

August 15, 2018

Mr. Phil Anderson, Chair
Pacific Fishery Management Council
7700 NE Ambassador Place, #101
Portland, OR 97220

RE: •Agenda Item G.3: Fishery Ecosystem Plan Climate and Communities Initiative Update

Dear Chair Anderson and Council Members:

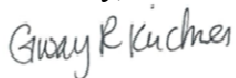
I am pleased to submit the Climate and Communities Initiative Workshop Report, summarizing the discussions that occurred in Portland, Oregon on May 15-16, 2018.

As you will remember, in November 2016, The Nature Conservancy (Conservancy) received funding to sponsor a two-day workshop focused on providing information to the Pacific Fishery Management Council (Council) on the third initiative selected through the process defined in the Fishery Ecosystem Plan (FEP). The Council worked to determine the appropriate use of the workshop in the Initiative process and thought the workshop would be serve the Council's need to help scope the initiative. A steering committee was developed and, along with representatives of the Fisheries Leadership and Sustainability Forum and the Creative Resources Strategy, created a workshop that was designed with maximum discussion time to achieve workshop goals. Invitations were extended to all members of the Council, the Ecosystem Working Group, the Ecosystem Subcommittee of Statistical and Scientific Committee, all members of the advisory subpanels, and the Chairs and Vice-Chairs of the management teams and the Habitat Committee.

A total of 67 individuals representing a variety of disciplines and organizations convened, with the primary goal of the workshop was to develop a set of recommendations to guide the Council in its implementation of the initiative. The report describes the information presented at the workshop as well as the outcomes of breakout sessions that explored the drivers of climate change and corresponding effects on fisheries and communities, potential pathways for addressing these issues, information gaps, and opportunities for the Council to play a role in addressing climate change issues to best position fisheries and communities for a changing era. Robust discussions resulted in many recommendations for initiative work. These recommendations have been provided in the report and could form the basis of Council discussion in September.

I will be attending the ecosystem agenda items at the September Council meeting and will be summarizing the workshop for the Council. I will be available to answer any questions. Additionally, please do not hesitate to contact me at gway.kirchner@tnc.org. Thank you.

Sincerely,



Gway Kirchner
Marine Fisheries Project Director, Oregon Chapter
The Nature Conservancy

The Nature Conservancy Climate and Communities Initiative Workshop

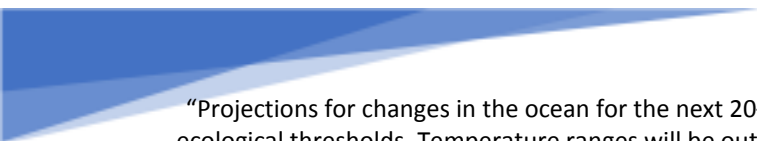
Portland, Oregon
May 15-16, 2018



Summary Report

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“Projections for changes in the ocean for the next 20–30 years are off the charts that cross ecological thresholds. Temperature ranges will be outside of historical experience. It will be a different ocean, which will bring new and greater challenges. Infrastructure is 50–100 years old, which makes it vulnerable to sea level rise, damage, and degradation. Dams are showing signs of vulnerability. We need to position fisheries and communities for a changing era in the foreseeable future.”

~QUOTE FROM A WORKSHOP ATTENDEE

Executive Summary

The Nature Conservancy hosted the Climate and Communities Initiative Workshop in Portland, Oregon on May 15-16, 2018. A total of 67 individuals representing a variety of disciplines and organizations convened to participate in the third initiative, the *Climate and Communities Initiative* (Initiative), undertaken by the Pacific Fishery Management Council (Council). The primary goal of the workshop was to develop a set of recommendations to guide the Council in its implementation of the Initiative, which is being developed under the Council's Fishery Ecosystem Plan. This report is intended to provide information for the Council to use in crafting Initiative details. It is important to note that this is not a full transcript of the workshop, rather it is a description of the information presented at the workshop as well as the outcomes of breakout sessions that explored the drivers of climate change and corresponding effects on fisheries and communities, potential pathways for addressing these issues, information gaps, and opportunities for the Council to play a role in addressing climate change issues to best position fisheries and communities for a changing era

The workshop was kicked off by panel of management, fishing, science, and tribal experts, focusing on the premise that this is the time to embark on this initiative. Panel participants shared that climate change is already here on the West Coast. Fishers and communities are experiencing the effects of climate change stressors at a variety of scales, intensities, and durations. While carbon dioxide emissions and greenhouse gases are the key drivers for climate change, with limited actions for the Council to take to impact these drivers, the Council can take significant actions to preserve stocks and ecological functions, and provide mechanisms to ensure vibrant fisheries and coastal communities. The Initiative is one way for the Council to develop and implement a suite of adaptation and mitigation strategies to ameliorate climate change effects.

Workshop presentations on the information necessary to set the stage for discussions, was focused into three sessions, with group discussions and breakout sessions following. The first session focused on the management and science foundations needed to frame the workshop context. Key agency climate staff were invited to share the current understanding of ecological and social impacts of a changing ocean. Workshop participants learned about direct and indirect impacts of climate changes in four areas: species, habitats, fishery management, and community/fisher behavior.

The second session was focused on Community and Tribal Foundations. Presenters framed the community and tribal context for workshop discussions and reflected on the importance of considering communities in relation to the impacts of climate change on Council managed fisheries. Workshop participants learned about the concept of community and that fishing communities are tied to place, practice, and cultural

identity. Tribal communities have strong cultural needs and often lack the ability to shift harvest areas and times. Participants also learned about the current social and economic considerations in the annual Integrated Ecosystem Assessment.

The third set of workshop presentations contained information on up and coming research that will inform the future climate change understanding. Presenters shared examples of the disciplines and methods of social science research to support Council consideration of communities relative to climate change.

During the workshop, attendees discussed several **potential Council principles that could guide the development of the initiative:**

- Ensure continued protection of ecological resources and functions.
- Continue to focus on existing Council priorities of reducing overfishing and appropriate management of target fisheries and bycatch.
- Incorporate a systems-level ecosystem-based approach to the management of fisheries.
- Incorporate social sciences, traditional ecological knowledge, and informal knowledge into the Council management structure and decision making
- Build trust and interaction with communities and fishers
- Enhance communication and outreach associated with climate change awareness.
- Recognize a regional, collaborative approach including a suite of stakeholders, such as fishers, fishery managers, industries, agencies, scientists, consumers, and policy makers, among others.
- Support adaptation by implementing changes to the management structure that allow for more resilient and adaptive fisher portfolios.
- Consider Council management actions in the context of all fisheries in adjacent jurisdictions (i.e., states and countries).
- Prioritize, on an ongoing basis, activities to address emerging climate change issues and the science and data needs to support those issues.

Throughout the discussions, attendees developed and honed a series of **actions the Council could take to implement the initiative**. The Council could pick a number of these actions to fill out the work of the initiative, building climate resiliency into the process and Council managed fisheries. The actions are summarized below.

- I. **Recognize, identify, and communicate the underlying drivers of climate change, including how they both constrain fisheries and affect the execution of Pacific Fishery Management Council authorities.**

- Workshop participants discussed the underlying drivers of climate change and what actions the Council could take to recognize, identify, and communicate the impacts of a changing ocean, including:
 - Communicate climate change drivers and effects with lawmakers, fishers, and others to inform national level policies;
 - Enhance flexibility using regional ecosystem-based solutions; share predictive tools;
 - Advocate for a reduced carbon footprint;
 - Develop a shared understanding of the management process and factors influencing predictions; and
 - Draft a resolution about climate change indicators so that the public is aware changes in the ocean are expected.

II. Establish a measurable, achievable, relevant, and timely (SMART) prioritized objectives for the initiative.

- Workshop participants provided several examples of objectives:
 - Improve understanding and awareness;
 - Ensure reliability of fishing as an activity;
 - Create opportunity to access resources (both commercial and recreational);
 - Monitor and assess impacts at varied scales; and
 - Enhance resilience, stability, and flexibility.

III. Develop a framework that identifies the most useful social, economic, and environmental climate change indicators and the science and data needs that best inform those indicators.

- Examples of science and data needs discussed include:
 - Obtain contemporary information on baselines;
 - Develop case studies to estimate significant change that requires flexibility and adaptation;
 - Assess community resilience to ensure Council decisions do not have a negative compounding effect;
 - Use real-time information to develop fishery specifications;
 - Use more intensive management systems that monitor and manage what is happening and can inform allocations;
 - Incorporate informal data in stock assessments;
 - Assess fishery infrastructure needs;
 - Address the increased need for information in an environment in which funding to obtain information is decreasing; and
 - Establish science and data standards and protocols.

