



TOWARD CLIMATE-READY FISHERIES

A roadmap for our nation's fisheries and fishing communities



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INTRODUCTION

Resilience is “the ability to prepare for, resist, cope with, recover from or adapt to a given stressor to ensure the sustainability of marine ecosystems, fishery resources and human benefits.”²

Nearly fifty years ago, United States lawmakers took bold action to protect fishery resources by establishing a comprehensive federal fishery management system. Today, our nation’s fisheries are among the most environmentally sustainable in the world, but a new threat has emerged that requires us to rethink how we approach fisheries management.

Climate change is fundamentally altering ocean ecosystems. Rising ocean temperatures can disrupt stock productivity and distributions, and extreme events like marine heatwaves can shock entire ecosystems. With warming waters, ocean acidification, sea level rise and more, U.S. fisheries — and the communities that depend on them — must adapt to new ecological, social, management and economic challenges.

Thriving fisheries help support vibrant coastal communities. In 2022, U.S. commercial and recreational fisheries generated \$321 billion in sales and supported nearly 2.3 million jobs.¹ To ensure our fisheries and fishing communities continue to thrive in changing conditions, it is critical to integrate climate change considerations into science and management practices to promote resilience — that is, work toward “climate-ready” fisheries.

In climate-ready fisheries, abundant fish populations and functional habitats are managed for resilience by incorporating climate and ecosystem considerations to support sustained and sustainable access to fishing.³

Progress toward climate-ready fisheries varies throughout the country. The nation’s primary federal fisheries law, the Magnuson-Stevens Fishery Conservation and Management Act (MSA), provides a strong foundation for supporting healthy fish populations through its requirements to prevent overfishing and rebuild overfished stocks — but additional, immediate action is needed to safeguard U.S. fisheries and fishing communities in the face of climate change. In this roadmap, we identify eight comprehensive actions to achieve climate-ready fisheries in the U.S. and offer national- and regional-level recommendations under each action that can be tailored to specific issues and contexts. The eight actions include:

1. Develop a robust understanding of climate impacts and a vision for change
2. Embed equity and environmental justice in all levels of fisheries management
3. Optimize the management process to be more responsive, adaptive and proactive
4. Advance technological and collaborative solutions for data collection and research
5. Utilize responsive harvest strategies and catch limits to support long-term sustainability and resilience
6. Employ community-based management approaches
7. Implement ecosystem-based fisheries management
8. Promote transparency and effective communication

By taking these actions, fishery managers and decision makers can ensure our nation’s fisheries and fishing communities are ready for the challenges of the future.

THE NEED FOR CLIMATE-READY FISHERIES

The MSA establishes an open public process for fisheries management that is designed to work robustly and deliberately toward fundamental goals of preventing overfishing, rebuilding stocks, protecting habitat, increasing long-term socioeconomic benefits and supplying seafood to the nation.⁴ Eight regional fishery management councils, consisting of fishermen or industry representatives, state and federal fishery officials and other stakeholders, develop and adopt science-based fishery management plans and other measures under the oversight of NOAA Fisheries. NOAA Fisheries approves or disapproves council-developed measures based on consistency with federal law and implements approved measures through regulations. This regional, bottom-up approach to U.S. federal fisheries management brings decision making closer to affected communities but is slow and bureaucratic, sometimes taking years to develop and implement a single action. Also, enacted in 1976 and reauthorized most recently in 2007, the MSA's management framework was developed at a time when the environment was assumed to be relatively stable.

Today, that assumption no longer holds,⁵ and the management system is not responding quickly enough to novel, extreme and rapidly changing climatic conditions to meet its fundamental goals. Changing abundance and distribution of fish stocks and other climate change impacts on marine and coastal ecosystems create new challenges for fishery productivity, ecosystem health and the well-being of fishery-dependent communities, while exacerbating impacts from other threats such as overfishing and habitat degradation. Sea level rise and increased storm intensity further threaten coastal communities that must respond to compounding stressors including infrastructure damage, reduced fishing access, conflicts resulting from new species distributions and more.^{6, 7, 8, 9} The interplay between climate change impacts on communities and a management system struggling to adapt renders both fisheries and their communities increasingly vulnerable.



