MEETING OVERVIEW

ISFMP Policy Board Meeting
Thursday October 19, 2017
9:30-11:30 a.m.
Norfolk, Virginia

Chair: Doug Grout (NH) Assumed Chairmanship: 10/15	Vice Chair: Jim Gilmore (NY)	Previous Board Meeting: August 3, 2017
Voting Members: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC, SC, GA, FL, NMFS, USFWS (19 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from August 3, 2017

3. Public Comment – At the beginning of the meeting public comment will be taken on items not on the agenda. Individuals that wish to speak at this time must sign-in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Executive Committee Report (9:40-9:45 a.m.)

Background

- The Executive Committee will meet on October 19, 2017

Presentations

- D. Grout will provide an update of the two meetings

Board action for consideration at this meeting

- none

5. Update on Non-compliance Decision and Meeting with the Secretary of Commerce (9:45-10:05 a.m.)

Background

- The Commission sent a letter to the Secretary of Commerce requesting additional information on the decision to not find New Jersey out of compliance with Addendum XXVIII to the Summer Flounder, Scup, and Back Sea FMP. The Commission also requested a meeting with the Secretary to discuss the Non-Compliance process.
- The Commission received two memos and one letter from NOAA and the Secretary (**Briefing Materials**)

Presentations

- None

Board discussion for consideration at this meeting

- Discuss next steps

6. Review Risk and Uncertainty Workgroup Progress (10:05-10:20 a.m.)

Background

- Previously, the Risk and Uncertainty Policy Workgroup presented a draft Commission Risk and Uncertainty Policy and were advised by the Board to continue development.
- The Risk and Uncertainty Policy Workgroup was tasked last Annual Meeting with creating a Workshop to walkthrough the Policy using striped bass as an example.

Presentations

- J. McNamee will present the progress to-date the workgroup has made.

Board actions for consideration at this meeting

- None

7. Discuss Recommendation from the Atlantic Herring Section on New England Fishery Management Council Participation in the Atlantic Herring Management (10:20-10:30 a.m.) Possible Action

Background

- The NEFMC has requested to participate on the Atlantic Herring Section. The Herring FMP is a complimentary FMP with the NEFMC.
- The Charter, as it is written, does not allow for Council participation by invitation on Sections. This is only a provision for Boards.
- The Policy Board tasked the Herring Section to discuss the issue and bring a recommendation back to the Board.

Presentations

- R. White will provide the recommendation from the Herring Section.

Board actions for consideration at this meeting

- Determine how the NEFMC should be included in the Commission's management of Atlantic Herring.

8. Discuss Non-compliance in the Charter and Party Boat Sector (10:30-10:40 a.m.)

Background

- Recently there have been violations in the for-hire sector. In some states the Captain of the vessel is not held accountable when anglers on the vessel do not follow fishery regulations.
- Some states have set regulations to incentivize Captains to follow regulations; for example
- *Liability for Violations Onboard For-hire Recreational Vessels. With respect to recreational for-hire fishing operations permitted: Permit Requirements Applicable to For-hire Vessels, an individual patron, as well as the named for-hire permit holder or for-hire vessel operator, may each be held liable for any violations of recreational size, possession or daily bag limits established that are attributable to the patron fishing onboard the for-hire recreational fishing vessel. In enforcing this provision, law enforcement officers may exercise their discretion on whether to cite the named*

for-hire permit holder or for-hire vessel operator for such violations in instances where the best industry practices required: Permit Requirements Applicable to For-hire Vessels have been used on the for-hire vessel.

Presentations

- None

Board action for consideration at this meeting

- Discuss ways to improve compliance within the for-hire fleet

9. Review White Paper from the Climate Change Working Group (10:40-10:55 a.m.)

Background

- The Climate Change Work Group was tasked with developing science, policy and management strategies to assist the Commission with adapting its management to changes in species abundance and distribution resulting from climate change impacts.
- In fall of 2016 the Work group met via conference call to brainstorm how to address the Policy Board task. In January 2017 the working group met to make recommendations to include in the white papers to address the Policy Boar task. In May the working group met to continue to develop drafts of science and policy white papers.

Presentations

- T. Kerns will present the Working Group White Paper.

Board action for consideration at this meeting

- None

10. Standing Committee Reports (10:55-11:05 a.m.)

Background

- The Habitat Committee will meet on October 18.
- The Atlantic Coastal Fish Habitat Partnership will meet on October 16 and 17.
- The Law Enforcement Committee will meet on October 17 and 18.

Presentations

- An overview of Habitat Committee and ACFHP meetings will be presented by L. Havel and the LEC meeting will be presented by M. Robson.

Board action for consideration at this meeting

- None

11. Discuss the Utility of Reporting Species Technical Committee Assignments (11:05-11:10 a.m.)

Background

- The Assessment Science Committee (ASC) recommended the creation of an annual task list for each species, complied annually by Commission staff and the Technical Committee (TC) and/or Stock Assessment Subcommittee (SAS) chairs.
- The list will include all current tasks with timelines, assign an activity level for the committee, a committee overlap score based on membership overlap with other TC/SASs, as well as list TC and SAS members and their affiliations.

- At the time of tasking a Committee, the Task List can be projected to help prioritize the task and assign a deadline.

Presentations

- S. Madsen will review an example task list and discuss the Utility of the list.

Board action for consideration at this meeting

- None

12. Review and Consider Committee on Economics and Social Sciences' (CESS) Recommendation on the ISFMP Charter Guidance for CESS Membership (11:10-11:15 a.m.) Action

Background

- The CESS has been working to assign members to Commission-managed species in order to have more socioeconomic background and analyses integrated into management-change documents (e.g. amendments and addenda).
- The CESS currently has many vacancies and would like to fill them to assist with gaps in species' coverage.
- The CESS would like to request a relaxation of the membership requirements outlined in the ISFMP Charter to reach broader pool of volunteers. (**Briefing Materials)**

Presentations

- S. Madsen will review the language in the ISFMP Charter that outlines the CESS membership requirements and present suggested changes. **(Briefing Materials)**

Board action for consideration at this meeting

- Approve the stock assessment schedule

13. Review and Consider Approval of the Assessment Schedule (11:15-11:20 a.m.) Action

Background

- The Shad and River Herring Board will consider changes to the 2018 Shad stock assessment update at the Board meeting on October 17.
- It is recommended the Weakfish benchmark be delayed until 2019 until after the new data from MRIP (calibrated data from the FES and APIS changes) is available.

Presentations

- T. Kerns will present the changes to the assessments

Board action for consideration at this meeting

- Approve changes to the assessment schedule

14. Review Non-Compliance Findings, if Necessary Action

15. Other Business

16. Adjourn

Draft White Paper: Management, Policy and Science Strategies for Adapting Fisheries Management to Changes in Species Abundance and Distribution Resulting from Climate Change

Climate change is already having impacts on the fishery resources the Commission manages. As average temperatures rise, mobile marine species are moving towards the poles and/or deeper water to stay cool. Shifts in the distributions and productivity of stocks can cause ecological and economic disruptions, such as predators become separated from their prey impacting food webs, or fisherman no longer catching a species their livelihood relies on. In the face of climatic shifts, change is likely to be the only constant. Accordingly, managers will need to learn how to respond to and manage these changes. Managers will likely need to focus on sustaining ecological functions, rather than historical abundances. As conditions change, current conservation goals and management objectives may no longer be feasible. Successful climate adaptation will depend not only on adjusting management strategies, but also in reevaluating and revising, as necessary, the underlying conservation goals and objectives of fishery management plans.

The Climate Change Working Group was tasked with developing science, policy and management strategies to assist the Commission with adapting its management to changes in species abundance and distribution resulting from climate change impacts. The following climate adaptation strategies are provided as guidelines to assist Boards and Sections in the management of species impacted by climate change, with a focus on stocks with low biomass and allocation.

A Stepwise Approach

Carrying out effective management strategies in the face of climate change can seem complex. By clarifying a process and demonstrating how the various parts of this process fit together, implementing adaptive management can be less daunting. A generalized framework can break the process down into discrete steps designed to help managers understand how the pieces of the process fit together, and how to recognize when various methods and approaches may be appropriate. *The stepwise approach is detailed in a resource document from the National Wildlife Federation: Climate Smart Conservation* was modified slightly for ability for marine resource management.

