Additionally, available data streams were identified as having the potential to contribute to nimble management decisions. These centered around near-real-time electronic data such as automatic identification system (AIS), vessel monitoring system (VMS), and electronic monitoring (EM) data. Ecosystem status reports and other environmental data show potential to be incorporated into existing management frameworks.

Scenario planning was also discussed as a means to move forward with the data at hand. This approach would lay out a portfolio of plausible futures that would guide the development of risk management frameworks, identify the preferred responses once tipping points are passed, and put management of present conditions in the context of future climate projections rather than historic baselines. PIRAP 2.0 includes an action item to conduct scenario planning. And, given that the topic arose multiple times throughout the workshop, a POC mentioned in one of the workshop's informal conversations, an interest in moving up their project timing to make these scenarios available earlier in the PIRAP 2.0 timeframe.

## **Fisher knowledge**

Throughout the discussion, panelists kept returning to the importance of fisher knowledge in both research and management. The wealth of available traditional and industry knowledge could improve understanding of ecosystem dynamics. The importance of listening and building trust was mentioned by several panelists while acknowledging that this process cannot be rushed. Panelists also mentioned that the Magnuson-Stevens Fishery Conservation and Management Act (MSA) obligates managers to include community information, such as local and traditional ecological knowledge. Here, again, the recent American Samoa bottomfish fishery data workshop was hailed as a model example.

Fishers can contribute knowledge ranging from multi-decadal ecosystem observations to real-time environmental observations. For example, one participant raised the example of fishers on Kauai noting that recent rain events have fallen outside the range of historical observations and have had significant consequences for reef fisheries. Managers on the panel noted that the instrumentation used by fishers to identify fishing locations (e.g., Doppler profilers on commercial fishing vessels) could potentially provide useful environmental data currently unavailable through other means. Scientists on the panel expressed a need to complement what is “on [their] computer screen” with what is actually occurring out on the water.

## **External Partners and Resources**

The external partners and resources session marked the first time the Annual Collaborative Climate Science Workshops included external participants. In an effort to start small, the workshop steering committee asked PIRAP 2.0 POCs to extend an invitation to their existing and/or potential climate collaborators to join this session. A total of 37 people from outside NOAA and unaffiliated with the WPRFMC or its advisory bodies RSVP'd to this session. The full list of attendees and their affiliations can be found in Appendix B.

This session began with a brief overview of PIRAP 2.0, its themes, and the action items within those themes. A draft of the action plan was also shared with all who RSVP'd. After this introduction, the session featured lightning talks from external organizations. All external attendees were invited to give a brief presentation about their organization. Presenters were asked to touch on the following questions:

- What is your organization's mission?
- What are your key climate initiatives?
- How do you partner with NOAA?
- What do you need from NOAA?

Seven organizations presented lightning talks (see Appendix A). Despite these organizations ranging from the military to territorial governments to non-governmental organizations, some common themes arose (discussed below).

### **Organizations' missions**

Most of the speakers included in their organizations' mission an element of supporting the conservation, protection, management, and recovery of regional marine environments, species, and communities. Some organizations looked at this mission through at least some degree of a fisheries lens (e.g., The Pacific Community or SPC, University of Guam Marine Lab). Other aspects of organizations' missions included advancing research to support resource management, providing technical guidance to inform management, and fostering community. Some organizations mentioned unique aspects to their mission. For example, Pacific Coastal Research and Planning serves as a geospatial capacity hub in Micronesia, focusing on the Marianas; NAVFAC supports military operations; and The Pacific Community (SPC) develops adaptation pathways for sustainable fisheries.

### **Key climate initiatives**

A number of speakers mentioned work by their organization to foster regional coral reef resilience, such as participating in regional coral bleaching monitoring efforts. Speakers also touched on work to understand the effects of climate variability and change on regional fisheries. Mitigation planning efforts were also among many organizations' key climate initiatives. Likewise, marine debris prevention and removal were common initiatives. More specific climate initiatives included revision of the Papahānaumokuākea Marine National Monument climate change action plan (US Fish and Wildlife Service), serving as the Pacific Islands Ocean Observing System (PacIOOS) liaison to CNMI (Pacific Coastal Research and Planning), and a

focus on tackling climate issues through community initiatives (Mariana Islands Nature Alliance).