ROADMAP FOR U.S. CLIMATE-READY FISHERIES

This roadmap identifies eight comprehensive actions to achieve U.S. climate-ready fisheries. Each action includes recommendations and tactics for decision makers at the national and regional levels (NOAA Fisheries, regional fishery management councils and Congress). Given the diversity of fisheries in the U.S., we recognize that certain actions, recommendations and tactics may be more applicable to some fisheries than others and that additional recommendations or tactics may be necessary to achieve climate-ready fisheries nationwide. The goal is that this roadmap serves as a guide for managers, decision makers and stakeholders in their efforts to adapt the fishery management system to climate change.

Action 1: Develop a robust understanding of climate impacts and a vision for change

Employ a multi-disciplinary approach to build a foundation of knowledge and a shared vision that support proactive and adaptive management.

A critical step in this effort is for NOAA Fisheries to establish a clear vision for U.S. climate-ready fisheries, including metrics to evaluate success, in a formal policy that can guide national and regional decision making and funding. Having a vision for climate-ready fisheries will help ensure management is grounded in science and build consensus and support among fishery managers and stakeholders, which is critical to successful management.¹⁰ With climate readiness prioritized, U.S. fisheries will better withstand future uncertainties and better support sustainable livelihoods, marine biodiversity and ecosystem resilience.

The Marine Fisheries Advisory Committee, a diverse group of stakeholders that advises the Secretary of Commerce and NOAA Fisheries, has noted two key challenges to advancing climate-readiness in fisheries:

1. The lack of clear definitions for concepts such as climate-ready fisheries, climate-ready fisheries management and climate-ready fishing communities creates ambiguity and stymies collaborative adaptation among scientists, managers and stakeholders.
2. The science-to-management gap negatively impacts the full use of climate science and information in management.¹¹



Even with a clear vision, fisheries management is only as strong as the science that underlies decision making. Despite the increasing frequency of devastating climate impacts on fisheries and fishing communities, fishery managers still have an inadequate understanding of the drivers of change and what to expect for the future of our fisheries and ecosystems. A diverse, multi-disciplinary approach is critically needed to support informed decision making that accounts for change and mitigates risk.¹²

Fishery science, monitoring and data collection systems must adapt to the scale and pace of climate impacts, and managers must embrace new tools and approaches that facilitate more holistic decision-making. This calls for a movement away from localized, single-species approaches toward ecosystem-level understanding.^{13, 14, 15} It requires broad investment in and adoption of tools that NOAA Fisheries is already advancing but needs to continue to progress, such as climate vulnerability assessments,¹⁶ ecosystem assessments,¹⁷ risk tables and other qualitative approaches¹⁸ and socioeconomic approaches.^{19, 20}

NOAA Fisheries and councils are making progress to embrace a multi-disciplinary approach in meeting their mandate to use the “best scientific information available.” It is increasingly recognized that this must include multiple knowledge systems to enable more holistic understanding of and rapid response to ecosystem change.²¹ Broader adoption of participatory tools and approaches is needed to elevate Indigenous and fisheries ecological knowledge, which can help address the diverse impacts on communities’ livelihoods, subsistence, traditions and lived experiences and facilitate their unique adaptive responses.

NOAA Fisheries should encourage and guide councils to integrate data-rich tools such as climate and stock assessment modeling with data-limited tools, qualitative data and other sources of information.²² For example, in the Mid-Atlantic, annual fishery performance reports summarize “on-the water” observations from fishermen, including environmental changes and information about fishing efforts and market trends.²³ These reports provide managers and scientists with information that may not otherwise be captured by stock assessments.

Action 1: Develop a robust understanding of climate impacts and a vision for change

