



## Protected Species Science Review Northeast Fisheries Science Center Summary and Response August 2015

### Introduction

In April 2015, four peer reviewers evaluated the Northeast Fisheries Science Center's protected species science programs. The panelists were: **Gary Stenson** (Chair), Department of Fisheries and Oceans, Canada; **Daryl Boness**, Smithsonian Institution (retired); **Jamie Gibson**, Department of Fisheries and Oceans, Canada, and **Robin Waples**, Northwest Fisheries Science Center, NOAA. Their review focused on the impact of science products for conservation management, with a particular focus on stock assessments. Science programs addressed in this review include those directed at marine mammals, sea turtles, and fish that occur in the Northeast region and fall under provisions of the Endangered Species Act (ESA) or Marine Mammal Protection Act (MMPA).

The program review provided information on the structure and operation of the Center's protected species science programs and the science needs for management identified by the Center's principal partner, the Greater Atlantic Regional Fisheries Office (GARFO). The panel then evaluated the Center's protected species science programs within four taxa themes (North Atlantic right whales, seals, Atlantic salmon, and other ESA-listed fishes) and one cross-cutting theme. The taxa themes were selected to provide examples of well-developed, well-resourced programs (right whales and salmon) and poorly-developed, poorly-resourced programs (seals and other listed fishes). Other taxa were covered only in the cross-cutting theme, and, as a result, we received less direct feedback for those other taxa. We also worked with the Southeast Fisheries Science Center (SEFSC) to coordinate our reviews to highlight collaboration and avoid duplication. For example, we included aspects of SEFSC research in our review of right whales, passive acoustics, and the Atlantic Marine Assessment Program for Protected Species (AMAPPS). The SEFSC review will include aspects of our sea turtle research, though they will likely focus more on SEFSC issues than a comprehensive coast-wide review of turtle research.

In reviewing the science conducted under each theme, panelists were asked to consider five core questions or terms of reference:

1. Do current and planned protected species scientific activities fulfill mandates and requirements under the ESA and MMPA, and meet the needs of the regulatory partners?
2. Are there opportunities to be pursued in conducting protected species science, including shared and collaborative approaches with partners?
3. Are the protected species scientific objectives adequate, and are we using the best suite of techniques and approaches to meet those objectives?
4. Are the protected species studies being conducted properly (survey design, statistical rigor, standardization, integrity, peer review, transparency, confidentiality, etc.)?

5. How are advances in protected species science and methodological approaches being communicated/applied in the NEFSC?

NMFS scientists provided the panel with presentations and information relevant to each of the themes. 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/](http://www.nefsc.noaa.gov/program_review/).

The reviewers were presented with information covering many aspects of our protected species science program, with a focus on protected species stock assessments and other products to support management. 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' General Comments

### Broader Scope

The panel noted that the Center has done an excellent job working closely with GARFO and other stakeholders to develop research programs that meet their needs. The panel recognized the Center's excellent publication record and outreach programs, open data sharing, and many examples of innovation. The panel also noted that all of the programs have a high degree of collaboration and partnering involving a wide array of government agencies, academia, industry, and other non-governmental organizations.

The panel, however, also recognized that future demands likely will require program changes to address new issues (e.g. impact of climate change, large scale marine projects, oil and gas exploration, wind farms, etc.), and understanding changes in the environment and human use patterns, and particularly how those changes will impact population health, status, and trends is critical. The panel recommended [**Recommendation 1.1**] developing programs to address emerging issues, as well as those related to multispecies and ecosystem interactions, and the impacts of cumulative and combined stressors on populations of concern.

In this review, the Center focused on work related to stock assessment, so many broader protected species scientific efforts were not presented or discussed. For example, AMAPPS, in addition to supporting basic stock assessments, also investigates the seasonal-temporal density distributions of protected species to better understand: (a) their ecosystem role and relationships; (b) distribution and density changes as related to habitat changes; and (c) any impacts of energy exploration and development. The Passive Acoustics group is leading the agency both in integrating acoustic data into assessments and monitoring efforts and in evaluating ocean noise impacts, including providing leadership for the NOAA CetMap/CetSound project. Furthermore, protected species staff members serve on the biological team for the Northeast Regional Ocean Council, dealing with spatial-based management questions for the northeast US waters.