IV. Identify a suite of management tools available to ameliorate climate change effects.

- Examples included:
 - Lessen the spottiness of fishery openings and closures by better coordination among the states and tribes;
 - Monitor and incorporate species range shifts and identify the corresponding impediments to community adaptation to these shifts;
 - Address the reduced flexibility of limited entry fisheries;
 - Increase monitoring using citizen science;
 - Develop consistent protocols for monitoring and management;
 - Better understand equity and distribution impacts within and across sectors;
 - Streamline and enhance flexibility of regulations;
 - Consider ecosystem optimum yield versus fishery optimum yield;
 - Address access issues to alleviate community impacts;
 - Facilitate group coordination (e.g., community cooperatives) and co-management;
 - Implement regulatory mechanisms using scenario planning to respond more rapidly to a set of conditions;
 - Ease the regulatory path to new fisheries access;
 - Fast-track/streamline the Exempted Fishing Permit (EFP) process;
 - Maintain/offer open access fisheries;
 - Reduce maximum sustained yields to create an uncertainty or variability buffer; and
 - Establish mutually agreed upon criteria to use community set-asides.

V. Develop solutions to roadblocks by developing an institutional framework that is flexible, creative, and adaptive.

- Examples provided include:
 - Expand partnerships to achieve enhanced equity among fishers, supporting;
 - Support fisher diversification to enhance resilience;
 - Increase engagement with fishers to develop scientific information needed to fish unexploited stocks and support greater innovation;
 - Work collaboratively with state-managed fisheries; increase opportunities for open access;
 - Facilitate succession planning to foster intergenerational equity; seek standardization across state and federal entities; and
 - Encourage fuel efficiency of fishing vessels through incentives.

The broad themes heard throughout the workshop were summarized in closing remarks from Council members, Rich Lincoln and Dorothy Lowman. Themes included metric, indicator, and data development and collection, using case studies to inform needs, providing flexibility in the management system, and connecting with communities. They ended the workshop noting the significant role of the Council as a leadership voice for issues, including climate change, facing the ocean environment.

I. Background

The Nature Conservancy hosted the Climate and Communities Initiative Workshop in Portland, Oregon on May 15-16, 2018. A total of 67 individuals representing industry, management, science, tribal, and non-governmental organizations as well as Pacific Fishery Management Council (Council) members (Appendix A) convened to participate in the development of the third Fishery Ecosystem Plan initiative, the *Climate and Communities Initiative*, undertaken by the Council. The goals of the workshop were to provide an opportunity for managers, scientists, and stakeholders to provide input into the Pacific Fishery Management Council's development of a climate and communities initiative through the Council's Fishery Ecosystem Plan by:

- Increasing understanding of climate-related changes, the drivers of change, and the scientific information available;
- Developing a shared understanding among the Council, its science and management advisors, industry and the public to discuss and respond to climate-related changes;
- Sharing perspectives on the region's most pressing issues related to climate variability and change;
- Considering the pathways for addressing these issues including specific management and non-management actions;
- Identifying information needs to support action and further considerations; and
- Providing ideas and information to support the Council's development and implementation of the Climate and Communities Initiative.

Workshop participants were provided with documents to review in advance of the workshop. Documents that were identified as "highly recommended" reading/viewing are:

- [Webinar series on climate and communities from January and February 2018](#)
- [Ecosystem Working Group Report 1](#), [Ecosystem Working Group Report 2](#) (presented at the March 2018 Pacific Fishery Management Council meeting)
- [Ecosystem Working Group Report](#) (presented at the April 2018 Pacific Fishery Management Council Meeting)
- [Ecosystem Based Fishery Management Roadmap](#)
- [National Climate Science Strategy](#)
- [Western Regional Action Plan](#)

- [2018 California Current Integrated Ecosystem Assessment](#) and [appendices](#)
- [Lenfest Fishery Ecosystem Plan Evaluation](#)

In addition, workshop steering committee members encouraged review of the following materials:

- Feeny, D., F. Berkes, B.J. McCay, and J.M. Acheson. 1990. The Tragedy of the Commons: Twenty-Two Years Later. *Human Ecology* 18(1):1–19.
 - Focuses on Hardin’s Tragedy of the Commons model, which predicts eventual overexploitation or degradation of resources used in common, encouraging expansion of the model to incorporate institutional arrangements and cultural factors to inform analysis and prediction.
- Clay, P.M., and J. Olson. 2008. Defining “Fishing Communities”: Vulnerability and the Magnuson-Stevens Fishery Conservation and Management Act. *Human Ecology Review* 15(2): 143–160.
 - Addresses vulnerability in fishing communities in the context of inclusive and holistic forms of management, noting Magnuson-Stevens requires managers to minimize economic impacts and sustain participation in fisheries.
- Coulthard, S. 2012. What does the debate around social wellbeing have to do with sustainable fisheries? *Current Opinion in Environmental Sustainability* 4:358–363.
 - Explores the concept of eudaimonic wellbeing, living a life that is valued and worthwhile as well as a three-dimensional framework that includes material, social, and subjective wellbeing, both of which can contribute to sustainable fisheries via articulating social and subjective impacts of fisheries declines and fisher behavior.
- Bell, R., and J. Odell. 2018. Actions to promote and achieve climate ready fisheries: Summary of current practice. A publication of The Nature Conservancy.
 - Identifies and compiles examples of implementing climate-ready fisheries principles and actions to reduce and mitigate impacts of climate change on the fisheries sector.

II. Workshop Framing and Purpose

To frame the purpose of the workshop, six individuals shared perspectives on drivers, need, and timing for the Climate and Communities Initiative. Panel participants and workshop attendees were asked the following questions:

- Why do you think a climate and communities FEP initiative is timely and valuable?
- What climate-related impacts are you experiencing or concerned about?
- From your perspective, how can this workshop contribute and add value to the Council's consideration of a Climate and Communities Initiative?

Presentations

Caren Braby, *Manager of Marine Resources Program at the Oregon Department of Fish and Wildlife*

Caren highlighted the scope of the climate change problem, noting the water off the Oregon coast during the summer months originated in the poles 60-80 years ago. Carbon dioxide sinks in the cold water, equilibrates, and is transported in long-term ocean currents that are now reaching our region and causing changes in species distribution and abundance because of ocean acidification. Hypoxia has driven distribution changes that have been observed in Dungeness crab, Pacific oyster, halibut, Pacific cod, and salmon. The Council needs to understand the changes taking place to ensure accurate fishery predictions.

Joshua Etherton, *Quileute Tribe*

The Quileute Tribe, located on the northern half of the Olympic Peninsula, harvests marine species year-round in usual and customary areas. Tribal members have observed changes related to climate change, including ecological regime shifts and ocean acidification. The community makes its living in association with the marine system. Baseline data is lacking relative to economical, ecological, and infrastructure concerns associated with climate change. Clear communication is critical to collaborate and build rapport, and art is a form of communication that can effectively transfer information. Disciplines outside of science can help connect information, people, and regions.

Walter Chuck, *Recreational angler, Oregon Department of Fish and Wildlife advisor*

The emphasis on sustainable demand requires good management and science from fishing communities. Changes are being seen more frequently, including domoic acid levels influencing shellfish production, hypoxic areas, shellfish closures, reduced recruitment of juvenile fish, and increasing warm water species. Oregon coast freshwater is groundwater; there is little snowpack. Increased populations on the coast will increase the demand for water – how will it affect fish? If rain events are becoming more intense, then our ability to store the water will be a challenge. Fishery disaster declarations affect our ability to provide services. The increase in disasters makes it more difficult for new people to be recruited to recreational and commercial fisheries. We need to ask ourselves

about constraints, the impacts of the changes, how fishing effort will shift along the coast, how agencies will work together, and how communities will be affected.

Nate Mantua, *Southwest Fisheries Science Center*

Nate acknowledged the challenges associated with addressing climate change issues, providing an example of how whale entanglements increased with the delay in the opening of a fishery, a decrease in krill populations, and an abundance of whales inshore feeding on anchovies. There are more frequent and intense impacts associated with drought, floods, and warm ocean conditions, which affect resources. Shifts in food webs and harmful algal blooms have negatively impacted species. He asked workshop attendees to think about ways to incorporate flexibility into fisheries management strategies.

