

Scenario Planning for Climate Change

Mid-Atlantic Fishery Management Council Discussion Document, April 2020

During their April 2020 meeting, the Mid-Atlantic Fishery Management Council will discuss initiating a climate change scenario planning process, which is included in the Council's 2020 implementation plan.¹ This discussion document provides introductory information about scenario planning (section 1.0), relevant examples of scenario planning for marine resource management (section 2.0), and a discussion of approaches the Council could consider for such a project in coordination with management partners (section 3.0).

1.0 Introduction to Scenario Planning

1.1 What is Scenario Planning and How is it Used?

Much of the following background information is taken from the National Parks Service (NPS) handbook on climate change scenario planning released in July 2013: "Using Scenarios to Explore Climate Change: A Handbook for Practitioners." As defined in the NPS handbook, scenarios are "a tool that managers can use to test decisions or develop strategy in a context of uncontrollable and uncertain environmental, social, political, economic, or technical factors."

While scenario planning can be used for a wide range of applications, it is well-suited to natural resources management applications in the face of climate change. It provides a structured process for managers to explore and describe multiple plausible futures and to consider how to best adapt and respond to them. It is not a tool for predicting future conditions; rather, scenarios are essentially stories about plausible combinations of future conditions that allow for explicit consideration of uncertainty in future conditions. Scenarios are created in response to a focal question developed based on a major strategic challenge faced by an organization.

Managers can use the resulting scenarios to strategize and prioritize for the future, including by identifying near-term actions that are likely to be beneficial under a range of future conditions and by planning to avoid actions that may reduce flexibility or increase the difficulty of adapting to future conditions. It can also provide insights into data gaps and monitoring needs for changing conditions.

Scenario planning uses "outside in" thinking, which considers broader forces in the world such as societal change, climate and environmental change, and changes in the policy and legal environment, and considers how these drivers that are outside of the organization's control may affect organizational priorities. Scenario planning forces participants to explore their underlying assumptions and perceptions about the range of possible future conditions. It reduces the tendency for managers to become overconfident in their expectations of future conditions, too focused on a limited view of the future, or paralyzed by uncertainty. Scenario thinking provides a way to organize complex information about changing conditions and stimulates creative and innovative thinking about how to prepare for change.

Within NOAA Fisheries' six-step process toward a climate-ready approach to fisheries management (Karp et. al 2018; 2019), structured scenario planning is identified as a planning strategy to manage fisheries under changing conditions. This would follow other steps such as

¹ http://www.mafmc.org/s/Final-MAFMC-2020-Implementation-Plan_2020-02-11.pdf

understanding the drivers of change and conducting climate vulnerability and risk assessments. Thus, scenario planning would be a logical follow up to the Northeast region climate vulnerability assessment (Hare et al. 2016) and the Mid-Atlantic Ecosystem Approach to Fisheries Management (EAFM) risk assessment (Gaichas et al. 2018) and its updates.

1.2 Scenario Planning Process

The NPS handbook for scenario planning outlines a five-step process involving one or more workshops organized by a core group of individuals and attended by key stakeholders. In advance of the workshop(s), core team members interview workshop participants and stakeholders to understand the assumptions, perspectives, and important management challenges associated with climate change. The participants and core team then identify specific questions or issues to explore using scenarios. The phases of this process are summarized below. Additional details are described in the NPS handbook (National Park Service 2013).

Timelines of these processes can vary widely depending on the details, but a guideline from the NPS handbook of possible lengths for each stage of the process in a one-workshop and two-workshop processes are shown in Figure 1.