The Center will continue these types of efforts to address new and developing issues, recognizing that more work is needed beyond current capacity. The Center's upcoming Strategic Plan also calls for more focus on integrated and forward-looking science and products. The

Center also has formed a Climate Ecosystem Habitat and Assessment Steering Group, which is a cross-cutting Center Leadership group focused on incorporating broader context into commercial and protected species stock assessments. While these planning efforts are underway, Center staff will co-organize two workshops that directly address broader ecosystem considerations: one on marine mammals and ecosystem function, and the other on baleen whale migrations, their diversity, and the selective pressures driving their movement ecology. Center staff also co-organized a symposium focused on coordinating science efforts on endangered anadromous salmonids across both coasts of North America.

The panel also provided a specific recommendation [1.2] to compile a document outlining the issues faced by protected species in the region and identifying the research required to monitor the impact of climate change on their population dynamics. The Center piloted a Fish Climate Vulnerability Assessment last year, which is providing information on which fish species (including protected species) are most vulnerable to climate change and why. Center staff are on a national steering committee to develop and guide a similar climate vulnerability assessment for marine mammals and sea turtles. An initial workshop to develop the assessment framework was held on 22-23 July 2015. Similarly, Center Staff are involved in international telemetry coordination teams (Ocean Tracking Network and NASCO Telemetry Group) to expand upon baseline monitoring to track changes in ocean migration over time in a more coordinated manner.

### Fiscal Resource Constraints

The panel recognized that current federal funding of the Center's protected species science programs is insufficient to meet the full mandate under legislation. The panel noted that the protected species science programs are carried out very effectively, and the Center has done an excellent job dealing with shrinking budgets and increasing restrictions on allocation of funds. Protected species staff and leadership have obtained extensive outside funding and forged collaborations with external groups to pool resources and accomplish important research that is not feasible with federal funds alone.

To build on this, the panel recommended [1.3] the Center and GARFO identify an optimal distribution of resources to meet their needs and then take steps to steer implementation of effort toward that desired outcome. The panel further recognized the burden placed on staff scientists to obtain external funding and recommended [1.4] that burden be shifted to higher levels in the agency to minimize the burden on the scientists doing the critical work.

The Center and GARFO work closely together in the national Protected Resources Science Investment and Planning Process (PRSIPP), which involves annual coordination to develop a list of regional science needs. That process and list has been used to develop national internal funding initiatives and inform distribution of temporary funds managed by the Office of Protected Resources. Center and GARFO staff also developed a joint regional plan for sea turtle research and management, with prioritized action items. After the series of national protected species science reviews are complete, Center and GARFO staff will evaluate which taxa may warrant additional review or development of regional plans. For example, the NEFSC sea turtle program may not be comprehensively reviewed between the NEFSC and SEFSC reviews and additional review may be warranted. Other taxa, such as harbor porpoise or baleen whales may warrant development of additional regional plans. If PRSIPP and other efforts are successful in attracting resources, that will reduce the burden on individual scientists, but it is likely they will continue to need to pursue additional external funds in order to keep vital research going.

## ESA Roles

The panel noted that the NOAA recovery planning guidelines stipulate that recovery plans must contain objective, measurable criteria that indicate when a species can be delisted, and developing these targets should largely be a scientific responsibility, but it was not clear how the Center contributes to this process, except in the case of salmon. The panel recommended [1.5] improving the transparency of the listing process by producing a publicly available document that summarizes the key scientific issues that must be considered in listing determinations and recovery planning. The GARFO or Office of Protected Resources can then work appropriately with the Center to prepare listing determinations and recovery plans, which can cite the science document and explain policy overlays required to reach listing and recovery decisions.