Scott McMullen, *Oregon Fishermen's Cable Committee*

Scott shared information on carbon dioxide associated with a recent trip to Cape Point, South Africa. The carbon dioxide concentration at Mauna Loa Observatory was the highest ever in recorded history during the end of April of 2018. He asked workshop attendees to think about ways to address the issue. He shared the graphic on page 15 of the [Council's Fishery Ecosystem Plan](#), which documents the food web of the Northern California Current Ecosystem—a snapshot of the 1960s documenting standing biomass and biomass flux of prey to predators—and asked workshop attendees to think about how this complex food web would shift as a result of climate change effects.

Corey Ridings, *Ocean Conservancy*

Corey asked attendees to think about how we manage an environment that is more variable, where change is occurring rapidly. He asked attendees to evaluate our conservation, use, and community goals so that we can manage for the future, improving on and tracking goals through time so that the change in environmental variability considers both fisheries and communities. Climate change is driving changes in fish productivity and stocks as well as habitats. Droughts in California, hypoxia, and ocean acidification are affecting numerous species. The East Coast is experiencing geographically shifting stocks. We need to ask ourselves what changes are happening here—in our fisheries and communities. This workshop can add value by gathering perspectives on the most important climate-related issues the Council can address.

Session Discussion

Workshop attendees addressed topics of interest in the panel presentations as well as why they think the Climate and Communities Initiative is timely and valuable, climate-related impacts of concern, and ways the workshop can add value to Council efforts. The following are relevant comments from participants during the discussion:

Timeliness and value of the Climate and Communities Initiative

- Stock assessments may help to inform climate change impacts and response. It is timely to ask what gaps exist and what steps may be taken to close the gaps.
- Ocean acidification is an intellectually challenging concept such that people erect walls to protect themselves against the emotional challenges it presents. What is happening in our oceans has never happened on this planet both in human terms and in geological scales.
- The water upwelling off our coast now could be 80 years old. We would still have 60–80 years of this train moving at us, even if we acted to eliminate carbon emissions today. We need to ramp up our response, which has been meager compared to the size of the problem. We must respond dramatically.

Climate-related impacts of concern

- We are not addressing the fact that people are burning fossil fuels at an unprecedented rate; we need to incentivize society to reduce the carbon footprint.
- There are numerous climate change-related effects, such as on birds and traditional cultural values (e.g., Yurok and eulachon). The Council has been proactive (e.g., bans on krill, investigating environmental characteristics of sablefish recruitment). Fisheries impacts due to climate change are important, but there are other things facing society that other organizations without restrictive legislative mandates may be able to explore.
- Financial resources will be needed to address climate change effects, such as sea level rise, on fishing communities. Changes in fishing gear will need to occur to adapt to changing fisheries, and infrastructure will need to be addressed.
- The ability to process fisheries will become more necessary, yet the infrastructure to process these fisheries is declining. Oregon is changing—the population and dynamic is changing. The values of people and the emphasis on fisheries may not be as great as it was in the past. Fishers see real changes that need to be incorporated into management decisions.

Additional Takeaways

- The Council needs to be more adaptive to correspond to changes in the environment.

- We control capacity (i.e., effort) in fisheries through restricted access and permitting, but need to be more flexible to allow fishers to pursue targets available to them at a time.
- Climate change information should be more formally incorporated into Council processes and communication, despite the lack of certainty.
- Researchers could add value to the types of information collected and presented on climate change issues by working more closely with fishery managers and the Council.
- Involve fishers in research. When fishermen are involved, they need to understand how their data is being used in real time, not 4–5 years later.
- When you connect with people, talk about climate change solutions that resonate with their own values and what they care about.
- Provide a clear message on the drivers of climate change- emissions and greenhouse gases and the issues of the impacts on fisheries.

III. Management and Science Foundations

Five individuals gave presentations to frame the management and ecosystem context for the workshop, reflecting on how both might inform the initiative.

Presentations

Yvonne deReynier, *West Coast Regional Office*

PFMS Fishery Ecosystem Plan and the Climate and Communities Initiative

The West Coast has one fishery management council and four fishery management plans that address more than 100 species. In 2013, the Council completed the development of an ecosystem management plan that describes Council’s priorities for the California Current Ecosystem (i.e., the Fishery Ecosystem Plan; FEP), including an appendix with policy process and ideas that cross fishery management plans—topics such as addressing bycatch and the long-term structure of managed stocks. The FEP defines a process developed to ensure continued work on ecosystem issues (i.e., Initiatives).

The first ecosystem initiative completed by the Council prohibited currently unmanaged forage fish, to protect the forage base. The second ecosystem initiative reviewed the

indicators reported on in the annual Ecosystem Status Report, an educational tool to help people understand the California Current Ecosystem and create an annual story, to tailor them more closely to the needs of the Council. The third initiative—the Climate and Communities Initiative—is intended to examine potential long-term effects of climate on fish stocks and fisheries by exploring ways to improve flexibility and responsiveness to the climate changes we are experiencing.

This workshop should address strategies for improving the flexibility and responsiveness of our management actions to near-term climate shifts and long-term climate change while increasing the resilience of our managed stocks and fisheries to those changes.

Chris Harvey, *NOAA Northwest Fisheries Science Center*
California Current Integrated Ecosystem Assessment (IEA) and Science Center
Webinar Series

The integrated ecosystem assessments (IEA) is provided to the Council annually, with the goal of establishing a framework for developing integrated science support in partnership with end users. There are seven major types of components—focal ecosystem components, habitats, climate and oceanographic drivers and pressures, human activities, human wellbeing, local social systems, and social drivers. The process includes establishment of targets, metrics that reflect the status and trends of targets, quantifying the uncertainty and the risk in achieving the goals and targets, and then simulating and comparing strategies to implement, defining tradeoffs, and providing science support to management. Indicators, targets, and risks have been developed for the Council—this workshop is intended to help achieve other elements of the IEA. California Current IEA scientists are working on all components of the ecosystem. Enhanced communication and coordination with management and stakeholder partners is needed to inform management-relevant and management-ready science.

In support of the Climate and Communities Initiative, IEA scientists and colleagues described the state of science of climate change effects on the California Current ecosystem via four webinars:

- **Webinar #1:** *What is expected to happen in the California Current under climate change*—Temperature and droughts will increase; primary production, dissolved oxygen, and pH are likely to decrease; upwelling is expected to increase slightly in the north, and decrease strongly in south; climate stress tests (such as El Niño/blob) are more likely in the future because climate change is pushing us into thresholds and unknown territory that will lead to changes in species distribution and salmon fishery disasters. Caveats—it may

take several decades for climate change signals to distinguish from interannual, interdecadal variability.

- **Webinar #2:** *The state of the art for ecological forecasting at short, medium and long-term time frames*—Forecasts can be tailored to specific Council needs and should include rigorous skill assessment and estimation of uncertainty. These include seasonal forecasts (6–9 months) of oceanographic conditions (e.g., temperature, dissolved oxygen) and species distributions; and long-term (up to ~50-year) forecasts of climate scenarios, ocean acidification, food web dynamics and potential fishery dynamics and economic impacts in different ports. A key gap is models that forecast 1–20 years with skill.
- **Webinar #3:** *Distributional changes of West Coast species and impacts of climate change on species and species groups*—Fall Chinook salmon stocks are expected to shift north in warm years, but the shifts are modest and there are many exceptions. Spatial models that include habitat effects indicate groundfish distribution is mostly static or shifting north, ranges of some rockfish are contracting, and this changes accessibility to ports. Large pelagic species distribution correlates with temperature and chlorophyll a; this can be mapped and projected forward. Caveat—future effects will be a function not just of climate and oceanography, but also surviving in that habitat.
- **Webinar #4:** *Modeling changes in fishery participation and economic impacts in response to climate variation and climate change*—NOAA scientists are studying links between environmental change, species dynamics, social motivation and fisher behavior, and how this linked system responds to environmental or economic shocks. Connections to broader coastal/regional economies can be tracked with economic input/output models.

Michelle McClure, NWFSC

NMFS Western Regional Action Plan and Climate Vulnerability Assessment

The NOAA Fisheries Climate Science Strategy (Strategy) is the federal approach to increase the collection and use of climate-related information needed to meet fishery management needs. From the strategy, the Western Regional Action Plan (WRAP) was born. The WPAP, with a 3-5 year lifespan, identifies current and future priority needs and specific actions, such as a coordinated climate program that builds on the existing IEA work by sustaining scientific expertise, coordinating and optimizing survey and observation efforts, conducting Management Strategy Evaluations, and disseminating information, that will implement the Strategy on the West Coast.