Step 1. Define planning purpose and scope. This includes: articulating a purpose; clarifying existing management goals; identifying management targets; specifying a scope and time frame; engaging key stakeholders; and determining resource needs and availability.

Step 2. Assess climate impacts and vulnerabilities. Understanding climate vulnerabilities is crucial for designing effective adaptive management strategies, and the specific components of vulnerability—exposure, sensitivity, and adaptive capacity—can provide a useful framework for linking actions to impacts.

Step 3. Review/revise management goals and objectives. Because goals serve as the basis for subsequent strategies and actions, they should be climate-informed and forward looking. Reevaluation of goals and objectives may either validate their continued relevance, or indicate a need for refinement or modification.

Step 4. Identify possible adaptive management options. What are possible approaches for reducing key climate-related vulnerabilities or taking advantage of newly emerging opportunities? At this stage, a broad array of alternative strategies and actions should be identified, with particular attention to creative thinking in crafting possible management actions.

Step 5. Evaluate and select adaptive management options. The array of possible adaptation options can now be evaluated to determine which are likely to be most effective from a biological/ecological perspective, and most feasible from social and economic perspectives.

Step 6. Implement adaptive management options. Successfully implementing adaptation requires individual leadership as well as institutional commitment and resources, and often depends on engaging diverse partners early on, and emphasizing benefits to multiple sectors of society.

Step 7. Track action effectiveness and ecological responses. Monitoring helps provide context for understanding climate-related impacts and vulnerabilities and for informing adaptive management. Monitoring approaches should be carefully designed to ensure they are capable of guiding needed adjustments in management strategies.

Managements Options for Stocks at Persistent Low Biomass

There are two main questions that should be addressed for stocks with persistent low biomass: 1) what, if any, is an appropriate harvest level, and 2) how many resources should be committed to continue monitoring and managing the species.

Approaches

1. Status Quo: Following the current status quo addresses the first question (appropriate harvest level) but does not address questions related to continuation of monitoring and management. The current harvest strategies include allowing landings that target a rebuilding F with a biomass target based on historic assessment information with the assumption that the stock will eventually respond to a low F. If biomass continues to decline there are two harvest options:
    a. Continue the above scenario with further reductions in F
    b. Put a harvest moratorium in place for a period of time based on the life history of the species

2. Evidence of a Change in Productivity: As with the status quo option, the monitoring and management would be retained at historical levels. The harvest level would be adjusted as reference points are redefined based on evidence the stock will likely not recover to previous biomass targets because of a change in productivity from environmental causes. The reference points will target a sustainable yield from a biomass that is much lower than previously targeted. The actual yield will be much reduced from historic levels, leading to a very small fishery with presumably much fewer participants. This approach may also entail a rebuilding period. The rebuilding period would be reflective of the new reference points based on an expected lowered productivity level of the stock.

3. Evidence the stock has a low to no Productivity; recovery to sustainable levels is highly unlikely

a. Management: A permanent moratorium is put in place or harvest continues until it becomes economically unfeasible. Decision between these options could be based on confidence in prediction of no recovery and consideration of genetic diversity that is often high at the tail end of a species range (Nowack et al., 2013). It may be more beneficial to protect the remaining genetically diverse stock, or it may be more beneficial to allow economic harvest of the species.

b. Monitoring: Determine what level of monitoring would occur: Increased, current, or reduced

4. Management and monitoring cease and harvest does not continue because it becomes economically unfeasible.

Science requirements

Each of the options places great demands on the science. Questions to be answered before choosing among the options would include:

1. What is the mechanism of decline/loss of productivity?
2. What evidence is there that the stock will likely not come back to its former productivity?
3. How is sustainable yield determined and at what level of biomass will a harvest be permitted?
4. Are there ecological/genetic considerations to be considered before taking any of these approaches to manage a stock or population?
5. What are the economic and ecological tradeoffs of continuing to harvest at lower levels vs. a moratorium?

Management Options for Stocks with Changing Spatial Distributions:

1. Maintain current state-by-state or regional allocations.
    - Quota Sharing by fishery or within fishery: Under state-by-state management without quota reallocation it is necessary to allow for transfer of quota between states in order to have a mechanism to respond to changing distributions of stocks. But under regional or coastwide quota management; sharing of quota becomes less important when responding to distributional changes in stocks; although sharing between two regions may still be needed.
    - Add a minimum allocation for states with low quotas or states that are on the edge of stocks that are moving north or south
    - Include an episodic events approach (quota set aside) for species that are moving northward
        - A certain percentage of the coastwide quota would be set aside for use by specified states/regions. The set aside is designed to allow for harvest of fish that episodically move in and out of a region
2. Maintain regional or state-by-state allocations and develop a Commission policy to revisit allocation based on identified triggers (see NMFS Allocation Policy).
    - Triggers could be based on time, an indicator of change, or a threshold of public comment.
        a) For time based triggers, triggers could be a set number of years or could be related to the life history of the species. Allocation reviews may not automatically result in a re-allocation, but they would require the Board to

"revisit" the state or regional allocations periodically and decide whether to initiate management action to change allocation or vote to reaffirm current allocation. Alternatively, the board could include a provision in the FMP where the state or regional allocations would "sunset" on a prescribed date so the Board must initiate management action to either reinstitute current allocation or modify allocation.

- Options for who makes the final decision regarding reallocation could be internal or external to the Commission:
    a) Species management boards know the fishery the best but could be open to strong political pressure from impacted states.
    b) Australia has used independent panels to determine allocations as they can take the pressure off managers and allow fairer compromises. For more information, see section 9.2 in Morrison and Scott 2014.
- Potential options for adjusting allocations:
    a) Use distribution and abundance data from certain fisheries independent surveys that cover extended geographical areas to help determine the state or regional quota allocation percentages (e.g NEAMAP surveys; NEFSC bottom trawl survey, etc.)
    b) Use a combination of historical allocations and current distribution that adjusts through time: 75% historical allocations years 1-2, 65% historical allocations years 3-4, etc.
    c) Use Management Strategy Evaluation (MSE) to determine allocation using 4 evaluators:
        - Catch distribution
        - Recruitment
        - Productivity
        - Total yield across years
    d) Use it or lose it provisions—revisit a state's quota after X number of years of not utilizing quota.

3. Change management away from state-by-state allocations. Ideas include:
    - Change management from species focus to area focus. Allow for area allocations where industry can be permitted for multiple species at once where they can move from stock to stock as they rise and fall
        - For example- an area could be GOM; species could be lobster, herring, groundfish, menhaden, black sea bass, dogfish, others?
        - Allocations would be set based on the health of the ecosystem overall. Every 1-3 years do assessments on an area to determine what level of harvest is feasible for stocks. Look at more than just species assessment to determine allocations. Also look at ocean environment to help make predictions of the direction of stock levels.
        - This would be a significant change to how we manage stocks
    - Allocation by timeframe (example quarters)

- Quotas could be allocated by seasons and open to all fishermen when the season opened (e.g 4 seasons: spring, summer, fall, winter each with a specified percentage of the quota with equal)
- Seasonal quota could be further broken out by area (e.g. the summer quota could be divided into a northern and southern allocation.

Resources to Assess How Species and Environments are Being Impacted by Climate

The following are potential resources managers could use to determine if a stock has reached a point that necessitates change in a fisheries management strategy to adapt to climate change impacts

- Northeast Fish and Shellfish Climate Vulnerability Assessment developed by NOAA
- Ecosystem status reports/Ecosystem indicators- large scale requires significant resources would need to partner with NOAA
- Ocean Adapt- analysis of changing distributions by NMFS and Rutgers
- NOAA National Center for Environmental Information – hosts and provides public access to archives of climate data
- Stock predictions
    - Climate predictions
    - Species distributions
    - Species abundance (climate velocity)
- Citizen Science—create venue for watermen to report changes they are seeing on the water as an advanced warning to managers.
- Triggers defined by fishermen: seek public input on triggers for when management would adapt due to changes in the resource from climate change

Climate Change Data Availability and Gap Analysis

The Climate Change Working Group was tasked with "developing science, policy and management strategies to assist the Commission with adapting its management to changes in species abundance and distribution resulting from climate change impacts". Work group discussions resulted in a recommendation that stock assessment committees consider including a Terms of Reference to evaluate whether climate change impacts on the species of interest are evident. Climate change recommendations were reviewed by the Commission's Assessment Science Committee (ASC). The ASC supported a process where assessment committees consider including new climate TORs when starting new stock assessments. If a TC/SAS thinks there may be climate impacts on a stock and related analyses are possible, a climate TOR is to be added. If a TC/SAS does not think there are climate impacts, a TOR does not need to be added. TCs will then have the option to include a brief assessment report section describing why climate impact analyses on a stock were not conducted.

