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|  | Rapid Assessment of the Governance System’s Ability to  Respond to Climate Change |

In support of the East Coast Climate Change

and Fishery Governance Workshop

March 19-21, 2014

Atlantic States Marine Fisheries Commission

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|  | Introduction |

**Overview**

The following rapid assessment approach and compiled document were developed to inform the agenda and discussions at the East Coast Climate Change and Fisheries Governance Workshop, March 19-21, 2014 in Washington, DC. This workshop will be hosted by the Mid-Atlantic Fishery Management Council, and was developed in partnership with the New England Fishery Management Council, South Atlantic Fishery Management Council, Atlantic States Marine Fisheries Commission and NOAA Fisheries, with coordination and facilitation support provided by the Fisheries Leadership & Sustainability Forum (Fisheries Forum).

The purpose of these rapid assessments is to describe the current state of knowledge regarding climate change impacts and concerns for managed fisheries, and in particular to help identify intersections with the workshop focus on management and governance. These initial rapid assessments were completed by council and Commission staff, and represent an investment of their time as well as an effort to share their experience and insight. The assessments are not intended to be comprehensive; rather they are a first pass at gathering information, and will serve as living documents that can be refined and updated over time to incorporate new information and perspectives.

**Approach**

Fisheries Forum staff, the workshop steering committee and Atlantic States Marine Fisheries Commission staff collaborated to develop a data collection template. The templates are comprised of a set of questions designed to capture information on a) observed or potential impacts on managed stocks and/or fisheries from climate change; b) management measures and communication/ coordination mechanisms in place; and c) perceptions of the ability of the governance system to address/respond to current or future climate impacts.

The initial data collection template contained two numerical ranking questions to gauge climate vulnerability and the adaptability of management measures. Assigning a numerical value to these questions was valuable to help articulate current thinking on these issues. However, given that the purpose of this assessment was not to compare fisheries, these numerical rankings have been removed or characterized qualitatively to better highlight the insights provided by council staff in their discussion of these questions. Several terms found in the rapid assessment, such as “vulnerability” and “adaptation”, have a number of different meanings. These terms have been left undefined in the rapid assessment, and thus responses to the assessment questions may reflect different perspectives on what we mean by these terms and how we measure them.

**Current and Future Use**

The process of conducting the rapid assessment, and the information contained in the assessments contribute to climate change governance discussions in several ways. First, the responses contained in the rapid assessments have been a valuable input in the development and design of the workshop. The assessments are helpful for framing workshop discussions, and are provided as a reference for workshop participants. Second, the information provided by council and Commission staff in the assessments, along with broader scoping efforts by Fisheries Forum staff, was distilled into a discussion document provided to workshop participants prior to the workshop. The discussion document highlights many of the themes that emerged from looking at the assessments across all council and Commission managed species, and helps to succinctly communicate the value of these assessments in support of the workshop. Finally, these regional rapid assessment documents can be used as a platform to capture additional insights and information, and serve as a “living document” that can be used to support future discussions around climate change and its governance implications.

If you have questions or comments regarding the rapid assessment in regard to the East Coast Climate Change and Governance Workshop, please contact Katie Latanich with the Fisheries Leadership & Sustainability Forum (cal7@duke.edu). If you have questions regarding the specific information contained in the individual assessments, please contact the appropriate member of council and/or Commission staff.

**East Coast Climate Change and Fisheries Governance Workshop**

March 19-21, 2014 – Washington, DC

**Workshop objectives**

The purpose of this workshop is to convene managers and staff of the New England Fishery Management Council (NEFMC), Mid-Atlantic Fishery Management Council (MAFMC), South Atlantic Fishery Management Council (SAFMC), Atlantic States Marine Fisheries Commission (ASMFC), and NOAA Fisheries (NMFS) to discuss the potential governance challenges arising from the impacts of climate change on East Coast marine fisheries. Specifically, workshop participants will work collaboratively to:

* Explore the existing and potential impacts of climate change on the management and governance of East Coast marine fisheries, with an emphasis on the policy implications of shifting fishery distributions and changing productivity;
* Evaluate processes for documenting and acknowledging climate-related changes and initiating a management response;
* Identify key management questions, concerns and information needs to guide future research and coordination between management bodies;
* Examine the flexibility of the existing management framework to accommodate climate-related governance challenges; and
* Discuss potential solutions and next steps for adapting and responding to climate change impacts, and opportunities to maintain a dialogue between East Coast fishery management partners.