The Climate Vulnerability Assessment (CVA) is a key analysis included in the WRAP. The CVA assesses the vulnerability of fish species to a changing climate to provide relative vulnerability rankings, identify key attributes/factors and life stages driving vulnerability, identify key data gaps or information needs, provide input to management options at the regional and Council level, and contribute to life cycle modeling efforts. Vulnerability is a combination of exposure, sensitivity, and whether response (adaptive capacity) can reduce impacts. To assess stock vulnerability, scientists have compiled information on exposure (e.g., sea surface temperature, sea surface salinity) and sensitivity (e.g., prey specificity, acidification) and asked experts to score exposure and sensitivity for each of the factors.

A range of vulnerability occurred across the 80-species analyzed. Analysis showed that salmon (e.g., Chinook and coho), green sturgeon, and yelloweye rockfish were the most vulnerable to impacts from changing ocean conditions. Demersal species, such as rockfish tended to be more vulnerable, while mobile and highly migratory species tended to be less vulnerable, as they have a greater likelihood of changing location in response to climate change.

Kristin Marshall, NWFSC

Incorporating Climate and Ecosystem Information in Stock Assessments and Management Strategy Evaluation

There are multiple on-ramps for climate and ecosystem information in stock assessments and management strategy evaluations. Existing examples and on-going research demonstrate diverse tools and approaches. More isn't always better; prioritization is needed.

Climate and ecosystem information can inform tactical management and strategic planning—tactical management cycles (short to longer term). Assessments happen short term versus management strategies on a longer time frame.

Using Climate and Ecosystem Information in Stock Assessments—Bycatch target, bycatch other, habitat, climate, diet, predation, and competition are pieces of information used in U.S. stock assessments—there is quite a bit of information on the ecosystem side (quantitative). A total of 14% of these assessments included climate information, such as catchability factors (temperature dependent), catch (temperature-dependent assignment), productivity/recruitment (environmental indicators), and growth. Lessons learned:

- Progress has been made including climate and ecosystem information in US stock assessments
- More isn't always better, multiple pathways exist
- Inclusion may be influenced by life-history, overfishing, data availability, and other factors
- Potential extension: develop guidelines for prioritizing use of system-level considerations

Management Strategy Evaluation (MSE) is a good practice that improves decision making, tests the robustness of a current management strategy to current and future uncertainty and alternative hypotheses about the fishery system, and develops and screen alternative strategies. MSE is a highly engaged, stakeholder-driven process.

Dan Holland, *NWFSC – Human Dimensions*

Human Dimensions of Ecosystem-based Fisheries Management and Climate Change

Along the West Coast, fisheries revenue and relative shares change through time primarily because of fish productivity and prices. Many key species have variable productivity (landings). Most fishers rely on the ability to fish a suite of fish species throughout the year (portfolios). Resilience is increased in communities that have a diverse portfolio of fisheries, though diversification has been declining since the early 1990s, driven by limited access to fisheries and the higher cost of involvement in multiple fisheries. In 2016, 50 percent of fishers earned less than \$50,000 in gross revenue. Some fishing households are doing well, however, most that are doing well, rely on other sources of income.

We are working to provide information for planning (how will the ecosystem change and when, and how are markets changing?); facilitate planning by individuals and communities; and enable adaptation—support resilience without strangling adaptation; explore alternative access regimes; consider alternative industry structures (West Coast is dominated by owner-operator structure versus cooperatives); facilitate diversification strategies. The missing link is assessing what happens off the water—we understand how the natural system works, and we have some understanding of what happens in communities, but we don't have a strong understanding of what drives investment decisions, how it affects what is caught and landed, and what drives the locations of processing plants.

Session Discussion

Workshop attendees discussed the panel presentations as well as what they viewed as strengths of existing information foundational to the development of a climate change initiative, and how they envisioned climate-related information being integrated into management and decision making. Specific takeaways from the discussion are:

Council opportunities

- Develop ways for the Council to address key data gaps using strategic approaches, such as where future fisheries should be focused;
- Work cooperatively with fishers;
- Conduct scenario planning with communities;
- Align vulnerability assessments with species that need to be monitored more closely;
- Explore opportunities to transition to different organizational structures such as community-based cooperatives as the fleet ages¹;
- Assess how much diversification is practiced by fishers (e.g., not just in terms of fish harvested, but activities such as ecotours); and
- Explore the potential for enhanced adaptability (e.g., we may see more production as well as shifts in the timing and geography of fisheries).
- Reduce maximum sustainable yields to create a buffer to improve resilience and enhance flexibility,.

Vulnerability assessments

- Across the suite of reasonable exposure and biological sensitivity factors, a suite of species seems to be more vulnerable than others. Every species is exposed to ocean acidification, but we don't know how it will affect each species. Nearshore communities could be more impacted by climate change.
- There are 6,000 square miles of federally designated wilderness areas in Idaho, which contain high elevation spawning and rearing habitat, a sanctuary for salmon. Protecting cold water refugia and habitats critical for life stages of some species will enhance resilience to climate change stressors.

¹ The fleet is aging (median age is higher than 60), yet there are few replacements; as fishers age, they don't fish as much, but retain their permit (which becomes part of their retirement portfolio). A young fisher doesn't have the resources to buy into multi-million-dollar fisheries. In the south, there is an interest in individual marketing, which omits the processing sector portion of the industry. An opportunity exists to transition to a different organizational structure, such as community-based cooperatives, as the fleet ages.

IV. Breakout #1—Impacts to Fisheries and Communities

Following the presentations described above, attendees explored the potential direct and indirect impacts of climate change to Council-managed fisheries and communities by convening in three separate breakout sessions, and then sharing the results of their discussions. There were a few pre-planned questions (below) developed to initiate the discussion and then talks continued in an open format.

- How do you anticipate that climate and ecosystem variability and change could impact the Council's managed fisheries, fishery participants, and communities?
- What management tools and strategies are used in each fishery or example? To what extent do you feel they are robust or responsive to change? What attributes make fisheries more or less resilient to change?
- How might climate change increase or change interactions and intersections with other species and fisheries (e.g., state managed fisheries, bycatch, effort shifts, protected species interactions, emerging fisheries)?

Overall themes of discussions were focused on Council process, impediments to policy/regulatory change, opportunities, and access to fish. Participants identified the following impacts to species, habitats, fishery management, and community/fisher behavior:

Species—Changes to fish stock abundance and distribution, changes to community structure for indefinite periods of time, alterations of fish migratory routes and timing (which could inform treaty changes), distribution and feeding behavior of fish, and absence of forage fish.

Habitats—Increased numbers and intensity of harmful algal blooms (pH declines, ocean temperature increase, harmful algal blooms increase), and loss of habitats (e.g., kelp).

Management—Increased risk and uncertainty (which affects investment decisions), unintended consequences (example given: whales switched prey to anchovy, then domoic acid affected the delay of the crab opening, which resulted in increasing number of whale entanglements), shortened or closed fisheries, increasing interceptions in trawl bycatch, changes in the fishery itself², response to the precautionary approach to uncertainty (which doesn't encourage risk), uncertainty of the ability of some climate change indicator signals (e.g., sea surface height for sablefish recruitment) to be picked

² Examples given included the ability of larger boats to fish further offshore; the ability of some boats to process their fish at sea, which allows them to stay at sea longer; and an enhanced focus on other fish species because of the limited offshore access.

up via stock assessments (and a mismatch in surveys and species distribution), changes to and closures of fishing seasons (noting the only way to control is to manage the fishery, especially when drivers, such as drought in California, are outside of the jurisdiction), the ability to access abundant stocks in locations where weak stocks exist, such as fishing below the minimum escapement level (e.g., Klamath), forecasting a few years in advance (which is possible when the exploitation rate on a certain age fish is determined, and the response is a restructuring of a season that would result in an expected number of an age class available for harvest the following year), recognizing the tradeoffs that exist when adaptation occurs, e.g., further north, fishers are taking advantage of the distribution shifts, but communities that harvested those fish as part of their portfolio are impacted, the need to maintain port infrastructure to respond to changes in fisheries (e.g., Oregon ports don't have the ability to offload squid), the effects of limited entry (which is dependent on the species, e.g., it is more difficult for an albacore fisher to switch to another species than it is for a salmon fisher)³, introduced variability and its effects on the current harvest control rule, the need to reassess assumptions⁴, lack of in-season assessment tools, spotty fishery openings and closures, transboundary impacts (e.g., hake, groundfish, sardine and distances fishers must travel).

Community/fisher behavior—Loss of faith in the management system by fishers, trawl permit fishers using pots and longline harvest larger fish (affecting future abundance)⁵, reluctance to invest in ephemeral fisheries because of the inability of the management system to respond in a timely manner, loss of institutional knowledge as fewer people enter fisheries, increased barriers to new entrants, and consolidation of fleets.

