2. National

2.1 Introduction

Much of the focus in implementing the NCSS centers around a regional approach; addressing locally specific climate impacts and information needs and building regional capacity and partnerships to address goals under each of the seven main NCSS objectives (Figure 1.1). Though each region has specific science and management goals and capacities, there are a number of actions that address needs in all regions and are able to be addressed by taking a more national approach. Unlike the Regional Action Plans, there was not a specific “National Action Plan” developed and published in the same manner. Rather, a variety of priority or recommended actions in the NCSS lend themselves to national level efforts, and goals and metrics to accompany these were developed internally. National Offices and Programs also directly (e.g., funding) or indirectly supported the RAP efforts. The following sections present a synthesis of the national-level goals, activities, and achievements organized under each of the seven main objectives. The seven objectives are organized into a pyramid in order to depict that each objective supports those above it, and that climate-readiness depends on an integrated suite of capabilities from production of information and climate-informed advice, to effective use of that information in decision making. As such, the goals and activities will be described from the bottom to the top in numerically descending order of objectives.

2.2 Activities and Progress

Build and Maintain Infrastructure (Objective 7)

NOAA Fisheries is a service-based organization responsible for the stewardship of the nation’s ocean resources and their habitats. U.S. fisheries are among the largest and most sustainable in the world, due in large part to a science and ecosystem-based approach to management. NOAA Fisheries depends on its network of five regional offices, six science centers, and more than 20 laboratories across the U.S. and its territories to provide high quality advice to resource managers. However, the NCSS identified a clear need for increased capacity to better understand changing climate and ocean conditions and their impacts on the nation’s valuable living marine resources. Fulfilling this need requires a multi-pronged approach, including identifying and filling workforce, observational, and data gaps; better coordinating new and existing programs; and fostering and expanding the many valuable collaborations NOAA has with international, state, and local partners.

Goal(s)

Several specific goals were identified to help identify needs and actions and to build capacity to conduct climate-related research:

1. Complete and begin implementing NCSS RAPs in six regions by 2018
2. Maintain a nationally coordinated group of regional teams to promote and support climate activities within and across regions
3. Increase capacity for conducting management strategy evaluations (MSEs) in six regions by 2020, specifically through having a dedicated person in each region
4. Expand engagement with international partners

Activities – highlights
A number of actions to reach the goals were conducted over the past five years. Highlights of several are listed below.

● RAP teams were established soon after the 2015 publication of the NCSS. The teams worked with regional partners to develop, publish, and begin implementing seven RAPs, including five in 2016 (Bering Sea, Gulf of Mexico, Northeast, Pacific Islands, West Coast), one in 2018 (Gulf of Alaska) and one in 2020 (South Atlantic). Additional details are provided in each of the regional sections of this report.

● “Climate Quarterly” meetings - Along with the establishment of RAP teams, there has been a coordinated effort to hold quarterly teleconferences with people conducting climate-related activities across the regions. There are currently about 60 individuals from across the Science Centers, Regional Offices, and NOAA Fisheries headquarters offices that are invited to share information on recent and upcoming climate-related activities. More formally, the RAP teams develop annual progress reports that are presented to regional leadership as well as to the NOAA Fisheries Science Board to provide continued awareness of accomplishments and needs.

● MSE capacity - Dedicated funding has allowed each Center to hire a full-time employee for MSE development and build capacity in their region.

● International partners - A new framework between NOAA Fisheries and Fisheries and Oceans Canada was established to increase collaboration to understand and respond to climate impacts on fisheries (2019). Additionally, NOAA Fisheries, along with many international partners, hosted and co-organized the 4th International Symposium on the Effects of Climate Change on the World’s Oceans\(^2\) (2018).

Progress summary
Overall, there was great progress made in achieving the stated goals. Establishment of NMFS Regional Climate Teams and RAPs provided a positive framework that helped increase coordination, collaboration, and implementation of regional efforts towards national goals. Individual RAPs have been developed for seven regions and there is an active community of researchers in each region conducting climate-related research and other activities to address their specific needs. However, there is continued need to increase research capacity. Collaborations with federal, state, local, and international partners have helped increase this capacity, but it has not yet caught up with the demand for information needed by decision-makers.

