NOAA FISHERIES
Northeast Fisheries Science Center

Ecosystem Science Program Review Northeast Fisheries Science Center Summary and Response to Ecosystem Science Review Recommendations November 2016

Introduction

In June 2016, five peer reviewers evaluated the Northeast Fisheries Science Center's ecosystem and climate science programs. The panelists were: Charles Stock (Chair), NOAA Geophysical Fluid Dynamics Laboratory, Princeton NJ; Cisco Werner, NOAA Fisheries Southwest Fisheries Science Center; Jeremy Collie, Graduate School of Oceanography, University of Rhode Island; Jon Helge Volstad, Institute of Marine Research, Norway, and Simon Jennings, Center for Environment, Fisheries, and Aquaculture Science, UK. The reviewers evaluated the Center's scientific programs that provide information relative to the management, protection, and restoration of resilient and productive ecosystems. These ecosystem-related science programs are those that study ecological, oceanographic, climate and habitat-related processes as they are linked to living marine resources (LMRs).

Center and agency leadership began the review by providing reviewers with an overview of national and regional strategic plans and goals with respect to ecosystem science. Center staff then provided overviews of the Center's ecosystem and habitat research programs, before providing more detailed information and presentations related to the full suite of the Center's ecosystem-related science programs, including research into climate-related forcing and impacts on LMRs, development and implementation of multispecies and ecosystem models, evaluation of social and economic interactions with climate and ecosystem dynamics, management strategy evaluation in an ecosystem context, and studies of ecosystem productivity. Center staff also described cooperative research efforts with industry and academic partners within these ecosystem research areas, as well as communication and reporting efforts to provide synthesized ecosystem research products and information to stakeholders and the public. The review concluded with presentations of a regional climate science action plan, the agency's roadmap for ecosystem based fishery management, and a panel discussion with LMR managers on how to use ecosystem science products in the resource management arena.

In their review, panelists were asked to consider eight core questions or terms of reference:

1. Does the Center have clear goals and objectives for an ecosystem-related science program? Is ecosystem-related science integrated with the other science activities across Divisions within the Center? Are the Center's ecosystem science and research activities appropriately prioritized and evaluated as part of an overall strategic plan?

2. Do the Center's ecosystem-related science programs focus on information to address the priority needs of the Regional Offices, other NOAA managers, Fishery Management Councils and Commissions, and other partners that require ecosystem-related information to achieve their mission?

3. Has the Center appropriately established a Regional Action Plan to identify the major climate threats to the ecosystem, identify major vulnerabilities of living marine resources with respect to climate, address the core science needs to address impacts from a changing climate, and integrate this information into management advice, congruent with the NOAA Fisheries Climate Science Strategy

4. What is the status of oceanographic, habitat, climate and ecological data required to fulfill ecosystem-related science needs? Has the Center developed strategies to obtain and manage such data?

5. Is the Center appropriately analyzing and modeling ecosystem-level processes? Are cumulative and integrative ecosystem-level analyses being conducted? If not, is there a plan in place to initiate or contribute to the science needed to address cumulative impacts?

6. Is the Center's oceanographic, habitat, climate and ecological advice sufficiently included into living marine resource management advice? Are there suitable mechanisms to determine when such inclusion is warranted?

7. Are the Center's ecosystem-related science programs and products adequately peer-reviewed relative to their purpose and use? If not, has the Center developed a strategy for peer-review?

8. Does the Center appropriately communicate research results and resource needs to conduct ecosystem-related science to various managers, partners, stakeholders and the public?

NMFS scientists provided the panel with presentations and information relevant to each of these questions. Each panelist subsequently provided a report documenting observations, findings, and

recommendations. The chair's report summarized and synthesized comments provided by all panelists, and all review materials are archived at http://www.nefsc.noaa.gov/program_review/. Center staff reviewed the panelists' and chair's reports and identified core recommendations from the panel under each of five themes: Assessments, Research, Observational Programs, Communication, and Personnel. The Center provides responses to those recommendations below, with specific actions identified in Table 1.

