

Synthesis of Public Comments to NOAA on Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad,* Section 216(c): Recommendations on How to Make Fisheries and Protected Resources, Including Aquaculture, More Resilient to Climate Change

Marina L. Cucuzza, Heather L. Sagar, and Roger B. Griffis



U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-F/SPO-218
October 2021

Synthesis of Public Comments to NOAA on Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, Section 216(c): Recommendations on How to Make Fisheries and Protected Resources, Including Aquaculture, More Resilient to Climate Change

Marina L. Cucuzza, Heather L. Sagar, and Roger B. Griffis

**NOAA Technical Memorandum NMFS-F/SPO-218
October 2021**



U.S. Department of Commerce
Gina Raimondo, Secretary

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

National Marine Fisheries Service
Janet Coit, Assistant Administrator for Fisheries

Recommended citation:

Cucuzza, Marina L., Heather L. Sagar, and Roger B. Griffis. 2021. Synthesis of Public Comments to NOAA on Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, Section 216(c): Recommendations on How to Make Fisheries and Protected Resources, Including Aquaculture, More Resilient to Climate Change. NOAA Tech. Memo. NMFS-F/SPO-218, 79 p.

Copies of this report may be obtained from:

Office of Science and Technology
National Oceanic and Atmospheric Administration
1315 East-West Highway F/ST7
Silver Spring, MD 20910

Or online at:

<http://spo.nmfs.noaa.gov/tech-memos/>

Table of Contents

List of Acronyms	iv
Acknowledgements.....	v
Executive Summary	vi
I. Introduction and Document Overview	1
II. Summary of Public Comment Responses	3
III. Qualitative Data Analysis Process	8
IV. Results: Summary of Public Comments by Theme.....	9
1. Executive Order Approach	9
2. Management for a Changing Climate	11
3. Habitat Considerations	23
4. Protected Resources	26
5. Aquaculture.....	29
6. Economic Considerations in Advancing Climate-Resilient Fisheries and Protected Resources	32
7. Data Needs	34
8. Research Needs	36
9. Reductions in Anthropogenic Carbon Emissions	42
10. Ocean-Based Renewable Energy.....	43
11. Outreach, Education, Training, Communication	44
12. Funding Needs and Considerations	46
V. Discussion	51
VI. Literature Cited	52
Appendix A: Region-Specific Recommendations Received	53
Appendix B: Tribal Recommendations	70
Appendix C: International Recommendations.....	77

List of Acronyms

ABC	Acceptable Biological Catch
ACLIM	Alaska Climate Integrated Modeling Project
AOOS	Alaska Ocean Observing System
ASMFC	Atlantic States Marine Fisheries Commission
CVA	Community Vulnerability Assessment
EBFM	Ecosystem-Based Fisheries Management
EC	Ecosystem Component
eDNA	Environmental DNA
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FEPs	Fishery Ecosystem Plans
FFP	NOAA Fisheries Finance Program
FMP	Fishery Management Plans
HAPC	Habitat Areas of Particular Concern
HBCU	Historically Black Colleges and Universities
HCR	Harvest Control Rule
IEA	Integrated Ecosystem Assessment
LSRD	Lower Snake River Dams
MMPA	Marine Mammal Protection Act
MNM	Marine National Monuments
MPAs	Implementing Marine Protected Areas
MRIP	Marine Recreational Information Program
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSE	Management Strategy Evaluations
MSY	Maximum Sustainable Yield
NCCOS	National Centers for Coastal Ocean Science
NERR	National Estuarine Research Reserve
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NPFMC	North Pacific Fishery Management Council
OECM	Other Effective Area Based Conservation Measures
ORF	Operations, Research, and Facilities
PBR	Potential Biological Removal
RAD	Resist, Accept, or Direct
RFMC	Regional Fishery Management Councils
RODA	Responsible Offshore Development Alliance
SRKW	Southern Resident Killer Whale
SSC	Scientific and Statistical Committee
TAC	Total Allowable Catch
TED	Turtle Excluder Devices
TEK	Traditional Ecological Knowledge

Acknowledgements

This synthesis report was improved with edits from Jay Peterson (NMFS), Eleanor Bors (NMFS), Wendy Morrison (NMFS), Helen Chabot (NMFS), Marifrancis Moschopoulos (TechGlobal, Inc. in support of NMFS), Bette Rubin (ERT Inc. in support of NMFS), Travis Thyberg (NMFS), Katlyn Robinson (OAR), and Shawn Choy (NOS).

Executive Summary

On January 27, 2021, President Biden issued Executive Order 14008¹ “Tackling the Climate Crisis at Home and Abroad.” Section 216(c) of the Executive Order directs the Secretary of Commerce, through the Administrator of the National Oceanic and Atmospheric Administration (NOAA), to “collect input from fishermen, regional ocean councils, fishery management councils, scientists, and other stakeholders on how to make fisheries, including aquaculture, and protected resources more resilient to climate change.” This includes recommendations on changes in management and “conservation measures and improvements in science, monitoring, and cooperative research.”

In response to the Executive Order, NOAA published a federal register notice² requesting written input from interested parties on how the agency could best achieve the objectives outlined in Section 216(c) of the Executive Order. Additionally, NOAA hosted three national stakeholder listening sessions during the public comment period — two were open to all stakeholders, and one was specifically for tribal and state governments. Special sessions were also held at meetings of the regional fishery management councils³ to gather input.

This document is a synthesis of public comments received by NOAA in response to section 216(c) of Executive Order 14008 on “Tackling the Climate Crisis at Home and Abroad.” The agency received a total of 231 comments⁴ from emails, stakeholder listening sessions, and fishery management council meetings, of which 219 were unique comments (i.e., 12 individuals spoke at a public hearing and also submitted an email comment). In total, the public comments represent over 2,500 individual signatures, as many emails had multiple individuals associated with the comment. Input came from a variety of organizations, largely non-profit, non-governmental organizations, including environmental advocacy groups, in addition to members of the commercial, recreational, and aquaculture fishing sectors, state and tribal wildlife agencies, and academic and scientific entities. Comments primarily focused on science and management recommendations for fisheries and protected resources.

All responses were analyzed using a qualitative data analysis process called content analysis, detailed below. This synthesis highlights the range of input received in the public comments and is organized by major themes of comments identified through systematic analysis. This synthesis

¹ Executive Office of the President. 2021. Tackling the Climate Crisis at Home and Abroad. Presidential Document E.O. 14008 of Jan 27, 2021. [Available at <https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad>]

² NOAA. 2021. Recommendations for More Resilient Fisheries and Protected Resources Due to Climate Change. Notice 86 FR 12410. [Available at <https://www.federalregister.gov/documents/2021/03/03/2021-04137/recommendations-for-more-resilient-fisheries-and-protected-resources-due-to-climate-change>]

³ <https://www.fisheries.noaa.gov/southeast/funding-and-financial-services/fishery-management-councils>

⁴ <https://www.fisheries.noaa.gov/feature-story/give-us-your-input-making-fisheries-and-protected-resources-more-resilient-climate>

should not be viewed as a complete analysis of all the views of NOAA's constituents, only those that provided comments.

The analysis of the public comments identified the following major themes in the input received:

- **Executive Order Approach:** Comments focused on stakeholder inclusion and recommendations regarding the Executive Order implementation process.
- **Management for a Changing Climate:** Comments focus on the need for science-based, ecosystem approaches to decision-making, recommendations for climate-informed catch limits, recommendations on management approaches, management tools and plans, recommendations to the regional fishery management councils, comments related to the Magnuson–Stevens Fishery Conservation and Management Act, and recommendations on place-based conservation and protection of ocean areas.
- **Habitat Considerations:** Comments focused on conserving, protecting, and restoring habitat, sea level rise concerns, water quality, pollution, and algal blooms, Essential Fish Habitat, and habitat considerations for salmon.
- **Protected Resources:** Comments focused on marine mammals and sea turtles, salmon, and improving planning and policy actions for Threatened and Endangered Species.
- **Aquaculture:** Comments focused on aquaculture as a climate solution, aquaculture needs, resilient aquaculture infrastructure, and oppositions to aquaculture.
- **Economic Considerations in Advancing Climate-Resilient Fisheries and Protected Resources:** Comments focused on fishery supply chains, promotion of U.S. seafood, working waterfronts, and coastal economies.
- **Data Needs:** Comments focused on data integration and improvements as well as data modernization needs to advance climate-ready fisheries and protected resources.
- **Research Needs:** Comments focused on cooperative research, monitoring and accounting, and research needs identified for marine renewable energy, bycatch, changing fisheries, changing ocean conditions, greenhouse gas reduction, habitat, trophic dynamics, marine mammals and sea turtles, as well as social and economic considerations.
- **Reductions in Anthropogenic Carbon Emissions:** Comments focused on the carbon footprint of commercial fishing, as well as carbon sequestration.
- **Ocean-Based Renewable Energy:** Comments focused on concerns with marine renewable energy development.
- **Outreach, Education, Training, Communication:** Comments focused on increasing ocean literacy, enhancing consumer education related to fisheries and aquaculture, job training programs, and communication and outreach strategies.
- **Funding Needs and Considerations:** Comments focused on NOAA grant considerations, funding for scientific surveys, as well as fisheries and aquaculture funding needs.

Stakeholders universally emphasized that NOAA must lead collaborative, equitable, inclusive, and transparent efforts to make fisheries and protected resources more resilient to climate change. Comments stressed that in an environment of unpredictable change in marine ecosystems, long-term, robust ecological monitoring must be put in place in all regions. Additionally, climate-informed science must underpin management approaches that are ecosystem-based, proactive, and informed by the knowledge of local and traditional users.

The public input received will be used to inform NOAA's work with federal agencies, state and tribal governments, and relevant stakeholders and constituents to ensure more resilient fisheries and protected resources due to climate change. NOAA will continue to have ongoing discussions with regional fishery management councils, interstate fishery commissions, and other managing partners. NOAA Fisheries will use the input received to inform rulemaking, policy, and notably the next series of Regional Action Plans to advance implementation of the NOAA Fisheries Climate Science Strategy⁵.

Addressing many of the recommendations will be an ongoing effort. Some recommendations may require building and advancing partnerships and others may take years to develop and implement. Many of the recommendations will require additional funding for NOAA to implement. Importantly, all of the public comments received will serve as a starting point for additional public input and continued engagement with stakeholders to inform NOAA's efforts to ensure resilient fisheries and protected resources in the face of a changing climate.

⁵ <https://www.fisheries.noaa.gov/national/climate/noaa-fisheries-climate-science-strategy>



Word cloud of key terms identified from the analysis of public comments, scaled by frequency of occurrence.

I. Introduction and Document Overview

a. Introduction

On January 27, 2021, President Biden issued Executive Order 14008¹ “Tackling the Climate Crisis at Home and Abroad” that included a series of directives to the Executive Branch to advance the nation’s resilience to climate change. The Executive Order puts climate change at the center of U.S. domestic and foreign policy, highlighting “The United States will also move quickly to build resilience, both at home and abroad, against the impacts of climate change that are already manifest and will continue to intensify according to current trajectories.”

Section 216(c) of the Executive Order directs the Secretary of Commerce, through the Administrator of the National Oceanic and Atmospheric Administration (NOAA), to “collect input from fishermen, regional ocean councils, fishery management councils, scientists, and other stakeholders on how to make fisheries, including aquaculture, and protected resources more resilient to climate change.” This includes recommendations on changes in management and “conservation measures and improvements in science, monitoring, and cooperative research.”

In response to the Executive Order, NOAA launched a coordinated agency-wide effort to gather public input on how the agency can best achieve the objectives outlined in section 216(c). NOAA published a federal register notice² requesting public input and initiating a 30-day public comment period on March 2, 2021. Stakeholders were invited to submit comments via email to OceanResources.Climate@noaa.gov by April 2, 2021. In addition to collecting email comments, NOAA hosted three national stakeholder listening sessions during the public comment period — two were open to all stakeholders, and one was specifically for tribal and state governments. Special sessions were also held at meetings of the regional fishery management councils to gather input.

All public comments NOAA received during the comment period, as well as recordings and transcripts from the public hearings, were posted on a NOAA web page³. NOAA will continue to have ongoing discussions with management partners including the regional fishery management councils, interstate fishery commissions, and other managing partners.

¹ Executive Office of the President. 2021. Tackling the Climate Crisis at Home and Abroad. Presidential Document E.O. 14008 of Jan 27, 2021. [Available at <https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad>]

² NOAA. 2021. Recommendations for More Resilient Fisheries and Protected Resources Due to Climate Change. Notice 86 FR 12410. [Available at <https://www.federalregister.gov/documents/2021/03/03/2021-04137/recommendations-for-more-resilient-fisheries-and-protected-resources-due-to-climate-change>]

³ <https://www.fisheries.noaa.gov/feature-story/give-us-your-input-making-fisheries-and-protected-resources-more-resilient-climate>

b. Additional Relevant Executive Orders

There are other Executive Orders issued by the Biden Administration that are compatible with this effort. It is important to recognize that this data can be used for developing policy or guidelines for administration priorities for all efforts. These include:

- [EO 13985](#): Advancing Racial Equity and Support for Underserved Communities Through the Federal Government
- [EO 13990](#): Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis

c. Document Overview

This document is a synthesis of public comments received by NOAA in response to section 216(c) of Executive Order 14008 on “Tackling the Climate Crisis at Home and Abroad.⁴” The agency received a total of 231 comments from emails, stakeholder listening sessions, and fishery management council meetings. All responses have been analyzed using a qualitative data analysis process called content analysis, described below. This synthesis highlights the range of comments received in the public comments and is organized by the themes of those comments identified through systematic analysis. This synthesis should not be viewed as a complete analysis of all the views of NOAA’s constituents, only those that provided comments.

The majority of public comments were nationally focused, however some stakeholders conveyed important regional, tribal, and international considerations. These comments and recommendations are detailed in the appendices of this synthesis document.

NOAA received a number of comments on “30x30” in response to Section 216(a) of the Executive Order, which outlines President Biden’s national goal of conserving 30 percent of America’s lands and waters by 2030. All comments that focused on 30x30 goals were forwarded directly to the Department of the Interior who included them in the development of the America the Beautiful⁵ report. Many comments touched on both 216(a) and 216(c). These comments were included in the analysis if they discussed climate and other themes in section 216(c) of the Executive Order.

⁴ This analysis was conducted on all public comments received within the public comment period from March 2, 2021 to April 2, 2021. Additional comments received after the public comment period until May 1, 2021 were also included in the analysis.

⁵ DOI, USDA, NOAA, CEQ. 2021. Report to National Climate Task Force: Conserving and Restoring America the Beautiful. 24 p. [Available at <https://www.doi.gov/sites/doi.gov/files/report-conserving-and-restoring-america-the-beautiful-2021.pdf>]

II. Summary of Public Comment Responses

During the 30-day public comment period from March 2nd to April 2nd, 2021, NOAA received a total of 217 public comments from emails, three public hearing sessions, and regional fishery management council meetings. The month after the public comment period closed, 13 additional emails were received and included in this analysis. In total, NOAA received 231 comments in response to section 216(c) of the Executive Order, of which 219 comments were unique (i.e., 12 individuals spoke at a public hearing and also submitted an email comment). In total, the 231 public comments represent over 2,500 individual signatures, as some emails had multiple individuals associated with the comment. A summary of comments received by input avenue is detailed in Table 1.

Table 1. Public comments received by input avenue.

Input Type	Number of Comments
Total Emails Received	167
Public Hearing Comments	53
Fishery Management Council Meeting Notes and Letters	11

Three public hearings were held to gather stakeholder input during the public comment period. Table 2 outlines attendance, participation, and details of each of the three listening sessions.

Table 2. Public participation at national stakeholder listening sessions.

Date of public hearing	Hearing open to	Total number of attendees	Number of comments made
March 23, 2021	All stakeholders nationally	149	16
March 25, 2021	All tribes and states	104	7
April 1, 2021	All stakeholders nationally	179	30

Input on Section 216(c) was provided by a variety of individuals and organizations. Table 3 summarizes organizations that submitted comments.

Table 3. Stakeholder responses by organization type.

Organization Type	Number of Respondents from Organization Type
Non-profits, non-governmental organizations, and environmental advocacy groups	70
Unaffiliated individuals, individuals that did not specify affiliation, other	42
Commercial, recreational, and aquaculture fishing sector	35
State and tribal wildlife agencies	27
Academic and scientific groups	14
Fishing, trade, development, and community organizations	13
Federal agencies	11
Fishery management council meeting notes and letters	11
Private companies (ex: retailers, private consulting, technology companies)	8

Stakeholder comments included concerns and recommendations focused on science and management. Table 4 summarizes the primary focus of each public comment.

Table 4. Percentage of stakeholder comments by primary focus area.

Comment Focus Area	Percentage of Stakeholder Comments
Science and management	67%
Management	20%
Science	7%
Other	6%

Comments primarily focused on fisheries, protected resources, and aquaculture. Table 5 summarizes the percentage of comments by major focus area.

Table 5. Percentage of stakeholder comments by topic.

Comment Topic	Percentage of Stakeholder Comments
Fisheries and protected resources	47%
Fisheries	17%
Other or not specified	13%
Protected resources	10%
Aquaculture	10%
Aquaculture and fisheries	3%

Write-in Campaigns

NOAA received five write-in campaigns from Friends of the Earth, the Responsible Offshore Development Alliance (RODA), the Billfish Foundation, as well as write-in campaigns from individuals supporting actions to protect North Atlantic Right Whales, and recommendations on climate resilient fisheries from Alaska fishermen and fishing community members. A summary of write-in campaigns received during the public comment period is detailed in Table 6.

Table 6. Summary of write-in campaigns NOAA received during the public comment period.

Organization	Focus and Recommendations of Write-in Campaigns	Number of Submissions
Friends of the Earth	<ul style="list-style-type: none"> • Opposing industrial ocean finfish farming and highlighting the impacts to sustainable fisheries, fishing communities, and marine and coastal ecosystems (fish spills, disease risk, and economic impacts to wild fishing communities). • These risks oppose the Executive Order's mission to support resilient fisheries, fishing communities, and the marine and coastal ecosystems on which they rely. • NOAA should refrain from supporting industrial ocean finfish farming and focus on sustainable seafood production methods such as wild-capture fishing and certain regenerative, recirculating systems on land that do not carry the risks found in floating factory farms. 	24,784
Responsible Offshore Development Alliance (RODA)	<ul style="list-style-type: none"> • Regional fishery management councils are the appropriate venue for climate related changes in management. • Current management policies and practices are too inflexible to respond to changing ocean conditions. • NOAA Fisheries should increase cross-agency collaboration, expand and promote the health and environmental benefits of seafood, and expand fish and protected resource surveys. • Action on climate-resilient fisheries must acknowledge and address the contributions of land-based activities to the depletion of stocks. • Robust cumulative impacts assessments are needed, support for carbon sequestration and capture methods, ecosystem policies must balance human use and environmental protection. 	62
Billfish Foundation	<ul style="list-style-type: none"> • Implementing Marine Protected Areas (MPAs) that close out all fishing from 30% of U.S. waters would generate significant negative economic impacts to people, communities, and related businesses. • Greater thought and evaluation are needed of larger industrial actions that generate more negative impacts on the climate than does fishing. 	53
Alaska Fishermen and Fishing	<ul style="list-style-type: none"> • The process established to implement Executive Order 14008 should be driven by the people and communities who stand to be most heavily impacted by climate change. • Ocean-based solutions must be locally defined to support local livelihoods and ecosystems, 	41

Community Campaign	<p>and science-based solutions must incorporate traditional knowledge.</p> <ul style="list-style-type: none"> • Climate must be considered in all fisheries management decisions. • Magnuson-Stevens Act should be improved and reauthorized to ensure fisheries management is science based and uses the precautionary approach. • Carbon emission reductions are needed to achieve climate resilient fisheries. 	
Right Whale Protection Campaign	<ul style="list-style-type: none"> • Supporting actions to protect North Atlantic Right Whales: Restore the Northeast Canyons and Seamounts Marine National Monument. • Increase funding of research and technology to support wireless fishing gear and technology to prevent vessel strikes. • Reintroduce the SAVE the Right Whale Act. 	10

III. Qualitative Data Analysis Process

The qualitative data analysis of public comments involved three main phases: preparation, organization, and reporting. Public input from emails, transcripts from public hearings, and notes from regional fishery management council meetings were first compiled into a spreadsheet that served as a comment database to centrally record all stakeholder input and store the full text of correspondence. For each comment received, stakeholder information and organization type were recorded, as well as comment topic, region, focus of comment, specific recommendations, and high-level themes.

Following the data organization phase, all public comments were analyzed using the process of content analysis. Content analysis is a qualitative research method used to identify the relationships and themes in text data in order to provide a holistic description of a phenomenon (Miles et al., 2018). The objective of content analysis is to systematically and objectively distill large amounts of text into organized and concise summaries of key themes (Krippendorff, 2018). To achieve this, content analysis utilizes the process of coding, where passages of text are grouped and labeled to describe their meaning (Miles et al., 2018). To analyze stakeholder input, an inductive coding approach was employed, where codes are derived from the data. Utilizing an inductive approach, there are no preconceived notions of what the codes should be. Insights originate and are driven from themes that emerge from the raw data to prevent restricting or excluding any ideas (Fereday and Muir-Cochrane, 2006).

