



## National Response to the FY 2016 Reviews of NOAA Fisheries' Ecosystem-Related Science Programs

### 1. Background

Scientific integrity is a fundamental element of the process by which NOAA delivers the best available science and earns the public's trust in our science and management. To this end, NOAA drafted a policy to uphold scientific integrity principles contained in the President's March 9, 2009, Memorandum and in the December 17, 2010, Memorandum on Scientific Integrity<sup>1</sup> from Dr. John Holdren, Director of the Office of Science and Technology Policy. Peer review is an essential element of this policy and these reviews are an opportunity for scientific exchange, maintaining and improving standards, improving performance, and increasing scientific credibility.

Peer reviews are an important feedback mechanism needed to provide fresh ideas and improve fisheries science programs. The National Marine Fisheries Service (NOAA Fisheries) provides opportunities for peer reviews at multiple levels (<http://www.st.nmfs.noaa.gov/science-quality-assurance/index>) and uses a suite of processes to ensure the quality of its scientific products including:

- Internal peer review of Fundamental Research Communications (including both internally and externally published scientific manuscripts, abstracts, and other media);
- External review of fishery stock assessments;
- External review of marine mammal stock assessments; and
- External review of Fisheries Science Centers' scientific programs.

Historically, all NOAA Fisheries Science Centers and the Office of Science and Technology (OST) have individually conducted reviews of elements of their science programs on an *ad hoc* basis. NOAA Fisheries added the Science Program Reviews<sup>2</sup> in FY 2013 as the overarching and systematic, national approach to peer review that ensures the NOAA Fisheries science enterprise is being properly conducted. This approach complements NOAA's Science Advisory Board and its Ecosystem Science and Management Working Group, which provide overarching thematic reviews of NOAA science by adding advice directed toward specific topics relevant to the NOAA science portfolio. Through continued use of this agency-wide peer-review process NOAA Fisheries will more effectively maintain a high level of scientific quality, advance its science nationally, and provide guidance for future science investments.

This document serves several purposes:

- Provides an overview of how NOAA Fisheries' Science Program reviews were conducted in FY 2016;
- Summarizes the key issues reviewers identified during the FY 2016 reviews; and
- Presents a national-level response for those issues identified within four or more of the reviews.

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<sup>1</sup> <http://nrc.noaa.gov/ScientificIntegrityCommons.aspx>

<sup>2</sup> <http://www.st.nmfs.noaa.gov/science-program-review/>

The Science Program Reviews, developed in FY 2011, are an approach to the NOAA Fisheries peer review process and provide the ability to compare science programs across all regions simultaneously. As a part of this process, a national strategic planning effort (as a baseline for the reviews) was conducted in FY 2012 to facilitate the incorporation of results from the program reviews into operations.<sup>3</sup>

During FY 2012, the individual Science Centers and OST developed a five-year schedule for the program reviews:

- FY 2013 - Data used for fishery stock assessments
- FY 2014 - Fishery stock assessment process
- FY 2015 - Protected species data and science
- FY 2016 - Ecosystem-related science including climate and habitat
- FY 2017 - Economics and human dimensions

Fishery stock assessment reviews were split into two years (data and the assessment process) to ensure each received substantive feedback.

The Science Center and OST Directors worked with OST staff to develop terms of reference<sup>4</sup> for the FY 2013-16 reviews. The focus of the 2016 program reviews was ecosystem-related science including climate and habitat. Each Science Center and OST refined the terms of reference to meet their specific needs.

## 2. The Structure of the FY 2016 Ecosystem Science Program Reviews

The seven reviews for FY 2016 were scheduled between March and July 2016 as follows:

- Southeast Fisheries Science Center – March 14-18, Miami, FL
- Pacific Islands Fisheries Science Center – April 4-8, Honolulu, HI
- Southwest Fisheries Science Center – April 18-22, La Jolla, CA
- Alaska Fisheries Science Center – May 4-6, Juneau, AK
- Northeast Fisheries Science Center – June 6-10, Woods Hole, MA
- Northwest Fisheries Science Center – July 12-14, Seattle, WA
- Office of Science and Technology – July 26-29, Silver Spring MD

Review panels were chaired by a non-NOAA Fisheries scientist, and generally included:

- One scientist from NOAA Fisheries (but not from the Science Center conducting the review);
- One scientist from another NOAA line or staff office (optional);
- Three to five (the majority) scientists external to NOAA; and
- One Science Center Director (optional, and not from the Science Center conducting the review).

