

NOAA's Integrated Ecosystem Assessment Program: Northeast Region 3-Year Work Plan (FY2016-FY2018)

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Regional IEA Goal/Vision:

The overarching goal of the Northeast U.S. Continental Shelf Integrated Ecosystem Assessment Program over the next three years is to produce a first generation IEA for the region from Cape Hatteras to the Gulf of Maine. We have partitioned this broad area (encompassing approximately 260,000 km² within the 200m isobath) into four main ecological production units that accommodate nested subregions within each. Of these regions, three fall within US waters and one is principally in Canadian waters. We will focus on the US portion of the Northeast Continental Shelf Large Marine Ecosystem. The IEA will include sections for each US ecological production unit (which can be mapped to areas of authority for the two Regional Planning Bodies and the areas of responsibility of the two Fishery Management Councils in the Northeast.

Introduction:

Since the inception of the NOAA IEA Program, we have been assembling key elements required to undertake a full IEA cycle in the Northeast Region. To date, we have worked as advisors to regional management authorities in the region in establishing goals and targets (Phase 1 of the IEA cycle). We have also assembled an extensive body of physical, ecological, and social-economic indicators for this region (Phase 2 of the IEA cycle; see <http://www.nefsc.noaa.gov/ecosys>). We have been engaged in elements of Phase 3 of the IEA cycle – assess the ecosystem - by undertaking analyses of ecosystem status through our Ecosystem Status Reports. Recently, we have focused on evaluating evidence for regime shifts in the coupled social-ecological system of the Northeast Region (see <http://www.nefsc.noaa.gov/ecosys/ecosystem-status-report/executive-summary.html>). We have also compiled all current legally binding status determinations made under the Endangered Species Act, the Marine Mammal Protection Act, and the Sustainable Fisheries Act as part of our current Ecosystem Status Report.

We have partitioned our plan into two inter-related components. The first element comprises work to be accomplished under base funding levels. Our activities specifically related to implementation of Ecosystem-Based Management in the region have been identified as a potential Strategic Theme Area if additional IEA funds should become available. Accordingly we have identified those elements related to direct management requirements collectively in a separate goal statement below. We note however that should supplemental not be available, we will strive to address critical elements of the work related to completion of management plans by both the Regional Planning Bodies and the Fishery Management Councils. This will entail

scaling back on selected activities identified in the core and supplemental funding parts of this proposal.

REGIONAL GOALS, OBJECTIVES, ACTIVITIES, AND DELIVERABLES PRIORITY
GOAL #1: Complete first iteration of a full IEA cycle for the Northeast Region

Our work in the next three years will center on completing an assessment of the status of Northeast Shelf Large Marine Ecosystem; developing risk analyses with a focus on climate impacts; undertaking management strategy evaluations to test the potential efficacy of different management options; and supporting the implementation of management actions. These activities will entail making important progress on the remaining phases of a complete initial IEA cycle for this region. Work on elements of the IEA cycle related to performance evaluations of the management system once specific management actions have been identified and implemented will be undertaken. A major element of our work in the next three years will involve strengthening NOAA-Line Office collaboration with a particular focus on (1) climate-related research and (2) collaborative work with our colleagues in the Stellwagen Bank National Marine Sanctuary Program

Objective 1: Continue to enhance our Ecosystem Status Report with compilation of indicators related to ecosystem services, threats to the sustainable delivery of these services, and specification of reference points. (*Core*).

Deliverables:

- In our most recent Ecosystem Status Report we significantly restructured our approach to place Ecosystem Services explicitly at the nexus of the report. We further expanded our treatment of the threats to sustainable delivery of these services. In both cases, this entailed identifying and incorporating new data sources to provide a fuller accounting of the diverse ecosystem services important to the Northeast and the spectrum of stressors affecting these services. We will continue to expand our treatment of these issues, seeking new data sources and refining the analytical treatment of the services and stressors.
- A central challenge in making the transition from the compilation of a suite of indicators for a coupled social-ecological system to use of these indicators in a management setting is synthesizing these metrics into an informative composite index and establishment of reference points based on this index. We will synthesize our suite of climate-ecological-social-economic indicators in the form of a leading Social-Ecological index. This will entail establishing which of our indicators hold the greatest promise in predicting change in ecosystem services and assembling these into one or more composite indicators.
- We will examine the relationships between stressors and ecosystem services to determine whether nonlinearities in these relationships can be used to establish reference points that can serve to guide management actions.