The Center agrees that such a policy document would be valuable. Panelists also noted during discussion that Center roles in ESA listing and recovery processes can vary among regions and even among actions. To address the need for national consistency, this recommendation is best addressed by a national effort. An upcoming review of the national protected resources regulatory program could consider more clearly defining the roles and processes that should occur when regulating ESA species. In the absence of such guidance, the Center and GARFO should work to clarify roles, responsibilities, and scientific inputs required for ESA processes.

## Responses to Reviewers' Comments on Specific Themes

### Theme 2: Assessments, surveys, and other data collection analyses

#### Survey Support

The panel recognized the fundamental importance of abundance surveys to an assessment and the importance of the AMAPPS program for fulfilling assessment science needs for marine mammals and sea turtles. To ensure continuation, the panel recommended [2.1] NMFS develop a long-term nation-wide survey plan and secure long-term funding for assessment surveys, perhaps through a permanent multi-institution supported program.

The Center has entered into a new 5-year interagency agreement with BOEM (2015-2019) and has initiated another 5-year agreement with the Navy that should begin in 2016. We regularly meet with funding partners to review the goals and objectives of the collaborative work. Though currently unfunded, NMFS is in the process of developing a long-term national plan to have ships and funds available for all US waters using a rotational scheme. This plan would support broad-scale surveys for marine mammals and sea turtles; efforts to survey ESA listed fishes rely on different survey platforms.

#### Stock Assessment Improvements

The panel determined that the Center has done an excellent job of obtaining estimates of abundance for most of the marine mammal populations found in the Greater Atlantic area, allowing the estimation of potential biological removal (PBR) level for most marine mammal stocks. While this meets the basic requirements for assessment (Tier 1 assessment), it does not necessarily provide the data needed to understand trends in populations, identify factors influencing changes in abundances, understand ecosystem interactions, and predict how species

may respond to changes in the environment or human activities. Sea turtle and ESA-listed fish assessments also fall short of providing the data needed to address these broader issues. The panel recommended that [2.2] all efforts should be made to collect the data required to improve the assessments to Tier II, at a minimum, and preferably Tier III as soon as possible. This may require changing research priorities and developing ways to improve allocation of fishery observer effort to address marine mammal and turtle bycatch issues.

The Center has included such broad and integrated, ecosystem concepts as a central part of its new strategic plan and the Climate Ecosystem Habitat and Assessment Steering Group. In order to make more rapid improvement on targeted species, the Center will pursue a national or regional workshop(s) to review marine mammal, sea turtle, and ESA-listed fish stocks, identify stocks where enhanced assessments are particularly critical for management decisions, and identify stocks where small additional effort could result in substantial enhancement to their assessments (e.g., where data are available but have not been analyzed).

### Turtle Assessment Framework

The panel acknowledged that assessing the status of listed marine turtles is difficult in the absence of a framework to assess the impacts of takes on turtle populations, such as the frameworks that exist for marine mammals and salmon. They also recognized the management strategy evaluation-type simulations being developed by the NEFSC and SEFSC for sea turtles are an excellent approach to evaluate the efficacy of potential monitoring metrics under various ecological and management scenarios for turtles, as well as to prioritize potential threats for research and management purposes. The panel recommended [2.3] completing the research to develop a framework to evaluate sea turtle takes, and to ensure that the levels identified are sustainable. They also recommended that the impact of changes in age structure, for example due to environmental changes, should be accounted for and monitored in this framework.

The Center has plans and partial funding to continue the framework development. However, the concept of developing reference points for sustainable takes of sea turtles is controversial and future funding uncertain. Age-structure monitoring will be challenging, but the current simulation work may be able to explore sensitivity of assessments to demographic assumptions.

### Possible Shift to Electronic Monitoring

The panel recommended that [2.4] studies to compare results from the observer programs and electronic monitoring should be conducted as a high priority because they are critical for understanding how these proposed changes in observing bycatch would impact assessment results and associated management decisions. The panel also noted that it may become necessary to find alternative means for collecting data (e.g., biopsy or other biological data) that are now a very important component of the observer program.