All coding was conducted using the NVivo qualitative data analysis software package (Version 1.4 (4)) which facilitates the systematic analysis and organization of qualitative data. Two cycles of coding were employed in the content analysis process. The first cycle of open coding involved reading and re-reading each public comment to identify broad themes and key points. Following the thematic coding cycle, the second cycle of coding involved creating sub-categories of themes derived from the initial coding categories. The second-cycle codes were generated through the process of sub-coding, where meta-codes are developed by grouping related codes. The content analysis process is iterative and includes additional rounds of coding to re-examine relationships between subcategories and further combine, rearrange, and organize codes (Schreier, 2012).

After the content analysis process was completed, the coding structure was used to construct a narrative that summarizes and describes themes of key needs, recommendations, and concerns that emerged from the review of the stakeholder comments. Quotes were pulled from the public comments and incorporated through the narrative that illustrate and represent major themes. Figures and tables were subsequently generated to quantify and summarize the presence of themes identified by stakeholders.

IV. Results: Summary of Public Comments by Theme

Twelve major themes and a variety of sub-themes were identified in public comments through the qualitative data analysis process. Each theme is described in the sections that follow. Major themes in order of frequency of codes are depicted in the figure below (Figure 1). The descriptions that follow are ordered differently for narrative purposes.

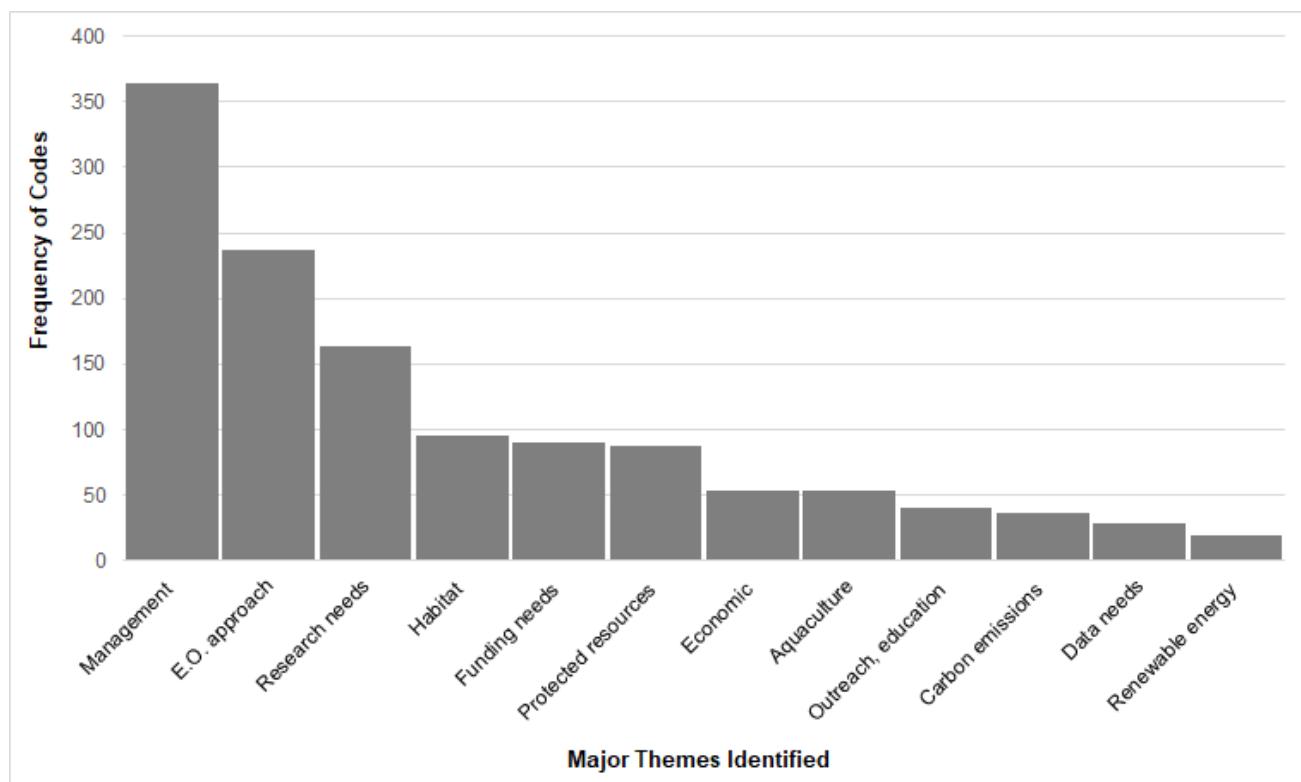


Figure 1. Frequency of codes to major themes in public comments identified in the qualitative data analysis of public input. The majority of comments and recommendations focused on management, Executive Order approach, and identified research needs. Each one of these themes associated with public comments are described in detail below.

1. Executive Order Approach

A predominant theme that emerged from analyzing the public comments was how to engage stakeholders in NOAA's approach and response to implementing Section 216(c) of the Executive Order. Most of the comments provided examples of the various stakeholders that should be engaged, and provided recommendations on how NOAA should engage with those stakeholders to implement Section 216(c) and improve resilience for fisheries, protected resources, and aquaculture moving forward.

a. Stakeholder Inclusion

Stakeholders called for NOAA to lead an inclusive process in efforts to make fisheries and protected resources more resilient to climate change. Comments articulated that coastal community members, recreational, commercial, and traditional fishers must be engaged and considered as partners in NOAA's efforts to implement measures that address climate. Stakeholders noted that ocean-based solutions must be locally-defined and crafted to support local livelihoods. Many comments recognized that the perspective and experience of these groups is invaluable, as they are on the front lines of climate change and know best how climate change is affecting local resources.

Rural communities, tribal communities, marginalized, underrepresented, and underserved communities, were highlighted as key stakeholder groups for NOAA to engage in climate efforts. Comments recognized that vulnerable and frontline communities who face disproportionate impacts from climate change must be included in planning efforts and management decisions. It was noted that in particular, the voices of rural and indigenous coastal community members need to be amplified and engaged early and often. Comments identified that ocean-based climate solutions that are informed by the knowledge of local and traditional users will increase the effectiveness of these solutions. Stakeholders encouraged NOAA to engage with Tribal governments and communities and explore ways to implement co-management programs that respect, uplift, and integrate Traditional Ecological Knowledges (TEKs) and incorporate traditional practices into adaptation planning and decision-making.

Many comments asked NOAA to consider states, non-profit organizations, and the scientific community as key partners and called to increase coordination between federal agencies to foster a “whole of government” approach in addressing climate issues, as called for in the Executive Order. Stakeholders encouraged the regional fishery management councils to play a key role in climate resiliency efforts. International coordination and collaboration were highlighted as imperative in NOAA’s work to address climate issues. Many of the ecosystems that NOAA manages cross state and international borders. These comments urged NOAA to adopt a “one-ocean” approach and operate across jurisdictions, disciplines, and agencies to better understand and predict how ocean conditions are changing and how species and communities are impacted by climate change.

b. Executive Order Implementation Process

Comments stressed that how the Executive Order and climate-ready management is implemented matters. In NOAA’s efforts to include diverse stakeholders in climate management approaches, public comments highlighted that genuine, meaningful, and iterative engagement must be sustained. Comments noted that all stakeholders must have meaningful access to the decision-

making process and managers must consider and account for diverse stakeholder needs. These processes should prioritize equity, inclusiveness, and transparency. Stakeholders noted that climate change unevenly impacts the communities that rely on ocean, coastal, riverine, and Great Lakes species and habitats, therefore environmental justice concerns must be embraced as an integral component of building resilience in a changing climate. Comments underscored that it is imperative that NOAA improves research and management frameworks to more efficiently and equitably address the dynamic impacts climate change is exerting on communities.

Specific recommendations to NOAA on Executive Order implementation include:

- *Open access and accessible data*: Developing and implementing policies to share information related to environmental impacts and resilience by promoting open-access and accessible research.
- *Diverse Council Membership*: Ensuring fishery management council membership includes diverse backgrounds including tribal representatives.
- *Commitment to social justice*: Ensuring policies affecting management enact a commitment to social justice and protecting public health while spurring economic growth.
- *Integrated problem solving*: Comments encouraged an integrated problem solving approach that emphasizes co-benefits, such as climate change strategies that support businesses, culture, habitat, and biodiversity simultaneously.
- *Act quickly and deliberately*: Comments on the Executive Order process urged NOAA to act quickly. These comments stressed that NOAA must be deliberate and avoid delay in efforts to incorporate climate into the management of fisheries, protected resources, and habitat.

2. Management for a Changing Climate

Recommendations, concerns, and thoughts on management for a changing climate were predominant themes in the analysis of stakeholder input. These comments focus on: the need for science-based decision-making, considerations for management processes, management tools, policy needs, governance recommendations, and recommendations related to the fishery management councils, the Magnuson–Stevens Fishery Conservation and Management Act, stock assessment considerations, and place-based conservation and protection of ocean areas.

a. Science-Based, Ecosystem Approaches to Decision-Making

“Our ability to adapt to and mitigate the worst of climate change will depend on the degree to which we understand what is happening in our waters.” - Leigh Habegger

Comments on management predominantly highlighted the need for a strong investment and prioritization of science and research to inform climate-related decisions. Many comments called for a better integration of climate science into fisheries management. These comments urged NOAA to strengthen and transform the science and knowledge enterprise to support implementation of climate-ready management. Stakeholders largely agreed that the best available science should underpin all management decisions and that climate considerations should be incorporated throughout the management process.

Overall, comments underscored that ocean-based climate solutions must be ecosystem-based. Many stakeholders acknowledged and appreciated NOAA Fisheries' efforts to transition from single-species management to Ecosystem-Based Fisheries Management (EBFM). These comments stressed that EBFM provides a framework for incorporating climate considerations into fishery management, aimed at achieving the EBFM Roadmap's ultimate goal of "maintaining resilient ecosystems." Comments encouraged and supported continued efforts to transition to EBFM and recognized that climate change is not a threat that fisheries face in isolation. Protecting ecosystem structure and functioning will be necessary for resilient fish stocks, healthy fisheries, and healthy ecosystems as a whole.

Ecosystem recommendations include: improving protections of forage fish and predator species, expanding the Integrated Ecosystem Assessment (IEA) program, and implementing management measures that promote sufficient abundance of habitat engineers and top predators so that they can fulfill their role in supporting ecosystem health. Comments also called for continued development of fishery ecosystem plans and expanded utilization of existing tools that evaluate tradeoffs of different management strategies as well as better assess vulnerability and risk.

The NOAA Fisheries Climate Science Strategy and the Regional Action Plans were pointed to as solid foundations for the science needed to support climate resiliency. Stakeholders recommended the Regional Action Plans should be updated within the next five years and that the process should provide information to managers and the public about what to expect and how to best prepare. Developing and implementing updated plans should be a collaborative effort between the councils, NOAA Fisheries, and stakeholders who bring essential on-the-water knowledge, values, and information into the process.

Comments identified the need for enhanced regional forecasting tools to provide early warning systems and predict events such as harmful algal blooms and heat waves. These forecasting tools should provide support for climate-informed management and build community resilience. Recommendations include developing a series of leading indicators that serve as an alarm for changing fish stocks and habitats in a region. The cross-NOAA Climate and Fisheries Initiative was supported in multiple comments as a necessary bridge within NOAA that will support a

variety of services to advance and inform climate-ready marine resource management. Comments recommended the initiative expand to include protected species and their habitats.

Multiple stakeholders highlighted that a critical aspect of building resilient fisheries and protected resources is improving our understanding of the linkages between terrestrial and marine ecosystems. These comments identified the need for research, policies, and management strategies that reflect how interconnected these biomes are and how climate change impacts the land-sea interface.

b. Climate-Informed Catch Limits

The majority of comments that referenced climate-informed catch limits encouraged federal fishery assessments and assessment updates to include comprehensive climate and ecosystem data as well as consider how stocks may be vulnerable to changing ocean conditions. Stock assessments should also offer recommendations for addressing climate change impacts on a fishery and identify any additional research needed to better understand them. In moving towards climate-informed stock assessments, many comments also called for improvements in ecosystem-linked assessments that include the impacts of climate on complex trophic relationships and fish habitat areas as a consideration for determining catch levels. This includes ensuring annual catch limits and bycatch limits are informed by the latest climate information.

Most comments stressed that effective monitoring, accounting, and enforcement through observer and electronic monitoring systems are critical to understand fisheries in a changing climate and to ensure catch is accounted towards the annual catch limits to prevent overfishing, and potential impacts on seabirds and marine mammals are monitored. Comments also focused on the need to rebuild overfished stocks, particularly of forage species.

Specific recommendations related to stock assessments include:

- *Life history:* Consider how life history characteristics of species interact with climate change uncertainty when implementing proactive strategies to buffer impacts and promote resilience of stocks and ecosystems.
- *Catch buffers:* Improve resilience of exploited fish species by limiting catch to buffer against climate impacts and prohibit new fisheries from developing without adequate analysis of the ecosystem impacts.
- *Climate-informed stock assessments:* Establish guidance on climate informed stock assessments and on setting catch limits for data limited and data poor stocks, enhancing coordination of councils on shifting stocks, and effective management of emerging fisheries.

- *Community Vulnerability Assessment*: Use Community Vulnerability Assessment (CVA) to prioritize stocks for Management Strategy Evaluations (MSEs) examining climate readiness or to receive research or management attention. CVAs could also identify vulnerable stocks, where a council and its Scientific and Statistical Committee (SSC) add precaution (e.g., buffers) to increase stock resilience.
- *Precautionary catch rules*: Implement precautionary catch rule policies that not only avoid overfishing, but also maintain diverse age and size-structure.
- *Rebuilding plans*: Now and in the future, rebuilding plans should aim to quickly rebuild populations to levels of higher abundance to reduce the likelihood of future collapse as managers ease fishing restrictions due to increases in population size.
- *Forage fish*: NOAA Fisheries should adopt standards consistent with growing scientific consensus that target populations of forage species should be set no lower than 75% of unfished biomass while the overfished threshold should be set correspondingly higher than traditional levels and no lower than the biomass level associated with Maximum Sustainable Yield (MSY).

c. Management Approach

Comments that focused on management approaches emphasized the need for NOAA to adopt adaptive, precautionary, flexible, and proactive approaches to management. Overall, comments noted that climate change will increase the pressure on management systems and affect every part of the management process. Stakeholders recommended that NOAA evaluate existing climate management linkages across the agency and streamline and coordinate decision-making processes to handle an expected increased workload resulting from climate and ocean change impacts. Comments additionally noted that given the large and varied impacts of climate change, NOAA should seek to enhance and expand cooperative management efforts, not only with existing partners, but also with members of the broader community that are involved in shoreside support infrastructure.

Flexibility in management was a recurring theme that emerged in many stakeholder comments. As one comment noted, “*Strategic investments and planning to increase flexibility can help prepare fisheries managers, fishers and coastal communities for more variability and declines in fisheries. Greater climate-related uncertainty and non-stationarity in complex ecological and social systems will impose fundamental limits on our predictive ability. As management proceeds into this uncertain future, it will be important to deploy decision frameworks and communication strategies that reflect these constraints and that can accommodate more conservative harvest regimes on some stocks.*” Proactive governance encompasses forward-looking management. Comments highlighted the need to manage ahead of the arrival of new species and enact regulations and plans before emerging species become a target. This includes anticipating

conflicts as species distributions change, proactively managing interactions that come with expanded ranges, and addressing ongoing or prospective transformation in a strategic manner.

Other comments on flexibility in management were largely focused on the need for flexible permit systems that are less restrictive in geographic, species, or effort-based dimensions. This would enable livelihood diversification for fishers and aquaculture harvesters in a changing environment as well as lessen the impacts of emergency closures or unanticipated shifts in species distributions. One comment focused on federal permit systems stated “*The limited-access, fishery-specific nature of most federal permitting schemes makes it expensive if not impossible for federally licensed fishermen to switch or diversify target species as the resource composition in their area changes. NOAA and the councils should devise measures to address this barrier, such as incidental catch permits, flexible permit structures, ecosystem-based management approaches, or financing or permit bank structures that facilitate the purchase of additional permits when needed.*”

These comments point to diversification as a key climate change adaptation strategy that can help to buffer against income variability caused by changes in environmental or socioeconomic conditions, increasing the capacity for resource harvesters to adapt. Additional comments on flexibility in management called for flexibility in the harvest control rule (HCR) and quota allocation which allows for changes in target species, areas, and times, including an optimal harvest policy that maximizes the long-term economic benefit of stocks.

Stakeholder comments highlight the importance of adaptive approaches in management that addresses climate. Comments noted that resource management is capable of continuous learning, accommodating uncertainty, and coping with rapid shifts in climatic, ecological, and socioeconomic conditions. Recommendations included assessing and improving capacity for adaptive management and implementing decision-making frameworks that enable rapid response to emerging issues through emergency actions and long-term planning processes that allow for proactive management. Other recommendations called for NOAA to review structures, agreements, and processes with state, territorial, tribal, and local governments, and councils to better address the dynamic nature of climate impacts and what information is used to form the basis of decisions to better incorporate risk and uncertainty. It was noted that management strategies that optimize fishery resilience vary from region to region and strategies such as open access fisheries, territorial user rights, and individual transferable quotas should be compared to better understand how managers may facilitate resilience under climate change.

While most comments on management stressed the need for climate to be integrated into every aspect of management, a few stakeholders noted that climate should not become the driving force of management. These comments urged NOAA to not become myopic in the focus on climate, which could blind the agency to the many other factors impacting fisheries, habitat, and protected resources. Additionally, multiple comments highlighted that fishing restrictions alone

cannot address climate change impacts, and NOAA Fisheries should not support fishery reductions without a transparent, independent, and verifiable scientific process.

Other recommendations on management approaches include:

- *Anticipate fishery migrations:* Anticipate and manage ahead of emerging fisheries when “exotic” species migrate to new regions where no management plan exists. Examples include adjustable reference points and catch allocation by fishery and/or gear type.
 - Many comments urged NOAA to adopt a policy that prohibits new fisheries until fishery managers have an adequate opportunity to assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem.
 - Address emerging quota and harvest challenges with respect to changing climate. Some stocks are shifting across council managed and jurisdictional lines. In these cases, there is a need for reallocation both by states, regions, and between sectors.
 - Better coordination between the Atlantic States Marine Fisheries Commission (ASMFC) and state fishery management agencies and their federal counterparts as fish migrate is needed.
- *Adaptive Management Plans:* Ensure that management plans for ocean areas take an adaptive management approach, as changing environmental conditions necessitate flexibility to assess and revisit decisions over time.
- *RAD framework:* Manage using Resist, Accept, or Direct (RAD) framework for ecosystem change to help managers make informed decisions and be better prepared for surprises. This encompasses: be deliberate, avoid delay, proceed intentionally, avoid paralysis, conduct experiments using pilot testing, consider multiple strategies, identify tipping points, and maintain management flexibility.
- *Engagement with Recreational Fishing Sector:* Establish a working group that engages recreational fishing stakeholders to improve recreational fishing management approaches and address climate change impacts and resiliency in the recreational fishing sector.

d. Management Tools and Plans

“Existing tools will not be enough. The agency should provide managers and scientists with more specific guidance on when and how to implement climate ready management and create clear mechanisms to use climate information and decisions even in situations where uncertainty exists. Climate information should be more fully integrated into key parts of management from science and statistical committee advice to fishery management plan decisions.”

-Meredith Moore, Director, Fish Conservation Program,

Ocean Conservancy

Public comments on management tools for climate-ready fisheries and protected resources emphasized that NOAA should continue to develop and expand management tools and

frameworks that incorporate climate information into management and prioritize informing managers and the public about what to expect and how to best prepare. Comments supported and promoted greater use of tools such as MSEs and risk assessments. Stakeholders noted there are a broad range of MSE applications, from ecosystem-scale to species-specific. The agency should issue technical guidance to promote effective use of MSE as part of the council decision-making process relevant to climate change.

Stakeholders recommended that NOAA Fisheries take a leadership role in facilitating climate scenario planning initiatives, ensuring all regions have access to this tool. Comments noted this approach allows regional stakeholders and managers an opportunity to envision future scenarios such as shifting stocks and unpredictable recruitment. Other stakeholders noted that the agency should consider promoting scenario planning as a tool that can create buy-in from stakeholders and foster a shared understanding of the challenges and opportunities for management action.

Stakeholder comments called for enhanced climate policy; specifically, policy that directs fisheries management to take into account environmental variability and uncertainty, changes and trends in climate and oceanographic conditions, and fluctuations in productivity for managed species and associated ecosystem components, such as habitats and non-managed species, and relationships between marine species. Additionally, policy guidance, regulation, and legislation to facilitate ocean acidification adaptation was highlighted by a number of stakeholders. These comments urged NOAA to publish guidance on ocean acidification for state, regional, and municipal bodies that oversee coastal and ocean management.

e. Recommendations to the Regional Fishery Management Councils

Many comments highlighted that the regional fishery management councils (RFMCs) are the appropriate venue to advance climate-ready fisheries management. Stakeholders overall support the existing public, collaborative RFMCs processes to address climate change impacts to, and conservation of, marine resources. A number of comments provided draft guidance for NOAA Fisheries to provide to the RFMCs. Overall, these comments noted that RFMCs need more technical guidance and decision-support tools to incorporate climate change science into fisheries management plans, stock assessments, and other research and scientific analysis. These comments urged the agency to continue to clarify the RFMCs' existing responsibilities and additional opportunities to include climate and ecosystem information in management measures as part of the conservation and management of fish stocks.