Objective 2: Initiate Formal Tradeoff Analyses as a Decision Support Tool

Deliverables:

- Confronting tradeoffs lies at the very heart of Ecosystem-Based Management. Instances in which different ocean use patterns involve the pre-emptive use of space in particular involve stark tradeoff choices. We will begin by examining classical decision-theoretic approaches applied to conflicting use of space for two ocean use sectors under uncertainty. We will also explore an alternative paradigm using a satisficing framework which involves making less rigid assumptions than classical decision theory. We will start by testing these two alternative approaches on simulated data and then progress to an application with real data.

Objective 3: Finalize Conceptual Models Connecting Ecosystem Services to Drivers of Change to Guide Research and to Serve as Communication Tools (*Core*).

Deliverables:

- We have developed an initial set of conceptual models for the region centered on the concept of Ecosystem Services and the threats to sustainable delivery of these services. We will finalize these conceptual models, engage a graphic artist to render these concepts into infographic form, and use these conceptual models as a principal communication tool for stakeholders in the region.
- We will develop model analogues of these conceptual frameworks using qualitative modeling approaches based on loop analysis. These qualitative models will be used to predict the direction of change in the status of ecosystem services in response to change in one or more stressor variables. The key stressors to be considered include climate change and variability and exploitation. We will also explore the utility of structural equation modeling for this purpose.

Objective 4: Enhance Climate Web Portal and the Delivery of High Resolution Climate Model Outputs (*Core*)

Deliverables:

- We will continue to expand our Climate Web Portal for enhanced IEA applications in the NES and other regions. We will continue to expand the number of variables to include:
 - physical variables such as stratification, surface currents, upwelling, sea level, surface winds and temperature, salinity and currents at depth
 - biogeochemical variables from earth system models in the CMIP5 archive, including nitrogen, primary productivity, and zooplankton biomass
 - multiple greenhouse gas scenarios and ensemble members from the same model started with different initial conditions to explore the spread among climate projections

- output from GFDL's high resolution earth system model to provide regional high resolution retrospective simulations, forecasts and projections

Objective 5: Improve collaboration with the Office of National Marine Sanctuaries by focusing IEA data and products to support development of the Stellwagen Bank National Marine Sanctuary (SBNMS) Condition Report(s) (Core).

Deliverables:

- IEA data and information products will support movement from a primarily a qualitative approach to more quantitative metrics to define the condition or current status of SBNMS. This will require a significant effort to compile, synthesize, and analyze bio-physical data sets to develop quantitative metrics that can be tracked over time to aid in Sanctuary management

Objective 6: Apply new High Resolution Climate Models and regionally downscaled climate information in support of EBM in the Region (Core)

Deliverables:

- A fully functioning version of a Northeast US Shelf Atlantis Modeling Framework has been available for several years. A new high resolution ROMs model for the region has been developed through a collaborative effort between Rutgers University and the NOAA Geophysical Fluid Dynamics Laboratory. We will incorporate the Western Atlantic 7 km version of ROMs in our current version of Atlantis to enhance its capabilities.
- Continue work on statistical downscaling for application of climate models to estuarine systems on the eastern seaboard
- Apply the high resolution GFDL Version 2.6 Climate Model to develop forecasts of changing climate conditions on the Northeast Continental Shelf for consideration of the effects of resource distribution shifts, changing productivity patterns, and shoreline vulnerability.

Objective 7: Develop a Risk Assessment Framework for Evaluating Vulnerability of Social and Ecological Components of the Northeast Shelf Ecosystem to Climate Change and Resource Extraction Policies (Core).

Strategies/Activities:

- We have developed an initial climate risk assessment protocol for the Northeast Shelf system (Gaichas et al. 2014). The approach centers on expert opinion evaluations of the potential vulnerability of over 70 species to climate-induced changes. We will revisit this analysis and supplement it with additional empirical metrics. We will then develop an expanded risk analysis that examines interactive effects between climate change and exploitation

***REGIONAL GOALS, OBJECTIVES, ACTIVITIES, AND DELIVERABLES PRIORITY
GOAL #2: Support Regional Management Authorities in Moving Towards Ecosystem-Based
Management in the Northeast Region through Direct Participation in Advisory Committees and
Panels of Regional Planning Bodies and Fishery Management Councils***