The Center is aware of the potential pros and cons of the shift to an electronic monitoring program, and the Center's observer program is participating in and monitoring pilot studies of electronic monitoring. The Protected Species Branch will work more closely with the observer program to assess the impact of such changes on the quality of bycatch data.

### Acoustic Data Management and Archiving

The panel recognized that acoustic research accumulates large data sets and requires considerable data archiving and management. The panel recommended that [2.5] options be identified to archive these data and ensure that they are available for data sharing and analysis.

The Center's passive acoustic group currently has a contractor employed specifically to handle data management. To develop a longer-term solution, the Center is starting a pilot study with the data management group of NOAA's National Center for Environmental Information (NCEI) to assess how acoustic data archiving can become part of NCEI's mandate. Funding will be needed for data management at the Center and archiving at NCEI.

The Center's telemetry team currently has dedicated staff handling acoustic telemetry data. These data are archived locally in standard databases as well as available for public access on the Ocean Tracking Network data portals. Center staff can maintain these databases without additional support for another 3-6 years unless data acquisition increases at a more rapid rate than anticipated. Center staff are actively involved in working groups developing data standards, archives, and public access in the US and internationally.

### Additional Acoustic Program Staff

The panel recognized that the need for passive acoustics and other acoustic work is broad, and the Center's passive acoustics program currently includes only one full-time federal employee. They noted the increasing need for this program as energy development and other industrial activities expand in the Atlantic, and current staffing is likely insufficient to address this growing need. Therefore, the panel recommended that [2.6] an additional full-time federal employee with expertise in the impact of noise or sound propagation is needed and stable funding is needed to fund this researcher.

The Center concurs and, with support from NMFS' Chief Scientist, has reprogrammed funds and started the process to hire an additional full-time federal employee to support the passive acoustics program.

## Theme 3: North Atlantic Right Whales and other listed large cetaceans

### Right Whale Research

The panel agreed the NOAA research program on North Atlantic right whales (right whales) is critical in providing data that cannot be obtained by the other right whale collaborators. The panel recommended that [3.1] recent right whale distribution changes should be investigated further, including additional data collection and re-examination of analytical methods. With respect to data collection, they suggested considering reinstating the large-scale synoptic aerial surveys, expanding the collection of passive acoustic data in the mid-Atlantic, and using other methods to monitor movements, such as satellite telemetry and stable isotopes. With respect to analyses, they suggested examining the mark-recapture estimates to determine if changes in distribution will impact the apparent trends in abundance estimated using minimum counts and integrating the passive acoustic presence data with seasonal distribution data from surveys.



The panel also recommended that [3.2] the slower than expected recovery of the right whale population should be investigated, and a greater emphasis should be placed on investigating sub-lethal effects of impacts, factors affecting reproductive success, and ecological processes responsible for changes in population dynamics and habitat usage.

The Center has started to investigate the effects of the changing right whale distributions by a multi-prong program that includes: conducting aerial surveys in Canada; collaborating with Canadian scientists (from DFO and Dalhousie) to integrate our aerial surveys with a new passive acoustics program in Canadian waters; increasing passive acoustic monitoring in the mid-Atlantic; evaluating the aerial survey design; and developing methods to integrate visual and acoustic passive data (including a September 2015 workshop on this topic). In addition, the Center has submitted a proposal to the NMFS' Advanced Sampling Program to develop a new satellite tag attachment for large whales, with the goal of starting a new satellite tagging program. Center staff collaborate with students and staff of Woods Hole Oceanographic Institution and New England Aquarium on studies of sublethal, energetic impacts of entanglements on North Atlantic right whales; assessment of stress hormones from fecal samples; and use of unmanned aerial systems to obtain photogrammetry images to compare the body condition, and patterns of growth and development of North Atlantic right whales with those of southern right whales. Other Center staff are developing new mark-recapture analytical approaches to address changes in the current right whale photo-identification data resulting from the changing distribution patterns.