The reviewers were presented with information covering many aspects of our ecosystem and climate related science programs. I would like to thank Center staff and others who prepared documents and presentations for the review and otherwise ensured that we were well-prepared and responsive to the reviewers' needs. I would also like to thank the panelists for their committed and insightful participation and for their comments and suggestions, both during the proceedings and in their written reports. This review was open to the public, and I am grateful to our many partners and stakeholders who participated and contributed positively and constructively to the process.

Responses to Reviewers' Recommendations

Theme 1: Assessments

The Center conducts a large number of assessments that can benefit from the inclusion of ecosystem, climate, and habitat data, and panelists provided several recommendations on how to improve assessments and the assessment process.

Stock Assessment Process

With respect to the stock assessment process, panelists recommended that [**1.1.**] immediate stock assessment demands need to be reduced or the workload streamlined in order to free up more staff time to conduct research relevant to incorporating climate, ecosystem, and habitat considerations into the stock assessment process. The Center recognizes this need and notes that this recommendation has been repeated in various forms by reviewers for the Data Collections and Stock Assessment program reviews conducted in 2013 and 2014, respectively. The Center strongly supports this recommendation, but has struggled to implement it due to the overwhelming demands for analytic support relative to single species stock assessment and the need to support the Councils' and agency's management actions.

Reducing the demand of stock assessments is unlikely, but some progress has been made in terms of streamlining assessments. One main approach is through the application of a less time-demanding "operational" assessment process. This was tested in 2015 with operational assessments for 20 groundfish stocks. Another approach is a standardization process, which creates standard outputs and formatting for the assessment outputs. Recognizing that in order to continue progress requires close coordination with the Councils, the Center will provide to the Northeast Regional Coordinating Council (NRCC) an example template of an operational assessment update to be used as a model for the 20 groundfish stock assessment update scheduled in autumn 2017. This template, if adopted, will result in a significant streamlining of the work required to prepare these stock assessment updates. In addition, the Center will evaluate the level of support being provided to directly support management actions including MMPA Take Reduction Teams, ESA Recovery Teams, and Fishery Management Council Plan

Development Teams (PDTs), Fishery Management Action Teams (FMATs) and Science and Statistical Committees (SSCs), with the goal of better balancing the workload between direct management support and research to improve that support over time. Through streamlining and standardization, the Center's goal is to increase the time available to assessment scientists to conduct research, including research to support ecosystem science in the Northeast.

Ecosystem Dynamics and Assessment Research

With respect to direct ecosystem dynamics and assessment research, the panelists recommended [**1.2.**] a shift in resources from ecosystem model development to collaborative work connecting ecosystem science to management. Panelists noted that this could be done through management strategy evaluation (MSE) work where the performance and associated risk of multispecies models could be evaluated. Panelists recommended a focus on multispecies models that provide tactical advice and are ready to be operationalized for stock assessments and management, which in turn could reduce the number of single species stock assessments needed. This more operational work could focus on models that include climate effects on productivity and spatial range of stocks, as well as significant species, climate, and habitat interactions. The Center agrees completely with this recommendation. There is ongoing collaborative work between the Population Dynamics Branch, the Ecosystem Dynamics and Assessment Branch, and the Ecosystem and Aquaculture Division on shifting from development to implementation. This work includes but is not limited to an MSE focused on Atlantic herring as forage fish and collaborations on comparing models of differing degrees of complexity... Simulation tests of the performance of multispecies management procedures have been undertaken and published (Gaichas et al. 2016), and this work will be expanded. This general approach has been introduced in the development of the New England Fishery Management Council's (NEFMC's) draft Fishery Ecosystem Plan, which was presented to the council in September 2016. To further support this effort, NEFSC will commit to hiring a scientist to specialize in MSE development and application.