Members of the Northeast IEA team are formal members of advisory committees of both the Regional Planning Bodies and the Fishery Management Councils in the region and are positioned to provide direct management support. We have a representative on the Northeast Regional Planning Body Ecosystem-Based Management Working Group. The Mid-Atlantic Regional Planning Body does not yet have a comparable Working Group. We have representatives on the Scientific and Statistical Committees (SSCs) of both Councils. We also have four representatives on the New England Fishery Management Council Ecosystem-based Fishery Management Plan Development Team. The Northeast and Mid-Atlantic Regional Planning Bodies, established under the National Ocean Policy, have adopted clearly defined goals and objectives and are now working on Regional Ocean Management Plans in both areas. Similarly, we are now working with the New England and Mid-Atlantic Fishery Management Councils to specify goals and objectives. The New England Fishery Management Council is currently developing a Fishery Ecosystem Plan through its EBFM Plan Development Team. The Mid-Atlantic Fishery Management Council is developing an Ecosystem Approach to Fishery Management Guidance Document. The following activities will be undertaken to provide analytical support for the development of the Ocean Management Plans of the RPBs and the Fishery Ecosystem Plans/Guidance Document of the Fishery Management Councils.

Objective 1: Undertake Management Strategy Evaluations in Support of Ecosystem-Based Management in the Northeast Region using the Atlantis Modeling Framework (Supplemental)

Deliverables:

- We will use the end-to-end Atlantis model for the Northeast US Shelf to explore the implications of two major management issues:
 - The potential development of offshore renewable energy installations is under very active consideration on the Northeast US Continental Shelf. Interest has focused on wind farms but tidal installations are also under consideration. We will assess the potential impact on other ecosystem services of (a) placing a wind farm installation in the large RI-MA lease block and (b) the energy transmission corridor in the Mid-Atlantic Bight. We will also use NCCOS species habitat suitability models to assess potential impacts from offshore wind energy development to complement the Atlantis Model work.
 - Alternative management strategies for the forage fish complex on the Northeast Shelf with a particular focus on herring and mackerel. Both the New England and Mid-Atlantic Fishery Management Councils are actively considering forage fish management strategies. The MAFMC is considering the entire forage fish complex while the New England Council

has expressed a particular interest in Atlantic Herring as a keystone species in the forage species complex.

- We will use Atlantis in MSE mode to integrate the present-past climate state in an extended stock assessment context for the Fishery Management Councils

Objective 2 Implement the NCCOS Biogeographic Assessment Framework (BAF) as a decision support process for marine spatial planning in the region. The BAF provides a rapid, flexible, and multi-disciplinary approach to integrate geospatial information into formats and visualization tools readily useable for spatial planning. (Supplemental)

Deliverables:

- Provide a rapid, flexible, and multi-disciplinary approach to integrate geospatial information into formats and visualization tools readily useable for spatial planning
- Undertake the full BAF Cycle of Planning , Data Evaluation , Ecosystem Characterization and Management Application in support of ocean planning in the Northeast with particular emphasis on the SBNMS.

Objective 3: Complete Development of Multispecies Bioeconomic Model with Climate Inputs for Georges Bank (*Supplemental*)

Deliverables:

- We will finalize and test the performance of a ten species multispecies bioeconomic model for Georges Bank with the following attributes:
 - *Multimodel Inference:* we have developed three alternative assessment model types for this multispecies complex. These models range from simple production models to age-structured forms. These models are each designed to include covariates representing climate impacts.
 - *Social and Economic Considerations:* these are included through a portfolio analysis framework
 - *Management Strategy Evaluation:* we have developed a simulation model (Hydra) for Management Strategy Evaluation that includes demographic structure, environmental forcing, and interspecific interactions. Hydra serves as an operating model to test the performance of simpler assessment models.
 - *Management Procedures (MPs):* We are developing options for simple and easy to explain alternatives for management that include reference points for functional groups within the system. The MP entails setting an overall cap on removals from each functional group and constraints on exploitation on species comprising the functional group, Performance of these MPs are being tested using Hydra in a Management Strategy Evaluation.

Model results will undergo formal peer review and provided to the Fishery Management Councils in the region.