Specific takeaways from the discussion include:

Communication

- Openly discuss climate change impacts on fisheries to inform national level policies.
- Use the ability of individual Council members to independently provide information, if asked by Congress.
- Use existing communication avenues with fishers to inform them of the tools available, e.g., harmful algal bloom models.

³ And even if people gear switch, having a broad portfolio is needed to make ends meet.

⁴ If the reference points that control catch limit no longer have the same meaning with changing environmental conditions, it would suggest stock is not at expected levels.

⁵ Gear and vessel type affects impacts of climate change – and permitting regimes. Some vessels better allow for the ability to participate in multiple fisheries with the same vessel, e.g., Dungeness, groundfish, salmon.

- Disaster declarations—Encourage states to obtain disaster relief associated with harmful algal blooms.
- Advocate for reduced carbon footprint.
- Better communicate the management process, explaining factors influencing predictions.

Partnerships

- Work with fishermen along the coast to distribute the pain and the benefits equitably.
- Better define roles and expectations of levels of Council structure and NOAA science and regional offices.
- Coordinate and frame the issues of access and flexibility to support fisher diversification.
- Engage with fishers to develop scientific information needed to fish unexploited stocks.
- Support greater innovation and partnerships and how to obtain resources to fill gaps.
- Work in collaboration with state-fishery managers.
- Use subpanels and management teams as think tanks to identify threats and provide feedback.

Science and Information

- Account for uncertainty about distribution, abundance and through time, species persistence.
- Obtain contemporary information on baseline, which is in flux constantly, not flatline (some existing baseline dates back to the 1970s and 1980s). Develop a few case studies where we estimate significant change that requires flexibility and adaptation and will require us to adapt—framework adaptive decisions based on scenario.
- Assess community resilience to ensure Council decisions do not have a negative compounding effect.
- Foster nimbleness, using real-time information to base the development of fishery specifications – or use more intensive management systems that monitor and manage what is happening and can inform allocations.
- Consider informal data in stock assessments.
- Determine what is needed to install new processing facilities, including permits, zero waste fishery consideration.
- Address the dichotomy of the need for information, which is increasing, while funding for obtaining information is decreasing.
- Assess how to use systems-level thinking to fulfill needs.

- Review objectives to ensure they are strong quantifiable statements and then prioritize which are most important, which will drive the science support needed.

Management approaches

- Move faster to implement pop-up experimental fisheries (e.g., market squid, use of Exempted Fishing Permit \ \
- . Use institutional creativity to establish a framework that has sideboards and would allow a variety of activities, including access to pop-up fisheries.
- Lessen the spottiness of fishery openings and closures by better coordinating among the states and tribes.
- Think about distribution and abundance. Abundance may be constant, but distribution is shifting, or both abundance and distribution may be changing. Range shift (constant overall abundance) versus range expansion (greater overall abundance) leads to different management solutions.
- Strategize ways to address the reduced flexibility that limited entry fisheries cause (e.g., permit banks attached to communities or ports, with reduced transferability, assess the dynamic between state and federal permit systems, more diverse fishers are less likely to leave fishing)
- Increase monitoring to inform adaptive management, enlisting fishers in the collection of the information (e.g., temperature and salinity sensors on East Coast lobster pots)
- Develop consistent protocols for monitoring and management of crab—impacts to market (monitoring needs to be responsive to human health and the market)
- Continue to seek to understand equity and distribution impacts within and across sectors.
- Describe regimes that can achieve sustainability and economic viability and provide flexibility.
- Consider a climate change insurance plan (community or fishery level insurance, similar to crop insurance).
- Review layers of regulations and seek to streamline, articulating objectives for newer, more flexible regulations.
- Consider Ecosystem Optimum Yield versus optimum yield for a cxcsingle species.
- Recognize how access to fisheries can alleviate or exacerbate community impacts.
- Implement scenario planning to respond more rapidly to a set of conditions.
- Assess how species are going to rearrange themselves along the coast, and impediments to communities adapting to that distribution to enhance community resilience.

Attendees were asked if climate change presents the Council with a fundamentally different challenge, or one additional change that requires a response. Participants agreed that we are on a trajectory toward something different that requires a fundamentally different framework for decision making. Fortunately, there are other places where lessons learned can be extracted, such as the Bering Sea crab industry, which collapsed, then adapted. The Council can identify the upper level of constraints that might be in place for populations; e.g., urbanization alone creates an upper limit for recovery – then consider that constraint to better defining the upper ceiling.

V. Community and Tribal Foundations

The objective of this portion of the agenda was to frame the community and tribal context for workshop discussions and reflect on the importance of considering communities in relation to the impacts of climate change on Council-managed fisheries.

Presentations

Melissa Poe, *Washington Sea Grant*

Leila Sievanen, *California Ocean Science Trust*

Fishing Communities 101

Fishing communities are fluid and heterogeneous—The concept of community connotes familiarity, place, and connection. Community is place-based. Magnuson-Stevens (NS8 – Communities Standard) states a fishing community is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs. Their members reside in a specific location and share a common dependency on commercial, recreational, or subsistence fishing. Fishing communities are both tied to place and to practice (target species, gear types); cultural identity (African American oysterman from the Gulf Coast, Vietnamese fishers, Portuguese families of New Bedford – cultural, ethnic, or racial identity); tribes (uniquely historic and place-based consideration – also comanagers with decision making authority). All of these communities are part of other non-fishing communities.

Fishing is important to communities for many reasons—Livelihoods and economic security, food security and food practices, cultural identity, social relationships, recreation and connection to ocean, health, self-determination—human wellbeing.

Communities are unevenly impacted by climate change— There is an intersection between climate-driven species vulnerability with socioeconomic vulnerability. Social indicators can help identify “climate equity hotspots” (communities most at risk). Hotspots direct attention, assistance and relief accordingly.

The ability of communities to adapt to climate change is at a variety of scales— In the California Current, adaptation is shaped and constrained by regulatory, economic, social and ecological factors. Diversification has been a key adaptation strategy to weather the vicissitudes of fisheries. Increasing regulatory inflexibility coupled with limited access and cost to engaging in new fisheries reduces the potential for diversification and thus adaptability.

Ecosystem-based fishery management allows us to think/study/account for human dimensions of fishing and ecosystems in more dynamic ways (scales, processes, interactions, connectivity, feedbacks, bio-cultural systems,). The ecosystem approach contrasts with a production-function approach of single species sectors (where marine systems are sources of economic-production/harvest for MSY and such that fishing is an impact on ecosystems). Opportunities exist to reposition communities as more than just sites of ‘social impact’ but rather as determinants of both fisheries dynamics and management options.

Mike Chang, *Makah Tribe*

Climate Change and Health Impacts for Tribal Communities

The Makah Tribe are based in Neah Bay, Washington. Via the 1955 Treaty of Neah Bay, they ceded 300,000 acres of land to the United States and reserved the rights to hunt, fish, gather, seal, and whale within usual and accustomed areas, maintaining co-management of resources. They are place based and place bound.

An internal climate change working group developed a set of lessons learned from climate change assessments, including: many are dense and highly technical—written by scientists for scientists; there is a lack of traditional and cultural knowledge expressed; and there is a lack of planning relevancy—how can vulnerability assessments be implemented across sectors and for multiple species?

The Makah Tribe conducted a survey and convening with tribal members to help identify community concerns, learn about community understanding of climate change, understand the level of support for climate planning efforts, and explore the challenges natural resource managers face when attempting to incorporate climate change planning into their own work. The results of the survey (140 respondents or 10% of the tribe) demonstrated climate change has already impacted and will continue to impact Makah

people's livelihoods and jobs—68% of survey respondents said they were observing climate change impacts (ocean acidification and warmer ocean temperatures were significant concerns). Fishing employs 80% of community on-reservation members. Climate change will impact Makah members and their families' ability to respond to extreme events—6–8 power outages (power is out for hours to days) per winter due to severe storm events, causing concerns for the elderly. Climate change will impact Makah cultural practice and affect people's identity and wellbeing—phenological changes are impacting subsistence harvest and seasons; impacts to fisheries will directly impact all other resources (natural and cultural); there are connections between ocean acidification and berry harvests; changing ocean conditions directly impact “being a coastal native.” Some of these resources are irreplaceable for tribal communities (i.e., diversification is not a means of resilience because the resources in question are unique due to their cultural importance).