Comments called for more explicit instructions and guidance from NOAA Fisheries to councils on how to translate information from Fishery Ecosystem Plans (FEPs) and Climate Vulnerability Assessments into management action. Comments urged that all Fishery Management Plans (FMPs) should include an assessment of the impacts of climate change on each managed fishery,

and establish conservation and management measures that respond to those impacts in a planned manner. Guidance for RFMCs is needed on how to adapt FMPs to incorporate the impacts of climate change on managed fisheries and ecosystem components and to mitigate impacts to the extent possible. Comments noted that RFMCs could additionally benefit from increased use of FEPs and greater cross-region communication of best practices and lessons learned, particularly in addressing shifting stocks and effectively managing emerging fisheries.

Additionally, the need for proactive management in the council process was underscored by many comments. Stakeholders urged NOAA to increase the ability of RFMCs and other management bodies to be flexible, adaptive, and responsive to the needs of their particular region. These comments noted that proactive management will allow the governance process to anticipate challenges and respond flexibly and adaptively, enhancing outcomes for fisheries, stakeholders, and fishery dependent communities. Comments also suggested that NOAA prioritize closing the gap between data collection and management action in efforts to support the RFMCs in adaptive management.

The most frequent RFMC-specific recommendations included: requiring all FMPs to analyze the impacts of climate change; integrating information on climate impacts into the advice that Scientific and Statistical Committees provide to the RFMCs; developing guidance on climate-informed stock assessments; requiring measures in climate-impacted fisheries to promote resilience of fish populations; developing management frameworks that are more responsive to the effects of climate change (e.g., climate-informed harvest control rules); and promoting greater use of tools such as Management Strategy Evaluation (MSE), risk assessment, and scenario planning.

Comments received also included the following recommendations specific to the RFMC process:

- *Scientific and Statistical Committees (SSC)*: The agency should assess the climate expertise on SSCs and consider whether there are ways to support and develop additional climate expertise, for example through training or expanded membership. The agency could also consider reviewing the SSC Terms of Reference for each council to assess opportunities to include more explicit direction on the inclusion of climate and ecosystem information in SSC duties and objectives and provide guidance.
 - The SSC should consider climate vulnerability when making fishing level recommendations.
- *Governance related to Allocation and Council Voting Representation*: Sync state-by-state catch allocations with current distributions. Some regional management councils allocate fishery resources on a state-by-state basis using historical landings records that are decades old. This practice is problematic as species' distributions shift. States that depend

heavily on certain species should be fully represented on that species management council.

- NOAA Fisheries should work with the councils, within regions and nationally through the Council Coordination Committee, to identify and resolve governance restrictions that hinder inter-council decision making and result in constituents feeling disenfranchised.
- *EBFM*: Ensure regional fishery management councils implement ecosystem-based fisheries management plans where they do not already exist, and ensure those plans include precautionary approaches to managing forage fish, habitat protection and restoration, and incorporate climate change.
 - The Integrated Ecosystem Assessment (IEA) program should be prioritized to make EBFM actionable. NOAA Fisheries should support and continue to prioritize the work of the IEA programs and encourage close collaboration between IEA scientists and the RFMCs to link indicators to FEP goals and objectives.
- *Essential Fish Habitat*: Encourage the RFMCs to create regional plans related to climate-resilient Essential Fish Habitat.
- *Forage Fish*: Ensure that each council has a plan to protect unmanaged forage fish.
- *Management Strategy Evaluation*: The agency should issue technical guidance to promote effective use of MSE as part of the council decision-making process relevant to climate change.
- *Seafood traceability*: NOAA should also work with councils and the USDA to establish effective, workable seafood traceability requirements that incentivize bycatch reductions.
- *Tribal consultation*: Make the council process more accessible to tribal members by encouraging meaningful, timely, and consistent tribal consultation throughout the fishery management process.
- *Recreational fishing*: In absence of specific language recognizing the differences between recreational and commercial fishing, establish a working group that engages recreational fishing stakeholders to improve recreational fishing management approaches and forage fish conservation, and address climate change impacts and resiliency.
- *Climate emergencies*: Establish processes for councils to use emergency regulatory authority for emergencies that are attributable to climate change.
- *Total allowable catch study*: Commission an independent review of total allowable catch levels in the context of climate change.
- *Ecosystem Component (EC) designation*: NOAA Fisheries should clarify the use of the EC designation, including how measures intended to protect the ecosystem roles of such species may be implemented across jurisdictions and FMPs.

Maximum Sustainable Yield (MSY): NOAA Fisheries should re-evaluate guidance on MSY and associated catch levels to ensure councils can respond to current stock conditions that may be different from historic trends. In particular, the influence of the earliest years in a

time series used to estimate MSY should be critically evaluated if a stock shows signs of climate related change.

f. Magnuson–Stevens Fishery Conservation and Management Act

Many stakeholder comments underscored that the Magnuson–Stevens Fishery Conservation and Management Act (MSA) provides a strong foundation to build climate-ready fisheries and urged NOAA to maintain strong implementation of the science-based conservation requirements of the MSA. These comments highlighted that the MSA has enabled effective management for many fisheries, however climate change is threatening this success. Maintaining species abundance is critical in the face of climate impacts to recruitment, productivity, and distribution. Stakeholders recommended potential improvements and reauthorizations to establish standards, tools, and requirements to incorporate climate change into the fishery management process.

MSA recommendations include:

- *Tribal fishing opportunities and trust responsibility:* Direction and improvement in the MSA and the national standards regarding trust responsibility to native tribes as well as indigenous access to fishing opportunities is needed.
- *Habitat conservation programs:* NOAA should evaluate its current habitat conservation programs in light of the impacts of climate change to determine ways to ensure habitat conservation remains consistent with the goals and requirements of the MSA.
- *Rebuilding timelines:* Consider modifying MSA language to extend timelines for rebuilding overfished fisheries and ending overfishing by allowing councils to ease into rebuilding plans when possible, which can help reduce negative impacts to fishermen and fishing communities.
- *Seabirds:* Add seabirds to the definition of bycatch in MSA reauthorization.
- *Emergency regulatory authority:* NOAA should work with the councils to establish processes for using its emergency regulatory authority under MSA §305(c) during emergencies that are attributable to climate change. Often the speed at which acute climate-related events impact fisheries is too rapid for FMP amendments to be enacted or regulatory actions taken. The Secretary of Commerce should have the ability to enact emergency regulations or interim measures during a fishing season or fishery management cycle to prevent overfishing while maximizing access for fishery dependent communities.
- *Acceptable Biological Catch:* Modifying Acceptable Biological Catch (ABC) recommendation language in Sec. 302(h)(6) could help increase regulatory flexibility and remove over burdensome restrictions.

- *Science based, precautionary approach to fisheries management:* The MSA should be improved and reauthorized to ensure fisheries management is science based and uses the precautionary approach in all fisheries management decisions.
- *Voting authority for states:* The MSA should be amended so states can petition to have a voting authority for a particular species. Language would have to be added to the Act stating that for actions regarding a particular species, the Secretary of Commerce would have the authority to temporarily, for a period of five to ten years, add a state or states with an active fishery for a particular species to the council managing that species for decisions regarding management actions. The Secretary would add a state only after a request by the governor of a particular state and upon a successful review of yet to be determined qualification criteria, perhaps a combination of landings data and survey data demonstrating the distribution of the species.

Comments on National Standards and National Standard Guidelines:

- *National Standard 1:* Including more thorough identification and discussion of the ecological factors used in assessing and specifying maximum sustainable yield and optimum yield, including ecosystem relationships, would improve fishery managers' ability to understand the fishery and identify management needed to improve its resilience.
- *National Standard 2:* The agency should consult with stakeholders to develop and adopt policies that require federal fishery managers to buffer and account for the impacts of climate change in the development of all fishery management plans, as well as include conservation and management measures to mitigate those impacts.
- *National Standard 8:*
 - Should be strengthened to instruct councils to provide for the sustained participation of fishery dependent communities, within resource limits, rather than simply take into account the impacts of management decisions on these communities.
 - Should be updated to require councils to establish clear measures to assess and minimize any adverse economic impacts to fishing communities in FMPs while achieving conservation goals, and to adopt FMP amendments and take other regulatory actions that secure sustainable community participation in fisheries.
- *National Standard 9:*
 - NOAA Fisheries must use the data it has to set enforceable, precautionary bycatch caps that not only aim to rebuild them to a supposed MSY abundance level, but to an ecologically functional abundance level.
 - Should be updated to prioritize directed fisheries over bycatch. The agency should prioritize and promote traditional directed fisheries over bycatch uses, providing institutional support for consistent improvements to monitoring and reporting systems to better quantify bycatch and provide guidance to encourage councils to establish full retention requirements for species with high catch mortality rates.

g. Place Based Conservation and Protection of Ocean Areas

Comments that explicitly focused on the section of this Executive Order detailing the effort to protect 30% of land and 30% of water by 2030 (“30x30”), were not included in this analysis, however, many stakeholder comments addressed place-based conservation, and protection of ocean areas outside of 30x30 comments. These comments overall urged NOAA to pursue opportunities to designate new national marine sanctuaries, marine national monuments, and expand the marine protected area (MPA) network as a climate resilience tool. Support for these efforts is driven by needs to protect habitat, ensure the ocean has the chance to adapt in the face of climate pressure, and allow populations to recover.

Comments stressed that the designation, creation, and expansion of protections must consider local biodiversity, habitat, endemism, climate change, and other relevant local ecological and social factors. These processes must be science based and driven by stakeholders with a focus on working waterfronts and resilient fisheries and fishing communities. Comments noted that these areas should aim to provide the most strategic biodiversity protection and climate resilience through the complementarity of species and habitats in regional and national contexts. Many comments recognized that it is critical for NOAA to identify gaps in the marine protected area system and understand how filling those gaps will enhance climate resilience. These comments stressed that protection and conservation of protected areas requires extensive monitoring and baseline studies to quantify changes over time. Some comments called for a ban on fishing in marine protected areas, and others recommended that new marine protected areas focus on critical fish breeding habitat. Other recommendations called for the establishment of Restricted Federal Wildlife Zones for important off-shore areas for breeding, and nursery grounds for fish, invertebrates, birds, and/or mammals.

Stakeholders supported an Important Ecological Area approach to national or regional processes for MPA designation, including identification, protection, and monitoring. Other comments urged NOAA to increase protection of living seafloor habitats, such as sponges and corals, from the impacts of trawling. Some stakeholders called for static management, while others urged that adaptive management is critical for ocean health. While some comments pushed for no-take reserves to increase biomass in exploited areas, other comments favored dynamic ocean management approaches that change in response to the shifting nature of the ocean and its users based on the integration of new biological, oceanographic, social and/or economic data. These approaches were emphasized as being able to help meet conservation goals while also supporting multiple uses of ocean resources.

Opposing viewpoints countered that MPAs are not a sustainability panacea. These comments stated that static area-based management approaches are outdated and the science does not

support that these protections increase climate resilience in the marine environment. They argued that area-based conservation measures need to be put in place for specific defined purposes, and with clear license for scientists and managers to revisit them and change their parameters as appropriate over time. These comments stated that the marine ecosystems are dynamic environments, thus climate change effects on the ecosystem and the appropriate area-based measures and other responses must also vary over time. Other effective area-based conservation measures (OECMs) were additionally highlighted in multiple comments as an effective approach widely used by councils to achieve science-based conservation and management goals for sensitive species and habitats. These comments stressed that OECMs should serve as a model for future conservation action and existing OECMs should be carefully inventoried and evaluated and potentially implemented instead of protected areas.

3. Habitat Considerations

“Conserving essential fish habitat (EFH), Habitat Areas of Particular Concern (HAPCs) and designated ESA critical habitat including estuaries, seagrass, kelp, corals and mangroves, is an essential component of ensuring climate resilience for fisheries and protected species.”

-The Pew Charitable Trust

Public comments on habitat focused on sea level rise, water quality, considerations for salmon, Essential Fish Habitat, and considerations for conserving, protecting, and restoring habitat in order to make fisheries and protected resources more resilient to climate change.

a. Conserving, Protecting, and Restoring Habitat

Stakeholder comments called for NOAA to invest in restoration and protection of ocean and coastal habitats such as coral reefs, salt marshes, mangroves, estuaries, oyster reefs, wetlands, kelp forests, and seagrass beds. These habitats are crucial to support biodiversity and fisheries, sequester carbon, and are a critical component of protecting the nation’s coastal communities from more frequent and severe storm impacts and coastal flooding due to climate change. Recommendations included: prioritizing nature-based solutions and living shorelines, maintaining habitat connectivity, implementing market-based mechanisms that support the restoration and protection of coastal ecosystem biodiversity, and expanding research and monitoring efforts focused on climate impacts on habitat. Additionally, multiple stakeholders urged NOAA to address non-fishing impacts to habitat and hold the other sources of impacts to marine ecosystems equally accountable.

b. Sea Level Rise

A number of comments urged NOAA to support and expand efforts that seek to improve habitat resiliency to sea level rise. Comments stressed that NOAA should rely on the best-available

science for observed and projected sea-level rise at a regional scale to make the most scientifically informed decisions about the threats that sea-level rise poses to protected species and their habitats. Stakeholders urged NOAA to prioritize efforts that support nature-based solutions to address sea level rise and shoreline stabilization to protect coastal resources and infrastructure. Comments requested additional federal support for state and local pilot projects to demonstrate the efficacy of nature-based solutions and to help identify refinements in federal laws and policy to facilitate their siting and development.

c. Water Quality, Pollution, Algal Blooms

A number of stakeholder comments noted that pollution in many forms, such as noise pollution, derelict fishing gear, plastic pollution, chemical pollution, and nutrient pollution significantly degrade ocean health. Climate change will interact with and amplify the adverse impacts of contaminants on species and ecosystems. Comments recommended that NOAA increase coordinated monitoring, public education, and enforcement efforts around these different forms of pollution, and ensure remediation of impacts from contaminants. NOAA should prioritize water quality research and monitoring, and request renewed investments in wastewater, stormwater, and drinking water infrastructure to limit pollution impacts. Modeling of algal blooms was recommended to provide insight into which areas may be more prone to blooms and therefore need more resources to protect against the spread and impacts of blooms. Additionally, a number of comments called for increased efforts from NOAA to collect derelict fishing gear.

d. Essential Fish Habitat

Stakeholders commented on the critical role that NOAA plays in identifying Essential Fish Habitat (EFH). Comments recommended that NOAA work to advance the development and application of new habitat valuation approaches and associated policies to better ensure that federal actions not only avoid and minimize adverse impacts, but restore and conserve these places. Multiple comments noted that protecting and restoring EFH has helped to maintain productive fish stocks, but has focused on physical structures and static boundaries in the ocean. A changing climate will cause a shift in the variables used to determine EFH (e.g., prey distribution and abundance, salinity, temperature, etc.). These shifts should be taken into account and designated EFH should not be limited by geographic boundaries; instead, the EFH designation should be flexible to accommodate physical changes in the environment as a result of climate change.

Stakeholders recommended that Fishery Management Plans (FMPs) identify a range of potential actions that could be taken to address adverse effects of climate change on EFH, including an analysis of the practicability of adopting any new measures. Commenters also suggested that reviews of, or revisions to, FMPs of forage species should trigger EFH consultation with respect

to any EFH in which the forage species are a designated component of EFH. Comments noted that NOAA should use consultation authority not only to protect existing habitat, but also to enhance or expand habitat in the future to foster ecosystem resilience.

Multiple stakeholders pointed out the need for EFH to protect and restore habitat from non-fishing impacts. Stakeholders noted that many additional factors such as coastal development, pollution, mining, and dredging, shape marine ecosystems and impact habitat. Other comments encouraged RFMCs to create regional plans related to climate resilient EFH, enforce the regulation for RFMCs to update designations of EFH and Habitat Areas of Particular Concern (HAPCs) at least every 5 years, and put in place protections from fishing impacts for designated EFH, for example prohibitions on bottom trawling. These comments also encouraged RFMCs to exercise their full consultation authorities to protect EFH and HAPCs from non-fishing impacts.

Stakeholders expressed support for expanded definitions of “adverse impact” and “Habitat Areas of Particular Concern” to strengthen the councils’ roles in protecting fisheries habitat beyond their immediate jurisdiction, noting: *“to achieve the [Magnuson Stevens Fishery Conservation and Management Act (MSA)] conservation mandate and build resilience into fisheries, the Secretary must be vested with appropriate levels of consultative authority over fish habitat whether that habitat falls in State, federal or private lands or waters, and the authority to require mitigation of identified impacts.”*

One recommendation was for NOAA to conduct seascape-scale restoration plans that are multi-species in nature and provide for connectivity between areas. This would require approaches that focus on multiple ecosystem and economic benefits including fisheries productivity and coastal resilience. Multiple comments touched on the damage that trawling causes to the seafloor and called for the banning of trawls and drag nets due to bycatch and damage to the seafloor. Other comments called for more explicit focus on habitat in fisheries management. As one stakeholder noted, *“The US Federal Magnuson Stevens Fisheries [sic] [Conservation and] Management Act, for example, states that managers should ‘consider’ habitat in management strategies, far from a mandate.”* One recommendation was for NOAA to freeze the footprint of bottom trawling and identify and protect Important Ecological Areas within the trawl footprint based on priority habitat features such as rocky reefs, cold water and deep sea corals, sponges, or submarine canyons.

e. Habitat Considerations for Salmon

A number of public comments called for breaching the four lower Snake River dams in Washington to help ESA-listed (Endangered Species Act) salmon and the Southern Resident Killer Whale. These comments highlighted that the dams impede juvenile salmon migration out to the ocean and adult salmon migration returning from the ocean to their spawning grounds, causing fewer and fewer fish to return every year. Numerous stakeholders commented that

modifications to hydropower, habitat, fish harvest and hatcheries have not succeeded in restoring lower Snake River salmon and steelhead runs, nor have they stopped the decline of the populations.

Ecosystem connectivity was repeatedly highlighted as essential to achieving sustainability goals related to salmon populations. Stakeholders called for increased habitat for west coast salmon by restoring access to habitat areas that have been constrained by flood control and hydropower structures. These comments suggested creating functional, natural, mountain-to-ocean corridors that can be used by fish, and by people for recreation, aesthetic values, some agriculture or silviculture, and education. Additional habitat considerations include protecting and restoring spring chinook to headwater rivers dominated by groundwater recharge, identifying and protecting cold water refugia currently being used by fishes and other aquatic animals, and restoring access to cold water habitat by improving fish passage on small streams.

4. Protected Resources

“While climate effects will vary by species and ecosystem, actions to reduce harm and stress now will give protected marine life a better chance of survival in the face of climate threats, and for threatened and endangered populations, a better chance at recovery.”

-Oceana

Stakeholder comments related to protected resources covered a variety of topics. The most common topics included: recommendations related to marine mammals and sea turtles, salmon, and improved planning and policy actions for protected resources. Many of the recommendations on protected resources were region-specific and are listed in the appendix.

a. Marine Mammals and Sea Turtles

“In addition to increasing the biodiversity of an ecosystem, large whales, dolphins, and porpoises have a clearly proven support of ocean productivity and ultimately fishery abundance and health. Large migratory whales are crucial for nutrient transport across large swaths of ocean, and all cetaceans provide balance to ocean food webs, leading to healthier ocean ecosystems. In addition to the socio-ecological interactions, particularly in coastal communities, whales provide multiple benefits to human well-being such as primary production, nutrient cycling, recreation (ecotourism), education, and carbon sequestration.”

-Pacific Whale Foundation

Stakeholder comments highlighted that climate change is profoundly impacting marine species including North Atlantic right whales, Hawaiian monk seals, Southern Resident orcas, and sea turtles, among many others. Comments pointed out direct and indirect effects from increased

ocean temperatures, sea level rise, and acidification such as habitat loss, changes in food availability, changes in migration patterns, and increased susceptibility to disease. Comments urged NOAA to monitor and mitigate climate change impacts on protected species. These comments stressed that NOAA Fisheries has a legal mandate through the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA) to conserve these species from anthropogenic pressures so that they can adapt to changing ocean conditions. Recommendations include: considering cetacean health by integrating health monitoring of cetacean species in surveys, increasing observer coverage aboard fishing operations, and incorporating climate scenario planning into evaluations of marine mammal status.

Many stakeholders from across organizations directed NOAA Fisheries to use the best available science to prevent entanglements and vessel strikes by implementing dynamic closures that are adaptive to right whale movements, as the distribution and migratory patterns of this species shifts in time and space. Many comments encouraged NOAA to support the development of technologies such as ropeless fishing gear to prevent entanglements while sustaining fishing economies. One write-in campaign recommended the reintroduction of the SAVE the right whale Act. Other comments urged NOAA to expand or create mandatory vessel speed limits to protect large whales from vessel strikes. The Southern Resident Killer Whales were mentioned in many comments as being impacted by changing climate conditions and human population growth. Efforts to adapt approaches to species recovery, overhaul actions, speed up recovery timelines, and increase collaboration are necessary to protect this species.