Objective 4: Directly contribute to the development of the Northeast Regional Planning Body's Ocean Management Plan (Supplemental)

Deliverables:

- Evaluate approaches to identifying regions of high vulnerability to disturbance on the Northeast Continental Shelf
- Make projections of future species distribution shifts under different scenarios using the GFDL High Resolution Climate Model V. 2.6
- Integrate information from Priority Goal 2 No. 1 into the NRPB Regional Ocean Plan with an explicit focus on evaluating the tradeoffs involved in establishment of renewable energy installations in selected locations

Objective 4: Continue contributions to the development of a Fishery Ecosystem Plan for the New England Fishery Management Council (Supplemental)

Deliverables:

- Provide analyses supporting the delineation of spatial ecosystem-based management units on the Northeast Continental Shelf
- Integrate information from Management Strategy Evaluations developed under Priority Goal 2 No. 1 with an explicit focus on Atlantic herring as a forage fish.
- Integrate information from Management Strategy Evaluations developed under Priority Goal 2 No. 2 with an explicit focus on multispecies management of functional groups in the New England area.

Objective 5: Continue contributions to the development of an Ecosystem Approach to Fishery Management Guidance Document for the Mid-Atlantic Fishery Management Council (Supplemental)

Deliverables:

- Integrate information from Management Strategy Evaluations developed under Priority Goal 2 No. 1 with an explicit focus on Atlantic herring as a forage fish.
- Integrate information from Management Strategy Evaluations developed under Priority Goal 2 No. 2 with an explicit focus on multispecies management of functional groups in the Mid-Atlantic region.

End-Users (e.g. recipients/ beneficiaries of regional IEA work and impact):

Translation of scientific advice into management action follows carefully prescribed pathways. Adoption of results from IEAs by management authorities accordingly depends on integration of IEA scientists into scientific advisory bodies to present findings in a formal management setting and, often, to serve as voting members of advisory councils. As noted above, the principal end users of the information for the Northeast Region IEA initiative are the Northeast and Mid-

Atlantic Regional Planning Bodies, the New England and Mid-Atlantic Fishery Management Councils, and the Atlantic States Marine Fisheries Commission. In addition, work developed in the Northeast Regional IEA Program is contributing to international efforts through the Working Group on Northwest Atlantic Regional Seas (WGNARS) of the International Council for Exploration of the Sea and the Working Group on Ecosystem Science and Assessment (WGESA) of the North Atlantic Fisheries Organization. A Northeast Region IEA team member is currently co-chairs WGNARS and IEA team members are represented on WGESA.

Long-term Outcome(s): How will this work contribute to the broader IEA vision in your region and beyond?

This work will lead to the completion of a first generation IEA comprising all major components of the IEA cycle for the Northeast. Scientific assessments in support of management activities are part of an iterative and evolutionary process. Completion of the first generation full IEA for the region will provide the foundation for future refinements and enhancements.

Evaluating Success:

Success will be measured in terms of the integration of our products into management plans and decisions as outlined above. The Northeast IEA team is well placed to contribute to direct management decisions in the region. We will consider the development of methods that are transferable to other NOAA regions as a key measure of success. Activities to be undertaken within this three year planning cycle that we believe will be directly transferable include the methodology underlying the development of an Index of Leading Social-Economic Indicators; protocols for Tradeoff Analyses; and formalization of Management Procedure approaches and their application to actual management settings.

BUDGET

A budget Request table is provided in the Appendix

Budget Justification:

OAR/ESRL

The budget provided in Appendix A is required to enable core and supplemental data collection, integration, data visualization, and assessment products to be delivered to NE IEA partners. Seventy nine percent of the funds will support contract labor with the remaining component supporting travel and product development.

NOS/NCCOS

The above budget is required to enable core and supplemental data collection, integration, data visualization, and assessment products to be delivered to NE IEA partners. Seventy nine percent of the funds will support contract labor with the remaining component supporting travel and product development.

OAR/GFDL

The funding will be used to cover salary and all overhead costs for a support scientist (Gaelle Hervieux) at PSD to continue developing the climate change web portal and to develop a new web-based system for visualizing results from the NE regional ROMS simulations.

NMFS/NEFSC

Recent directives at NEFSC have dictated that no work by full time permanent staff can be undertaken that is not directly linked to specific funding lines specified by congress or provided through external funding sources. Accordingly, any funds made available to NEFSC through the NOAA IEA program will have to go to cover personnel costs. We will continue to seek outside funding from other sources to support elements of our program as reflected in our Leverage section. We have adhered to the budget limits assigned to the Northeast in the guidance memorandum. All of the tasks identified in this 3-year plan may not be feasible under the suggested level of funding. We have identified all elements that we think will be necessary to produce the first-generation IEA for the Northeast without consideration of the constraints under the suggested funding levels.