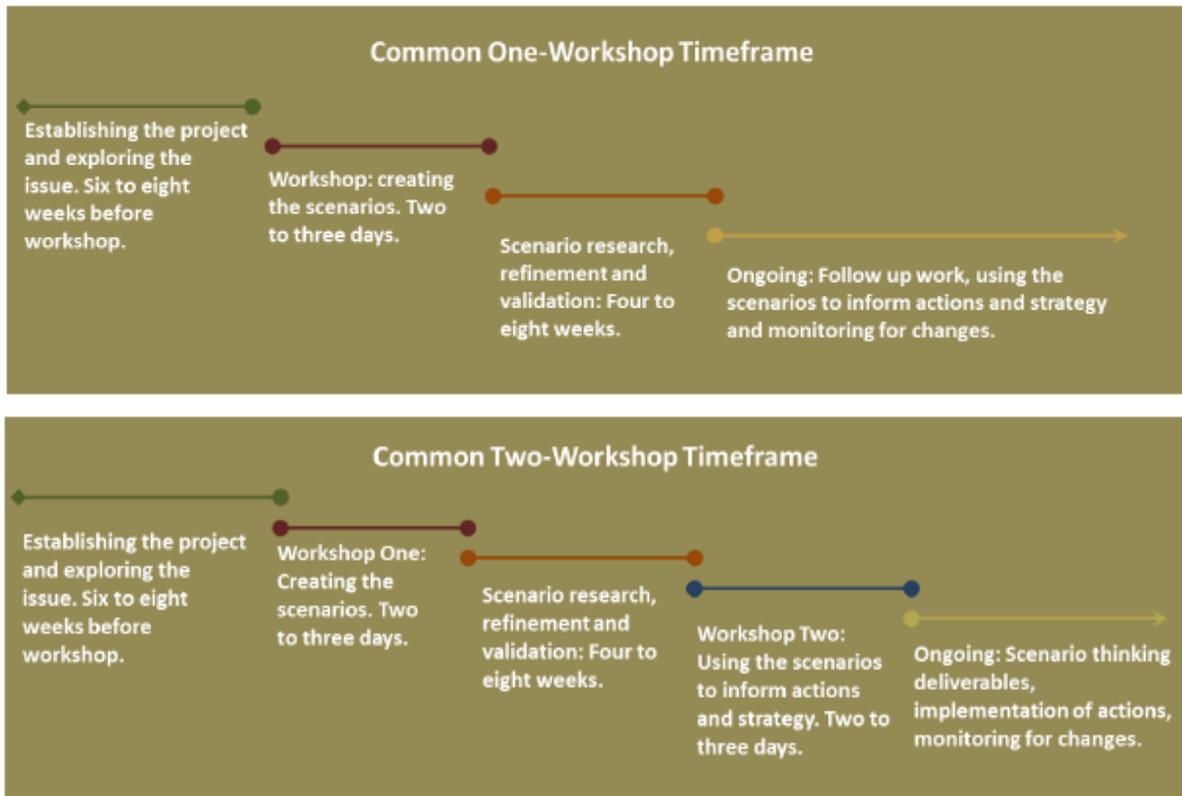


Figure 1: Common timeframes for one and two workshop processes. Source: National Parks Service, 2013 (Appendix III).

1.2.1 Phase 1: Orientation

During the orientation phase, the organization learns about scenario planning and establishes the purpose of the project, including identifying the issue or question to be explored using scenarios. Desired outcomes and goals should be identified, and a core team should be established to steer the project work. Bringing in an experienced facilitator to guide the process would be beneficial at this stage.

In many cases this phase includes stakeholder interviews to inform development of a focal question or issue. The goal of these interviews is to obtain perspectives from a wide range of stakeholders on major factors causing uncertainty in the fisheries, such as their underlying assumptions and beliefs about these drivers. This phase also involves planning and developing a schedule for the rest of the process and identifying likely participants.

1.2.2 Phase 2: Exploration

During this phase, the core team and subject matter experts (from academia, agencies, or the private sector) prepare research to inform scenario building, including identification of external "driving forces" and uncertainties that may affect the focal question. Driving forces tend to be those social, economic, political, or environmental factors that are important to the focal question, and that the organization cannot control. In climate change scenarios, this often includes a mixture of climate variables (e.g., ocean temperatures, pH, storm frequency) and sociopolitical factors (policy, legal framework, funding, market forces and trends, etc.).

Materials and background information should be provided to workshop participants to inform discussions at the workshop(s). Ideally, some time is spent prior to the workshop (via webinars or other means) orienting workshop participants to scenario planning and the driving forces, so that workshop time can be spent mostly on the scenario development process.

1.2.3 Phase 3: Synthesis (Scenario Creation)

The goal of the synthesis phase is to produce a small number of plausible, relevant, and challenging scenarios using the critical forces and impacts identified during the exploration phase. This phase usually begins with a workshop, where the core team and participants build scenarios using driving forces and select three to five final scenarios.

This phase would likely include a discussion of the degree of uncertainty around each driving force, i.e., which driving forces are the most uncertain, and which have the potential to change quickly or dramatically. The idea behind this discussion is to identify assumptions being made by participants and create a shared understanding of which elements are more vs. less certain.

There are several methods for building scenarios, but a typical and relatively simple method is using a 2x2 matrix process. This method considers two driving forces (ideally separate categories of drivers such as one social/political and one ecological) that present a spectrum of uncertainty. Overlapping these two spectrums of uncertainty produces a matrix with four quadrants with four possible scenarios, as shown below.