Tracking Change (Objective 6)

NOAA Fisheries’ world-class science-based enterprise is dedicated to the collection of environmental and fisheries information used to produce data-based assessments of fish stocks

\(^2\) [https://meetings.pices.int/meetings/international/2018/climate-change/background](https://meetings.pices.int/meetings/international/2018/climate-change/background)
and status of other living marine resources. In many cases, however, climate and environmental information is not explicitly incorporated into the assessments. Outside of direct incorporation in stock assessments, reports of ecosystem status and trends can provide important environmental context for managers when making decisions, can provide early warnings of improving or declining conditions, and provide commonly needed climate-related data inputs for species and ecosystem models.

Goal(s)
Specific goals to better track and report on changes to climate and ocean conditions include:
1. Establish and strengthen Ecosystem Status Reports (ESRs) in 6 regions by 2020
2. Annually track and report on the distribution of major fish stocks in each region

Activities – highlights
- Ecosystem Status - Through support from NOAA’s Integrated Ecosystem Assessment (IEA) program, many regions have produced an Ecosystem Status Report (ESR) or State of the Ecosystem report. The ESRs use a suite of indicators (e.g., physical, biological, human dimension) to provide decision-makers with information on past and current ecosystem conditions. They are produced for resource managers and stakeholders such as the Fishery Management Councils, National Marine Sanctuaries, state governments, and other marine resource management organizations. ESR production has increased over time and ESRs are produced in all five NOAA IEA program regions (Figure 2.1), some annually and others on longer timescales ranging up to every four years. Examples of regional reports and publication years are as follows: California Current (2016 - present); Gulf of Mexico (2013, 2017) and Florida Keys National Marine Sanctuary (2019); Northeast U.S. shelf (2002, 2009, 2011, 2018-present; includes Mid-Atlantic); West Hawai‘i (2016, 2019); Alaska (1999 - present; sub-regions separated out starting in 2016 to now include Eastern Bering Sea, Gulf of Alaska, and Aleutian Islands).

- Marine Ecosystem Indicators Portal - A national marine ecosystem status web portal (https://ecowatch.noaa.gov) was developed to provide stakeholders with easy access to data and information to track changes in their marine ecosystems.

3 IEA program webpage with links to the ecosystem status reports - https://www.integratedecosystemassessment.noaa.gov/national/Ecosystem-Status-Reports
Figure 2.1. IEA supported Ecosystem Status Reports in five IEA program regions. Different regions produce ESRs on different timescales, from annually to every four years. 2020 was still in progress when this figure was created.

- Tracking species distributions - In 2014, Rutgers University and NOAA Fisheries launched the OceanAdapt website and database to provide information on the distribution of marine species in U.S. waters. The site was specifically designed as a tool to provide decision-makers, educators and others with information on past, current, and possible future changes in distribution of fisheries-related species based on fish survey data from NOAA Fisheries and other sources. Since the initial launch, the partnership has updated the site annually with new information from NOAA trawl survey data. The dataset was recently expanded to include historic data on fish stock distributions in some Canadian waters through collaboration with Fisheries and Oceans Canada.

**Progress summary**

Focused efforts have helped to establish ESRs in five new regions/sub-regions since 2015 while also expanding data collection, synthesis, and reporting and increasing the frequency of reporting of some previously established regional ESRs. There are currently ESRs available for eight regions/sub-regions, with many updated annually (NOAA, 2021). Following a national workshop in 2017, additional effort has been put into developing more automated procedures for some of the time-consuming operations that are performed in all regions, such as assembling data and plotting indicator trends. Two fishery management councils (NEFMC, NPFMC) request annual updates on ecosystem status and incorporate the information provided by the ESRs.

Tools such as OceanAdapt (https://oceanadapt.rutgers.edu) have proven to be quite valuable in terms of being able to visually show trends in the spatial distribution of fish stocks. Several fishery management councils have expressed the need to better understand current and future species distributions so as to have better information for addressing allocation concerns as species move across management jurisdictions.
Understanding Mechanisms (Objective 5)

Species, ecosystems, habitats, and human systems are affected by climate related changes in both positive and negative ways. Having a mechanistic understanding of how and why these different components are affected provides a basis for being able to assess vulnerability, risk, and adaptive capacity. Developing this mechanistic understanding requires process-based research that requires capacity and investment. Strong partnerships with research institutions and other NOAA Line Offices are critical to being able to leverage expertise and resources and make substantial progress. Resulting information and tools such as vulnerability assessments provide key information to help prioritize where additional science is needed and where management efforts may need to be focused.

Goal(s)

Several goals were identified to help better understand mechanisms and develop products to convey vulnerability of LMRs to changing climate and ocean conditions.

