CLIMATE SCENARIOS WORKSHOP REPORT

HELD JUNE 5-6, 2024 KODIAK, ALASKA

SEPTEMBER 2024

North Pacific Fishery Management Council

Climate Scenarios Workshop Report[1]

The Council held a Climate Scenarios Workshop on June 5-6, 2024, in Kodiak, AK and virtually. The purpose of the workshop was to generate ideas for short- and long-term management approaches and tools to improve climate resiliency of federally managed fisheries in the North Pacific. This report summarizes and compiles the range of ideas and discussions shared from over 200 decision makers, scientific and industry advisors, agency and Council staff, and members of the public who attended the workshop.

[1] Prepared by Katie Latanich, Council staff

For definition of acronyms and abbreviations, see online list: https://www.npfmc.org/library/acronyms

Executive Summary

The North Pacific Fishery Management Council ("Council") convened a Climate Scenarios Workshop on June 5-6, 2024, in Kodiak, AK. The purpose of the workshop was to generate ideas for short- and long-term management approaches and tools to improve climate resiliency of federally managed fisheries in the North Pacific.

The Climate Scenarios Workshop provided the opportunity for the Council community to develop a shared frame of reference for the current and potential climate change impacts to North Pacific fisheries, and generate ideas for improving climate readiness in the Council process. This report captures the range of ideas shared at the workshop as a starting point for further discussion and planning.

Reading and interpreting the report

In reading and discussing the ideas in this report, it's important to keep in mind the following considerations.

Ideas are aggregated across the four workshop scenarios.

The workshop explored four different possible scenarios with the aim of identifying tools and information needs that could be relevant across a wide range of potential climate futures. Ideas and themes of discussion are aggregated across the four breakouts to identify commonalities and avoid repetition. Ideas and concerns that were specific to a particular scenario are discussed in Section 6.

Themes of discussion are presented as ideas and not recommendations.

The Climate Scenarios Workshop was an idea-generating discussion, and not an attempt to reach consensus, prioritize ideas, or generate recommendations. Participants sometimes shared their ideas as recommendations, and many ideas were also shared as possibilities and "what ifs" (e.g., "in this scenario we could…", "it might be necessary to…", "I wonder if we could…"). All of the ideas and themes of discussion described in this report are provided as information for further consideration by the Council and public.

Ideas vary in feasibility and resource needs.

The report is inclusive of workshop ideas and potential directions, although the feasibility of pursuing these ideas would vary widely in terms of timing, staffing, support that may be needed from NMFS or other partners, the mechanism for implementing change (for example, some

ideas could require a Fishery Management Plan amendment), and other considerations. These considerations could be more fully explored and clarified in the future.

The report is a starting point and not comprehensive of all potential next steps.
Workshop discussions and the ideas in this report provide a foundation for the Council's climate readiness planning, and should be considered a starting point for further discussion. Further Council discussion and public input on climate readiness planning will provide the opportunity to share reactions, consider priorities, and generate additional ideas.

Ideas are not attributed or weighted.
Ideas in this report are for the most part not attributed to a particular group, fishery, community, region, or gear type. There are some ideas that are not attributed to a group but do convey concerns about the role or representation of a particular user group.

Ideas are also not "weighted," for example to indicate how many participants or breakout groups discussed a similar idea. This would not be feasible or meaningful given the mixed nature of the breakout groups, the wide variation in breakout group discussion topics, and the manner in which ideas were shared. For example, sharing an idea or observation in response to a hypothetical scenario may not mean a speaker supports that course of action. While the Council is understandably interested in the level of user group support for workshop ideas, this will be more effectively achieved through further public input.

Not all ideas are within the Council's purview and authorities.
While the workshop focused on ideas that could be within scope of the Council process, participants also shared ideas that could be implemented by individuals, businesses, Tribes, communities, and other agencies. These ideas are captured in the report as a resource and to share the Council community's ideas and concerns with other interested audiences.

Themes of workshop discussion

The discussion section of the workshop report includes ideas and themes from across all four breakout sessions, facilitator recaps, and plenary discussions. Ideas and themes are aggregated across breakout sessions, rather than organized by breakout discussion, since similar topics were discussed in all four breakouts and most of the ideas shared were not specific to one of the four hypothetical scenarios. Discussions also emphasized identifying strategies that could work well in all future scenarios.

The workshop report is organized into seven discussion sections, with the following key messages and suggestions for pathways for implementation. The body of the report includes

these key messages as well as key messages by subsection and a bulleted list of participant ideas.

Section 1: Defining climate resilience

Key message

There are diverse perspectives on the definition of climate resilience. Workshop participants discussed the components of climate resilience, what resilience could look like in practice, and the challenges and barriers to resilience faced by people and communities. Participants suggested there is not a singular one size fits all definition of climate resilience, and a shared definition would need to be grounded in clearly articulated goals, objectives, and values.

Implementation

This section explores the meaning of climate resilience and does not include specific ideas or action items. The Council could choose to develop a working definition of climate resilience, for example as part of a climate readiness work plan. This section also provides valuable context for continuing to develop the Programmatic Evaluation and could be informative for future public engagement.

Section 2: Council process

Key message

Workshop participants emphasized climate readiness depends on a timely, responsive, and inclusive Council process that includes the procedural mechanisms for rapid response, utilizes time and resources strategically, builds trust and mutual respect, and takes a strategic approach to define and achieve climate readiness.

Implementation

This section of the report includes many ideas for potential action items, as well as intersections with current discussions including efficient use of Scientific and Statistical Committee (SSC) time, policy initiatives (the Programmatic Evaluation) and potential future initiatives (for example, the role of goals, objectives, values, and metrics in developing a climate workplan). Some of the ideas in this section are not necessarily specific to climate change, or describe existing challenges that are exacerbated by climate change, and could be strengthened to meet multiple objectives. The public engagement and communication ideas in this section could help support any climate readiness initiatives the Council chooses to pursue.

Section 3: Management measures

Key message

Workshop participants reflected on existing Council management programs and management measures and identified how they could support or constrain adaptation. They also discussed mechanisms for ingesting and responding to information and change, new challenges that may

emerge due to climate change, and opportunities to more intentionally leverage existing tools in support of climate readiness.

Implementation

This section of the report includes specific ideas, and also includes broad themes of discussion (such as allowing for diversification and flexibility, identifying and responding to early warnings), that were not always associated with detailed suggestions or potential action items, but were a strong focus of breakout group discussions. These themes could be informative to the Council's development of the Programmatic Evaluation, management actions to implement a revised programmatic management policy, or through other onramps.

Section 4: External coordination

Key message

There are opportunities as well as stressors external to the Council process that will impact climate resilience of people and communities, and the ability of fisheries and fishing communities to have a voice in a busier ocean future.

Implementation

This section of the report includes some topics that are largely outside the Council's purview but could be opportunities for the Council community to collaborate, network, and communicate priorities and information needs; and for user groups to engage in advocacy and planning.

Section 5: Science and information

Key message

Climate readiness depends on having the data, information, and science products needed to anticipate, understand, and respond to climate change impacts. Participants discussed specific ideas and broad themes including building capacity to work with uncertainty, leveraging existing information, investing in fundamentals including research surveys, and supporting adaptation and innovation.

Implementation

Most of these ideas in Section 5 are not Council action items but pertain to how the Council articulates questions, sets priorities, and communicates information needs to NMFS and scientific partners, and are potentially relevant to SSC tasking.

Section 6: Scenario-specific discussions

Key message

The four scenarios discussed at the workshop emphasized different challenges and needs that could depend on the tools the Council has available and the degree of climate change impacts experienced. This section explores the distinctive attributes of the four scenarios and the tools and information participants think they would need to have in place to support climate resilience.

Implementation

This section of the report is included for additional context and to capture the nuance of the different breakout discussions. It could be useful as a resource for planning for a range of scenarios and considering how management and science needs could vary across climate futures.

Section 7: Workshop feedback form

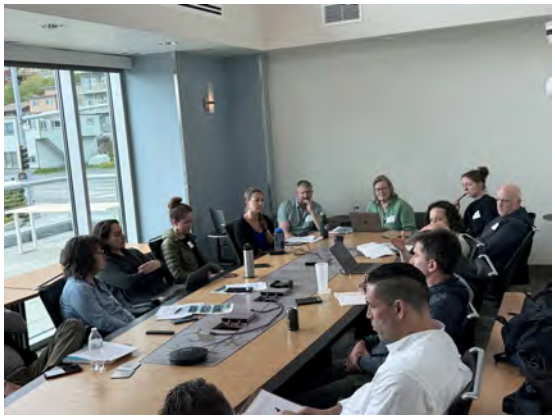
Key message

Workshop participants shared feedback on the use of scenario planning and their ideas for improving future workshops, including more participation and representation in the workshop planning and synthesis process, and providing more opportunities for discussions through the workshop agenda and facilitation strategies. Participants also provided suggestions for actionable next steps following the workshop.

Implementation

Council staff will account for logistics and development feedback in planning future workshops.

October 2024 discussion and pathways for advancing climate readiness



At the October 2024 Council meeting, this report will be presented as a discussion item for the Council to consider how ideas from the workshop could be implemented through new or existing pathways. Existing pathways could include the following.

Programmatic evaluation

The Programmatic Evaluation initiated by the Council in June 2023 will revisit the management policies, goals, and objectives for all of the Council's federally managed fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska. Through this process, the Council will consider whether its management approach should be updated and revised in consideration of current environmental variability and the ability of the management framework to respond to change. Along with other scoping inputs developed through the Programmatic Evaluation process, the broad concerns and themes of discussion discussed at the workshop may inform the Council's development and consideration of programmatic alternatives. Ideas from the workshop could be further explored through subsequent management actions to implement a revised programmatic management policy, or through other onramps.

Inflation Reduction Act (IRA) workplan

The Council submitted a proposal for NMFS and was approved for $2.5 million in funding for work in support of three objectives that build on and advance the Council's current work:

1. Develop a climate-resilient management policy. This work is intended to be carried out through the Programmatic Evaluation process.
2. Continue work to incorporate local and traditional knowledge.
3. Strengthen the consideration of uncertainty and risk in harvest specifications.

IRA funding could be used to implement ideas in this report, and/or new ideas identified by the Council and public, which complement or support these three objectives. The original work plan for accomplishing these three objectives needs to be updated due to funding delays, and while the IRA funding must be responsive to Council priorities from the proposal, there is some room for adaptation.

One additional consideration for IRA project timing is the Council's decision, in response to public feedback, to delay the formal National Environmental Policy Act (NEPA) scoping process on the Programmatic Evaluation (which would begin with NMFS publishing a Notice of Intent to prepare the Programmatic EIS) until after the Council has completed the initial review of the chum salmon bycatch action in February 2025. This delay could create new opportunities for utilizing IRA funds to support Objective 1, though all IRA funds must be spent by the end of 2027.

Developing a climate readiness strategy or plan

The Council could choose to develop a climate readiness work plan to guide and prioritize their climate-related work over the next several years, likely aligning with the timeline for IRA funding but potentially also extending beyond 2027. A climate readiness work plan could be helpful for linking the Programmatic Evaluation with the IRA funding objectives, and clearly communicating to the public that these Council initiatives (and potentially others) fall under the umbrella of climate readiness planning. This work plan could take different forms. For example, it could be structured as a formal document, or it could be maintained as a working version of an updated IRA work plan.

Other climate readiness planning strategies

The Programmatic Evaluation, IRA work plan, and a potential climate readiness work plan are broadly framed initiatives that would likely accommodate most climate readiness ideas the Council may wish to pursue. However, the Council is not constrained to these pathways and could choose to pursue other ideas in addition to these existing initiatives.

Tasking of existing and/or new advisory bodies

As part of considering these pathways for advancing climate readiness, the Council could consider tasking existing Council bodies, and/or establishing a new one, to provide advice.

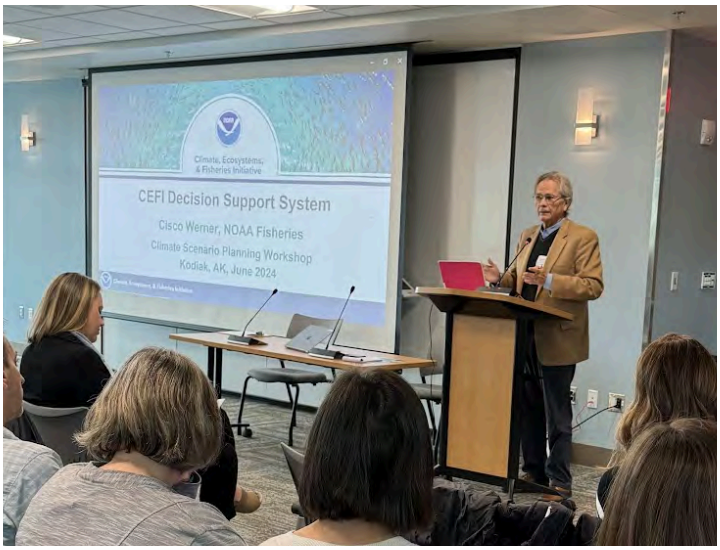
Building on previous work

Future climate readiness planning will build on the Council's previous work to advance climate readiness. Over the past several years the Council has invested in climate readiness through development of Fishery Ecosystem Plans (FEPs), the works of the Bering Sea FEP Climate Change Task Force and the Local and Traditional Knowledge Task Force, Protocol, and onramps; and discussion of risk and uncertainty in the annual specifications process via Ecosystem Status Reports (ESRs), Ecosystem and Socioeconomic Profiles (ESPs), risk tables, and consideration of climate variables in stock assessments.

Communicating priorities and needs to external audiences

While some of the ideas in this report are outside of the Council's purview, workshop participants noted that other audiences for this report and ideas could include communities, Tribal entities, industry groups, research partners (e.g. Seagrant, the North Pacific Research Board), and elected officials including the Alaska State Legislature.

Staff discussion and ideas for next steps



Council staff met as a group to reflect on the workshop outputs and consider ideas to help the Council and public consider the large volume of information in this report. Staff suggestions include 1) identify and consider key questions that can help the Council prioritize time and resources to make measurable progress toward climate readiness, and 2) establish a baseline to prioritize among the ideas in this document. The Council may also consider how workshop outputs integrate with next steps following from discussions at the August 2024 Eighth National Meeting of the Scientific Coordination Subcommittee ("SCS8") of the Council Coordination Committee, which are being presented to the Council in October 2024.

Staff suggestions are provided here to support discussion and are not comprehensive of the ways the Council may use the information in this report.

1. Identify and consider key questions

Workshop discussions (including Section 2.2 of this report, Council planning and prioritization) emphasize support for a strategic, goal-oriented approach to climate readiness. All of the ideas in this report would require resources and tradeoffs in the form of Council agenda time and attention, Council staff time, support from NMFS, the SSC, and/or other advisors and

committees, and would also create additional needs for communication and public engagement. Implementing these ideas will also create additional demands on interested members of the public who want to track progress and provide input on the Council's climate readiness planning.

Council staff identified the following examples of questions and topics that may be useful when considering the information in this report. The Council and public may identify additional questions.

Which ideas are specific to climate change?
Some of the ideas in this report are specific to the challenges of preparing for and responding to climate change impacts. Other ideas may reflect new or existing concerns that may be amplified by the pressures of climate change. Considering what needs are most specific to climate change and asking, "What is the problem we're trying to solve?," and "What is the timeline needed to address this challenge?" could be one way for the Council to prioritize how to focus resources in the next several years.

What are the advantages and constraints of different action pathways?
The potential pathways for implementing ideas in this report are outlined earlier in this Executive Summary and include the Programmatic Evaluation, IRA work plan, and a potential climate work plan that could be separate from or combined with an IRA work plan. The Council may find it valuable to consider the different parameters and timelines associated with each pathway. The Programmatic Evaluation is constrained by the timeline of the NEPA process, though the Council can determine when this timeline begins. IRA funds must be spent by the end of 2027 and for this reason the Council may find it helpful to consider at least a 3-year planning horizon.

Other considerations include efficiency and communication. The Council currently has multiple climate-related initiatives in progress and it will be helpful to find synergies in terms of planning, agenda time and public input, and clearly communicating to the public how these climate readiness efforts are linked.

How will the Council know whether climate resilience goals are being achieved?
Workshop discussions emphasized the value of metrics for measuring progress toward improving climate resilience. It may be helpful for the Council to reflect on the circumstances where metrics are most important, and where it may be important but more challenging to measure progress. For example, the Council could take discrete actions to improve two-way engagement with the public, though it would be difficult to evaluate whether these actions strengthen the important qualities of trust, respect, and inclusion in the Council process. The Council may find it helpful to discuss and hear from the public what success would look like for these important but less tangible outcomes.

Which ideas are one-time investments, and which are ongoing practices?
Some of the ideas in this report are specific actions and initiatives, while others describe ongoing practices and process improvements. Many are a combination of both. The Council may find it helpful to consider the implications of both for Council time, resources, staff tasking,

and NMFS support. For example, developing a process to identify and respond to early warnings could be a one-time exercise, and the implementation of this approach would likely require additional time on an ongoing basis.

How much agenda time is the Council willing to allocate for informational and discussion items?
Workshop discussions emphasized the value of carving out time for discussion and information to improve the Council and public's awareness of climate science and resilience efforts. For example, participants appreciated that the four case studies[2] shared at the workshop presented recent NPFMC environmental variability experiences as succinct but accessible stories that illustrate real world climate change situations and responses, and the principle of reflecting and learning from past experience. Other workshop ideas included additional opportunities for informal discussion and knowledge sharing (Section 2.2). The Council may want to consider the amount of agenda time they are willing to allocate to items that may not be associated with a Council action or decision point, but can be beneficial for building a common understanding of ongoing science and the state of knowledge.

2. Establish a baseline

There are many discussion areas in this report, and the Council is by no means starting from ground zero on many of these concepts. Given the timeframe for the Programmatic Evaluation and IRA funding, and the need to use limited resources wisely, staff suggest the Council consider establishing a baseline to assess the degree to which the Council is or is not making progress toward addressing the needs in this report. This approach could help clarify and communicate to the Council and public where there are existing pathways, tools, and work in progress, and where there may be opportunities for change and improvement. In response the Council could have a more informed baseline to consider where to invest time and resources to have the greatest impact. This approach could also complement analyses in support of the Programmatic Evaluation, which will require an analysis of the status quo.

As a next step, the Council could request that staff prepare a follow-up document or series of documents for discussion at the April 2025 Council meeting that could explore the following topics, and/or others suggested by the Council and public. This document could discuss some topics in detail and identify other topics that could be addressed through the Programmatic Evaluation.

Rapid response capabilities (Section 2.1)

Potential approach: Identify where the Council already has rapid response capabilities (for example through emergency actions, in-season adjustments through the specifications process) and where there may be the opportunity or need to move more quickly. This approach could clarify the opportunities, bottlenecks, and considerations and tradeoffs involved in using these and other tools including frameworking; and explore examples of the phenomena (such as

[2] Case studies included Gulf of Alaska Pacific cod, Bering Sea snow crab, changes in the Northern Bering Sea, and high sablefish recruitment. The presentations are available on the workshop eAgenda and a recording of these presentations is available on the Council's YouTube channel.

marine heatwaves, large recruitment events, and protected species interactions) that could drive the need for rapid response and how these tools might perform in these circumstances.

Council planning and prioritization (Section 2.2)

Potential approach: More clearly articulate the underlying problem or need for which Council process ideas might be suggested as solutions (for example, changes to staff tasking procedures; tasking a Council body with providing climate advice), and identify tangible examples of resource needs and tradeoffs (for example, the amount of staff time needed to staff a committee).

Public participation (Section 2.3)

Potential approach: Assess past and current efforts to improve two-way communication with the public, clarify key messages and misconceptions that would benefit from more effective communication, distinguish between ongoing needs and those that may be more specific to climate change, and identify potential success metrics and priorities for strategic improvements.

Adaptation, diversification, and flexibility (Section 3.1)

Potential approach: Explore approaches for systematically considering climate adaptability and vulnerabilities as part of all future management actions. This work could include identifying specific questions or a section that could be included in analyses, as well as suggestions for avoiding overlap or redundancies with other sections of analytical documents, and identifying information that could be more explicitly identified as relevant to climate adaptation.

Early warnings and responsiveness (Section 3.2)

Potential approach: Identify where in the process early warnings could be most relevant. For example, are early warnings primarily a function of the annual specifications process, or are there other opportunities for identifying and responding to signals of change? Another idea would be to explore specific examples of the information or scenarios that could constitute early warnings, such as signs of stock collapses, changes in fishing behavior, and market collapses, and assess where there are new or existing opportunities for bringing this information into the science and Council process, whether as a trigger for action or information to share with the Council and public.

Diverse information inputs and knowledge systems (Section 5.1)

Potential approach: Identify areas where the Council has been working to address concerns raised at the workshop, particularly with regard to integration of LKTKS and where there are opportunities to advance this work and the ideas in the LKTKS Protocol and onramps. This could include describing normative changes in the Council process that are difficult to measure but important as indicators of progress.

Social and economic vulnerability and information needs (Section 5.2)

Potential approach: Identify data and information products that are already available to inform the Council process, work in progress, and opportunities to elevate specific questions and information needs.

Introduction and workshop approach

Climate change is already impacting North Pacific federally managed fisheries and the communities that depend on them. With support provided under the Inflation Reduction Act (IRA), the North Pacific Fishery Management Council (Council) has the opportunity to plan comprehensively and strategically to support a climate-ready fisheries management process.

As a first step in this process, the Council held a Climate Scenarios Workshop on June 5-6, 2024, in Kodiak, AK. The purpose of the workshop was to generate ideas for short- and long-term management approaches and tools to improve climate resiliency of federally managed fisheries in the North Pacific.

The workshop convened over 200 decision makers, scientific and industry advisors, agency and Council staff, and members of the public, in person and virtually, to accomplish the following objectives:

- Examine case studies and hypothetical scenarios to explore plausible “what ifs” and identify specific examples of climate readiness needs, barriers, tools, information needs, opportunities, and risks.
- Explore strengths and weaknesses of status quo management and governance for supporting climate readiness of fisheries under the Council’s jurisdiction.
- Consider where the pace and deliberative aspect of the Council process is a strength, and where a more rapid response to changing conditions may be appropriate; and clarify the opportunities for and constraints to responsiveness within the Federal regulatory process.
- Develop strategies for ensuring a robust and inclusive process for advancing the Council’s climate readiness planning.

Workshop participants participated in breakout discussions exploring four hypothetical scenarios developed with input from the Council’s Climate Change Task Force (CCTF) and National Marine Fisheries Service (NMFS) Alaska Fisheries Science Center (AFSC) scientists, based on modeling projections developed through the Alaska Climate Integrated Modeling Project (ACLIM). These scenarios were meant to prompt discussion of what could happen, and were not meant to be predictive (what will happen?). The scenarios were developed based on two key areas of uncertainty identified by the CCTF and presented to the Council’s Scientific and Statistical Committee (SSC) and Council in December 2023.[3] These key uncertainties are:

[3] Additional information about scenario development and the approach of climate scenario planning is available in the Introduction to Climate Scenario Planning Memo

1. Future conditions (including climate, ecosystem, markets, etc.) may be generally more predictable or less predictable.

2. In the future, fisheries management may be more focused on single-species management, or cross-sector ecosystem-based management.

The four workshop scenarios were provided to workshop participants prior to the workshop. All workshop materials are available on the Climate Scenarios Workshop eAgenda, including additional information about the approach of scenario planning and the process for developing the workshop scenarios. More information about the approach of scenario planning and an overview of the workshop scenarios was also provided as a workshop presentation, and as a pre-workshop webinar.

The four scenarios included the following attributes.

Scenario 1: Current trajectory
Some progress toward ecosystem-based fisheries management (EBFM), significant climate change impacts, and moderate predictive capabilities

Scenario 2: Best of both worlds
Highly effective and inclusive ecosystem-based management (EBM), lowest potential climate change impacts, and strong predictive capabilities

Scenario 3: EBM and rapid change
Highly effective and inclusive ecosystem-based management (EBM), high climate change impacts, and low predictive capabilities

Scenario 4: Siloed management and high challenges
Sector and stock specific management focus, extreme climate change impacts, and low predictive capabilities

Breakout discussions were facilitated by Council, AFSC, NMFS Alaska Regional Office (AKRO) and Alaska Department of Fish and Game (ADFG) staff and by SSC members. In-person participants were divided into six breakout groups each including a mix of Council, Advisory Panel (AP), SSC members, NMFS and Council staff, and members of the public. Online breakout sessions were held using Zoom and participants self-selected into regional groups focusing on the Gulf of

Alaska, Bering Sea/Aleutian Islands, and all regions.[4]

The following questions were used to help guide the discussion of all four scenarios.