Climate change is affecting a number of aspects of the environment which may affect abundance, distribution, and productivity of various species. Besides warming waters, changes to other aspects of the marine environment (such as salinity, pH and currents – Table 1) may also be occurring. To assist

the assessment committees in this work, the Climate Change Working Group recommended the creation of a coast wide database summarizing the types of climate related data various state, federal, and university programs collect. The database would not store the actual data, but provide metadata on the programs. I.e., the database would contain a summary of the types of environmental data collected, temporal and spatial aspects of the data, sample design, and contact information. The database would be a central reservoir of information for the species assessment committees to identify and request available climate data appropriate for the species and area of interest. The decision to house the metadata and contact information and not the actual environmental data was to avoid:

- Needing to annually update the data
- duplication of datasets
- adapting the data inappropriately, and
- ensuring the most recent information is used

Development of the database will be a collaborative coast wide effort to ensure all known programs that collect environmental data are included. In addition to the numerous ocean observing buoys, data portals, and state and federal monitoring programs, the database should include power plant monitoring data and smaller-scale programs conducted by counties, towns, and universities for a variety of purposes. The ASC noted that some data sources may need to be converted to usable format.

Two levels of gap analysis will be conducted after development of the environmental metadata database:

1. Review to ensure all known programs that collect environmental data are included
    a. Verify that all appropriate information is included
        i. The review should be conducted by each state and federal agency to assure completeness coordinated by the ASC and reviewed by the MSC.
2. Review the types of environmental data collected and temporal and spatial scale of the information
    a. Determine if there are temporal and/or spatial gaps in data necessary to investigate the effects of climate change on species
        i. Task species TC and SASC for review
    b. Determine relative importance of filling individual data gaps
    c. Prioritize data gap filling and identify strategies to address the important gaps

Table 1. Climate Data Types

- Temperature
    - Annual, seasonal, daily
    - days above threshold (need daily data)

    - timing of ice melt
- Salinity
    - Temporal/spatial changes
    - Temporal/spatial changes of estuarine salt wedge
- pH (ocean acidity)
- Precipitation
    - River currents
    - Temporal/spatial salinity changes
- Wind
    - Changes to local wind patterns
    - Frequency of storm events – spatial and temporal patterns
- Currents
    - Strength and location of local currents
    - Location of basin wide currents (i.e. – Gulf Stream, Labrador currents)
- Global climate measures
    - North Atlantic Oscillation (NAO)
    - Atlantic Multidecadal Oscillation (AMO)

Stock Assessment Terms of Reference – Climate Analyses

The following are Terms of Reference options related to climate for Technical Committees to consider when devising the full set of Terms at the outset of a stock assessment.

- Describe the thermal habitat and its influence on the distribution and abundance of Species X, and attempt to integrate the results into the stock assessment.

- Consider the consequences of environmental factors on the estimates of abundance or relative indices derived from surveys.

- Characterize oceanographic and habitat data as it pertains to Species X distribution and availability. If possible, integrate the results into the stock assessment.

- Evaluate new information on life history such as growth rates, size at maturation, natural mortality rate, and migrations. Explore possible impacts of environmental change on life history characteristics.

- Present the survey data available for use in the assessment, evaluate the utility of the age-length key for use in stock assessment, and explore standardization of fishery-independent indices. Characterize the uncertainty and any bias in these sources of data, including exploring environmentally driven changes in availability and related changes in population size structure.

Explore the spatial distribution of the stock over time, and whether there are consistent distributional shifts.

- Provide best estimate of population parameters (fishing mortality, biomass, and abundance) through assessment models. Evaluate model performance and stability through sensitivity analyses and retrospective analysis, including variation in life history parameters. Include consideration of environmental effects where possible. Discuss the effects of data strengths and weaknesses on model results and performance.

- Update or redefine biological reference points (BRPs; point estimates or proxies for B_{MSY}, SSB_{MSY}, F_{MSY}, MSY). Evaluate stock status based on BRPs. If possible, develop alternative MSY-based reference points or proxies that may account for changing productivity regimes.

References:

Pauls, S., C. Nowak, M. Balint, and M. Pfenninger. 2013. The impact of global climate change on genetic diversity within populations and species. Molecular Ecology 22:925-946.

Background

The Atlantic States Marine Fisheries Commission's (Commission) Habitat Committee (Committee), a branch of the Interstate Fisheries Management Program, was developed to identify, enhance, and cooperatively manage vital fish habitat for conservation, restoration, and protection, as well as support the cooperative management of the Commission and jointly managed species.

In 2016 the Committee identified each state's ongoing practices that address climate change impacts, with a focus on state coastal regulatory planning (Appendix A).

This document builds upon the information gathered in 2016, adding new information since the report was produced, as well as identifying gaps in climate change initiatives among states and providing recommendations for the future. It addresses Strategy 4.6, Task 4.6.2 of the 2017 Action Plan:

4.6 Engage in state and federal agency efforts to ensure climate change response strategies are included in habitat conservation efforts.

4.6.2 Identify gaps in state coastal regulatory planning regarding climate change impacts and make recommendations to increase resiliency.

Summary of State Initiatives that Address Climate Change

From the information gathered in 2016, state initiatives were grouped into eight different categories:

1. Established a working group or legislation to reduce carbon output
2. Established a working group or legislation to respond to climate change threats
3. Produced reports on climate change
4. Assesses and monitors the effects of climate change
5. Has mechanisms in place for collaboration among agencies and other organizations
6. Addresses climate change in planning documents
7. Has responded to climate change on the ground
8. Includes climate change in outreach efforts.

Each state* has implemented 1 – 8 of the initiative categories listed above. New Hampshire, New York, New Jersey, and Virginia have practices in place that meet all eight categories. A table of each state's practices can be found in Appendix II (also Figure 1). All states address climate change in their planning documents (Initiative 6), at a minimum in their 2015 State Wildlife Action Plans. All but one are also assessing and monitoring the effects of climate change (Initiative 4). This includes habitat distribution and condition, sea level rise, changes in species distribution and abundance, and more. Twelve out of 14 states have produced reports on climate change (Initiative 3), some of which are regularly updated.

* Except Delaware – data not available.

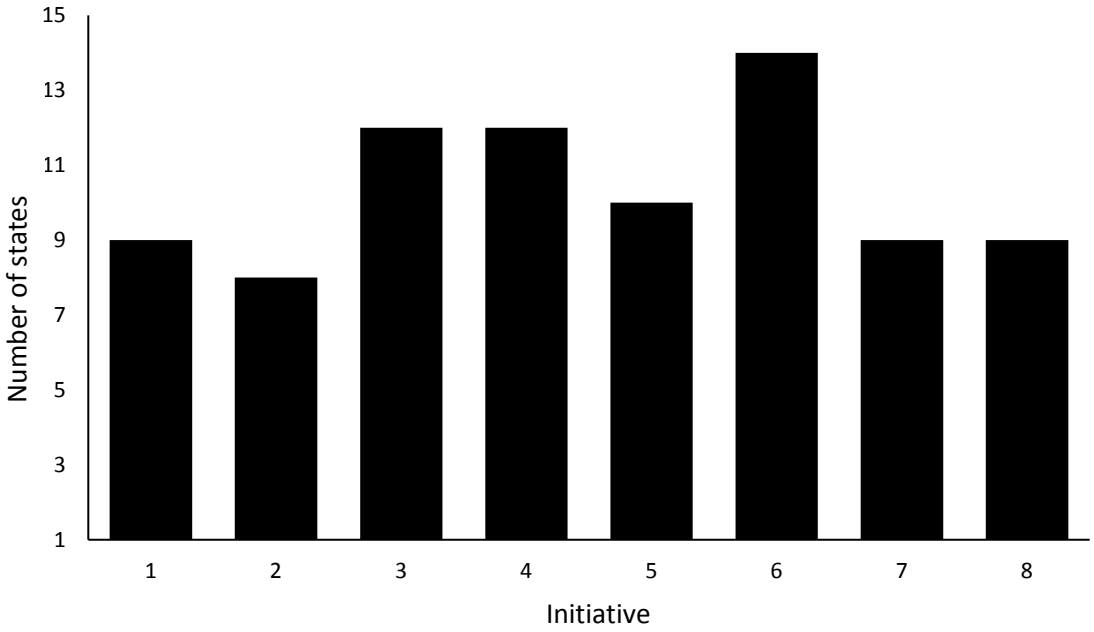

Figure 1. Number of Atlantic coast states carrying out each initiative category. List of categories can be found on page 1.