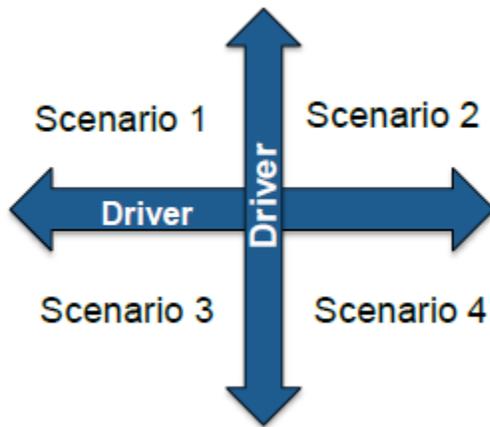


Figure 2: A common structure for scenario development where a 2x2 matrix is developed using two different driving forces, resulting in four scenarios to consider for further development.

After working through several of these quadrants with different uncertain drivers, the group would select their top plausible and relevant scenarios for further exploration and discussion. Once scenarios are identified, the group should work through and document potential impacts or effects that could occur within each scenario.

The impacts identified here will be incorporated into scenario "narratives" that will be used to drive further conversations about how to consider these scenarios in planning and prioritizing activities. Additional follow up work after the workshop includes reviewing scenarios with experts for plausibility and consistency.

1.2.4 Phase 4: Application

During the application phase, participants explore the scenario narratives developed in phase 3 to develop actions and strategies in response to the implications of the scenarios. Participants discuss the implications of each scenario to determine commonalities or patterns among scenarios, or if implications differ significantly between the scenarios.

At this stage, the organization can identify actions that it could take to prepare for and adapt to various scenarios, including actions that could be taken now to better adapt to future conditions, or actions to avoid to make future adaptation more successful. This stage could also identify process or structural changes that could better position the organization for operating under future conditions. Essentially, at this stage, the organization asks the questions, "If we knew this would be the future, what actions would we take now?" and "What actions would we avoid?" The scenario process can be used to inform the development of longer-term strategies beyond the scenarios, to identify which strategies are robust against various future conditions and to highlight areas of risk.

1.2.5 Phase 5: Monitoring

The final phase involves monitoring various indicators of the scenarios over time, collecting new information on uncertainties, and adjusting strategies as conditions evolve. The scenario planning process can be revisited if needed based on how conditions change.

Products of the process can include sets of indicators and warning signals for continued research and monitoring, as well as workshop deliverables describing the scenarios, implications, actions, indicators to monitor, and monitoring strategies.

2.0 Examples of Marine Resource Scenario Planning Initiatives

2.1 Atlantic Salmon

NOAA Fisheries undertook a scenario planning exercise for Atlantic salmon, which are highly vulnerable to climate change in the Northeast Atlantic. The project objectives were:

- 1) Better understand challenges of managing Atlantic salmon in a changing climate
- 2) Identify and discuss potential management actions and research activities that can be undertaken to increase understanding of drivers of Atlantic salmon productivity and resilience
- 3) Increase collaborations and coordination related to species recovery
- 4) Explore how scenario planning can be used to support decisions.

The focal question was: **"How can the effects of climate change impact the Atlantic Salmon Gulf of Maine Distinct Population Segment over the next 75 years?"** The 75-year time frame was selected to align with the Atlantic Salmon Recovery Plan.

Participants included experts in Atlantic salmon science or management, climate, watersheds, and fish physiology. Webinars and several small group discussions via phone were conducted in the summer of 2017 followed by a two-day face to face workshop in Portland, Maine to build the scenario narratives and discuss their management implications (Figure 3).