All Science Centers provided their panelists with briefing materials and background documents approximately two weeks prior to the start of the review (documents are available on the regional websites).

Reviews typically began with at least a half-day of background presentations on the roles and responsibilities of the individual Science Center. The next two to three days were devoted to presentations by the Science Centers' staff on the various ecosystem science programs and assessment methods used by the Science Centers (e.g., surveys, modeling approaches and peer review processes). Presentations typically ended by early afternoon to allow the panel time for discussion. Public comment was solicited daily at the end of presentations. After the public component of the reviews concluded, at least one day was set aside for panel follow-up discussions and report writing and a debriefing by the panel for the Science Centers' Directors, Leadership, and Headquarters representatives.

Following the review, the Panel Chair prepared a summary report of the meeting and submitted it, with the individual panelists' reports, to the Science Center Director. The Director forwarded these reports to the NOAA

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<sup>3</sup> <http://www.st.nmfs.noaa.gov/strategic-plan/index>

<sup>4</sup> <http://www.st.nmfs.noaa.gov/science-program-review/program-review-reports/index>

Fisheries Chief Science Advisor, along with a brief response to the Chair's summary report, usually within ten weeks of receiving the report package. The Science Center Director's response included action items, timelines and clarifying information, and sometimes responded to specific points within individual reports.

Generally, within three months of the close of the review, all documents (Chair's summary report, Director's response, and individual reviewers' reports) were posted on the Science Center and OST program review websites (<http://www.st.nmfs.noaa.gov/science-program-review/program-review-reports/index>).

### 3. Summary of Findings from the FY 2016 Ecosystem Reviews

The reviewer reports uniformly praised NOAA Fisheries Science Centers and OST staff for producing excellent ecosystem science as evinced by their peer-reviewed publication records and participation in scientific meetings. Many NOAA Fisheries ecosystem scientists and program managers are seen as leaders in the field that are moving the state of the ecosystem-related science forward with relatively few resources. Strong science support is provided to management partners through clear engagement with the NOAA Fisheries Regional Offices and the fishery management councils, largely via production of ecosystem status reports or other products that present ecosystem information (e.g., indicators, trends and model results). In particular, the reviewers applauded NOAA Fisheries effort to develop the Climate Regional Action Plans (RAP) in coordination with management partners and incorporating public comment, and providing scientific support to the Fishery Management Councils to update or develop Fishery Ecosystem Plans (FEP). Some of these products were being completed during the same time period as the external review. Also noted was the time and effort staff put into producing high quality presentations of their work and answering reviewers' requests for clarifying information.

The 2016 Ecosystem Review was different from other reviews in that an overarching national Ecosystem-Based Fisheries Management (EBFM) Road Map<sup>5</sup> was being developed at the same time as the Science Centers' and OST's reviews. While the panels were made aware of the development of the document, the draft EBFM Road Map was not available for the panelists during the reviews. The EBFM Road Map, released November 17, 2016 offers a way forward at a national level on matters related to ecosystem science. As such the comments and responses that follow below, are framed not just from the "targeted" comments directed at particular Science Centers or OST, but also in the role played by the broader umbrella offered by the EBFM Road Map. Given the likelihood of a flat resource (funding) environment, we anticipate advances in ecosystem science highlighted from these reviews will need to be coordinated through activities and objectives highlighted in the EBFM Road Map.

While most of the reviewer comments were specific to individual Science Centers or OST and are covered in the individual review reports and responses, those recommendations that span multiple Science Centers are considered as national themes. Recommendations made at four or more of the reviews that are appropriate to address at a national level are listed below, together with national-level responses.

### 4. Context and Overarching Comments from the FY 2013-2016 Reviews

Having conducted reviews<sup>6</sup> for four major program areas (data collection, stock assessment, protected species and ecosystem-related science), it is increasingly clear that there are interconnections between these focus areas. This limits the ability to fully present the interconnections between our fishery stock assessment, protected species assessment, ecosystem, climate, habitat, economics and human dimensions programs in a single review. As we conclude the fourth of five years of program reviews, there are themes that are not only recurrent among Science Centers, but also recurrent between years. The following themes were frequently noted during the FY2016 program reviews, and also relate to recommendations that have been made in past reviews.