Chris Harvey, NWFSC

Social and Economic Considerations in the IEA

Each March, the California Current IEA team delivers their annual ecosystem status report, which includes a human dimensions portion focused on fishing and non-fishing human activities. Indicators are reasonable proxies for social and economic conditions, but this portion of the report needs greater investment. Human activities related to fisheries, especially landings, are summarized by species, location, and state. Some non-fisheries marine activities, such as oil and gas activities and shipping, are tracked. Other activities of interest include freshwater use and basic measures related to National Standard 8 (e.g., total fishing or processing activity, infrastructure added because of climate change, etc.).

Human wellbeing—Fleet diversification is an indicator of wellbeing for coastal communities, however, it has been declining during the past several decades. Community social vulnerability is tracked using metrics that describe the vulnerability of a community due to poverty, low employment, education challenges, and other negative societal drivers. Caveats and considerations include information that is difficult to ground truth, dependence on census data, and difficulty discerning the useful spatial level at which to aggregate. Doing more requires resources, clear objectives and policies, and guidance on the most important social attributes.

Some possible ideas to consider for indicators: Mandates to National Standard 8; Information from survey work, such as what motivates people to fish, to help identify potential tradeoffs at the community level; identification of managed resources at greatest risk from climate change, including those valued most at the local, regional, or

coastal scales; other climate change effects with ramifications for coastal communities, e.g., sea level.

Session Discussion

Workshop attendees discussed the panel presentations as well as what they viewed as the impacts of climate change on communities. Specific takeaways from the discussion are:

- The Council could allocate small amounts of fish to increase the viability of a fisher portfolio, balancing the rights of those individuals that hold expensive permits. However, large boats traveling long distances leave a large carbon footprint; we want to encourage people to work small and do the right thing.
- How can the NW and SW Fisheries Science Centers be used to address climate change/community questions? Emerging research from the region is linking climate vulnerable species to climate vulnerable communities.
- Have the results of the vulnerability analysis been vetted with communities? It is intended to be part of the process. Ultimately communities are structured by human behavior that may not be captured by the assessment.
- Salmon troll fisheries are based on salmon abundance, which are linked to lingcod and halibut catch allowances. For every five salmon harvested, a fisher is allowed one halibut. Could trollers catch halibut if not fishing for salmon? That would better address the “community” approach to vulnerability.
- Tribes are important conservation partners. Some of the tribes receive funds from wetland mitigation banking, thus protecting the environment while securing valuable financial resources.
- Will dependence on commercial fisheries force a community into a higher vulnerability state? An approach to incorporate tribal community information is to incorporate the time component.
- We talk a lot about vulnerability, risk and sensitivity—disaster and risk reduction has not been mentioned.

Big session takeaways include:

- Indigenous livelihoods and economies are at risk (traditional subsistence economies – reliance on local natural resources for personal use, trade, barter, and

sharing) and commercial economies (fishing, timber, casinos, tourism, energy, and agriculture)

- Physical, mental, and indigenous values-based health are at risk—climate change is already impacting lands, waters, and species that tribes and indigenous peoples use for foods, ceremonies, historical and cultural sites and relationships; physical health disparities have direct linkages increased vulnerability to climate change impacts; health impacts are compounded by social, political and economic factors.
- Climate response actions include adaptation, disaster management, displacement, and community-led relocation. However, there remains many institutional barriers. Within the region, there are many different types of legal and recognition statuses for Tribes in Washington, Idaho, Oregon, and California, and many of these tribes and indigenous groups have to not only address climate impacts at the local scale, but also deal with issues of recognition, management status, and other barriers (such as water rights).

VI. Communities and Change: Research Highlights

Session presenters shared examples of the disciplines and methods of social science research to support Council consideration of communities relative to climate change.

Presentations

Arielle Levine, San Diego State University

Climate Impacts in the California Current: Exploring Fishermen’s Vulnerability and Adaptive Capacity

Components of vulnerability include:

- Exposure—the degree, duration, and/or extent to which the system is subject to perturbation.
- Sensitivity—the degree to which a system is modified or affected by a disturbance or set of disturbances.
- Adaptive capacity—the ability of a system to adjust to disturbance, moderate damage, take advantage of opportunities, and cope with the consequences of the transformations that occur.

Adaptive capacity has two components—the capacity of a social-ecological system to absorb stresses and maintain function in the face of climate change; and adapt, reorganize, and change in ways that improve the sustainability of the system.

The goal of the project is to better understand how predicted changes in climate and ocean circulation will affect three key fisheries (squid, sardine and lobster), with a focus on sardine and lobster, both of which contribute significantly to the California economy.

Assessing the vulnerability and adaptive capacity of fishers is based on location, seasonal characteristics, reliance on other species or income sources, mobility, infrastructure, adaptive capacity, and perceptions and potential outcomes of management alternatives.

There are different social and ecological characteristics of each fishery. Squid catch shifts north during warmer El Niño events and shifts south in cooler conditions. Squid spawn in cooler waters, have a wide geographic range, and the fishery is characterized by large, mobile vessels. The northern limit for lobster is Pt. Conception. Lobsters are more active and achieve faster growth rates in warmer waters. Boats are typically smaller and less mobile, it is a highly territorial fishery, with no big shift difference.

Information is being gathered from fishers, with planned follow-up focal groups to assess reliance on fishing and species fished, current fishing locations, patterns they have seen and adaptations to past short-term climate variations, changes in reliance and participation in the fishery, spatial flexibility and limitations to mobility, what they would they do if the fishery was no longer viable, obstacles to adaptation, and perceptions of management measures for the fishery.

Melissa Poe, *Washington Sea Grant*

Ocean Acidification Impacts to Coastal Communities

The goal of ongoing projects is to better understand climate driven ocean changes for community wellbeing and vulnerability.

Olympic Coast as a Sentinel is an integrated social-ecological regional vulnerability assessment of ocean acidification, focused on determining the social importance of key ocean acidification-sensitive species and the role they play in community wellbeing, synthesizing existing socioeconomic data for factors that affect vulnerability and the ability to cope, assessing the social vulnerability to ocean acidification through workshop-based sensitivity analyses, and identifying community-driven strategies for responding to threats and increasing adaptive capacity.

Some of the indicators include physical health, cultural use and practice, community connections, balance/resilience, natural resources security, education, self-determination. Some decline to a greater degree than others – physical health and cultural use and practice were equally highly vulnerable, followed closely by community connections.

Dan Holland, NWESC

The Dynamics of Adaptation to Climate Driven Variability

The objectives are to understand how environmental vulnerability travels through and is dampened and amplified by linked social and ecological processes in fisheries systems on the U.S. West Coast; to explore how more integrated management of fisheries can be used to increase resilience and human benefits derived from West Coast commercial fisheries; and to engage a disparate part of the fishery management community.

Big picture questions focus on biological fluctuation interactions with management, assessing how adaptations respond to system variability and robustness, understanding system dynamics to anticipate and mitigate climate change effects, and how effects across fisheries enable formation of robust fishery portfolios.

There are four themes: Linking environmental variability to marine species' recruitment and distribution; Psychological and social benefits and drivers of fishery participation and wellbeing; Linking stock status, regulation, and social motivations to fisher behavior; and Model Integration.

As part of the 2nd theme, which is focused on understanding factors other than fishery profitability that drive participation decisions of individual fishers, a mail survey of 2,800 vessel owners active in West Coast commercial fisheries produced a 50 percent response rate.

The next steps in the process include analyzing time series data on fish stock productivity with climate and ocean conditions and determining why some fish stocks' productivity varies synchronously or asynchronously.

Session Discussion

- Are there more stress-related illnesses in depressed fishing communities? For the Washington State marine spatial plan development process, they looked at wellbeing indicators, but that process is not communicating with the Council process.

- Some communities are assessing what they can do themselves, e.g., Monterey Bay Fisheries Trust [MBFT]). Four of these trusts have been established in California. A community sustainability plan was developed by the MBFT; extending it beyond the groundfish fishery and could be a model to replicate.
- Understanding the distribution of stocks through time, and the ability to both identify and ground truth social indicators could inform modeling efforts.

VII. Breakout Group #2 – Intersection of Climate and Communities

Attendees discussed the relationship between climate and communities, and the reasons for considering climate and communities as part of a linked initiative.

Linking climate to communities is an opportunity to preserve fishing conditions and culture, allowing a holistic versus solely economic assessment, assessing the increased frequency and intensity of climate impacts, not only in fisheries, but also in the community as the whole. Current tools are not adequate to plan for climate change—we need more tools to manage the changes in our environment to have fisheries and sustainable resources. Focusing on communities is a paradigm shift for the Council—we don't simply want to shift the focus from fishing to another water use. By engaging communities, we develop a partnership with communities that builds trust that generates accurate information.