There is a lot of opportunity regarding initiatives 1, 2, 5, 7, and 8. Only nine of the states have responded to climate change on the ground. Examples of on-the-ground responses that have taken place include installing or working towards offshore wind facilities, encouraging living shorelines during the permitting process, minimizing road crossing impacts on aquatic habitats, and restoring connectivity among habitats. Restoration efforts that promote resiliency, adaptive strategies, and habitat enhancement are also underway. Working groups or legislation to reduce carbon outputs have been created in nine states, and working groups or legislation to respond to climate change threats have been created in eight states. Initiatives range from no action to Maryland's commitment to 100% clean energy by 2050. There is also room for more collaboration and outreach – only ten states work with other agencies or organizations, and nine include climate change in their outreach efforts. Example of outreach that states are conducting include messaging in K-12 and teacher education programs, community preparedness programs, providing guidance on best management practices, and more.

Recommendations

1. Increase renewable energy production.
2. Increase communication, coordination, and collaboration among federal, state, local, tribal, and nongovernmental organizations.
3. Continue monitoring key climate change parameters and sentinels to assess ongoing effects.
4. Promote the development or modification of regulatory mechanisms so that sea level rise and storm surge flooding are factored into development assessments.

5. Analyze long-term datasets to understand the effects of climate change variables on fishery species.
6. Conduct new research to understand the effects of climate change on fish habitats and species.

Additional Literature and Initiatives

Beier, P., D. Behar, L. Hansen, L. Helbrecht, J. Arnold, C. Duke, M. Farooque, P. Frumhoff, L. Irwin, J. Sullivan, and J. Williams (Actionable Science Workgroup of the Advisory Committee on Climate Change and Natural Resource Science). 2015. Guiding principles and recommended practices for co-producing actionable science: a How-To Guide for DOI Climate Science Centers and the National Climate Change and Wildlife Science Center. Report to the Secretary of the Interior: Advisory Committee on Climate Change and Natural Resource Science. Washington, DC. https://nccwsc.usgs.gov/sites/default/files/files/How-to-Guide_Formatted_Aug%2013%202015.pdf

Advisory Committee on Climate Change and Natural Resource Science (ACCCNRS). 2015. Report to the Secretary of Interior. Washington, DC. https://www.eenews.net/assets/2017/08/17/document_cw_01.pdf

Please see Appendix III for NOAA and US Fish and Wildlife Service climate change initiatives.

Appendix I 2016 Report on State Climate Change Initiatives

Background

The Atlantic States Marine Fisheries Commission's (Commission) Habitat Committee (Committee), a branch of the Interstate Fisheries Management Program, was developed to identify, enhance, and cooperatively manage vital fish habitat for conservation, restoration, and protection, as well as support the cooperative management of the Commission and jointly managed species. In 2016 the Committee has been focused on Goal 4 of the current Commission Action Plan: to 'Protect and enhance fish habitat and ecosystem health through partnerships and education.'

This document addresses Strategy 4.6, Task 4.6.2 of the Action Plan:

4.6 Engage in state and federal agency efforts to ensure climate change response strategies are included in habitat conservation efforts.

4.6.2 Identify ongoing practices in the state coastal regulatory planning that address climate change impacts.

It contains information on climate change initiatives, as well as links to documents and websites, as reported by each within the Commission's boundaries. This information is the first step towards identifying gaps and making recommendations for improving coastal preparedness and resiliency to climate change.

Maine

In 2013, the State of Maine established the Environmental and Energy Resources Working Group to identify administrative and strategic opportunities to improve Maine's ability to respond and adapt to changing physical conditions in the environment due to climatic influence. The Working Group was led by the Commissioner of the Department of Environmental Protection, and included the Director of the Governor's Energy Office, and the Commissioners of the Departments of Transportation; Marine Resources; Agriculture Conservation and Forestry; and Inland Fisheries and Wildlife. The report, Monitoring, Mapping, Modeling, Mitigation and Messaging: Maine Prepares for Climate Change, presents current programs and activities and contains 32 recommendations. In general, the recommendations are to continue the interdepartmental cooperation; as well as current monitoring, mapping, modeling, and mitigation activities.

The Department of Environmental Protection's Sustainability Division is developing mechanisms for cross agency partnerships, information sharing, efficiencies, and streamlining. These efforts will provide specific and identifiable tools to assist decision-makers. The Adaptation Toolkit, in development, will aid climate adaptation efforts by providing a centralized source to go to for the information one might need for designing and implementing resiliency practices, as well as information on important regulations and standards to integrate into their project or planning

process, and opportunities to connect with state and other engaged practitioners for technical expertise.

In 2015, The Maine Department of Inland Fisheries and Wildlife collaborated with over 150 public and non-profit Conservation Partner groups (including private landowners, conservation organizations, sporting groups, scientists, and governmental agencies) to draft Maine's 2015 Wildlife Action Plan. The Action Plan addresses the full array of Maine's wildlife across all taxa groups and habitats and identifies 378 Species of Greatest Conservation Need and provides species-specific and habitat-based actions to help prevent further species declines over the next ten years. In an effort to understand which of Maine's species and habitats are most vulnerable to climate change impacts, the Department of Inland Fisheries and Wildlife collaborated with the Manomet Center for Conservation Science and other partners on a climate change vulnerability assessment. The report, Climate Change and Biodiversity in Maine: Vulnerability of Habitats and Priority Species, classifies the vulnerability of the species and habitats to climate change.

The Maine Stream Connectivity Work Group and Maine's Aquatic Resources Management Strategy are working to minimize the impacts of road crossings on Maine's aquatic systems, which are becoming stressed by more frequent and severe storms.

The Department of Marine Resources continues to implement a wide range of fisheries research monitoring activities for stock assessments; however, the time series will also be useful for understanding changing environmental conditions.

The Department of Marine Resources has maintained an Environmental Monitoring Program in Boothbay Harbor for over a century. The observations began in March of 1905 and constitutes one of the longest running, continuous series of sea temperature observations for any point on the North American Atlantic Coast. Currently, observations of air temperature, barometric pressure, sea surface temperature, relative humidity, wind speed, and wind direction are recorded at daily intervals.

New Hampshire

The New Hampshire Fish and Game Department (NHFG) is addressing climate change through four different avenues: planning, science, outreach, and communication.

The NHFG's 2015 Wildlife Action Plan (WAP) Update specifically recognized climate change as a risk factor for both habitats and species. Because of this, species and habitat profiles include their sensitivity to climate change-related parameters, and the weighted risk of those species and habitats in regards to impacts such as sea level rise (SLR), changes in precipitation, increased storm activity, changes to air and sea temperature, etc.

The Great Bay National Estuarine Research Reserve (NERR, part of NHFG) continuously monitors salt marsh distribution and condition along with information about the salinity of pore water and marsh

elevation. Over time, this information will help inform if and how SLR is impacting salt marsh health at three sites around Great Bay. NHFG also has detailed habitat maps for Great Bay (and will have them for the whole coastal region by next fall). These are considered baseline maps from which to compare future changes. The NERR is also installing a tide gauge in the southern reach of Great Bay to monitor water level over time. The Sea Level Affecting Marsh Migration Model (SLAMM) was run for all of coastal New Hampshire as a part of the WAP, predicting how salt marsh distribution is likely to change under different SLR scenarios and where there is potential for migration. This information was combined with current condition information to determine where the highest quality marsh is likely to migrate, and where restoration opportunities are likely to be valuable in light of potential SLR.