Recommendations and Tactics	NOAA Fisheries	Councils	Congress
Develop and implement a formal Climate-Ready Fisheries Policy with clear principles, goals and objectives to guide national and regional decision-making processes, as recommended by the Marine Fisheries Advisory Committee²⁴	●	●	
Develop clear definitions for climate-ready fisheries, climate-ready fisheries management and climate-ready fishing communities	●	●	
Require and provide guidance for fishery management plans to consider and incorporate environmental changes associated with climate change as best scientific information available	●		●
Provide robust funding for NOAA Fisheries and regional fishery management councils to ensure sustainable and equitable U.S. fisheries for the benefit of the nation by adapting science and management programs to account for climate change			●
Identify the long-term resources needed for NOAA Fisheries to advance the Climate, Ecosystems and Fisheries Initiative	●		●
Continue to develop a shared understanding of the ecological, social and economic impacts of climate change on fisheries, assessing heightened risks from extreme events and long-term shifts as well as ecosystem and community vulnerabilities (e.g., through climate vulnerability assessments, ecosystem risk assessments, etc.)	●	●	
Complete a comprehensive review of data infrastructure and systems to more effectively bridge science and management processes	●	●	
Develop climate-related terms of reference for all stock assessments and peer review	●	●	
Utilize hindcasting and forecasting approaches (e.g., management strategy evaluations) to test potential outcome scenarios and identify tools for adaptive management	●	●	
Regularly update maintain and utilize the Community Social Vulnerability Indicators Toolbox ²⁵	●	●	
Invest in social science capacity and employ interdisciplinary scientists who can bridge the gaps between social and natural sciences	●	●	
Require lessons on climate change and ecosystem-based fisheries management as part of council member training programs	●	●	
Develop mechanisms to solicit diverse stakeholders' ecological knowledge	●	●	
Engage stakeholder knowledge via participatory processes such as scenario planning or conceptual modeling workshops	●	●	
Develop guidance, support tools and training for incorporating Indigenous knowledge and fisheries ecological knowledge into science and management	●	●	
Collaborate with fishermen, communities, industry members and others to identify climate-ready data needs and opportunities for research partnerships	●	●	
Better engage advisory panels (e.g., through fishery performance reports) to provide qualitative on-the-water information to councils and Scientific and Statistical Committees	●	●	

Action 2: Embed equity and environmental justice in all levels of fisheries management

Identify and address gaps in scientific inquiry and management pathways to critically evaluate where improvements and modifications can help achieve more equitable, collaborative and fair fisheries systems.

Climate change interacts with and exacerbates existing equity and environmental justice (EEJ) challenges in U.S. fisheries. Incorporating EEJ into fisheries management is an important priority no matter what but has become even more urgent due to climate change. Underserved communities are often disproportionately burdened by the impacts of climate change with the most severe impacts on their livelihoods, infrastructure and overall well-being. Communities with less access to resources may have less agency and fewer means to adapt to change. This inability to adapt can interfere with sustainability efforts, as can disruptions and instability resulting from inequity.

In 2023, NOAA Fisheries published its EEJ Strategy to define the agency's commitment to EEJ and guide the agency in serving all communities more equitably and effectively, with a focus on underserved communities.²⁷ This strategy and other scholarship about EEJ in fisheries recognize that while the U.S. fisheries management process strives to be an open, transparent public process, even stakeholders who regularly participate can feel alienated or disenfranchised.²⁸ By identifying EEJ concerns in science and management processes, managers can be better positioned to understand and address community challenges in the face of climate change, particularly for those that are underserved.

This will require investment in social science capacity throughout the science and management process, as well as dedicated efforts to foster and rebuild trust among communities. Participatory processes that engage diverse perspectives, and are built on social capital, can increase cooperation between actors, increase transparency through more information sharing and increase capacity to inform management decisions – factors that help contribute to maintaining resilience.²⁹ Importantly, opportunities should not only be identified to improve participation in management but also to diversify leadership. The EEJ Strategy provides an important foundation, and sustained efforts are needed to ensure all fishery policies adhere to it.

Underserved communities are those “that have been systematically denied a full opportunity to participate in and benefit from aspects of economic, social, and civic life, which include geographic communities as well as populations sharing a particular characteristic, history, or identity.”²⁶

Action 2: Embed equity and environmental justice in all levels of fisheries management

Recommendations and Tactics	NOAA Fisheries	Councils	Congress
Ensure all policies and procedures reflect and incorporate the core areas and objectives of NOAA Fisheries' EEJ Strategy and regional implementation plans	●	●	
Define specific and measurable (when possible) equity goals and objectives for management actions	●	●	
Conduct research to clearly identify underserved communities, including Indigenous communities and tribes, and understand their needs to adapt to change	●	●	
Develop and refine methods for elevating diverse forms of knowledge into decision-making processes, ensuring that all relevant perspectives are considered	●	●	
Hire community liaisons or engagement teams to build stronger, consistent connections between communities and the fishery management process	●	●	
Invest in and develop participatory processes for community engagement (with a focus on underserved communities) outside of the action-based council process to regularly gather information on climate impacts with clear feedback loops to council decision making	●	●	
Provide staff with the necessary knowledge, skills and tools, and adjust internal workflows as needed, to better engage with and support diverse communities	●	●	
Expand options and provide supportive funding to facilitate communities' equitable participation in the council process, particularly on advisory panels (e.g., stipends for missed days fishing, split seats, etc.)		●	●
Diversify leadership and participation in management processes to ensure fair and balanced representation	●	●	
Ensure committees and advisory panels reflect diverse sectors and communities involved in each region's fisheries, including underserved communities, young fishermen and women		●	
Support more transparent and equitable decision-making processes for council appointments, including tribal participation	●	●	●