#### *Data Management*

#### ***Reviewer Observations & Recommendations:***

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<sup>5</sup> [http://www.st.nmfs.noaa.gov/Assets/ecosystems/ebfm/EBFM\\_Road\\_Map\\_final.pdf](http://www.st.nmfs.noaa.gov/Assets/ecosystems/ebfm/EBFM_Road_Map_final.pdf)

<sup>6</sup> <https://www.st.nmfs.noaa.gov/science-program-review/index>

Reviewers noted the Science Centers have impressive long-term data sets. There is a need to improve data management and access in order to more effectively utilize the data. Data management should improve data quality control and archiving, and increase data access and sharing, both within and outside of the agency. There remain barriers (some historical, some technical) to data sharing across Centers, laboratories, or even across divisions. Additionally, in the 2016 reviews it was noted that improvements in file and data sharing should include exchanging modelling code. Finally, it was recognized that an increase in ecosystem modeling will require more information technology (IT) and high-performance computing (HPC) resources.

*Response:*

The Science Centers and OST are continuing to address many of these issues as part of implementing the Public Access to Research Results (PARR) Plan, which has led to improvements in data archiving and access across NOAA Fisheries. NOAA Fisheries will continue to migrate all environmental data subject to PARR<sup>7</sup> to publicly accessible websites either at the Centers, at NOAA National Center for Environmental Information (NCEI), or through the NOAA Big Data initiative. Currently, NOAA Fisheries has 100% of our data sets in the metadata catalog, with all specific fish survey and related oceanographic data available by the end of FY 2018 and 100% of all data sets archived by March of 2019.

*Action items:*

Further actions that NMFS will take include:

- Explore file sharing solutions to improve sharing of ecosystem monitoring data and model code across Divisions and Science Centers, and with external partners
- Enhance partnerships with other NOAA offices or academia which can increase access to HPC for NMFS ecosystem modelers
- Offer training on NOAA HPC resources so that NMFS scientists have greater awareness on how to utilize the HPC resources that are available

## Increase Capacity to Support Ecosystem Science Programs and Ecosystem-Based Fisheries Management (EBFM)

*Reviewer Observations & Recommendations:*

There was the recognition that increased capacity will be needed to meet our ecosystem science and management needs moving forward. In the current state of flat budgets, much ecosystem work is dependent on temporary funds and lacks long-term, stable funding. Panelists recommended that the Science Centers and NOAA Fisheries seek to increase the resources and staff necessary for maintaining ecosystem science programs and implementing Ecosystem Based Fisheries Management (EBFM). This includes increasing staffing for ecosystem and climate modeling, as well as other science that supports ecosystem understanding (e.g., habitat, protected species interaction, and human dimensions).

*Response:*

In the current budgetary situation, NOAA Fisheries' ability to hire new staff will be limited. Further, with a Federal hiring freeze, it is likely that overall staffing levels will have to decrease at the Science Centers and OST. Based on past reviews, NOAA Fisheries has implemented some actions to increase scientific capacity; for example, NOAA Fisheries has supported hiring one new management strategy evaluation (MSE) scientist at each Center. Additionally, NOAA Fisheries regularly meets with NOAA Office of Oceanic and Atmospheric Research (OAR) to coordinate projects. Through the establishment of the NOAA Integrated Ecosystem Assessment (IEA) program<sup>8</sup>, the

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<sup>7</sup> Environmental data is defined as recorded and derived observations and measurements of the physical, chemical, biological, geological, and geophysical properties and conditions of the oceans, atmosphere, space environment, sun, and solid earth, as well as correlative data, such as socioeconomic data, related documentation, and metadata.

<sup>8</sup> <https://www.integratedecosystemassessment.noaa.gov//>

Science Centers and IEA partners are developing a consistent toolbox for addressing ecosystem requirements in legislative mandates as funding allows. The recently released EBFM Road Map recognizes that IEAs are the framework for implementing EBFM and that increased scientific capacity is needed. The Road Map lists specific actions to advance resources for EBFM, assess and bolster ecosystem and Living Marine Resource (LMR) modeling needs in each Science Center, and develop an EBFM analytical toolbox with modeling tools and best practices. The EBFM Road Map also calls for support of regional and national positions identified in the Road Map. The Science Centers will need to continue to increase partnerships with other agencies, Line Offices and academia to develop the ecosystem models and information products that can be incorporated directly into management. NOAA Fisheries agrees with the recommendation to review staffing plans with a view toward EBFM needs. In addition, the Science Centers and OST will continue to provide a balance between competing resources priorities related to stewardship of living marine resources.