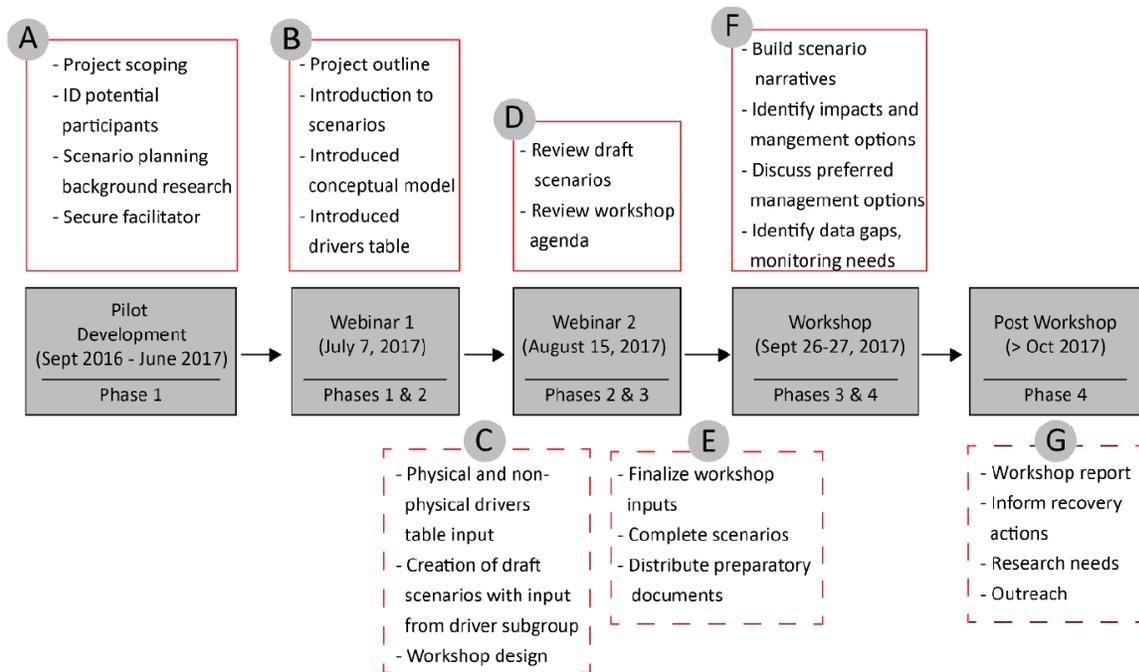


Figure 3: Process outline for Atlantic salmon scenario planning exercise. Source: Borggaard et al. 2019.

Scenarios were developed for Atlantic salmon following the 2x2 matrix method, considering 1) a warmer future that was either wetter or drier based on the uncertainty around future changes in precipitation and seasonality impacts on stream flow and 2) higher or lower freshwater accessibility based on future changes to fish passage and stream access. This matrix resulted in the four scenarios shown in Figure 4.

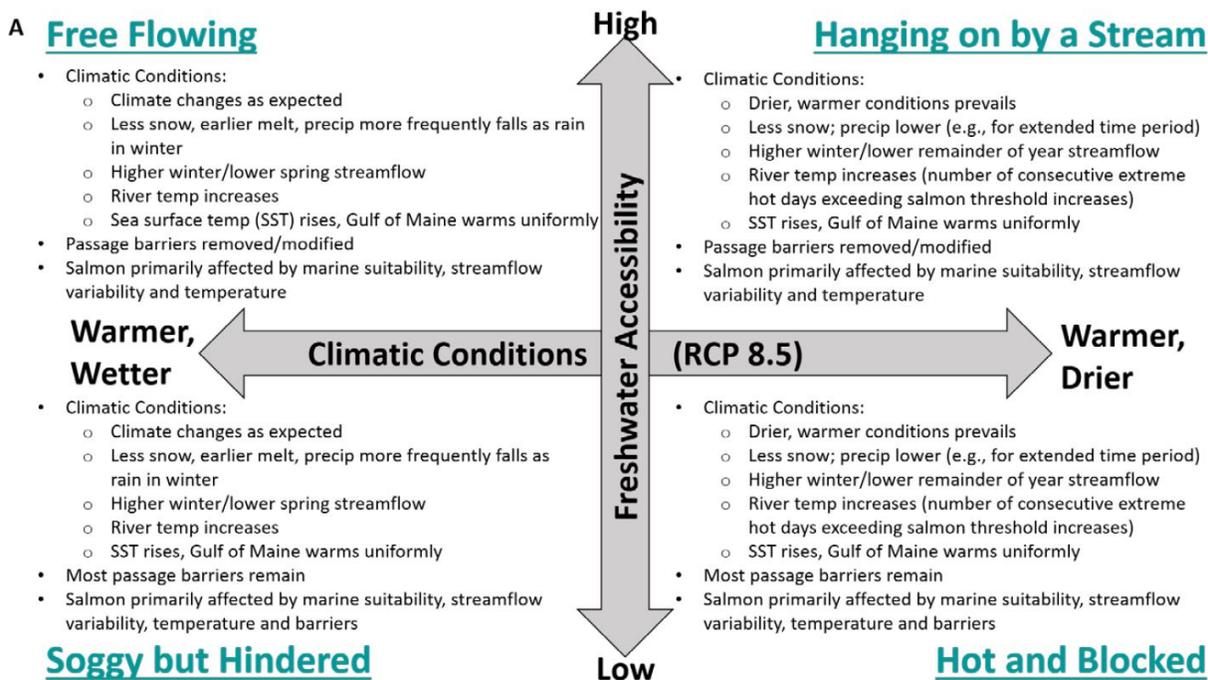


Figure 4: Atlantic salmon scenarios developed in 2017 process. Source: Borggaard et al. 2019.