Stakeholders recommended that NOAA should deny permits to new fossil fuel infrastructure projects such as those that export methanol to produce plastics, due to the harmful impacts to marine mammals. Additional comments urged NOAA Fisheries to explicitly incorporate climate change stochastic events and climate change into its Biological Opinions and associated Incidental Take Statements for ESA-listed species and incorporate adaptive management language into Biological Opinions. It was noted that climate vulnerability assessments should be expanded to include all marine mammal stocks.

Many comments noted that increasing the resilience of protected species such as sea turtles and marine mammals to climate change must involve implementing best fishery management practices. Multiple comments criticized the marine mammal stock assessment process for having missing, outdated and/or imprecise information regarding population abundance and trends. Comments noted that incorrect stock definitions for marine mammals result in misleading abundance estimates and inaccurate trend data that could result in populations experiencing a significant decline without detection. Additionally, outdated survey data is used for some marine mammal stock assessments, leaving many marine mammals without abundance estimates. It was also noted that a lack of potential biological removal levels (PBRs) for marine mammals hampers the agency's ability to comply with MMPA mandates. It was noted that a PBR approach

that accounts for stochastic events and climate change-induced mortality in the recovery factor when calculating PBR is necessary.

Comments on sea turtles focused on concerns about access to nesting habitats with increased coastal armoring structures, sea level rise, and expanding coastal development. Viewshed modeling was recommended to identify hotspot sources of light pollution that may impact turtle nesting. Additional comments recommended that NOAA should enforce all fisheries to use the best management practices to minimize turtle bycatch including Turtle Excluder Devices (TEDs) in all trawls that may catch sea turtles and are not yet required to use TEDs.

b. Salmon

Many comments identified that approaches to salmon resource management must be robust to the variety of future climate change scenarios for marine and freshwater ecosystems. State agencies called for increased funds to document salmon populations as well as drivers of population survival in order to forecast and mitigate future declines in salmon. Comments pointed out a need for stricter regulations for unpermitted takes of ESA listed salmonid species. Other recommendations include implementing alternative commercial fishing gear for selective harvest of hatchery-origin salmon, ensuring fish passage is adequate, reducing bycatch of salmon, safeguarding adequate estuary habitat for salmon, improving water quality, and prohibiting incompatible development to protect listed species.

Other comments requested NOAA follow recommendations in the Treaty Rights at Risk document for salmon, reduce water withdrawals from spawning tributaries of salmonids, support and contribute to fund stream incubation boxes for aid to the spawning of salmonids, eliminate ocean mixed stock fishery for chinook and coho, and safeguard the genetic diversity of wild Pacific salmon stocks. Other comments recommend that NOAA Fisheries designate or revise critical habitat for all marine species listed under the Endangered Species Act and protect those areas where populations have moved or are projected to move in response to climate change, including breeding and feeding areas. Comments recommended that NOAA Fisheries identify areas with high rates of listed species bycatch and prohibit use of the implicated gear in those areas at the times when bycatch occurs.

c. Improved Planning and Policy Actions for Threatened and Endangered Species

Comments directed NOAA to improve upon climate change planning and actions for Threatened and Endangered Species. These comments urged NOAA to fully utilize the Endangered Species Act to address the climate crisis. Multiple stakeholders noted that recovery plans are highly variable in their incorporation of climate change threats and typically do not include a discussion of how climate change affects or is projected to affect the species and its habitat. Additionally,

these recovery plans often lack actions for research and/or monitoring to better understand those threats, actions to eliminate or reduce the impacts of those threats on listed species, and other components that address climate change. Stakeholders urged for the development and expansion of existing policies, processes, and infrastructure to prioritize protection and improve resiliency of threatened and endangered species and called for enhanced guidance and support to other agencies to do so as well. Comments called for NOAA to support the rights of tribes to sufficient instream flows to support salmon and other treaty-protected fish.

Stakeholders emphasized taking a precautionary approach to promote healthy abundance levels of threatened species. It was also noted that as climate change causes species to shift their geographic range, it is crucial to protect suitable habitat outside of the species' current range that accommodates its shifting distribution and provides room for a recovering population. NOAA can ensure that listing analyses and determinations comprehensively consider the threats from sea-level rise and increasing storm surge. Other recommendations from comments related to sea level rise and threatened species included: conducting comprehensive, science-based assessments of sea-level rise threats in listing determinations for coastal species, designating critical habitat that protects upland areas needed for landward migration as the oceans rise, ensuring that recovery plans include actions to reduce sea-level rise threats, consultations include sea-level rise analyses for coastal projects, and that consultations on projects with major emissions sources provide mitigation benefits that directly reduce the threats of sea-level rise.

5. Aquaculture

“Supporting and leveraging aquaculture as a tool for climate policy has the potential to transform how we view and use our oceans and coasts.”

-Florida Department of Agriculture and Consumer Services

a. Aquaculture as a Climate Solution

Comments focused on aquaculture as a climate and seafood solution, the need for resilient aquaculture infrastructure, aquaculture as a diversification strategy for fishers, negative impacts of aquaculture, the role of marine aquaculture, and other aquaculture-related climate considerations.

Overall, public comments urged NOAA to keep aquaculture at the forefront of discussions on climate-resilient fisheries. Comments highlighted a need for U.S. aquaculture to serve as a model of sustainable management. This requires developing predictive tools to support adopting the same data driven, adaptive, and precautionary management approaches for aquaculture that exist for fisheries management. Recommendations included incentivizing states to prioritize lower-impact aquaculture such as shellfish and seaweed, increasing federal funding and support to equip state and municipal regulators to handle the volume of aquaculture applications, and

increasing permit opportunities for shellfish and seaweed aquaculture in more areas that are suitable for food growth, including federal waters.

Other comments urged NOAA to support and prioritize conservation-based aquaculture to aid in the restoration of coastal and marine ecosystems with the aim of enhancing climate resilience. These comments noted that lower-impact aquaculture such as marine bivalve and seaweed aquaculture in coastal and open ocean environments can help to meet seafood security while acting as a carbon sinks, increasing coastal water quality, helping to prevent eutrophication, reducing coastal erosion, and requiring no feed input, arable soil, or freshwater.

b. Aquaculture Needs

A number of growers from the North Pacific and Gulf of Maine highlighted impacts of phytoplankton blooms on aquacultured shellfish mortality. These comments stressed the need for research to understand how climate impacts harmful phytoplankton blooms that lead to mortality events, and the need for expanded funding to help businesses adapt and respond to climate-related stressors and emergency events that impact their businesses. Other comments urged NOAA to work with and continue engaging relevant stakeholders including the U.S. Department of Agriculture, state and tribal governments, other federal agencies, research institutions, and Sea Grant programs, nonprofits and private industry to incentivize, fund and support applications in aquaculture and to develop, and fund aquaculture education and training programs for both new and existing blue economy workers. As one stakeholder noted, *“there needs to be more intentional and sustained logistical and financial support from the federal government for aquaculturists as well as research and educational institutions, state and Tribal governments, non-profits and other entities.”* This includes continued work through the National Centers for Coastal Ocean Science (NCCOS) on coastal ocean siting and sustainability to better understand the potential synergies of co-locating green energy, such as offshore wind, with other ocean uses such as fisheries and aquaculture.

Other comments addressed hatchery needs. These comments relate to ocean acidification compromising juvenile shellfish survival, as larvae cannot develop hard shells. Recommendations include developing hatcheries using recirculating systems to increase survivability of juvenile shellfish. These cultured shellfish may be necessary to restore and rehabilitate wild stocks to prevent crashes from which it would likely take decades to recover. Comments also called for better introduction of juvenile finfish, particularly salmon, from hatcheries to wild water environments to increase survival rates. Hatchery supplementation will not be a “quick fix” for reduced abundances caused by climate change. However, it still plays a role to supplement wild populations and increase harvest opportunities.

c. Resilient Aquaculture Infrastructure

Other comments highlighted the need for climate-resilient aquaculture infrastructure. Many farms are located in coastal areas that are susceptible to coastal flooding, storm surge, and hurricanes. These events lead to loss of power, damaged property, displaced fish, and water contamination. Comments stressed the need for climate-ready aquaculture infrastructure that can support unpredictable weather conditions. One comment suggested development is needed to move aquaculture facilities underground to provide more stable conditions. Other comments identified that relative sea level rise for the region of interest should be considered when siting facilities. Comments noted that particular attention should be paid to supporting resilient aquaculture infrastructure in rural, low income, and historical working waterfront communities as well as communities that have been disproportionately impacted by climate change.

d. Oppositions to Aquaculture

Comments opposing aquaculture were primarily concerned with land-based aquaculture and large-scale commercial finfish aquaculture. Concerns with land-based aquaculture were related to carbon emissions produced by these facilities in addition to discharge and pollutants. Recommendations include adopting a zero effluent criteria for aquaculture facilities that want to use public water. Other comments urged NOAA to refrain from supporting land-based aquaculture systems that are not carbon neutral and to research the carbon emissions associated with these facilities. Additionally, comments recommended refraining from supporting siting efforts that rely on dilution and stressed that facilities must be fully enclosed with no effluent entering rivers, streams, estuaries, or bays. Comments were received suggesting that aquaculture operations should not be permitted where dam removals, fish ladder installations, and other restoration methods may have not yet taken place as the wild fishery must be the priority.

Comments opposing “industrial offshore finfish aquaculture,” which largely came from the Friends of the Earth write-in campaign (Table 6) outlined environmental and socio-economic concerns. These include: escapes, discharge of pollutants, potential harm to marine wildlife, animal welfare, public health concerns, and socio-economic impacts to communities as facilities could close off and privatize large swaths of the ocean that are currently available for numerous other commercial purposes, including fishing, tourism, shipping, and navigation. They noted that large populations of farmed fish also require input of fish feed, which could carry its own environmental, public health, and human rights concerns. This campaign urged NOAA to refrain from supporting offshore finfish aquaculture as a potential climate-friendly food solution and support wild-caught fisheries and other smaller-scale aquaculture operations.

6. Economic Considerations in Advancing Climate-Resilient Fisheries and Protected Resources

Stakeholders noted that climate change will transform economies. Many stakeholder comments identified economic considerations associated with making fisheries and protected resources more resilient to climate change. These comments focused on: economic threats associated with climate change, fisheries supply chains, jobs and coastal economies, promotion of U.S. seafood, and working waterfronts.

a. Fishery Supply Chains

“For recent lessons on resilience, we can look to the Covid-19 pandemic, which has profoundly impacted the U.S. seafood industry. Each and every fisherman, buyer, processor, and related business suffered different but serious impacts that will take a long time to fully understand and recover from. These impacts underline the importance of supply chain health as a component of resilience. It has also shown the key role that seafood plays in the U.S. food system: when beef, pork, and poultry processors shuttered because of the pandemic, we continued to provide a healthy, sustainable and low carbon protein for American families. This highlights the need for the supply chain to be able to adapt to changing composition in landings, due to climate change, in order to meet market demand with a potentially variable supply. NOAA Fisheries should closely coordinate with agencies that have jurisdiction over related topics to provide its expertise and support healthy fisheries.”

-Responsible Offshore Development Alliance (RODA)

A number of comments highlighted how the COVID-19 pandemic impacted the fishing industry around the country and exposed the vulnerabilities of the seafood supply chain. Many of these comments conveyed the resilience of the fishing industry overall, as fishermen and seafood dealers around the U.S. adapted quickly to distribute seafood products directly to consumers when restaurants shut down. The pandemic underscored that innovation, diversification, and access to local fisheries and working waterfront infrastructure are critical to the resilience of fishing communities to adapt in changing environmental and socioeconomic conditions. Comments flagged that as the climate changes and species become variable, the public and private sectors must work together to create conditions for fishing businesses to tap into diverse market channels. This includes a need to understand market challenges to integrating species into the supply chain, as well as barriers to diversification of production systems.

The need for a comprehensive economic assessment of the seafood supply chain to quantify the economic impacts of sustainable seafood harvest in the U.S. was underscored by multiple comments. Other recommendations pointed to improvement and enforcement of wild-harvest seafood traceability guidelines and monitoring of seafood imports. Many comments flagged the need to better understand the conservation and human rights implications of importing non-U.S.

seafood. Other comments expressed concern over the climate impacts of U.S.-caught seafood that is sold internationally for processing and then transported back to the U.S. for distribution and sale. Comments also urged that the United States should require that imported seafood is subject to the same level of management measures (e.g., gear requirements and monitoring) for protected species as U.S. fisheries.

b. Promotion of U.S. Seafood

“We need the chance to support the nation’s food security. We need better promotion of U.S. wild caught species. U.S. seafood is sustainable. It’s some of the best in the world. We need to look to ways to increase seafood demand.”

-Eric Brazer, Deputy Director of the Gulf of Mexico
Reef Fish Shareholders Alliance

Comments highlighted that sustainable fisheries and aquaculture are part of the climate solution. Stakeholders widely endorsed NOAA Fisheries’ efforts to promote the health and environmental benefits of U.S. seafood and the food security it provides. Comments called for increased marketing and promotion of domestic seafood including aquaculture products, and recommended NOAA expand relationships and opportunities with the U.S. Departments of Agriculture and Health to utilize their existing expertise and resources. Comments called for a need to understand the market challenges of integrating certain species into supply chains and the need for market promotion of lower demand species to reduce fishing pressure from other species with higher demand.

Small-scale, community-based fisheries were cited as critical to local food security, coastal community resilience, and local economies. Comments called on NOAA to invest in community-based fisheries, provide assistance and tools for modifying vessels to reduce climate impacts, and support the working waterfront infrastructure that is required to preserve and enhance the resilience of these small-scale fisheries that are foundational parts of sustaining communities. It was also highlighted that increasing climate variability disproportionately impacts small-scale fisheries, who are less mobile than large-scale industrial fleets. Recommendations called for NOAA to develop collaborative programs with USDA to support distributions of seafood purchased from small scale community-based fishermen and processors to meet regional food needs. Comments also urged NOAA to support the access and co-management of community-based fisheries to local resources and aid in the development of regional seafood distribution infrastructure.

A number of comments outlined the need to incorporate climate change mitigation strategies into seafood production. This requires research on the impacts of climate change from a social, economic, and institutional perspective. There is a need to address questions such as how range

shifts of economically-important species impact regional socioeconomics, particularly in fishing-dependent communities. Other needs include business adaptation and evolution support as fishing businesses operate in a rapidly changing environment.

c. Working Waterfronts and Coastal Economies

“Coastal fishing communities and working waterfronts are intricately linked to the marine ecosystem on which they rely, and thus play a critical role in fisheries management. They support a suite of community-based fishing related activities and sustain the intergenerational fishing culture that forms the economic and social fabric of the coastal United States. These fishing activities support industries and infrastructure, processors, chefs, restaurants, seafood retailers, as well as generate an economic multiplier effect when revenue stays within a community.”

-Alaska Longline Fishermen’s Association

Stakeholders underscored that advancing climate resilient fisheries is inseparable from supporting climate resilient fishing communities. A number of comments called for NOAA to prioritize investments in preserving and protecting working waterfront structures such as marina infrastructure, fish processing facilities, and other local infrastructure to freeze and preserve fish. These investments would increase resilience to variability in fishing seasons, create local jobs, and support recovery from COVID impacts that many fishing-dependent communities experienced.

Sea level rise has already and will continue to reduce property values, damage infrastructure, and increase investor risk exposure. Stakeholders noted that ocean-dependent businesses are continually losing ground to more high value uses like real estate. As climate change and sea level rise impact the frequency and intensity of storms, federal funding is needed to preserve working waterfronts and water-dependent businesses. This should include federal assistance to help states and municipalities develop regional strategies for community infrastructure needs. Assistance is also needed to provide sustainable alternatives and resources for ocean-dependent businesses that will be affected by climate change, such as recommendations on where best to move their practice, government assistance/grants available to make the change, and educational resources. Finally, comments urged NOAA to incentivize more public-private partnerships by further engaging the insurance, reinsurance, and health industries in efforts to collaborate to build the collective resilience of communities, natural resources, infrastructure, and economies.

7. Data Needs

“Improved fisheries information is fundamental to climate ready fisheries. Modernized fisheries information systems are well understood to be foundational to achieving the full potential of U.S.

fisheries in the face of climate change and in U.S. and global seafood markets. Expanding the accessibility and usability of appropriate information for managers, stakeholders and consumers alike provides numerous benefits.”

-Kingfisher Foundation

Stakeholder comments highlighted data needs that are critical for NOAA to address in efforts to make fisheries and protected resources more resilient to climate change. Themes include: data management and modernization systems, the need to develop, improve, and integrate data collection systems, expand the data workforce, and provide open-access, coordinated data collection.

a. Data Integration and Improvements

Climate change poses a significant challenge to the way data is collected and used. Climate-ready management requires increasing the production of climate information used in decision-making. State agencies noted that access to high quality fisheries, protected resource, and habitat data is critical for them to make time-dependent, science-informed management decisions. These stakeholders recommend the development and expansion of federally funded data platforms and servers that include data visualization and interpretation tools. They noted this would help alleviate the need to download and process large data sets, as some organizations do not have the processing capabilities and capacity to do so.

Stakeholders highlighted that data transparency and access is key for building broad, sustainable support for climate and ocean action. Greater emphasis should be placed on clear metadata and quality control measures, modernized data governance frameworks, an expanded information professional workforce, enhanced coordination of federal data portals, and increased funding for regional data portals. Investments in updated data collection systems and enhanced coordination and integration of data with other parts of NOAA and external partners is necessary to ensure that information is accessible and usable by marine related industries and the public.

Real-time, integrated data from fisheries reporting, monitoring, and science programs enables dynamic and adaptive fisheries management. Stakeholders noted that integrated spatial data on U.S. fishing activity can help inform transboundary allocations as stocks shift, informing fishing opportunities for commercial and recreational fishers. Comments noted that a key challenge is making data accessible and sharing it in more user-friendly ways, including to decision-makers in order to inform timely actions.

b. Data Modernization

Enhancing data collection and strengthening the agency's internal and external collaborative data efforts are a critical component of enhancing sustainable fisheries and healthy coastal and marine ecosystems in a changing climate. Regional modeling was flagged as essential to providing an array of services for stakeholders, including early warning capabilities for extreme events such as ocean heatwaves. This requires funding for existing and new coastal and marine monitoring and observation programs, enhanced research and modelling, and improved data distribution to help marine dependent industries, state and federal agencies, and local governments make decisions informed by accurate data. Stakeholders noted that NOAA has embarked on an agency-wide data management modernization effort that must continue at an accelerated pace.

Stakeholders noted that an initial report by NOAA Fisheries was released in 2020 to address concerns and opportunities related to data management and modernization raised by stakeholders. These comments recommend NOAA develop an implementation plan that includes a schedule and budget for implementation as well as a plan for stakeholder engagement for the development of user-centric systems, processes, and policies. They also encouraged collaboration with technology experts inside and outside of the government. Comments noted advancing data efforts may require building capacity to create and sustain partnerships with institutions who can serve as content experts and neutral repositories of data.

8. Research Needs

a. Cooperative Research

Many comments directed NOAA to expand investment in cooperative research efforts, noting specifically that cooperative research should become the cornerstone of stock assessment science and other research needs. Stakeholders noted that: "*cooperative research leverages fishermen's unique expertise of the natural environment and builds two-way information flow between fishermen and scientific researchers to generate the most robust and credible data possible.*" Comments highlighted that cooperative research builds trust between fishermen and scientists, bringing together the problem-solving ability of fishermen with the rigors of science to improve resource management and resilience. Research partnerships between the fishing industry and scientists improves communication, leading to better resource stewardship. Comments called for increased cooperative research opportunities with the recreational fishing sector.

Recommendations included: clearer mechanisms for data collected through cooperative research to feed into stock assessments, cooperative research efforts focused on climate change impacts on changing fisheries including bait fish, and the prioritization of fishery independent surveys and expanded use of study fleets and industry vessels for surveys. Finally, comments suggested

that environmental data collected on industry vessels through cooperative research is a potential approach to rapidly collect data to better understand changing ecosystem conditions.

Stakeholders noted that survey approaches that detect shifts and anticipate the future require robust monitoring efforts. This may mean expanding or supplementing the traditional survey to assess additional areas or species. The use of cooperative research provides a pathway to incorporate more community knowledge of observed changes into assessment planning in addition to supporting population monitoring to help address declining survey resources.

b. Monitoring and Accounting

“Comprehensive ecosystem monitoring programs are critically important for detecting ecosystem change.”

-State of New Jersey Department of Environmental Protection

Many comments highlighted that fisheries and protected resource resilience in the face of a changing climate will require enhanced ecosystem assessments and comprehensive monitoring of fisheries, protected resources, and oceans. Chemical, physical, and biological monitoring data are needed to inform habitat restoration and protection actions, as well as fish distribution models and forecasts. Expanded coordinated monitoring and early detection of changing ocean conditions, species migration, biotoxins, and invasive species were also highlighted by stakeholders as needs. Additionally, enhanced ocean acidification monitoring was flagged as a monitoring need by many stakeholders.