Ecosystem, Climate, and Habitat Data

More broadly, the panelists recommended [**1.3.**] enhancing the delivery of ecosystem, climate, and habitat data into management pathways. The focus of this recommendation was on making sure those data are used by management. The Center agrees with this recommendation and will continue to work to include ecosystem, climate, and habitat information into management pathways, recognizing that many of the Center's efforts thus far have been focused on fisheries management rather than living marine resource management as a whole. Progress has been made in the stock assessment arena with the inclusion of environmental and habitat variables in assessments (Miller et al. 2016, Manderson et al. in review). The Center currently provides a State of the Ecosystem report to the fishery management councils annually. The Center has also formed a working group focusing on the integration of ecological information into Index-Based Assessments (to include both biotic and abiotic environmental considerations). Index-Based Assessments comprise a substantial fraction of the stock assessments conducted by NEFSC. The development of a repository for environmental information has been established to provide broad access within the Center, and specific efforts are now underway to incorporate this information into upcoming stock assessments. The Center will continue to work with the NRCC to develop an approach for including climate, ecosystem, and habitat terms of reference in future assessments. Any expanded activities will be coordinated and discussed by the Center's cross-divisional Climate, Ecosystem, Habitat, and Assessment Steering Group (CEHASG). However, the Steering Group does not have dedicated funding, so support for these cross-Division collaborations will need to be supported from Division research budgets. To aid in this effort,

staff will be encouraged to seek out collaborations across the Center and with external partners to compete for internal funding programs (e.g., Fisheries and the Environment), which are designed to support new ideas and approaches with regards to ecosystem, climate, and habitat data. As part of the Northeast Regional Climate Action Plan, the Center will be coordinating climate, ecosystem, and habitat activities in the region. The Center will report annual progress on the Northeast Regional Climate Action Plan. Currently, the No New Resources scenario will be followed for the Northeast Regional Climate Action Plan, but staff will be encouraged to pursue temporary funding for activities identified in the Plan.

Ecosystem Based Fishery Management

Specifically, the panelists recommended that [**1.4.**] the Center rapidly develop an illustrative case study for ecosystem based fishery management that provides tactical management advice. The Center appreciates this recommendation and is already engaged in relevant efforts. The NEFMC is in phase II of the development of a Fishery Ecosystem Plan that lays out the strategy for developing tactical management advice in a multispecies setting. The plan was presented to the Council at their September 2016 meeting. The plan uses the Georges Bank system as a case study. The intent of this phase is not to present actual tactical quota recommendations (which will require a detailed review component) but rather to lay out the elements of the overall strategy with sufficient detail to allow the Council to evaluate whether the approach is feasible. The Council in their September 2016 meeting accepted this plan and passed a motion to conduct a peer review of the models described in the document and the Center will support this peer-review. The Center also will continue to support the Council's efforts to investigate tactical ecosystem based fishery management advice; the direction of this effort will be partly determined by the peer-review identified above.

Theme 2: Research

The Center carries out a large volume of diverse research across its five geographic locations; panelists provided several recommendations on how to enhance the interdisciplinary research to support ecosystem science.

Center Integration and Collaboration

The panelists recognized the importance of integration and recommended that [**2.1.**] the Center foster collaboration across and within the divisional structure by continuing to support and encourage cross-divisional working groups. The Center appreciates this recommendation and has already taken steps to address the need for increased collaboration across and within Divisions. We will continue to support cross-divisional working groups such as CEHASG, with the aim of promoting and coordinating interdisciplinary teams to address complex issues. The Center has formalized the prioritization and planning of cross-divisional research collaborations particularly for topics benefiting from integration of ecosystem, climate, and habitat science, with the aim of increasing operational efficiencies and improving our products and services. For example, we are setting up meetings between key staff of multiple divisions to enhance and better focus research to support assessments of finfish and invertebrates as well as to provide social and economic analytical support to research divisions. The Center's Cooperative Research Program also is working with other Divisions and through CEHASG to identify research needs and opportunities, as well as to get advice on fishing fleets and areas that are of most interest to recruit for future cooperative research efforts, thereby providing better integration across not

only the Center but also research partners in the fishing industry. To support this Cooperative Research effort, the Center will hold a workshop to bring together scientists from across the Center to discuss opportunities for cooperative research. The Center also is initiating cross-laboratory seminars, which will have the added value of cross-fertilization across divisions and branches.