At the workshop, conversations extended beyond scenario building and into the application stage, where participants discussed what actions NOAA Fisheries and others could take to prepare for each of these four futures. The outcome of this process was the identification of high priority research and management actions to further collaborations and efforts to recover this species. Several identified action items are now completed or underway such as the incorporation of high priority climate -related items into the revised Atlantic Salmon Recovery Plan (USFWS and NMFS 2019) and NOAA funded projects to 1) conduct a range-wide habitat analysis/mapping of key attributes of the physical environment important to Atlantic salmon and synthesis of life stage specific quantitative thresholds; and 2) to map Gulf of Maine Distinct Population Segment Atlantic salmon cold water refugia under a changing climate. Additional detail on these recommendations can be found in Borggaard et al. 2019.

2.2 Resilient Fisheries Rhode Island Project

In 2015, a group of Rhode Island fishermen received a NOAA Saltonstall-Kennedy grant to design environmental change adaptation strategies for Rhode Island's commercial fishing industry, known as the Resilient Fisheries Rhode Island Project. This project culminated in the publication of the "Rhode Island Commercial Fisheries Blueprint for Resilience" (Resilient Fisheries RI 2018).

Part of this project involved a scenario planning process, conducted via a full-day workshop in February 2017, facilitated by the consulting firm Futures Strategy Group. This workshop was attended by forty-five fishermen from Rhode Island ports, representing a variety of fisheries and gear types. Participants were split into breakout groups and given four scenarios characterized by different combinations of environmental and sociopolitical conditions. The scenarios in this case had been created ahead of time by the project coordinators and the consulting firm, based on feedback received in interviews and workshops during earlier stages of the project. Each group's mandate was to develop strategies that the Rhode Island fishing industry can start advocating for in the present to help the industry thrive in 2025-2030, if their scenario were to play out in the real world. The four scenarios considered by the breakout groups were the following:

- ***High climate variability (“Global Weirding”) and a “Do It Yourself” Governance Structure:*** Chaotic climate trends, with greatly variable water temperatures, salinity, dissolved oxygen, and pH, with no apparent trends. Small government from a new third party, with policies influenced by the Silicon Valley high-tech industry. Higher business investment with higher competitive pressure.
- ***Global Cooling & Eutrophication, with a “Second Wind” socio-political environment:*** Natural cooling cycles counteract effects of greenhouse gas emissions. Salinity is increasing; coastal areas are experiencing increasing eutrophication and more anoxic events. The U.S. economy is growing with a new wave of technological innovation, with much closer relations between government and industry.
- ***Anthropogenic Warming with a “Long Plateau” economy:*** Higher water temperatures primarily driven by manmade greenhouse gas emissions. Lower salinity due to the melting of glaciers and polar ice caps. Lower dissolved oxygen and more frequent anoxic events. Ocean acidification (lower pH) is also occurring. The U.S. economy is sluggish and opportunities are limited, with fewer affluent households. Tough protectionism and government programs are keeping a lid on frustration.
- ***Natural Warming and a “Next Big Thing” new economy:*** Water temperatures have continued to rise due to natural cycles like the North Atlantic Oscillation. Lower salinity due to the melting of glaciers and polar ice caps. Lower dissolved oxygen and more frequent anoxic events. Ocean pH has remained relatively constant. A new economy is developing based on cheap renewable energy but is causing many economic uncertainties.

After discussing the implications of these scenarios, participants proposed a series of strategies for fishing communities to adapt to the potential futures described in the scenarios. These strategies represent a spectrum ranging from those that the fishing industry can implement on its own to those that require varying degrees of action by other parties. Strategies identified include "low hanging fruit" that the fishing industry can begin to implement on its own in the short term, as well as strategies for collective industry organizing, local and niche marketing, public relations, workforce development, and methods to promote adaptive science and management. Additional detail on the outcomes of this process can be found in Schumann et al. 2017.