### **How organizations partner with NOAA**

The ways in which organizations partner with NOAA were primarily tied to the type of organization. Partners within the U.S. federal government (U.S. Fish and Wildlife Service, NAVFAC) cited examples such as participating in Endangered Species Act (ESA) and essential fish habitat (EFH) consultations as well as co-management of marine national monuments. A territorial government (American Samoa Department of Marine and Wildlife Resources) and the largest science and technical consortium of Pacific countries and territories (The Pacific Community) noted that they partner with NOAA through fisheries monitoring and data sharing. Academic (University of Guam Marine Lab) and non-governmental organizations (Pacific Coastal Research and Planning, Mariana Islands Nature Alliance) highlighted collaborations with NOAA and their role in the regional coordination of NOAA-funded projects.

### **What organizations need from NOAA**

One common theme in what our climate collaborators need from NOAA is easily accessible climate and fisheries data. Speakers highlighted NOAA's unique role in collecting and serving both regional *in situ* data as well as satellite remotely sensed data. At the same time that these data streams were applauded, speakers also noted an ongoing need for timely access to updated data, improved data format options, and a wider array of derived data products. Highlights included the extension of fine-resolution observations and forecasts that are available for the continental United States, and in some cases for Hawai'i as well, to the territories.

Beyond data services, our partners also highlighted the need for ongoing robust collaboration to advance regional research and management as well as to build capacity around the Pacific Islands region. Scientific advice and the review of management plans were also mentioned among our partners' needs.

## Summary and Next Steps

Three main themes emerged from this year’s workshop. In all discussions, panelists noted the need to move toward adaptive and dynamic management in the Pacific Islands region. The importance of connecting with others without adding to meeting fatigue was also a constant thread throughout the workshop. And, in contrast to previous workshops, this year’s workshop conversations tended to be very fish-focused with little discussion of protected species.

### Adaptive and dynamic management

The need for adaptive and/or dynamic management arose in all four panel discussions and is among the objectives of the NOAA Fisheries Climate Science Strategy (Link et al. 2015). Ideas for adaptive management included processes that contain climate-related thresholds for action, climate-informed reference points that contribute to management decisions (also among the NCCS objectives; Link et al. 2015), and also more quantitative approaches to include uncertainty in management. Dynamic management ideas focused mostly on spatially dynamic approaches to management. One suggestion was to focus on geographic areas with conditions likely to lead to fishery interactions with non-target or protected species, including incorporation of how these areas may shift as a result of climate change. Another potential application of dynamic spatial management could be targeted responses to extreme events like marine heat waves or severe storms. PIRAP 2.0 includes action items to advance both adaptive and spatially dynamic management. These include “working toward developing tools to inform future FEP amendments regarding catch and/or effort controls that are more adaptive to new data and/or environmental variables (both current and future conditions), acknowledging management benchmarks (e.g., fishing mortality or catch related to MSY) may be dynamic,” and “investigating 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.”

### More conversations (not necessarily more meetings)

Another topic common to all panel discussions was the need for increased communication and collaboration. Even though this will remain a serious challenge due to factors such as hybrid work environments and the size of the Pacific Islands region, many groups and fora were mentioned repeatedly in this year’s workshop as good venues to increase effective communications. These include:

- [Plan Teams](#):
  - Archipelagic Plan Team,
  - Pelagic Plan Team,
- [Fisheries Integrated Toolbox](#) (FIT),
- [Council meetings](#),
- Stock Assessment and Fishery Evaluation (SAFE) [reports](#) and [data portal](#),
- Ecosystem status reports (ESRs; Gove et al. 2019),
- West Hawai‘i Integrated Ecosystem Assessment (IEA; contact Jamison Gove),
- Oceanic Pacific Island Habitat Initiative (OPIHI; contact Michael Parke),

- Regular PIFSC-PIRO meetings (PIFSC contacts: Beth Lumsden, Rebecca Walker; PIRO contact: Malia Chow),
- [Council's Scientific and Statistical Committee](#) (SSC),
- Ecosystem, Climate, Habitat, and Oceanography (ECHO) [cards](#), and
- PIFSC [staff directory](#).

All staff are encouraged to reach out through these venues as well as to individual staff to collaborate or learn more. This year's workshop conversations demonstrate that people are hungry for collaboration; collaboration inquiries are likely to be met with enthusiasm. And, as one participant noted, there's a demonstrated history of successful grassroots efforts within the Agency (e.g., NOAA Fisheries' ecosystems program).

Many panelists and participants also mentioned the continual need to ensure that all the right people are involved in collaborations. This often means adding seats to the table. As regional staff continue their climate-related research and management efforts, they are encouraged to continually ask themselves and their collaborators who is missing from the conversation – and to fill that gap. Barriers to collaboration should also be evaluated and addressed (e.g., adding staff capacity where needed, clearly communicating regional priorities).