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|  | Black Drum |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: NJ, DE, MD, VA, NC, SC, GA, FL
* Inter-state: ASMFC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Black drum distribution spans from Argentina to Maine. This species is tolerant of a wide range of temperatures and salinities. Black drum along the Atlantic Coast of the United States are all of a common stock and undergo extensive south to north spawning migrations to the Delaware and Chesapeake Bays, likely influenced by increasing water temperatures. However, black drum also spawn from south Florida to North Carolina during different time periods, supporting recruitment to the coastal stock. Increased frequency of catastrophic weather events due to climate change, such as hurricanes, has the potential to impact survival of YOY fish that use estuaries and coastal bays as nurseries. However, black drum is a relatively early-maturing, fecund and long- lived species, so recruitment over time should not be significantly impacted by these events.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Ecosystem changes due to climate change are more likely to decrease black drum’s vulnerability to climate change. Estuarine habitat used for growth and development is likely to increase due to rising sea levels. Tolerance to a wide range of environmental conditions will likely allow black drum to compete more effectively for this increasing habitat than more vulnerable species. Black drum diet relies heavily on zooplankton (larvae) and mollusk species (adults) and if climate change-related declines in these prey species occur, increased competition will increase black drum’s vulnerability to climate change.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

Given black drum’s vulnerability to climate change is largely tied to habitat rather than temperature range, the impact to other fisheries is low. If black drum are more available there may be increasing effort in the black drum fishery.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Changes in other fisheries are unlikely to influence black drum vulnerability.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Depending on the location on the Atlantic coast , short to long term concerns are the availability of viable estuarine habitat, increasing prevalence of coastal development, and/or poor water quality.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

There has been documentation of a subsistence fishery for black drum in some areas of the Atlantic coast, but this is not significant. Otherwise Black Drum is primarily a recreational fishery.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

The current management system can readily respond if there’s an expansion in range and/or increases in abundance and fishery effort in order to constrain F. The Management Board can easily add states into which the stock’s range is expanding.

Existing management measures - *What management measures are primarily used in the management of this species? Please list.*

Possession and minimum size limits.

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

The black drum FMP allows for quick adaptation. A change in management to a more complex structure would take more time to do the technical analyses to advise more complex management.

Communication and coordination - *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Current communication is facilitated by staff coordination through the Black Drum Management Board, by the states of NJ-FL.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

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| --- | --- |
|  | Black Sea Bass |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: MA, RI, CT, NY, NJ, DE, MD, PRFC, VA, NC
* Inter-state: ASMFC
* Regional: MAFMC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Black sea bass may display range shifts and changes in timing and spatial pattern of seasonal migration in response to climate change. Whether or not these changes will result in overall increased or decreased productivity across the entire stock is unclear.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Climate-induced changes to estuarine nursery and other inshore habitats may affect growth, maturity, and subsequent productivity of the stock.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

The range of black sea bass is expanding to the north. There is potential for decreased effort on other species (summer flounder, scup, tautog, winter flounder) as fishermen switch to newly available sea bass, particularly in the recreational fishery.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

One example is decreased availability of SNE lobster may cause pot fishermen to increase F on black sea bass.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Current specific concerns center around range expansion along the coast and ability to estimate abundance. States and their fishermen in the expanding northern range are seeking larger total quotas. (Long-term concern).

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

There are potential economic opportunities in the expanding areas.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

The Commission is able to add states to its black sea bass board. Management is still complex because of joint management and that Council membership does not represent the entire range.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Size limits, possession limits, gear specifications, commercial and recreational quotas, seasonal closures (recreational)

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

While there is still much to determine about the age structure and sex ratios at different sizes, the current FMP structure and political interest allows for some flexibility to address concerns quickly. The joint management plan requires more time to coordinate changes in management.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Black Sea Bass is jointly managed by the Commission and the Mid- Atlantic Council, allowing for communication through joint board meetings. Joint management is complicated because the Southern New England states do not have seats on the Mid-Atlantic Council.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
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|  | Bluefish |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC SC, GA, FL
* Inter-state: ASMFC
* Regional: NEFMC, MAFMC, SAFMC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Bluefish are a highly migratory, open ocean species with a wide range. There is no evidence that their growth, recruitment, or productivity are highly sensitive to temperature or ocean acidification.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Bluefish abundance will be affected by changes in the forage fish populations.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

Abundance for other forage fish populations may be impacted by climate change effects, but to what extent is unclear.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Yes, again Bluefish abundance will be affected by changes in forage fish populations.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Establishing more information on the age length keys along the coast is annual research priority, but no short-term climate change concerns given the migratory nature of the species.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

The recreational sector makes up the majority of the fishery, so the economic costs associated with trips, fuel, and supplies can influence participation.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

N/A.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

Maximum possession limits, minimum size limits (commercial), commercial and recreational quota.