NOAA currently collects data on the biological, geological, oceanographic, chemical, and atmospheric conditions occurring in or affecting our ocean, and comments noted that gathering more observations and strengthening data integration capabilities will paint a clearer picture of how these systems function, as well as provide a baseline from which we can monitor changes and, eventually, predict threats. Expanding ocean observing infrastructure to leverage the potential of uncrewed systems, environmental DNA (eDNA), cloud computing, and other growing fields will also advance these goals. Efforts to improve observing infrastructure must also include measures to increase our understanding of marine biodiversity, abundance, and distribution.

c. Summary of Research Needs

Most public comments identified research needs that NOAA should prioritize in order to make fisheries and protected resources more resilient to climate change. These research needs spanned a variety of topics. The two most predominant research needs identified in public comments relate to understanding the impacts of climate change on fisheries, as well as how oceans and marine ecosystems are changing as climate changes. Table 7 summarizes specific research needs identified in public comments.

Table 7. Research needs identified in public comments.

Topic identified	Specific research needs called for in stakeholder comments
<u>Marine Renewable Energy</u>	<ul style="list-style-type: none"> ● Cumulative biological impacts of offshore wind. ● Research and monitoring to track short and long-term impacts of ocean-based renewable energy. ● How will the placement of offshore wind energy sites impact fishable areas?
<u>Bycatch</u>	<ul style="list-style-type: none"> ● Advancements for bycatch solutions. ● Assess the magnitude of bycatch and determine options for minimizing its impact. ● As species distributions change, how will bycatch encounter rates change? ● Will fish become more or less vulnerable or react differently to fishing gear based on their physiological stressors brought on by climate change? ● How will NOAA Fisheries strengthen the 2017 Standardized Bycatch Reporting Methodology guidance with clear standards for accuracy and precision to better ascertain bycatch information and ensure that the impacts of fishing are appropriately monitored, analyzed, and reported to stakeholders and managers?
<u>Changing Fisheries</u>	<ul style="list-style-type: none"> ● Understanding the dynamics of shifting stocks and subsequent impacts on fisheries management is needed to allow fishery science, management, and industry operations to adjust to shifting stocks. ● Research is needed into how climate change may impact the ranges of predators, invasive plant, fish, and invertebrate species, and pathogens that could impact our marine and freshwater aquatic fisheries resources ● How are bait fish changing? ● What are the climate drivers of fisheries productivity and the development of predictive models to determine where stocks may shift and how climate change will impact important vital rates of fish populations, particularly recruitment and survival? ● Understanding changes in species distribution, migrations, and assessing historical footprints of species. ● Complete more frequent biomass assessments for forage species to account for variability in biomass. ● The extent of larval connectivity between regions, and how that might be changing with climate change. ● Changes in ocean temperature and implications for spawning seasons of populations and migration patterns of Highly Migratory Species. ● How is climate change impacting economically important stocks and cross-boundary stocks? ● Research to advance robust ecological monitoring in all regions. ● More research is needed to evaluate if fisheries production is being influenced by environmental conditions, and if so, which conditions are driving the observed changes.

<u>Changing Ocean Conditions</u>	<ul style="list-style-type: none"> • Research and monitoring for relating atmospheric and oceanic circulation patterns to marine ecosystems and watershed processes to develop seasonal forecasts and longer-term viability assessments under a changing climate. • Evaluate which species or species complexes are most sensitive to environmental conditions. • Support of basic marine and climate change research in the Antarctic. • Tracking water chemistry, biotoxins, and invasive spread across domains to provide managers with real-time data for decision-making. • Ocean acidification (real-time monitoring and forecasting, biological indicators, mapping OA hot-spots, assessment of vulnerable species). • Cumulative impact analysis of activities impacting ocean ecosystems. • Climate effects on marine circulation patterns. • Modeling, monitoring, and predicting marine heat waves and ecosystem impacts. • Coral restoration and bleaching recovery. • Addressing human-caused nutrient pollution across watersheds contributing to reduced estuarine water quality.
<u>Greenhouse Gas Reduction</u>	<ul style="list-style-type: none"> • Characterize, inventory, and quantify carbon storage potential in various aquatic vegetation habitats. • What is the impact of commercial fishing and trawling on carbon emissions? • How can the carbon footprint of commercial fisheries be reduced? • Evaluate aquaculture operations' emissions, including the carbon footprint of the feed; also consider the operations' impact on mangroves, eelgrass, and other habitats that capture and sequester carbon.
<u>Habitat</u>	<ul style="list-style-type: none"> • Mapping and monitoring how changing climate conditions impact habitats. • Advancing research on non-fishing impacts to habitat. • Economic evaluation of dams and if removal is beneficial to recover lost spawning areas for salmon, smelt, and alewives. • Coastal habitats that have historically been flooded infrequently will become more connected to their estuaries. Will predation pressure on these species increase with increased connectivity? • How will essential fish habitat such as spawning, aggregation, and foraging structural features decrease fish community productivity and resilience with the effects of climate change? • Early detection and rapid response efforts for invasive species that may impact fisheries, as climate change and sea level rise will increase vulnerability of many areas to invasion. • Understand the extent of fishing gear-based habitat damage. • How to promote facilitated transitions of habitats as they move shoreward and inland as a result of sea level rise, and reduce or prevent physical barriers to up-slope migration.

	<ul style="list-style-type: none"> Effects of fragmentation of coastal habitat by past and ongoing anthropogenic habitat loss and degradation. Additional research is needed to inform further consideration of whether a transition from static to dynamic Marine Protected Areas (MPAs) would be a prudent management action to accommodate shifts in species distributions and allow the ecosystem to adapt over time. Analysis of closed-area benefits on protected areas. Will no-take MPAs redistribute and concentrate effort elsewhere/outside the MPA?
<u>Trophic Dynamics</u>	<ul style="list-style-type: none"> Research into how climate change may affect marine food webs. Identification of significant trophic interactions, and any subsequent changes in them as climate change progresses. Tracking and managing for spatial and temporal disjunctions among trophic assemblages, life history stages, etc. Climate impacts on lower trophic levels: More information is needed on how climate change will affect the quality and quantity of species at the base of the food chain (krill, forage fish, copepods, etc.). Changes in prey species abundance over time and space due to climate change. Understanding phytoplankton impacts on aquaculture. Better monitoring of the large zooplankton via ocean color satellites.
<u>Marine Mammals and Sea Turtles</u>	<ul style="list-style-type: none"> Supporting research into how the health and condition of marine mammals change in response to changes in their ocean ecosystems. How climate change-driven marine mammal redistribution will interact with human activities, especially fisheries, vessel traffic, and ocean development. Research is needed to understand impacts to incubating sea turtle nests from wetter and warmer beaches (i.e., hatch success, temperature dependent sex determination, shifts in nesting season). This research could be completed cooperatively by the FWC, USFWS, NOAA, USGS, FDEP, EPA, local universities, local municipalities, non-profit organizations, and/or other partner agencies and groups.
<u>Social and Economic Considerations</u>	<ul style="list-style-type: none"> Economic analyses of impacts of changing fisheries on coastal communities (including tribal and rural communities). Studies to better understand the seafood supply chain, particularly under pressure/stress points such as COVID-19. How can species be better integrated into the supply chain? Understanding vulnerability, adaptation approaches, and capacity of fishers to respond to changing oceans. Socio-economic effects of ocean acidification.

9. Reductions in Anthropogenic Carbon Emissions

“Fundamentally, carbon emissions reductions are needed to achieve the goal of climate resilient fisheries by slowing the trajectory of ocean acidification, marine heatwaves, coastal erosion and lower oxygen levels in the ocean.”

-Alaska fishing community write-in campaign

Many stakeholders urged NOAA to communicate that the mitigation of carbon and other greenhouse gas emissions is the primary means of increasing resilience of fisheries and marine ecosystems. These comments noted that even under reduced emission scenarios, we can expect to see and are already seeing significant changes in marine systems such as loss of Arctic sea ice, ocean warming, marine heatwaves, and ocean acidification. Adaptation efforts for the ocean and coasts will only be effective and have long-term success if they are carried out alongside comprehensive, rapid mitigation and reduction of greenhouse gas emissions. Comments urged NOAA to prioritize initiatives and legislation both nationally and internationally that reduce greenhouse gas emissions and support a rapid national exit from fossil fuel use. NOAA can work to monitor and reduce emissions from agency actions, reduce emissions from ocean-based transport, support sustainable businesses, and support new technologies to make shipping more efficient.

a. Carbon Footprint of Commercial Fishing

There were conflicting stakeholder comments about the emissions associated with commercial fishing. Some noted that bottom trawling releases more emissions than other fishing operations by releasing stored carbon through disturbing the seabed. Many noted that fishing overall has a lower carbon footprint compared to other food production activities like terrestrial agriculture. These comments noted that the climate “cost” of U.S. harvested seafood is extremely low and much lower in comparison to imported seafood. It was also noted that depleted coastal fisheries force vessels to travel farther to catch the same number of fish, expanding the carbon footprint of fisheries. Some comments identified that the Magnuson-Stevens Fishery Conservation and Management Act does not have any language that addresses the carbon footprint of fishing vessels. Comments agreed that more research is needed to understand the carbon footprint of fishing vessels and aid is needed to make any transitions to more sustainable technologies that increase energy efficiency and reduce emissions, particularly in smaller-scale, community-based fisheries.

b. Carbon Sequestration

In addition to comments focused on emission reduction, many comments highlighted the need for NOAA to support efforts that sustain the natural ability of ecosystems to cycle, sequester, and store carbon. Numerous comments specified the need to preserve, restore, and protect coastal and

marine habitats that sequester and store carbon, such as mangroves, kelp forests, and salt marshes. These comments called for increased policy that promotes ocean and coastal ecosystems as carbon sinks. Recommendations included mapping and inventorying blue carbon ecosystems in the United States and developing criteria for coastal carbon areas of significance that sequester carbon and also provide valuable ecosystem services such as storm and flood protection.

Other recommendations encouraged NOAA to consult on federal projects that will produce large amounts of greenhouse gas emissions that contribute to sea-level rise, with the goal of implementing reasonable and prudent mitigation measures to lower the project's greenhouse gas emissions and ultimate sea-level rise impacts on coastal species. One stakeholder recommended setting global and national targets to protect and restore carbon dense ecosystems, such as peat, sea grasses, and other wetlands to sequester carbon, prevent greenhouse gas emissions, and reduce the impacts of climate change.

10. Ocean-Based Renewable Energy

"A rapid transition towards energy sources and other products and services that do not release greenhouse gases, and research and policies that favor an efficient transition to a low carbon world is required to slow the degradation of aquatic systems."

-Dr. Scott Bonar

a. Concerns with Marine Renewable Energy Development

Overall, stakeholder comments supported the development of ocean-based renewable energy as a climate solution that provides clean and renewable energy while providing jobs. With the expansion and development of ocean-based renewable energy technologies, a number of concerns were raised about avoiding, minimizing, and mitigating adverse impacts on habitats from wind development. Members of the commercial fishing sector expressed their concern that fast-paced construction timelines of offshore wind development may impede fishery conservation efforts. Recommendations included establishing robust science and monitoring programs prior to construction of these sites, in addition to long-term, continuous monitoring to understand the impacts of these technologies on ocean habitat. Multiple stakeholders noted that modeling of shifting stocks and projected conditions should be a prerequisite for offshore energy development and that NOAA Fisheries should be consulted to ensure that these development activities do not adversely affect Essential Fish Habitats and avoid important ecological areas or ESA-listed species.

Other comments from the fishing industry concerned the extent of un-fishable area resulting from wind energy development and how this reduction in fishable area may impact their livelihood. Some noted that this unfishable area should be considered a protected area. Other

comments highlighted the potential of offshore wind sites as a platform to increase monitoring of ocean changes and as early detection systems for weather emergencies and navigational hazards. A number of comments called for federal funding to spur innovation, commercialization, and deployment of ocean-based clean energy technologies and provide critical research on the impacts of these technologies on ocean systems.

11. Outreach, Education, Training, Communication

Comments related to outreach, education, training, and communication focused on the need for public education and increasing ocean literacy, communication and outreach strategies, consumer education related to fisheries and aquaculture, and job training programs.

a. Increasing Ocean Literacy

“Public awareness of how the changing climate will affect fisheries and protected resources is essential to building support for measures that can increase resilience. Deepening and broadening this awareness will depend on more of the consistent leadership that NOAA has shown in creating and disseminating accessible information for diverse audiences.”

-State of Washington Department of Fish and Wildlife

Many comments noted that educating the public on how climate change is impacting oceans is critical. Recommendations urged NOAA to develop strong outreach and education programs to promote stakeholders' engagement in addressing the challenges the nation faces in marine conservation and changing ocean ecosystems. These comments highlighted that information should be presented in a way that is accessible to a variety of audiences, including youth. Comments addressed an important role NOAA can play in informing K-12 curricula that engages children in understanding climate impacts on the ocean. Recommendations included encouraging NOAA's Office of Education and Office for Coastal Management to strengthen and elevate NERRS programs that help citizens of all ages build their environmental literacy and take actions that make their communities and natural resources more resilient as the climate changes. Overall, increasing ocean literacy with a focus on climate was stressed as a necessity and priority recommendation to the agency.

b. Enhancing Consumer Education Related to Fisheries and Aquaculture

“As the mix of species in local waters changes, so too must the mix of species on local dinner tables. In many locales, customers enjoy experiencing local traditions by eating seafood. However, climate change means that traditional species are being replaced by emerging species in ever-greater measure. Consumer education can play a vital role in helping local seafood supply chains adapt to the new mix of available species. For example, in Rhode Island, this can

mean educating lobster lovers about how to enjoy Jonah crab, or educating restaurants about how to utilize scup.”

-Rhode Island Commercial Fishing Industry Letter

Many comments focused on the need to educate consumers about the benefits of eating seafood caught in the U.S. Other comments noted that climate change will continue to impact the seasonal availability of seafood in many regions around the country and consumers play a critical role in ensuring the demand for what is being caught. Recommendations included leveraging NOAA’s Saltonstall-Kennedy program, Fish Watch program, and other market-related activities and investments to embed climate resilience into consumer awareness.

c. Job Training Programs

“The future of U.S. wild-capture seafood providers is in the balance, due to a number of exogenous factors, of which climate change is only one. We must ensure that successors exist for our harvesters and shoreside businesses and that younger generations have the opportunity to build their careers in the same fulfilling line of work that we have. This requires certainty in our ability to make business plans beyond the short term. We must facilitate a viable and secure future for our seafood providers.”

-Responsible Offshore Development Alliance (RODA)

A number of references to job training programs were noted in public comments. These comments highlighted the need to cultivate and mentor the next generation of seafood harvesters and build the nation’s seafood workforce in the U.S. These comments noted that climate change, among many other challenges facing the commercial fishing industry, are adding to the uncertainty about the future of the industry. This uncertainty was described as a barrier preventing youth from engaging in the commercial fishing sector. Recommendations include expanding efforts that help young people enter the fishing sector, such as finance opportunities, apprenticeship programs, and vocational training opportunities to build a skilled and resilient workforce and provide a platform where young people can develop and build necessary skills and learn from older generations.

As climate change displaces people from fisheries, stakeholders noted that job training should be available to support and educate those who are entering new fisheries due to socioeconomic and environmental stressors. Many comments noted that these education opportunities should expand on existing aquaculture training programs to cross-train fishers and members of other ocean-related sectors in aquaculture as a diversification strategy and alternate economic opportunity. Other training program comments recommended that NOAA increase resources and technical training on climate science for resource managers. Such training would need to occur at all levels of government, including federal and state ocean and coastal managers, regional fishery council

members, tribal governments, interstate fisheries commissions, and members of international management bodies.

d. Communication and Outreach Strategies

“We currently suffer from being data rich, but information poor when it comes to developing information products for diverse constituents.”

-Dr. David D. Dow

Many comments related to communication and outreach called for stronger engagement and science communication efforts from NOAA with a variety of stakeholder groups in the context of fisheries, protected resources, and climate change. These comments highlighted a need for increased communication between government agencies, industry, commercial and recreational fishing sectors, academia, non-profits, and tribal governments. Other comments called on NOAA to be a leader in enlisting the cooperation of stakeholders such as hunters, birders, environmentalists, and divers. Comments noted that engaging stakeholders in research and outreach broadens support for conservation. Multiple comments noted that engagement of stakeholders around climate issues must occur at the local scale and show local benefits of conservation.

Stakeholder comments directed NOAA to prioritize marginalized and underrepresented groups in all of their education initiatives agency-wide, including expanding and sustaining programs for undergraduates, graduates and faculty at Historically Black Colleges and Universities (HBCUs) and other minority-serving institutions. This includes developing new internship, research fellowship, and scholarship programs specifically for students from traditionally marginalized, minority, and underrepresented communities.

12. Funding Needs and Considerations

The majority of public comments that identified funding needs called for increased funding for NOAA programs as well as funding for state and regional partners to support efforts focused on understanding and predicting ocean changes and climate impacts on fisheries, aquaculture, protected resources, marine habitats, and ecosystems. A list of funding needs identified in the public comments is detailed below (Table 8). Funding needs are separated by comments specific to NOAA grants, comments on scientific surveys, and funding for fisheries and aquaculture.

Comments urged NOAA to examine how grant funding mechanisms can better contribute to long-term sustainability and community resilience in a climate and environmental justice context. Recommendations include: 1) allow more flexibility in what is considered a grant deliverable (e.g., building a new community partnership); 2) have longer time frames to allow organizations to build partnerships and execute research within communities; 3) allow more

creativity in what is considered relevant past experience or qualifications for carrying out research (e.g., community organizing, working with religious institutions); 4) require active and intentional partnership building within communities impacted by climate change and environmental injustice in order to carry out research; and 5) explicitly address equity and inclusion for marginalized and underrepresented groups in grants.

Table 8. Funding needs identified in the public comments.

Topic identified	Specific funding needs called for in stakeholder comments
a. <u>NOAA Grant Considerations</u>	<ul style="list-style-type: none">● Expansion of NOAA’s Office for Coastal Management to address climate-related challenges facing state coastal resources and users.● Support NOAA’s Community-based Restoration Program, the Coastal and Marine Habitat Restoration Grants, the NOAA Coastal Resilience Fund, Coastal Zone Management Programs, Regional Habitat Restoration Partnership Grants, and NOAA’s other coastal and marine habitat research, protection, and restoration programs within the National Ocean Service and NMFS’s Restoration Center.● Expand the National Estuarine Research Reserve (NERR) system to all bioregions: a vital resource for local communities, providing good jobs, critical funding of science in the natural resources space, and co-benefits to coastal and inland residents.● Increase funding in the annual President’s budget for the NERRS Operations, Research, and Facilities (ORF) budget (NOAA’s National Ocean Service section). This will allow Reserves to expand their capacity to make coastal natural resources more resilient to climate change by enhancing NERRS work in conservation, monitoring, and collaborative science.● NOAA’s Saltonstall-Kennedy (S-K) Program: increase total amount of funds available annually, increase the per-project cap, allow projects to be 3-4 years in duration, set aside distinct pool of funding for rapid deployment research projects that respond to unforeseen environmental events such as marine heat waves.● Increased funding for and access to the NOAA Fisheries Finance Program (FFP).● Review and revise the steep requirements (often 1:1 federal-state cost share) for habitat restoration, nature-based infrastructure and shoreline resiliency projects.● Increased funding to support climate change research within NOAA Fisheries.● NOAA Fisheries should increase the staff dedicated to climate issues.● Prioritize funding to implement management actions to address pinniped predation and expand fisheries and marine mammal research to inform state and federal management.

b.
Scientific
Surveys

- Increase budget for NOAA Fisheries Science Centers to provide the core fishery and ecosystem research, surveys, and stock assessments needed to support climate-informed fisheries management.
- NOAA Fisheries should ensure compatibility of its surveys to ensure changes in stock distribution can be observed and detected.
- The Administration should invest in NOAA Fisheries' research survey capacity, expand in-water monitoring, and ensure consistency in surveys across regions. Increasing investments in surveys will maintain the production of high-quality data on fish abundance and drive improvements in survey efficiency and methodology.
- Expand funding opportunities for partners. State agencies and regional partners conduct economically and ecologically needed climate and ocean change research – much of which relies on federal funding from NOAA to supplement limited resources.
- As fisheries move poleward and into deeper water, NOAA Fisheries should expand in-water monitoring and revitalize its survey capabilities.
- Prioritize fishery independent surveys. Consider new ways to obtain data; enhanced with new technologies and expanded cooperative research programs. Species with high coefficients of variation would potentially benefit from additional sampling efforts. Careful consideration should be given to determining the amounts and types of additional sampling that would most efficiently reduce such variation.
- Species that occupy structured habitats that are not sampled well would benefit from additional effort using gear types (e.g., gillnets, longlines) capable of sampling within them.
- Integrate health monitoring of cetacean species and increasing observer coverage aboard fishing operations would help support fisheries resilience by integrating cetacean health and abundance in management practices.

c.
Fisheries and
Aquaculture

- NOAA funding that can be used on a discretionary basis to assist small fisheries and aquaculture businesses investigate production crises related to climate change.
- Assist the fishing industry by supporting investments in new aquaculture techniques and practices focused on climate resiliency.
- NOAA Fisheries should complete the work of the Marine Recreational Information Program's (MRIP) Rare Event estimation group and implement changes to improve estimation of rare event species and resolve regional differences in calculating recreational statistics.
- NOAA should increase its support for aquaculture education, research, technology development, business innovation, and community engagement.
- Support funding initiatives to research more sustainable and effective fishing and aquaculture equipment, including gear and other supplies such as feed.
- Provide funding support to help fishing enterprises transition their equipment to more sustainable alternatives.
- Expanded access to advanced GPS, VMS, and AIS technology for fishermen provide more accurate data on where fishing is occurring, in turn providing valuable information for responding to changing conditions.