#### *Action items:*

Based on this review NOAA Fisheries will:

- Complete current efforts to hire an MSE FTE position in each Center resulting from the Stock Assessment programs reviews
- Provide support for Science Center efforts to hire additional ecosystem MSE and modeling positions. If temporary funds are provided from HQ to a Science Center, these funds will be made permanent once an FTE is hired to fill the position
- Continue to strengthen the IEA efforts for each region as resources permit.
- Increase collaborative efforts with other scientific partners (e.g., other Science Centers, Line Offices, academia, etc.) similar to those mentioned above
- Ensure regularly developed staffing plans include needs to implement ecosystem science programs and EBFM

## Evaluate Current Surveys & Observing Systems

#### *Reviewer Observations & Recommendations:*

Considering both data management needs and increasing demands from management, reviewers urged NOAA Fisheries to conduct a thorough evaluation of current resource survey and monitoring efforts to optimize data collection, not only for fisheries stock assessments, but also ecosystem assessments. This evaluation could include the use of MSEs and power analyses to refine experimental design with respect to sample size and degree of confidence. Panelists noted that shifts in species distribution, as well as EBFM, may require changes to optimize survey design. It was also suggested that some ecosystem data collection could be “piggybacked” on current fisheries or protected species surveys in order to obtain more ecosystem data in an efficient way. Panelists also commented on the need to include socioeconomic data in ecosystem research and analyses.

#### *Response:*

This recommendation echoes past reviews. It was made for Fishery Data Collection efforts in 2013 and some progress in optimizing surveys has been accomplished since then, including the use of multi-criteria decision analysis in prioritizing current research surveys and adaptive sampling strategies. Additionally, NOAA Fisheries is investing in the use of advanced technologies that can complement current surveys and increase efficiency in data collection. The Protected Species Reviews included recommendations to piggyback protected species data collection on fishery data collection surveys and to increase the collection of oceanographic data when possible. There is clearly still work to do in this area. The EBFM Road Map recommends a “national review of data collection programs across a wide range of disciplines” that includes economic and human dimension research data (slated for review in 2017).

#### *Action items:*

- Continue to strategically optimize NOAA Fisheries research, by evaluating current surveys and observing systems

## Communication

### *Reviewer Observations & Recommendations:*

Lastly, communicating the high-quality science done at our Science Centers should continue to build on successful stakeholder and public engagement through improved web presence and innovative communications products. This should include greater web access to many of the ecosystem reports and products the Science Centers produce.

### *Response:*

NOAA Fisheries has worked to increase communications capacity through the NOAA Fisheries and Science Center Communications Offices, and communications staff supported by individual programs. Efforts have increased over the past several years to develop innovative outreach tools as there are clear benefits from communicating our science to the public. For example, the IEA program provides timely and focused ecosystem summaries to the constituent audiences and partners such as the Fisheries Management Councils and the National Marine Sanctuaries. NOAA Fisheries has also finalized the Climate Science Strategy<sup>9</sup> to meet growing demands for information and tools to prepare for and respond to climate impacts on marine and coastal resources. The EBFM Road Map calls for the development of “National and Regional EBFM engagement strategies” and to develop Standardized EBFM Policy and Road Map Materials for widespread use. The EBFM Road Map also plans to create an “X-prize” like competition for visualizing and communicating ecosystem modeling and MSE.

### *Action items:*

- Continue to develop NOAA Fisheries communications capacity, especially related to ecosystem science-related efforts (e.g., IEAs, Climate Regional Action Plans, Climate Vulnerability Analyses) and EBFM
- Continue to utilize Science Center Communication Offices and the NOAA Fisheries Communication Office to engage the public regarding the importance of ecosystem science and on-going studies

## 5. Ecosystem Science: Main Comments (FY 2016)

In addition to the above themes, raised in past reviews, the ecosystem program reviews raised other, more specific recommendations which appeared frequently and are appropriate to address at a national level.