The Great Bay NERR and NH Department of Environmental Services co-chair the Coastal Adaptation Workgroup – a group of outreach professionals that coordinate to bring the best climate-related science to local communities. Much of this revolves around wise planning to protect both natural and built assets. The Great Bay NERR hosts a Climate Summit each spring (topics this year include: living shorelines, presentations about the WAP, fisheries impacts in the Gulf of Maine, impacts on groundwater along the coast, culvert assessment work, dune restoration, city planning case studies, etc.). NHFG is also incorporating climate-related messages into their K-12 and teacher education programs. This summer they will host a teacher training workshop focused on how protected places can be observed to determine climate-related impacts over time; and the NHFG will be hosting an intern who will be developing a volunteer phenology program for the center.

NHFG has two representatives on the Coastal Risks and Hazards Commission, a state wide legislatively-directed commission that was charged with providing guidance and consistent information to state agencies and municipalities on how to assess and prepare for coastal storms, SLR, and increased precipitation. A draft report and recommendations on "Preparing New Hampshire for Projected Storm Surge, Sea-level Rise, and Extreme Precipitation" has been prepared. Because of the recommendations from the report, each state agency is going to be asked to review its rules and regulations in light of the science and recommendations provided by the commission. The legislation is pending now (2016), and if passed would likely go into effect next year (2017).

Additional Links:
The NH Fish and Game Department's Wildlife Action Plan:
http://www.wildlife.state.nh.us/wildlife/wap.html
The State of New Hampshire website: http://www.nh.gov/climate/
The NH Department of Environmental
Services:http://des.nh.gov/organization/divisions/air/tsb/tps/climate/

Massachusetts

In 2008 Massachusetts passed a global warming solutions act to reduce emissions, increase green infrastructure, and to analyze strategies for adapting to predicted changes in climate. The Massachusetts Climate Change Adaptation Report released in September 2011 by the Executive Office of Energy and Environmental Affairs includes an overview of anticipated impacts and key adaptation strategies to increase resilience and preparedness.

Regarding fisheries, Massachusetts sits on the boundary of two biogeographic provinces, the Gulf of Maine and the Mid-Atlantic Bight. The state is already seeing shifts in species range

distributions (black sea bass, American lobster, northern shrimp). The Division of Marine Fisheries collects bottom temperature data, every two hours at 60-70 sites across the state. Bottom temperature data is stored in an in-house database containing over 2 million readings dating back as far as 1986 for some sites. The Division of Marine Fisheries also has trawl data back to the 1970's.

In 2007 the mayor of Boston passed an Executive Order Relative to Climate Action, which called for a plan every three years. The first update was produced in 2014 (summary here: http://www.cityofboston.gov/images_documents/Greenovate%20Boston%202014%20CAP%20Update_Summary_tcm3-49733.pdf), and includes a variety of proposals, addressing open space, education, renewable energy, etc.

Rhode Island

In July 2014, the Rhode Island General Assembly approved the Resilient RI Act (RIGL §42-6.2), which formally established the Executive Climate Change Coordinating Council, as well as set specific greenhouse gas reduction targets, and incorporated consideration of climate change impacts into the powers and duties of all state agencies. The Coordinating Council is comprised of Directors and Commissioners from nine state agencies/offices and is supported by an Advisory Board and Science and Technical Advisory Board. It is charged with leading and coordinating state agencies in responding to the challenges posed by climate change in a timely and effective manner, focusing in particular on:

- assessing, integrating and coordinating efforts throughout state agencies to reduce greenhouse gas emissions, strengthen the resilience of communities, and prepare for the impacts of climate change;
- improving our understanding of the effects climate change will have in RI;
- working in partnerships to identify, develop and implement strategies to be better prepared, and reduce risk and losses.

There are several projects underway that will provide information to support future Coordinating Council recommendations. A few coastal related projects include the following. As first step in helping to reduce Rhode Island's greenhouse gas emissions is the completion of the 30 Megawatt Block Island Offshore Wind Project. This will be the first offshore wind project in the country. Located approximately three miles southeast of Block Island, the project which started construction in 2015, is now complete and currently undergoing operational tests. The system is expected to be commercially operational by the end of 2016. The spatial planning and fisheries-related research and monitoring used to guide this work may provide a blueprint for other states and coastal communities.

To assess the effects climate change in Rhode Island the Executive Council's Science and Technical Advisory Board prepared a brief synopsis of the state of knowledge of the following manifestations of climate change: SLR, warming air temperatures, warming water (marine and fresh) temperatures, storm frequency and intensity, biodiversity (changes in species and

habitats), and precipitation and inland flooding. The information summarized in this report will assist state agencies, decision-makers, and the public understand the real impacts RI is already experiencing due to a changing climate.

The Coastal Resources Management Council continues work on the Shoreline Change Special Area Management Plan, developing scientifically-based data and tools to aid in coastal hazard adaptation planning. The Management Council has completed revised Shoreline Change Maps for the shout shore communities showing how Rhode Island's shoreline has changed over time due to erosion, and how we might expect it to change in the future. Additional tools and other key resources are available from the website to aid the state and municipalities in supporting sound policy decisions which address coastal erosion, SLR and storm surge inundation problems.

The Department of Environmental Management has also addressed considerations related to climate change throughout the recently updated State Wildlife Action Plan. In short, Wildlife Action Plan reviewed vulnerability assessments for several species of great concern, identified threats to species and their habitats, and proposed actions to reduce these threats. In addition, the Division of Fish and Wildlife's Marine Fisheries Section continues to conduct long-term monitoring programs and collaborate on several local and regional research projects investigating the effects of climate change on managed species and the state's marine resources. State Wildlife Action Plans also have to specifically take into account climate change adaptation. Climate change is primarily in Chapters 1 (species), 2 (habitats), 3 (threats), and 4 (actions to abate threats to species and habitats).

In October 2015, the State Planning Council voted to adopt Rhode Island's new State Energy Plan "Energy 2035" as an element of the State Guide Plan, codifying the Plan as the state's formal long-term, comprehensive energy strategy. The Plan, produced by the Office of Energy Resources in collaboration with the Division of Planning, represents Rhode Island's first data-driven energy planning and policy document. Its vision is to provide energy services across all sectors—electricity, thermal, and transportation—using a secure, cost-effective, and sustainable energy system

In January 2016, the Management Council adopted amendments to Section 145 - Climate Change and Sea Level Rise of the Coastal Resources Management Program to update SLR projections for short-, mid- and long-term timelines of 2035, 2050, and 2100 respectively, as calculated using the current NOAA methodology, and based on the Newport, RI NOAA tide gauge.

In early 2016, OER launched the state's first ever electric vehicle rebate program to support adoption of electric vehicles by Ocean State drivers: Driving RI to Vehicle Electrification (DRIVE). The program made $200,000 available for qualified RI residents interested in purchasing or leasing an electric vehicle to apply for a financial rebate of up to $2,500, based upon vehicle battery capacity. Modeled closely on existing rebate programs offered in other states, DRIVE offers the potential to increase the total number of EVs on RI roadways by 20-35%.

Connecticut

The Connecticut Climate Change Action Plan was initiated in 2005 with the goal of reducing greenhouse gas emissions to achieve regional goals set by the New England Governors/Eastern Canadian Premiers. The Action Plan addresses quantification of benefits and costs of greenhouse gas reductions using existing analytical measures and a newly developed desktop modeling tool developed under the direction of the Environmental Protection Agency (EPA). As the first state to utilize this new tool, Connecticut was able to identify benefits previously not quantified. To successfully meet the requirements of the Action Plan, a Governor's Steering Committee established working committees at both the agency head and staff level to develop, implement, and track progress on recommended actions.

Additional legislation passed in following years, and complementary to the Action Plan, Connecticut adopted California emissions standards; promoted hybrid fuel cars through tax incentives; set efficiency standards for products and appliances; and promoted the purchase of "Connecticut Grown" foods. A Governor's Executive Order requires the state to purchase renewable energy in increasing amounts, leading to 100% clean energy by 2050. Legislation also simplified the permitting process in ways that encourage implementation of 'living shorelines' in place of shoreline armoring.