Action 3: Optimize the management process to be more responsive, adaptive and proactive

Map current fisheries management processes to identify and address opportunities and obstacles for implementing adaptive policies, ensuring a more streamlined and nimbler management system.

Despite numerous reports and data about the impacts of climate change on fisheries, their use in management has been limited. As of 2022, only 26 percent of federal fishery management plans considered climate-related information, and most fishery managers were unaware of climate initiatives being implemented outside their regions.³⁰ Possible obstacles to incorporating climate-related information into management include a simple lack of awareness of information, isolated or siloed processes and narrow policy windows.^{31, 32}

Given the rapid environmental shifts associated with climate change, managers need to overcome these obstacles and quicken the pace of decision making to achieve climate-ready fisheries while still ensuring inclusive and equitable approaches. This is a tension that will require carefully delineating roles and processes. A useful first step is to map management processes and structures to identify information “on-ramps.” For example, the North Pacific Fishery Management Council’s Climate Change Task Force³³ worked to identify where and how climate information was – or was not – being incorporated into decision making. Through this process, the Task Force was able to clarify what information was needed in decision making and how to provide it to managers in a timely manner to improve efficiency and effectiveness.

Limited resources, competing priorities and negative perceptions also pose a challenge to incorporating new information into the management process. Managers, however, can “work smarter, not harder” by aligning climate initiatives within existing management mandates and processes.³⁴ For example, managers could develop climate-related terms of reference in stock assessments or identify opportunities for cross-regional collaboration. Managers can also pilot initiatives in healthy or lower-risk stocks to demonstrate and generate buy-in for adaptive approaches, including the potential to support increased fishing opportunities. While incorporating climate change considerations in management may currently feel additive, it will need to become business as usual.



Action 3: Optimize the management process to be more responsive, adaptive and proactive

Recommendations and Tactics	NOAA Fisheries	Councils	Congress
Assess management processes through conceptual modeling or other methods to identify and create on-ramps for integrating climate information into near- and long-term decision making	●	●	
Conduct a comprehensive review of internal management processes and timelines to identify and correct inefficiencies that interfere with timely responses	●	●	
Identify opportunities to account for data and management lags related to stock assessments such as by utilizing scientific and management uncertainty buffers as assessments become outdated, integrating ecological considerations into buffers and aligning specification timelines with stock assessments	●	●	
Fund and develop a climate-ready fisheries innovation program at NOAA Fisheries to develop innovative tools and approaches to management under climate change	●	●	●
Together with affected parties, develop strategies for cross-jurisdictional collaboration and conflict management particularly in response to challenges with shifting stocks	●	●	●



Action 4: Advance technological and collaborative solutions for data collection and research

Enhance data collection, research and survey efforts to support effective and collaborative fisheries management tools and solutions.

Timely and reliable data is the foundation of effective fisheries management, and federal law requires that management measures be based on the best scientific information available.³⁵ In practice, this means that managers frequently rely on long-running monitoring regimes that produce time-series data to inform management decisions. Nevertheless, even in relatively data-rich fisheries, lack of adequate data to inform management is often cited as a challenge, while fishermen may perceive that surveys are not conducted in appropriate habitats or with unbiased gear and practices. This challenge is now compounded by changing ocean conditions, which increase uncertainty in our estimation of critical parameters to determine total allowable catch and other management decisions. To adapt, managers, scientists and stakeholders will need access to data and information that supports more forward-looking decision making, necessitating new data collection, potential expansion of existing efforts and collaboration across jurisdictions and borders. This is a paradigm shift that is necessary but must occur within difficult funding, staff and time constraints.

Citizen science can greatly expand the scale and scope of fisheries data collection by leveraging those who have “eyes on the water” and a stake in sustainable management outcomes. These programs can help bridge the gap between scientists, managers and the public, increasing community buy-in³⁶ to climate-ready management and the representation of diverse stakeholders within management processes.