### **Keeping protected species in the climate conversation**

Another workshop theme was noted by its absence: discussion of climate-related issues that affect protected species. Protected species face some of the starkest climate change impacts in our region – up to and including extinction – which makes their near absence from the conversation all the more striking. Also, the resilience work at Lalo grew from protected species (monk seals) work at previous climate workshops (Woodworth-Jefcoats et al. 2020, 2021). That said, PIFSC and PIRO staff who focus on protected species attended the workshop and were invited to serve as panelists. They also participated in the workshop's informal conversations. The workshop steering committee will explore avenues to ensure that this component of our region's work is well represented in future Annual Collaborative Climate Science Workshops.

One possible explanation for the 5<sup>th</sup> Workshop's almost exclusive focus on fish-related topics may be the themes around which the workshop was structured. Previous workshops included a session dedicated to protected species, whereas this year's workshop did not. Rather, session themes followed those of PIRAP 2.0, and were selected in part to address feedback from previous workshop attendees who expressed a desire to have climate conversations across our traditional organizational stovepipes (insular fisheries, pelagic fisheries, coral reefs, protected species). Going forward, greater effort may be needed to ensure all regional staff working on climate-related issues see a place for themselves at the Annual Collaborative Climate Science Workshops.

Another suggestion for broadening the focus of future workshops is to focus on ecosystems rather than fisheries. This approach would align with regional Ecosystem-Based Fisheries Management priorities. It would also encompass topics such as climate effects on prey, which are important to both protected species and fishery interests.

## Stay Engaged

Until the next workshop, we encourage people to stay engaged. Options for engagement include:

- PIRAP 2.0 Public comment period: Open through 29 July 2022, you can access the document and comment portal [online](#).
- PIRAP 2.0 rollout: This is anticipated to be in autumn 2023. For the latest details contact [Phoebe.Woodworth-Jefcoats@noaa.gov](mailto:Phoebe.Woodworth-Jefcoats@noaa.gov), [Kate.Taylor@noaa.gov](mailto:Kate.Taylor@noaa.gov), or [Matt.Seeley@wpcouncil.org](mailto:Matt.Seeley@wpcouncil.org).
- Quarterly ECHO call: Join our quarterly discussion on regional Ecosystems, Climate, Habitat, and Oceanography (ECHO). You can subscribe to NOAA's [ECHO calendar](#), or contact Ann Barlow or Phoebe Woodworth-Jefcoats to be added to the standing event.
- Intranet Site: You can keep tabs on all PIRAP 2.0 updates, including providing your own, on our PIRAP intranet site: <https://sites.google.com/noaa.gov/pirap><sup>7</sup>.

## See you next year!

The 6<sup>th</sup> Annual Collaborative Climate Science Workshop will be held in autumn 2023. If you would like to help plan the workshop or provide feedback on this year's workshop, please contact a member of the workshop steering committee:

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<sup>7</sup> An @noaa.gov email address is required for access.

## **Acknowledgements**

The steering committee extends their thanks to the workshop panelists and presenters for contributing their time and expertise. Panelists: R. Ahrens, J. Arceneaux, A. Barlow, G. Davis, J. DeMello, M. Fitchett, A. Ishizaki, A. Jacobs, D. Kleiber, T. Oliver, J. O'Malley, J. Ruzicka, M. Sabater, and J. Wren. Presenters: R. Greene, R. Guerrero, A. Halford, P. Houk, D. Ochavillo, D. Polhemus, and A. Reyes.

Thanks also to the recorders whose notetaking deftly captured the workshop: D. Kramer, T. Souza, T. Spence, and N. Trevino. The steering committee is grateful to C. Lewis for addressing IT challenges, and to E. Duke for providing the production support for the online platform.

Feedback from J. Brodziak, J.A. Cruz, R. Domokos, R. Greene, D. Kleiber, K. Leong, J. Marra, J. O'Malley, M. Parke, J. Ruzicka, M. Seeley, and K. Taylor improved this report as did editing by A. Rivero.