Additional monitoring programs include:

Long Island Sound Study Sentinel Monitoring for Climate Change: A multidisciplinary scientific approach to provide early warning of climate change impacts to Long Island Sound ecosystems. This program is conducted jointly by EPA Regions 1 & 2, Connecticut Department of Energy and Environmental Protection, New York Department of Environmental Conservation, and several academic institutions.

Connecticut Institute for Resilience and Climate Adaptation: Established in 2013 under the direction of the Department of Energy and Environmental Protection and the University of Connecticut to conduct research, outreach, and education projects as well as guide the development of technologies and regulatory provisions that increase the protection of ecosystems, coastal properties, other lands, and attributes of the state that are subject to the effects of rising sea level.

New York

New York has an Office of Climate Change within the New York Department of Environmental Conservation that coordinates efforts relating to climate change. The New York State Energy Research and Development Authority developed the Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State report that includes the impacts of climate change and recommendations.

New York developed a Sea Level Rise Task Force Report in 2009, which includes impacts and recommendations as well. The report led to the 2014 Community Risk and Resiliency Act. This Act:

1) Incorporates state-adopted SLR projections as regulation by Jan. 1, 2016 (Department of Environmental Conservation) and establishes a new 6 New York Community Risk and Resiliency Part 490, Projected Sea-level Rise (Part 490). Part 490 will establish projections of SLR in three specified geographic regions over various time intervals, but will not impose any requirements on any entity.

2) Adds mitigation of SLR, storm surge, and flooding to Smart Growth Public Infrastructure Policy Act criteria and guidance by Jan. 1, 2017 (Department of Environmental Conservation, Department of State).

3) Models local laws to enhance resiliency by Jan. 1, 2017 (Department of Environmental Conservation, Department of State).

4) Considers SLR, storm surge, and flooding in 19 programs (facility-siting regulations, permits and funding) by Jan. 1, 2017 (Department of Environmental Conservation, Department of State), including a checklist on how to consider SLR, storm surge and flooding in permitting decisions.

5) Requires guidance on implementation of the Community Risk and Resiliency Act and the use of natural resiliency measures to reduce risk by Jan. 1, 2017 (Department of Environmental Conservation, Department of State), considering the ability of natural resiliency measures to provide for storm-related and other benefits.

New York also has guidance on flood risk management standards, culvert sizing, living shorelines, nature-based shorelines, and wetland migration. The Office of Climate Change also has a greenhouse gas emissions initiative, which develops caps, performance standards for CO_2 emissions, Climate Smart Communities programs – certifying communities for climate-friendly actions, greenhouse gas emissions targets, and grants to assist in implementation.

The New York State Energy Research and Development Authority conducts environmental research and analysis and provides technical expertise and support to New Yorkers in order to increase renewable energy usage and efficiency. They are currently studying atmospheric deposition and impacts on natural resources. New York also has a Climate Change Science Clearinghouse, which provides New York State-related climate change data and information to inform decision making.

New York is involved in National Estuary Programs and National Estuarine Research Reserve sites, which conduct research monitoring, the results of which are integrated in all climate change management plans and state wildlife action plans, ultimately affecting how we manage resources. Vulnerability assessments are being conducted – these assess at-risk natural

resources and infrastructure, develop adaptation strategies, support low impact development and green infrastructure, and include wetland migration pathway modeling to advise management decisions.

Finally, New York also has monitoring networks (climate sentinel monitoring projects, sediment elevation tables, water quality, is developing wetland rapid assessments, and conducting marsh loss trend assessments). Restoration efforts support habitat connectivity, large scale wetland restoration, and focus on managing threats to trust species.

New Jersey

There are many efforts underway in New Jersey to mitigate and respond to the impacts of climate change including: substantial investment in clean energy initiatives such as renewable energy production from solar, wind, and geothermal sources; improving energy efficiency; and reducing overall energy use and intensity. In addition, the State of New Jersey has taken significant steps in creating climate change-related community preparedness programs with a focus on resiliency and adaptation efforts at the local and state level. These programs involve strong interaction with local governments at the land use planning level as well as efforts to protect critical infrastructure and ecosystems, and new suites of regulations related to the design of buildings, roads, and bridges (www.globalchange.gov).

Following Superstorm Sandy, New Jersey State Departments and Agencies have incorporated resiliency strategy and planning into every aspect of the recovery process in an effort to rebuild better and more resilient than before. Many of these initiatives will serve to make New Jersey more resilient to the adverse effects of future climate change. Among the initiatives are: beach and dune projects, acquisition of properties in repetitive flood loss areas, energy resilience at critical facilities throughout the State, and actions to address emergency fuel – highlighted during Superstorm Sandy by building resilience in fuel supply and distribution. As part of their long-term recovery strategy, New Jersey has committed to rebuilding by focusing on implementing *resilient* infrastructure projects and mitigation opportunities to prevent future damage, and utilizing construction techniques and materials that will better withstand future weather events. The State will continue to leverage existing federal and state resources to pursue these long-term strategic priorities and empower local governments to revitalize their communities. New Jersey has also focused its efforts on future emergency response programs. For more detailed information, please visit the Governor's Office of Recovery and Rebuilding website at http://nj.gov/gorr/.

The continued development of a long-term comprehensive statewide adaptation plan needs to involve the input and action of many parties, including federal, state and local governments; non-governmental organizations; academia; private industry; and the citizens of New Jersey. Safeguarding New Jersey's residents, its built and natural environment, and ensuring that the State continues to grow in a manner that is both sustainable and resilient to the adverse effects of climate change will require adaptation planning. More information on New Jersey's Adapting

to a Changing Environment Program is available at http://www.nj.gov/dep/ages/adapting.html.

Additionally, Rutgers University formed the New Jersey Climate Adaptation Alliance in 2011 (http://njadapt.rutgers.edu). The Climate Adaptation Alliance is described as *"a network of policymakers, public and private sector practitioners, academics, and NGO and business leaders designed to build climate change preparedness capacity in New Jersey…The Alliance is focused on climate change preparedness in key impacted sectors (public health; watersheds; rivers and coastal communities; built infrastructure; agriculture; and natural resources)."* The ultimate goal of this initiative is to assess climate vulnerability and preparedness needs for critical sectors in New Jersey and to develop capacity for response implementation in New Jersey. One of the important products of the Climate Adaptation Alliance was the development of the New Jersey Climate Adaptation Directory. According to the Climate Adaptation Alliance, *"the directory was created to provide resources that assist in guiding practitioners in New Jersey through the adaptation planning process. This directory brings together geographic data, tools, reports, model policies and ordinances, case studies, and current projects focused on evaluating vulnerabilities and developing and implementing climate change adaptation plans and strategies. The resources included are aimed at professionals in a range of fields, including but not limited to infrastructure, public health, emergency management, hazard mitigation, natural resources, economic development, agriculture, and land use planning."* This resource can be found here: http://njadapt.rutgers.edu/resources/climate-adaptation-directory#.

Pennsylvania

Pennsylvania has two separate fish and wildlife agencies: Pennsylvania Fish and Boat Commission and Pennsylvania Game Commission. The state also has the Pennsylvania Department of Environmental Protection, which is primarily regulatory, and the Department of Conservation and Natural Resources that manages the State Parks and Forests.

The Pennsylvania Climate Change Act of 2008 required the Department of Environmental Protection to produce a report on the anticipated climate change impacts in Pennsylvania and also a Climate Change Adaptation Strategy. Both are to be updated every three years. The original reports were produced in 2009 and have both been updated in 2013 and 2015 (http://www.dep.pa.gov/Business/Air/BAQ/AdvisoryGroups/CCAC/Pages/default.aspx#.VyJQWYLD-po). The report addresses freshwater tidal waterfront on page 197. From the report: Pennsylvania has approximately 56 miles of coastline on the Delaware Estuary that is largely freshwater and home to diverse flora and fauna. This includes approximately 1200 acres of freshwater tidal wetlands. Impacts to these habitats include decreased dissolved oxygen concentrations, SLR, and salinity intrusion. The potential for loss of these wetlands is high if accretion rates do not keep up with SLR. There is a low potential for migration due to development. Further discussion on typical climate change impacts and strategies is extensive in these documents.