The Center agrees that investigating the low right whale recovery rate is important. The Protected Species and Oceanography Branches are recruiting a new post-doctoral researcher to assess the relationship between right whales and *Calanus* copepod distribution. Center staff are advising a Ph.D. student studying ecological relationships between zooplankton-feeding marine megafauna and their prey. As mentioned earlier, Center staff are co-organizing two workshops associated with the Society for Marine Mammalogy Biennial this year that directly address broader ecosystem considerations that may influence recovery.

### Unobserved Mortality

The panel recognized a considerable amount of mortality of large whales is unaccounted for and recommended [3.3] exploring methods that would better account for unobserved mortalities of large whales, particularly as the level of known ship strikes and entanglement decline.

The Center is exploring methods to better account for unobserved mortalities of large whales. A Bayesian hierarchical mark-recapture approach is being developed for right whales which will provide estimates of survivorship and mortality that will begin to shed light on the unobserved mortality question. If successful, this work will be published in the peer-reviewed literature.

### Other Large Whale Research

The panel noted that research is limited by funding. However, with the exception of the large-scale surveys, there was very little research on listed large whales (or other protected marine mammals) other than right whales. The panel recommended that [3.4] the Center should work to fill the large gap in science to meet its MMPA mandates for poorly funded stocks.

Despite the lack of resourcing for other large whale work, we do as much as we can without straying from our mandated work on right whales. For example, many years of collaboration by Center staff on humpback whale research in the Cape Verdes Islands has led to new understanding of breeding segregation in humpback, which has important implications for

management. Center staff also participated on the Biological Review Team that reviewed the ESA listing of humpback whales.

The Center will continue to pursue additional internal funding for large whale (and other poorly funded stocks) research, and will continue to leverage right whale funds and external funds from federal partners to accomplish research on these poorly resourced taxa. For example, Center staff are advising a Ph.D. student studying the presence of sei, fin, blue and humpback whales from 2003 to present in the Western Atlantic using data from passive acoustic recorders. Other efforts focusing on sei whale acoustics have already led to the discovery of a new and unique call type, which will improve our capacity to understand sei whale distribution.

#### Theme 4: Seals

The panel agreed that a considerable amount of research has been accomplished by the seal research program using a combination of external funding and collaborations. However, the program suffers from inadequate funding and staffing. The lack of staffing and funding precludes anything more than a minimal effort to collect abundance information and insufficient effort to investigate interactions between humans and seals.

#### Seal Research Program

The panel recommended that [4.1] a cohesive seal research program should be developed to identify priorities and to develop collaborative research initiatives, including those with Canadian scientists, stakeholders, and pinniped researchers elsewhere in the USA. In addition to this overarching recommendation, the panel identified priority research areas, including understanding long-term population trends in grey and harbor seals, understanding and mitigating human interactions with seals, and understanding the impact of seals on commercial and endangered fish species. These require data on abundance and distribution, diet, growth, and condition. Collecting such information would require investments in new technologies, such as stable isotopes, unmanned aerial survey platforms, and satellite or cell-phone telemetry tags.

In response, the Center has organized a workshop for the fall of 2015 to bring together scientists from around the country and Canada who collaborate with the Center to develop a prioritized research action plan and budget for seal research. This effort will guide future seal research in the Center, reinforce collaborative research efforts, and provide the foundation for soliciting external sources of funding for the program.

In addition, since the science review the Center has devoted money and staff-time to complete analyses of aerial survey haul-out count data collected from 2005 to 2015 and to derive minimum estimates of abundance and pup production of grey seals in U.S. waters. Staff also are analyzing commercial fisheries data from 1990-2015 to document characteristics of phocid bycatch, factors affecting bycatch rates, and the effect of pingers on observed bycatch rates. A parallel study is underway to document the stomach contents of bycaught seals to better understand prey items of seals foraging around commercial gear. The Center plans to also continue current collaborative research studies (e.g., Massachusetts Institute of Technology studies of influenza A virus in grey seals with associated samples for baseline health assessments, genetics, stable isotope, and heavy metal studies).



## Outreach and Education

The panel recommended that the Center [4.2] increase outreach and education programs to better inform the public about seals.