V. Discussion

Public comments received by NOAA in response to section 216(c) of Executive Order 14008 on “Tackling the Climate Crisis at Home and Abroad” include a range of ideas, opinions, and recommendations on how the agency can advance climate-ready fisheries, aquaculture, and protected resources in the face of a changing climate. Stakeholders emphasized how rapidly changing oceans have profound implications for marine ecosystems, the sustainability of fisheries, and the resiliency of coastal communities. Comments touched on a variety of themes such as management considerations as well as recommendations for advancing climate resilience for habitats, protected resources, aquaculture, economies, and local communities.

Stakeholders universally emphasized that NOAA must lead collaborative, equitable, inclusive, and transparent efforts to make fisheries and protected resources more resilient to climate change. Comments underscored that in an environment of unpredictable change in marine ecosystems, long-term, robust ecological monitoring must be put in place in all regions. Additionally, climate-informed science must underpin management approaches that are ecosystem-based, proactive, and informed by the knowledge of local and traditional users. Finally, there were a number of comments or suggestions on programs or issues that NOAA is currently undertaking which shows a great synergy between NOAA and our constituency.

The input provided in public comments will inform NOAA’s work with federal agencies, state and tribal governments, and relevant stakeholders and constituents to ensure more resilient fisheries and protected resources due to climate change. NOAA will continue to engage in ongoing discussions with management partners including the regional fishery management councils, interstate fishery commissions, and other managing partners. NOAA Fisheries will use the input received to inform rulemaking, policy, and notably the next series of Regional Action Plans under the NOAA Fisheries Climate Science Strategy. The National Ocean Service (NOS) will assess and predict climate change impacts on marine protected areas and implement strategies to mitigate and adapt to these impacts.

Addressing many of the recommendations will be an ongoing effort. Some recommendations may require building and advancing partnerships to achieve and others may take years to develop, and many of the recommendations will require additional funding for NOAA to implement. Importantly, all of the public comments received will serve as a starting point for additional public input and continued engagement with stakeholders to inform NOAA’s efforts to ensure resilient fisheries and protected resources in the face of a changing climate.

VI. Literature Cited

- Fereday, J., and E. Muir-Cochrane. 2006. Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *Int. J. Qual. Methods* 5(1):80-92. <https://doi.org/10.1177/160940690600500107>
- Krippendorff, K. 2018. Content analysis: An introduction to its methodology. 4th edition. 472 p. SAGE Publications, Inc.
- Miles, M., M. Huberman, and J. Saldaña. 2018. Qualitative data analysis: A methods sourcebook. 4th edition. 408 p. SAGE Publications, Inc.
- Schreier, M. 2012. Qualitative content analysis in practice. 280 p. Sage Publications Ltd.

Appendix A: Region-Specific Recommendations Received

Alaska

- *Relationship between rural and tribal communities and the North Pacific Fishery Management Council:* Multiple comments noted that rural and tribal communities have a poor relationship with the North Pacific Fishery Management Council. These stakeholders stated that the council process does not allow for good public engagement. As one comment noted, “*a lot of the system is virtually inaccessible to our tribal fishermen, to our rural community members that livelihoods and cultures are inextricably hived to fishing and fishery resources.*” As one stakeholder noted, “*Council members tell us that tribal consultation is a mandate of our National Fishery Service and not the council itself and thus we have a disjointed process whereby actions are taken, policies are made, management decisions are finalized without inclusion of any results that come from tribal consultation without tribal consultation being initiated. And this really highlights the brokenness of the system that we are operating in. I think that if we are to continue to benefit economically from Alaska’s bountiful fishery resources, we must first fix the very broken institutional processes that govern those resources.*”

Recommendations include:

- Add dedicated Tribal voting seats on the North Pacific Fishery Management council.
- Provide clear direction and improvement for the Magnuson-Stevens Act national standards around the trust responsibility to Alaskan native tribes.
- Make council process more accessible to tribal members by encouraging meaningful, timely, and consistent tribal consultation throughout the fishery management process.
- Improve meaningful efforts to collaborate and partner with Indigenous people of the northern Bering Sea.
- *Support for Council’s climate resiliency efforts:* NOAA should continue to support the North Pacific Council’s proactive efforts to incorporate climate resiliency into the conservation and management process and provide consistent funding and support for the multiple fisheries and ecosystem surveys that form the fundamental basis of fisheries management in the North Pacific.
- *Bycatch in the North Pacific:* There are increased interactions with bycatch in large-scale trawl fisheries and it is critical to increase our understanding of the role of climate change and impacts to the bycaught species. The impacts to these bycaught species must be understood and addressed through management action to mitigate the impact to these critical ecosystem species. Councils must factor in bycatch of non-target species when setting ACLs for target species in a changing climate. The SSC should consider climate vulnerability when making fishing level recommendations.

- *Total Allowable Catch (TAC)*: NOAA should commission the National Academies of Sciences/National Research Council to independent review the Total Allowable Catch (TAC) levels over time for all harvested fishery resources in Alaska federal waters to evaluate the utility of revising downward the TACs in the context of climate change impacts in Alaska's oceans.
- *Black carbon concerns*: Prohibit large scale commercial fishing north of 60 degrees latitude.
 - Reduce the amount of black carbon that fishing ships, tankers, and cargo vessels omit in Alaska, as it contributes to earlier and more rapid meltdown when it covers ice and snow.
- *Ocean pasture restoration*: Fishermen in the Gulf of Alaska encourage NOAA officials to explore ocean pasture restoration and ongoing good shepherding of ocean pastures, and to explore the “improvements in science, monitoring and cooperative research” as put forth by the proposals of the private company OPR Alaska, Inc., Kodiak, Alaska.
- *Marine National Monuments*: The administration should design and establish several Marine National Monuments (MNMs) in Alaska's federal waters, encompassing several productive, but threatened, Large Marine Ecosystems in Alaska: Arctic Ocean, Bering Strait, Aleutian/Pribilof Islands, Northwestern Gulf of Alaska, and Eastern Gulf of Alaska. These monuments should be established under the President's Antiquities Act authority.
- *Finance an Alaska Climate Change Coastal Resilience Initiative*: Funding is needed to support Alaska coastal villages and subsistence users with climate adaptation needs, including relocation, food security, and resilient infrastructure.
- *Establish an Alaska Ocean Advisory Council*: This Advisory council will represent all stakeholders in Alaska offshore management, to advise government and industry.
- *Reduce total allowable catch*: Reduce the total allowable catch of certain fish stocks, such as Bering Sea pollock, to increase prey availability for declining seabird and marine mammal populations.
- *Funding for marine research in Alaska and the Alaska Fisheries Science Center*: Increase federal funding for Alaska marine research, particularly on climate change, endangered species, and sustainable fisheries; and better apply research results in ocean management. A well-funded and high-functioning Alaska Fisheries Science Center is a critical ingredient in building climate resilience for fisheries and protected resources in the region. Funding constraints to the Center have restricted critical survey capacity and hampered their ability to maintain robust monitoring efforts. Efforts like the Alaska Climate Integrated Modeling Project (ACLIM) and the Bering Sea Fishery Ecosystem Plan Climate Change Task Force are important sources of climate information and must continue to be supported.

- *Marine debris*: Develop a robust program in the National Oceanic and Atmospheric Administration to reduce marine debris (including microplastics), invasive species, and persistent organic pollutants in Alaska waters.
- *Northern Bering Sea Climate Resilient Area*: Reestablish the Northern Bering Sea Climate Resilient Area by Executive Order.
- *Invasive species*: Develop robust program in NOAA for reduction of marine invasive species introductions, partnering with ship owners and State of Alaska.
- *Lease sale 258*: One comment stressed that lease sale 258 needs to be permanently canceled and the Cook Inlet Outer Continental Shelf lease area withdrawn from all future lease sales. Instead of taking actions to slow down the rate of climate change, oil and gas development in Lower Cook Inlet will accelerate it and industrialize a previously undeveloped, ecologically intact wilderness area, which impacts the recovery of the cod fishery and also places the viability of the, halibut, salmon, and rock fish fisheries at risk. Additionally, Lease Sale 258 in Lower Cook Inlet will upend the regional tourist economy which is based upon the unsurpassed wilderness aesthetic and a marine ecosystem which supports charter and recreational fisheries in addition to subsistence and commercial fisheries.
- *Need for increased survey activity in the Northern Bering Sea*: Climate change is precipitating a shift of commercially-important fish populations, including Alaska pollock and Pacific cod, further into the North Bering Sea region. A clear picture of the scale and consequences of those shifts can only be obtained through a consistent stream of survey data. The Center needs to be able to support consistent ecosystem surveys and to understand and forecast effects of climate change on marine ecosystems.
- *Ocean observing systems*: NOAA's Integrated Ocean Observing System and the partnerships that exist within the various regions provide a unique information source to inform real time and retrospective data. As with all the 13 regional systems, the Alaska Ocean Observing System (AOOS) provides valuable data to improve maritime safety, enhance the economy and protect the environment. As NOAA works to fill information gaps, the agency may consider an enhanced role with the ocean observing systems in place. It will be critical to maintain ongoing data sources and monitoring buoys and to consider expansion, particularly in remote regions like the North Pacific.
- *Fishing community engagement in Pebble Mine discussions*: Given the huge community-wide engagement on the Pebble Mine issue and cross-cultural coalition building that's taken place in the region, fishermen are concerned with the health of the ecosystem and must be engaged participants in discussions of its wellbeing. Fishermen must be at the tables participating in these conversations. Connecting with the Pebble Mine leaders may be one way; other ways may be sending representatives to the bay pre- and post-season.
- *Ecosystem approach to management in the Bering Sea*: Climate-ready fishery management in the Bering Sea includes looking at fisheries management in the context of

this ecosystem-wide crisis, which extends beyond fishery-specific impacts. Climate-ready fishery management must center the importance of Bering Sea Indigenous Peoples' ways of life in NOAA's approach to research, management, and policy. It must also apply an equitable approach to fishery management. In the North Pacific, NOAA Fisheries and the North Pacific Fishery Management Council (NPFMC) must make meaningful efforts to collaborate and partner with Indigenous people of the northern Bering Sea, and there must be dedicated Tribal voting seats on the NPFMC. An ecosystem-based and precautionary approach should be applied, and there should be critical examination of expansion of industrial commercial fisheries into the northern Bering Sea. Any such expansion would have irreparable impacts on an ecosystem in flux and collapse and impacts on Indigenous food security, traditional cultural activities, and spiritual practices. NOAA should engage in partnerships and collaborative research to create a shared understanding of the Bering Sea. Traditional Knowledge is highly valuable in understanding climate change and must play a central role in management decisions.

- *The Importance of the Bering Sea for the Continuance and Sustainability of Indigenous Ways of Life Must be Central to NOAA's Approach to Research, Management, and Policy:* Due to the amplified impacts of climate change in high latitudes, the Bering Sea is warming at a significantly faster rate than oceans in temperate zones. Indicator species such as zooplankton, seabirds, and marine mammals are showing signs of stress and population declines under warmer, more acidic, and increasingly toxic conditions as a result of harmful algal blooms and increasingly ice-free ocean conditions.
- *Apply a precautionary and equitable Approach to Fishery Management in the Northern Bering Sea:* Marine pollution poses significant threats to wildlife and overall ecosystem health, especially in the remote Arctic where enforcement is lacking. It is imperative that NOAA Fisheries and NOAA use Traditional Knowledge to better understand the shifts in the carrying capacity of the Bering Sea that Indigenous people are witnessing.
- *Marine traffic and shipping concerns:* While some decision-makers celebrate the fact that the loss of Arctic sea ice creates new “opportunities” for marine shipping and tourism, military exercises, resource extraction and more, there are significant concerns that these new activities will cause additional harm to the Bering Sea ecosystem. A rise in vessel traffic increases the likelihood of major events like oil spills and whale strikes and entanglements and also raises the risk of pollution from the discharge of wastewater, chemicals, trash, or debris, in addition to noise pollution.
- *Marine debris and plastic pollution in Alaska:* Despite its small population and remote location, Alaska's coast is littered with thousands of tons of marine debris, the majority of which is fishing-related gear. Human generated waste is deliberately or accidentally deposited in oceans and waterways, making its way to the Arctic from lower latitudes. Marine debris is generated by vessels of all types and sizes operating in and outside of the Arctic. Weather events and ocean currents may transport large volumes of debris from afar. Growing populations, increased maritime activity, and consumer preference for

plastic-based single-use products have resulted in a rapid accumulation of marine debris, which threatens wildlife and ecosystem health in numerous ways.

West Coast

- *Climate change and critically endangered species:* NOAA must address the impacts of climate change on ESA-listed wild Snake River salmon and steelhead, and Southern Resident Killer Whales immediately to prevent their extinction. All of these listed species are critically-endangered. Climate change is only further exacerbating their path to extinction.
 - Many stakeholders wrote in to urge NOAA to breach the four lower Snake River Dams: The single most impactful way to save these listed species from further harmful impacts of climate change is to breach the four lower Snake River Dams (LSRDs) owned and operated by the U.S. Army Corps of Engineers. Every wild salmon and steelhead run in the Snake River has been listed as either threatened or endangered under the Endangered Species Act. Modifications to hydropower, habitat, fish harvest, and hatcheries have not succeeded in restoring lower Snake River salmon and steelhead runs, nor have they stopped the decline of the populations. Increasing constrained habitat is necessary.
 - Degraded estuarine and riparian habitats already impair various fisheries, but habitat protection and restoration efforts such as marine protected areas and watershed conservation projects can provide crucial buffers against both existing and anticipated threats. Committing resources to protection and restoration programs will be vital to long-term fishery and resource resilience.
 - Accelerate contaminant remediation in and around critical habitats for federally protected salmon and steelhead, themselves essential food for Southern Resident Killer Whales, may ameliorate additional harm from climate change for these protected species.
 - NOAA must support and contribute to funding in-stream incubation boxes to aid to the spawning of salmonids in what is forecasted to be a challenging time for salmonids facing climate change. It is forecasted that water flows in tributary streams will drop and warm to the detriment to salmonid fishes using these tributaries, therefore a proactive approach is called for.
- *NOAA should maintain and augment/expand ecosystem and fisheries-independent monitoring programs in marine, estuarine, and freshwater (i.e., the Columbia River) ecosystems.* Chemical, physical, and biological monitoring data are needed to inform habitat restoration and protection actions, as well as fish distribution models and forecasts. Oregon has large spatial and temporal gaps in marine environmental monitoring, including state waters (three miles from shore) and along the Southern Oregon Northern California Coasts (SONCC) continental shelf. NOAA support of this and other regionally important data programs (e.g., Newport Hydrographic line) are essential to both state and federal understanding of the California Current Ecosystem and understanding the trends in climate and ocean change over time, predicting future change and allowing communities to prepare. Additionally, biological responses and population trends are fundamental to federal stock assessments, and federal actions (e.g. protected

species management). Oregon examples where state-federal partnership and continued monitoring by NOAA is essential include: sea lion distribution and foraging within the Columbia River and whale distribution related to Dungeness crab pot interactions.

- *Protections for large whales on the West Coast:* Vessel strikes are a top source of human-caused mortality for U.S. whales. Vessel strikes are also the biggest source of human-caused mortality to large whales along the U.S. west coast, followed closely by fishing gear entanglements. Large cargo ships funnel into shipping lanes to ports near San Francisco and Santa Barbara. Scientists estimate that 80 whales die from ship strikes each year on the U.S. west coast. The comment urged NOAA Fisheries to establish mandatory vessel speed limits of 10 knots in all voluntary speed restriction zones off Southern California and in the San Francisco Bay region.
 - California/Oregon/Washington stock of humpback whales. NOAA has not revised since the 2016 listing of humpback whale distinct population segments (DPSs). The small Central America DPS therefore is inadequately protected from anthropogenic threats.
- *NOAA Fisheries should re-initiate ESA consultation with US Forest Service for the NW Forest Plan due to inadequate no cut riparian buffers for logging projects and new information about climate change.* The Bureau of Land Management in Western Oregon has replaced the NW Forest Plan with a 2016 Resource Management Plan that included consultation with NOAA Fisheries. The plan establishes no cut 120 ft. buffers along perennial streams and 50ft no cut buffers along intermittent streams based on best available science. The Forest Service on adjacent lands is implementing 60-90 ft. no cut buffers on perennials and 20 ft. no cut buffers on intermittent. These outdated standards are inadequate for protecting aquatic resources and need to be updated via Section 7 consultation.
- *Protect and restore spring chinook to headwater rivers dominated by groundwater recharge.* Historically large-scale ground water dependent ecosystems were hugely productive of spring chinook but nearly all have dams which block spring chinook migration. The most promising example of restoration is the ongoing effort to restore spring chinook to the upper Klamath where tributaries such as the Wood River and Williamson River have unbelievably yearlong cold water. Other examples for potential restoration of spring chinook to cold water refugia are the Cascade tributaries to the Willamette River, upper Rogue River, Shasta River (Klamath) and Pit/McCloud river system (Sacramento). Spring chinook is a genetically based ecotype that is best adapted for climate change since it migrates in spring before streams warm up (Prince *et al.* 2017). An ongoing threat to spring chinook blocked by dams is hybridization with fall chinook (Thompson *et al.* 2019). The ongoing threat of hybridization needs timely intervention by National Marine Fisheries Service since state agencies such as Oregon Department of Fish and Wildlife (ODFW) are in denial about the significance of hybridization and have no plans to change management, which exacerbates hybridization (O'Malley *et al.* 2020).

- *Eliminate ocean mixed stock fishery for chinook and coho.* The ongoing mixed stock ocean fishery for chinook salmon is hugely wasteful and damaging because it harvests immature fish and an unknown number of ESA listed runs as well as stocks with low abundance. Consumption of fossil fuels by hundreds of boats trawling all day is huge. Biologists have been calling for an end to the ocean mixed stock fishery for decades. The most recent analysis by Gayeski et al. (2018) provides alternative mechanisms for harvest focused on watershed specific stocks. For example, there is a “bubble” fishery at the mouths of the Elk River and Chetco River when chinook salmon returns are predicted to be high. A watershed specific fishery could largely eliminate the harvest of ESA listed fish and less abundant stocks. At a recent Oregon Fish and Wildlife meeting, an ODFW biologist told the commission that low abundance runs can be expected to be more frequent in the future. Harvesting chinook salmon in a mixed stock fishery of mostly low abundance stocks is certain to diminish the ability of natural runs to persist into the climate change future.
- *Restore and protect beaver.* Studies in eastern and western Oregon (Bruner 1990, Talabere 2002) have shown that beaver dams/ponds provide important rearing habitat for native and anadromous fish. Demmer and Beschta (2008) report that “beaver had positive ecological effects and assisted in riparian plant community recovery along Bridge Creek, a low-gradient mountain stream in central Oregon. Beaver dams, whether functioning or breached and in combination with a variable natural flow regime, resulted in increased area and diversity of riparian plant communities and more complex channels during the nearly two decades of this study, thus contributing to the ecological recovery of riparian and aquatic habitats.”
- *NOAA Fisheries and Oregon Department of Fish and Wildlife (ODFW) engagement:* The ODFW climate policy is a comprehensive framework for implementing change in ODFW management based on climate change analysis. The policy has been formally adopted and is coded as Oregon statutes. This policy could serve as a model for other agencies, however, the ODFW needs some specific direction/coordination from NOAA Fisheries on how to actually implement the policy. Status quo hatchery production, restoration priorities and harvest need to be fully re-evaluated by NOAA Fisheries in the context of the newly adopted policy.
- *Recommend that NOAA provide continued resources to support regional and national collaboration partners.* To coordinate and maximize limited state resources for climate and ocean change, ODFW relies on partnerships with many NOAA funded programs. Without well-supported partners, ODFW’s ability to effectively conduct our mission to protect and conserve Oregon’s natural resources will be greatly diminished. However, in recent years, many of our key partners (e.g., Northwest Association of Networked Ocean Observing Systems (NANOOS), Pacific Fishery Management Council (PFMC)) have received reduced or stationary funding support from NOAA. Funding shortfalls for our partners not only impacts their ability to operate, but ODFW’s ability to collaborate to gain needed data and expertise to inform ocean and climate change mitigation and adaptation planning and management.