The Department of Conservation and Natural Resources has developed the DCNR and Climate Change: Planning for the Future document describing climate change's current and projected impacts on the state parks and forests, and their approach to adapt to these impacts. The 2015-2025 Pennsylvania Wildlife Action Plan offers a review of threats posed by climate change. This plan includes species with declining or imperiled populations, or with secure populations, but substantial environmental threats, and their habitats. Among the primary climate change information sources in this plan include the Northeast Climate Science Center (Staudinger et al. 2015), and state documents produced by the Department of Environmental Protection. Climate change is identified as a threat to 29.5% (196 species of a total 664) of the Species of Greatest Conservation Need in the plan, which also discusses vulnerability and associated risk of those species and habitats to climate change (2015-2025 Pennsylvania Wildlife Action Plan, Chapter 3, pp. 29-70 and 95-107). The Plan (Chapter 4, pp 85-101) also includes conservation actions to address climate change, including regional (Staudinger et al. 2015) and national adaptation strategies (National Fish Wildlife Plants Climate Adaptation Partnership 2012).

Maryland

Maryland has developed the Climate Change Maryland website to educate citizens about climate change and the actions that the state is taking to reduce its carbon footprint. This program includes participation from over 12 states agencies. It contains information on the Greenhouse Gas Reduction Plan, which was written in 2012 (and updated in 2015) to address the 2009 Greenhouse Gas Emissions Reduction Act. The Greenhouse Gas Reduction Plan's goals are to reduce greenhouse gas emissions by 25% by 2020 by reducing all sectors' (energy, transportation, agriculture, etc.) carbon footprint. It has more than 150 programs and initiatives to address carbon emissions related to energy, construction, fisheries, forestry, etc.

The state also has a two phase plan to reducing Maryland's vulnerability to climate change. Phase I was published in 2008 and addresses SLR and coastal storms. Phase II was completed in 2011 and focuses on building societal, economic, and ecological resilience.

In 2012 the Climate Change and CoastSmart Construction Executive Order was signed to ensure all new and reconstructed state structures have minimal to no flood risk based on improved planning and construction.

Virginia

The Governor's Commission on Climate Change published A Climate Change Action Plan in 2008, which includes the effects of climate change (on the built environment, insurance, natural systems, etc.), recommendations, and commission deliberations. In December of 2014, the state published Virginia Accomplishments Since the 2008 Climate Action Plan Release. According to the executive summary, Virginia has taken many mitigation and adaptation actions in regards to climate change, but these changes were not necessarily in response to particular recommendations or carried out in a coordinated manner. One year later, in December 2015,

the Governor Terence R. McAuliffe's Climate Change and Resiliency Update Commission published the Report and Final Recommendations to the Governor, which includes the top five recommendations to address climate change in the state. These include: i.) establishing a climate change and resilience resource center, ii.) creating a new Virginia bank for energy and resiliency, iii.) establishing a renewable energy procurement target for Commonwealth agencies, iv.) adopting a zero emission vehicle program, and v.) leveraging federal funding to make coastal communities more resilient. During the 2016 legislative session Virginia created the Commonwealth Center for Recurrent Flooding Resiliency, a joint venture of Old Dominion University, the College of William & Mary and the Virginia Institute of Marine Science. With an initial budget allocation of $2 million in state support these institutions will work together to provide critical research, policy, and outreach resources to protect natural resources and create resilient communities across the Commonwealth.

North Carolina

In 2015, the North Carolina Coastal Resource Commission Science Panel completed their five-year update of their 2010 Report and the 2012 Addendum as mandated by the General Assembly in Session Law 2012-202. This update incorporated the most recent science and uses a 30-year projection for SLR. The report emphasized the different rates of SLR across the coast of North Carolina. These differences were attributed to subsidence and the effects of water movements within the ocean itself. The panel recommended that the report continue to be updated every five years.

The 2016 update of North Carolina's Coastal Habitat Protection Plan addresses SLR and climatic changes in several locations with recommendations specifically to the protection of wetlands and buffers to help offset the expected rise. The Source Document for the Coastal Habitat Protection Plan, and the Plan itself, can be accessed at: http://portal.ncdenr.org/web/mf/habitat/chpp/downloads.

The Albemarle-Pamlico National Estuary Partnership, through its 2012-2022 Comprehensive Conservation and Management Plan incorporates climatic impacts throughout, but has three actions focused on climate change and SLR. Two actions address the impacts of SLR and climate change on the regional ecosystem as well as supporting research on adapting to those impacts. The third action supports engaging state, regional, and local governments and assisting them with incorporating SLR and climate change into their planning processes.

Both the North Carolina National Estuarine Research Reserve and the U.S. Fish and Wildlife Service have incorporated significant aspects of SLR and climate change research into their strategic plans. With several extensive National Wildlife Refuge systems on North Carolina's coast and four National Estuarine Research Reserve sites in eastern North Carolina, significant research is being done in those locations. Much of the research deals with hydrologic restoration and the study of wetlands and their mitigating impacts on SLR.

South Carolina

In 2013, the South Carolina Department of Natural Resources compiled a report titled "Climate Change Impacts to Natural Resources in South Carolina." The following two sentences from the report highlight the goal the agency had in writing it: "The Department of Natural Resources is taking a lead role among South Carolina state agencies to advance the scientific understanding of the vulnerability of South Carolina's vital natural resources during an era of changing climate. This will enable the agency, its partners, constituents, and all Palmetto State citizens to avoid or minimize the anticipated impacts while protecting South Carolina's natural resources." The report identifies a number of concerns for the state's natural resources including SLR, ocean acidification, and temperature rise effects. The state has a high proportion of the coastline that is comprised of marshes, barrier islands, and hammock islands. Many of these lands are owned by state and federal entities. The document has various strategies for research and for developing and protecting land to provide for migration.

Other scientists, such as Dr. James Morris from the University of South Carolina, are conducting research evaluating the fate of marshes due to potential SLR. The recent thousand-year rain event in the state and King Tides are raising public awareness of what SLR will probably entail.

Georgia

In Georgia, most of the authority for responding to climate change rests with the local governments. There is not a statewide plan or regulatory measures in place. Their State Wildlife Action Plan, however, does address climate change. With that in mind, there aren't any vulnerability assessments regarding fisheries. NOAA Fisheries Science Centers are working on assessing climate vulnerabilities for many species at the federal level.

Georgia is home to Gray's Reef National Marine Sanctuary, and NOAA is taking a three-pronged approach to address climate change: they are using Gray's Reef as a sentinel site, responding to change through adaptive management, and increasing climate change communication. Climate change links for Gray's Reef and other National Marine Sanctuaries include:
http://sanctuaries.noaa.gov/science/sentinel-site-program/climate-change-ocean-acidification.html
http://marineprotectedareas.noaa.gov/sciencestewardship/climatechangeimpacts/
http://sanctuaries.noaa.gov/science/sentinel-site-program/grays-reef/climate-change-ocean-acidification.html

Florida

The Florida Fish and Wildlife Commission led a stakeholder summit on Climate Change in 2008. A report was generated in 2009 from this summit entitled "Florida's Wildlife: On the front line of climate change." As a result of this summit and due to the resulting recommendations, the Fish and Wildlife Commission established a Climate Change Oversight Team and developed

adaptive strategies to address identified climate change threats to fish and wildlife and their habitats. Climate change considerations have been integrated into Florida's State Wildlife Action Plan, and funding has been provided to aquatic habitat projects supporting climate change adaptive strategies, such as living shoreline projects and regional climate change effects mitigation planning efforts. Funding opportunities for aquatic habitat restoration and enhancement projects supported by the Fish and Wildlife Commission ensure evaluation of climate change adaptation in all project proposals submitted. The state follows guidance in Adapting to Climate Change: A Planning Guide for State Coastal Managers, a 2010 report from NOAA.

The Florida Oceans and Coastal Council published The Effects of Climate Change on Florida's Ocean and Coastal Resources in 2009, and updated the report in December 2010. These reports were written for the Florida Energy and Climate Commission and the residents of Florida. The original report included information on the 2007 Intergovernmental Panel on Climate Change Report, the impacts of climate change on Florida's infrastructure, human health, and economy, the effects of the 'drivers' of climate change, and research priorities, while the update focused on SLR effects and research priorities.