### Relationship between Science Center & OST Ecosystem Science Programs and their Science Priorities

It was not always clear to the reviewers the relative prioritization and rank of ecosystem science programs within overall activities in the Science Centers and OST. Sometimes, this left questions as to how ecosystem-related science relates to other core activities such as fish stock and protected species assessment. These observations stemmed from various reasons such as a systemic lack of funding for ecosystem science, the need to balance expanding ecosystem scale work with the continued need for single species stock assessment, the relative amount of temporary versus permanent funding, the *ad hoc* nature of some ecosystem-science projects which often responded to internal funding allocation decisions for ecosystem science projects, or a lack of details of how the various programs relate to each other. These factors contributed to some panelists noting that there did not seem to be a clear directing vision for ecosystem science and to ask whether ecosystem science was a priority core activity among the scientific research activities at the Centers. It was also noted that much ecosystem work is isolated within Science Centers’ Divisions or Branches, and that increased collaborations between oceanographers or ecosystem scientists and stock assessment scientists should be encouraged.

### *Recommendations:*

The reviewers suggested that, although it exists in pieces under various legislation, there is no standalone federal legislation (statute or act) that mandates we do ecosystem science or management. Hence, there is a need to better define the relation of ecosystem science to the Magnuson-Stevens Act (MSA), Endangered Species Act (ESA),

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<sup>9</sup> <http://www.st.nmfs.noaa.gov/ecosystems/climate/national-climate-strategy>

Marine Mammal Protection Act (MMPA), and National Environmental Protection Act (NEPA) mandates and improve communication of these relationships. It was suggested this might be accomplished through case studies or an overall vision document. Reviewers also noted that there was a need for a more systematic way to set ecosystem science priorities that details clear goals and objectives for the Science Centers. Increased collaboration between ecosystem scientists and assessment scientists working with fish and protected species stocks was recommended to better incorporate ecosystem information into assessments. Likewise, developing projects that cross Divisions (or Laboratories), possibly establishing formal within- and across-Center working groups or task teams, was seen as a way to harmonize projects that are often *ad-hoc* and do not necessarily support strategic programmatic goals. Finally, it was suggested that there may be a need to evaluate current staff workloads to make sure there is capacity to support ecosystem science.

**Response:**

NOAA Fisheries recognizes the need for more internal collaboration and is committed to the inclusion of ecosystem science into management of our trust resources. Development of the tools needed to accomplish the goal is constrained by limited funding and personnel. Yet, progress is occurring and NOAA Fisheries is leading the development of the tools necessary to assess stocks through an ecosystem approach for both management and conservation. The IEA process defines the steps necessary to reach these goals and offers a framework to increase integration across partners and incorporation of ecosystem, climate, habitat and human dimensions information. The need to clarify goals and objectives for ecosystem science is addressed in part in the EBFM Road Map. The EBFM Road Map, released on November 17, 2016, affirms NOAA Fisheries' commitment to EBFM and details a vision and actions for implementation, some of which are directly related to recommendations from the program reviews. These include actions for each Science Center, Regional Office and Headquarters Office to establish an EBFM point of contact to help coordinate EBFM activities and to create regional EBFM Road Map Implementation Plans that include an ecosystem science strategy. The EBFM Road Map also calls for a biennial workshop on science and management that would bring together NOAA Fisheries staff from around the country as well as other NOAA Line Offices and partners. In addition to actions already laid out in the EBFM Road Map NOAA Fisheries proposes the following action items.

**Action items:**

- Ensure NMFS Annual Priorities, as well as Center Annual Guidance Memoranda and Science Plans (due for five-year revision) include appropriate ecosystem science program activities
- Implement NOAA Fisheries Climate Science Strategy Regional Action Plans and complete Climate Vulnerability Analyses
- Develop EBFM Regional Action Plans
- Continue to prioritize ecosystem science activities at Science Centers

## Improve Incorporation of Science Products and Information into Management Advice

The majority of the Science Centers and OST programs have a good relationship with their management partners and deliver ecosystem related information and products to their management partners. Some of the reviewers observed there can be a breakdown in the incorporation of that information and how well it is integrated into management. Products such as Ecosystem Considerations chapters or Ecosystem Status Reports (ESR) were considered a valuable product but it was not always clear how that information is used by the Councils when making management decisions. In some cases it was clear that ecosystem-related science advice is incorporated directly into management, though reviewers could not discern a formal mechanism (such as Magnuson Stevens National Standards) to ensure this, and the incorporation of ecosystem advice was not universal. This was seen to stem in part because scientists may not always know what managers need and managers may not always know what to ask for or how to use ecosystem-science advice.