- **Understand what is at stake**—What is at stake depends on how drastically and quickly our situation will change. Small changes can make big impacts on our small coastal communities.
- **Build trust and interaction with communities**—Trust can be built through a variety of programs and actions—port liaison program (NMFS had a program working with and communicating with individuals in communities to do projects); Sea Grant has developed effective tools; social scientists and academic researchers can fill gaps in NMFS (boundary organizations links researchers and management organizations, e.g., California Ocean Science Trust and graduate programs that shape their questions to answer Council questions); create a community working group to be part of the FEP process; hire social science skills as Council staff and dedicate a staff member as a social science expert; use existing forums and organizations, e.g., Western Groundfish Conference, Tuna Forum, American Fisheries Society, to share information and science, focus on a topic area and produce a research recommendation to the council.

- **Support Adaptation**—Fishers have difficulty obtaining expensive permits. Maybe portfolios of permits should be offered instead of individual permits—allocate them in a way that is more strategic or complements another fishery. How can we think about making these portfolios more adaptive and resilient and correspondingly structure management?

- **Define Community**—Consumers of fish products should be considered part of a fishing community. Is community census-based, or is it everyone that fishes? There are many decades of social science deliberations to determine “community.” We have a challenge in the Pacific region defining community. We belong to so many (community of practice, place-based, social). The fluid sense of community makes it difficult to study communities. What is the scale of data we are applying to community and how are we associating it to datasets, such as Pacific Fisheries Information Network (PacFIN)? Where people land their fish isn’t necessarily the place where they live, therefore, the link to fishing dependence on ports is, to a degree, unknown. We have to make inferences. “Three governs all” is one approach that is used—there are three vessels and three buyers; lump them together. There needs to be some way to mash aspects into a weighting system to assess the intensity of the impact to communities, i.e., a multi-variate approach, which would indicate issue priorities. Then use the information in the management structure. Across the United States, we are observing reductions in resource-based livelihoods in fleets, farms, and ranches—where is our food going to come from? Climate-related ocean challenges are important.

- **Advance understanding of vulnerability assessments**—Request that the NW and SW Science Centers (as part of the IEA) conduct an inventory of existing vulnerability assessments (Coastal Zone Management agencies understand where this work is occurring). Explore how to monitor the adaptability of communities and how the Council’s work would enhance or disrupt that work. Define elements of existing adaptation plans as well as future needs.

Participants developed a number of items that could be included in the Climate and Communities Initiative. The following list, combined with the results of the final breakout session, provide a suite of work that the Council could pick and choose from to develop a full initiative.

- **Facilitate Group Coordination and Co-management**—Provide the flexibility for communities to purchase shares and manage based on their needs. Consider the transfer of state permits by vessel and individuals—to allow a different type of organization to exist. Develop policies that facilitate group coordination. Insert “**community group**” into the legal framework. Poundage

on the table could be directed to helping new entrants and could be community focused; it is a tool that is available, and we have the process.

Provide more flexibility for diversification:

- Frame the discussion by mapping the tools and opportunities
 - Enhance the intersection between science and communities
 - Establish a focused group to help inform this issue and make recommendations
-
- **Assess Permit Constraints**—Identify existing federal and state permits and the constraints on both. What are the license structures outside of the Council that fishers are moving into? You can't limit it to what the Council has authorities to manage.

 - **Increase Opportunities for Open Access**—Retain entry-level open access fisheries (limited entry), and possibly convert halibut into individual quota instead of the current derby fishery. Entry-level permits have no cost, and capital output for the gear is nominal. Fishers in these fisheries may not make a lot of money, but it's a good entry point. Opportunities for open access need to increase. The consequences of access being driven by market include lost opportunity. Open a fishery to little used species that may not have been profitable 5–10 years ago. A small group of fishers could participate, and the fishery could be capped at a lower rate.

 - **Facilitate Succession Planning to Foster Intergenerational Equity**—How do we solidify the baby boomer hold on the fishery without harming the retirement nest egg of people that have been participating? In some places, traditional dependence on a fishery has been lost, causing a shift in community. How do decisions enable small-scale or diverse fisheries participation so that we're able to maintain fishing-based livelihoods for a lot of people, not just the most affluent?
 - The gig economy is driven by people self-employed across multiple jobs. There is a massive accumulation of debt among millennials, who won't be buying farms, boats, etc. The new economy will look very different from the one we have now because of the loss of the middle class. Who will be controlling the permits? Corporations? Will someone else own the share, resulting in a fisher receiving a smaller percentage of the take? It's the loss of much more than the monetary value. If corporations are the only ones that can purchase the fishing permits, then we are protecting the retirement nest egg at the risk of losing an emerging generation of fishers

- **Seek standardization across state and federal entities**—Could the Council describe their concept of Community Association, or could the state assess the potential for privatization?
- **Define community (but don't be restrictive)**—Consider tiers of priority similar to the [Community-Based Subsistence Fishing Area in Hawaii](#). Be inclusive in defining community to incorporate fishers, buyers, consumers, and others. As climate change occurs, new fish will enter the fishery and the Council can facilitate development of products. Define communities in ways that don't build silos. Define a vision and objective with respect to communities—what other types of information do you want to inform community discussions? Let fishers be innovative and reward efficiency. Try not to maintain communities for the sake of maintaining them. Let communities change naturally to become more efficient – little niche fisheries. Understand the effect of Council decisions on all types of communities. Think of tools in terms of how they help communities.
- **Better define the Council role relative to community**—Determine the level of engagement in the Council process that scientists should be looking for (subpanels, management teams, council floor), then define the process, deadlines, and expected interactions. Understand what the Magnuson-Stevens Act informs relative to Council obligations—it may mean enhancement for some human populations and not for others. The Council can better understand the human interactions and how changes in one fishery impact another. Solicit members from other fishery management plan teams to participate in the ecosystem working group. Add social scientists, community experts, climate experts, and Sea Grant staff.
- **Enhance engagement with communities**—Establish a Council-funded Speakers Bureau (to provide travel support) that allows community members to receive presentations they are interested in. Establish travel grants to allow community members to participate in Council efforts to engage community members early and throughout processes. Promote Marine Resource Education Events: educates people about council processes and decision making without an agenda at the meeting. Connect managers and fishers. Reach out to other community leaders. Build on existing community discussions (e.g., conversations already underway with communities linked to salmon).
- **Engage on the carbon dioxide emissions issue**—Encourage fuel efficiency with fishing vessels by establishing a program and incentives to help pay for

more efficient engines and move away from the use of fossil fuels. Develop a council webpage that addresses the topic, incentives, and other work (e.g., sea grass protection that the Council commented on).

VIII. Breakout session #3 — Focusing the Initiative

Attendees were asked to reflect on workshop discussions and discuss the questions, issues, and information needs that could be addressed through this initiative.

Themes that were shared from previous discussions at the workshop included:

- Flexibility (for individuals and communities)
- Partnership
- Communication
- Risk and uncertainty
- Identifying constraints and bottlenecks that cause things to be slow to respond
- Data needs (monitoring and cooperative research)
- Integration and use of climate information
- Port and shoreside access
- Stability and continuity for the fishery
- New entrants
- Defining community
- Defining goals (for this initiative)
- Overlap and interaction between state and federal management systems
- Adaptation
- Maintaining access
- Links across fisheries (“economic keystones”)
- Taking advantage of new opportunities (pop up fisheries, creating new markets)
- Baseline is changing

Discussions in this session incorporated the information learned in the workshop presentations and all previous discussions, and homed in on what the Council could accomplish in the Climate and Communities Initiative. The following bullets provide a list from which the Council could select from in determining the work to be conducted in the initiative.

- **Frame some objectives for the initiative** to create a foundation to move the action items along for Council to make progress. Think about ecosystem-level goals and objectives and indicators inclusive of the socioeconomic issues.. At the same time, maintain the current Council functions.