Florida has also worked with partner organizations, such as The Nature Conservancy, to implement projects addressing resiliency and plan for coastal climate change. This has been a key focus of south Florida, which is generally recognized as being one of the most vulnerable regions in the Commission management region to SLR. Partners have developed shoreline resiliency and coral reef teams including the Shoreline Resiliency Working Group and Southeast Florida Coral Reef Initiative, which are focused on assessing and addressing the effects of climate change on coastal habitats. The Governor's South Atlantic Alliance recently sponsored (April 2016) a southeast U.S. Living Shorelines Summit in Jacksonville, Florida, which specifically addressed coastal habitat resiliency in the face of accelerated SLR. This effort has resulted in the development of a number of different regional resources, including a living shoreline training academy, which provides managers and the public with a certification in living shoreline design and implementation.

Appendix II Summary of Climate Change Initiatives by State

(see Excel spreadsheet – will be incorporated into the document in final form)

Appendix III NOAA and US Fish and Wildlife Service Climate Change Initiatives

NOAA

NOAA Program	Climate Change Initiative Description
Annual NOAA/NCDC State of the Climate Reports	These began in 1991 and can be downloaded from http://www.ncdc.noaa.gov/bams-state-of-the-climate/
NOAA-wide effort	The Third National Climate Assessment (2014). It includes regional chapters, as well chapters for coastal and oceans, ecosystems, and ancillary reports with additional details for some regions and subject areas. http://nca2014.globalchange.gov/report
NOAA Restoration Center, Community-based Restoration Program and Damage Assessment, Remediation and Restoration Program	Restoration project designs consider climate change impacts to both the immediate restoration and long-term stewardship of project sites. E.g., sea level rise impacts
NOAA Restoration Center, Northeast Region	Guidance on flood frequency estimates for resilient infrastructure and stream restoration. The Restoration Center has been studying historical climatic trends in river floods in the Northeast to support the design of fish passage and river restoration projects, and findings have documented increasing flood magnitudes and frequencies in recent decades. They have also developed Planning for Sea Level Rise in the Northeast: Considerations for the Implementation of Tidal Wetland Habitat Restoration Projects (2011)
NMFS Habitat Conservation Division (HCD), Essential Fish Habitat and Hydropower License – Fish Passage Prescriptions	Consider climate change effects on habitats from the action. Includes climate effects on the proposed action that result in adverse effects to habitat
NMFS HCD (GARFO)	Developing a regional climate change guidance document to assist in integrating climate change information in consultation processes
NMFS Office of Habitat Conservation	Climate Smart Habitat Conservation webpage on climate change information with links for Coastal Blue Carbon, addressing sea level rise in salt marsh restoration projects, and other climate-related topics. http://www.habitat.noaa.gov/ourwork/climate.html
NOAA Climate Program Office	U.S. Climate Resilience Toolkit, hosted by NOAA's National Centers for Environmental Information. https://toolkit.climate.gov/. The U.S. Climate Resilience Toolkit includes training materials and guidance documents to assist coastal resource managers in incorporating climate change

	information into new or existing conservation plans. https://coast.noaa.gov/digitalcoast/training/considering-climate-change
NOAA Coral Reef Conservation Program	Competitive grant program providing funding and coordination for external and internal NOAA activities on shallow-water coral reef conservation, including research on ocean acidification and bleaching
NOAA Chesapeake Bay Office	Program contributes to climate change research, monitoring, resiliency, and adaptation, e.g., research on climate change effects on oysters
NOAA Sentinel Site Cooperative in North Carolina and Chesapeake Bay	NOAA works with regional partners and leverages resources on issues related to climate change, including sea level rise and inundation through coordinated data sharing, monitoring, research, local community capacity building, and adaptation support, which includes habitat conservation
National Fish, Wildlife, and Plants Climate Adaptation Strategy	Office of Habitat Conservation contributed to the development of this broad strategy that includes coastal habitat adaptation needs
NMFS Office of Habitat Conservation, Coastal Blue Carbon	General information on coastal blue carbon, with a number of links for further reading on the subject including research and development and protocol standards. http://www.habitat.noaa.gov/coastalbluecarbon.html
NOAA Living Shorelines Guidance	NOAA's living shorelines webpage contains background and technical information on, as well as examples of, living shorelines: https://www.habitatblueprint.noaa.gov/living-shorelines/; NOAA Fisheries Office of Habitat Conservation's Restoration Center website contains information related to living shorelines: http://www.habitat.noaa.gov/restoration/techniques/livingshorelines.html; NOAA guidance on living shorelines can be downloaded here: http://www.habitat.noaa.gov/pdf/noaa_guidance_for_considering_the_use_of_living_shorelines_2015.pdf
NOAA Regional Coastal Resilience Grant Program	Grants program to support regional approaches that build resilience of coastal regions, communities, and economic sectors to the negative impacts from extreme weather events, climate hazards, and changing ocean conditions. https://www.coast.noaa.gov/resilience-grant/
NMFS Saltonstall-Kennedy Grant Program	$10 million competitive grant program to build resilient coastal communities and sustainable marine resources.
NMFS Northeast Region Fishery Science Center, Ecosystems Dynamics and Assessment Program	Program website includes a comprehensive review of climate change effects on the Northeast Continental Shelf ecosystem. https://www.nefsc.noaa.gov/ecosys/
NMFS Climate Science Strategy and Regional Climate Science Action Plans	Informs NMFS science activities (monitoring, research, modeling, and assessments), including tracking current conditions, providing early warnings and forecasts, understanding the mechanisms of climate impacts, and projecting future conditions, evaluating possible options for fisheries management and protected resources conservation in a changing world
NOAA's Earth Science Research Laboratory,	Climate Change Portal, a web interface that users can access and display climate and earth system model output. https://www.esrl.noaa.gov/psd/ipcc/ocn/

Physical Sciences Division (PSD)	
NOAA National Oceanographic Data Center, National Centers for Environmental Information, Ocean Climate Laboratory Team	Provides support for the Northwest Atlantic Regional Climatology webpage, providing high-resolution ocean climatology as part of the NOAA-wide Sustained Marine Ecosystem in Changing Climate Project. https://www.nodc.noaa.gov/OC5/regional_climate/nwa-climate/
NOAA's Office for Coastal Management	In collaboration with The Nature Conservancy and ESRI, NOAA developed the Climate Wizard, a web-based interactive mapping platform which provides access to U.S. and global climate change information including historical and projected temperature and precipitation data using different greenhouse gas emission scenarios for two future time periods. http://climatewizard.org/. Digital Shoreline Analysis System is an ArcGIS-based software package jointly developed by NOAA and the U.S. Geological Survey. The software computes the rate of shoreline change using historical shoreline positions represented in a GIS. https://coast.noaa.gov/digitalcoast/tools/dsas.html. The Digital Coast is a sea level rise projection mapping tool. https://coast.noaa.gov/digitalcoast/tools/slr
The National Ocean Service (NOS) National Center for Coastal and Ocean Science	Ecosystem Effects of Sea Level Rise research program provides a suite of science products to inform coastal managers of local coastal vulnerability and solutions to mitigate flood risk.
NOAA's National Centers for Environmental Information (NCEI)	Arctic Regional Climatology Data. https://www.nodc.noaa.gov/OC5/regional_climate/arctic/

NOAA-Related Publications

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Department of Interior

DOI Program	Climate Change Initiative Description
US Geological Survey (USGS)	Responsible for climate change science leadership within the Department of Interior
USGS Climate Science Centers and National Climate Change and Wildlife Science Center	Work with natural and cultural resource managers to gather the scientific information and build the tools needed to help fish, wildlife, and ecosystems adapt to the impacts of climate change. https://nccwsc.usgs.gov/
US Fish and Wildlife Service (FWS) The Climate of Conservation in America: 50 Stories in 50 States	State-by-state look at how accelerating climate change is impacting or may impact fish and wildlife across America. https://www.fws.gov/home/climatechange/stories505050.html
National Fish, Wildlife and Plants Climate Adaptation Strategy	National, government-wide strategy to safeguard fish, wildlife, plants, and the natural systems upon which they depend. Led by FWS, NOAA, and New York Division of Fish, Wildlife, and Marine Resources. https://www.wildlifeadaptationstrategy.gov/index.php
FWS Climate Change Strategic Plan	Rising to the Urgent Challenge, Strategic Plan for Responding to Accelerating Climate Change. https://www.fws.gov/home/climatechange/pdf/CCStrategicPlan.pdf