Leveraging:

Assuming the level of requested funding above, NCCOS will provide \$30,000 in federal labor in FY16. In FY 16 & 17 NCCOS will provide \$50,000 in kind federal labor and the project will leverage \$150,000 of data already collected and processed to support development of bio-physical geospatial data.

ESRL and GFDL will leverage off the NOAA/COCA grant entitled "A high-resolution physical-biological study of the Northeast U.S. shelf: Past variability and future change." to Enrique Curchitser (Rutgers University), Michael Alexander and Charles Stock. This project uses a high-resolution (7 km) coupled physical-biogeochemical model for the NEUS shelf and is based on an existing coupled implementation of the Regional Ocean Modeling System (ROMS) and NOAA/GFDL's Carbon, Ocean Biogeochemistry and Lower Trophics (COBALT) biogeochemical model. Model simulations include 30-year assimilative hindcasts and projections of future climate change. We will also leverage off a NOAA Special Early-Stage Experimental or Development (SEED) proposal and follow on funding from the NOAA Climate Program Office to examine the predictability of monthly sea surface temperatures for coastal ecosystems using the North American Multi-Model Ensemble (NMME) and a base funded NOAA project between GFDL and PSD to investigate marine tipping points.

OAR and GFDL will each provide 50K of in kind federal labor.

NEFSC will provide \$350K per year in in-kind labor

COMMUNICATION AND OUTREACH

Climate Web Portal

The Climate Change Web Portal is being developed by the NOAA/ESRL Physical Sciences Division to access and display the large volumes of climate and earth system model output from the climate model inter-comparison project version 5 (CMIP 5) that informed the recently released Intergovernmental Panel on Climate Change (IPCC) report. The portal includes many fields that are relevant for physical oceanographers and marine ecosystem scientists. The goal is to allow scientists, managers, stakeholders and the general public to evaluate and interpret the models and view how they project climate change in the future.

Ecosystem Considerations Website

One of our principal communication tools to reach a diverse array of stakeholder groups in the Northeast is our Ecosystems Considerations webpage <http://www.nefsc.noaa.gov/ecosys/>. We have revamped this site in its entirety and made the transition to a totally web-based product. This allows us to use more advanced communication tools, including animations to convey information to viewers. We have used a responsive design format that allows viewers to access the product using different platforms including smart phones, tablets, laptops, and desktops. We also now update the web product as new information and analyses becomes available rather than on a set schedule. We view the site as a living web document that evolves as we access new sources of data. In addition to our ESR, the site provides an basic overview of the ecology of the Northeast Shelf system; a description of climate process of particular importance to the system; a biannual Current Status page that provides twice-annual updates on changes in the system; a spatial analysis page documenting shifting distribution patterns of marine organisms on the shelf; and a modeling page documenting our efforts at ecosystem modeling.

State of the Ecosystem Report

At the request of the New England Fishery Management Council, we have developed a State of the Ecosystem (SOE) Report to be delivered annually in the spring to the Council. The report is deliberately concise (not to exceed 20 pages) and we use this SOE report as an Executive Summary for our Ecosystem Status Report .

Data and Model Visualization

Effective communication also involves dedication to the development of effective visualization tools. NOAA IEA scientists have partnered with the Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC) at the University of New Hampshire. The JHC is a formal cooperative partnership between the University of New Hampshire and NOAA. NOAA IEA scientists have worked closely with students and faculty at CCOM/JHC to develop interactive visualization tools for presenting (1) results of multispecies models used in our prototype Georges Bank analysis and (2) dynamic food web representations providing a vehicle for visualization of trophic interactions.