- What does climate resilience look like in each scenario?
- What are the challenges to climate resilience?
- What management tools and approaches could help?
- What scientific tools and information could help?
- What other assets and opportunities could help support climate resilience? (E.g., diverse knowledge sources, collaborative approaches, community and industry-led initiatives).
- How can the Council support a robust and inclusive process for climate readiness planning?

Workshop discussions and the guidance provided by facilitators focused on generating ideas and exploring different perspectives. Breakout discussions were not intended to seek consensus, generate recommendations, or identify priorities. Breakout sessions were not recorded. Each group was assigned a notetaker (primarily Council staff), and provided with flip charts and markers. Some virtual breakouts opted to use online collaborative tools for participatory note taking. Following breakout sessions 1, 2 and 3 (which were combined) and 4, facilitators provided a short 2-3 minute summary of their group's discussion. Additionally, several participants were assigned to rotate between breakout groups and provide an in-workshop synthesis of workshop themes.[5]

Following the meeting, an online post-workshop feedback form was made available to provide all participants with the opportunity to share additional ideas and feedback on the use of workshops as a discussion opportunity. The form was available following the workshop through the end of June, and 18 replies were received. Most of the ideas from the workshop feedback form are aggregated with those from the in-workshop notes, and summarized, however some specific ideas are captured more literally in order to preserve their intended meaning. Ideas that came primarily from the workshop feedback form are noted in parentheses.

Finally, many of the ideas in this report corroborate or build on suggestions and themes provided in the 2022 Climate Readiness Synthesis and in the 2023 SSC Workshop Report (Rapid change in the northern Bering and southern Chukchi Seas - Identifying ecosystem responses and effects on the management of Federal fisheries). Excerpts from these documents are provided as appendices.

This report is based primarily on the detailed notes taken by notetakers. It also incorporates flipchart and collaborative notes used by virtual participants, facilitator summaries, notes from plenary group discussions, synthesis slides and remarks by rotating participants, and ideas provided using the online feedback form.

[4] The Gulf of Alaska and "All Regions" virtual breakouts were combined on the second day of the workshop to balance group sizes.
[5] Observers included NMFS AFSC Director Dr. Robert Foy, former SSC Chair Dr. Anne Hollowed, and Council staff Senior Scientist Dr. Diana Stram. Synthesis slides are available on the workshop eAgenda.

Discussion: Climate resilience opportunities and needs

1. Defining climate resilience

Key message: There are diverse perspectives on the definition of climate resilience. Workshop participants discussed the components of climate resilience, what resilience could look like in practice, and the challenges and barriers to resilience faced by people and communities. Participants suggested there is not a singular one size fits all definition of climate resilience, and a shared definition would need to be grounded in clearly articulated goals, objectives, and values.

Workshop discussions explored the meaning of both **climate readiness** and **climate resilience**. The Climate Readiness Synthesis prepared by the CCTF defines climate readiness as "whether management tools, assessments, and information on-ramps are designed to address and consider long-term climate change and the unprecedented conditions and unique challenges that it presents."[6] Participants did not draw a strong distinction between the two terms, and primarily referred to climate resilience in discussion.

Scenario 1 prompted the most robust discussion about the meaning of climate resilience in the Council process. While there was not agreement on a singular definition of resilience, participants generally reinforced the definitions of resilience referenced in the workshop materials, including the definition used in the Fifth National Climate Assessment which defines resilience as "the ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions.[7] The Climate Readiness Synthesis includes a more detailed discussion of resilience including community resilience, biological and ecological resilience, and the importance of considering the nexus between these two components.[8]

Participants explored additional nuance to the meaning of resilience, including the following observations.

[6] Climate Readiness Synthesis. Prepared by the NPFMC Climate Change Task Force 2022. p. 4
[7] Grade, A.M., A.R. Crimmins, S. Basile, M.R. Essig, L. Goldsmith, A.R. Lustig, T.K. Maycock, A. McCarrick, and A. Scheetz, 2023: Appendix 5. Glossary. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023.A5
[8] Climate Readiness Synthesis p. 6

There are different but linked components to resilience.

Participants observed resilience can refer to different components of social-ecological systems, including community and industry resilience, the resilience of individuals, biological resilience of a species, ecological resilience of a system, and more. These forms of resilience are closely linked, and the resilience of people and communities depends on resource and ecosystem resilience.

Participants shared definitions that were specific to their disciplines or perspectives, that may differ in focus but highlight the quality of recovering from or adapting to change. For example, from a social scientists' perspective resilience might refer to the ability of people and communities to cope, adapt, and/or transform[9]; and resilience at a species level describes the ability of an individual or population to recover from or adapt to changing conditions. Participants used other descriptions including healthy, stable, and sustainable resources and communities, "bouncing back" from disruption and change, and the ability to continue practices, whether that means earning an income from fisheries or practicing subsistence. There can be differences within these definitions, such as whether recovery means returning to a previous state or achieving a different stable state.

There is not a one size fits all definition of resilience.

Participants felt resilience may look different or mean different things to different people, Tribes, industries, and communities. They felt there is not a one size fits all approach, and that resilience can be described in a bottom-up way by those seeking to build climate resilience. There can also be language and terminology barriers across fields of study. Participants also noted it's important to consider the different scales, resolution, and time horizons at which resilience can be defined; for example is it based on a fiscal year? A five year time horizon?

Participants considered whether an agreed-upon definition of resilience is necessary to the Council's climate resilience planning, saw the value of both perspectives: that having a shared working definition is useful, but it's also acceptable for resilience to be nuanced and complicated.

Breakout groups also discussed whether the meaning of resilience is the same or different across climate scenarios. Participants generally felt the meaning of resilience is consistent across scenarios, as are the challenges of managing vulnerabilities and enabling adaptation What varies across scenarios are the scale and degree of exposure to climate risks, and the opportunities for adaptation.

Resilience can be a process or an outcome.

Participants discussed whether resilience is an attribute, an ongoing endeavor, or an outcome, or all of these. Some described adaptation is the ongoing process and activities (such as diversifying a business) that lead to the outcome of resilience. Some viewed resilience as a more dynamic and active process of improving what isn't working well. One perspective was

[9] From presentation by Dr. Marysia Szymkowiak, NMFS AFSC. "Gulf of Alaska Fishing Communities and Climate Change Adaptation." June 5, 2024

that resilience may not be achievable as a long-term or permanent state, and that ongoing adaptation may be a more constructive way to describe the work of resilience planning.

A point emphasized in the synthesis of Breakout 1 was to distinguish between what can be done to prepare and adapt to climate change, and the ability to withstand and recover from adverse conditions and disruptions. Evaluating the potential to withstand and recover from disruption is important to evaluating progress toward climate resilience. Metrics and evaluation are discussed more in Section 2.5.

A shared definition of resilience is grounded in values, goals and objectives

While individuals have their own values and objectives, participants also commented that working toward resilience in the Council process depends on having clearly articulated, shared goals and values to guide management responses. Participants remarked that it also means considering questions such as: Resilience for whom? Whose value systems and wellbeing are included? What does success look like? What are we trying to optimize? Values, goals, and objectives may also vary in different climate futures.

Groups shared examples of the values that could guide climate resilience planning, and values are discussed in more depth in Section 2.4.

- Sustaining fisheries as a food production system and achieving net benefits to the nation
- Community wellbeing, industry and community participation, and economic and social objectives
- Ecosystem health and wellbeing, health, balance, and interconnectivity
- Indigenous values and knowledge, subsistence food security, cultural values, and Tribal sovereignty
- National-level goals derived from the MSA and National Standards and defining Optimum Yield
- Building on what's working well in the Council and scientific process

Participants also reflected on the challenges of defining resilience and developing shared goals, objectives, and values. One observation was that resilience is not solely the responsibility of the Council. Resilience is a function of individual decisions and tradeoffs as well as the opportunities and constraints created through the Council process. Another comment was resilience may not be achievable for everyone, or achieved uniformly, and resilience doesn't mean individuals and communities don't experience adverse impacts of climate change. A related question was what resilience means to people who are leaving fisheries and communities, or have already been excluded. Finally, the relationship between resilience and specific objectives such as stability can be complicated or open to interpretation. For example a question was, does resilience imply achieving stability, or accepting that stability is no longer feasible?

Examples of attributes of and challenges to climate resilience

Participants described the following qualities and attributes of resilience, and what they think resilience would look like in practice. They also reflected on the challenges and barriers to

resilience, noting that it can be easier to identify what a lack of resilience looks or feels like. The meaning of resilience was a particular focus of discussion in Scenario 1. While workshop presentations used both the terms “readiness” and “resilience,” participants almost exclusively used the term resilience.

This section provides a snapshot of how people initially described resilience, but is not meant to be a comprehensive definition of all the ways resilience was discussed over the two days of the workshop. Later sections of this report discuss these topics in more detail.

Ecosystem attributes

Resilience can include: Supporting habitat and ecosystem function to mitigate and buffer against the impacts of climate change, and support recovery from climate shocks; supporting all phases of a stock’s life cycle, building population level resilience, allowing for recovery, and maintaining ecosystem function and services.

Challenges can include: Understanding and accounting for interactions between species, fisheries, and ecosystem components; habitat conservation, bycatch concerns, and understanding how habitat and ecosystem protections translate to resilience and productivity.

Individual, industry, and community attributes

Resilience can include: The sustained ability to continue fishing for business, subsistence, and cultural values; stable economic circumstances (for example as a function of an individual or company’s resources, access to capital and loans, investments, debts), access to infrastructure, the ability to diversify and leverage new opportunities, the lead time and ability to plan ahead, amd the ability to cope with fluctuations.

Challenges can include: Rapid pace of change and short or seasonal planning horizons, economic circumstances and having the means to diversify, business stressors (such as market dynamics, processing capacity, declining revenue, operating costs, fuel, waterfront access, having a low margin for error), individual economic stressors (housing, energy costs), vulnerabilities (such as reliance on a single stock for subsistence or income, weather), availability of other food sources for subsistence users, and access to disaster relief.

Council process attributes

Resilience can include: The procedural mechanisms to respond quickly to information and changing conditions, public access to the management process (the ability and capacity to participate in the process), trust, equitable representation and power in the process, effective and positive collaboration, effective two-way communication, clear articulation of goals and risk tolerance, metrics for resilience, and achievement of Magnuson-Stevens Act (MSA) mandates including rebuilding and ending overfishing and the National Standards.

Challenges can include: Lack of diversity in representation, particularly Tribal; lack of information and communication, barriers to participation.

Management attributes

Resilience can include: Providing access to fishery resources, supporting management values and objectives (e.g. stability in harvest levels, income, markets), the ability to support timely decision making and react quickly in response to new information; ability to practice dynamic, responsive management, the ability to keep pace with change; having confidence/comfort with change, and practicing precaution,

Challenges can include: Slow pace of the management process, lack of flexibility and opportunities to diversify or switch targets, siloed management approaches, inertia and resistance to change and exploring new approaches, and resource constraints (capacity, funding).

Science and information attributes

Resilience can include: The ability to plan ahead, clearly communicated information, climate-informed products and onramps for information into the management process, inclusion and use of diverse knowledge sources and systems including LKTKS, strong foundations including fully funded surveys, timely flow of information, improving the use of existing tools including ESRs, ESPs, and risk tables, monitoring and understand ecosystem change, and understanding vulnerabilities.

Challenges can include: The rapid pace of change, high uncertainty, resource constraints (especially surveys), timely identification of challenges and when to respond (e.g., how do we know when there is a problem? What scenario are we in?); and resistance and lack of onramps for diverse information and knowledge sources particularly LKTKS.

External factors

Participants focused primarily on challenges rather than what resilience could look like. Discussion focused on the global scope and nature of climate change and inability to address the underlying causes through the fisheries management process.

2. Council process

Workshop participants talked about the qualities of a timely, responsive Council process that supports climate readiness and a robust and inclusive public process. Participants commented on strengths they see in the existing process including strong scientific foundations, a desire for data-driven decisions, the capacity and experience gained from recent climate shocks including GOA Pacific cod and Bering Sea snow crab, and willingness to act in response; and conversation between user groups. Discussions also recognized limitations on what the Council process can do given all the external factors and variables that influence how climate change impacts unfold, and the context in which decisionmaking and adaptation occur. The ideas in this section address opportunities to improve the responsiveness of the Council, make progress toward climate readiness planning, and strengthen Council operations and processes to support public engagement.

2.1 Rapid response capability

Key message: Responsiveness depends on having the procedural tools to respond quickly to changing conditions and new information.

Ideas

- ➢ Explore ideas for rapid response, including regulatory and procedural flexibilities, constraints, and bottlenecks.
- ➢ Consider the use of framework agreements to speed decision making.

Discussion

Timely response to changing conditions is a function of having the science and information to inform decision making (Section 5), and how quickly the management process is able to respond. Participants discussed whether the Council process provides the flexibility and procedural tools to respond to changing conditions and new information. This includes responding to early warnings (Section 3.2) as well as dynamic and responsive management tools (Section 3.5). The need for responsiveness was especially prominent in Scenarios 3 and 4, in which predictive capabilities are lower and the need for rapid response is higher.

Participants felt the Council process can be slow, rigid, and constrain the Council's responsiveness. Some also noted there could be tradeoffs between rapid response and the deliberative, inclusive aspects of the public Council process. Groups discussed the kinds of tools currently available in the regulatory process, and noted it would be helpful to better

understand regulatory and procedural flexibilities, constraints, and bottlenecks. Participants also identified challenges to responsiveness within existing programs; for example, in-season quota adjustments would be difficult in rationalized fisheries.

Frameworking

Framework actions were the most-discussed procedural pathway for supporting rapid response. The use of frameworking and the terms used to describe this process vary across Council regions. The Council's annual specifications process is a form of expedited decision making.

Participants discussed frameworking in terms of actions that create pre-analyzed, agreed upon range of options within clearly defined conditions and parameters, that can be implemented without the need for further rulemaking. The NMFS Operational Guidelines for the Magnuson-Stevens Fishery Conservation and Management Act Fishery Management Process describe frameworking as follows (emphasis added).

> Planning ahead can enhance management responsiveness to the dynamic nature of fisheries. To this end, Councils have employed a variety of adaptive management planning techniques (referred to generally in this document as "frameworking") to implement regulatory actions more rapidly, as needed and appropriate. **Frameworking typically entails establishing in an FMP/amendment or regulations a mechanism for implementing recurrent, routine, or foreseeable actions in an expedited manner.** Examples include certain FMP procedures for setting annual specifications and taking various inseason management actions, such as quota adjustments, in-season closures, and trip limit or bag limit adjustments.
>
> Frameworking is not intended to circumvent standard FMP/amendment and rulemaking procedures under the MSA, and must be done consistent with requirements of the MSA, APA, ESA, MMPA, NEPA, and other applicable law. **To the extent that statutory requirements can be addressed up front when establishing the framework mechanism, this may result in less analysis and process being needed when individual actions are executed under that mechanism**. What analysis and process (including public comment) is required for each individual action will depend on the specific facts and circumstances of that action.[10]

Many felt frameworking would be essential to enabling the use of "if-then" triggers or other approaches to streamline the Council's response to new information and changing fishery or ecosystem conditions. Another comment was that frameworking could potentially be used to plan for other kinds of "if-thens," such as new technology becoming available (for example, real-time genetic testing of salmon bycatch). Participants noted that the MSA, Council process, and regional practices are not the only constraints to responsiveness. Other federal laws including the National Environmental Policy Act (NEPA) and the Administrative Procedures Act

[10] Operational Guidelines for the Magnuson-Stevens Fishery Conservation and Management Act Fishery Management Process. National Marine Fisheries Service Procedure 01-101-03. Effective October 25, 2017.

(APA) constrain how quickly the regulatory process can move. Participants also questioned whether there could be other processes for expediting decision making when flexibility and rapid response are needed.

Emergency actions

The MSA authorizes the Secretary of Commerce to promulgate emergency regulations or interim measures in response to a Council request for emergency action.[11] Participants mentioned the 2021 emergency actions[12] taken by the Council in response to the Covid pandemic as an example of the Council process responding quickly when necessary.

Non-regulatory guidance and performance standards

Participants mentioned examples of performance-standard based approaches, in which the objectives and requirements of a program are established in regulation while the details are provided in supporting documentation that can be revised and updated without the need for regulatory changes. Examples include electronic monitoring Vessel Monitoring Plans, and the Incentive Plan Agreements used for managing Chinook salmon bycatch in the Bering Sea pollock fleet.

Dynamic and in-season management

Groups discussed in-season and dynamic management, such as opening and closing areas, as a strategy for responding rapidly to new information, changing conditions, and early warnings. Participants did not discuss in depth what might be needed procedurally. Participants mentioned the Inter-Tribal Fish Commissions and ADFG in-season management (for example, of Yukon salmon) as examples of more flexible management approaches that incorporate timely fishery-dependent and fishery-independent information. This topic is also addressed in Section 3.5.

Adaptive management

Participants also mentioned the structured approach of true “adaptive management”, which involves an iterative process of monitoring, assessment, and decision making to support continuous learning and improve management over time.[13] While the term adaptive management is often used informally, there are limited examples of structured adaptive management in practice.[14]

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[11] U.S.C. 1855, §305(c). Additional resources: NMFS Policy Guidance for the Use of Emergency Rules, AKRO Frequently Asked Questions on NPFMC Requests for Emergency Actions

[12] The emergency rules recommended by the Council for the 2021 fishing season are to: Allow temporary transfer of halibut and sablefish IFQ, Waive vessel use cap on IFQ halibut in Areas 4A, 4B, 4C, and 4D, Suspend residency requirements applicable to the Adak CQE program, and Move up the start date for the Central GOA Rockfish Program from May 1 to April 1. February 2021 Council Newsletter

[13] Adapted from Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.

[14] The U.S. Fish & Wildlife Service practices adaptive management for setting waterfowl hunting regulations.

2.2 Council planning and prioritization

Key message: The scale of climate resilience planning demands dedicated time and resources to address specific issues and emerging challenges, as well as ongoing and long-term planning needs.

Ideas for prioritization, triage, and long-term planning

- ➢ Undertake a formal climate readiness planning process such a climate readiness policy, workplan, or strategic plan.
- ➢ Revisit the process for identifying new issues via staff tasking.
- ➢ Include more groups including the SSC, AP, and plan teams in prioritization.
- ➢ Use the Council's 3-meeting outlook strategically to evaluate priorities and tradeoffs with regard to resources and timing.

Ideas for efficient use of time

- ➢ Consider more focused SSC tasking.
- ➢ NMFS and the SSC could provide input on the timing and scheduling of climate-related actions that depend on the timing and availability of scientific inputs and review.

Ideas for generating guidance and input on climate-related issues

- ➢ Consider tasking a Council body, such as the Ecosystem Committee, with providing climate advice.
- ➢ Consider a new committee that could provide a forum for open discussions and capacity building.
- ➢ Provide more opportunities for informal discussion and interaction across roles and Council bodies.
- ➢ Consider how to engage other committees and Council bodies in climate readiness discussions.

Discussion

Climate change is increasingly at the forefront of Council decision-making, and the scale of this challenge will require dedicated time and resources to address specific challenges and actions, as well as support ongoing and long-term planning needs. Participants emphasized that creating capacity for climate readiness planning will require prioritizing finite time and resources at all levels, particularly the Council and SSC. Climate readiness planning increases or creates other kinds of demands on the Council process, such as coping with greater uncertainty, responding to new and novel challenges, providing more space for deliberation, supporting more collaboration, and engaging in long-term strategic discussion.

Participants commented on existing challenges including full meeting agendas, finite agenda and meeting time, staff capacity, compartmentalization of issues, and a tendency toward very

in-depth Council and SSC discussions. They also identified specific challenges related to climate readiness planning, including the following.

- Recognizing multiple climate change shocks and impacts will occur simultaneously.
- Achieving efficiency and prioritizing limited resources, while also making opportunities for expanded discussion (for example discussion that is more in depth, inclusive, and proactive.)
- Making time to be proactive and forward-looking, while continuing to make progress on existing issues and ongoing needs, including annual and cyclical tasks like reviewing stock assessments, that are time consuming but critical to having a robust scientific foundation for decision making.
- Managing existing programs and tasking in the pipeline while potentially considering changes. Participants questioned whether all of this can be done simultaneously, and whether the Council would need to stop taking on new items to review existing programs and needs.
- Taking on new, potentially large initiatives, actions, or planning exercises; participants felt some issues can be perceived as “too big” to undertake.
- Overcoming siloing and compartmentalization of issues and responsibilities that can create barriers to sharing ideas and information, including observations and red flags that could help provide early warnings.

One group discussed siloing in depth in response to Scenario 4. Siloing can describe a lack of coordination, barriers to information flow, as well as groups not feeling represented or heard in the process. This can occur at every level where there is a lack of coordination and information flow, including by stock, user group or sector, regionally, internationally, and both the management and science process. In the scientific process siloing can include compartmentalization by discipline as well as practices such as not accounting for flow of stocks between regions. Participants in this group felt siloing occurs now, and recognized that overcoming this tendency can take additional work and intentional coordination.

Participants discussed the following steps the Council could take to create more capacity for climate readiness planning.

Prioritization and long term planning

Participants emphasized the need to prioritize limited time and resources by making tradeoffs, prioritizing issues based on impact, and being willing to deprioritize or not pursue other issues. One idea was to revisit the current process for considering new issues, which is currently done via staff tasking. Participants also suggested more groups including the SSC, AP, and plan teams could contribute to prioritization.

Another idea was to develop a climate work plan, to provide a longer planning horizon and evaluate which aspects of the Council process are most in need of additional flexibility. The Council’s 3-meeting outlook approach could be used more intentionally for triage and prioritization. Another suggestion was for NMFS staff and the SSC to provide input on the timing

and scheduling of climate-related actions that depend on the timing and availability of scientific inputs and review.

Use of SSC capacity

Participants suggested making more strategic use of SSC time through prioritization and Council direction, and creating space to focus on bigger picture questions. This is an ongoing conversation between the Council and SSC. There were also comments on practices that may be specific to the NPFMC SSC. For example, one comment was that the NPFMC SSC does peer review of analyses, which in other regions might be conducted by the regional office or science center. Another comment was that other regions' SSCs follow more explicit terms of reference.

Some also questioned whether the SSC could be more independent and proactive in bringing forward ideas or new information for Council consideration, though it was noted that the SSC's role is constrained by Council tasking and the responsibilities specified by the MSA and National Standard Guidelines.

Meeting procedures

Some participants questioned whether the Council's current meeting procedures and structure could be an opportunity to find efficiencies. For example, some Councils delegate to species, issue, or FMP-specific Council committees rather than discussing most issues in full Council. However, participants commented that single-species committees wouldn't work well for the North Pacific, and that the practice of holding consecutive AP, SSC, and Council meetings is a strength of the current process. One comment was that the AP would benefit from seeing the SSC meeting report, which is usually not feasible due to the overlap between AP and Council sessions.

Climate-specific tasking

Participants questioned what existing or potential Council body could be responsible for providing the Council with climate advice, and what tasks this could entail such as advice on utilizing existing products like ESRs, keeping up to date on tools and approaches, and providing more forward-looking climate advice. Some felt this could be a role for the Council's Ecosystem Committee, if membership were realigned with this task. Others noted this role is somewhat fulfilled by plan team discussions. It could also be clarified through a future reauthorization of the MSA.

Inclusive discussion

Participants suggested creating space for climate planning discussions to happen outside of the Council meeting level. This could be achieved by delegating and tasking advisory bodies, or by empowering groups including the SSC and AP to be more involved in big picture planning and contributing ideas and questions to the Council process. More inclusive discussion could also be a way to counteract compartmentalization and help share diverse knowledge. Another idea was for more interaction between FMP plan teams though it was recognized this could create more demand on meeting agendas and plan team member time.

Groups also commented on the value of informal conversations and brainstorming that happen outside of a Council decision-making context. Constructive elements of informal dialogue can be the lack of a decision point, the ability to take a bottom-up approach (as opposed to focusing on tasking and agenda items), and allowing for conflict, disagreement, creative thinking; though the lack of an entry point into formal Council discussion can be a downside.

2.3 Public participation in the Council process

One of the workshop objectives was to develop strategies for ensuring a robust and inclusive process for advancing the Council's climate readiness planning. Participants talked extensively about challenges and opportunities for supporting meaningful public engagement. Some of these ideas are specific to climate resilience, and many also address ongoing challenges that have already been raised by the public.

2.3.1 Two-way communication and feedback loops

Key message: In contrast to traditional outreach and information sharing, workshop participants wanted to see true two-way communication that brings diverse perspectives and information inputs into the process, and helps create trust and shared purpose.

Ideas specific to climate readiness

- ➢ Clearly explain the actions managers are taking in response to climate change.
- ➢ Utilize stories, like the case studies presented at the workshop.
- ➢ Provide more opportunities to share climate-related work that may not be tied to a Council agenda item, including examples of research, collaborations, and adaptation efforts.