Northeast Regional Action Plan

The panelists appreciated the value of the Northeast Regional Action Plan but recommended that [**2.2.**] the Center review the plan and further prioritize the proposed actions within the plan. The Center agrees with the need for prioritization, and notes that it will be addressed in the revision of the Northeast Regional Action Plan. The public comment period closed 29 July 2016. The Plan, with prioritized activities, was submitted to NOAA Fisheries Office of Science and Technology on 3 October 2016.

Theme 3: Observational Programs

The Center has a number of well-developed observational programs that have a large foundational role in ecosystem science, and the panelists had several recommendations for maintaining or enhancing those programs.

Observational Activities & Survey Designs

First, the panelists recommended that [**3.1.**] the Center continue funding core observational activities. The panelists recognized that these observational activities form the foundation of EBFM and cannot be "backfilled" once observations are missed. The Center is the main collector of oceanographic and biological observations in the region and, thus, our data collection programs are fundamental to developing and supporting EBFM in the region. Support for surveys has come under various pressures over the past several years (e.g., funding, ship availability, maintenance), but despite these pressures, the Center is committed to continuing to support core observational activities. As part of the implementation of the Center's strategic plan, these activities will be clearly mapped against the Center's mandates to ensure that the contribution of these efforts are fully realized and appreciated. An effort to do this was undertaken in 2005, and the results from this effort will be updated as part of the Northeast Regional Action Plan. The Center also is actively reviewing one key set of observational activities, namely its spring and fall bottom trawl surveys, as part of the Center's recent decision to initiate a planning process to evaluate and integrate the use of fishing industry vessels into the standardized research vessel surveys conducted by the NOAA Ship *Henry B. Bigelow*. Depending on the outcome of that review, this could represent a potential significant change in how the Center conducts its observational programs, and the Center is committed to the requirement that survey data collection quality and time series integrity be maintained. Further, the integration will occur only to the extent that it is workable and does not compromise trawl survey capacity and outcomes.

The panelists also recommended that [**3.2.**] the Center examine the current survey designs and evaluate if they are sufficient for ecosystem program goals given the observed and anticipated shifts in species distributions. The Center appreciates this recommendation and recognizes that ongoing changes in marine ecosystems call for careful consideration of survey designs. A review of Center surveys will be conducted as part of the evaluation effort associated with the

potential integration of commercial vessels into trawl surveys conducted by the NOAA Ship *Henry B. Bigelow* or in complementary surveys. The range of options is large, and includes a full transition to industry platforms, prioritization of resuming the survey of near-shore strata, development of new strategies for evaluation of untrawlable habitats, and research with the use of non-random sampling designs. From an ecosystem perspective, data from the Bottom Trawl Survey and the Ecosystem Monitoring Survey have been instrumental in understanding species interactions and the links between climate change and fish and invertebrate populations in the northeast region. An internal Working Group has been established that will work closely with the Northeast Trawl Advisory Panel. The objective of using the Bottom Trawl Survey and Ecosystem Monitoring Survey to track shifts in species distribution will be evaluated as part of this Working Group's considerations. The Northeast Regional Action Plan also calls for coordination between ocean observing activities in the region, and the Center's surveys will be included in the broader, regional evaluation. Finally, the Center will evaluate leveraging opportunities available through its Cooperative Research program, which can engage fishing vessels in collecting enhanced environmental data coincident with year-round fishing activity, which in turn can be applied to enhance survey efforts. The industry is especially interested in providing additional information on changing species distribution patterns in a manner that can support more timely and dynamic management processes.