1. Advance understanding of climate-related impacts on fish stocks and fisheries
2. Complete fish climate vulnerability assessments (CVAs) in 6 regions by 2020
3. Complete Protected Species CVA for marine mammals and sea turtles by 2020

Activities – highlights

- **COCA-NOAA Fisheries partnership**[^4] - NOAA Fisheries has partnered with the NOAA Research Climate Program Office through their Coastal and Ocean Climate Applications (COCA) program to fund research on the impacts of climate on fisheries and fishery-dependent communities. This has been a valuable partnership, with the majority of the funding for the program provided by NOAA Research but focused on addressing NOAA Fisheries needs. The program releases a notice of funding opportunity (NOFO) every 2-3 years. The initial NOFO (FY15) focused on funding research to better understand mechanisms of climate impacts on fisheries in the NE region and the impact on fishery-dependent communities. The next competition (FY17) included the NE/Mid-Atlantic and California Current. In FY19 the focus was on resilience of NE fishing communities. The most recent NOFO (FY20) included the NE, California Current, Bering Sea, and Gulf of Alaska.

- **Vulnerability Assessments**[^5] (fish stocks, habitats, protected resources including mammals, turtles) - NOAA Fisheries completed the methodology for assessing the climate vulnerability of fish stocks in 2015 and committed to completing fish stock climate vulnerability assessments in at least six regions by 2020. The first fish stock climate vulnerability assessment was completed in the Northeast region in 2016. Similar assessments have been completed in five other regions (Southeast, Gulf of Mexico, Bering Sea, West Coast, Pacific Islands). In 2019 NOAA Fisheries completed the methodology for conducting climate vulnerability assessments for marine mammals. Since then marine mammal vulnerability assessments have been completed for the U.S.

[^4]: The COCA program was rebranded in 2021 to the Climate and Fisheries Adaptation (CAFA) Program. [https://cpo.noaa.gov/CAFA](https://cpo.noaa.gov/CAFA)

[^5]: NOAA Fisheries Climate Vulnerability Assessment web page - [https://www.fisheries.noaa.gov/national/climate/climate-vulnerability-assessments](https://www.fisheries.noaa.gov/national/climate/climate-vulnerability-assessments)
Atlantic and Pacific Coasts. Similarly, NOAA Fisheries completed methodologies for climate vulnerability assessments for sea turtles and habitats, and these assessments are on-going.

**Progress summary**

The COCA-NOAA Fisheries joint program has funded a modest number of projects in several regions (Figure 2.2). The seven projects funded in 2015 focused on climate impacts on fisheries in the Northeast. In 2017, five projects were funded across the California Current and Northeast. In FY19 there were five projects funded focused on resilience of Northeast fishing communities. The most recent set of projects, funded in FY20, consist of five projects that focus on developing integrated modeling frameworks to evaluate management strategies under different climate and ocean scenarios and inform climate-resilient fisheries management. Details of these projects are available through the program website ([https://cpo.noaa.gov/CAFA](https://cpo.noaa.gov/CAFA)).

**Figure 2.2.** Projects funded by the COCA-NOAA Fisheries joint program focused on advancing the understanding of climate-related impacts on fisheries and fishery-dependent communities.

Since 2015, NOAA Fisheries has developed methodologies to assess climate vulnerability for fish stocks, marine mammals, sea turtles, and habitats. NOAA Fisheries achieved the goal of completing fish stock climate vulnerability assessments in at least six regions, completed climate vulnerability assessments for marine mammals in both the Atlantic and Pacific regions, and is on track to complete climate vulnerability assessments for sea turtles and habitats by 2022.

**Projecting Future Conditions (Objective 4)**

Forward-looking management of LMRs depends upon robust projections of future ocean conditions and the response of species, ecosystems and socio-economic components. Developing these model-based projections and responses is a major challenge, particularly
when needing to down-scale to appropriate temporal and spatial scales relevant to management. Further, coupling across models to develop an integrated system that links physiochemical systems to marine resources and human communities and economies is not trivial. At a national level, efforts have been focused on developing partnerships and increasing resources to address model development and forecasting needs.