Ideas for Council communications and information sharing

- ➢ Use plain, accessible language and concise, focused messaging.
- ➢ Identify clear takeaways to make dense documents more readable, and provide more transparency in how the management process works.
- ➢ Adapt to how people ingest information now (for example Youtube shorts, visuals); make it easier for people to share and educate one another.

Ideas for public engagement

- ➢ Provide space for informal interactions to overcome compartmentalization.
- ➢ Bring in skilled experts, including science communicators and community liaisons.
- ➢ Hold meetings in rural communities to provide more opportunities for meeting people and learning.
- ➢ Provide more forums for open discussion across perspectives, including workshops like the Climate Scenarios Workshop.
- ➢ Provide more ways of providing input than 3-minute testimony.
- ➢ Implement the ideas in Section 3: Knowledge Base Overview of the Climate Readiness Synthesis.[15] (Feedback form)

Discussion

Participants felt two-way communication is essential to a climate-ready Council process. The Council process is already challenging to engage with due to the siloing of issues, the formality of the process, and the volume and pace of information. Participants described typical outreach, education and information-sharing as a one way, linear process of listening and receiving information, that tends to focus on explaining how the Council process works.

In contrast, participants described two-way communication as a feedback loop that includes the following attributes: the public is able to engage in the process from beginning to end, people feel heard, included and motivated to participate; and there are pathways for bringing diverse information inputs and perspectives into the process, including observations of change that can

[15] See Appendix 1

help identify red flags. Participants felt two-way communication can help build trust and positive working relationships, and foster the values of respect, empathy, and shared purpose that are important in all scenarios and particularly in the more challenging climate futures.

Communication was discussed primarily in terms of the communication between the Council and user groups, but also includes communication with NMFS and within the agency (such as between the region and AFSC, and between programs within NMFS); across disciplines, and between all voices in the process including scientists, managers, Tribes, communities, and user groups.

2.3.2 Capacity

Key message: The public faces challenges to participating in the Council process including the time involved, the complexity and volume of information, and cost and logistics of participating in meetings.

Ideas for financial support and capacity building

- ➢ Provide funding, grants, and resources, especially for rural communities.
- ➢ Support scholarships, knowledge sharing, investing in people, and mentorship.
- ➢ Compensate participants or provide an honorarium for their time and contributions, whether financially or through other means such as fishing opportunity.
- ➢ Invest in educating and bringing more young people into the process (also in Section 4.3)

Ideas for Council process improvements

- ➢ Utilize the Community Engagement Committee, which has not been active in recent years but provides another pathway for input and supporting engagement.

Discussion

Workshop participants discussed a lack of capacity and resources for people to participate in the Council process. Climate change enhances the need and ideally the opportunities for public engagement, not only in the decision making process but to collaborate, build knowledge, and bring diverse information and perspectives into the process. The Council process can feel overwhelming. Challenges to participation include access to information, the time and learning curve of understanding the Council process, tracking specific issues, and meeting preparation and follow up; the financial costs including travel and taking time away from work, and opportunity costs such as time away from family.

Participants talked about the additional challenges facing those who participate as volunteers rather than as part of their profession, including those from rural and Alaska Native communities. For example, there were comments that village leaders and elders often hold multiple jobs and positions, some unpaid; and that communities are already at capacity keeping

up with other demands. It's difficult for a single person to serve as the point of contact and source of information, and there is value in "widening the circle" of people involved.

2.3.3 Building trust and respect

Key message: Mutual trust and respect are essential for including diverse perspectives and information inputs, and developing the credibility and buy-in to plan for and respond to change.

- ➢ Support outreach and communication by trusted liaisons who have existing relationships and are familiar with community culture and history.
- ➢ Support more of what participants described as the "co" words: collaboration, co-production, cooperation, and co-management, which help build trust in management and science.
- ➢ Demonstrate ideas and comments are heard and considered in the decision making process.

Discussion

Participants felt trust is an essential quality of a climate-ready Council process from beginning to outcome. The theme of trust was discussed with regard to inclusion and diversity in perspectives and information inputs, and feeling respected in the process; establishing a shared understanding and baseline, trust in scientific information and products, the credibility to respond rapidly to new information, and the ability to engage in hard conversations. Participants emphasized the need for trust between user groups and sectors, as well as between science, management, and user groups. Building trust can be a feedback loop. Many of the ideas described in this report require trust to execute effectively, and also have the potential to build and strengthen trust in the Council process.

A specific suggestion was to support outreach and communication by trusted liaisons who have existing relationships and are familiar with community culture and history. One idea was to work with and compensate Alaska Native representatives as part of a communications strategy.

Participants also talked about building trust through individual actions. Within the Council process, opportunities for building trust overlap with many of the ideas discussed in other sections of this report including two-way communication (Section 2.3.1) and equity, inclusion, and representation (Section 2.3.4). Everyone who participates in the Council process can help build an atmosphere of trust and mutual respect. Participants emphasized practicing empathy, being aware that words matter, acknowledging different value systems as well as willingness to work together and find common ground, and focusing on being part of the solution rather than assigning blame.

2.3.4 Equity, inclusion, and representation of perspectives

Key message: Participants were concerned about equity, representation, power, and influence, in terms of how groups are able to participate in the Council process, how time and resources are allocated to issues and fisheries, and how climate and management impacts are distributed across user groups.

Ideas for improving representation and acknowledging equity and inclusion concerns

- ➢ Diversify representation and include more Tribal seats on Council advisory bodies and committees, including the SSC.
- ➢ Support more of what participants described as the "co" words: collaboration, co-production, cooperation, and co-management, particularly for including Tribal interests.
- ➢ Hold dedicated discussions around procedural justice and equity.
- ➢ Provide for representation and equitable involvement in Council initiatives such as workshop development.

Ideas for governance changes

- ➢ Change the Council appointments process.
- ➢ Look at other, more equitable governance models (as an example the Arctic Council has permanent indigenous participants).

Ideas for communicating how public input is considered

- ➢ Provide clearer explanation of how Council decisions are informed by public input.
- ➢ Consider innovations in processing and summarizing information and incorporating public testimony.

Discussion

Participants shared concerns regarding equity, inclusion representation, power and influence in the Council process. They felt these concerns are amplified by climate change in terms of the uneven impacts of climate change across user groups, and the ability to have a voice in planning for an uncertain future. Climate change impacts may be felt most acutely by user groups and communities, particularly subsistence users, who are most vulnerable and/or reliant on fishery resources. Some commented that subsistence users are the first and most heavily impacted by climate change, and that the definition of a "worst case scenario" looks different to different sectors and user groups. Participants emphasized having a clear process and expectations for climate readiness planning to avoid amplifying existing inequities, and providing advantages to those with more resources.

Participants talked about equity and representation in terms of how groups are able to participate in the Council process, and whether these opportunities are fair and equitable. One comment was that from a Tribal community perspective it can be difficult to participate in climate readiness planning when they already do not feel adequately represented in the Council

process. Participants also talked about equity in terms of how time and resources are allocated to issues and fisheries, and how climate and management impacts are distributed across user groups. They also described equity and inclusion in terms of utilizing diverse information inputs and perspectives (Section 5.1) and taking a longer-term and wider-angle view of environmental change. One specific concern about representation was raised with regard to Arctic communities in the Beaufort and Chukchi seas as reduced sea ice and shifting stocks potentially result in fishing effort and infrastructure moving northward.

Participants talked about the importance of building trust and a sense of fairness in the process. One group referred to the concept of procedural justice, which can be defined as the fair and meaningful involvement of communities in environmental decision-making processes, regardless of race, color, national origin, or income.[16] Participants suggested having more deliberate conversations around equity. Another comment was that Tribal interests are more effectively included through “co” words such as co-management and co-implementation.

Council and advisory body composition

Some participants commented that the current composition of the Council and its advisory bodies does not equitably reflect all user groups, particularly subsistence and Tribal perspectives, and that some interests are able to have a stronger voice in the process. The Council does have the ability to designate seats and perspectives on advisory bodies and committees. For example, participants commented that the AP could include more community perspectives, and that the SSC should include an LKTKS holder. Some participants supported full Tribal integration into Council decision making through a majority of designated seats on all voting bodies.

Some discussion focused on changing representation via the Council appointment process, which is not within the Council’s control. Participants also commented more generally that people and communities should have a stronger voice or vote in the process, and suggested looking at more equitable governance models. One example shared was the Arctic Council, which has permanent representation from Indigenous organizations. Participants also commented on a desire for Tribal representation and equitable involvement in other areas like workshop development, discussed further in Section 2.3.5.

Accountability

Participants also discussed accountability as an element of equity. They described accountability, and the lack of, in terms of feeling that input is heard and considered, understanding how the Council integrates information and public testimony into decision making, and the connection between AP advice and Council direction. Participants discussed ideas for improving and demonstrating accountability, including clearer explanation of how Council decisions are informed, innovation in processing and summarizing information (for example, using AI), and whether there could be other ways of incorporating public testimony, such as integrating this information earlier in the decision making process.

[16] Dr. Marysia Szymkowiak, NMFS AFSC, pers.comm. July 31 2024

2.3.5 Representation of Tribal perspectives in workshop planning and outcomes

This feedback was shared via the post-workshop feedback form.

Key message: Some participants felt Tribal perspectives are not adequately reflected in the Council process and in the workshop planning process, and that this will impact the final workshop product.

Council process ideas

- ➢ Climate readiness objectives should prioritize ecosystem health, subsistence access, and Tribal well being, and meaningful inclusion of Tribes and knowledge systems. (Also in section 2.4).
- ➢ The Council and NMFS should recognize shortcomings with regard to recognition of Tribal impacts and concerns, coproduction of knowledge, and meeting consultation mandates.
- ➢ Implement and use LKTKS protocol and on-ramps (Also in Section 5.1.1).
- ➢ Engage in more outreach to Tribal organizations.

Workshop planning ideas

- ➢ Provide more diversity in presenters, facilitators, floaters, and more inclusivity and presentation of Tribal perspectives, contributions, and climate change impacts.
- ➢ Recognize lack of Tribal input will impact the final workshop product.

Discussion

Respondents emphasized that many of the concerns expressed by managers and commercial industry are already being felt by Tribal communities as a result of climate changes as well as the impacts of past management actions; and that these impacts should be more fully acknowledged. Respondents commented that climate readiness objectives should focus first on Tribal and subsistence wellbeing, and that failure to prioritize these objectives and meaningfully integrate Tribal knowledge and perspectives would fall short of achieving ecosystem-based management and climate resilience.

Respondents also commented that the structure of the Climate Scenarios Workshop, location and timing, and lack of inclusion of Tribal perspectives in the planning process and workshop presentations and facilitation were detrimental to inclusion and recognition of Tribal perspectives, concerns, and experiences with climate change. They felt these concerns should be acknowledged, and that the lack of Tribal input will impact the final workshop product. Participants encouraged more engagement with Tribal organizations including the Alaska Federation of Natives, other Tribal organizations, Alaska and Village Corporations.

2.4 Goals, objectives, and values

Key message: The Council could be clear and deliberate about what they want to achieve through climate resilience planning, and develop a shared frame of reference and rationale for taking actions, making tradeoffs, and setting priorities. This could be a collaborative and inclusive process and could provide the space to acknowledge difficult tradeoffs and hard questions.

Ideas

- ➢ The Council could engage in a process to articulate a vision and/or goals, objectives, and values for climate resilience and recognize hard questions and tradeoffs.
- ➢ Build on common values including ending overfishing and rebuilding overfished stocks, and recognize the MSA and National Standards provide guideposts and are part of shared values.
- ➢ Climate readiness objectives should prioritize ecosystem health, subsistence access, and Tribal well being, and meaningful inclusion of Tribes and knowledge systems. (Also in Section 2.3.5). (Feedback form)

Goals, objectives, and values for climate readiness were woven throughout all workshop discussions. Workshop participants felt the Council could be deliberate about what they want to achieve by articulating a vision and/or goals and objectives for climate readiness and other attributes such as wellbeing. This high level guidance could guide climate readiness actions and responses, particularly in rapid response situations where the Council needs to react quickly; help frame tradeoffs and priorities, and help the Council identify what may need to change.

The MSA and the National Standards provide high-level guidance on the purpose and objectives for fishery conservation and management. Participants had different perspectives on whether the National Standards are intended to be balanced, which implies tradeoffs are made, or whether the intent is for all of them to be fully achieved. Some felt certain National Standards already do take precedence, or should be prioritized. For example, it was suggested that the meaning of optimum could focus more on socioeconomic outcomes.

Goals, objectives, and values are also embedded in the Council's Fishery Management Plans and other guidance such as the Ecosystem Policy.[17] The Programmatic Evaluation will provide a pathway for the Council community to revisit the management policies, goals, and objectives for all of the Council's federally managed fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska.

Participants felt that while people have different values and priorities, developing a vision of what success and resilience looks like could provide a clear rationale and shared reference point for the Council's climate readiness work. This process could also be an opportunity to identify shared values and areas of agreement, whether as a Council community or at the

[17] Council policies are available on the Council website

regional and sector levels, and explore how people perceive risk. This would be especially important in scenarios where resource scarcity creates conflict. Participants felt a process for articulating goals, objectives, and values would need to be inclusive and collaborative, and would also involve confronting challenging conversations and tradeoffs.

Participants shared examples of values for climate readiness, including some that are general attributes of resilience, and others that are more individual. In some cases participants referred to balancing or optimizing multiple values, and in others they spoke of values as priorities or elements that should take precedence. The section is not meant to be comprehensive of all values and perspectives shared; rather it is included to illustrate the ways in which participants talked about their values and could help provide structure should the Council continue this discussion. Some of these ideas may be areas for agreement, while may highlight areas for accepting where there are differences of perspective and conflicting or competing interests.

Goals, objectives, and values can overlap with attributes of resilience.
Participants often spoke about goals, objectives, and values in ways that overlap with the discussion of climate resilience in Section 1. Examples included attributes of management and the Council process such as flexibility, stability, fairness, equity, and access, and healthy fisheries and communities.

Goals, objectives, and values can emerge through tradeoffs.
Participants identified many examples of tradeoffs that could either involve seeking balance and compromising, or choosing to prioritize one outcome over another. Risk tolerance is also a component of making tradeoffs. One comment was to consider where there may be “red line” or unacceptable tradeoffs.

Participants identified where they see the potential for tradeoffs, including the following.

- Short term economic opportunity vs. long term stability
- Maximizing participation and social, economic, and community objectives vs. efficiency
- Fishing as a livelihood vs. as a way of life
- Inclusiveness vs. speed and responsiveness in management
- Efficient food security and production vs. community composition and participation
- Stability and opportunity for existing participants, vs. opportunities for those experiencing adverse conditions
- Affordable domestic seafood for consumers vs. higher prices for industry

Goals, objectives, and values can be situation dependent.
Participants discussed objectives that could be more important under certain future climate conditions, particularly the low productivity and high unpredictability of Scenarios 3 and 4. For example, objectives in these scenarios could include maximizing the value of limited catch and supporting food security to meet rising demand and population growth.

Goals, objectives, and values can include personal and community value systems

Participants shared examples of individual and community-level values they felt should be reflected in Council-level priorities, including the following.

- Fishing as an identity and way of life, and recognizing the non-financial reasons why people (including the commercial sector) choose to fish
- Taking only what you need, not wasting resources, and considering impacts on others (including people, fish, ecosystem components)
- Sustaining cultural practices and traditions
- Ensuring subsistence food security including fish, marine mammals, and terrestrial species, in ways that recognize connectivity between marine and river/terrestrial systems
- Taking a long term view, thinking of future generations, sustaining fishing as a way of life
- Scaling back industrial fishing to bolster resilience of communities (fishing communities, Tribal, subsistence)
- Focus on supporting participation by reducing catch and effort, focusing on less impactful fishing gear, and improving product quality

Goals, objectives, and values can involve different perspectives on the Council's role and "levers" for action.

Participants shared different perspectives on whether climate change inherently creates "winners" and "losers" (which could refer to individuals, communities, geographical regions, fisheries, etc.), the appropriateness of using these terms, and whether these outcomes reflect policy choices, environmental factors, or other factors.

Goals, objectives, and values will raise difficult questions.

Participants commented on difficult questions the Council community will have to confront. Some of these ideas are challenging conversations the Council may need to have, and others were described more as "hard truths." Examples include the following.

Examples of questions shared by participants

- How can the Council build confidence in programmatic change when people feel the process has not allowed change, and excluded some user groups from participation?
- What should be the Council's conservation priorities in a drastically altered ecosystem where species may not recover, and/or new species may be available?
- What is the range of scenarios for which the Council should engage in contingency planning? Should the Council plan for the worst and hope for the best? How can or should plan for high impact, low probability scenarios like oil spills or harmful algal blooms?
- How can or should the Council support people who are the most impacted? What is the Council's role and what tools are available for rebalancing benefits?
- How should the Council make risk tolerance calculations? Is it acceptable to inflict short-term economic pain to avoid worse outcomes?
- At what point are people willing to consider transformative change, such as restructuring a management program?

- How can the Council community work with people who hold fundamentally different beliefs in the validity of science and climate change?
- What happens when disasters become more frequent? Are we moving from the expectation that disaster leads to recovery, to instability becoming a new norm?

Examples of “hard truths” and advice shared by participants

- The Council has limited time, bandwidth, and ability to respond to climate change impacts; it’s not feasible to respond to everything.
- Science may not be able to reduce uncertainty in a highly unpredictable environment, and the Council will have to make rapid decisions in the face of increasing uncertainty
- Business models based on the concept of continued growth may struggle in a changing climate.
- There will be the possibility of sometimes “getting it wrong” (for example, responding to an early warning), and even a robust process (whether this is referring to the public process, management approaches, or science and information) will be stress tested.
- Previous management approaches may not work well in the future; it will be important to practice humility and the willingness to adapt.
- Responses will have both positive and negative impacts on people.
- Anyone can and will be impacted by climate change; everyone will have to cope with change, giving up something, and moving away from the status quo. Empathy and respect are essential.
- Climate change will challenge the Council community to think creatively and operate outside their comfort zone.
- Climate change is now the context in which the Council process operates. It shouldn’t be used as a scapegoat to avoid contentious issues or excuse inaction.
- Those with the most resources are often able to profit from the instability following natural disasters and other crises. The Council community can be deliberate in avoiding this outcome. (Feedback form)

2.5 Metrics and evaluation

Key message: Establishing metrics and conducting evaluations is important for assessing whether progress is being made toward climate resilience.

Ideas:

- ➢ Establish metrics to evaluate progress toward climate resilience.
- ➢ Conduct periodic performance reviews to ensure the management system is responsive to emerging knowledge, events, and trends.

Discussion

In addition to goals, objectives, and values participants talked about the importance of establishing metrics and evaluating progress toward improved climate resilience. These two concepts are linked; in order to measure progress it would be necessary to articulate what the Council wants to achieve.

Participants discussed metrics and evaluation as a way to guide decisions, focus, and assess whether decisions are incrementally increasing resilience. They also suggested metrics could help rightsize management responses to change, avoid over- or under-reacting, and consider the question of “How resilient do we need to be?” Participants also discussed indicators as a form of metrics for measuring the vulnerability and resilience of people, communities, populations, and ecosystems. Evaluation can also include ongoing learning and incorporating lessons learned into the Council and scientific process.

Another suggestion from the synthesis of Breakout 1 was to establish a routine process or performance review to ensure the management system is responsive to emerging knowledge, events, and trends. Climate change is an ongoing and evolving challenge. Periodic evaluation can help take stock of new information and progress made, and assess how climate change impacts are unfolding relative to projections.

3. Management measures

The four workshop scenarios prompted participants to reflect on the Council's existing management programs and tools, and additional ideas for supporting resilience in an uncertain future. Participants had different perspectives on whether the Council has the necessary management tools. Some felt existing approaches operate under the expectation of stability and stationarity, and may not perform as intended. Others felt the Council has robust tools but they may need to be utilized differently. Participants also had different perspectives on whether adapting management to changing conditions should be incremental and attempt to provide stability, or whether transformative changes might be needed.

Workshop discussions about management tools varied depending on the scenario. The higher predictability and longer planning horizon in Scenario 2 encouraged participants to think about the attributes of management under a more ideal future. In contrast, the low productivity, high variability, and more reactive circumstances of Scenarios 3 and 4 prompted a more tactical discussion of how management might respond to worst case scenarios. Section 6 provides a detailed overview of themes and differences between the four scenario-specific breakout sessions.

3.1 Adaptation, diversification, and flexibility

Key message: Current management programs, particularly for rationalized fisheries, were designed to manage effort and access and can also constrain the ability of people, businesses, and communities to diversify and adapt to change.

Ideas

- ➢ Continue to explore opportunities for building flexibility into new and existing management programs, including the mechanisms identified in Section 3.1.1 and the challenges and considerations in Section 3.1.2.

Discussion

Participants identified flexibility and diversification as essential strategies for building resilience and adapting to changing conditions. These terms include a wide range of adaptive actions that could be taken by people, businesses, and communities to proactively and efficiently build resilience, respond to adverse conditions and climate shocks, and take advantage of new opportunities and fisheries that are doing well under climate change. Participants primarily talked about diversification as developing a portfolio of fishing opportunities and moving away from reliance on a single species. Other strategies for responding to change could include adapting to shifting stock distributions, entering emerging fisheries, adjusting business strategies and investments, and exiting fisheries.

The Council's existing management programs, particularly rationalization and IFQ management programs, can encourage specialization and create barriers to flexibility and diversification. Participants recognized that the rigidity of current management programs reflect past decisions that were intended to manage access, limit effort, and provide stability, rather than to provide flexibility. Some programs include features that were specifically designed to limit flexibility to achieve social and economic objectives and limit spillover from rationalized to non-rationalized fisheries. Participants highlighted the opportunity for the Council to proactively create more flexibility in the system to enable user groups to cope with fluctuations in availability and abundance, respond to unpredictable conditions, and pivot to focus on stocks that are doing well and avoid those that are not.

3.1.1 Mechanisms

Participants discussed the following ideas for providing more flexibility and opportunity for diversification. Some of these strategies would be a significant departure from current practices and as with all ideas in this report are not presented as consensus or recommendations.

Management tools and strategies

Provide opportunities for new entrants

Participants discussed the themes of intergenerational access and equity, and suggested rationalized fisheries could be adapted (and/or future programs could be designed) to provide more opportunities for new entrants and upward mobility for individuals, Tribal interests, and communities. There were different perspectives on barriers to entry. Participants recognized rationalized programs have higher entry costs, but some noted they do provide pathways for people who want to invest in an industry.

All of the Council's limited access privilege programs (LAPPs) have considered new entrants. One example of providing entry-level opportunity is the crew "C" shares created under the 2005 crab rationalization program. Another example was the set-aside for adaptive management that was created as part of the Pacific Fishery Management Council's groundfish rationalization program, though this program is not currently operational.[18]

Other suggestions were to learn from past experience around access and intergenerational equity, and to set a Council research priority to explore ownership structures for federal fisheries to identify lessons learned. The Council has previously tasked staff with discussion papers on opportunities for IFQ program access.[19]

Combine or integrate management programs

Participants suggested creating flexibility by integrating or allowing for more transferability between management programs. Examples included combining gear type allocations, combining management of co-occurring species, and allowing for more flow between fisheries (such as American Fisheries Act (AFA) pollock and Amendment 80 flatfish). On a much larger scale, participants raised the possibility of moving from sector based management toward a more holistic, integrated program or "marketplace" for quota at a regional level.

Provide cross-sector and within-sector flexibility

Participants mentioned cross-sector quota leasing and transfer (for example between catcher vessels and catcher processors, or across gear types) as strategies for allowing more movement of quota shares. They also noted this is not a solution that could provide benefits for all sectors, including subsistence users

[18] The set-aside was designed as a way to help mitigate adverse effects of the program and/or provide opportunities for new entrants, but has not been operational since the program was implemented in 2011. For more information see Pacific Coast Groundfish Fishery 2019–20 Harvest Specifications, Yelloweye Rebuilding Plan Revisions, and Management Measures. Environmental Assessment/Magnuson Stevens Act Analysis/Regulatory Impact Review/Regulatory Flexibility Act Analysis

[19] Discussion Paper: IFQ Access Opportunities- Global Examples. D5, June 2019 and Expanded Discussion Paper: IFQ Access Opportunities. D2, April 2021

Revisit program features that reduce flexibility

Participants commented on program features, particularly within the crab rationalization program, that add complexity. While some distinctive features of this program such as community delivery requirements and harvester-processor quota sharing matching were designed to support social and economic objectives, they can also constrain flexibility. The Council's recent action on crab facility use caps was mentioned as a positive example of creating flexibility.[20]

Develop "off ramps" to exit fisheries

Participants mentioned the idea of offramps for harvesters or processors to exit fisheries in decline, noting this is particularly difficult for high-investment fisheries. Cross-sector leasing was suggested as one strategy.