Technological advances also present an opportunity to increase and improve data collection in U.S. fisheries. Electronic monitoring, electronic reporting and modern data management systems are cost-effective tools that can support more responsive management and increased accountability. Many other innovations such as autonomous underwater vehicles, eDNA and artificial intelligence also hold promise for bringing U.S. fisheries science and management into the 21st century.

Use of new technologies in fisheries has increased in recent years, but uptake and implementation have still been slow and inconsistent between regions. A more cohesive, strategic approach to modernizing fishery data systems — including the infrastructure to support the use of data in management decisions — can help improve coordination among regions and ultimately improve science, enhance enforcement, increase safety, support more traceable seafood supply chains and promote fisheries resilience.

Citizen science programs can be implemented in a range of scientific frameworks:

Contributory research: Scientists determine which data are required and engage citizens to collect those data. Experimental design, data validation and standardization tasks are conducted by scientists.

Collaborative research: Citizens and scientists form an intellectual partnership where citizens are incorporated into all phases of research, including the development of research questions and hypotheses.

Co-created research: Citizens are closely involved in all phases of research and also participate extensively in the implementation of scientific findings into fisheries management processes.



Action 4: Advance technological and collaborative solutions for data collection and research

Recommendations and Tactics	NOAA Fisheries	Councils	Congress
Prioritize and fund national, coordinated efforts to modernize fishery data collection and infrastructure, with established procedures for increased utilization of electronic technologies	●		●
Strategically advance regional implementation of electronic monitoring and reporting in key fisheries where practical and cost effective ³⁷	●	●	
Invest in innovations to improve the cost effectiveness of electronic monitoring and reporting, including streamlined use of electronic data	●	●	●
Embrace opportunities to support and expand collaborative approaches in federal science and research efforts	●	●	●
Utilize exempted fishing permits, cooperative research, study fleets and citizen science to fill key data gaps	●	●	
Develop the capacity and infrastructure needed to support the long-term storage, management and quality control of citizen science data sets	●		
Provide robust funding for collaborative research and citizen science to fill key data gaps, including appropriate compensation for contributors			●

Action 5: Utilize responsive harvest strategies and catch limits to support long-term sustainability and resilience

Evaluate and adopt responsive measures to manage human impacts on fish populations.

Climate-ready fisheries, first and foremost, rely on strong implementation of the MSA's core conservation and management requirements to prevent overfishing, rebuild overfished stocks, protect habitat and more. The MSA provides a strong foundation to support healthy, diverse fish populations and vibrant communities that will need to be maintained and, ideally, strengthened to support resilience.

To sustainably control fishing pressure, managers use various forms of harvest control rules to set annual catch limits. As climate change alters the productivity and distribution of fisheries, managers will need to ensure that fishing pressure – and therefore catch limits – is responsive to the impacts.

Using harvest control rules that vary according to changes or thresholds in stock status, bycatch or environmental factors can reduce the risk of overfishing, particularly under climate change.³⁸ When formal stock assessments are not available, managers should use other appropriate tools, such as empirical harvest control rules, to support decision making. While the increased uncertainty associated with climate change calls for a precautionary management approach, responsive harvest control rules can help managers reduce catch as well as increase fishing opportunities as appropriate.

Climate-ready fisheries also necessitate continued commitment to ensuring all fishery participants are held accountable to the regulations, such as through monitoring of catch and through reliable and appropriate enforcement.

Action 5: Utilize responsive harvest strategies and catch limits to support long-term sustainability and resilience

Recommendations and Tactics	NOAA Fisheries	Councils	Congress
Maintain steadfast commitment to preventing overfishing, rebuilding overfished stocks, minimizing bycatch and protecting essential fish habitat in compliance with federal law	●	●	●
Implement measures to ensure accurate and timely catch accounting to prevent overfishing, including 100% at-sea monitoring in catch share fisheries	●	●	●
Prioritize legislative updates that increase accountability for stock rebuilding and precautionary management			●
Hold agency accountable (e.g., through oversight hearings) to the core principles of science-based and sustainable fisheries management, including requirements to prevent and end overfishing			●
Update management approaches for setting annual catch limits to more effectively respond to changing conditions	●	●	
Implement harvest control rules that are responsive to shifts in biomass and the impacts of climate change	●	●	
Leverage empirical harvest control rules where appropriate to facilitate precautionary decision making for stocks that lack formal stock assessments	●	●	
Proactively develop measures to monitor, collect data on and manage catch of new and emerging fisheries	●	●	



Action 6: Employ community-based management approaches

Evaluate and adopt management approaches that facilitate proactive planning and decision-making processes to improve community preparedness for and response to the impacts of changing ocean conditions, including extreme events.