APPENDIX A: WORK PLAN AND BUDGET TABLES AND PAST ACCOMPLISHMENTS/ PROGRESS

Priority Goal #1 Workplan

Activity (from above)	Key Tasks/Input/ Deliverable	Expected Completion Date	Responsible LO/ Partner (or Person)	Progress Reporting
<i>Enhance Ecosystem Status Report</i>	<ul style="list-style-type: none"> ▪ <i>Identify and add new Ecosystem Service and stressor variables into the ESR</i> 	<i>Continuous</i>	<i>NEFSC Michael Fogarty with contributions from all line offices</i>	<i>Periodic updates as new information added</i>
<i>Tradeoff Analysis</i>	<ul style="list-style-type: none"> ▪ <i>Develop and test analytical methods for tradeoff analysis using classical decision-theoretic approaches and satisficing</i> 	<i>Dec. 2017</i>	<i>NEFSC Michael Fogarty</i>	<i>Interim report Dec. 2016 Final Report Dec. 2017</i>
<i>Conceptual Models</i>	<p>Develop infographics for conceptual models of the system</p> <p>Conduct qualitative stability analyses</p> <p>Develop Structural Equation Models</p>	<p>October 2016</p> <p>October 2017</p> <p>December 2018</p>	<i>NEFSC Michael Fogarty</i>	<i>Interim report October 2016, 2017 Final Report Dec. 2018</i>
<i>Climate Web Portal</i>	<p>Add additional physical and biological variables to the web portal include additional statistical measures of model spread</p> <p>Include fields from large ensembles of simulations with a single model</p>	<p>June 2016</p> <p>Sep 2017</p>	<p>ESRL/PSD Michael Alexander</p> <p>ESRL/PSD Michael Alexander</p>	<p>Implement in the web based system. Document in Bulletin of the American Meteorological Society (BAMS)</p> <p>Implement in the web based system.</p>

Activity (from above)	Key Tasks/Input/ Deliverable	Expected Completion Date	Responsible LO/ Partner (or Person)	Progress Reporting
	Develop capacity to display high resolution (< 10 km data)	Sep 2018	ESRL/PSD Michael Alexander	Implement in the web based system.
SBNMS	<p>Review existing SBMS condition metrics & determine which ones can be quantified using IEA data streams or new ones to be developed</p> <p>Finalize sanctuary condition metrics and develop for key indicators.</p> <p>Bio-physical data collection & synthesis</p> <p>Assess condition of SBNMS with new and/or quantified metrics.</p>	<p>June 2016</p> <p>Oct 2016</p> <p>Dec 2017</p> <p>Aug 2018</p>	<p>NOS/NMFS/OAR</p> <p>NOS/NMFS/OAR</p> <p>NOS/NMFS/OAR</p> <p>NOS/NMFS/OAR</p>	<p>Interim reports</p> <p>Report</p> <p>Report linked to digital data to be used to derive condition metrics</p> <p>Report linked to digital data on the condition of SBNMS</p>
High Resolution Climate Models and regional climate downscaling	<p>30-year hindcasts of physical model</p> <p>seasonal forecasts</p> <p>climate change projections</p>	<p>Sep 2016</p> <p>Oct 2017</p> <p>Jan 2018</p>	<p>OAR ESRL& GFDL</p> <p>OAR ESRL & PSD</p> <p>OAR ESRL& PSD</p>	<p>Data available to download</p> <p>Data available to download</p> <p>Data available to download. Journal Article(s).</p>
<i>Risk Assessment</i>	<ul style="list-style-type: none"> ▪ Enhance existing climate risk assessment for the Northeast ▪ ▪ ▪ Examine 	<p><i>December 2016</i></p> <p><i>October</i></p>	<p>NEFSC Michael Fogarty</p>	<p>Interim Reports December 2017, October 2018</p> <p>Final Report October 2016</p>

Activity (from above)	Key Tasks/Input/ Deliverable	Expected Completion Date	Responsible LO/ Partner (or Person)	Progress Reporting
	<ul style="list-style-type: none"> options for exploitation risk assessment ▪ Develop risk assessment for climate/exploitation interactions 	<p>Interim Reports December 2017, October 2018</p> <p>Final Report October 2016/2017</p> <p>October 2018</p>		

Priority Goal 2 Workplan

Activity (from above)	Key Tasks/Input/ Deliverable	Expected Completion Date	Responsible LO/ Partner (or Person)	Progress Reporting
<i>Atlantis Management Strategy Evaluation</i>	<ul style="list-style-type: none"> ▪ <i>Conduct MSE for spatial management options for Regional Planning Bodies</i> ▪ <i>Conduct MSE for Forage Fish Management</i> 	<p><i>October 2016</i></p> <p><i>March 2018</i></p>	<i>NEFSC Michael Fogarty</i>	<p>Interim Reports October 2016, October 2017</p> <p>Final Report October 2018</p>
<i>Multispecies Bioeconomic Model</i>	<ul style="list-style-type: none"> ▪ <i>Finalize simulation testing of multispecies bioeconomic assessment model</i> ▪ <i>Complete application of multispecies bioeconomic model to tern species complex on Georges Bank</i> ▪ <i>Integrate</i> 	<p><i>July 2016</i></p> <p><i>October 2017</i></p> <p><i>October</i></p>	<i>NEFSC Michael Fogarty</i>	<p>Interim Reports July 2016, October 2017</p> <p>Final Report October 2018</p>