2.3 North Atlantic Right Whale

NMFS conducted a scenario planning exercise for North Atlantic Right Whale recovery. The purpose of this scenario planning exercise was to explore future conditions for right whales throughout their range and develop possible options to address those conditions to improve recovery. The focal question was **"What will affect/influence the recovery of right whales**

throughout their range over the next 60 years?" Participants include federal experts from NMFS, the Marine Mammal Commission, and the National Ocean Service. The summary of this scenario planning exercise is still in progress, but during the April Council meeting, NMFS will provide a general summary and some highlights of this effort.

2.4 Pacific Council Scenario Planning Exercise

As part of their ongoing Climate and Communities Initiative pursuant to their Fishery Ecosystem Plan, the Pacific Fishery Management Council initiated a scenario planning process in late 2018. In March 2019, the Council adopted shifting stock availability (including shifting distribution) across species, fishery management plans, and communities across the West Coast as the topic for a climate change scenario planning exercise. This exercise was intended to help the Council define the tools, products, and processes necessary to plan for potential future ecosystem states resulting from climate variability and climate change. The Council formed an Ad Hoc Climate and Communities Core Team ("Core Team") to drive the project and hired Jonathan Star of Scenario Insight to facilitate the process.

Core team members participated in a workshop in May 2019 to learn scenario planning principles and plan the project. Interviews were then conducted with stakeholders and Council advisory bodies, asking open ended questions encouraging respondents to think about the future. The focal question developed for this process was identified as **"How will West Coast fishing communities be affected by climate-related shifting stock availability and other developments between now and 2040?"** A preliminary list of driving forces was then developed by the Core Team with input from the Council's SSC, Committees, and Advisory Subpanels. A list of 21 driving forces² shaping West Coast fishing communities to 2040 was finalized prior to a January 2020 scenario building workshop in Garden Grove, CA. This workshop brought together more than 80 participants from different components of the fisheries and fisheries management.

The two-day workshop began with background presentations on the driving forces, followed by breakout group discussions attempting to build "sketch" scenarios from combinations of important driving forces, to familiarize participants with the driving forces and the process of scenario building. The second day involved more focused scenario development, where participants identified two critical uncertainties of interest as 1) climate variability (more vs. less frequent dramatic climate variability) and 2) species abundance and availability (greater or lesser availability of Council managed species to the fisheries). This framework led to the development of four scenarios for further discussion (Figure 5). Participants broke into four groups to discuss how these scenarios might play out for species and fisheries managed under the Council's four FMPs, and also considered how market and other socioeconomic and political forces may interact with future conditions.

The outcomes of the workshop included the four draft scenarios described below, to be further refined and validated in the next steps of the process.

² The summary of driving forces is available at: <https://www.pcouncil.org/documents/2020/02/cci-workshop-driving-forces-summary.pdf/>.