**Recommendations:** Reviewers saw a need for NOAA Fisheries science staff to continue to work with managers to determine clear goals and objective for ecosystem science efforts and then direct analyses and products to meeting those objectives. As in past reviews, reviewers called for increased use of MSEs to address possible future states of the ecosystem under various management scenarios. Some reviews recommended ecosystem-related science products such as Ecosystem Status Reports (ESR) be examined to determine how they may be of best use to managers and whether there could be changes made to increase their utility. In some cases, reviewers thought products such as Ecosystem Considerations Chapters, or ESRs, would benefit from being center-wide products to

increase participation across the Science Centers in their production. It was also recommended that delivery of ecosystem, climate, and habitat data into management pathways be enhanced.

**Response:** Like elements of ecosystems, recommendations to improve incorporation of ecosystem advice into management are varied and not uniform from region to region. Progress is being made as NOAA Fisheries' dedicated staff continues to develop the cutting-edge tools needed to enhance system-wide implementation of ecosystem-based approaches to fisheries and protected species management and conservation. These tools build on the decades of ecosystem science conducted at NOAA Fisheries Science Centers. As indicated as action items above, NOAA Fisheries intends to complete efforts to hire MSE FTE positions in each Center resulting from the Stock Assessment program reviews and to provide funding to each Science Center to hire an additional ecosystem MSE or modeling position. This will increase capacity to address ecosystem-related work. IEAs, MSEs, CVAs and EBFM evidence the significant progress toward adopting ecosystem approaches to management. The EBFM Road Map provides a formal policy that adopts the IEA framework from which to build ecosystem-based approaches as a way of doing business in NOAA Fisheries. Elements of the Road Map include actions, such as the following:

- Continue using the IEA process to refine the engagement strategy in each region
- Conduct a national review of existing ESRs
- Work with all Councils to ensure their Fishery Ecosystem Plans (FEPs) are robust
- Make sure ESRs and Risk Assessments are written for each Large Marine Ecosystem (LME) as part of the National and Regional IEA programs
- Continue development of MSEs
- Establish ecosystem-level Terms of Reference (TOR) for stock assessments, stock assessment reviews
- Define and develop ecosystem-level reference points, best practices in incorporating ecosystem considerations, and a protocol for ecosystem information in Essential Fish Habitats (EFH)

Additionally, NOAA Fisheries proposes the following action items.

**Action Items:**

- Where appropriate, Centers will work with their Councils to enhance the use of ESRs to management and that information will be shared nationally to develop or refine ESRs for all regions and supplement the EBFM Road Map national review of ESRs
- Develop, with relevant management partners, protocols to include ecosystem information into management advice

## 6. The FY 2017 Economics and Human Dimensions Program Reviews

The fifth year of NOAA Fisheries' program reviews will focus on economics and human dimensions. We will continue to monitor progress on action items from past reviews. We will also work to develop outreach products that illustrate the benefits of conducting these program reviews.

Overarching Terms of Reference for the FY 2017 reviews, the review dates and locations are posted at <http://www.st.nmfs.noaa.gov/science-program-review/index>. Results of all reviews will be posted on this site as they become available.

**Table 1. Summary of national action items arising from the previous NOAA Fisheries program reviews relevant to ecosystem science, and specific 2016 ecosystem-related science reviews. Highlighted (bold-faced) action items are the highest priority.**

Program Review Action Item	EBFM Road Map Actions <sup>10</sup>	Timeline
<b>2012 – 2016 Overarching Themes</b>		
<b>Data Management</b>		
1. Explore file sharing solutions to improve sharing of ecosystem monitoring data and model code across Divisions and Science Centers, and with external partners		FY 2017
2. <b>Enhance partnerships with other NOAA offices or academia which can increase access to High Performance Computing (HPC) for NMFS ecosystem modelers</b>		FY 2017
3. Offer training on NOAA HPC resources so that NMFS scientists have greater awareness on how to utilize the HPC resources that are available		FY 2017
<b>Increase Capacity to Support Ecosystem Science Programs and Ecosystem-Based Fisheries Management (EBFM)</b>		
4. <b>Complete current efforts to hire an MSE FTE position in each Science Center resulting from the Stock Assessment programs reviews</b>		FY 2018
5. <b>Provide support for Science Center efforts to hire additional ecosystem MSE and modeling positions. If temporary funds are provided from HQ to a Science Center, these funds will be made permanent once an FTE is hired to fill the position</b>	<b>Support regional and national positions called for in the EBFM Road Map</b>	FY 2018
6. Increase collaborative efforts with other scientific partners (e.g., other Science Centers, Line Offices, academia, etc.) similar to those mentioned above		FY 2017 then ongoing
7. Continue to strengthen the IEA effort for each region		Ongoing