Consider area-based access

Participants raised the possibility of community or area-based fishery access, such as Territorial Use Rights for Fishing (TURFs) used in other regions of the world, that could provide flexibility to shift between species and enable users to access the resources near them.

Industry and community-led approaches

Participants also discussed examples of including cooperatives, Community Development Quotas (CDQs), and other approaches that enable industry and communities to share access opportunities, information, and risks for mutual benefit. Participants felt these approaches could be more widely implemented or adapted as models for providing flexibility, particularly in lower productivity and more volatile futures. They also felt these tools can encourage and empower people, communities, and industry to innovate.

Cooperatives

Cooperative models, in which members participate in a contractual agreement to manage fishing effort and harvest, are one way to provide industries and communities with the tools for flexibility and innovation. The option to participate in cooperatives is generally authorized by Council action, and the Council establishes requirements and performance standards that help them operate effectively, though this does not preclude industry from forming a cooperative by mutual agreement. Participants commented on the advantages of existing cooperative models for managing fleet effort and cooperating on bycatch avoidance.

Participants suggested cooperatives could provide a more efficient approach to managing effort in a more volatile, lower productivity future through the ability to stand down vessels and right-size fleet capacity. Another idea was that cooperatives could support fleet diversity by allowing for a combination of large and small vessels. One comment noted the potential for harvester-owned seafood processing cooperatives that provide shareholders with flexibility and access to processing capacity, as well as providing job opportunities within communities.

[20] See C2 materials on Final Action - Crab Facility Use Caps, December 2023

Community Development Quota (CDQ) program

Participants mentioned the CDQ program as a structure that, by design, provides communities and entities with flexibility and resilience to climate change impacts. The western Alaska CDQ program, authorized by the MSA,[21] provides eligible western Alaska villages with the opportunity to participate and invest in Bering Sea and Aleutian Islands fisheries, support economic development, and provide social and economic benefits to communities.

The CDQ program provides entities with the ability to maintain a diverse portfolio, and also provides flexibility in terms of how CDQ entities use their fishery access privileges and choose to invest. Participants recognized the CDQ program is a specific program authorized by statute, though questioned whether features of this model could be scaled or adapted to other fisheries and regions.

Information and risk sharing

Scenarios 3 and 4 described a high level of real-time monitoring, information sharing and coordination within and across sectors to cope with highly unpredictable conditions. Though this was not a strong focus of discussion participants mentioned other forms of information sharing and risk management focusing on bycatch avoidance. Examples included voluntary third-party monitoring and information sharing to manage bycatch and avoid prohibited species catch (PSC) caps, and the example of risk pools for bycatch management in the west coast groundfish fishery.

Other community and industry approaches

Participants also shared examples of steps communities are taking or could take to adapt, share resources, and work toward common goals. Examples shared by participants included villages working to address infrastructure and food insecurity, and community and industry groups exploring alternative energy sources for vessels and communities. Other efforts could take the form of community-level climate resilience planning. One observation was that the community and industry-based approaches are scale dependent and depend on relationships and commitment to shared outcomes. Another comment was that community and industry-led approaches may be more necessary in more challenging scenarios like Scenario 4.

Aquaculture and mariculture

Aquaculture and mariculture were briefly discussed as opportunities for diversification, reducing pressure on fishery resources, and for sustaining food production and food security especially in more volatile futures. Participants felt these options may be part of the solution but also shared concerns. They noted aquaculture and mariculture are not a replacement for cultural values of wild capture fisheries, and that it is still important to address loss of and dependence on subsistence resources. They also expressed concern about displacement of fishing livelihoods.

[21] U.S.C. 1855 §305(i)

3.1.2 Challenges and considerations

Participants had in-depth discussions of challenges that can make it difficult to access fishing opportunities, diversify operations, and take advantage of flexibility. They talked about both fishery **access**, meaning what is possible and allowable under existing regulations programs, and **accessibility**, meaning whether options are feasible and available to people given their individual circumstances.

Managing for diversification and flexibility would involve difficult questions and tradeoffs.

Creating opportunities for diversification and flexibility would likely necessitate revisiting past management decisions as well as the goals, objectives, values, and difficult questions described in Section 2.4. Participants identified the following challenges.

- Resistance to change: Participants felt flexibility and diversification are different problems than the Council is used to solving for, and that there isn't a precedent for designing programs with the degree of flexibility discussed at the workshop. At the same time, some of these ideas aren't necessarily new and some, such as entry level opportunities, have been discussed but not always resulted in uptake in the Council process. A comment was that it may be more feasible to build flexibility into new programs as opposed to existing ones. Participants also questioned how to identify the right time for change.

- Tradeoffs between participation and efficiency: Current management programs have built-in inefficiencies to support social and economic objectives to allow for more participation. Future scenarios, particularly the low-productivity future described in Scenarios 3 and 4, could necessitate aligning and reducing capacity to align with productivity.

- Balancing equity, stability, and access: Groups discussed the challenge of balancing stability for existing participants and communities with opportunities for those who are most impacted by climate change, and scaling access to these opportunities to the level of community participation and engagement. One question was whether and how opportunities should aim to support those who are most impacted by climate change.

Diversification poses financial and logistical challenges.

Participants talked about the financial and logistical challenges of diversifying fishing businesses and communities to acquire access privileges and adapt vessels, gear, and operations to target different species. They raised the following points.

- Individuals and communities face many other stressors and costs that impact their ability to diversify, including operating and maintenance costs, market volatility, and cost of living (discussed more in Section 1 on defining resilience). Small businesses in particular may not have the resources and capital to invest.
- Specific policies can create costs, for example vessel replacement cost structures in some programs.

- Economies of scale vary by fishery, and some fisheries are only profitable at high volume.
- Transitioning or standing down effort still comes with costs, such as maintenance of unused infrastructure and vessels, and the loss of crew or employees moving on to different opportunities.
- Transitioning to new opportunities includes a learning curve and investment of time, for example to comply with different regulations and adapt to new gear.

Participants felt diversification and flexibility are especially difficult in the processing sector due to high investment and operating costs (including space and equipment), the impacts of market conditions and availability of buyers, and the difficulty of pivoting or "modularizing" to process other species or cope with volatile conditions. They observed processing capacity isn't designed to handle large fluctuations and variability in species, especially under the conditions described in Scenarios 3 and 4. Processing capacity could be a constraint to the success of strategies for diversification, and have significant impacts to community resilience.

Participants also noted access to disaster relief and other financial mechanisms (Section 4.4) could potentially offset these challenges.

Diversification isn't equally available to everyone.

Some participants shared frustration with viewing diversification as a climate resilience strategy, when individuals or communities might not have the resources for diversification to be a feasible option. They pointed out that diversification is least feasible in the face of decline or collapse, when investments and resources are losing value. Participants also felt there are existing inequities that make diversification less accessible to some. They commented that current circumstances reflect past decisions that favored certain participants, and that diversification isn't a solution for subsistence users and those who have been excluded from existing management programs.

Participants also questioned whether diversification is a "zero sum game," or whether it can result in mutual gains. One perspective was that effort shifting into a fishery creates uncertainty for existing participants, and depends on some form of redistribution or an increase in the number of people wanting access privileges. A different perspective was that with fluctuations in productivity, movement between fisheries would not necessarily be at the expense of existing participants.

Diversification will reflect individual choices and preferences.

Participants observed that diversification is not only about mechanisms and opportunities, but about self-determination and choice. Participants commented that steps for diversification and building resilience, whether shifting fisheries or even industries, should be led by what people and communities want for themselves. How an individual or community perceives diversification as an opportunity also reflects personal choices and values, investment decisions, and risk tolerance.

Some commented that diversification could include taking on new roles in other fisheries, leaving fishing for other roles, and retraining. While they felt these options aren't appealing they also questioned what happens when opportunities are lost and fisheries can't support the same level of participation.

Rationalization programs have altered incentives and created new challenges to resilience.
Participants talked about the challenges and consequences of rationalization programs, and some expressed frustration with rationalization being seen as an ideal management strategy. In addition to the flexibility challenges described above, participants' concerns included communities losing access to fisheries in their vicinity, lack of intergenerational access, high costs that to entry that can result in individuals being highly leveraged and financially vulnerable, and incentivizing individuals to specialize and make risky investments that may contribute to the need for disaster relief.

Consolidation could have positive or negative consequences.
Participants shared different perspectives on whether consolidation of effort would reduce or amplify the negative impacts of climate change. Consolidation was mentioned as an outcome of rationalization but could also be a consequence of strategies to allow more flexibility or and movement between fisheries, and to align effort with productivity. One perspective was that consolidation and reduced participation is detrimental to communities, and results in the concentration of decision making power. Consolidation could also mean there is less capacity to respond when a stock rebuilds or becomes more abundant. Another comment was that consolidation is not entirely negative, and without the consolidation that occurred due to existing rationalization programs, even more people would be impacted by climate shocks.

Different climate futures would shape how diversification occurs.
Participants commented that the incentives and pathways for diversification could play out in different or unexpected ways in different scenarios. One comment was that there may be less reason or incentive to enable diversification under higher predictability scenarios like Scenario 2. In contrast, Scenarios 3 and 4 prompted people to think about what diversification might look like in a highly unpredictable, lower productivity system, where catches would be lower and more variable. Participants suggested lower productivity could result in more generalists if it's no longer feasible to specialize, or even lead to a single fleet that changes gear and targets. Fleet diversity could change; for example if fish move further offshore there could be consolidation of catch by larger vessels.

Shifting and emerging fisheries will create new access challenges and questions.
Participants discussed the opportunities and challenges that could arise when fisheries expand or shift, or when a new species is able to support a viable emerging fishery. Range shifts and emerging fisheries could provide an opportunity to build resilience and enable diversification. Participants observed that the response to shifting and emerging fisheries could look very different under the status quo, as compared to a hypothetical, more flexible management system.

In addition to the scientific and management considerations of emerging fisheries (Section 3.6), participants raised concerns about access and equity in determining who has access to resources, and how other user groups are affected. A suggestion was to learn from past experience and not proceed directly to rationalizing these fisheries. One question was whether people who have lost access to other resources might get preferential access to emerging species. Participants also raised specific concerns about the impacts to subsistence users and communities of fisheries and infrastructure expanding northward into the Arctic.

3.2 Early warnings and responsiveness

Key message: Climate readiness includes the willingness and ability to identify and act on early warning signals and "red flags." Rapid response may or may not result in better stock outcomes but would provide more time for adaptation and adjustment.

Ideas for informing and implementing early warnings

- ➢ Continue to explore mechanisms and considerations for implementing and responding to early warnings.
- ➢ Develop "crash plans" to guide the actions that could be taken by the Council and user groups in anticipation of a major stock decline.
- ➢ Develop reliable ocean model forecasts and projections for advanced planning (also see Section 5.6) and improve integration of diverse information and knowledge sources (Section 5.1).
- ➢ Develop reliable ecosystem indicators that could trigger management responses.

Ideas related to harvest specifications (also in Section 3.7)

- ➢ Explore ways to framework or automate climate-enhanced management responses, for example by using management-binding definitions within risk tables.
- ➢ Consider a stepped or tapered approach to reducing catch limits over multiple years, rather than making abrupt changes.

Discussion

Participants discussed what would be needed in a science and management process that is able to identify and act on early warnings, "red flags," and indications of change. They described an ideal system as nimble, responsive, adaptive, and capable of reacting without overreacting. Much of this discussion took place in the breakouts focusing on Scenarios 1 and 2. Scenario 1 discussions prompted reflection on the role of early warnings in the case studies of snow crab and Pacific cod shared on the first day of the workshop. Scenario 2, as a "best case" scenario, prompted groups to think about what an early warning system could look like if this process were functioning well.

This section includes participants' discussion of what would be needed to identify and respond to early warnings, and the considerations involved in translating information to response. The topic of early warnings and responsiveness are also referenced in other sections, including

Section 2 on Council process, which considers procedural mechanisms and the importance of trust and two-way communication, and Section 5.1 on diverse information inputs, which discusses the role of LKTKS and on-the-water observations for identifying signals of change.

Benefits of early warnings

Participants felt the primary benefit of effective early warnings would be to mitigate the impacts of climate shocks to harvesters, processors, and communities. Many questioned whether a more robust early warning system could have resulted in different or better management decisions and stock outcomes in the cases of snow crab and Pacific cod. In the case of snow crab participants felt an early warning could have resulted in lowering the TAC sooner, could have increased communication of concerns to industry, and could have bolstered industry planning and capacity for lowering harvest levels. Participants also noted that cancellation of the 2020 Eastern Bering Sea Shelf bottom trawl survey due to COVID contributed to missing signals of change.

Some participants felt early warnings would likely not result in better stock outcomes or avert climate-driven declines and collapse, but could help reduce the socioeconomic impacts of climate shocks by providing user groups with more time to prepare, adjust, and make informed decisions. They commented on being mindful of what the Council process can control (i.e., human behavior and fishing mortality) and what it cannot (ecosystem change).

The additional information and lead time provided by an early warning system could allow for adaptive measures to be taken within the Council process. As one example, participants suggested a stepped or tapered approach to reducing catch limits over multiple years rather than making abrupt changes. Early warnings could also inform actions taken outside of the Council process by individuals, businesses, and communities. For example, participants mentioned that signals of strong recruitment in the snow crab fishery contributed to high industry expectations and investment that exacerbated the impacts of the subsequent collapse. Another idea was to develop “crash plans” to guide the actions that could be taken by the Council and user groups in anticipation of a major stock decline.

Mechanisms and considerations

Participants identified barriers to leveraging information that could help inform early warnings. Challenges include acceptance of predictive tools, and a lack of on-ramps for diverse information sources (Section 5.1) including observations and LKTKS that can help identify changes and red flags.

Participants commented that while there are opportunities to consider information and highlight ecosystem and climate-related concerns through risk tables, Ecosystem Status Reports (ESRs) and Ecosystem and Socioeconomic Profiles (ESPs), there are not clear pathways to act on this information. Some felt there could be more formalized triggers or “if-then” mechanisms that link this information with a management response, and that this could be tailored to information availability and the characteristics of different programs.

Participants discussed the following considerations with regard to early warnings and triggers.

Trust and credibility

Participants emphasized the importance of trust and buy-in for acting on early warnings including the following attributes.

- Trusted and timely information, including the use of diverse information sources including observations and LKTKS that help corroborate observations with other information sources; and clearly communicating risks concerns to the public. One example was the risk assessment "report card" approach used by the Mid-Atlantic Council.[22] (This idea is also referenced under Section 5.3).
- Agreement and consistent interpretation of an early warning and clear rationale for responding and supporting a decision.
- Clear parameters and expectations for a response, and effective two-way communication.
- Awareness of consequences; it's also important to recognize that acting on early warnings has consequences for people and communities and that being more responsive to early warnings comes with the possibility of "getting it wrong" sometimes.
- NOAA's Climate Ecosystem and Fisheries Initiative is developing oceanographic and ecosystem predictions that could be used to raise alerts of upcoming shocks. Responding effectively requires understanding prediction accuracy and identifying impacted species and ecosystem elements (e.g., through simulations or best available knowledge).

Interpreting information and risks

Participants felt it could be difficult to agree on what constitutes a "red" flag in real time, as compared to the clarity of identifying warning signs in hindsight. An early signal may not be clearly good or bad ("red" or "green"), and the Council and user groups may interpret them differently depending on how they perceive risk. One comment was that multiple red flags or information sources might be needed to trigger a response.

Developing the procedural mechanisms

Participants discussed the need for the Council to have the authorities and procedural pathways (such as frameworking) for a timely response to information and early warnings. This is discussed in more detail in Section 2.1.

Scaling and right sizing the response

Participants raised the possibility of reacting too quickly or strongly to early warnings, and suggested having flexibility to adjust the magnitude of response. One example was to think of management as a throttle rather than a lever.

[22] MAFMC 2024 EAFM Risk Assessment Report; see Summary, p. 44

Learning from past experience and considering what-ifs

Participants discussed the value of learning from case studies and past experiences and asking: What indicators would have helped us see climate shocks coming? Planning for contingencies and frameworking Council actions would also involve considering a range of possible scenarios and outcomes. Participants raised the caveat that future shocks could look different and a changed ecosystem might respond differently than anticipated.

3.3 Ecosystem-based approaches

Key message: Ecosystem-based approaches embody and can help advance the qualities of climate-ready fisheries management including inclusion of diverse information inputs, knowledge systems, and perspectives; consideration of social, economic, and cultural needs and values; understanding of ecosystem dynamics and processes, and interactions between user groups and sectors.

Ideas

- ➢ Continue articulating what EBFM and EBM look like in practice and incremental steps forward.
- ➢ Utilize strategies of co-production of knowledge, co-management, collaboration, and cooperative management to support EBFM principles and integrate diverse knowledge sources.
- ➢ *Additional ideas are provided in the discussion sections below and overlap with ideas for climate resilience presented in other sections of this report.*

The Council's use of ecosystem-based approaches, including ecosystem-based fisheries management (EBFM) and ecosystem-based management (EBM), was one of the two factors used to frame the four workshop scenarios. The second factor or "axis" was the degree of unpredictability. Ecosystem-based approaches are a spectrum of approaches for incorporating ecosystem information and tradeoffs into science and management, rather than a set of clearly defined levels. However, it's helpful to understand the key terms[23] used to describe ecosystem management approaches, and the information that is used in each of these approaches to conduct stock assessments, provide scientific advice and set biological or system reference points, and inform management decisions.

> **Ecosystem-based fisheries management** (EBFM) considers ecosystem and environmental information. EBFM also accounts for interactions and tradeoffs between fisheries in an ecosystem and utilizes system-level reference points that can account for biological reference points as well as other ecosystem-level goals.

[23] Definitions in this section are adapted from Tara E. Dolan, Wesley S. Patrick, Jason S. Link, Delineating the continuum of marine ecosystem-based management: a US fisheries reference point perspective, ICES Journal of Marine Science, Volume 73, Issue 4, March/April 2016, Pages 1042–1050, https://doi.org/10.1093/icesjms/fsv242; and the NMFS Ecosystem-Based Fisheries Roadmap

> **Ecosystem-based management** (EBM) is a coordinated, whole-ecosystem approach that considers tradeoffs and supports coordination between ocean use sectors that impact and are impacted by the fishing sector, such as shipping, aquaculture, and energy development.

EBM was primarily discussed in the context of Scenario 2, in which integrated EBM is in place. Participants focused on what they hoped would be working well in this future, rather than on the specifics of how EBM would be implemented. Ideas specific to Scenario 2 are discussed in Section 6.2, and ideas related to the cross-agency and cross-sector coordination that could be achieved under EBM are discussed in Sections 4.5 and 4.6. The ideas in this section are more general points about the value of continuing to advance ecosystem-based approaches.

Participants highlighted the role of ecosystem-based approaches for supporting ecosystem function and resilience, balancing a range of uses and user groups, and thinking about ecosystems in a holistic way that includes all components and not just target stocks, and considers humans and fishing activity including subsistence as part of the ecosystem. They emphasized that by definition, ecosystem-based approaches must be inclusive of perspectives and knowledge systems, and actively include and consider impacts to communities, Tribes, and ways of life.

Participants highlighted the following attributes of effective ecosystem-based approaches.

- Inclusive of diverse perspectives, information sources, and values and value systems (for example, participants mentioned values of respect, regeneration, and balance); and also based in a shared vision and values.
- Inclusive of the social and economic dimensions of fishing and fishing communities, including factors that affect resilience and community viability (such as markets, costs, shipping, infrastructure), as well as inclusive of people who don't or no longer fish.
- Effective trust, communication, and representation of interests.
- Supports implementation of "co words" and practices including co-management, co-production, cooperation, and collaboration. One comment was that FMPs could be structured as cooperative management agreements.
- Addresses issues that may not have a clear entry point into the Council process, such as concerns about hatchery releases of salmon.
- Provides a robust understanding of the ecosystem that can support creative solutions.

A suggestion was to continue articulating what EBFM and EBM look like in practice and incremental steps forward. Some groups also reflected on how the understanding of ecosystem-based approaches has evolved over time. Some emphasized fisheries management is managing fishing behavior and impacts on ecosystems and exercising precaution, rather than managing or engineering ecosystems. Others questioned whether some scenarios, particularly the highly changed ecosystems in Scenarios 3 and 4, could raise the question of what we want the ecosystem to look like and what we're managing for. Another question was whether EBFM and EBM mean setting catch limits based on ecosystem targets, or whether the more applied

approach involves including climate and ecosystem considerations in single species management and multispecies management systems.

Participants also emphasized that the capacity to practice ecosystem-based approaches depends on having the data inputs and products described in Section 5 including research surveys, science and data collection that are responsive to changing conditions, advanced predictive capabilities, effective use of existing tools and processes, and developing new capabilities. It's also important for scientists and managers to iterate, build on the use of existing tools, and align information with management questions and needs.

Another observation was that practicing EBFM and EBM may involve overcoming constraints and/or finding innovative opportunities for flexibility within the MSA.

Panel discussion
The workshop agenda included a presentation and panel discussion exploring how ecosystem-based approaches can support climate resilience, and relating the Council, SSC, and NMFS AFSC's current work and ideas for the longer term. Speakers included Dr. Robert Foy, NMFS AFSC Director; Nicole Kimball, Council member; Dr. Franz Mueter, SSC Co-chair, and Dr. Kirstin Holsman, NMFS AFSC scientist.

Speakers emphasized the following qualities of the science and management system that are currently working well and should be recognized or maintained.

- ➢ The Council system has a **robust baseline** of information including biology, physiology, ecology, and oceanography that are all critical to understanding how climate change impacts ecosystems and diagnosing "what happened." It's important for NMFS to **modernize** the scientific enterprise while **maintaining** and **building** on a strong foundation, and adapting to meet new information needs.
- ➢ Existing processes for **digesting** and **synthesizing** ecosystem information have helped the Council respond to climate change impacts and developed a shared understanding of what happened.
- ➢ The work of the **LKTKS Task Force** has developed protocols and onramps for incorporating information, knowledge, and potential impacts into the Council process.

Looking ahead, speakers made the following observations and suggestions.

- ➢ **Research surveys** are essential for understanding ecosystem change and should be maintained and funded.
- ➢ Maximize the use of **all available data sources**, embed **lessons learned** from case studies and formalize the ability to flag concerns so there is less reliance on individuals (such as SSC or plan team members).
- ➢ Continue developing **end-to-end ecosystem models** for large marine ecosystem regions to provide the ability to play out questions and scenarios.

- ➢ Clearly communicate stories, **distill key information**, and improve the ability to ingest **diverse information and knowledge inputs** including LKTKS, fishery dependent data, and community and industry observations and research.
- ➢ Continue developing **indicators** that reflect the condition of prey and target stocks; identification of changes in ecological interactions and **energetic conditions** was important to understanding past climate shocks for snow crab and Pacific cod case studies.
- ➢ Think about **communities** from more of an ecosystem perspective, including their social-cultural **interconnectivity**, the **infrastructure** and supporting services that support fishing communities, the economic and non-economic value of harvesting, and how these factors are connected to community resilience and individual wellbeing.
- ➢ Consider ways to quickly bring and **embed ecosystem and climate information** into the process, without relying only on rulemaking action.
- ➢ **Sustain** and **adapt the scientific enterprise** to keep up with rapid change and the ways in which climate change challenges assumptions. Ensure a foundation of sound science to support the Council process.
- ➢ Continue **integrating climate change** into all aspects of scientific information and advice. Move the climate science and advice process toward a more **planning** and **prediction** based approach, and build interdisciplinary teams to provide scientific advice more efficiently. Facilitate partnership building, **collaboration,** and **co-production** of knowledge.
- ➢ Improve understanding of how **climate shocks** manifest, which can be more difficult than understanding long term changes, and improve understanding of other perturbations including ocean acidification.
- ➢ Improve the capacity to rapidly **attribute climate impacts** (versus non-climate drivers of change) in order to implement climate-change specific responses.
- ➢ Recognize climate change will impact people unequally. Improve the ability to understand **vulnerability** and **tradeoffs**, and invest in and use socioeconomic information and knowledge to understand impacts and tradeoffs.
- ➢ **Explore what is possible** for particular stocks under changing conditions and nonstationarity, in terms of **production, recruitment, carrying capacity**, and overall ecosystem production, and the potential for species and ecosystems to recover to previous conditions in response to climate shocks.

Ideas for meeting emerging needs

- ➢ Prepare for **new interactions** between species, fisheries and user groups, and with other sectors such as shipping and transportation.
- ➢ Prepare for **mitigation planning** (wind, carbon recapture,) and how this may intersect with fisheries.

3.4 Bycatch management

Key message: Climate change could exacerbate bycatch management challenges but could also drive innovation and improved flexibility to cope with volatility and changing productivity.