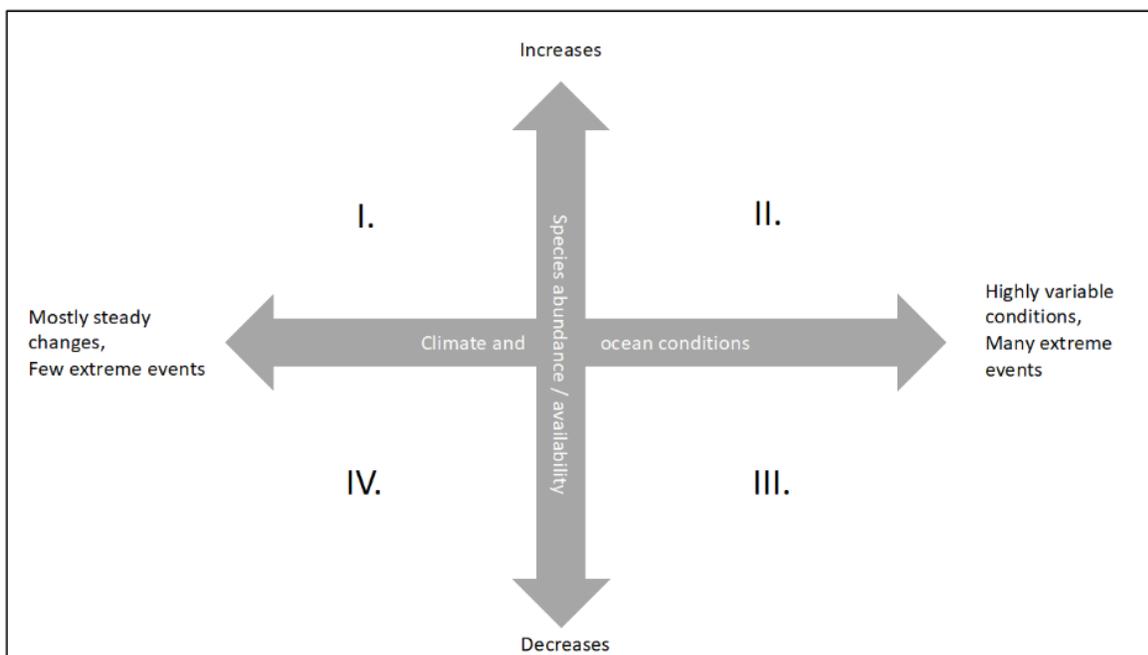


Figure 5: Framework for scenarios developed at January 2020 Pacific Council scenario building workshop. Source: PFMC, 2020.

- I. Changing ocean conditions, moderate unpredictability, relatively few extreme events, coupled with high and/or increasing stock abundance. West coast fishing is supported through trade policies, a shift in societal values, and increasing consumer demand for wild caught fish.
- II. Rapidly changing ocean conditions, high unpredictability, and frequent and intense extreme events coupled with high and/or increasing stock abundance for some species. Greater investment in, and use of, data monitoring technologies, helping fishing communities prepare for surprises.
- III. Rapidly changing ocean conditions, high unpredictability, and low/declining stock abundance. Difficult circumstances compounded by market conditions (consolidation, ageing of the fleet, and declines in demand) leading to a hollowing out of the fishing industry.
- IV. Changing ocean conditions, moderate unpredictability, relatively few extreme events, coupled with low/declining stock abundance. Aquaculture and other commercial ocean uses become more popular, changing the dynamic and make-up of fishing communities.

The workshop concluded with a discussion of next steps. Additional work is needed to validate the above scenarios as well as "deepen" the narrative surrounding each scenario to help make them as useful as possible. The planned next steps for the Pacific Council include using scenarios to generate ideas about how to effectively plan and prepare for the future. A "focal group" process is proposed to solicit ideas from a series of conversations with a range of stakeholders.

Mid-Atlantic Council staff is following the developments of the Pacific Council's process and plans to coordinate with them on lessons learned. Additional information about their Climate and Communities Initiative and their scenario planning exercise can be found at:

<https://www.pcouncil.org/actions/climate-and-communities-initiative/>.

3.0 Potential East Coast Scenario Planning Exercise

In November 2019, the Northeast Regional Coordinating Committee (NRCC) discussed a potential climate change scenario planning process for the East Coast. Diane Borggaard of GARFO's Protected Resources Division presented an overview of scenario planning and NMFS scenario planning efforts. The NRCC generally agreed to move forward with a region-wide scenario planning initiative as a way to explore jurisdictional and governance issues related to shifting stocks. The NRCC also agreed to form a planning team/working group to explore East Coast scenario planning. This group would include representatives from all NRCC partners (Mid-Atlantic and New England Councils, ASMFC, GARFO, and NEFSC) as well as representatives from NMFS Headquarters, the Southeast Regional Office, the Southeast Fisheries Science Center, and the South Atlantic Fishery Management Council. The NRCC discussed that at a future meeting, this group would put together a proposal for the NRCC to review and decide how to move forward.

Additional NRCC and Council discussions are needed regarding the Council role in this process, in particular whether the Council would prefer to undertake a Council-focused scenario planning effort in parallel to a broader East Coast effort, if the Council would lead a broader East Coast effort, or if the NRCC working group would take the lead on an East Coast effort. There are tradeoffs associated with these approaches. Given that climate change and related species distribution changes will impact all management partners, and that adaptation will require strong coordination, it would be beneficial to involve all major partner organizations on the East Coast in some manner. However, the expected outcomes of this process, including broader planning strategies and specific management actions may be easier to identify and prioritize within one or two organizations as opposed to many organizations. Regardless of the approach selected, close coordination and continued communication between the Council, the NRCC and other management partners will be needed. Efforts should be made to minimize duplicative efforts, attempt to align expected outcomes, and consider resources available to each partner organization.

Below are some questions for the Council to consider regarding a potential path forward:

- **Who should lead the organizations through the process?** Given the nature of scenario planning and the limited expertise and experience among staff and partners, it may be beneficial to contract with a facilitator with experience in scenario planning for climate change and natural resources management.
- **Who should participate on a core team?** Depending on the approach taken, the core team could be the NRCC working group, or could be another group of individuals representing managers, staff, and technical experts from various partner organizations. In general, the core team would be responsible for: 1) developing the strategic challenge and focal question to be addressed, with input from the participating organizations and other stakeholders, 2) gathering stakeholder input prior to a scenario building workshop, 3) identifying and recruiting workshop participants, 4) planning workshop logistics and workshop sessions, and 5) producing meeting materials.
- **Who should participate in the broader process (i.e., interviews and workshops)?** Scenario planning should engage stakeholders who provide diverse perspectives and expertise. A broader range of perspectives can help challenge assumptions and illuminate blind spots. This phase would involve identifying fishery participants, decision makers, experts, and creative thinkers to participate in addition to core team members.