Cooperative Research

The panelists recognized the importance of cooperative research with industry and recommended that [**3.3.**] the Center improve how data collected through cooperative research are integrated into management processes. The Center agrees that collaborative research with industry plays a key role in developing trust and augmenting Center data sets, and also recognizes that tighter integration of these data streams into the management process and industry operations is needed. The Center is in the process of conducting an independent review of our Cooperative Research Program, and we are committed to taking actions based on that review to improve the program and the integration of the data it can provide into broader Center activities. The Center is also continuing to evaluate methods and technologies to improve Observer Program data collection and apply observer data to questions related to Ecosystem-Based Management. For example, evaluations of wind energy areas have included observer data with regards to the interactions between fishing and potential energy development locations. These efforts should help to ensure collection of additional high-quality data that can be used in species, habitat and ecosystem assessments. In addition, we recognize not only the scientific value of building partnerships with our industry partners to improve our data streams but also the social and economic benefits. As mentioned above, the Center recently announced its decision to initiate a planning process to support integration of industry fishing vessels in its bottom trawl surveys. When fully implemented, this plan will likely result in a significant new suite of cooperative research data for use in management, and it is hoped that the integration of fishing vessels into the survey process will build mutual trust and lead to a more transparent understanding of the collection and application of the data, which in turn should facilitate the use of these data streams in the management process. Moreover, the Center has formed collaborations with the aquaculture and pharmaceutical industries, which have significantly facilitated access to field research sites, particularly for invertebrate and multitrophic aquaculture investigations, and also has helped us to plan and implement laboratory investigations of particular interest to those industries. The data from these investigations are of value not only to industry but also to aquaculture managers, particularly with respect to monitoring of existing and permitting of proposed aquaculture sites.

The panelists also recognized the importance of other research collaborations and recommended that [**3.4.**] the Center continues collaborations with government and academic research partners to develop and operationalize advanced technologies for data collection. The Center agrees that these partnerships are important, and will evaluate our capacities with respect to short and long-term science objectives, identify gaps in our in-house science expertise and capacity, and promote collaborations with experts in academia, agencies and NGOs to augment our own workforce. This will be completed as part of the annual implementation of the Center Strategic Plan and preparation of the Director's Annual Guidance Memo. We will also strengthen our interactions with partners and continue to encourage staff to compete for internal (e.g., Fisheries and the Environment) and external (e.g., National Aeronautics and Space Administration) funding opportunities to support new ideas and approaches. The Center has implemented a new policy with regards to extramural proposals designed to enhance cross-divisional collaboration on projects where it is warranted as well as ensure that the proposed work is aligned with the Center's strategic plan. Finally, we will continue to pursue cooperative research opportunities for technology development and testing of new technologies in operational settings. For example, the Cooperative Research Program has worked with industry vessels for years on and electronic reporting of catch and discards and collection of bottom temperature and depth data associated with fishing tows and the Center's Fisheries Sampling Branch has also done collaborative work on electronic monitoring. Although these are not government or academic partners, they are good platforms for testing operational uses of technologies.

Ocean Observing Portals

The panelists also recognized the value of long-term, large-scale monitoring efforts, and recommended that [**3.5.**] the Center continue supporting ocean observing portals. The Center shares the panelists' view of the importance of these monitoring efforts. There are numerous ocean observing portals in the region, and the Center will continue to support these portals by working to make Center data publically available in machine-readable formats. This is required by NOAA's Plan for Increasing Public Access to Research Results, and we will continue to meet our obligations under that plan, in particular by communicating how to access Center data with ocean observing portals and the region as a whole. Making Center data more available in general will also make Center data more available for internal and external analyses. This will serve to encourage collaboration between Center scientists, visiting scientists, and external collaborators.

Theme 4: Communication

Development toward ecosystem based fishery management will require not only advancement in ecosystem science, but also communication of that science and close cooperation between the Center and various management bodies. The panelists provided several recommendations on how to develop and enhance such communication.

Ecosystem Based Fisheries Management Communication Strategy

With respect to implementing EBFM, the panelists recommended that [**4.1.**] the Center develop a communication strategy that clarifies the transition process from single-species management to EBFM and addresses any misconceptions surrounding EBFM. These misconceptions include but are not limited to EBFM being synonymous with enhanced buffers, that the transition comes with high risk, and that legal mandates for single stock management preclude EBFM. The Center recognizes both the misconceptions and the need for a communication strategy and is