Ideas

- Generally, improve flexibility (Section 3.1) and rapid response capabilities (Sections 2.1 and 3.2), and leverage new information and technology.
- Improve understanding of relationships between habitat usage and species distribution .
- Practice more comprehensive rather than piecemeal planning for spatial overlap and fishery interactions (including bycatch, marine mammals, and fishery displacements).
- Reduce regulatory discards, for example by considering flexibility on maximum retainable amounts (MRAs), allowing multispecies retention, or practicing full utilization.
- Continue to practice information sharing between fleets for bycatch hotspot avoidance.
- Leverage technology to fine-tune bycatch management, including real-time genetic testing of chum salmon bycatch to distinguish between western Alaska and Asian hatchery origins.
- Utilize forecasting tools connected to species distribution models to provide bycatch risk forecasts and support bycatch avoidance efforts.
- Practice a risk averse approach and maintain current spatial and seasonal protections. (Feedback form)

Discussion

Bycatch management and incentivizing bycatch avoidance are already areas of focus of Council management and fishery operations, recognized in existing FMP goals and objectives as well as National Standard 9. Shifting stocks and emerging fisheries due to climate change could create new and changing patterns of bycatch interactions.

Participants suggested improving bycatch management strategies could help build and improve climate resilience. Bycatch management and avoidance measures can be a challenge to resilience, for example by adding to business operating costs and creating constraints to flexibility. There are also proactive opportunities for bycatch management strategies to provide flexibility and reduce waste and optimize use of available resources, such as in the low productivity and high variability conditions described in Scenario 3 and 4. Participants felt empowering the fishing industry with flexibility to practice bycatch avoidance, for example the ability to switch gears and make decisions about how and when to fish, can contribute to resilience.

Participants also discussed bycatch in terms of their values including respect for the ecosystem, avoiding waste, and maintaining subsistence and cultural practices. Some expressed that climate change should not be used as a scapegoat to avoid confronting bycatch and habitat conservation challenges.

3.5 Dynamic, in-season, and spatial management

Key message: Dynamic and in-season management approaches could enable the Council to respond rapidly to new information.

Ideas

- Continue to explore and communicate potential uses for dynamic and in-season management strategies and climate-informed spatial management tools to increase effectiveness under shifting conditions.
- Establish metrics and periodically re-evaluating the efficacy of closures.

Discussion

Participants discussed dynamic and in-season management as strategies for responding to new information and rapidly changing conditions. The workshop scenarios described dynamic management with regard to time and area closures, such as for bycatch management and habitat protection, that are currently fixed but could be used in a way that is more responsive to current conditions. The description of Scenario 2 also proposed that dynamic management strategies could enable rapid response to other climate-driven environmental changes, such as changes in spawning times and critical bycatch or protected species risk periods.

Dynamic management was viewed differently depending on the scenario discussed. Dynamic management was discussed as an opportunity to fine-tune management in the higher predictability, EBM-supported future described in Scenario 2. Participants felt in this scenario, managers would have the data and capabilities to support highly responsive, targeted management. In contrast, participants felt dynamic or in-season management could be more of a necessity and way to utilize limited information in situations of high unpredictability and more reactive management, as described in Scenarios 3 and 4. A comment was that the term “reactive” shouldn't necessarily have a negative connotation, particularly if there is a clear process for interpreting information, making decisions, and evaluating and revisiting both.

Discussions also referred more generally to dynamic, in-season or real-time management as a counterpoint to the slower pace of the Council process. Participants focused on the capability of responding to new information such as fishery-dependent information about catch rates, species distributions, environmental conditions such as temperature, and other factors such as market conditions. They also highlighted the importance of trust and willingness to rely on data sources. Participants felt it would be important to have both the information and the procedural mechanisms (Section 2.1) to enact closures and other management adjustments.

3.6 Shifting and emerging fisheries

Key messages: Shifting and emerging fisheries will provide new opportunities as well as new challenges. The Council can plan proactively to anticipate these challenges, and consider opportunities for building flexibility into new management programs.

Ideas

- ➢ Consider a plan and process for management of emerging and/or previously unmanaged fisheries, and determine when emerging fisheries are viable.
- ➢ Build on the existing Arctic FMP by continuing to develop a plan and guidance for what fishing could look like in the region, and by considering increased interactions with Arctic communities and subsistence users.
- ➢ Prepare for increased food security concerns, demand for protein from ocean sources, interest in lower trophic level fisheries, and interest in expanding into previously unexploited systems.
- ➢ Utilize emerging fisheries as test cases for alternatives to rationalization.
- ➢ Utilize climate projections and predictions of changing species distributions to help plan for future management measures.
- ➢ Address transboundary management issues more proactively.

Discussion

Under all future climate scenarios, managers may be confronted with shifting fishery distributions and the possibility of emerging fisheries. These could include fisheries shifting or expanding their range from another jurisdiction into North Pacific Federal waters (for example, albacore tuna), novel or previously unfinished species, and invasive species. Participants felt these changes provide the opportunity for the Council to plan proactively and consider more flexible management approaches (Section 3.1).

In the case of emerging and previously unmanaged fisheries, participants emphasized having a plan and process to rapidly develop the necessary management tools. These could include fishery management plans, permits, gear authorizations, and regulations, as well as considering potential bycatch and protected species interactions. Participants also questioned what the process would be for determining when an emerging fishery is fishable. Participants discussed the potential utility of predictions of species shifts as a way to prioritize management actions and initiate early agreements across sectors or jurisdictions before species and resources shift.

Emerging fisheries could provide new opportunities for people and communities, and anticipating these new opportunities could be part of resilience planning. Participants questioned how access to an emerging fishery would be granted and commented that this process should be equitable. One question raised was whether access to emerging fisheries might be prioritized for those who have lost access to other fisheries.

Participants also discussed the possibility of fishing expanding into Arctic waters. The Council's Arctic FMP takes a precautionary approach to prevent the development of commercial fisheries until sufficient research and information exists. Some felt there continues to be insufficient information, while others emphasized that change is already happening quickly. The workshop scenarios and climate projections they are based on raise the prospect of reduced sea ice cover or even an ice-free Arctic. One suggestion was to be prepared for this possibility by continuing to develop a contingency plan.

3.7 Harvest specifications, TACs, and risk

Key message: The annual specifications process and supporting information including ESRs and risk tables are key functions of the Council process, and provide pathways for incorporating climate information and risks and implementing a precautionary approach.

Ideas for accounting for climate change risks in total allowable catch (TAC) setting

- ➢ Provide more explicit consideration of risk in ABC and TAC setting.
- ➢ Consider how harvest control rules and the tier system (used to characterize information availability and specify the Overfishing Limit (OFL) and Acceptable Biological Catch ABC) could be adjusted to cope with changing conditions and climate shocks.
- ➢ Consider revisiting the time frame for defining productivity and determining when productivity has changed, including the possibility that some stocks can no longer support fisheries.
- ➢ Scale buffers to the level of uncertainty (precautionary management).

Ideas for broadening or increasing the role of diverse knowledge systems and information considered in TAC setting

- ➢ Consider a stronger process for inclusion of climate and ecosystem information, social and economic information, and LKTKS in TAC setting (also referenced in Section 5.3).
- ➢ Consider more explicit consideration of socio-economic objectives in TAC setting.

Ideas for supporting stability through TAC setting

- ➢ Explore ideas for using harvest specifications to achieve stability and/or communicate expectations to the public, such as setting stable multi-year TACs, supporting a multispecies portfolio approach to TAC setting, and simulation testing the performance of cumulative OY limits under climate change and modifying the OY limits or ranges accordingly.
- ➢ Consider how to respond to climate shocks that may result in increased productivity for a stock.

The annual specifications process and supporting information, including ESRs and risk tables, are a critical function of the Council process and a tool for responding to shocks and change, and implementing a precautionary approach. Participants suggested looking at harvest control

rules (HCRs) and how they could be adjusted to cope with changing conditions. The August 2024 Eighth National Scientific Coordination Subcommittee of the Council Coordination Committee meeting[24] focused on the topic of "Applying Acceptable Biological Catch Control Rules in a Changing Environment" and convened SSC members from across all eight Council regions to discuss this topic in depth. Proceedings from this meeting could help inform the Council's work on this topic. Strengthening the consideration of uncertainty and risk in harvest specifications is also an objective of the Council's IRA funding proposal for climate readiness.

One idea participants considered was the use of setting stable multi-year TACs to provide more stability for harvesters, processors, and communities, and markets. This was discussed as a tool in multiple scenarios, though mentioned as being more feasible in a higher predictability scenario like Scenario 2, with a longer time horizon for planning. Participants recognized this would involve trading off yield for stability, and that it would still be necessary to plan for volatility and shocks within this approach. Other benefits of this approach could be lower overall harvest pressure, and a longer planning horizon for users to engage in the process. Another idea was using the TAC setting process in a more condition-specific way to support a multispecies portfolio approach, by taking advantage of stocks that are doing well under current conditions and reducing pressure on those that are not.

Participants discussed the concept of Optimum Yield, both in concept (what constitutes "optimum" and what values should this reflect?), and specifically the use of an upper limit to OY as a tool for resilience and responding to change. OY is specified as a range in both the Bering Sea and Gulf of Alaska, though only the 2 million mt Bering Sea OY upper limit has been constraining. Participants noted the OY range is an example of an EBFM tool and considered how it could be used more deliberately as a tool for climate resilience. Ideas included setting an upper limit that is dynamic and responsive to change, rather than fixed from year to year, and reducing OY ranges in lower productivity stanzas to help set expectations and inform planning.[25]

Groups also discussed the importance of being able to adapt management and conservation targets to align with what is possible in a changing environment. This could include recognizing changes in productivity and distribution, as well as facing the possibility that it may not be possible to rebuild stocks to previous levels under changed environmental conditions. Specific challenges will include defining when a stock is considered collapsed, and at the other extreme, defining when new opportunities exist.

[24] Agenda and workshop materials
[25] Such approaches are being evaluated through ongoing simulation testing in ACLIM and the Gulf of Alaska Climate Integrated Modeling Project (GOACLIM).

3.8 Precautionary management

Key message: A more precautionary management approach could help support more proactive and less reactive management, provide stability, and buffer against climate shocks.

Ideas

- Adopt a more precautionary management policy.
- Scale buffers to the level of uncertainty (precautionary management) (Also in Section 3.7)
- Continue to explore and define the meaning of precautionary.
- Focus precautionary management on supporting Tribal, subsistence, and ecosystem wellbeing. (Feedback form)

Discussion

The terms “precaution” and “precautionary” were used with regard to annual specifications and application of risk tables, protecting habitat and ecosystem resilience, and in terms of buffering or insulating people and communities against climate shocks. Participants felt the benefits of precaution could include a supporting more proactive and less reactive approach, providing more stability, and buffering against impacts that may be worse than anticipated. The precautionary approach was discussed as being particularly important for making decisions under conditions of limited information, high uncertainty, and high unpredictability, as in Scenarios 3 and 4. Other ideas included scaling the degree of precaution to the degree of uncertainty, and developing metrics for resilience

It was noted that the meaning of precautionary, how it is interpreted and applied, and the degree of precaution implied, can be subjective. The term precautionary appears in the current management approach statement for the GOA and BSAI Groundfish Fisheries and in the Council’s Ecosystem Policy.[26] The January 2024 Programmatic Evaluation discussion paper notes that defining the meaning of precautionary management is a topic that could be explored further through this Council action.[27]

[26] Council policies are available on the Council website
[27] D3 Programmatic Policy Evaluation Discussion Paper, February 2024; see p. 5

3.9 Habitat conservation and ecosystem resilience

Key message: Supporting habitat and ecosystem resilience can help mitigate and buffer against the impacts of climate change and support recovery from climate shocks.

Ideas

- ➢ Support nature based solutions to support habitat and ecosystem resilience.
- ➢ Improve understanding of habitat-related risks and vulnerabilities to better understand how habitat conservation translates to population and ecosystem-level benefits.
- ➢ Address habitat research questions and needs.

Discussion

Participants discussed prioritizing habitat and ecosystem resilience to mitigate and buffer against the impacts of climate change, and support recovery in the aftermath of climate shocks. Habitat conservation and protection and ecosystem resilience were discussed in terms of supporting all phases of a stock's life cycle, including for anadromous species and with attention to reliance on bottom habitat; building population level resilience, allowing for regeneration, and maintaining ecosystem function and services. Participants also mentioned not using climate change as a scapegoat to avoid confronting bycatch and habitat conservation challenges (also mentioned in Section 3.4).

Participants felt it would be important for managers to better understand habitat-related risks and vulnerabilities, and to better understand how habitat conservation translates to population and ecosystem benefits. Nature based solutions, which rely on natural features and processes to conserve and manage ecosystems, were discussed as methods to build resilience and reduce impacts of climate change and arose in the context of habitat protections including closure areas to protect productivity hotspots and climate refugia.

Specific habitat related questions and information needs included building understanding of habitat usage by species and life stage, and bottlenecks and vulnerabilities; investing in habitat mapping and information to support conservation, protection, and enhancement; improving the ability to assess risks, vulnerabilities, and potential benefits; improving understanding what habitat is fixed or known as well as habitat that is not as well defined or may be shifting spatially and temporally; and improving understanding of fishery impacts to benthic habitat and resulting feedback loops.

3.10 Magnuson Act, National Standards, and legislative solutions

Key message: There are different views on whether the Magnuson-Stevens Act provides the flexibility and tools to cope with climate change.

- ➢ Consider whether there are existing flexibilities that haven't been fully leveraged and that could help accommodate non-stationary conditions.
- ➢ Individuals and groups have the ability to advocate for legislative changes.
- ➢ The Council Coordination Committee Legislative Work Group provides a forum for Councils to articulate how their operations could be impacted by the reauthorization process. (Staff note)

Discussion

While changes to the MSA are not within the Council's purview, scenarios prompted groups to think about carrying out Council mandates under a range of climate futures, and whether legislative changes or implementation guidance may be needed. Participants shared different views on whether the MSA provides the flexibility and tools to cope with climate change. One comment was that the law does have flexibilities that haven't been fully leveraged. Others felt the MSA is not designed to accommodate climate change and doesn't account for ecosystem shifts, stock declines, and rebuilding challenges that are climate-induced rather than caused by fishing pressure. There are also different perspectives on whether the National Standard Guidelines provide adequate guidance under conditions of climate change. One comment was that it's appropriate to revisit guidance on the National Standards in light of changing circumstances.[28] At a more hypothetical level, some participants questioned whether the Council process and MSA are the best or ideal framework for coping with climate change.

Participants noted that user groups do have the ability to advocate for legislative changes. Councils are not permitted to lobby, but the Legislative Work Group Council of the Coordination Committee provides a forum for Councils to articulate how their operations could be impacted by the MSA reauthorization process.

[28] The Council recently submitted comments to NMFS indicating that it does not support revisions to the NS 4, 8, and 9 Guidelines. NPFMC comments on the Advance Notice of Proposed Rulemaking for revisions to the National Standard 4, 8, and 9 Guidelines

4. External coordination

There are opportunities as well as stressors external to the Council process that will impact climate resilience of people and communities, and the opportunity for fisheries to have a voice in a busier ocean future. This section includes bigger-picture coordination and planning opportunities that involve working with agencies and entities outside of the Council process. Some of these ideas are outside the Council's purview but could be opportunities for the Council community to collaborate, network, and communicate priorities and information needs. There are also opportunities for user groups to engage in advocacy and planning outside of the Council process.

4.1 Climate action

Key message: The trajectory of climate change, and the climate future facing the Council and user groups, depends on taking climate action at a national and global level.

Ideas for advocacy
- ➢ Individuals and organizations can advocate for climate action.

Ideas for marketing and messaging (Also in Section 4.2)
- ➢ Emphasize the lower carbon footprint of seafood as a source of protein.
- ➢ Communicate the financial stakes of climate change impacts to fisheries and communities.

Ideas for reducing emissions
- ➢ Reduce the carbon footprint of the fishing industry.
- ➢ Transition vessels and shoreside infrastructure to alternative energy sources.

Discussion
Participants observed that the trajectory of climate change, and the future facing the Council community, depends on the actions taken to reduce carbon emissions at a national and global level. While global climate action was not a strong focus of discussion, participants commented that it's difficult to plan for the consequences of climate change without acknowledging the

underlying drivers. This topic was mostly discussed in the context of Scenario 4, which along with Scenario 3 described a future of extreme climate change impacts.

Global and national climate action is outside of the Council's authorities. Participants did comment on the opportunity for individuals to advocate for action. Other ideas included communicating what's at stake, reducing the carbon footprint of the fishing industry, transitioning vessels and shoreside infrastructure to alternative energy sources, and from a marketing angle, emphasizing the lower carbon footprint of seafood as a protein source.

4.2 Markets and marketing

Key message: Global market volatility, instability, and competition with imports can negatively impact the resilience of businesses and communities, and building demand for Alaska seafood could help support resilience.

Ideas

- ➢ Build and diversify consumer demand, and focus on optimizing quality and value of seafood products. Ideas included more direct marketing and building markets for a more diverse range of products.
- ➢ Elevate domestic seafood as a national resource and component of national food security. Ideas included:
  - Develop a Federal program akin to (or as part of) the Farm Bill to promote U.S. fisheries and seafood
  - Educate consumers on seafood options and preparation
  - Emphasize seafood as a lower-carbon protein option
- ➢ Build capacity to account for market and economic factors in decision-making in the management process (also in Section 5.2).

Discussion

Market volatility and stressors can negatively impact resilience, but there are also opportunities to leverage markets and marketing opportunities to build resilience and support adaptive capacity. Concerns about markets were most prominent in Scenarios 3 and 4, in which there is lower ecosystem productivity and more variability in what is available to harvest and sell. Other market-related stressors include shipping costs, consumer demand, and competition from imports.

Participants recognized all North Pacific fisheries and products involve global markets that are outside of the Council's control, and that have strong impacts on prices, profitability, and resilience for businesses and communities. While these impacts tend to be negative, participants also noted a possibility that markets for North Pacific seafood products could expand depending on climate change impacts and economic and political factors in other regions.

Participants also noted that conditions that are favorable for a species may not be favorable for markets, pointing to the examples of sablefish and Bristol Bay sockeye salmon. A related observation was that the profitability of fishing for species positively impacted by climate change–or conversely, the idea of increasing harvest on a stock like snow crab that is anticipated to decline due to climate factors–depends on whether there is a market for a high volume of product.

Participants discussed ideas and strategies to cope with market challenges, and shared different perspectives on what the Council is able to do. Most of these ideas are largely outside of the Council's direct purview, though could be supported through management or regulatory changes. Other strategies might involve industry or community-led initiatives, or require coordination or support from other state or Federal agencies. Participants also recognized there are limits to what these strategies can accomplish in a highly globalized seafood market.

Build and diversify demand.
Participants suggested focusing on the quality and value of stocks and seafood products that are available, especially in high unpredictability and low productivity scenarios. Opportunities could include more direct marketing and “off the dock” sales, and building markets for a more diverse range of products that are currently low in value or lack markets, for example old shell crab and arrowtooth flounder. More flexibility in consumer demand could also help compensate for fluctuating availability.

Elevate domestic seafood as a national resource and contributor to food security.
Participants proposed building national-level support for domestic seafood production, and raising political awareness of seafood as a national resource and contributor to food security. Some ideas involve cross-agency coordination, including the idea of a Federal program akin to or part of the national Farm Bill to promote and support U.S. fisheries and seafood (also discussed in Section 4.4). Other suggestions focused on educating consumers on seafood options and preparation, and building public understanding of food systems. Government as well as the private sector can facilitate these efforts; for example, the Alaska Seafood Marketing Institute operates as a public-private partnership between the State of Alaska and the seafood industry. Ideas included marketing seafood as a lower-carbon protein option, and developing environmental ratings for shipping, processing, and vessels.

Other comments noted that high prices are a barrier to growing the domestic market for North Pacific seafood, and devaluing products from international markets could create more opportunity for domestic products (though it was not clear how this could be accomplished). Another question was whether trade policies or international collaboration could help to stabilize markets.

Build capacity to account for market and economic factors in decision-making.
Participants suggested incorporating more information on market conditions and stressors into the management process, and sharing this information with decision makers as well as communities. One perspective was that there is more engagement on these topics at the SSC level.

4.3 Building durable capacity

Key message: Invest in building capacity for younger generations to continue participating in fisheries and maritime trades to build resilience, maintain a voice for the fisheries sector, and thrive in a Blue Economy future.

Ideas
- ➢ Support capacity building opportunities, including trade-focused programs, scholarships, and national-level fisheries or other workforce development programs.

Discussion
The topic of generational capacity building was frequently discussed as a strategy for building climate resilience and adaptive capacity. Participants used the term capacity in multiple ways at the workshop, including in terms providing opportunities for new entrants (Section 3.1), and capacity for individuals and communities to participate in the Council process (Section 2.3.2).

Participants also discussed capacity building in terms of recruiting younger generations to be involved in the fishing industry, fisheries management and science, and the marine trades and supporting industries, particularly in the face of an uncertain future. Challenges include the "graying of the fleet" and the "brain drain" of people leaving industries and communities to seek other opportunities. Participants felt building capacity is important to sustaining fishing communities and a voice for fisheries interests in a more volatile future affected by climate change and other ocean uses. Groups also talked about capacity building as a strategy for resilience and diversification that could include building the skills to thrive in a more integrated and Blue Economy[29] -focused future.

Participants discussed a range of ideas for building knowledge and experience, from outreach and education (such as educating younger generations on climate change and opportunities in fisheries) to more formalized opportunities including scholarships, training, and trade programs. Participants shared the following ideas.

- Consider local and regional-level programs, such as trade-focused high school programs, particularly for rural and outlying communities.

[29] The term Blue Economy refers to the economic contributions and importance of coastal and marine industries. The NOAA Blue Economy Strategic Plan focuses on 5 pillars of marine transportation, seafood production, ocean exploration, coastal resilience, and tourism and recreation.

- Build on existing programs including NOAA programs, for example the Hollings Scholarship Program, and identify opportunities to make them more accessible and affordable (for example by covering housing costs).
- Consider national-level fisheries training and other capacity building programs. Participants shared the examples of the recently launched American Climate Corps, a workforce training and service initiative in partnership with the White House and Federal agencies. They suggested an ocean and coastal or Tribal equivalent, and proposed this could be used to address existing needs such as data collection.

4.4 Disaster relief, subsidies, and financial tools

Key message: The ability to weather climate shocks depends both on reactive responses, including disaster relief, and proactive opportunities such as access to capital, insurance programs, and subsidies that could equip people and communities with the resources to adapt to changing conditions,

Ideas for the Council process

- ➢ Engage in disaster planning to develop strategies for worst-case scenarios. This could be a Council-led initiative or led by communities and sectors.

Ideas for national level action

- ➢ Improve the timeliness and equity of disaster relief, and consider whether disaster relief could be used in a more proactive way.
- ➢ Provide national-level support for seafood production (for example, through the Farm Bill or equivalent) to provide tools for resilience and risk mitigation.

Discussion

Participants discussed the role of financial mechanisms including disaster relief, subsidies, and other approaches to bolster resilience and insulate against climate shocks and impacts. The impacts of climate change to people, communities, and fisheries, and their ability to recover, will be felt unevenly. Participants reiterated that while climate change is outside of the Council's control, the ability to respond and mitigate the socioeconomic impacts can be an area of focus. Participants emphasized the need for equity and timeliness.

Participants identified a range of ways in which financial support could enhance resilience and support adaptation. These ideas included reactive responses including disaster relief and financial support for lost fishing opportunities, and examples of direct Congressional appropriations for research (past examples have included funding for Steller sea lion research, and funding for red king crab enhancement). Participants also explored proactive opportunities that could be implemented before climate shocks are felt. Ideas included providing access to capital, insurance programs, and subsidies; funding for specific purposes such as compensated reallocation to support fishery restructuring (especially under the low productivity futures in

Scenarios 3 and 4), sustaining port and processing infrastructure, and supporting adaptive strategies such as transitioning fleets to alternative energy sources.

Disaster relief

The MSA[30] provides the authority and process through which the Secretary of Commerce can determine a fishery resource disaster and authorize the release of relief funds, subject to Congressional appropriations. Requests for fishery resource disaster declarations are typically made by the governor of the affected state. Funds are administered by NMFS, usually in partnership with the state, in accordance with an approved spend plan.

Participants recognized disaster relief is an important tool for coping with climate shocks, and shared concerns about timeliness, equity, and the growing number of climate-related disasters. Participants questioned whether the current disaster relief program could be restructured to provide an existing pool of funding without the need for Congressional appropriations. Other ideas included re-envisioning the concept of disaster relief to proactively avoid or mitigate disasters and facilitate transition.