<sup>10</sup> EBFM Road Map was established with a 5-year horizon and actions are characterized as having short- (ongoing or already planned and either are or will be funded from existing resources), mid- to long-term actions needed to fully implement this Road Map (not yet be completely funded and therefore not immediately implementable), and continuing timelines.

Program Review Action Item	EBFM Road Map Actions <sup>10</sup>	Timeline
<b>8. Ensure regularly developed staffing plans include needs to implement high priority ecosystem science programs and EBFM</b>		FY 2018
	Advance resources to conduct EBFM	Continuing
	Assess and bolster ecosystem and LMR modeling needs in each FSC	Short-mid
	Development of an EBFM analytical toolbox that includes ecosystem modeling tools and best practices	Mid
<b>Evaluate Current Surveys</b>		
<b>9. Continue to strategically optimize NOAA Fisheries research surveys and observing systems</b>	A national review of the data collection programs on a wide range of disciplines, including but beyond the typical abundance and basic biological data	FY 2018, Mid
<b>Communication</b>		
10. Continue to develop NOAA Fisheries communications capacity especially related to ecosystem science-related efforts (e.g., IEAs, Climate Regional Action Plans, Climate Vulnerability Analyses) and EBFM		Ongoing
11. Continue to utilize Science Center Communication Offices and the NMFS Communication Office to engage the public regarding the importance of ecosystem science and on-going studies		Ongoing
	Develop National and Regional EBFM engagement strategies	Short
	Develop Standardized EBFM Policy and Road Map Materials for widespread use	Short
	Create "X-prize" like competition for visualizing and communicating complex ecosystem model and MSE outputs	Long
<b>2016 Overarching Themes</b>		
<b>Relationship between Science Center &amp; OST Ecosystem Science Programs and their Science Priorities</b>		
<b>12. Ensure NMFS Annual Priorities, as well as Center Annual Guidance Memoranda and Science Plans (due for five-year revision) include ecosystem science program activities</b>		FY 2018 then ongoing
	Establish EBFM Point of Contact at each Regional Office, Fisheries Science Center,	FY 2017

Program Review Action Item	EBFM Road Map Actions <sup>10</sup>	Timeline
	and Headquarters Offices	
13. Implement National Climate Science Strategy Regional Action Plans and complete Climate Vulnerability Assessments		FY 2017 then ongoing
<b>14. Develop EBFM Regional Action Plans</b>	Each NOAA Fisheries region develops a regional EBFM implementation plan with specific milestones	FY 2018
	Conduct biennial EBFM Science and Management Conference	Mid
<b>Improve Incorporation of Science Products and Information into Management Advice</b>		
15. Where appropriate, Science Centers will work with their Councils to enhance the use of Ecosystem Status Reports (ESRs) to management and that information will be shared nationally to develop or refine ESRs for all regions and supplement the EBFM Road Map national review of ESRs	Conduct a national review of existing ESRs to assess Fisheries Science Center (FSC) indicator information needs to identify where ESRs address similar indicators across	FY 2018/Short
<b>16. Develop with relevant management partners, protocols to include ecosystem information into management advice</b>	Identify best practices for incorporating ecosystem considerations into management decisions	Short-Mid
	Delineate, evaluate, and establish best practices for estimating and using system-wide or aggregate group harvest limits, ecosystem production measures, and other ELRPs to inform management decisions	Mid
	Establish ecosystem-level Terms of Reference (TOR) for stock assessments, stock assessment reviews	Mid
	Establish routine, regular and dynamic reporting of ESRs for each LME	Mid
	Assist Councils, Commissions, Regional Fishery Management Organizations, and other bodies as requested, in their development of new, or revision of existing FEPs	Continuing
	Develop functional system-level MSEs	Mid
	Identify best practices for incorporating ecosystem considerations into management decisions	Short-mid
	Explore protocols for considering ecosystem-level information in EFH reviews, identifying ecosystem-level habitat areas of particular concern, and setting habitat conservation objectives and/or indicators	Short