- **How should we determine our goals and refine the focal question?** A successful scenario planning exercise should have a clearly identified set of goals and expected outcomes developed toward the beginning of the process. The process is centered around a question (or questions) regarding the plausible futures we are trying to explore. As described in phase 1 of the process above, the core team should assemble stakeholder input to identify a specific strategic challenge or question that the process will seek to address. Example questions could include things like "How might climate change driven species distribution shifts influence Council and NMFS governance and management of fisheries over the next 25 years?" or "How might climate change drive ecological and socioeconomic fishery changes over the next 25 years?"
- **What time horizon should be considered?** A scenario planning process should identify how far into the future to consider in the development of scenarios. Do we want to develop scenarios that consider possible conditions in 10 years, 20 years, 30 years, or more? The time frame needs to be long enough to sufficiently consider longer term uncertainties and changes in conditions but should be short enough that near-term actions and strategies would still be relevant to influencing responses to future conditions.
- **What is the intersection with other ecosystem and climate initiatives?** While this scenario building process would be largely independent of other Mid-Atlantic Council EAFM initiatives, a scenario planning exercise could draw on past, current, and planned EAFM efforts, as well as other climate related initiatives in the Greater Atlantic and South Atlantic (if applicable) regions. For example, insight from the EAFM risk assessment could be used to identify and refine driving forces that may be appropriate to consider in a scenario planning exercise. In addition, similar to the way that a conceptual model was developed to identify priority management questions and objectives for a Management Strategy Evaluation for summer flounder, a simplified conceptual model framework could be used to synthesize the links between climate, other environmental factors, and species response (this type of conceptual model was used during development of the Atlantic salmon scenario planning exercise). This scenario planning exercise would be intended to advance and support the Council's EAFM framework without duplicating the efforts of other climate and ecosystem related efforts.

4.0 Literature Cited and Resources

[Borggaard, D. L., et al. 2019.](#) Atlantic Salmon Scenario Planning Pilot Report. Greater Atlantic Region Policy Series [19-05]. NOAA Fisheries Greater Atlantic Regional Fisheries Office.

[Gaichas S.K. et al. 2018.](#) Implementing Ecosystem Approaches to Fishery Management: Risk Assessment in the US Mid-Atlantic. *Front. Mar. Sci.* 5:442.

Hare JA, Morrison WE, Nelson MW, Stachura MM, Teeters EJ, Griffis RB, et al. 2016. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf. *PLoS ONE* 11(2): e0146756. <https://doi.org/10.1371/journal.pone.0146756>

[Karp, M. A., J. Peterson, P. D. Lynch, and R. Griffis](#) (editors). 2018. Accounting for Shifting Distributions and Changing Productivity in the Fishery Management Process: From Detection to Management Action. U.S. Dept. of Commerce, NOAA. NOAA Technical Memorandum NMFS-F/SPO-188, 37 p.

[Karp, M. A., et al. 2019.](#) Accounting for shifting distributions and changing productivity in the development of scientific advice for fishery management. ICES Journal of Marine Science, doi:10.1093/icesjms/fsz048.

[National Park Service, 2013.](#) *Using Scenarios to Explore Climate Change: A Handbook for Practitioners*. National Park Service Climate Change Response Program. Fort Collins, Colorado.

[Pacific Fishery Management Council. 2020.](#) Fisheries Ecosystem Plan Climate and Communities Initiative: Developing Future Scenarios for Climate Change in the California Current Ecosystem, Workshop Report.

[The Resilient Fisheries RI](#) project (with support from the Rhode Island Natural History Survey.) 2018. Rhode Island Commercial Fisheries Blueprint for Resilience

Schumann, S. 2017. Report of the workshop “Future-Proofing Rhode Island’s Commercial Fisheries”, South Kingstown, R.I., 21 February. Online at: www.resilientfisheriesRI.org.

[U.S. Fish and Wildlife Service and NMFS. 2018.](#) Recovery plan for the Gulf of Maine Distinct Population Segment of Atlantic salmon (*Salmo salar*). 74 pp.