Activity (from above)	Key Tasks/Input/ Deliverable	Expected Completion Date	Responsible LO/ Partner (or Person)	Progress Reporting
	<i>outcomes of multispecies bioeconomic model into management actions</i>	2018		
<i>IEA Support for NRPB Ocean Management Plan</i>	<ul style="list-style-type: none"> ▪ Delivery of biophysical data via geospatial portal ▪ Application of BAF for interim Geospatial Assessments to support marine planning scenarios ▪ After review by NEROC/NERPB define & conduct final suite of geospatial assessments for marine planning under various scenarios 	<p>Sept 2017</p> <p>Dec 2017</p> <p>July 2018</p>	<p>NOS/NMFS/OAR</p> <p>NOS/NMFS/OAR</p> <p>NOS/NMFS/OAR</p>	<p>Report & digital data</p> <p>Interim report & digital data</p> <p>Final geospatial database and analytical framework to run scenario analyses</p>
NEFMC Fishery Ecosystem Plan	<ul style="list-style-type: none"> ▪ Contribute to the development of NEFMC Fishery Ecosystem Plan ▪ Update NEFMC FEP 	<p>October 2016</p> <p>October 2017</p> <p>October 2018</p>	<i>NEFSC Michael Fogarty</i>	<p>Final Document October 2016</p> <p>Updates October 2016, October 2017</p>
MAFMC Ecosystem Approach to Fishery Management Guidance Document	<ul style="list-style-type: none"> ▪ Contribute to the development of MAFMC Ecosystem 	<p>October 2016</p> <p>Update</p>	<i>NEFSC Michael Fogarty</i>	<p>Final Document October 2016</p> <p>Updates October 2017, October 2018</p>

Activity (from above)	Key Tasks/Input/ Deliverable	Expected Completion Date	Responsible LO/ Partner (or Person)	Progress Reporting
	Approach to Fisheries Management Plan Guidance Document Update MAFMC EAFM Guidance Document	October 2017, October 2018		
	▪			

BUDGET

ANNUAL AMOUNTS (THOUSANDS)

Line Office	2016	2017	2018
GFDL	75	100	100
ESRL	75	75	75
NCCOS	75	100	100
NEFSC	325	275	275

Past Accomplishments:

- Developed our third Ecosystem Status Report. This version greatly expands our previous ESRs with extensive new sections on Ecosystem Services, Stressors and Impacts, Status Determinations, and an extensive summary section.
- At the request of the New England Fishery Management Council, developed our first Annual State of the Ecosystem Report. We reached out to the Mid-Atlantic Fishery Management Council to ensure that this product would also be relevant to the interests and needs of the MAFMC.
- Initiated new project in collaboration with The Nature Conservancy to assess distributional shifts in relation to climate velocity for over 70 species of fish and invertebrates. We have presented results to both the New England Fishery Management Council and the Northeast Regional Planning Body. As part of this work, we developed animations of shifting distribution patterns of these species based on NEFSC spring and autumn research vessel surveys and are making these movies available to the Northeast Regional Ocean Council Data Portal and also to the Mid-Atlantic Regional Council on the Ocean Data Portal.

- Applied new NOAA Climate Risk Assessment Framework to the Northeast U.S. Continental Shelf in the first demonstration of this methodology in the nation. The approach will now be applied in other parts of the country.
- Expanded web-based portal (<http://www.esrl.noaa.gov/psd/ipcc/ocn/ccwp.html>) for exploring and evaluating state of the art climate change information from the CMIP5 archive with a focus on variables relevant for marine ecosystem management.
- Expanded new climate change website for the Northeast Continental Shelf [http://www.nefsc.noaa.gov/ecosys/climate_change/index.html]
- Published our semiannual Ecosystem Advisory Reports for Spring and Fall 2015 [<http://nefsc.noaa.gov/ecosys/advisory/>]
- Expanded our work on developing empirically-based reference points for Ecosystem-Based Fishery Management