- *Recommend that NOAA streamline and coordinate decision making processes to handle an expected increased workload resulting from climate and ocean change impacts to native species.* Administrative processes under the Endangered Species Act will likely see an increased workload as native species are impacted by climate and ocean change. This includes listing decisions; consultations, permitting, planning, and other mechanisms associated with impacts on, and recovery of, listed species; and legal challenges to decisions. Current staffing capacity and administrative approaches will likely not be able to keep up with the increased demand, resulting in ramifications to NOAA, ODFW, numerous sectors that are required to obtain authorizations, and the aquatic resources.
- *Flexible management:* Ocean resilience with regard to fisheries must also include the seafood industry from top-level management down to the individual fishermen and the communities on which they depend. Oftentimes current management practices are too slow to respond to rapidly-changing environmental conditions. The Pacific Council and NOAA Fisheries West Coast Region (WCR) depend on biennial harvest specifications for managing groundfish stocks, which may be too inflexible to address changes that happen either on the ocean or on land that affect the fishery. The Pacific Council has used emergency actions three times in the last year to address pandemic-related changes that caused limited opportunities for fishing. Climate changes will likely increase the number of fishing opportunity challenges that will require flexible management.
- *Implement alternative commercial fishing gears for selective harvest of hatchery-origin salmon.* Evaluate the potential of selective fish traps as a means to enable safe release of ESA-listed salmon while selectively harvesting hatchery-origin salmon.
- *Communication of fishing community on West Coast:* Enhance communication with fishers residing in southern resource areas (BC, Washington, Oregon, California) who are currently coping with warming and novel species assemblages.

Pacific Islands

- *Data collection:* NOAA Fisheries should assess their data collection systems to develop a program that will collect, analyze, and produce information appropriate for the management of these fisheries in the Western Pacific region. Data and data products should include:
 - In situ current speed at depth which could explain fish behavior and shifting benthic habitat distribution;
 - Finer scale oceanographic data to calibrate the satellite derived products; integration of environmental data with fishery dependent data sets to better inform stock assessments. Climate informed assessments will provide fishery managers future projections of biomass accounting for climate effects. Spatial shifts in productivity are important for driving the spatial distribution of the fishing fleet.
 - Ecosystem models that are linked to federal conservation and management measures so that the management decisions are in the context of the state of the ecosystem;

- Dynamic harvest control rules are adaptive to allow flexibility for councils to adjust harvest based on the prevailing environmental condition;
- Mechanistic relationships of target and prey species (e.g. forage fish and mesopelagic or nektonic plankton) and their distributions linked to satellite derived oceanographic features are needed to be discerned so that they may validate or improve modeling platforms that use remote sensing information to project fishery distributions into the future. Changes in prey species abundance over time and space due to climate change is a major driver in terms of target species distribution and fishery dynamics.

Caribbean

- *Cooperative research:* There is a need for cooperative research to improve the science for the monitoring and development of fishery management plans in the U.S. Caribbean. It is imperative to close the data gaps in life history parameters of species under the management units. The lack of these data creates a challenge for stock assessment to determine status of the local fisheries.
- *Habitat issues:* Coastal development and erosion, river runoff, and unprocessed water discharges to the sea are a few issues that should be addressed urgently to make habitats and marine ecosystems stronger to confront climate changes. These factors greatly affect our waters which consequently affects the entire marine ecosystem in the U.S. Caribbean.
 - Sargassum has proliferated in association with increased sea surface temperatures, causing severe impacts to tourism (beaching and decay of the algae) and fisheries (clogging harbors and covering reefs upon dying and sinking). Changes in regional ocean circulation patterns have delivered mass quantities of Sargassum to island nations which have historically not encountered such influxes.
 - Ensure species diversity is critical to ensuring that multiple species are available to fill vital ecosystem functions like forage, grazers, and keystone predators. Coral reefs in the Caribbean have suffered dangerous algal overgrowth due to urchin die-offs and excessive take of remaining herbivores, especially parrotfish.
 - Better data is needed on habitats that are essential for these species. The betterment of the data collection, quality control, and analysis will be beneficial for not only assessing climate change (including hurricane effects) and resilience, but also for carrying out our fisheries management mandate under the MSA.
- *Continued development and implementation of fishery ecosystem plans (FEPs):* Agency support is particularly needed in the Caribbean and Gulf of Mexico regions, where fishery ecosystem planning efforts are now underway. FEPs can also provide a mechanism for incorporating the Traditional Knowledge held by Indigenous communities into the management of fisheries, as is being done through the Bering Sea FEP. NOAA Fisheries should expand these efforts to ensure that Traditional Knowledge plays a meaningful role in promoting climate resilience for both fisheries and protected species.
- *Closures in the Caribbean:* Appropriate management while respecting the expertise of each Federal or Local agency is at minimum appropriate. The U.S. Caribbean has already

a major percentage of its fishable grounds and areas closed or fully managed by different agencies. Any decisions must be based on science and on the social-economic effects of its creation. Solution: Add more and new resources to research and enforcement to the U.S. region, especially the Caribbean. This will result in great benefit to the natural resources and stakeholders.

- *Oceanographic research needs:* Is important to study the oceanographic connectivity of shared fishery resources throughout the U.S. Caribbean to the Southeast of the United States. For example, the spiny lobster fishery is a shared and economically important resource throughout the Wider Caribbean including the USA, where climate change may be affecting recruitment and the overall population of Caribbean spiny lobster (*Panulirus argus*) throughout its range.
- *Research needs:* Connectivity at depth, where the economically important deep-water snapper fishery (e.g., queen snapper, *Etelis oculatus*) takes place, is an unknown. Collaborative research with commercial fishers is yielding temperature-salinity measurements that may well be indicative of the depth at which climate change is impacting fisheries. These fisheries occur at more than 300 meters, under the influences of different water masses. Such studies should be continued by allocating funds to these investigations. These collaborative studies could be used for outreach and education to fishers, the scientific community, and the general public. There is a need to continue and expand the monitoring and further studies of climate change impacts on coral reefs and coral refugia, including mesophotic and deep-water corals that constitute the essential fish habitats for the tropical species in the U.S. Caribbean.
- *Underutilized species:* The development of programs to offer alternatives to the fishers to fish underutilized species and to promote the market of these species among the local consumers. This will alleviate the pressure on species suffering overfishing which also are being impacted by climate change, e.g., changes in temperature and salinity.

Gulf of Mexico

- *Concerns facing Gulf species and habitat:* Multiple comments outlined a number of issues and concerns facing coastal/marine habitats and fisheries in the Gulf. This includes regional meteorological effects (precipitation and flood mitigation, riverine induced hypoxia, tropical weather events), increasing temperature effects on fisheries (geographic population shifts, changing ocean temperature regimes impacting biodiversity, impacts in migration patterns of Highly Migratory Species (HMS), protracted spawning season, climate change influencing sex ratios in sea turtles and flounder), climate effects on marine circulation patterns (changes to larval dispersal/recruitment patterns of fishery-important HMS, shifts in the abundance and distribution of *Sargassum*, a vital habitat in Gulf marine waters), sea level rise (loss of marsh habitat, barrier island loss), and ocean acidification (affecting shellfish stocks and planktonic prey species). Additionally, red tide events and algal and bacteria blooms cause harmful human health effects and widespread coastal community environmental (and economic) damage. Changing water

flows threaten many of the 31 coastal bottlenose dolphin stocks. Ocean resource changes due to climate change appear to be increasing coastal flooding along the Texas coast. This is raising questions about sea turtle nest management as beaches increasingly erode Kemp's ridley nesting habitat.

- *Modeling algal blooms:* Harmful algae blooms could develop or spread to new locations with future changes in climate and flow of aquatic systems around the Gulf. Modeling of algae blooms and possible water flows could provide insight into which areas may be more prone to this impact and therefore need more resources to protect against the spread of the harmful organisms.
- *Habitat monitoring and mapping:* There is a need to better map and monitor the transition from salt marshes to mangroves in the northern Gulf of Mexico and along the Atlantic coast of northern Florida. It is not known whether these habitat types are functionally equivalent with respect to fish use. Analysis of existing datasets and experimental studies (for example creating a mix of saltmarsh and mangrove controlling for elevation at restoration sites) could help determine what, if any, changes to expect in fish communities and essential habitat of economically important species.
- *Angler catch reporting:* Mandatory, compatible private angler catch reporting and permitting systems in the Gulf and nation-wide that have a high degree of accuracy and precision.
- *Electronic reporting:* Implementation of electronic reporting and monitoring in the Gulf is needed.
- *Data input to Council:* The council needs raw data such as pH and temperature to be synthesized in a way the council can use to better manage fisheries. Data is available at the state level for use in state management efforts, but is not pooled and synthesized across the Gulf of Mexico.
- *Enhanced fishery-independent monitoring in the southeast United States:* At present, monitoring data to evaluate broad ecosystem trends, particularly at the lower trophic levels (e.g., primary and secondary producers), are largely spatially and temporally insufficient for incorporation into management efforts. Additional monitoring efforts that encompass not only managed species, but also monitor ecosystem conditions across space and time, are needed. From a system-level perspective, these conditions should include habitat, primary and secondary production, and trophic information.
- *Adaptation and community resilience:* The fishing industry in GOM needs workable options for climate adaptation. Some examples include assistance in developing markets for unutilized species, opening up areas that have not been fished before, and opportunities to build resilient and adaptable commercial fishing business plans. Additionally, more studies are needed to understand the short-term and long-term impacts of large-scale events (oil spills, red tides) on communities in the region.

- *Implementation of fisheries ecosystem plans (FEPs)*: Agency support is particularly needed in the Caribbean and Gulf of Mexico regions, where fishery ecosystem planning efforts are now underway. NOAA Fisheries should expand these efforts to ensure that Traditional Knowledge plays a meaningful role in promoting climate resilience for both fisheries and protected species.
- *Participation from recreational sector*: Comments encouraged NOAA to develop and use an array of data sources for fisheries management, including electronic reporting using smartphone apps, as well as assisting states in developing robust angler harvest data collection programs to supplement or replace the Marine Recreational Information Program where it fails to provide reliable information for management. The recent development of state-based surveys in states along the Gulf of Mexico has shown the potential for these sources to provide far more reliable and accurate data than MRIP, increasing access through longer seasons while ensuring sustainable, healthy fish populations.
- *Aquaculture*: The environmental benefits of marine bivalve and seaweed aquaculture can be leveraged in creative and innovative ways for both farmers and climate policy. There is tremendous potential to scale these types of approaches in other parts of the country, especially in coastal regions such as the Gulf of Mexico where interest in aquaculture is rapidly growing at the same time that seasonal dead zones, harmful algal blooms and other climate change impacts are becoming more frequent and more severe.
- *Sustainable seafood*: The Gulf of Mexico has a demonstrable track record for success when it comes to sustainable seafood, and commenters asked that NOAA build upon these achievements in order to improve climate resilience of the region's (and nation's) commercial fisheries.

Southeast

- *Stock assessment process*: Recognizing that the federal stock assessment process in the southeastern United States is already stretched to capacity, a high importance should be placed on additional stock assessment resources such that timely assessments can be completed, and appropriate ecosystem conditions can be considered in the process.
- *Funding for survey efforts*: Despite the documented need for increased survey effort and importance of survey information to reliable stock assessments, funding continues to be an impediment in the Southeast. NOAA Fisheries should ensure compatibility of its surveys to ensure changes in stock distribution can be observed and detected. NOAA Fisheries should fully fund the Southeast Reef Fish Survey and restore full MARMAP funding to increase survey effort and coverage. NOAA Fisheries should increase funding available for Cooperative Research and direct it to support population monitoring to help address declining survey resources.

- *Considerable improvement in basic scientific information is required in the South Atlantic Region to ensure resilient fisheries.* This includes catch monitoring, population surveys, and social and economic characterizations of the fisheries. More timely analysis of data, such as stock assessments, is needed along with distribution of information to the council through Stock Assessment and Fishery Evaluation (SAFE) reports. Compatibility across NOAA Fisheries regions of basic fishery statistics and population surveys is critical to identifying and responding to climate change.
- *Enhanced fishery-independent monitoring in the southeast United States:* Understanding broad ecosystem trends and how they influence population dynamics of fish stocks and protected species is critical to the successful management of these resources during climate change. However, at present, monitoring data to evaluate broad ecosystem trends, particularly at the lower trophic levels (e.g., primary and secondary producers), are largely spatially and temporally insufficient for incorporation into management efforts. As technologies advance and expand capacity for monitoring, additional monitoring efforts that encompass not only managed species, but also monitor ecosystem conditions across space and time, are critical. From a system-level perspective, these conditions should include habitat, primary and secondary production, and trophic information.
- *Expedite and expand climate vulnerability analyses:* Climate change is likely to have broad effects across entire ecosystems and a fundamental question remains regarding the relevant spatial scales at which ecosystem processes should be managed or accounted for. To determine this, an understanding of connectivity within and among regions is required. Climate vulnerability analyses are underway in the South Atlantic and Gulf regions; additional support is needed to expedite those efforts and expand to a broader suite of fish and invertebrate species.
- *Severe events and impacts to fish populations:* For federally-managed fisheries like gag and red grouper, severe events such as hurricanes, cold snaps, and harmful algal blooms resulted in reductions in catch limits (once analyses and/or stock assessments indicating fishery declines were available). Such events often affect local research assets (damage to structures, power outages, flooding), thus a broad network of cooperation among institutions is needed to step in following a severe event to assess the effects to fish populations.
- *Magnitude of linkages between nearshore and offshore habitats and fishery/resource production:* Observed effects of climate change have already impacted habitat in Florida and predicted effects indicate that impacts to sensitive habitat will increase (e.g., coral reefs, hardbottom, seagrass, mangroves). The health and connectivity of Florida's diverse habitats are the foundation for the high productivity and use of its natural resources. Understanding the magnitude of these linkages could provide guidance for habitat protection, restoration efforts, and drivers of fishery/resource production. Incorporation of such information into stock assessments could provide valuable insight to resource managers.

- *Changes in flooding frequencies of coastal nursery habitat:* Coastal habitats that have historically been flooded infrequently will become more connected to their estuaries. The primary nursery habitats for some species, however, depend on remote, infrequently flooded habitats, namely snook species, black drum, and tarpon. For example, using acoustic telemetry and water level loggers, the Florida Fish and Wildlife Commission has observed that emigration of juvenile tarpon from coastal nurseries is tied to storm events. Research is needed to understand how existing nursery habitats for these and other species are likely to function as flooding regimes change from a stochastic seasonal connection to daily tide. Predation pressure on these species is likely to increase with increased connectivity. Fish biologists can work with restoration practitioners to create new habitats landward of existing ones. There may also be opportunities to work with engineers and city planners to modify existing stormwater infrastructure into functional nurseries. The first step is to properly characterize nursery habitats, the appropriate flooding regimes, and degree of connectivity with open water in ways that can be easily transferred to engineers, city planners, and restoration practitioners.
- *Collaborative approach to changes in species distributions:* Several tropical and subtropical species are already expanding their range farther north into the southeastern United States. More cooperation and collaboration is needed with partners and other nations in the tropics where the abundance and evolution of these species have been historically centered. Cross-site studies of genetic structure and life-history traits (e.g., cold tolerance, counter-gradient growth) spanning countries in South, Central, and North America are needed to better understand how species may adapt to living at higher latitudes and in novel habitats. In some cases, range expansion may provide for new fisheries in areas where they did not previously exist. Protection or enhancement of these “new” fisheries will require identification of essential habitat and an appropriate management strategy depending on connectivity to populations farther south.
- *Changes in species migration:* Support for cooperative acoustic tracking networks like iTAG (Integrated Tagging of Animals in the Gulf of Mexico) and FACT (Florida Atlantic Coast Telemetry). A relaxation of temperature drivers (specifically milder winters in the southeastern United States) will affect fish migrations. Examples of these migrations along the Atlantic and Gulf coasts of Florida include the winter sailfish run to southeast Florida and fall/spring runs of cobia, mackerel, and coastal sharks.
- *Human dimensions research:* It is critical to evaluate the causes and impacts of climate change from a social, economic, and institutional perspective. Large-scale events that have affected entire ecosystems (e.g., Deepwater Horizon oil spill or Florida red tide event of 2017-2018) have highlighted the need for more resources to better understand the short- and long-term impacts of these events on society. Increasing stakeholder involvement in resource management may help elucidate climate impacts at the institutional level, but more research is needed on the social and economic aspects of resource management. For example, how will range shifts of economically important species impact competition, production, and regional socio-economics?

- *Sea turtles*: Continued cooperative research to understand impacts to incubating sea turtle nests from wetter and warmer beaches is needed (i.e., hatch success, temperature dependent sex determination, shifts in nesting season). This research could be completed cooperatively by the FWC, USFWS, NOAA, USGS, FDEP, EPA, local universities, local municipalities, non-profit organizations, and/or other partner agencies and groups.

Mid-Atlantic

- *Representation on Mid-Atlantic Fishery Management Council (MAFMC)*: Multiple comments highlighted that Rhode Island should be granted voting representation on the MAFMC. Rhode Island is the number-one squid port on the East Coast. Squid, along with many of Rhode Island's top species, including scup, black sea bass, and bluefish, are managed by the Mid-Atlantic Fishery Management Council. Rhode Island's lack of voting seats on the MAFMC gives rise to a situation of "regulation without representation." This disconnect is becoming sharper as these species continue to become an important part of Rhode Island's landings mix. In order to assure that fisheries management decisions are reflective of local realities and expertise, Congress must grant Rhode Island a voting seat on the MAFMC. Section 302 of the MSA should be amended so states can petition to have a voting authority for a particular species.
- *Increase oyster aquaculture in Virginia*: More oysters in the water means a cleaner, healthier Bay, and oyster aquaculture provides an opportunity to make this happen quickly and reliably. There is great potential for science-based, private-sector driven, water quality improvement using oyster aquaculture, while understanding the economic hurdles to expanding the aquaculture industry.
- *Tuna aquaculture*: One comment requested aquaculture quota for bluefin on the New Jersey coast.
- *Proactive management for forage species*: NOAA Fisheries should work with the councils to advance stronger measures for managed forage species, such as ecosystem-based harvest control rules (HCRs), to protect their role in food webs; and expand protections for unmanaged forage species as has been done by the North Pacific, Pacific, and Mid-Atlantic Councils. One comment applauded the agency for approving the recent amendment to the Atlantic herring fishery management plan (FMP) that includes a new HCR, but noted that recent attempts by the Mid and South Atlantic Councils to protect bullet and frigate mackerel, important prey for many pelagic predators, have been blocked rather than supported by NOAA Fisheries. NOAA should take a leadership role in advancing proactive conservation and management of all forage species.
- *Risk assessment*: The Mid-Atlantic Fishery Management Council has used risk assessment as part of its broader ecosystem approach to fisheries management. The goal of the effort was to bring ecosystem considerations into management actions in a stepwise evolution. In coordination with the Northeast IEA (Integrated Ecosystem Assessment) program, the council implemented a risk assessment tool using ecosystem

indicators. These indicators identified priority ecosystem considerations for further research and policy development, which were intended to be followed by development of a conceptual model and management strategy evaluation (MSE). While the effort was not designed solely to address climate change risks to meeting management objectives, it includes consideration of climate interactions and could be further adapted to support climate-ready tools.

- *Offshore wind*: With alternative energy set to expand across a large portion of southern New England and Mid-Atlantic waters, we need to make sure that we have a robust science and monitoring program in place prior to construction. Collaboration with entities involved with the recent research and monitoring initiatives for offshore wind (OSW) and future ocean renewable energy is important. These groups include the Responsible Offshore Science Alliance (ROSA), the mid-Atlantic regional wildlife science entity (RWSE), and state government groups and/or academics and nonprofits.
- *U.S. Atlantic sea scallop fishery*: Dredge survey estimates conducted in the Delmarva management area show a massive 97% decline in scallop biomass, from 10,923 MT in 2015 to 251 MT in 2020. Notably, the Virginia Beach rotational area, closed in 1999 to protect a cohort of sea scallops, is no longer commercially productive. As productivity declines in the southern periphery of the stock resource area, the fleets homeported in the mid-Atlantic region will have to incur additional operating costs, including fuel burn, to harvest their annual allotment of trips and days at sea (DAS). Adding a voluntary leasing mechanism to the Atlantic sea scallop FMP would bring flexibility to the sea scallop fishery, allowing limited access vessel owners to reduce operating costs, eliminate redundant economic inputs, and improve capital and operating efficiencies. Leasing would substantially improve the fleet's overall economic resiliency and prepare it to withstand the changes in the performance and distribution of the sea scallop resource that are expected to occur as climate change impacts this iconic resource.

Northeast

- *Incorporating climate in stock assessments*: Scientific methodologies and stock assessment must be improved in ways that make them far more responsive to and reflective of the impacts of climate change on fish distribution and abundance. This must be a top priority, especially in the highly dynamic oceanographic conditions and ecosystem in the northeast region. The more that is known the better managers can respond to climate changes and work to make fisheries and fishing communities more resilient in the face of such change.
- *Funding for Northeast Regional Ocean Council (NROC), the Regional Ocean Partnership (ROP) for the New England states*: Federal funding will ensure that NROC has the appropriate capacity to advance ambitious national policy priorities in the region. NROC can provide specific recommendations on data and mapping requirements, public engagement, and agency and interjurisdictional coordination.