Participants also raised some concerns and caveats about relying on disaster relief as a mitigation strategy. Some suggested focusing on advance planning, and viewing fishery resource disaster declarations as an outcome to avoid. One observation was disaster relief could become less available if there is more predictability and lead time for planning, such as under Scenario 2. Another comment was there can be downsides to stabilizing industries and participation rather than allowing for the ups and downs that allow for industry contraction and expansion and opportunities for new entrants.

Disaster planning

One group explored the idea of proactive disaster planning to develop strategies for responding to worst case scenarios and climate shocks. Participants suggested this approach could complement disaster relief, potentially help avoid disaster situations, and break through inertia and reluctance to consider worst case outcomes. They envisioned this could be a Council-led initiative with participants including Tribes, community governments, other federal and state agencies, fishermen, industry and community organizations and NGOs. It could also be a bottom-up effort led by individual communities and sectors. One suggestion was to learn from any comparable efforts by other regions, fisheries, and Councils, and consider what could be learned from other Councils' scenario planning approaches.[31] Participants commented that the North Pacific is well positioned to undertake this work as a data-rich region with the benefit of

[30] 16 U.S.C. 1861a § 312(a). For more information also see NMFS Frequent Questions: Fishery Resource Disaster Assistance

[31] Resources from the Pacific Fishery Management Council's Climate and Communities Initiative and climate change scenario planning are available on the PFMC website and include a final report by the Council's Ad Hoc Climate and Communities Core Team. Resources from the East Coast Climate Change Scenario Planning initiative, which included the New England, Mid-Atlantic, and South Atlantic Councils; NOAA Fisheries, and the Atlantic States Marine Fisheries Commission, are available on the MAFMC website and include a final report and potential action menu.

modeling resources like ACLIM. Additional suggestions were to make disaster planning manageable rather than overwhelming by starting with a case study.

National-level support for seafood production

Participants were interested in the idea of a national-level program that would recognize the role of fisheries as part of the country's domestic food production system, and provide the fishing industry and communities with access to financial resources to support resilience and mitigate risk. This could be an opportunity to work with other agencies and partners beyond the Department of Commerce. Participants drew parallels with the Federal Farm Bill, which authorizes and provides funding for U.S. Department of Agriculture programs that support farmers, ranchers, and forest managers. Specific ideas for resources that would be helpful for building climate resilience in the fishing sector included capital access grants, insurance programs, subsidies, marketing support, and disaster relief.

4.5 Cross-agency and international coordination

Key message: Coordination with state and Federal agencies with mandates and interests related to climate resilience can help share information, enhance connectivity between marine and terrestrial systems, amplify the Council's voice and priorities, and leverage synergies and resources.

Ideas

- ➢ Improve coordination between the Council and other entities with climate resilience and/or North Pacific fisheries interests and mandates.
- ➢ Improve joint understanding of terrestrial and marine ecosystems with particular improvements in anadromous fish management.
- ➢ Leverage opportunities for Council members and staff to serve as liaisons, advisors, or board members of other organizations.
- ➢ Request more regular and proactive engagement from non-voting Council seats.
- ➢ Increase engagement in international fora.

Discussion

Participants discussed enhancing coordination, collaboration, and co-management with state and Federal agencies with intersecting interests and mandates related to climate resilience and fisheries management. (Participants did not always distinguish between coordination that could occur via the Council, and coordination at an interagency level through NOAA/NMFS). Some of these ideas were discussed in the context of cross-sector EBM, as in Scenarios 2 and 3, but were not specific to those scenarios. The benefits of better cross-agency coordination could include sharing information and research, enhancing connectivity between marine and terrestrial systems, amplifying the Council's voice and priorities, and finding synergies and resources to support ideas discussed in this report (such as marketing and supporting domestic seafood production and consumption, the development of a national seafood policy, and disaster relief). Coordination could also occur at multiple levels. For example, understanding and managing for

the impacts of hatchery releases could have a regional and state as well as international coordination component.

Regional

Participants felt there could be more communication between the Council and other entities with climate resilience and/or North Pacific fishery management mandates and interests including the International Pacific Halibut Committee, the Alaska Department of Fish and Game and the Board of Fish, the Federal Subsistence Board, the North Pacific Anadromous Fish Commission, and local and Tribal governments. In addition to communication there are opportunities to explore mutually beneficial projects, research, and grant opportunities. Opportunities that enable Council members and staff to serve as liaisons, advisors, or board members (for example, with the Alaska Ocean Observing System and the North Pacific Research Board) can help provide fisheries with a voice. Tribal governments and the CDQ program and management organizations also support opportunities for regional collaboration. Participants acknowledged the challenges involved including the time commitment, managing personnel, and working across different legal authorities and institutional cultures.

Federal

Participants discussed opportunities for coordination between NMFS/NOAA and agencies outside of the Department of Commerce, including collaborating on a national program to support seafood production (also see Section 4.4). Additional ideas could include more regular and proactive engagement and updates from the U.S. Coast Guard and U.S. State Department, which hold nonvoting seats on the Council; and other parts of the Federal government with responsibilities related to climate resilience and energy development, including the Department of Energy, and the Bureau of Ocean Energy Management within the Department of the Interior. Specific initiatives and projects also provide opportunities for collaboration; for example the Climate, Ecosystem, and Fisheries Initiative (CEFI) helps connect offices within NOAA.

International

Participants also touched on the importance of international relations, including the potential for increasing transboundary stock issues, geopolitical tensions and barriers to sharing scientific information (for example, with Russia) and other challenges such as increasing fishing effort in international waters. They suggested the State Department could be more engaged in reporting to the Council and hearing their concerns. Participants also suggested engaging more in international coordination to support cooperation, exchange information and research, share experience, and link vulnerable communities. Participants mentioned the Arctic Council, an intergovernmental forum to facilitate cooperation among Arctic nations, as an example; and suggested identifying other fora that focus on fisheries and food access.

4.6 Integrated cross-sector coordination

Key message: While integrated ecosystem-based management (EBM) is not currently in practice, it's important to be aware of the activities and ocean uses that could increasingly intersect with federally managed species, and consider what effective cross-sector coordination and planning could look like.

Ideas

- ➢ Embrace Blue Economy planning through more participation in maritime industry and development fora.
- ➢ Engage in more coordination with other sectors including shipping and aquaculture through spatial planning opportunities. (Feedback form)
- ➢ Consider which Council body (for example, the Ecosystem Committee) could help monitor and address cross-sectoral issues. (Feedback form)

Discussion

Scenarios 2 and 3 described a future of integrated ecosystem-based management (EBM), in which fisheries and other interests and ocean users are able to plan and coordinate effectively. These scenarios prompted participants to reflect on the sectors and ocean uses that could increasingly intersect with federally managed species, and consider what effective cross-sector coordination and planning could look like.

The purpose for including EBM-oriented futures in the workshop scenarios was to recognize that social and ecological systems are complex, and that climate change impacts and responses impact multiple parts of this system. EBM accounts for a plurality of perspectives, needs, and tradeoff analyses across activities and sectors. Some of the known consequences of not accounting for this complexity can include inadvertently amplifying climate change impacts, exacerbating inequities in the system, failing to see the whole picture and impacts or opportunities, and reacting too slowly, too strongly, or too quickly.[32]

Scenarios 2 and 3 did not describe how integrated EBM would function, only that it was in place and operating effectively. Some groups felt this future was difficult to envision and that it would be difficult to consider tradeoffs and benefits at a cross-sectoral scale. They also raised questions about what the governance scale, structure, and decision-making process would look like. Concerns included whether this would be a top-down or regional process, whether it would provide an adequate voice for regional and fisheries interests, how it would coordinate across entities and mandates, including the MSA and National Standards; the logistics and resources of accommodating all of the user groups and public input involved, and the capacity of individuals to participate. Another question was whether EBM would be more process or outcome oriented; would it be focused on ingesting information, achieving certain outcomes and objectives, or both?

[32] Paragraph adapted from the presentation by Dr. Kirstin Holsman, NMFS AFSC, Ecosystem-Based Management Overview. June 6, 2024

One breakout group had an in-depth discussion of the ocean and coastal activities and risks that currently intersect with fisheries, or could have more of an impact in the future, especially with growing climate change impacts such as reduced sea ice cover or more energy development. These activities included shipping and vessel traffic, energy development (wind, oil and gas), mining (including deep sea), tourism, aquaculture and mariculture, marine debris, and military and national security interests; as well as place-based designations that can enable or disallow certain activities such as marine sanctuaries and aquaculture opportunity areas.

This group emphasized the need to plan inclusively, considering not just the activities of fishing and harvesting but of all of the user groups, mandates, and other considerations that are part of fisheries management including subsistence harvest, communities, bycatch, protected species interactions, and marine mammal co-management. They highlighted other issues that could or should become more prominent in this more integrated future, including:

- Increased focus on food security (at a national level, and subsistence food security including both marine and terrestrial sources).
- Awareness of the carbon footprint of industries and decarbonization efforts (for example of waterfronts, transitioning vessels, infrastructure like processors, and communities to alternative power sources).
- Impacts of other stressors including energy costs that impact individual and community resilience.
- Changing waterfront infrastructure and access.
- The potential for objectives and mandates that may conflict or create tradeoffs, such as sustainable fisheries and renewable energy development targets.

This breakout group shared their ideas on the attributes of effective cross-sector coordination. These are not necessarily exclusive to a fully integrated EBM future, and reiterate points raised in the previous section on cross-agency coordination. Participants emphasized coordination between Federal agencies with different mandates and missions, between state and Federal agencies, and across marine and terrestrial systems. As an example, participants mentioned the Gravel to Gravel initiative to support ecosystem and salmon population resilience.[33] Effective cross-sector coordination could also improve the ability to assess and mitigate risks (for example, associated with shipping and oil spill risks), and could include more international coordination in general and on specific issues such as shipping or wind energy. This group felt that effective cross-sector coordination could also recognize that all sectors are facing greater uncertainty due to climate change, and support values of inclusivity, equity, sovereignty, and two-way communication.

Participants also reflected on the role of Tribes in a more EBM-oriented future. This future could support fuller Tribal participation in the Council process and include more co-management

[33] The term “gravel to gravel” refers to research and management focusing on the entire life cycle of salmon from spawn to return, as well as the Gravel to Gravel Keystone Initiative coordinated by the U.S. Fish and Wildlife Service and Bureau of Land Management in partnership with Tribes, Indigenous leaders, communities, and other agencies. More information: https://www.fws.gov/page/gravel-to-gravel-keystone-iniative

partnerships, such as co-management between NMFS and the Tribal governments of St. Paul and St. George for fur seal management. Another comment was that Tribal perspectives are focused on self-governance, and could integrate the elements of better coordination and communication across sectors and user groups while also prioritizing other values that are important to Tribal governments.

This group also reflected on the role of fisheries in this more integrated future. As above, these ideas were prompted by discussion of an EBM future but are not contingent on this future. Maintaining a strong voice for fisheries would be important. There could be opportunities for fisheries to find synergies with other ocean and coastal industries as part of Blue Economy planning, for example by engaging more in maritime industry and development forums.[34] Leaning into the Blue Economy could provide the fisheries sector with access to more resources and opportunities for partnerships, broaden its reach beyond the Council process and the North Pacific region, and support collaboration toward shared goals such as supporting working waterfronts and enhanced data collection and sharing. Participants noted this could be an opportunity for younger generations to build capacity (Section 4.3) to participate in the fishing industry and marine trades, and counteract the “graying of the fleet. Another suggestion was to encourage other sectors and agencies to adopt strengths of the federal fisheries management process, such as the deliberative process and role of public input.

Participants considered that the growth of other maritime industries could provide pathways for individuals and communities to diversify. They emphasized that diversifying away from or in addition to fisheries is not a one-size-fits-all solution. Communities face different pressures and have different resources and infrastructure, which impact their resilience and the options available to them for adaptation and diversification. Communities’ choices and willingness to explore these other pathways will also reflect their values, tradeoffs, and cultural identities. Their choices and investments ultimately may or may not support resilience.

[34] Washington Maritime Blue was mentioned as a regional example of Blue Economy planning in practice.

5. Science and information

Workshop participants discussed the data, information, and science products that would be needed to support resilience in different climate change scenarios. At a high level, needs include monitoring how ecosystem dynamics and conditions are changing, understanding and anticipating how these changes are impacting the productivity and distribution of stocks, and improving the ability to identify and attribute climate-driven changes. Participants emphasized the opportunity for climate science to support resilience by enabling more flexible and responsive management, enhancing trust and credibility, and informing understanding of how both negative and positive climate impacts may be felt across regions, user groups, and stocks.

In addition to the ideas and needs described in this section, participants discussed the attributes of a scientific enterprise that can keep pace with change and support a climate-ready management process. General attributes included timely, high quality information that is clearly communicated, and adequately resourced in terms of people, expertise, and funding. The audience for this information includes the Council process as well as individuals, communities, and user groups.

Participants identified additional attributes of an effective science-management partnership including the following.

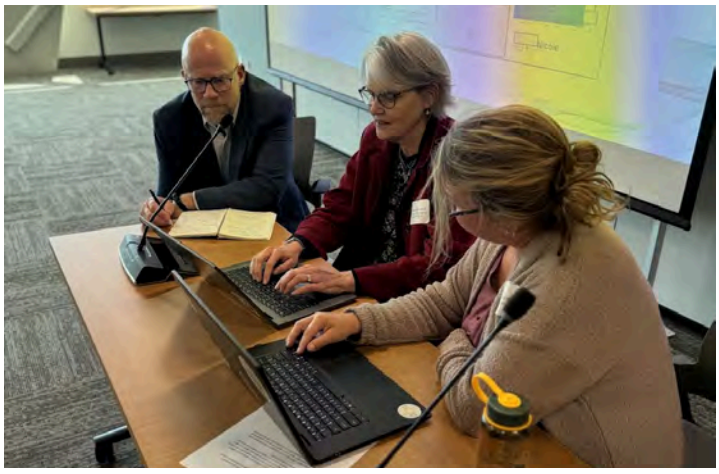
Build capacity to work with uncertainty.
Minimize and reduce uncertainty where possible, and build capacity for managers to understand, communicate, and work with uncertainty. Participants commented that more knowledge and information don't necessarily eliminate uncertainty; what matters is the ability to understand and account for uncertainty.

Leverage existing information, tools, and data sources.
Participants emphasized leveraging all available information and data sources including diverse information inputs and knowledge systems (Section 5.1), enhancing the use of existing tools and science products, and better utilizing other data sources including fishery-dependent data, monitoring, and observer program information.

Support a collaborative and inclusive approach.
Participants emphasized working directly with user groups to co-produce information and knowledge, as well as the importance of integration across disciplines and scientific program areas.

Invest in fundamentals and foundations.
Discussions highlighted the need to invest in consistent, continuous data collection to support fundamental needs like stock assessments, generate the inputs to feed models and predictive tools, and to support timely and responsive management. Participants also pointed to the importance of data acquisition and infrastructure planning, including faster data processing and information flow as well as sound data management practices to support the use and sharing of diverse information inputs.

Support a range of planning horizons and timelines.
Participants felt climate resilience depends on the provision of information and products that are appropriate to the pace of change, and support the timelines on which management decisions and community and individual adaptation decisions take place. They highlighted short term needs that could include in-year, near-term, or even real-time information to support responsive management and community and business planning.



Support adaptation and innovation in the scientific enterprise, and uptake of information into the management process.
Participants discussed how climate science, stock assessments, and data collection (particularly surveys) may need to adapt and become more dynamic in response to changing conditions. They also expressed concern about a lack of appetite for innovation and uptake of new climate-informed science products into the management process, whether this due to lack of onramps, communication challenges, or resistance to change. Participants encouraged ongoing communication and dialogue between scientists and managers.

Learn from experience.

Participants emphasized learning from case studies and past experience, as well as learning from the experience of incorporating new information and products into the Council process including technical review, communication, and familiarization.

5.1 Diverse information inputs and knowledge systems

Key message: Diverse information inputs including local knowledge, traditional knowledge, and subsistence information (LKTKS); industry and community observations and research, and other information sources including fishery-dependent data can support a more robust and resilient process, help identify early warnings and new questions research opportunities, and provide a broader and longer term perspective on ecosystem change.

Ideas

- ➢ Improving the integration of both LKTKS and industry and community observations and data requires dedicated onramps, two-way information exchange, and building confidence and trust.
- ➢ *Additional ideas are provided in subsections 5.1.1 and 5.1.2.*

Discussion

Participants felt strongly that utilizing all available information sources is essential to meeting the challenges of climate change. Valuable information is available in the form of local knowledge, traditional knowledge, and subsistence information (LKTKS); industry knowledge, and on-the-water observations and data collection. However, participants felt these information inputs lack adequate onramps into the Council process, and that there are missed opportunities for collaboration, cooperative research, and co-production of knowledge. This is also recognized in the Climate Readiness Synthesis. Participants also felt other data streams, particularly fishery-dependent data such as catch per unit effort (CPUE) and monitoring and observer program information are underutilized, and could be used more effectively to support in-season and responsive management.

How diverse information inputs can support climate readiness

Participants felt diverse information sources can support a more robust and resilient scientific and management process. Fishermen and communities are on the frontlines of change. Participants felt their observations can overcome data lags and help identify early warning signs (Section 3.2), often before these signals are picked up through other methods such as surveys. Observations can also provide additional context and prompt scientists to take a closer look and ask follow-up questions. These information sources also provide a longer-term view than other data collection methods, particularly surveys, that reflect a snapshot or window of time.

LKTKS and industry and community observations and data could also help meet the demands for more information, overcome resource limitations, and help cope with scenarios of high unpredictability. Participants also commented on the ability to provide timely information and observations that could support more flexible and responsive management tools, such as

dynamic closures and in-season management (Section 3.5). Stronger integration of LKTKS and industry and community observations and data could also enhance credibility and trust in science and management.

Participants also commented on practicing inclusive approaches to explore emerging research questions. As an example, one group had an in-depth discussion of salmon predation in the mouth of the Yukon River related from the recent northward shift of Pacific cod. They described this scenario as an opportunity to be more inclusive of LKTKS and collaborate on research with local communities and engage in coproduction of knowledge, rather than relying solely on outside scientists coming into a community. This group also expressed concern about the impact of using trawl gear for experimental fishing and surveys, and concern about community and Tribal inclusion, consultation, and equity in future Arctic research.

Effective use of diverse information inputs
Participants commented that effective use of diverse information inputs depends on having the information, as well as the pathways and willingness to put it to use. They defined successful, effective practices as including the following.

Dedicated on-ramps: Participants emphasized the need for established pathways to broaden the array of information, knowledge, and observations considered in science and management. They felt there needs to be a process and responsibility for carrying this information forward, and information should be fully integrated into science and management products. This should happen early in the process, beginning with stock assessments and plan team discussions.

Two-way information exchange: Participants felt processes for sharing information and knowledge should be inclusive and collaborative. There should be more consistent communication and information sharing between user groups, managers and scientists, in ways that are more rigorous and collaborative than public testimony and reflect the qualities of two-way communication described in Section 2.3.1.

Confidence and trust: Participants wanted to see diverse information sources incorporated in ways that build trust between scientists, managers, and user groups, and provide confidence that information is reliable and being used appropriately, particularly for Council actions such as acting on early warnings. Contributors want to feel the information they provide is valued and respected.

5.1.1 Local knowledge, traditional knowledge, and subsistence information (LKTKS)

Key message: LKTKS provides a broader and longer-term perspective on ecosystem change, includes resilience practices and experiences acquired on a multigenerational scale, and is inclusive of marine-terrestrial connections. The LKTKS protocol and onramps are an important step but LKTKS is not yet fully integrated, respected, or evident in decision making.

Ideas for advancing use of LKTKS

- ➢ Continue implementation of the LKTKS protocol and onramps.
- ➢ Recognize, include, and learn from the long history of Tribal resource stewardship and experiences with ecosystem change.
- ➢ Add to the Council's LKTKS search engine[35] and build greater awareness of existing Tribal studies and analyses.
- ➢ Provide an LKTKS component to all science and management information products (such as analytical documents), on par with the consideration of western science.

Ideas for Council processes

- ➢ Increase Tribal representation on the Council and advisory bodies (also in Section 2.3.4). Some called for full Tribal integration into Council management and more co-management.
- ➢ Develop capacity for effective communication and key points of contact on all sides, and the willingness to meet in the middle.
- ➢ Engage in more collaboration with villages and Tribal governments to support participation and data collection programs, and provide financial resources to support involvement and collaboration.

Discussion

The Council recently adopted a LKTKS Protocol[36] that defines these knowledge systems and includes guidance to inform the Council's decision-making process for how to appropriately identify, analyze, and incorporate Local Knowledge, Traditional Knowledge, and subsistence information into the Council's decision-making process. The LKTKS Task Force convened by the Council to develop the Protocol also identified onramp recommendations[37] for the Council's consideration at final action. These onramps identify potential changes to the Council's process to better incorporate these knowledge systems. While the work of the LKTKS Task Force was not specifically focused on climate change, diverse knowledge systems are a vital component of climate readiness and adaptation.

[35] Available at https://lktks.npfmc.org/
[36] Protocol for Identifying, Analyzing, and Incorporating Local Knowledge, Traditional Knowledge, and Subsistence Information into the North Pacific Fishery Management Council's Decision-making Process. D2, April 2023.
[37] Onramps for Local Knowledge, Traditional Knowledge, and Subsistence Information in the North Pacific Fishery Management Council's Process. D2, April 2023.

Participants emphasized that while western science is focused on the present, LKTKS spans a much wider and longer term perspective. It reflects the knowledge and experiences of people and communities, both coastal and interior, who have depended on fishery resources for millenia and experienced ecosystem change and disruptions over time. Participants described LKTKS holders as inherent observers of change and ecosystem processes, and holding knowledge of resilience practices and experiences acquired on a multigenerational scale. LKTKS is also inclusive of marine and terrestrial ecosystem connections. Participants mentioned the Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative[38] as an effective example of traditional knowledge communication.

Participants acknowledged the work of the LKTKS Task Force and efforts to better integrate LKTKS knowledge and perspectives, but shared their frustration that the Council has not fully adopted the LKTKS onramps and lacks the tools and capacity to integrate this information. They commented that LKTKS is compartmentalized and still does not have an equitable onramp into Council processes, that processes are still not necessarily more inclusive of LKTKS perspectives, and that LKTKS information is not evident in decision making.

More broadly speaking, participants felt western science discounts the validity of LKTKS, and that failure to incorporate LKTKS information and perspectives is detrimental to communities and resources. They felt western science and the Council process are constrained by the concept of Optimum Yield and language of the MSA, including the National Standards, that don't adequately reflect the values of all user groups and worldviews. Participants also expressed concerns about management plans being imposed without adequate consideration of Tribal and subsistence input and values, including for salmon and looking ahead, potentially for Arctic resources.

Participants commented on the logistical challenges to bringing LKTKS and knowledge holders into the Council process. These challenges and considerations are also described in more detail in the LKTKS protocol. They include the challenge of sharing information that is orally passed, the accessibility of Council information and communications, and especially the lack of resources to support the participation of individuals, Tribes, and communities. Participants also commented on the barriers to participation by Tribal knowledge holders and elders including difficulty traveling, the demands of balancing multiple roles and responsibilities, and the personal toll including a sense of frustration, uncertainty, and loss.

Participants also spoke to the importance of respect and making a commitment to bridging different worldviews and knowledge systems. They commented that LKTKS knowledge holders should be respected as valuable and legitimate, and that no single perspective or worldview should be considered the "right" one. Participants also noted that LKTKS holders may think in different, "non-linear" ways as compared to western science, and have different processes for

[38] The AYK SSI is a partnership including the Bering Sea Fishermen's Association and regional Native organizations (Association of Village Council Presidents, Kawerak, Inc., and Tanana Chiefs Conference) and state and federal agencies to identify and address critical salmon research needs in the region. https://www.aykssi.org/

considering information accepted and peer reviewed. They also emphasized the need to build greater awareness of existing Tribal studies and analyses, pointing out Tribal data were often collected to demonstrate resource usage and dependency, and are not in the public domain. They also described values they feel are qualities of LKTKS, including a greater focus on ecosystem resilience over maximizing yield, and a more holistic, less compartmentalized stock-by-stock approach to management.

5.1.2 Industry and community observations and data

Key message: The fishing industry, communities, and individuals can provide observations and participate in data collection and research to build knowledge, augment other data sources, groundtruth trends, and flag concerns.

Ideas

- ➢ Develop additional cooperative research programs and partnerships.
- ➢ Work with fishing fleets to collect data at high spatial and temporal resolutions to augment survey coverage and contribute to stock assessments.
- ➢ Support community-level participatory research and data collection.
- ➢ Support more direct access to stock assessment authors and plan teams to provide context and identify concerns.
- ➢ Include more observations and citizen science in Ecosystem Status Reports.