working closely with both management councils to develop communication strategies promoting EBFM implementation. As mentioned previously, the NEFMC is developing a draft Fishery Ecosystem Plan (FEP) that seeks to provide an example of how EBFM could work in practice. An objective of this approach is to specifically reduce uncertainty at the level of the management unit in a way that will not entail enhanced buffers. The draft FEP specifies the expected benefits of adopting this approach and addresses the question of risk. The specific request from NEFMC to the EBFM PDT specifies that the approach should not be limited by perceived legal mandates, and the agency's EBFM Roadmap clearly indicates that the agency believes movement toward EBFM is legal and appropriate. Similarly, the MAFMC has finalized its Ecosystem Approach to Fisheries Management Guidance Document, which describes its strategy for incorporating ecosystem considerations into management in their area of responsibility. Similarly, the NEFSC will continue to support ASMFC strategies to evaluate, understand and incorporate the driving forces of ecosystem function and climate change in their science and management. The documents of the Councils and the Commission are important communication vehicles conveying their objectives and intent to their stakeholders. In addition, staff will continue to support comprehensive risk assessments, as well as MSE analyses, appropriate to both Councils and the Commission. Further, the MSE process will continue to involve stakeholder workshops, which have excellent potential for generating dialog regarding EBFM, not just a one-way communication (as illustrated by the Atlantic herring MSE work).

Ecosystem Web Products

The panelists recognized the value of ecosystem science for a variety of stakeholders and the general public, and they recommended that [**4.2.**] the Center maximize the impact of its ecosystem web products. The Center appreciates this recommendation, and is already hard at work in this regard. The Center's website and other communication tools are intended to provide contextual information for management decisions and to give the community the ability to track key parameters including habitat, biological, social and economic parameters. As resource managers interpret information received from the science community and the fishing industry concerning changes occurring in the ecosystem, requests for ecological information have increased, clearly indicating the need for easy public access to this information. The Center will take several actions to enhance its web communication tools. First the Center will identify user groups and individuals who desire this information. Then the Center will design and carry out a survey to get input from those groups and individuals on the usefulness of information currently on the Ecosystem Considerations webpage, identify any information gaps, and seek recommendations or ideas for improvements. For key partners like fishery management councils and their Scientific and Statistical Committees, the Center will precede or follow the survey with in person discussions to get feedback. Based on the feedback provided, the Center will take steps to improve its web communication tools.

Industry Partnerships for Communication

The panelists recognized the value of industry partnerships for communication and recommended that [**4.3.**] the Center build on industry partnerships to enhance communication and encourage shared investments. The Center fully agrees with this recommendation and has significant efforts underway in this regard. The Center has already begun to build on the communication recommendations from the recent series of "Fish Tank" and "Taking Stock" meetings between the Center and fishing industry. The Center worked with port agents and recreational divers to gather local ecological knowledge from fishermen and divers to support the upcoming black sea bass assessment. The Center provided three direct questions that will help in the interpretation of assessment results. The outreach will be disseminated back to the

fishing/diving communities as a feature on Center web resources prior to the assessment and will be included in the assessment document itself. The Center's Cooperative Research program also has many collaborative research efforts underway, which provide an opportunity for communication, but importantly also provide an opportunity for shared investment in ecosystem data collection. The tow-by-tow bottom temperature and depth data collection mentioned above is a good example, where cooperative research efforts have led to improved data collection as well as interest in other leveraging opportunities for shared investment. Further, near real-time feedback loops providing recent trip performance information and bottom temperature forecasts from Cooperative Research efforts back to engaged fishermen appear to create positive incentives to improve self-reported data and engage in fishery management. The Center is also committed to continuing its Marine Resource Education Program (MREP) which brings fishermen, scientists and managers together in an effort to promote understanding and work toward a common goal of producing sound science that supports sustainable fisheries management. There are five separate training sessions scheduled for FY17 beginning with a session scheduled for October 2016. Finally, the Center is actively involved in the New England and Mid-Atlantic Fishery Management Councils' Northeast Trawl Advisory Panel, to identify options to increase transparency and credibility of research trawl survey results through the use of industry vessels.