**Goal(s)**
1. Increase research focused on improving near-term forecasts and long-term projections
2. Identify gaps in needed information and capacity to project future climate and ocean conditions

**Activities – highlights**
- **MAPP-NOAA Fisheries partnership** - The Climate Program Office Modeling, Analysis, Prediction and Projection (MAPP) Program partnered with NOAA Fisheries Office of Science and Technology to fund research focused on improving the modeling of climate impacts on the predictability of fisheries and other living marine resources across a variety of time-scales. In FY17 the partnership funded eight projects under the Marine Prediction Task Force and in FY20 another 12 projects were funded under the Marine Ecosystem Task Force.
- **Climate and Fisheries Initiative** - Leadership from NOAA Research and NOAA Fisheries launched this initiative in early 2019 to develop recommended actions to address the NOAA Fisheries requirements for climate information under two timeframes: 1) near-term (near-real-time to decadal) and 2) longer-term (multi-decadal). Two expert teams developed a white-paper, finalized in April 2020, to report findings from the initiative. The white-paper outlines four specific actions to achieve the strategic vision of the initiative: 1) better utilize existing climate information, 2) advance NOAA’s regional modeling system, 3) establish communities of practice and regional teams, and 4) fuel innovation through targeted research. The next step is the development of an implementation plan for the recommended actions.

**Progress summary**
Valuable partnerships with NOAA Research have provided resources to advance global and regional climate predictions and projections. Improvements to modeling capabilities, as well as the development of applications and tools relevant to decision makers’ needs, continues to help advance our ability to be proactive in addressing climate impacts on fisheries.

**Informing management (Objectives 1 - 3)**

The top three levels in the Objective pyramid (Figure 1.1) focus on using science to create robust and flexible climate informed fisheries management advice. Integrating the science into the management process relies on an adaptive approach that includes close coordination between scientists and managers to better understand how climate variability influences
uncertainty, and to identify options for incorporating climate information. Options, including alternative management approaches and strategies, need to be considered and evaluated. The best management approaches for LMRs today may not be the best management practices in the future, and thus having the capability and desire to evaluate various strategies under future conditions will help determine the most robust course of action to pursue.

**Goal(s)**

1. Coordinate and facilitate MSE development across the regions
2. Identify the best insertion points to incorporate climate information into the science-to-management process
3. Better communication between scientists, managers, and stakeholders to understand needs and share information and resources

**Activities – highlights**

- An MSE Working Group was formed in 2016. The group comprises one individual from each Science Center who serves as the point of contact and lead for the Center’s MSE activities. Additional participants in the Working Group come from HQ and Regional Offices. The primary objective of the working group is to encourage and guide the development and use of MSEs throughout NOAA Fisheries Science Centers, Regional Offices, and Fisheries Management Councils.

- ICE-FM - A team of 26 scientists from across the Science Centers, regional offices, and headquarters formed the Incorporating Climate and Environmental Information into Fisheries Management (ICE-FM) Working Group. The group identified six key steps in the science-to-management process needed to better account for and respond to climate impacts on fisheries, associated challenges and limitations for each step, and recommended actions to overcome them. The findings were published as a NOAA Technical Memo and journal article (Karp et al., 2018, Karp et al., 2019).

- Support for scenario planning on multiple fronts. Scenario planning is a tool to help fisheries managers better understand where flexibility and adaptability will be needed in the management process. The Office of Protected Resources supported the NE Region’s pilot tests of the tool and helped develop a training course that has been offered at the U.S. Fish and Wildlife Service’s National Conservation Training Center (NCTC). The Office of Sustainable Fisheries published a Technical Memorandum of case studies to help introduce the idea to fisheries managers (Frens and Morrison, 2020).

- Conceptual models - The Office of Protected Resources developed conceptual models to better understand climate impacts on protected species.

- **Climate resource survey** - NOAA Fisheries worked with the Marine Fisheries Advisory Committee to identify the types of climate information needed by managers and stakeholders and how best to provide that information.

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Progress summary
There are a variety of opportunities for NOAA Fisheries to better address changing ocean conditions in the science-to-fisheries management process, as identified by the ICE-FM effort. Implementing the recommended actions will better equip NOAA Fisheries to provide proper stewardship of living marine resources. Through increased efforts to develop and utilize MSEs, NOAA Fisheries will be better able to provide managers with the information they need to make climate-smart decisions.

Other Activities
In concert with the goals and activities under each of the NCSS objectives, the national activities also include efforts to promote cross-regional and international collaboration and exchange of information to help increase the delivery and use of climate information in resource management and adaptation actions.