The primary way that councils and NOAA Fisheries can support communities in the face of climate change is by satisfying their mandate to prevent overfishing and rebuild overfished stocks, but there are additional ways managers can ensure that fishermen and fishing communities have the tools and resources necessary to combat climate impacts.

To help build community resilience, managers should seek opportunities to support socio-economic flexibility – e.g., individuals’ or communities’ abilities to switch target species, fishing grounds or livelihoods – through expanding individual or community agency.³⁹ For example, flexible multi-species permits or community-led workforce development programs could empower communities to be more adaptive in the face of climate stressors and opportunities. Loss of access to shoreside infrastructure due to broad demographic, market and climate trends significantly limits fishing communities’ economic opportunities, so efforts to support working waterfronts are another key strategy to build community resilience.

For fisheries managed under catch shares, which are already a relatively flexible system, community agency and rapid responses could be enhanced via community quota trusts or banks and innovations to facilitate the flow of shares among fishery participants and to new entrants. Quota allocations are another mechanism to consider for readying fishing communities for climate change because allocations directly impact who gets to access the resource. Allocations are often based on proportional historical participation, but climate-driven departures from historical conditions can then lead to unfair, inequitable and inefficient resource use.^{41, 42, 43} Climate-ready fisheries will depend on procedures for adapting quota allocation policies so that they continue to advance conservation and equity objectives despite changing ocean conditions.



Action 6: Employ community-based management approaches

Recommendations and Tactics	NOAA Fisheries	Councils	Congress
Improve mechanisms and increase funding to support community response and adaptation to acute and long-term impacts of climate change, including declared fishery disasters	●	●	●
Pursue strategies to more readily facilitate shifts in fishery participation, target species and harvest levels through streamlined quota transfers, permitting innovations (e.g., permit splitting) and opportunities for new entrants	●	●	
Support fishermen and communities in utilizing adaptive capacity of catch share programs to facilitate rapid response to climate-induced challenges (e.g., community quota trusts or banks, risk pools, geographic-based management, etc.)	●	●	
Assess the vulnerability of recreational and tourism-based businesses in management actions, including aligning with the priorities of the Saltwater Recreational Fisheries Policy ⁴⁴	●	●	
Conduct education and outreach to communities and councils on shifting stocks, market dynamics and risks and opportunities regarding climate impacted species	●		
Develop allocation systems that prioritize equity, recognize historical dependence and incorporate adaptive measures that lead to conservation of the resource and ensure transparent co-management⁴⁵	●	●	
Invest in research and innovations around adaptive allocation policies that account for climate-driven range and abundance shifts of species	●	●	●
Develop strategies for anticipating and buffering impacts on working waterfronts and seafood markets resulting from management action	●	●	
Provide robust funding to support resilient working waterfronts and markets, including shoreside infrastructure and domestic processing capability			●



Action 7: Implement ecosystem-based fisheries management

Adopt ecosystem-based management practices that consider the interdependencies within and across marine ecosystems and human communities to promote sustainability and climate resilience.

Traditionally, fisheries management has taken a single-species approach, with limited to no consideration of interactions with other species or environmental variables. In recent years, though, managers have been working toward and developing approaches for ecosystem-based fisheries management (EBFM)^{46, 47}— a holistic approach that considers the entire ecosystem, including human communities, associated with a managed species. EBFM is a strong and streamlined opportunity to incorporate climate considerations into management and support resilience, though it must be implemented with urgency to adequately address climate impacts on fisheries and communities.