Discussion

Participants discussed opportunities for industry, communities, and individuals to participate in data collection and research and contribute their observations to build knowledge, supplement other data sources, groundtruth trends, and flag concerns. These ideas range from sharing observations to more structured research projects including citizen science and cooperative research. The ideas in this section may also pertain to the use of LKTKS though were not discussed as being specific to LKTKS.

Participants discussed cooperative research programs and coordination between industry, communities, and scientists or with other groups such as NGOs to enhance the information available for monitoring and responding to change. This could include the use of fishing fleets to collect data at high spatial and temporal resolutions in order to augment survey coverage and contribute to stock assessments. One group mentioned the example of New England's research study fleet program.[39] Another example shared was a community research program[40] to gather observations on conductivity, temperature, and depth. Participants also discussed challenges to establishing and sustaining cooperative research. These include funding, securing buy-in, analytical support and permits from NMFS; and compensating participants, which is done using

[39] The Study Fleet is a program of the NMFS Northeast Fisheries Science Center's Cooperative Research Branch and engages fishermen in collecting high-resolution data to address science and management needs. More information is available on the NEFSC website.
[40] The Coastal Community Ocean Observers Program, which concluded in 2017, was supported by the North Pacific Research Board and University of Alaska Fairbanks.

research set-asides in New England. Additional needs include effective communication and information sharing, coordination on research objectives, and robust data management practices to govern how data are collected, stored, and shared.

Participants also discussed more consistent and direct communication with stock assessment authors and plan teams to provide context and identify concerns, such as trends in fishing behavior and effort. They emphasized this should happen early in the process. An example is the annual crab skipper survey that is synthesized and presented to the Crab Plan Team. Another idea was to include more observations and citizen science in Ecosystem Status Reports (Section 5.3).

5.2 Social and economic vulnerability and information needs

Key message: Invest in and build capacity to collect and integrate social and economic information, with an emphasis on understanding attributes that influence vulnerability to climate change impacts.

Ideas for understanding vulnerability and tradeoffs

- ➢ Develop analytical and modeling capabilities, for example, to better understand the costs involved in diversification or pivoting to emerging species, and the ability to consider pricing and markets in decision making.
- ➢ Improve understanding of individual and community vulnerabilities, failure points, critical dependencies, and interconnectivities, including for subsistence communities.
- ➢ Build on existing information sources including Annual Community Engagement and Participation Overview (ACEPO) reports.
- ➢ Improve planning tools and evaluation of tradeoff horizons derived from socio-ecological models.
- ➢ Consider potential impacts to Arctic subsistence communities if fisheries and processing infrastructure shift northward.

Ideas for building expertise and capacity

- ➢ Increase diversity in Council and agency staffing and add more expertise in non-economic social science and LKTKS.
- ➢ Consider how to engage the Council's Social Science Plan Team.

Discussion

Participants discussed the importance of social and economic information for resilience planning and for mitigating the impacts of climate change. Across scenarios, they emphasized focusing on what is within the Council's control by preparing for and where possible mitigating the social and economic impacts of climate change.

Participants encouraged greater diversity in Council and agency staffing, and adding more expertise in non-economic social science and LKTKS. They also suggested developing

analytical and modeling capabilities, for example, to better understand the costs involved in diversification or pivoting to emerging species, and enhance the ability to consider pricing and markets in decision making. They observed that the recent high level of sablefish recruitment raises questions such as whether harvest strategies should focus on maximizing harvest or value, how these tradeoffs account for other considerations like operating costs, and whether pursuing economic objectives is worthwhile to harvesters.

Another suggestion was to build on existing information sources. One idea was to build on the Annual Community Engagement and Participation Overview (ACEPO) reports by updating these consistently and adopting a more inclusive approach, both in terms of co-developing the reports and including more information on the financial and other stressors communities face.

Participants emphasized the need to better understand the factors that cause people and communities to be more or less vulnerable to change, and how these vulnerabilities impact their resilience and the adaptive strategies they are able to pursue. Examples of vulnerabilities mentioned include community size and diversification, infrastructure condition and availability, processing capacity, exposure to weather events such as storms and droughts, access to transportation, access to fresh water, and financial stressors at the community, industry and individual level (for example the costs of housing and energy, and access to credit and capital).

Participants also highlighted the need to understand potential failure points and critical dependencies, especially in lower productivity and higher variability scenarios. Pressure points could include community dependence on processing capacity, and dependence on a single species or fishery. Concerns about processing capacity and vulnerability included the scale and high capital investment in processing operations, economies of scale that can determine whether processing is financially viable, and the difficulty of pivoting between species. Participants suggested gaining a better understanding of interconnectivity between and among communities and processors. Another idea was to look comprehensively at community vulnerabilities, identify commonalities, and assess how these vulnerabilities could be addressed and the resources required.

Participants also discussed the vulnerabilities and challenges faced by subsistence harvesters and communities including stress, instability, adverse impacts to mental and physical health, and the loss of cultural and community practices. One comment was that people can’t simply move from communities to which they have strong ties. Another concern was that there can be shifting and displacement of subsistence effort when opportunities are lost in a community. Participants noted the potential for impacts to Arctic subsistence communities if fisheries and processing infrastructure shift northward.

5.3 Tools for communicating climate information (ESRs, ESPs, risk tables, and CVAs)

Key message: Consider how to more fully leverage the value of existing tools for communicating and bringing ecosystem and climate change information into the decision making process.

Ideas for Ecosystem Status Reports and communicating climate information

- ➢ Enhance the use of ESRs and products for decision making.
- ➢ Consider the utility of ESPs and ESRs to a wider audience, such as for community and industry resilience planning.

Ideas for understanding and communicating risk and vulnerability

- ➢ Continue to develop and standardize the use of risk tables and consider whether they could be used more quantitatively to convey information about potential risks and outcomes.
- ➢ Continue to refine the concepts of exposure and vulnerability, and identify stocks that may be at risk of transitioning to a depleted or unstable state.
- ➢ Communicate socio economic risks for TAC setting using a "traffic light" approach[41] (Feedback form)
- ➢ Use CVAs and better communicate stock vulnerabilities to managers and the public.
- ➢ Improve understanding of risks from external factors and other ocean uses

Discussion

The Council process includes well developed pathways for documenting and bringing climate information into the Council process, including Ecosystem Status Reports (ESRs), ecosystem indicators, and report cards; Ecosystem and Socioeconomic Profiles (ESPs), risk tables, and climate vulnerability assessments (CVAs). Participants recognized the value of these tools and considered how to more fully leverage their value for decision making.

One suggestion was to enhance the use of ESRs and related products for TAC setting. Some participants commented that ESRs aren't often used or their impact is not evident in harvest specifications and management. It was noted that enhancing the use of ESRs for EBFM and TAC setting was a recommendation of a recent peer review.[42] Participants also questioned whether ESRs could be used to support an increase in ABCs for stocks that are resilient to or positively impacted by climate change, offsetting the impacts of decreasing ABCs for vulnerable stocks. (While ESRs provide contextual information for harvest specifications, increasing maximum ABC would require an FMP amendment). Participants also observed that ESPs and

[41] For example, following the approach used by the Mid-Atlantic Fishery Management Council. MAFMC 2024 EAFM Risk Assessment; see Summary, p. 44

[42] Independent peer review report --- Review of the Alaska Fisheries Science Center Ecosystem Status Reports for the Eastern Bering Sea, Aleutian Islands, and Gulf of Alaska. Prepared by Yan Jiao for the Center for Independent Experts, April 2023.

ESRs could potentially be useful to a wider audience, such as for community and industry resilience planning.

The role of risk tables was also discussed. It was clarified that risk tables can help document and communicate concerns to inform individual stock assessments, but don't automatically create a buffer and don't replace the role of robust management procedures; it depends how the information is used. A question was whether risk tables could be used more quantitatively to convey information about potential risks and outcomes. Participants also noted risk tables include fishery information, which provides one entry point for broadening the information inputs provided for decision making (Section 5.1). A related suggestion was for risk tables to incorporate additional information and observations, not necessarily to trigger action but as a way to communicate with resource users.

Participants also discussed leveraging CVAs, and continuing to improve understanding of vulnerability and exposure to identify stocks that are particularly susceptible to climate change impacts. They noted stocks may transition to a state where disaster is the norm, and where recovering to previous levels of productivity or supporting viable fisheries may no longer be possible. Another suggestion was to improve understanding of risks from external factors such as shipping.

5.4 Stock assessments

Key message: Climate change may challenge stock assessment assumptions and fixed parameters including natural mortality.

Ideas

- ➢ Support more robust analysis and interpretation of early warning signals, and support stock assessment authors to take these steps.
- ➢ Develop guidelines for stock assessment authors to account for changes in fixed parameters.
- ➢ Proactively develop assessment models that can rapidly adjust to climate-induced changes in productivity or natural mortality. (Feedback form)

Discussion

Discussions reflected on the role of stock assessments for understanding stock productivity under conditions of change. One group discussed whether predictive stock assessments will have the same value in high unpredictability scenarios, and observed stock assessments will still be valuable for understanding stock age structure, understanding the range of possibilities in terms of future productivity, and for informing operating models to utilize management strategy evaluation (MSE).

Participants also reflected on the case studies of Pacific cod and snow crab, and the lessons learned that speakers shared with regard to stock assessment. Both examples challenged the practice of assuming natural mortality is a fixed parameter, and demonstrated that environmental conditions can have a strong impact on natural mortality. Participants recognized it may not be feasible to change fixed stock assessment parameters until after there is evidence of change (as opposed to proactively/in anticipation of change), and that that more flexibility may be necessary though innovation and change can be difficult. Another observation was that in both case studies there were early signals and observations of change that weren't accounted for in the assessment process. There could be more robust analysis and interpretation of these signals as well as more support for stock assessment authors to take these steps.

5.5 Research surveys

Key message: Consistent, continuous research surveys are essential for supporting climate resilience and keeping pace with change, and there is a disconnect between survey budgets and their importance to science and management.

Ideas

- ➢ Fully fund research surveys, conduct them annually and/or on a frequency and spatial and seasonal scales appropriate to change, and adapt in response to environmental changes and shifting stocks.

Discussion

Routine research surveys conducted by NMFS AFSC and research partners provide biological and ecosystem information that feeds into the stock assessment process and other information products. Participants expressed strong concern that survey funding, frequency, and coverage are decreasing at a time when this information is vitally important for supporting climate resilience and keeping pace with change.[43] They felt there is a disconnect between survey budgets and their importance to science and management, and that the trend of decreasing survey coverage is detrimental to climate resilience. Routine surveys were critical to understanding the situations with snow crab and Pacific cod, although participants noted surveys were missing in key years (2020 surveys in the Bering Sea were canceled due to Covid, and the Gulf of Alaska bottom trawl survey is conducted every other year).

Participants questioned whether it's most important to prioritize survey consistency and coverage, or whether information needs and survey methods will also need to evolve with climate change. An observation, also raised in case study presentations, was that surveys are also important for understanding how ecosystem dynamics are changing. Sequential climate shocks may impact ecosystem and stock dynamics in ways that are difficult to anticipate in a

[43] In June 2024 the Council submitted a letter to the Assistant Administrator for NOAA Fisheries requesting the Agency continue to support the North Pacific Council's climate resilience work by providing consistent funding and support for core fisheries surveys and ecosystem surveys.

changed system. Some participants were concerned about allocating resources toward modeling at the expense of foundational data collection. The counterpoint was made that they are linked, and models require data to run and ongoing data collections help improve predictive capabilities.

Participants supported fully funding research surveys, conducting them annually and/or on a frequency and spatial and seasonal scales appropriate to change, and adapting in response to environmental changes and shifting stocks. Specific suggestions included conducting Gulf groundfish surveys annually rather than every two years, and investing in Northern Bering Sea surveys.

5.6 Predictive tools and understanding vulnerabilities and tradeoffs

Key message: There is strong interest from managers and the public in receiving more future-focused climate information, developing capacity to explore tradeoffs and management options, and continuing to articulate the questions and capabilities people would like predictive tools to support.

Ideas

- ➢ Continue developing predictive capabilities and tools to meet management needs and questions.
- ➢ Ensure reliable, routine delivery of observations including hindcasts, forecasts, and projections.
- ➢ Emphasize “co-words”: collaboration, coordination, communication; continue to improve understanding and incorporate knowledge to detect change and refine hindcasts, forecasts and projections.
- ➢ Develop tools to evaluate and acknowledge tradeoffs, including establishing thresholds and quantifying vulnerability in tradeoff processes.
- ➢ Develop management strategy evaluation capacity to evaluate tradeoffs in decision making and the information available to conduct them.
- ➢ Ensure modeling efforts including ACLIM and CEFI include onramps for management and are clearly communicated to the public. (Feedback form)

Discussion

Participants expressed their support for more future-focused climate information, and discussed the capabilities they would want from enhanced predictive capabilities. They used the term predictive capabilities in terms of what they would like to better predict, anticipate, and understand about the environment as well as the capability to explore tradeoffs and management options.

Interests included:

- Assessing vulnerabilities, risks, and tradeoffs (including among communities, stocks, and ecosystems) to support planning and mitigate the impacts of climate shocks.
- Understanding what species and user groups are more at risk and more resilient to climate change impacts.
- Anticipating the magnitude and distribution of potential climate change impacts.
- Assessing management options, for example whether to scale back fishing in anticipation of climate shocks, or fish while stocks remain available.
- Exploring specific questions; one example was understanding which Bering Sea stocks are and are not capable of shifting north based on biological and oceanographic factors.
- Retrospectively examine appropriate climate regimes for estimating Bmsy time frames to help inform future predictions.

Another observation emphasized in the synthesis of Breakout 1 was the importance of reliable, routine delivery of observations including hindcasts, forecasts, and projections. To be useful for management, this information needs to be routinely delivered and anticipated in the Council process.

One breakout group had a focused discussion about the meaning of predictability. They questioned what is meant by low predictability: Does this mean scientists and managers lack predictive capabilities, that the system is highly unpredictable, or both? Can predictability be improved? They also reflected on what predictability and predictive capacity could mean to managers and resource users. Predictability could mean a better understanding of how species and ecosystems respond to change, and it could also refer to the ability to predict major shocks.

This group noted that scientists are better able to anticipate trends and understand forcing mechanisms than to predict individual events. Predictive capabilities can also depend on information availability. There are some species, like crab, for which scientists have the studies to understand temperature limits and thresholds for survival and recruitment, but for many other species this level of knowledge doesn’t yet exist. In addition, biological responses to environmental change can be unpredictable because species adapt to change. This group also observed that some timescales are inherently more predictable than others. One observation was that while predictive capacity is an important tool, it may be more important for management to focus on proactive planning, response, and robust harvest control rules.

5.7 Other information needs and gaps

This section includes a list of additional information needs and questions raised in discussion. This list is not comprehensive and is provided to capture ideas that may not fit in other sections of this report. Some of these topics are referenced in other sections.

Information needs

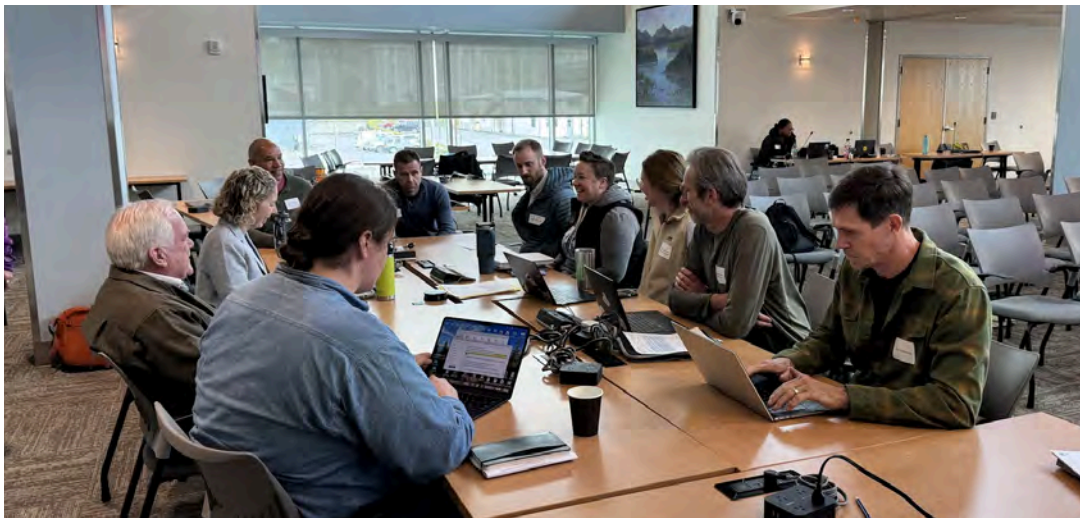
- Foundational data collection: Continue to invest in fishery independent data and biological information including fishery independent sampling (surveys, biological

sampling, stomach content analysis, spatial distribution of stocks) and fishery-dependent data.
- Ecological knowledge: Improve understanding of predator-prey dynamics, food web connections, and understanding and modeling the consequences and “downstream effects” on other species of disruptions, including lower trophic level species; improve understanding of species and ecosystem recovery post-crash; consider impacts of predation (for example, the impacts of cod shifting northward in the Bering Sea and preying on Yukon River salmon)
- Climate futures: Provide more information on what impacts could look for specific species and climate futures.
- Genetic information: Obtain more genetic information (on salmon as well other species like sablefish and halibut) to better understand subpopulations and geographic groups and how they’re responding, and provide finer resolution information for science and management.
- Hatchery releases: Improve understanding origins and impacts, including through the use of genetic information and the use of current hindcasting and forecasting tools to better understand current and future impacts to wild stocks and to ecosystems.

Areas of innovation
- Tradeoff analysis
- Bioeconomic modeling
- Uptake of AI including for surveys and electronic monitoring for species count and identification; general interest in how AI can enhance the use of predictive tools and scenario exploration, and where there are opportunities for innovation both in how AI is used, and building and sourcing the information AI can learn from (for example an idea was to look at ecosystem indicators more globally)
- Potential applications of emerging technology such as genomics and eDNA
- Multispecies modeling
- More narratives and visualization of models and scenarios
- Re-evaluating assumptions (for example, assumed discard mortality rates)

6. Scenario-specific discussion themes

This section of the report supplements previous sections, and captures the distinctive attributes of the four scenarios and the breakout conversations they supported. A brief summary of each of the four scenarios is provided below, and the full summaries are available on the workshop eAgenda.



6.1 Scenario 1: Current trajectory

Some progress toward ecosystem-based fisheries management (EBFM), significant climate change impacts, and moderate predictive capabilities

Scenario snapshot

Climate change continues to disrupt fisheries and marine ecosystems. **Climate shocks** and **extreme events** are much more frequent than in 2024. **Predictive capabilities** are improving, though primarily for data-rich stocks. For other stocks, the degree of change and uncertainty is outpacing, and thus decreasing, the ability to predict and plan for change.

The management tools and policies in place in this future, such as the use of area and seasonal closures, are similar to those used in 2024. Compared to the present day there has been some progress toward **ecosystem-based fisheries management** practices, such as exploring multi-species considerations in some stock assessments. Adaptive capacity varies widely across fisheries.

Themes of discussion

This summary of Scenario 1 breakout discussions is structured differently than the other three summaries that follow. Scenario 1 was the most similar to current conditions, though it still

describes a future of increasing climate change impacts. Participants focused on what they viewed as high priority needs for climate readiness under status quo conditions, while discussions of the other three scenarios were more specific to details of those hypothetical futures.

Participants pointed out that status quo doesn't mean conditions are good. People and communities have already experienced climate change impacts and collapses, and under this scenario existing challenges would be amplified and exposed. Participants felt Scenario 1 describes a future, similar to the present, in which people and communities already feel they lack resilience and encounter barriers to adaptation and diversification.

Scenario 1 supported robust conversation on topics that are covered in depth in the previous discussions section of this report, including:

- The definition of resilience, and challenges to resilience and adaptation (Section 1)
- Goals, objectives, and values (Section 2.4)
- Barriers to diversification and flexibility, and consequences of rationalization (Section 3.1)
- Early warnings and triggers (section 3.2)
- Council process, prioritization, and triage (Section 2)
- The importance of ongoing research surveys (Section 5.5)
- Diverse data inputs and perspectives, industry observations, and "co words" including collaboration, co-management, and co-production of knowledge (Section 5.1).

6.2 Scenario 2: Best of both worlds

Highly effective and inclusive ecosystem-based management (EBM), lowest potential climate change impacts, and strong predictive capabilities

Scenario snapshot

Alaska fisheries are experiencing periodic **climate shocks** and **extreme events** with slightly more frequency than in 2024. Although fisheries and communities are facing **greater uncertainty**, there are stronger predictive capabilities, more **lead time** to develop adaptation strategies, and improved planning for **emergency response** to support timely disaster relief and lessen the impacts of climate shocks.

Managers are now able to fully practice **ecosystem-based management (EBM)**. The environment is changing quickly but managers can effectively consider **interactions between species** and **spatial interactions** between fishing and other ocean uses.

What would it be like to live in this scenario?
Scenario 2 describes a future of highly integrated ecosystem-based management, with effective coordination between fisheries and other ocean and coastal uses. Some participants felt this future was difficult to envision. They raised concerns about what the governance structure and decision-making process would look like, the resources and capacity needed to engage in cross-sector management, and the feasibility of maintaining a voice for fisheries in this highly integrated future. More detailed reflections on cross-sector coordination are provided in Section 4.6.

Aside from these questions, Scenario 2 was productive for groups to think aspirationally about what they hope would be working well in this ideal future with the advantages of more predictability, moderate climate change impacts, and more lead time for planning. Participants described what success would look like including greater comfort with change, communities and fisheries that are able to adapt and thrive, stronger Tribal participation in decision making, and fishing continuing to be a sustainable occupation and way of life. Participants also talked about processes that would function well in this future. They felt that by definition EBM would support the integration of diverse knowledge and value systems, provide more opportunities for collaboration and coproduction of knowledge, and support a more inclusive Council process including equitable representation and effective two-way communication. Another idea was that by providing a more robust understanding of the ecosystem, EBM could make it more feasible to envision different management systems and solutions.

Management
Participants focused more on the attributes of climate-ready management than on specific approaches or needs. One topic of discussion was whether practicing EBM would help mitigate the uneven impacts of climate change to different fisheries, communities, and user groups. While EBM wouldn't preclude negative impacts, it could provide a more holistic approach to integrate all voices and perspectives, look across fisheries and user groups to consider how they interact, and help balance benefits and impacts.

Participants felt that in addition to supporting a more holistic perspective, this scenario would provide more ability to plan, consider social, economic, and community objectives, and avoid and mitigate the social and economic impacts of climate change. More lead time could allow for more planning and preparation, for example by providing five-year outlooks to support greater stability and long term planning; along with enhanced use of early warnings.

One question was whether this best case scenario future assumes the challenges identified elsewhere in this report have already been addressed, including whether the MSA provides flexibility to accommodate non-stationary conditions.

Science
In this scenario, participants felt there would be more predictive capacity and more information including continuous surveys, though they questioned whether the EBM capabilities in

Scenarios 2 and 3 imply science is well funded. Participants would want the ability to better anticipate shocks, assess tradeoffs, including through the use of management strategy evaluation; to quantify vulnerability, and to know what sectors, species, and communities would be impacted by climate change. This future would ideally support robust and diverse information streams, and rapid uptake of and response to information. The ability to meet specific information needs, such as better understanding species dynamics and habitat usage, could support more flexible management approaches and bycatch avoidance. This future could support improved understanding of terrestrial-marine ecosystem connections, and improvements in anadromous fish management.

Scenario 2 could also introduce some challenges. Even in this future of moderate climate change impacts, there would still be shocks and disruptions. High predictability would improve understanding of what might happen, but managers would still face the challenge of determining how to respond. One observation was that in a more predictable system, it may actually be more difficult for people and communities to adapt and diversify, and there may be less support and momentum to plan for resilience. The role of disaster relief could also be different in this scenario. Ideally disaster relief would be more readily available and less necessary with more lead time for planning; however, this could also mean resources are less available. Another concern was that if conditions are generally good and effort is high, managers may encounter familiar challenges such as short seasons and the race to fish, and that rationalization may not always be the best solution.

6.3 Scenario 3: EBM and rapid change

Highly effective and inclusive ecosystem-based management (EBM), high climate change impacts, and low predictive capabilities

Scenario snapshot

As in Scenario 2, managers are able to practice ecosystem-based management with effective **coordination**, **information-sharing**, and the ability to **consider interactions** between stocks/species and across fisheries and other sectors.

However, in contrast to Scenario 2 there are more **extreme climate change impacts**, with drastic impacts to ecosystem function and productivity. Extreme climate events and market shocks are common. **Predictive capabilities** are low and management is constantly in a **reactive** mode. The rapid rate of change contributes to **instability** for fisheries and communities.