The Center agrees that increased outreach and education is needed to inform the public about what we do and do not know about the role of seals in the ecosystem, including where we have data gaps and how we plan to fill them if possible. GARFO is increasing its efforts in this regard, working with the Center, the North Atlantic Seal Research Consortium, National Park Service, and U.S. Fish and Wildlife Service to develop scientifically valid outreach materials and messages. On a broader scale, the Center is active in providing outreach and education, including the NOAA Outreach and Education on Protected Species (NOEPS) Program (<http://www.nefsc.noaa.gov/psb/NOEPS/index.html>).

## Seal Program Staff

The panel recommended that [4.3] a full-time permanent position should be created to develop a seal research program and support its development and needs.

Following the review, the Center evaluated the available marine mammal research budget and decided that current funding cannot support an additional permanent position focused solely on seal research. The Center has restructured Protected Species Branch staffing to dedicate part of an existing position to coordinate the seal program. The decision to not hire a new employee to replace the recently retired seal research lead, and associated reduction in labor costs, hopefully will result in some additional operational funds becoming available for seal research, though the additional amount is expected to be small. Additional resources are needed to support research required to fulfill MMPA mandates with respect to seals and to inform increasingly heated public discourse regarding perceived impacts of increasing seal populations. Further, filling the seal program need by reprogramming staff comes at the expense of other activities in the Branch.

## Theme 5: Salmon

### Salmon Research Program

The panel recommended that [5.1] the Atlantic Salmon program continue the 3-pronged management support approach based on 1) marine survival, 2) dam impacts, and 3) diadromous ecosystem recovery. The Panel further recommended [5.2] considering a fourth approach associated with freshwater productivity, habitat, and habitat recovery initiatives. The fourth component would allow complete life cycle analysis and evaluation of existing recovery initiatives in the context of how actions reduce extinction risk.

As recommended, the Center and GARFO will continue to work together to identify science priorities in support of management through developing a joint 2016-2020 operational plan. The Center, with assistance from GARFO, also will develop a new 5-year co-operative agreement with Maine Department of Marine Resources to prioritize freshwater science, monitoring, and database systems to support broader NOAA efforts for Life Cycle Monitoring of salmon.

Primary field programs will support marine survival information needs: West Greenland fishery monitoring and Gulf of Maine telemetry. The West Greenland fishery-monitoring program describes overall population demographics and measures fishery impacts. The Gulf of Maine telemetry program indexes early marine salmon mortality and addresses emerging management needs (see 17.1). Secondary field operations supporting diadromous ecosystem recovery

(Penobscot Estuary hydroacoustics and diadromous fish as prey for coastal predators) will continue as will ongoing evaluations of the impacts of dam removal on ecosystem recovery conducted by partners. Dam impact life cycle modeling will continue. However, fully incorporating a freshwater program presents three additional challenges: a) increased resource needs, b) increased analytical needs, and c) overlap with responsibilities of other agencies.

### Adaptive Management Goals for Salmon

The panel recommended that [5.3] the Center should consider implementing experimental approaches in which goal-oriented recovery actions are initiated, their effectiveness in achieving those goals is evaluated, and results are interpreted in the context of how extinction risk is changed. Examples include methods of reducing and mitigating mortality in estuaries, and how dam removal alters the overall productivity of freshwater environments. The panel affirmed the value to be gained by a more deliberate or experimental approach to telemetry and other work.

Because these actions are at the nexus of management and science, this recommendation will be best implemented through the development of an integrated Center and GARFO operational plan. Resulting research program action plans will likely focus on:

- 1) Enhance and develop dam impact and freshwater habitat models to characterize decreased extinction risk with improved fish passage and habitat quality
- 2) Annually monitor and assess fishery and natural marine mortality by a) quantifying US-origin fish in distant water fisheries; b) maintaining hatchery and wild smolt-adult-return programs; c) indexing estuary and coastal mortality and identifying location, intensity, and causes of high mortality; and d) describing return migration from West Greenland. Some of this science is observational by definition: however the Center will work towards more deliberate and experimental approaches to evaluate recovery actions.
- 3) Evaluate the core management approach of recovering diadromous ecosystems to promote salmon recovery.