Goal(s)
1. Promote the exchange of climate-related activities and information across the regions and with national and international partners

Activities – highlights
- Climate Adaptation Leadership Awards - Established in 2016 through a partnership with the Association of Fish and Wildlife Agencies, these awards “recognize exemplary leadership by individuals, agencies, businesses, and other organizations to reduce impacts and advance adaptation of the nation’s vital natural resources in a changing world”.
- Climate Quarterly - Organize a regular teleconference (every three months) to allow NOAA Fisheries personnel working on climate-fisheries issues to exchange information on accomplishments and activities in their region.
- Effects of Climate Change on the World’s Oceans (ECCWO) 2018 - This international symposium is held every 4-5 years. In 2018, the 4th International Symposium was held in Washington, D.C. and was coordinated by a multi-organizational team consisting of NOAA Fisheries, PICES, ICES, IOC, and IMBeR and sponsored by over a dozen additional national and international organizations.
- National Climate Assessment - The 4th Assessment was released in 2018. NOAA Fisheries personnel helped coordinate the development of chapters on “Oceans and Marine Resources” and “Ecosystems, Ecosystem Services and Biodiversity”.
- Integration of climate change considerations into Essential Fish Habitat (EFH) conservation activities, including development of the national “EFH Climate Guide,” an internal white paper for resource managers; publication of regionally-specific climate change guidance for the EFH consultation process in the Greater Atlantic Region that has been socialized nationally and serves as a model document for other regional offices; and ongoing development of updated EFH climate change conservation recommendations for the Alaska region.

Progress summary
Over the last five years, the numerous national-level activities focused on raising awareness, exchanging ideas, and sharing information has facilitated national and international
collaborations and partnerships. These efforts have served to maintain and grow a community of practice of people working on climate and fisheries issues and has improved the capacity of NOAA Fisheries to address climate impacts on fish, protected species, fisheries, and fishery-dependent communities.

2.3 Conclusions

The progress made within each of the seven NCSS objectives has helped NOAA Fisheries be better prepared to respond to climate-related impacts on the Nation’s living marine resources. The design of the NCSS put much of the focus on implementation through customized RAPs that account for regional needs and capacities. The National-level activities, highlighted above and in Table 2.1 below, helped to support the implementation through facilitation, coordination, communication, funding, and the leveraging of resources through partnerships. As funding has been a limiting factor in fully implementing the NCSS, many valuable partnerships with other NOAA Line Offices (i.e., NOAA Research), academia, non-governmental organizations (NGOs), and State and local agencies have provided needed funding and other resources dedicated to reaching shared goals as efficiently as possible.

Activities over the next 3-5 years will continue to focus on maintaining and developing partnerships and resources to increase the production, delivery, and use of climate-related information in fisheries management. One of the challenges has been identifying how best to measure progress toward achieving each of the NCSS objectives. In coordination with the regional teams, effort will be made to develop performance measures (metrics and milestones) that incorporate key attributes (i.e. specific, measurable, achievable, relevant, time-bound) designed to better assess progress toward NCSS goals.

2.4 Acknowledgements

Contributors to this section include: Roger B. Griffis, Jay Peterson, and Wendy Morrison. Special thanks to the editors and authors of the NOAA Fisheries Climate Science Strategy as well as the numerous individuals within NOAA Fisheries who contributed to the many achievements highlighted in this report.
Table 2.1. Highlights of activities addressing National goals under the seven NCSS objectives.

<table>
<thead>
<tr>
<th>Informing Management (NCSS Obj. 1 – 3)</th>
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<tbody>
<tr>
<td>– Establishment of an MSE Working Group to guide and encourage development and use of MSEs in each region</td>
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<tr>
<td>– Identified on-ramps for climate information in the science-to-management process (ICE-FM)</td>
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<tr>
<td>– Support for scenario planning in partnership with OPR and OSF</td>
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<th>Understanding Mechanisms and Projecting Future Conditions (NCSS Obj. 4 &amp; 5)</th>
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<tr>
<td>– Fund research through the COCA-NMFS Climate and Fisheries program</td>
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<tr>
<td>– Vulnerability Assessments for fishery species, protected species, and communities</td>
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<tr>
<td>– Model development funded through the MAPP-NMFS partnership</td>
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<tr>
<td>– OAR-NMFS Climate and Fisheries Initiative to improve forecasting capability</td>
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<th>Infrastructure and Tracking Change (NCSS Obj. 6 &amp; 7)</th>
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<tr>
<td>– Establish and maintain capacity through coordination of RAP teams</td>
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<td>– Coordinate cross-regional communications – Climate Quarterly calls</td>
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<td>– Establish and promote international partnerships – DFO, ECCWO</td>
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<td>– Support Ecosystem Status Report development – IEA program</td>
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<td>– Species distribution tracking – Ocean Adapt</td>
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2.5 References