Fishery Management Council Engagement

The panelists recognized the special role of fishery management councils and recommended that [**4.4.**] the Center continue its engagement with councils on ecosystem issues. The Center appreciates this recommendation but also recognizes the challenges that exist in addressing the changes needed in the stock assessment process (see recommendation [**1.1.**] and prior Stock Assessment Data and Modeling reviews) and increasing the delivery of ecosystem information and products to the Councils and GARFO. As mentioned in response to that recommendation, the Center will evaluate the level of support being provided to directly support management actions, with the goal of better balancing the workload between direct management support and research to improve that support over time. With respect to communications, the Center is committed to continued work with the Councils. The communication between the Councils and the Center is not limited to support of EBFM actions, but also keeps the Councils informed of changes in the ecosystem through time. The Center will continue to provide an annual briefing on the State of the Ecosystem for New England and Mid-Atlantic marine ecosystems to the relevant Councils. The Center will request feedback from the Councils and work with them to improve the delivery and application of the information within the State of the Ecosystem report.

Theme 5: Personnel

The Center has a wide array of staff that focus part or all of their time on ecosystem science, but those staff resources are stretched thin. The panelists provided recommendations for ways to access additional human resources.

Recruiting and Hiring

The panelists recognized the need to increase Center staff working on ecosystem science and recommended that [**5.1.**] the Center creates a long-term strategy for recruiting and hiring scientists spanning the range of expertise needed for EBFM. The Center appreciates this recommendation and is committed to developing such a long-term staffing plan. The first step in

this process has already been completed; the Center Strategic Science Plan was published in 2016. The plan articulates the goals and objectives for the Center for the next five years. We recognize the need to sustain and in some cases renew capacities to meet the science objectives in this plan. We also agree with the reviewers that there is a need for expertise in the fields of oceanography, plankton, and benthic ecology in order to enhance the institutional capacity of the Center. In support of this recommendation, the Center will develop a long-term staffing plan with the aim of creating the necessary balance in our scientific expertise and taking into consideration hiring of both permanent and temporary positions, as well as students and postdoctoral fellows. In relation to the Center Strategic Science Plan and our implementation plan, we will assess our current capacities, consider expected attrition and retirements of permanent staff over the next five years, anticipate emerging fisheries needs and associated funding opportunities, consider collaborations and temporary funding through NOAA (or other agencies) as well as industry and NGOs, and develop a plan to recruit critical personnel. An important step in this process will be to consider what current activities may be eliminated or scaled back, in order to repurpose some of the labor pool. It is anticipated that the Center will complete a staffing plan in 2017. In addition, the Center will evaluate whether supporting the National Research Council Research Associateship Program can be re-instituted. The Center use to support two NRC post-docs per year, and this program was highly effective at advancing Center science, while at the same time providing research experience to early-career individuals.

Additional Resources

The panelists also recognized the need for additional resources and recommended that [**5.2.**] the Center continue leveraging external grants and visiting scientists for analysis of existing data sets. The Center shares the panelists' view that such leveraging is important and has many efforts underway to enhance such leveraging. The Center has actively pursued outside funds and expertise to support climate, ecosystem, and habitat science. Current activities include but are not limited to the Atlantic Marine Assessment Program for Protected Species (AMAPPS) (supported by Bureau of Ocean Energy Management and US Navy), the Center's Ocean Acidification Program (supported by the NOAA Ocean Acidification Program), and the development of EBM in the region (supported by the NOAA Integrated Ecosystem Assessment Program). One issue with relying on external funds is the potential that the Center's science enterprise could be shifted toward supporting the needs of others, rather than focusing on the core needs to support the Center's mission. The development of the Center's Strategic Plan and Annual Guidance Memo now provides clear guidance on priorities and needs in the next year and over the next several years. The Center has implemented a Science Planning, Evaluation, and Reporting System for internal funds, and this system is being used to plan, prioritize, and coordinate research activities in the Center. However, this system was not designed to handle funds external to the Center. The Center is reviewing and revitalizing its proposal approval process for external funds. The purpose is to encourage staff seeking external funds, but also to establish a process that ensures projects are in line with the Center's mission and priorities and promotes cross-Divisional collaboration where warranted.