- *EBM approach to North Atlantic Right Whale management:* Employ an EBM strategy in New England waters to reduce mortalities from fixed gear entanglements and ship strikes of the North Atlantic Right Whale as it doesn't appear that ropeless gear will be a near term solution to gear entanglements mortality.
- *Voting representation on Councils with shifting stocks:* Change the council voting structure for the final recommendations of each species. For example, when the Mid-Atlantic Council meets to manage black seabass, summer flounder, or scup, the members of the New England Council representing the states of Connecticut, Rhode Island and Massachusetts would have equal authority at the council table and be included in all discussions and votes. The same process could be applied to the scallop fishery. The fishery would continue to be managed by the New England Council but all discussions, debate and final recommendations would include the states of New Jersey and Virginia and as southern stocks shift to the Mid-Atlantic, Virginia, and Maryland may wish to have voting representation at the South Atlantic Fishery Management Council.
 - Grant Rhode Island voting representation on the MAFMC. Rhode Island is the number-one squid port on the East Coast. Squid, along with many of Rhode Island's top species, including scup, black sea bass, and bluefish, are managed by the Mid-Atlantic Fishery Management Council. Unfortunately, Rhode Island's lack of voting seats on the MAFMC gives rise to a situation of "regulation without representation." This disconnect is becoming sharper as these species continue to become an ever-more important part of Rhode Island's landings mix. In order to assure that fisheries management decisions are reflective of local realities and expertise, Congress must grant Rhode Island a voting seat on the MAFMC.
- *Carbon emissions and electricity use associated with Nordic Aquafarms:* Multiple comments expressed concern over the electricity use and carbon footprint of this large-scale facility.
- *Focus on vulnerable regions:* In areas such as the Gulf of Maine, where the waters are warming 99% faster than the rest of the ocean, there has also been a lack of success in preventing overfishing and rebuilding stocks, making New England the nexus for climate changes impacts on the country's most lucrative fisheries. In areas such as these, there should be an increased commitment to achieving the goals set forth by the MSA if we are to make fisheries resilient to climate change.

Appendix B: Tribal Recommendations

General tribal recommendations

- *Collaboration with state and federal partners:* Establish a collaborative tribal, state, and federal intergovernmental process to develop, evaluate, and implement measures to address the climate crisis. Contemporary ecosystem management recognizes the importance of communities' participation in effective management.
 - NOAA needs to explore and expand science and technology partnerships and increase resources and technical training on these new approaches for resource managers. Such training would need to occur at all levels of government, including federal and state ocean and coastal managers, regional fishery council members, tribal governments, interstate fisheries commissions, and members of international management bodies.
- *Meaningful, iterative engagement and tribal consultation:* Engagement in respectful dialogue to share knowledge, world views and values is vital to reach effective and lasting solutions that are consistent with reserved and legal rights, judicial decisions, laws, and political interactions. Comments called for NOAA to work with tribal councils on Executive Order implementation and to make tribal consultation timely, constant, and ongoing.
 - Tribal representatives need more than a listening session to gather input for others to consider and make decisions. Tribal governments want and need to poll participants in developing and implementing real solutions to the climate crisis and the problems that are confronting people in the U.S. and worldwide.
- *Co-management and incorporating Traditional Ecological Knowledge into management:* NOAA must engage with Tribal governments and communities and explore ways to implement co-management programs that respect, uplift, and integrate Traditional Ecological Knowledge (TEK). This includes seeking opportunities to learn and collaborate with tribal partners in incorporating traditional practices into adaptation planning and decision-making.
 - The intimate tribal understandings of place-based environments, resources, and socioeconomic and political relationships will be crucial to the ability to formulate and employ local actions to address the climate crisis.
- *Engagement in North Pacific Fishery Management Council Process:* Multiple comments highlighted that rural and tribal communities in Alaska feel that their concerns are unheard by the council and NOAA Fisheries. These comments noted that the council system is virtually inaccessible to rural and tribal citizens. One comment called for clear

improvement regarding the Magnuson-Stevens Act and the national standards around the trust responsibility to Alaskan native tribes. Additional comments noted that in the North Pacific, NOAA Fisheries and the North Pacific Fishery Management Council (NPFMC) must make meaningful efforts to collaborate and partner with Indigenous people of the northern Bering Sea, and there must be dedicated Tribal voting seats on the NPFMC.

Other comments recommended NOAA:

- Appoint an Alaska Native tribal liaison in NOAA.
- Appoint a new Assistant Administrator for National Marine Fisheries Service and establish a Tribal Liaison position in that office.
- *Increasing and requiring Tribal representation on Councils:* Increasing and requiring Tribal representation on councils, associated council bodies, and within research institutions is critical to creating an equitable management system. TEK should be on the same level with Western science, and approaches of knowledge co-production can assist in considering fisheries and communities within larger ecosystem contexts. Tribal representatives, TEK holders, and scientific TEK experts must have equitable voices throughout the management process and must be at the center of developing methods and processes for including TEK in management. To support these relationships, NOAA Fisheries should increase internal capacity to build equitable relationships and research co-production by investing in regional Tribal liaisons for science centers and councils, as well as noneconomic social science staff.
- *Tribal fishing opportunities and trust responsibility:* Direction and improvement regarding the MSA and the national standards regarding trust responsibility to native tribes as well as indigenous access to fishing opportunities.

Recommendations from Swinomish Indian Tribal Community, Washington

- NOAA Fisheries must bring its regulatory strength under the Endangered Species Act (ESA) to help protect ESA listed chinook and ESA listed steelhead habitats that are in dire need of trees to be planted in order to someday meet water quality standards for temperature pollution, but also to buffer against the climate warming that is absolutely here and is going to increase.
- Ensuring estuary habitat is adequate for ESA listed salmon. So we know from best available science that our chinook need enough estuary habitat so that our juveniles are healthy and strong enough and are grown enough before they take off out into the ocean.
- NOAA Fisheries and other federal agencies should be familiar with the Treaty Rights at Risk document that was published in 2011 with the tribes through the Northwest Indian Fisheries Commission. This can be a reference point as NOAA Fisheries and the

Swinomish community work together to improve salmon habitat in the face of climate change.

Recommendations from the Makah Tribe, Washington

- Recommend that NOAA continue to invest in existing management structures and support tribal, federal, and state fisheries managers in developing the tools and research necessary to further incorporate climate considerations into active and effective fisheries management that supports Makah treaty harvest in perpetuity.
- Makah treaty fishing rights are geographically limited to the extent of our U&A (usual and accustomed fishing grounds and stations) boundary. As climate change drives range shifts in commercially and culturally important fisheries species, the Tribe may face decreased access to these treaty resources as Makah fishermen are unable to follow the resource outside of the U&A. We suggest a future meeting between NOAA, Interior, and the Makah Tribal Council to continue discussions on this important climate resilience strategy and federal trust responsibility.
- Research priorities include coupled social-ecological modeling, research on the impacts of ocean acidification and climate change on the Makah people, socio-economic risk modeling, and economic analyses of climate impacts on Makah fisheries. Funding to support the ongoing implementation of culturally specific resilience strategies identified through this research is also needed.
- Climate-Driven Changes in Rivers Impacting Salmon: Better downscaled data on the climate change-driven impacts on water quality and quantity in rain-dominant watersheds is needed. Climate research in Washington State has focused on changes in snow dominated systems in the Cascade Mountains. Better data on projected impacts to water quality and quantity in our watershed would improve our ability to manage our resources. Better characterization of how interactions between streams outside the Makah Reservation and U&A boundary impact Makah resources (esp. salmon) and how climate change will affect this interaction is also needed.
- More detailed mapping of the marine environment at the scale of the Makah U&A would improve our ability to plan, model, and manage our fisheries effectively and in a climate resilient manner. This data would support our understanding of how climate change will impact the presence and seasonal movement of groundfish fishery species, distribution of key ecosystems (kelp forests, etc.), and localized upwelling of lower trophic level species.
- Our climate impacts assessment highlighted the need for better data on any potential northward shift for halibut and how this shift would impact the Makah U&A. We also need better downscaled information on how climate change will impact migration timing and stream temperature tolerance of specific salmon populations and their food sources.

Recommendations from the Lummi Nation, Washington

- There should be a more coordinated approach among federal agencies. Each agency has their own mandates, and they directly impact fisheries, such as water quality and water resources (EPA). In addition, while each federal agency may provide some funding to

address climate change impacts, we find that we need to not only search for funding, but piecemeal funding from both the state and the federal agencies, since most federal agencies won't allow match funds obtained from another federal agency.

- In order to determine effectiveness of projects to mitigate the impacts of climate change, we need access to long-term monitoring funds. Most grants fund at best one year of monitoring. Think of this as a lessons learned project- is the project meeting its goals, and why? In conjunction with monitoring funds, we are lacking capacity to analyze existing data and determine effectiveness.
- Financial support is not keeping pace with the change in management complexity. Science makes us more aware of current status and future impacts, but we can't do anything about it because we don't have funds to monitor, research, educate and train new scientists, etc. This is particularly harmful to groups, such as tribes, that are already struggling in many of these areas.
- There is a lot of good research being completed by NOAA on the impact of climate change on fish stocks. This information would be useful for our own research. Please ensure that this information is readily available, perhaps directly distributing reports to tribes.

Recommendations from the Puyallup Tribe, Washington

Monitoring and Tracking

- Full time temperature gauges in the Puyallup River.
- Water quality monitoring in the nearshore.
- Monitoring and tracking groundwater withdrawals.
- Identify, track, and protect cold water refugia.
- Identify and track diminished habitat connectivity and migration corridors.

Management and Conservation Measures

- Removal of shoreline armoring where sea level rise will occur.
- Ban new shoreline armoring and development of docks, piers, and other overwater structures.
- Discontinue land use zone changes that increase impervious surfaces where it reduces flood storage and impedes groundwater recharge.
- Prohibit the removal of areas out of the FEMA floodplain category and designate higher protections for these land types.
- Changes to grandfather laws that exempt projects from FERC licensing or other ESA regulations which allow them to evade best management practices.
- Increase minimum instream flow requirements in critical habitat.
- Increase buffer widths for critical areas to offset impacts from future development and the resulting non-point source pollution.
- Create a schedule for eliminating surface water withdrawals, water impoundment, and anthropogenic instream flow manipulations or alterations.

Cooperative Research

- Levee setbacks.
- Floodplain reconnections.
- Increasing off channel storage habitats.
- Purchasing freshwater habitat.

- Exemptions in codes and grant requirements that allow restoration projects to be fast tracked.

Recommendations from the Columbia River Inter-Tribal Fish Commission (CRITFC)

Habitat Recommendations for Fisheries Management Under Climate Change

- Support the rights of tribes to sufficient instream flows to support salmon and other treaty-protected fish, especially during the summer.
- Protect and restore stream connectivity to cold water refuges and the natural floodplain. Policies and legislation that prioritize protecting and increasing cold water refugia areas are needed for cold water aquatic species. Restoration actions needed include connections to side channels and floodplains, replanting native vegetation that provides shade, and increasing channel depths.
- Restore ecosystem function for streams and rivers (including riparian restoration, livestock management, and other restoration actions). Potential habitat and restoration areas should be prioritized based on salmon and steelhead vulnerabilities to climate change.
- Reduce existing stressors on fish, including fish toxins, habitat degradation, and impediments to fish migration.
- Protect coastal estuarine habitats. Positive action can be taken through salmon conservation by safeguarding the genetic diversity of wild Pacific salmon stocks and improving freshwater and estuarine habitat.
- Explore means for greater flexibility in the application of water rights and their potential use for ecosystem functions.

Hatchery and Harvest Recommendations for Fisheries Management Under Climate Change

- Hatchery supplementation will not be a ‘quick fix’ for reduced abundances caused by climate change. However, it still plays a role to supplement wild salmon population and increase harvest opportunities.
- Salmon resource management should be an integrated multi-agency system of adaptive management that is driven by scientific monitoring and research that assesses the impact of changing ecosystems across different life history stages including high seas, coasts and estuaries, and freshwater, in near-real time to decadal timelines. Resource management occurs for fisheries, habitat, and hatcheries.
- Manage hydropower systems to a greater extent to assist fish species migration and survival.
- Shift focus from managing salmon populations for past abundances to improve populations under current and predicted future environmental conditions. This shift is critical since past salmon productivity may not be achievable given large ecosystem and habitat changes occurring or anticipated in the future.

Stock Assessment and Research Recommendations for Fisheries Management Under Climate Change

- Changes to the fisheries management, stock assessment assumptions and priorities, habitat restoration, hatchery release strategies, and salmon recovery paradigms will be required to adapt to changes in salmon distribution, productivity, and abundance.
- Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), NOAA should establish standards, tools, and requirements to incorporate climate change into the fishery management process.
- The approaches to salmon resource management should be robust to the variety of future climate change scenarios for marine and freshwater ecosystems. In addition, stock assessments should be able to detect when population parameters exceed the ranges considered in those scenarios, triggering a re-evaluation of appropriate management strategy.
- For species populations that are most vulnerable, further genetic research into ways of increasing resilience to climate change is needed.
- Support research into how climate change may affect marine food webs that are critical to salmon and steelhead.
- Incorporate changes in salmon productivity within stock assessments and management processes. This includes developing benchmarks and reference points that include changing salmon productivity.
- Re-examine research and funding priorities to ensure best use of limited resources. Understanding what freshwater habitat adaptation will make these salmon species more robust to climate changes such as increased adaptation to extreme rainfall, drought, and warming temperatures, is necessary.
- Increase international collaboration among agencies and develop mechanisms to promote international research regarding the impact on changing ecosystems and management actions on salmon species.

Future Collaboration Recommendations for Fisheries Management Under Climate Change

- NOAA should implement a government-wide response to ocean and coastal acidification, establish an advisory board to strengthen the understanding of socio-economic effects of ocean acidification, conduct a study on the effects of ocean acidification on estuaries, require and update vulnerability assessments, and incentivize innovative research on ocean acidification.
- Reconsider financial resource allocation for stock assessment, hatcheries, and habitat actions that are aligned to future salmon production, not past, to prepare for economic, social, and cultural opportunities of the future.
- Salmon resource management should include a broad communications and engagement strategy to ensure interested people are informed of short- and long-term climate impacts and that those affected by the changes, economically or culturally, are engaged in respectful dialogue about the issues and potential responses. The dialogue should ensure

that salmon remain an essential part of both the Native and non-Native culture and lifestyle of the region.

Recommendations from the Skokomish Tribe, Washington

- *Managing tribal fisheries in Puget Sound:* Help is needed to develop a fisheries independent method to assess spot, crab, and shrimp population size and assess mortality after release. It's very important to do research on the basic life history parameters of these species that are important to the lives of tribal members and all the citizens of the State of Washington.

Appendix C: International Recommendations

- *Increased international collaboration on climate issues and research:* NOAA must, along with its international, federal, and state partners, tackle these challenges head on and create a fisheries management regime that can protect ecosystem functioning for future generations. This requires community engagement, cross-agency coordination, and the use of science-based solutions.
 - Operating across jurisdictions, disciplines, agencies, borders, and boundaries is critical. We also need to proceed with a global perspective because it is in truth, one global ocean.
- *One ocean approach to policy:* U.S. policy affects the global health of the entire ocean and vice versa. It would be self-defeating if we failed to embody this international perspective.
- *Global illegal, unreported and unregulated (IUU) fishing:* IUU fishing poses a worldwide threat to sustainable fisheries management and undermines legal fishermen. NOAA and its federal partners should build upon the foundation developed by President Obama's Task Force on Combating IUU Fishing and Seafood Fraud to support resilience of global fisheries by continuing to be a leader in the fight against IUU. Specifically, NOAA should take immediate action to expand the Seafood Import Monitoring Program to all species and support extending traceability requirements throughout the supply chain, which will help ensure that all seafood sold in the U.S. is safe, legally caught, responsibly sourced, and honestly labeled.
- *Seabird bycatch:* Supporting the reduction of seabird bycatch in U.S. and international waters through ESA consultation with USFWS, technical support for implementing bycatch mitigation measures, and drafting regulations to reduce seabird bycatch in Hawaii, Alaska, and west coast fisheries.
- *Aquaculture:* There is tremendous opportunity for the U.S. aquaculture industry to help meet this critical moment, but only if the industry's growth is supported at the local, national, and international levels. Leveraging aquaculture for addressing the climate crisis could be transformational for sustainable food systems, food security, green energy technology and innovation, environmental justice, resilient infrastructure, and resilient coastal communities.
- *Managing shifting species:* Shifts in managed species and habitats will inevitably lead to the need to adapt current management measures. International agreements must be prepared for shifts in species distributions. Climate change and loss of biodiversity will increase the pressure on management systems. NOAA has multiple management partners for fisheries and protected species. This includes state, territorial, tribal, and local governments as well as regional fishery management councils and commissions and international bodies. With these management partners, NOAA should review and adapt governance structures, agreements, and processes to better address the dynamic nature of climate impacts.

- *Management strategy evaluation:* MSE techniques are helpful and will need to be faster and easier for stakeholders to participate in and rely on. To achieve this, NOAA needs to explore or expand science and technology partnerships and increase resources and technical training on these new approaches for federal and state ocean and coastal managers, regional fishery council members, tribal governments, interstate fisheries commissions, and members of international management bodies. NOAA should aim to create learning pathways that will be inclusive and facilitate data driven decision making to identify, implement, and continue to evolve dynamic management approaches.
- *Engagement with Canada in North Atlantic Right Whale (NARW) protection efforts:* Canada had few, if any, risk reduction measures in place prior to 2017 for NARW. In contrast to the Maine lobster fishery's record of zero observed M/SI interactions since monitoring began and zero observed entanglements since 2004, there have been 16 observed entanglements, including 9 M/SI interactions, in Canadian gear since only 2016. Accordingly, as part of the U.S. efforts to improve “climate resiliency,” direct engagement with Canada at the highest levels of the U.S. government is essential to secure commitments that Canada will modify its regulatory regime to fully address risks to the NARW. The climate resiliency of protected resources that cross international boundaries cannot be accomplished if other countries are not taking management actions that are equally protective as those applied in the U.S.
- *Engagement with the Arctic Council:* Multiple comments highlighted that it is important for the U.S. to reach out and renew our engagement with the Arctic council in order to facilitate cooperative scientific research and projects to protect the climate resilience of our Arctic ocean. This could lead the way for an Arctic International Treaty, which will provide peace and protection for our Arctic marine ecosystem.
- *Fuel subsidies:* Fuel subsidies are especially harmful as they not only incentivize overfishing but also incentivize increased fossil fuel production and consumption and increasing emissions associated with the fishing industry. NOAA should support efforts of the U.S. Trade Representative (USTR) and other agencies in negotiating an ambitious fisheries subsidies agreement at the World Trade Organization, including ambitious fisheries subsidies provisions in future free trade agreements, and vigorously enforcing the fisheries subsidies provisions in the United States-Mexico-Canada Agreement. NOAA should make it a priority to prohibit harmful fossil fuel subsidies. The top nations for harmful capacity-enhancing subsidies, such as China, account for a significant portion of global harmful fisheries subsidies. NOAA, with the USTR, should prioritize addressing the subsidies from these nations.
- *Antarctic marine research:* Uncertainties concerning the current and future effects of climate change on the structure and dynamics of Antarctic marine ecosystems will be a major impediment to efforts assure that fisheries do not have avoidable adverse ecosystem or population effects. Meetings or workshops should be cooperatively structured, funded, and held annually or as needed by NOAA Fisheries and NSF to assure that (a) NSF-supported and other non-government researchers conducting relevant

research are aware of how their research can contribute to determining and meeting United States interests in Antarctic marine resource and ecosystems conservation, and (b) the results of relevant NSF-supported and other non-government research are routinely made available to U.S. Conservation of Antarctic Marine Living Resources (CCAMLR) decision-makers sufficiently in advance of annual and intersessional meetings of the CCAMLR Scientific Committee and Commission to enable the data to be used in the development of positions concerning issues expected to be addressed at the meetings; and NOAA Fisheries should continue its directed krill-related research in the Peninsula area/Scotia Sea, and increase funding of the U.S. Antarctic Marine Living Resources (AMLR) program to enable chartering a research vessel and development of a directed research program, possibly including a cooperative LTER program, to support differentiating and assuring that the combined effects of climate change and the toothfish fishery do not have avoidable adverse effects on the conservation of the Ross Sea regional ecosystem.

- *U.S./Russia working group:* Convene a Russia/U.S. scientific working group to enhance conservation management of Bering Sea and Chukchi Sea marine ecosystems across the international border.
- *Aleutian Islands and Bering Strait ship safety protocols:* Establish rigorous transit ship safety protocols through Aleutian Islands and Bering Strait, with rescue tugs, routing agreements, speed limits in critical marine mammal habitats, and areas-to-be avoided; nominate both areas as Particularly Sensitive Sea Areas in U. N. International Maritime Organization to better regulate transit ship traffic.
- *Nationally Determined Contributions (NDCs):* While the U.S. has now rejoined the U.N. Paris Climate Accord, we also must advocate an urgent two-fold increase in Nationally Determined Contributions (NDCs) to emissions reductions in all nations.