### Regime Shift

The panel recognized there has been considerable research on ecosystem changes in the NW Atlantic that occurred concurrently with the apparent decline in salmon productivity in the late 1980s. The panel recommended that [5.4] the Salmon Team should work with oceanographers and researchers working with other species groups to compile a comprehensive view of the changes that occurred associated with regime changes.

These recommendations reinforce a Center commitment to further investigate the impacts of a changing NW Atlantic ecosystem on salmon marine productivity. Center staff co-authored articles on regime shifts in salmon marine productivity. Partnering with Maine Sea Grant, the Center hosted a series of multi-disciplinary workshops (2008-2010) to narrow hypotheses as priority areas for research; climate change figured prominently in all 6 hypotheses. Recent projects with the University of Maine (UMaine) and Gulf of Maine Research Institute (GMRI) evaluated 1) the importance of predator and prey fields and ocean circulation on Atlantic salmon growth and survival in the Gulf of Maine and 2) the impact of oceanographic changes on Atlantic salmon survival in the Northwest Atlantic. This work described the cascading ecosystem impacts from large climate forcing mechanisms, and how they aligned with the identified salmon marine productivity regime shifts. Analysis of current and past diet data from salmon off West Greenland showed changes resulting in decreased availability of energy in key prey species.

The Center recently initiated a 5-year commitment with UMaine and GMRI to investigate the hypothesis that these identified ecosystem changes have influenced the energy needed by and available to Atlantic salmon and thereby have affected salmon growth, survival, and productivity, and the spatial extent of optimal marine foraging habitat.

#### Additional Salmon Program Staff

The panel recommended that [5.5] the salmon program would significantly benefit from hiring a full-time permanent quantitative ecologist who would advance the program via evaluation of the recovery actions and progress towards recovery using population dynamics models.

Filling the Salmon Team's vacant quantitative analysis position would increase analytical capacity to better utilize the wide, diverse, and dense datasets available. If core funding is restored to 2010 levels, an anticipated retirement in 2017 could be used to backfill the analytical position. In the meantime, the Salmon Team will enhance staff training in quantitative methods through set asides for training and will continue to foster collaborations with partners with quantitative skill sets to fill this gap.

### Theme 6: Other Fish Species

#### Staff Support for Other Listed Fish

The panel identified that, with current staffing levels, it is difficult for the Center to provide adequate scientific support for a) listed fish species other than salmon, b) listing actions (e.g. petitions, challenges, etc.), or c) species of concern. The panel recommended that the Center should [6.1] create a permanent federal position to support these needs while beginning to build a program for listed Sturgeon species. Panelists noted that a researcher with expertise in assessing data poor species may be most appropriate to fill these needs and that some re-organization may be necessary to group individuals together who are working on species with overlaps in sampling platforms, or threats.

Currently the Center is working to address these scientific needs with existing staff resources. However, the staff resources are limited and the workload is anticipated to grow and become more controversial in the next decade. In the short term, needs could be addressed by one quantitative conservation biologist position, but ultimately would require a 3-4 person team. With these resources, developing an integrated diadromous ecosystem team would be of strategic advantage because many of the threats to listed sturgeon or other species of concern (e.g., river herring) are shared with Atlantic salmon.