NOAA Fisheries defines EBFM as “a systematic approach to fisheries management in a geographically specified area that contributes to: the resilience and sustainability of the ecosystem; recognizes the physical, biological, economic, and social interactions among the affected fishery-related components of the ecosystem, including humans; and seeks to optimize benefits among a diverse set of societal goals.”⁴⁸

NOAA Fisheries asserts that EBFM is “the preferred way for the agency to meet its mandates to sustainably manage the nation’s trust living marine resources...”⁴⁹

EBFM can yield multiple benefits. It facilitates consideration of social and ecological trade-offs, improves understanding of the ecosystem, allows for forecasting of pressures and management action outcomes and supports a more stable, effective management framework.⁵⁰ Studying and understanding ecosystem interconnections can also help manage and mitigate unintended consequences due to human intervention.⁵¹ By managing for the diversity and connectivity of species, habitats, bycatch and more, EBFM can help promote resilience, enable recovery from disturbance and adapt to ongoing change.⁵²

NOAA Fisheries recently updated its EBFM Policy and Roadmap, which recognizes the importance of holistic management amidst shifting ocean conditions to maintain resilient and productive ecosystems and community well-being.⁵³ Overall progress to implement EBFM in U.S. fisheries, however, has been slow. A steadfast commitment to EBFM implementation — consistent with the robust actions outlined in NOAA Fisheries’ EBFM Policy and Road Map — on a timeline that keeps pace with the impacts of climate change on U.S. fisheries and communities is necessary.

Action 7: Implement ecosystem-based fisheries management

Recommendations and Tactics	NOAA Fisheries	Councils	Congress
Promptly advance efforts to implement ecosystem-based fisheries management as outlined in NOAA Fisheries' EBFM Policy and Road Map	●	●	
Prioritize data collection that supports development of ecosystem and social indicators in all regions	●		
Employ a range of fixed and dynamic protections for essential fish habitat to support healthy populations in response to climate-driven shifts	●	●	
Update NOAA Fisheries' bycatch reduction implementation plan with measurable performance goals and develop a plan for reporting bycatch estimates, as recommended by the Government Accountability Office ⁵⁴	●		
Strengthen legislative mandates for EBFM, including requirements to protect essential fish habitat and minimize bycatch			●
Provide robust funding to support fisheries observer programs for catch, bycatch and protected species			●



Photo credit: Greg McFall for NOAA Fisheries

Action 8: Promote transparency and effective communication

Improve both internal and external mechanisms that facilitate information-sharing and stakeholder engagement to ensure effective participation in and implementation of management.

Sustainable and equitable fisheries management relies on clear communication with stakeholders. Effective public engagement in complex fishery science and management processes can require an extensive investment of time and resources. Although regional fishery management councils were established to create a more accessible decision-making process, the technical nature of discussions creates a barrier to public participation. When managers ensure stakeholders understand the rationale behind management decisions, they can build trust and encourage support for regulations, rather than skepticism and non-compliance.

To improve accessibility for diverse stakeholders, fishery managers should increase transparency and effective communication around management decisions and their scientific foundations. Open dialogue enables managers to gather valuable feedback and adapt policies based on real-world implications and local knowledge. A valuable communication strategy to support trust-building is to frame management issues in terms of local priorities and stakeholders' experiences.⁵⁵ This can increase collaboration on management challenges and improve the overall capacity and legitimacy of the management system.⁵⁶

It is equally important to ensure transparent and effective communication among managers. NOAA Fisheries has a key role to play in facilitating cross-regional learning across the councils as well as between councils and NOAA Fisheries to ensure best practices and lessons are more readily shared. This collaborative exchange can lead to innovative strategies tailored to the unique challenges of each region, while also building upon the successes of individual regions. By fostering a network of cooperation and knowledge-sharing, fishery managers can create a more cohesive and responsive management framework that better addresses the diverse needs of U.S. fisheries.

Effective internal and cross-regional communication and transparency not only support resilience by enabling information flow for learning and decision making but also helps to fairly distribute the benefits and costs of fisheries management actions. These efforts can enhance the legitimacy of management actions and foster a more collaborative and effective fisheries management framework in a changing climate.^{57, 58, 59}

Action 8: Promote transparency and effective communication

Recommendations and Tactics	NOAA Fisheries	Councils	Congress
Develop guidelines and protocols to clarify and improve information flows, including how managers disseminate information and how public comments are integrated into decision making	●	●	
Present information in a manner that facilitates engagement (e.g., plain language summaries with limited use of jargon and unnecessary complexity)	●	●	
Purposefully design communication campaigns and strategies to include underrepresented communities and diverse audiences	●	●	
Increase opportunities for diverse fishermen to access trainings about the science and management processes	●	●	
Establish a formal knowledge-sharing mechanism to facilitate cross-regional learning and to coordinate climate-related efforts across councils and between NMFS regions and councils on an ongoing basis	●	●	



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For questions, please contact

Allison Shields
ashields@edf.org

Matthew Seeley
mseeley@edf.org