- **Refine ecosystem-level community goals and objectives** that are measurable and trackable, and do so through a climate lens.
- **Institutionalize the importance of climate change** by engaging communities that are not physically present at Council forums. Climate change should not be an episodic conversation; it should become engrained in all aspects of Council business. Provide climate information as handouts at Council meetings. Better connect Council priorities and science centers
- **Define the highest priority research and information needs through a climate change lens** by asking the advisory bodies what they need to know (from a community perspective as well as science). Have the advisory bodies assimilated current work to know how they are going to use it. Use a portion of allocation to fund research to address priority questions. Assess how cumulative effects and non-management actions can influence prioritization. Be open to ecosystem and cooperative research—different types of science, not just more science. Expand input, add timelines, and cross-link document with fishery management plans. Incorporate traditional ecological knowledge and social sciences.
- **Identify key indicators and data needs through a climate lens**—Ensure the indicators are relevant and broadly available to the fishing community. Indicators span a wide range of topics; how you integrate them is important.
- **Address priority regulatory impediments**—Identify existing regulatory impediments that prevent shifting and adapting to climate change. What changes to regulations can occur to reduce rigidity, enhance adaptability and flexibility, and be more efficient, providing less regulatory burden? Assess the tools we have and determine if we have the tools to achieve the goals. Map out the permitting/licensing impediments – and how to address that.
- **Conduct a retrospective** of how the Council dealt with past issues and how it could deal with future issues.
- **Look forward to increase flexibility**—Make the regulatory path to access new fisheries easier – flexibility to change permits from one species to another. What are the more resilient portfolios? What are the impediments to getting resilient portfolios? Management is getting more complex. There is a need to think about what is adequate managing species going forward. Can we achieve regulatory relief without managing every last fish? Is that feasible and doable? Simplification has a tradeoff. Instead of becoming more and more restrictive and more complex, simplify things

Assess regulatory mechanisms via scenario planning to identify impediments and respond to scenarios. Identify policy bottlenecks, constraints on flexibility, and potential changes. Have we consolidated access such that it is more difficult to access? How can we adapt it and make it flexible, perhaps by evaluating licensing and permitting issues? Assess all fisheries, not just council-managed fisheries. Provide for flexibility while ensuring management.

- **Use community set-asides to enable quick response**—Use these to address fishing for different stocks—not gear switching, but stock fishing. Use mechanisms as set aside for an emergency, e.g., allow sequential release of the sardine harvest, such that a portion of the harvest could be reserved for need, and is then released if it is not used. Establish mutually agreed upon criteria (tribal, research – ahead of time, so decision is made in advance).
- **Establish an open access portion of the quota**—In average years, quota would be allocated, but retain a portion in the case of proven climate impact (similar to the current sablefish fishery). Allow new permitted entrants into fisheries. Skiff fishing is a way people can enter. Initial low or no cost, and if they experience initial success, they may buy into more fisheries. Make it easier to transfer from the old system to a new system—make those permits easier to get.
- **Track species range shifts**—Establish a process to track and incorporate species range shifts and question assumptions.
- **Draft a resolution** about climate change indicators so that the public is aware changing in the ocean are expected.

The workshop concluded with remarks from Council members, Rich Lincoln and Dorothy Lowman. They summarized the broad themes they heard throughout the workshop, including the need for: metrics and indicators to assess the status of ecosystems; framing needs around vulnerability and life history; defining case studies that help inform tool development; diversification and connecting with communities to help them adapt using a portfolio approach; and assessing emerging fisheries; the role of the Council as a leadership voice for issues facing the ocean environment; considering opportunities to morph the Council’s management structure to respond to climate change issues; developing SMART objectives can be informed by key indicators; considering how other Council initiatives connect to the Climate and Communities Initiative; regulatory actions in the pipeline that might have higher value given climate change considerations; modification and streamlining of the regulatory process to facilitate adaptive management; filling gaps in ecosystem working groups to ensure social science and climate change science is well represented.

IX. Appendices

Appendix A. Climate and Communities Initiative Workshop Attendance List

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| Pete Adams | Adams Fisheries Consulting |
| Bob Alverson | Groundfish Advisory Subpanel- Fixed Gear |
| Debbie Aseltine-Nielsen | California Department of Fish and Wildlife- Readying California Fisheries for Climate Change |
| Susan Ashcraft | California Fish and Game Commission |
| Rich Bell | The Nature Conservancy |
| Dr. Caren Braby | Pacific Fishery Management Council Member- Oregon Department of Fish and Wildlife |
| Kathleen Brennan-Hunter | The Nature Conservancy |
| Dr. Evelyn Brown | Scientific and Statistical Committee- Ecosystem Based Management Subcommittee |
| Linda Buell | Highly Migratory Species Advisory Subpanel- Oregon Charter |
| Merrick Burden | Environmental Defense Fund |
| Mike Burner | Deputy Director - Pacific Fishery Management Council |
| Gregg Casad | Exulans Consulting |
| Mike Chang | Makah- Climate Adaptation Specialist |
| Walter Chuck | Fisherman/Port of Newport Commissioner |
| Shaun Clements | Oregon State University |
| Mariel Combs | Oceana |
| Kit Dahl | Pacific Fishery Management Council Staff Officer: Highly Migratory Species, Ecosystem, NEPA |
| Lisa DeBruyckere | Creative Resource Strategies, LLC |
| Yvonne deReynier | Ecosystem Working Group- NOAA |
| Jessi Doerpinghaus | Washington Department of Fish and Wildlife – Groundfish Management Team member |
| Michael Drexler | Ocean Conservancy |
| Ben Enticknap | Oceana |
| Joshua Etherton | Quileute- Harvest Manager |
| Jeff Feldner | Fisherman |
| Laura Gephart | Columbia River Inter-Tribal Fish Commission |
| Eliza Ghitis | Northwest Indian Fisheries Commission |
| Kimberly Gordon | Fishery Leadership and Sustainability Forum |
| Marc Gorelnik | Pacific Fishery Management Council Member- California |
| Jennifer Hagen | Quileute- Marine Biologist |
| Leslie Hart | California Sea Grant |
| Chris Harvey | Northwest Fisheries Science Center- Conservation Biology Division |
| Brianna Haugen | Oregon State University |
| Richard Heap | Salmon Advisory Subpanel- Oregon Sport |

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| Dr. Dan Holland | Scientific and Statistical Committee- Ecosystem Based Management Subcommittee |
| Kate Kauer | The Nature Conservancy |
| Erin Kincaid | Oceana |
| Gway Kirchner | The Nature Conservancy |
| Terrie Klinger | Ecosystem Advisory Subpanel- University of Washington |
| Catherine Latanich | Fishery Leadership and Sustainability Forum |
| Phillip Levin | The Nature Conservancy/University of Washington |
| Arielle Levine | San Diego State University |
| Rich Lincoln | Pacific Fishery Management Council Member- Washington |
| Dorothy Lowman | Pacific Fishery Management Council Member- Oregon |
| Heather Ludemann | David and Lucile Packard Foundation |
| Gilly Lyons | The Pew Charitable Trusts |
| Nate Mantua | Southwest Fisheries Science Center- Landscape Ecology Team |
| Kristin Marshall | Northwest Fisheries Science Center |
| Steve Marx | The Pew Charitable Trust |
| Lynn Mattes | Groundfish Management Team- Oregon Department of Fish and Wildlife |
| Ali VZ Mayeda | District Representative – Congresswoman Suzanna Bonamici |
| Michelle McClure | Ecosystem Working Group- NOAA |
| Scott McMullen | Ecosystem Advisory Subpanel |
| Jeff Miles | Groundfish Advisory Subpanel- Fixed Gear |
| Ann Mooney | Oregon Climate Change Research Institute Program Manager |
| Corey Niles | Pacific Fishery Management Council Member/Ecosystem Working Group- Washington Department of Fish and Wildlife |
| Jim Olson | Salmon Advisory Subpanel- Washington Troll |
| Davia Palmeri | Oregon Department of Fish and Wildlife |
| Diane Pleschner-Steele | Coastal Pelagic Species Advisory Subpanel |
| Melissa Poe | Lead Social Scientist – Washington Sea Grant & NW Fisheries Science Center |
| Heather Reed | Groundfish Management Team- Washington Department of Fish and Wildlife |
| Charlotte Regula-White | Oregon Department of Fish and Wildlife |
| Corey Ridings | Ecosystem Advisory Subpanel- Ocean Conservancy |
| Cyreis Schmitt | Ecosystem Working Group/Highly Migratory Species Management Team/Coastal Pelagic Species Management Team- Oregon Department of Fish and Wildlife |
| Dr. Richard Scully | Ecosystem Working Group- Idaho Department of Fish and Game |
| James Seger | Pacific Fishery Management Council |
| Leila Sievanen | California Ocean Science Trust |
| Bruce Steele | California Current Acidification Network |
| Nate Stone | Fury Group, Inc. |
| Chuck Tracy | Pacific Fishery Management Council- Executive Director |
| Dr. Theresa Tsou | Washington Department of Fish and Wildlife |
| Dan Waldeck | Groundfish Advisory Subpanel- At-Sea Whiting |

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| Lorna Wargo | Coastal Pelagic Species Management Team- WA Dept. Fish and Wildlife |
| Deb Wilson-Vandenberg | Ecosystem Working Group- California Department Fish and Wildlife |

Workshop report prepared by Creative Resource Strategies, LLC