## Summary of Recommendations and Response Actions

<b>Recommendation</b>	<b>Action</b>	<b>Deadline</b>
1.1. Develop programs to address emerging, ecosystem, and cumulative impact issues	1.1.a. Expand science via strategic plan and ecosystem working group	Ongoing
	1.1.b. Co-organize international workshops on broader ecosystem considerations	December 2015
1.2. Identify climate change issues and research needs for protected species	1.2. Develop and conduct climate vulnerability assessment for marine mammals and sea turtles	December 2016
1.3. Identify distribution of resources needed to meet management needs	1.3.a. Identify priorities in PRSIPP and pursue internal funding initiatives	Ongoing
	1.3.b. Evaluate which taxa warrant additional review or regional plans	April 2016
1.4. Shift the burden of obtaining external funds away from scientists	1.4. Leadership continue to pursue internal and external funding initiatives	Ongoing
1.5. Clarify scientific issues and roles in ESA listings and recovery planning	1.5. National consistency may be addressed by national regulatory program review	December 2016
2.1. NMFS develop a long-term nation-wide survey plan and secure long-term funding for assessment surveys	2.1.a. Develop new 5-year interagency agreements with BOEM (2015-2019) and Navy (2016-2020)	April 2016
	2.1.b. NMFS developing a national plan to make ships and funds available for all US waters using a rotational scheme.	Ongoing
2.2. Improve the assessments to Tier II, at a minimum, and preferably Tier III as soon as possible	2.2. Workshop(s) to review and identify stocks where enhanced assessments are critical and where opportunities exist	December 2016
2.3. Complete framework to evaluate sea turtle takes, and to ensure that the levels identified are sustainable	2.3. The Center has plans and partial funding to develop the framework; future funding is uncertain	April 2017
2.4. Compare results from the observer programs and electronic monitoring	2.4. Work with observer program to assess impact of changes on bycatch data	Ongoing
2.5. Options should be identified to archive and share acoustic datasets	2.5. Ongoing efforts and pilot study with NOAA's National Center for Environmental Information (NCEI)	December 2016
2.6. An additional full-time federal employee for passive acoustics	2.6. Funds reprogrammed funds and hiring process initiated	December 2016
3.1. Recent right whale distribution changes should be investigated	3.1. Ongoing projects including: increased work off Canada and mid-Atlantic; new tagging program; and new mark-recapture analytical approaches.	Ongoing
3.2. The slower than expected recovery of the right whale population should be investigated	3.2. Ongoing projects including: energetic impacts of entanglements; assessing stress hormones and body condition; assessing trophic relationships; and international workshops (see 1.1.b).	Ongoing
3.3. Better account for unobserved mortalities of large whales	3.3. Center staff developing and testing methods to accomplish this	April 2016
3.4. Fill science gap to meet MMPA mandates for poorly funded stocks	3.4. Leverage internal and external funds to carry out needed research as feasible	Ongoing
4.1. Develop collaborative seal research program and identify priorities	4.1.a. Convene workshop with partners to develop research action plan	December 2015
	4.1.b. Ongoing projects including: gray seal abundance, fisheries bycatch, and diet	December 2016
4.2. Increase outreach and education to better inform the public about seals	4.2. GARFO increasing its outreach efforts on seals, working with the Center	Ongoing

<b>Recommendation</b>	<b>Action</b>	<b>Deadline</b>
4.3. A full-time permanent position to support seal research program	4.3. Dedicated part of an existing position to coordinate the seal program	Complete
5.1. Continue salmon research focus on marine survival, dam impacts, and diadromous ecosystem recovery	5.1. Develop joint 2016-2020 operational plan with GARFO, identifying science priorities in support of management	April 2016
5.2. Consider fourth research focus on freshwater productivity, habitat, and habitat recovery initiatives	5.2. Develop new 5-year agreement with Maine Department of Marine Resources on freshwater science and Life Cycle Monitoring of salmon	April 2016
5.3. Consider experimental approaches, evaluating recovery actions in terms of reduced extinction risk	5.3. Develop operational and research action plans that prioritize monitoring effectiveness relative to extinction risk	April 2016
5.4. Compile comprehensive view of changes in salmon that occurred associated with regime changes	5.4. Ongoing multi-year investigation of impacts of changing ecosystem on salmon marine productivity	Ongoing, June 2019
5.5. A full-time permanent position to support salmon program with quantitative skills	5.5.a. If funding allows, backfill anticipated 2017 retirement	December 2017
	5.5.b. Enhance staff training in quantitative methods	December 2016
6.1. A full-time permanent position to support other listed fish, candidate species, and species of concern	6.1. Hire not possible with current funding; working to address scientific needs with existing limited staff resources	Ongoing