What would it be like to live in this scenario?
Scenario 3, like Scenario 2, describes a future of highly integrated ecosystem-based management with effective coordination between fisheries and other ocean and coastal uses. However, climate change impacts are much more severe, and predictive capabilities are very

limited, as in Scenario 4. One description of this scenario was “stress testing” EBM in a more challenging environment.

Some participants found it difficult to imagine this future that includes highly functional EBM and robust data inputs in a system that is also experiencing severe impacts to ecosystem productivity and function. This scenario also described a focus on long-term stability over short-term yield, which some participants felt was confusing. They questioned how stability would be achieved in a highly unpredictable system, and what kind of stability is implied (for example, biological, socioeconomic?).

Participants felt Scenario 3 would be hard on people and communities. They would be overall less healthy, resilient, and able to adapt, and have fewer opportunities to diversify in a less productive ecosystem. More communities and sectors would be impacted and forced to innovate, with fewer resources including the stability and financial resources to make this possible. Participants anticipated there would be more food insecurity, more social challenges, and a lower level of trust among resource users. There might be higher costs to entry in viable fisheries and less value to leverage from declining ones, and the loss of investments in access rights for nonviable fisheries. Participants expressed concern about the impacts to river and interior communities, and the need to be more inclusive of their concerns. Overall there would be lower participation and fewer people entering fisheries, and in a worst case, participants questioned whether people would still be able to fish.

Participants felt the volatility and drop in productivity in this scenario would be highly disruptive to all sectors and operations including harvesting, processing, markets, and infrastructure. This raised many questions about how people and communities might adapt and respond to better handle the variability in catch. Questions included whether fisheries might respond by consolidating and scaling up, or scaling down to be smaller and more nimble; and whether people might expand into new products and markets like aquaculture. Processing capacity was a concern, and participants questioned whether processors could adapt to processing a fluctuating supply. Other concerns were more specific; for example, would there be enough of a fishery to support tenders? Could there be more access to other markets through open Arctic waters? Would some people become climate refugees forced to relocate?

Management

From a management perspective, participants emphasized the need for triage, timeliness, and responsiveness. Scenario 3 could force the consideration of drastic changes (in contrast to Scenario 2, in which participants had a more positive perspective on the willingness to consider new ideas). Participants felt the low productivity and high volatility of Scenario 3 might support a very different system of harvesting and a shift toward more efficient harvesting and processing. For example, this could look like more diversified multi species vessels, and greater use of cooperatives. Some felt there would be more of a need for precaution, and others questioned whether risk aversion or short-term thinking would prevail.

Science
In Scenario 3 participants felt there would be greater reliance on and need for fishery-dependent data, real time monitoring, and short term predictions. They observed that in contrast to Scenario 4, Scenario 3 suggests managers have strong data inputs available. While management would be more reactive, real-time information and monitoring could be used in a robust way. Stock assessments would still be important though there could be a higher potential for mismatch of assessments with conditions. Assessments might be used in combination with other information (for example size, age structure, reproductive output) and in other ways, including real-time management.

Participants also emphasized the importance of integrating diverse information inputs including LKTKS, leveraging existing data collections, expanding data collection capabilities through cooperative research and other opportunities, and improving the ability to understand vulnerabilities and tradeoffs. One concern was that lower productivity would mean reduced funding. Participants also questioned whether low predictability is referring to the ecosystem or predictive tools, and whether predictability can be improved.

6.4 Scenario 4: Siloed management and high challenges

Sector and stock specific management focus, extreme climate change impacts, and low predictive capabilities

Scenario snapshot

A high degree of warming has dramatically altered the **structure** and **productivity** of Alaska's marine ecosystems. **Extreme climate events** and **market shocks** are common. Predictive capabilities are very limited, and with **limited advance warning** management is in a **reactive** mode.

Management is focused on **near-term management** of **individual stocks, sectors and fleets**. Ecological information is included in assessments and advice (an ecosystem approach to fisheries management, or EAFM) but there is little ability to account for impacts on other managed stocks and species. **Coordination** between fisheries management and other ocean users is low. The rapid rate of change creates **instability** for fisheries and communities.

What would it be like to live in this scenario?
Scenario 4 was the most challenging of the four scenarios, and participants focused on the difficulties of coping with this future. Challenges include the drastic drop in productivity, high volatility, the frequency of climate disturbances, and the potential for simultaneous, interconnected shocks. Some groups felt Scenario 4 actually describes the current trajectory due to the siloing of management and reactive responses to climate shocks. Some participants felt they're already living this future due to fishery collapses such as crab, impacts to subsistence users, and the loss of cultural and community practices.

Participants felt this scenario would exacerbate existing vulnerabilities, particularly for subsistence users and for those reliant on a single stock for harvesting or processing, and would increase existing inequities. Participants highlighted the loss of catch volume, variability, reduced revenue due to operational costs, further consolidation, and the potential for community failures. Given the high degree of unpredictability, there could be less of a focus on prediction and more focus on mitigating impacts to people and communities. There would be more need for timely, equitable disaster relief and financial support. Participants pointed out that even in this scenario there will be stocks that continue to thrive, and people who are able to take take advantage of boom and bust cycles.

Scenario 4 illustrated hard questions and realities, including reflection on whether it is the ecosystem or the management process that is failing in this scenario. Participants considered the challenge of aligning capacity with drastically reduced productivity, observing this future can't sustain the same number of people across all roles including harvest but also fisheries science, management, and supporting industries. Managers would need to consider how to balance the need for flexibility with protections for communities and fisheries, and potentially prioritize among user groups (one example was focusing on communities and coastal fisheries over large-scale harvest). Resource scarcity would likely exacerbate conflict, and it would be even more important to invest in finding common ground and working together.

Scenario 4 also prompted people to consider the global consequences of severe climate change impacts. These could include greater food security challenges and more of a reliance on domestic seafood, increasing global conflict and migration, and the potential for weakened governance leading to more fishing in international waters.

How did we get here?

In a conversation that was unique to Scenario 4, facilitators prompted their groups to reflect on how this scenario might have unfolded, the potential warning signs along the way, and steps that could be taken to avoid this outcome. Groups felt the underlying reason would be failure to take action on climate change. Other contributing factors could be a lack of trust in data, science, and institutions (for example a comment was lack of trust in "imperfect" red flags); along with management inertia, lack of flexibility and slow response, lack of investment in science and predictive capabilities, and users not feeling heard and included in the process. Participants also saw high potential for negative feedback loops and compounding impacts. More frequent and widespread shocks could lead to more reactive management that makes it difficult to act collaboratively and proactively, and greater impacts to people and communities could lead to more conflict, a lack of empathy, and less willingness to work together.

Warning signs along the way to this future could include signals from fisheries and markets, declining participation, community decline, and ecosystem signals such as a decrease in diversity, and terrestrial ecosystem changes experienced by interior communities. Participants felt the ideas described in this report could help avoid this future. They emphasized the opportunity exists now to develop the tools and plan proactively, better integrate diverse

information sources, creating the space for planning, improve communication and knowledge sharing, address equity and inclusion in the process, and avoid siloing.

Management
The ability to sustainably harvest the resources still available in this future would depend on the needs identified for all scenarios including allowing for innovation, providing flexibility, enabling adaptability and diversification, and providing more flexibility for industry and communities to align productivity with availability (for example, through the use of cooperatives and CDQ models). In this lower productivity state, there would be more emphasis on value over volume. Participants felt there would be more of a need for rapid response and triage, as well as capitalizing on new opportunities including emerging fisheries and allowing for rapid flexibility such as switching between gear types and areas.

Participants reflected that in this scenario management may need to act on incomplete information. At an extreme, they questioned whether it might be necessary to reduce data standards and expectations, and whether there could be insufficient information to allow fishing. Groups also questioned whether management in this scenario would be more precautionary and risk averse, or conversely, more focused on production.

Science
With the high degree of unpredictability in Scenario 4 participants felt there would be less reliance on models and more emphasis on observations, monitoring, and diverse information inputs including LKTKS. A concern was the lower productivity of Scenario 4 could translate to reduced funding and resources for data collection and understanding change, though it would be even more important to identify which species are and are not doing well. Participants felt it would still be important to collect baseline information and conduct surveys, but there could be more focus on cost effectiveness, use of existing resources, and evolving the data collection enterprise and infrastructure. This could look like more cooperative research and data collection, increasing reliance on technology (such as uncrewed systems, eDNA, and AI), and less impactful, non-lethal methods of sampling. Other ideas could include more focus on habitat information, and finding onramps for environmental information other than stock assessments.

7. Post-workshop feedback form

Following the Climate Scenarios Workshop, a voluntary online feedback form was provided as a way for workshop participants to share additional ideas related to the workshop discussions, and their suggestions for improving the use of workshops as a discussion opportunity. The feedback form stated responses would be reviewed by Council staff and incorporated into the workshop report, and that responses would remain anonymous and would be synthesized (not quoted directly) for use in future reports and publications. This form opened the day following the workshop (June 7, 2024) and remained open through the end of the month. 18 responses were submitted.

The form included three open-ended prompts:

- Please share your comments, ideas, and feedback related to workshop discussions and next steps toward building climate resilience for Council-managed fisheries.
- Please share feedback on the workshop format and structure, and your suggestions for improvement.
- Other comments

Feedback on the workshop format and approach is provided in this section. **Respondents also provided feedback on the representation of Tribal perspectives in workshop planning and outcomes. This information is summarized in Section 2.3.5.**

7.1 Workshop format and logistics

Positive feedback included appreciation for the workshop planning, meeting logistics, and organization; the pre-meeting webinars, the value of the information shared, the value of interactions between perspectives and user groups for building knowledge and promoting empathy, and the generally positive and respectful tone of conversations. Respondents offered more specific feedback on the following topics.

Scenario planning

Several respondents thought four scenarios were too many and fewer would have been sufficient. Comments included that the scenarios were repetitive or led to similar responses (for example, defining resilience), that the underlying fishery management challenges were similar, and that the scenarios felt too extreme and specific. One comment was that the scenarios were too prescriptive and placed too much emphasis on ecosystem modeling and predictive tools that may not perform well in unprecedented conditions, and that focusing on resilience is more valuable. Another suggestion was to focus on specific issues rather than entire scenarios.

Format

Suggestions for improving the workshop format included the following.

- Allocate less agenda time for presentations, and focus more on discussion and dialogue and less on imparting information. Panel sessions are preferable to long talks. Some presentations were repetitive of the pre-meeting webinars.
- Provide more time in plenary discussions for feedback, questions, and conversation.

- The small group breakout discussions were valuable for hearing from different perspectives, and creating dedicated time for discussion. Smaller breakout groups would have been preferable.
- The four case study presentations focusing on recent experiences with climate-related disruptions were a highlight of the workshop, and would have benefitted from more time and a follow-up panel discussion.
- The mixed breakout groups were appreciated but some felt they were industry dominated.
- Provide more diversity in presenters, facilitators, and “floaters” (participants who rotated between groups and helped provide in-meeting syntheses).
- Clearly emphasize the workshop is meant to be action informing not action forcing.

Facilitation

Respondents appreciated the visual tools used by some facilitators. All groups were provided with flip charts, and some facilitators provided unstructured time for participants in their breakout groups to add ideas and notes to the charts. Respondents commented this approach enabled participants to share thoughts without having to speak or wait to be called on, and aided in summarizing and building on points of discussion. One of the virtual groups used an online collaborative notetaking tool that provided similar value.

Other comments noted more pre-workshop training and consistency across facilitation approaches could be useful, especially for ensuring discussions aren’t dominated by a few participants. Council, SSC, and AP members have dedicated time to speak on the record, and it’s important to hear from other voices.

Some felt the short breakout session report outs by facilitators were useful but several respondents expressed frustration that these recaps were overly summarized and left out ideas and nuance from the breakout conversations. Suggestions included providing more time before report outs for facilitators to synthesize themes, structuring report outs as a panel session with time for the audience to add ideas, or omitting the report outs altogether with the expectation workshop discussions would be captured in detail in the meeting report.

Venue and AV

Respondents shared mixed feedback on virtual participation. Some appreciated the option and others would have preferred to attend in person. Respondents note some challenges with audio and room acoustics, and suggested providing more room for groups to spread out.

Accessibility and outreach

Several respondents commented that holding the workshop in June in Kodiak was not ideal due to the cost and June being a busy time for fishing. Participants also suggested sharing workshop information as far in advance as possible, and supporting more outreach and participation by fishermen and Tribal perspectives.

7.2 Next steps and workshop follow-up

Exploring and implementing workshop ideas

Respondents shared their ideas and expectations for next steps following the Climate Scenarios Workshop. Positive feedback focused on appreciation for dedicating the two days to focused discussion, the value of sharing ideas and perspectives across roles and user groups, and the volume of ideas and information generated through workshop discussions. Most shared forward-looking advice for next steps, though some also expressed concerns about the workshop and the Council's next steps achieving progress toward climate resilience.

Multiple respondents wanted to see the workshop inform actionable next steps. Suggestions for continuing to explore and implement workshop ideas included the following. Some of these ideas were suggested in terms of next steps, and others as discussions respondents would have liked to explore more deeply at the workshop.

- Develop an **actionable climate resilience plan or policy**. This could be an iterative, living document. One suggestion was for the CCTF's remaining time and work product to focus on actionable ideas and recommendations.
- Pursue ideas for being more **proactive and less reactive**.
- Implement workshop ideas via **comanagement, co-stewardship, co-production of knowledge, and Tribal consultation**. FMPs could be structured as cooperative management agreements.
- Support words through **implementation and meaningful action.** Examples of where follow-through is particularly important include EBFM, sustainability, and incorporation of Tribal interests and knowledge.
- Be clear that **the report is a first step** and not action-forcing.
- **Establish goals and define success**. A comment was to focus on ecosystem, Tribal, and community wellbeing, sustainability, and resilience. (This is also captured in Section 2.4). Another comment was to recognize user groups have different goals and objectives, and take the time to understand how and why these goals differ.
- Explore different **perspectives** and interpretations of **key terms** including the meaning of precautionary.
- Support more **concrete discussion** of steps that *are* within the Council's authority, including ideas that have been previously explored such as the topics of flexibility and entry-level opportunities. One idea was to work with professionals trained in facilitation, mediation, and conflict resolution.
- Support an **inclusive planning process** in partnership with state and Federal agencies, Tribes, industry, communities, and other user groups; create more opportunities for informal discussion across user groups and perspectives. User groups have different views on whether the current system is successful, which emphasizes the need for inclusivity.
- Be willing to **identify what isn't working** well in the current system.

- Provide **more context** for what adaptation and precaution look like in other well-managed, highly regulated fisheries worldwide given the strengths and data availability of the North Pacific Fishery Management Council management process.
- Consider a **wider range** of possible futures.

Inclusion of perspectives

Respondents also shared questions and concerns about representation of ideas and perspectives in the workshop report. Multiple respondents asked about plans for reviewing the workshop report and expressed support for involving more people and diverse perspectives, including the CCTF and public, in reviewing and synthesizing workshop ideas prior to finalizing the report and determining next steps. Their concerns focused on ensuring all ideas and perspectives are included. One comment was that this would be particularly important given challenges to attending the workshop in person. Comments emphasized the workshop report should be based on detailed workshop notes rather than the summaries provided by facilitators. Another question was how public comment will be incorporated. One comment suggested making the Climate Scenarios Workshop a standalone agenda item for October to provide focused discussion and the opportunity for written comments and testimony.

The Climate Scenarios Workshop Report will be presented to the Council at the October 2024 meeting. As with all Council documents, this will provide the opportunity for additional public feedback and direction from the Council.

Appendix 1: Excerpts of Climate Readiness Synthesis[44] Opportunities

Excerpt from Section 1: Management Overview

1.6 Future directions/Potential Future Work

As previously discussed, this report is not intended to be a comprehensive overview of all management measures in the BSAI. Future work could create a set of metrics that provide measures of climate resilience across management actions and, potentially, climate warming scenarios. These key metrics could provide detail that better ties management actions to adaptation, maladaptation, limits to adaptation, and amount of adaptive flexibility relative to anticipated climate outcomes. In addition, time scales related to management response could also be considered such that some events may require a large and rapid response (e.g., heat waves), whereas other events may be slow to develop and offer a longer lead-in period for management response (e.g., movement of core stock areas).

1.6.1 Near-term considerations

- Evaluate the effectiveness and feasibility of measures that increase flexibility in current and future Council- defined management actions and which may allow for rapid responses to change
    - Seasonal flexibility in allocations, quota programs
    - Transferability amongst sectors and seasons
- Explore measures that support appropriate and timely response mechanisms in management
    - More rapid response in some circumstances while others may exhibit longer-term stability and/or flexibility in response timing
- Development of metrics to evaluate climate resilience in management measures
    - Improved integration of fishery dependent information with fishery independent information (e.g., habitat, oceanographic, survey, climate model outputs, stock dynamics) and coordination amongst data providers
- Explore the performance of, and feasibility to implement, spatial and temporal dynamic management measures through case studies like those identified in [Section 1 of the CRS]
- Evaluate / re-evaluate OY cap performance under climate change and alternative sub-designs (e.g, proportional caps, dynamic as function of climate indices) below the 2MT to ensure this measure continues to impart stability and productivity benefits under future change.
- Identify enabling factors to support industry led measures to increase rapid adaptation, reduce impacts, and respond to climate driven changes (e.g., communication and near-real time information sharing).

[44] Excerpted from Climate Readiness Synthesis. Prepared by the NPFMC Climate Change Task Force 2022.

Excerpt from Section 2: SAFE Report Review

This table summarizes the potential near-term, medium- high feasibility measures identified by the team. Details regarding these are provided below in the section 2.7 of the CRS, “Potential On-ramps”.

Table 2-5 Summary Table: Potential near-term On-ramps

Potential on-ramps	Near Term Feasibility
1. Indicator / climate change section in ESR	
a. Add ESR indicator regarding long term projections of climate variables (e.g., bottom temperature, cold pool, OA)	High
b. Add climate change synthesis section, similar to the climate variability and forecast section (Bond et al.) of the ESR	Medium
2. Separate section in SAFE or an independent climate change report	Low-Medium (requires an author to produce annually)
3. Intro section for each SAFE report could include a climate change section (e.g., in the ecosystem section)	Medium- High
4. SAFE Chapters (each species individual assessment) could include climate change information	Medium
a. Species specific climate change paragraph in each safe chapter	Medium
b. Each stock assessment chapter could include a climate change information section or slightly modified ESP	
c. Risk, vulnerability (and adaptation potential) table	
d. Safe author survey of climate readiness of each stock (based on their opinion and set criteria for climate readiness)	
5. Econ Safe Report could include climate change information (especially around risk, portfolio approaches to reduce risk, and future opportunities) a. General paragraph on climate change, global demand, and global to regional economics b. Risk, vulnerability (and adaptation potential) table c. Synthesis of integrated socio-econ MSE results (e.g. ACLIM)	Low-medium
6. Include a climate briefing as part of the Plan Team meetings to help inform this section	High
7. CCTF climate report(s) can be used to periodically update this information through producing synthesis sections for each species as well as the ecosystem as a whole.	Medium (will take coordination to draft and dedicated resources)

Excerpt from Section 3: Knowledge base overview

Section 3.6: Gaps and next steps: knowledge base elements and activities which can potentially be brought into the existing management system in the near-term

- Provide input into the Research Priority setting process foregrounding the importance of diverse sources of climate information and their relationship to climate-ready fisheries science and management
- Test mechanisms within the CCTF (e.g., Climate Briefings, Ecosystem Matrix tool, etc.) for bringing diverse knowledge sources related to climate change into the Council process
- Finalize and implement LKTKS Taskforce protocol regarding incorporation of LK, TK, and subsistence information into the Council process
- Track and consider climate change information and implications in light of recommended evaluations (as suggested by the Ecosystem Committee in March 2022) of the Programmatic EIS
- Scope development of Fishery Ecosystem Plans in other regions for connectivity issues (e.g., Gulf of Alaska, Arctic), as discussed at the March 2022 meeting of the Ecosystem Committee
- Increased development and implementation of EBFM tools across Council processes
- Work on marine planning and protections that are equitable and inclusive of a diverse set of communities, people, knowledges, methodologies, and values
- Implement a number of the CEC Final Report (NPFMC 2021) recommendations which could increase the flow of diverse sources of climate change information (including resilience tools) into the Council process. This includes:
    - Co-presentation from Tribal representatives on all agenda items
    - Standing Community Engagement or Tribal Advisory Committee
    - Increase the input of Tribal Consultation activities into the Council process
    - Council travel to rural communities for Council meetings and visits
    - Continuation and ongoing improvement of current outreach practices to foster two-way engagement
    - Taking steps towards Co-Production of Knowledge
    - Increased capacity at AFSC in the non-economic social sciences, particularly as regards expertise working with Alaska Native communities and their knowledge
    - Increased Indigenous inclusion on Council advisory and working bodies
- Increased uptake of broader climate change knowledge base not, or not fully, integrated into the Council process through additional steps not indicated above in other bullets, e.g., through exploring collaborations, partnerships and co-production (also see Section 2 for near-term steps to advance climate integrated advice)
- Conduct an analysis of Council documents as outlined above to explore whether and how the climate-relevant information from a variety of ‘other’ knowledge bases are currently making their way into the Council process in order to facilitate a gap analysis and recommendations for improvement, as necessary

Appendix 2: Excerpts from SSC Workshop[45] key take-home messages, recommendations and next steps

Key science and management recommendations (for science community and the Council)

	Science	Management
Local (NBS & Chukchi)	• Develop a monitoring program focused on understanding process changes in the NBS that inform current understanding of carrying capacity and expectations for future commercial fisheries. • Develop recommendations and secure additional funding for a periodic assessment of the southern Chukchi Sea ecosystem. • Improve overall science coordination in the region.	• Improve engagement with tribes and communities. • Consider mechanisms for incorporating the full spatial distribution of transboundary stocks into management.
'Global'	• Re-assess the time periods that are currently used to define the productivity of crab and groundfish stocks. • Consider alternatives to current HCRs based on available analyses. • Increase dialogue between SSC and Council on issues that straddle the science-policy interface. • Identify which stocks are likely to do better or worse in a changing environment to help fishers build the best fishing portfolio.	• Increase dialogue between SSC and Council on issues that straddle the science-policy interface. • Renewed discussion on reference period determinations in light of increased periodicity of extreme events. • Improve the use of approaches that explicitly consider risks

[45] Excerpted from Final Workshop Report: Rapid change in the northern Bering and southern Chukchi Seas - Identifying ecosystem responses and effects on the management of Federal fisheries. North Pacific Fishery Management Council Science and Statistical Committee Workshop, February 7-8, 2023

Recommendations for next steps

- Consider outcomes from this workshop as the Council identifies research priorities for 2023-24.

- Incorporate the recommendations from this workshop into the development of the planned Programmatic Environmental Impact Statement process to better address the impacts of climate change on the marine ecosystems and on the people dependent on those ecosystems.

- Produce a brief, plain language summary report from this workshop as a useful outreach tool to invite further input and engagement, and to learn more about local needs and concerns.

- Form a sub-group of Council and SSC members (2-3 members each) to develop a roadmap that builds a bridge from assessment and climate science to adaptive management under climate change.The roadmap should include the products and recommendations from the Climate Change Task Force, the LKTKS Task Force, and the national Council Coordination Committee - Scientific Coordination Subcommittee (SCS) meeting held in August 2022. The roadmap would recommend a direction and timeline for moving forward, recognizing the urgency for action as the North Pacific expects continued change in the near future. Questions for the subgroup to consider include:
    - Is the use of more dynamic reference points a viable alternative to current management practices, given the current Council processes under the Magnuson Stevens Act? This includes consideration of when to change the time periods over which reference points are calculated for crab and groundfish stocks.
    - Could and should social or economic objectives (e.g. Maximum Economic Yield, biomass thresholds, catch stability) be incorporated into adaptive management approaches for some stocks?
    - As stock footprints expand and shift in distribution, are regional allocations of catches in the EBS and NBS appropriate and could they be dynamic enough to address temporal variability?
    - Can risk considerations be improved upon in the context of both stock assessments (ABC considerations) and management (TAC considerations).

- Plan for a February 2024 follow-up workshop that focuses on discrete aspects of the key recommendations for science and management raised at this workshop to advise the Council. In addition to the outcomes from the sub-group roadmap, the SSC may consider the following questions that emerged during this workshop:
    - What temporal and spatial scales of information are needed to track non-stationary production, shifting boundaries, and changing species interactions?
    - What baseline information is required ahead of future extreme events to be better positioned to manage fishery responses?

- How can we better identify ecosystem bottlenecks influencing production of key commercial fish species so the limited resources are effectively focused.
- Can overall as well as benthic vs. pelagic carrying capacity be reasonably assessed and tracked to inform optimum yields in an environment changing as quickly as the NBS?