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## Appendix A Agenda

**Tuesday, February 8, 2022**

9 AM – 12 PM          Regional Coordination and Operations

9:00 am          Introduction to the Session          Phoebe Woodworth-Jefcoats

9:10 am          Remarks from PIFSC Director          Mike Seki

9:20 am          Remarks from PIRO Director          Mike Tosatto

9:30 am          Panelist Introductions

*Ann Barlow (PIRO)*

*Ariel Jacobs (PIFSC)*

*Asuka Ishizaki (WPRFMC)*

*Mark Fitchett (WPRFMC)*

9:45 am          Panel Discussion

10:30am          Introduction to Wonder          Ann Barlow

10:40am          *Break*

10:55 am          Conversations in the online platform Wonder

11:40 am          Regroup in WebEx

11:45 am          Ah-ha Moments          Open forum

1 PM – 4 PM          Ecosystems, Habitats, and Humans

1:00 pm          Introduction to the Session          Phoebe Woodworth-Jefcoats

1:10 pm          Panelist Introductions

*Tom Oliver (PIFSC)*

*Danika Kleiber (PIFSC)*

*Gerry Davis (PIRO)*

*Joshua DeMello (WPRFMC)*

1:25 pm          Panel Discussion

2:25 pm          Introduction to Wonder          Ann Barlow

2:35 pm          *Break*

2:50 pm          Conversations in the online platform Wonder

3:35 pm          Regroup in WebEx

3:40 pm          Ah-ha Moments          Open forum

## Wednesday, February 9, 2022

### 9 AM – 12 PM      Invitational Special Session on Lalo Resilience

- 9:00 am      Introduction to the Session      Ann Barlow & Kilo Ka’awa-Gonzales
- 9:10am      Resilient Lalo and Review of  
Systems/Stressors Framework      John Marra
- 9:25 am      Systems/Stressors Breakouts (Coral & Birds Teams)
- 10:35 am      Break - then return to Plenary
- 10:50 am      Seabird small group report out
- 11:00 am      Corals small group report out
- 11:10 am      Systems/Stressors Synthesis Discussion (all, including Seal and Turtles)
- 11:50 am      Next steps and closing

### 1 PM – 4 PM      Impacts to Life History and Biology

- 1:00 pm      Introduction to the Session      Phoebe Woodworth-Jefcoats
- 1:10 pm      Panelist Introductions  
*Joe O'Malley (PIFSC)*  
*Jim Ruzicka (PIFSC)*  
*Gerry Davis (PIRO)*  
*Mark Fitchett (WPRFMC)*
- 1:25 pm      Panel Discussion
- 2:25 pm      Introduction to Wonder      Ann Barlow
- 2:35 pm      *Break*
- 2:50 pm      Conversations in the online platform Wonder
- 3:35 pm      Regroup in WebEx
- 3:40 pm      Ah-ha Moments      Open forum

## Thursday, February 10, 2022

9 AM – 12 PM	Baselines and Shifting Distributions	
9:00 am	Introduction to the Session	Phoebe Woodworth-Jefcoats
9:10 am	Panelist Introductions	
	<i>Johanna Wren (PIFSC)</i>	
	<i>Rob Ahrens (PIFSC)</i>	
	<i>Marlowe Sabater (WPRFMC)</i>	
	<i>Mark Fitchett (WPRFMC)</i>	
	<i>Joe Arceneaux (PIRO)</i>	
9:25 am	Panel Discussion	
10:25 am	Introduction to Wonder	Ann Barlow
10:35 am	<i>Break</i>	
10:50 am	Conversations in the online platform Wonder	
11:35 am	Regroup in WebEx	
11:40 am	Ah-ha Moments	Open forum
1 PM – 4 PM	External Partners and Resources	
1:00 pm	Introduction to the Session	Phoebe Woodworth-Jefcoats
1:20 pm	Lightning Talks	
	<i>US Fish &amp; Wildlife Service</i>	<i>Dan Polhemus</i>
	<i>American Samoa Dept of Marine &amp; Wildlife Resources</i>	<i>Domingo Ochavillo</i>
	<i>University of Guam Marine Lab</i>	<i>Peter Houk</i>
	<i>Pacific Coastal Research &amp; Planning</i>	<i>Robbie Greene</i>
	<i>Mariana Islands Nature Alliance</i>	<i>Roberta Guerrero</i>
	<i>Navy (NAVFAC Marianas)</i>	<i>Andres Reyes</i>
	<i>Pacific Community Coastal Fisheries &amp; Aquaculture</i>	<i>Andrew Halford</i>
2:30 pm	Introduction to Wonder	Ann Barlow
2:40 pm	<i>Break</i>	
2:55 pm	Conversations in the online platform Wonder	
3:40 pm	Regroup in WebEx	
3:45 pm	Ah-ha Moments	Open forum

## Appendix B List of Participants with Affiliations

Jesse Abdul	Pacific Islands Fisheries Science Center
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Ryan Nichols	Pacific Islands Fisheries Science Center
Simon Nicol	The Pacific Community
Domingo Ochavillo	American Samoa Department of Marine and Wildlife Resources
Ryan Okano	State of Hawai'i Division of Aquatic Resources
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