Table 1 – Summary of Recommendations and Response Actions

Recommendation	Action	Deadline
1.1 - Reduce immediate stock assessment demands or streamline workload	1.1.A - Provide NRCC with an example template of an operational assessment update schedule	May 2017
	1.1.B – Conduct work-flow analysis of stock assessment scientists to suggest streamlining and efficiency options	Dec 2017
1.2 - Shift from ecosystem model development to collaborative work connecting ecosystem science to management	1.2.A – Complete first stage of Atlantic herring MSE work	Dec 2016
	1.2.B. Hire a scientist with expertise in MSE development and application	Sept 2018
	1.2.C Develop MSE framework for testing the efficacy of using ecosystem models in tactical fisheries management	Dec 2019
1.3 - Enhance the delivery of ecosystem, climate, and habitat data streams into management pathways	1.3.A – Work with NRCC to agree on approach for including climate, ecosystem, and habitat ToR in assessments	May 2018
	1.3.B - Implement Northeast Regional Action Plan. Report annual progress.	Sept Annually
1.4 - Develop an illustrative case study for EBFM that provides tactical advice	1.4.A – Conduct peer review of models to be used in Georges Bank multispecies case study	Dec 2018
2.1 - Foster collaboration across and within the divisional structure	2.1.A - Continue support of working groups such as the CEHASG and conduct coordinated research among Divisions with aim of integrating climate, ecosystem, and habitat information to improve NEFSC products and services.	Ongoing
	2.1.B – Convene Center-wide Cooperative Research workshop to	Sep 2017

	discuss current and future uses of cooperative research in Center science	
	2.1.C - Initiate cross-Center seminars	Mar 2017
2.2 - Review and prioritize the Northeast Regional Action Plan	2.2 - Revise Northeast Regional Action Plan with further prioritization (see 1.3.C)	Completed
3.1 - Continue funding core observational activities	3.1.A - Map observational activities to mandates and mission elements to highlight value of these activities	Sep 2017
3.2 - Evaluate survey designs for ecosystem program goals	3.2.A – Form an internal working group to work with the Northeast Trawl Advisory Panel	Completed
	3.2.B – Review survey design as part of the integration of data collected on industry fishing vessels into the Center's bottom trawl survey program and ecosystem assessments.	Dec 2018
3.3 - Improve integration of collaborative research data into the management process	3.3.A – Implement FY 17 recommendations from the independent review of the Cooperative Research Program	Dec 2017
	3.3.B – Evaluate improvements to observer program data collection and expand use of those data	Ongoing
	3.3.C – Continue collaborations with aquaculture and pharmaceutical industries	Ongoing
3.4 - Continue collaborations with academic and other government partners	3.4.A - Evaluate current internal capacity and identify partnership opportunities to fill gaps	Mar 2017
	3.4.B - Review and revise guidance and process for seeking external funds. Encourage staff to compete for funding sources and collaborate with partners.	Jun 2017, produce report annually thereafter

3.5 - Continue support of the ocean observing portals	3.5 - Make Center data publicly available in a machine-readable format and share with portals	Dec 2018
4.1 - Develop an EBFM communication strategy	4.1.A – Work with the NEFMC on their draft Fisheries Ecosystem Plan and continued development of EBFM	Ongoing
	4.1.B – Work with the MAFMC on their Ecosystem Approach to Fisheries Management Guidance Document and continued development of EBFM	Ongoing
	4.1.C - Work with the ASMFC on climate and ecosystem issues and continued development of EBFM	Ongoing
4.2 - Maximize the impact of Center web products	4.2.A - Improve web products based on user evaluations	Dec 2017
4.3 – Use industry partnerships to improve communication and shared investment	4.3.A – Conduct pilot project of using Port Agents to collect relevant data for the Black Sea Bass stock assessment	Dec 2016
	4.3.B – Continue support of the Marine Resource Education Program (MREP)	Ongoing
4.4 - Continue engagement with councils	4.4.A – Continue to provide annual state of the ecosystem reports	Ongoing
	4.4.B – Request review of ecosystem reports by Councils and then revise based on suggestions	Dec 2017
5.1 - Create long-term strategy for hiring new ecosystem scientists	5.1.A - Develop a long-term staffing plan consistent with the Center Strategic Science Plan	Jun 2017
	5.1.B - Evaluate re-initiation of NEFSC support for National Research Council Research Associateship program	Sep 2017
5.2 - Leverage external grants and visiting scientists	see Action 3.4B	Dec 2017