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

The current FMP structure allows for enough flexibility to address concerns quickly.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Bluefish is jointly managed by the Commission and Council, allowing for communication channels from the state to the federal level on a regular basis.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Coastal Sharks |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, DE, MD, VA, NC, SC, GA, FL
* Inter-state: ASMFC
* Federal: NOAA Fisheries HMS Division

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

The extent to which sharks would be affected by climate change is unknown. However, the quality and availability of nursery habitat (particularly shallow, estuarine areas) and coastal reef habitat for juveniles and adults would likely be negatively affected by climate change. Reductions in these habitats could lead to reduced productivity of the affected stocks. Growth and migration patterns may be affected as well by climate change, but the anticipated direction and magnitude of that change is unclear at this time.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

In many ecosystems, sharks contribute significant predation pressure and can serve as keystone species. If sharks are affected by climate change, ripples could be felt among multiple prey stocks and throughout the ecosystem. However, the effects of disturbing predator-prey interactions are complicated and thus difficult to predict. The anticipated direction and magnitude of anticipated changes would be species-specific.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

It is unlikely that climate change would impact global shark fisheries enough to cause fishermen to focus their efforts elsewhere.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

It is unlikely that changes in other fisheries will influence the vulnerability of coastal sharks.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

No concerns related to climate change have been raised in the management process.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

There are no concerns related to social or economic considerations that are relevant to climate change.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

There is little risk to the fishery if climate is impacting the stock.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Quotas based on species groups (which are based on gear type used in fishery)
* Possession limits

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

Specifications for coastal sharks are set every year, and can be adapted throughout the season to address changes in species’ vulnerability. Extensive rule-making is required through the HMS.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Communication via the Highly Migratory Species Division of NOAA Fisheries. Coordination with ASMFC FMP staff and Spiny Dogfish and Coastal Shark Management Board to encourage complementary management in state and federal waters.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Croaker |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: NY, NJ, DE, MD, VA, NC, SC, GA, FL
* Inter-state: ASMFC

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Recruitment in croaker is variable, but evidence suggests that it is favorably impacted by warmer water temperatures. Climate change would allow them to shift their range northward and possibly be more productive in the more northern parts of their range. However, warming at the southern extent of their range may not be as beneficial, causing a range shift rather than a range expansion. If the southern part of the range is a separate stock (evidence is inconclusive, and they are managed as a single stock), the southern stock may be more strongly impacted than the northern stock.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Croaker rely on estuaries as nursery grounds, thus will be sensitive to changes in those habitats, as well as to changes in their prey field, which is primarily invertebrates and small fish. In addition, juvenile croaker are an important prey item for other commercial important species.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

There is the potential for new directed fisheries on croaker to the north, and potential reduction of fishing on croaker to the south. Croaker is bait for other fisheries. Expansion of croaker’s range to the north may provide an alternative bait supply. Alternatively, loss of croaker may have negative impacts in reducing bait supply in the southern portion of the range*.*

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

As there is evidence of bycatch of croaker in shrimp fisheries, changes to the shrimp trawl fishery may have impacts on abundance.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Scientists are concerned about possible impacts to croaker due to changes in annual rainfall and freshwater flows to estuarine habitats, as well as coastal development and loss of habitat in coastal areas.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

There are potential economic opportunities in the expanding areas. Primarily a near shore recreational fishery, in some instances primarily for bait.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

No concerns, the management system can adapt quickly.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

A mix of minimum size and possession limits.

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

Given some concerns over uneven regulations along the management unit in combination with the short lived nature of the species, makes croaker management more vulnerable to climate change. The FMP process facilitates timely adaption of management measures.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Staff coordination between Technical Committees and Management Board for the states within the management unit.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
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|  | Spiny Dogfish |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, DE, MD, VA, NC , SC, GA, FL
* Inter-state: ASMFC, NEFMC, MAFMC
* Federal: NOAA Fisheries HMS

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

The extent to which dogfish would be affected by climate change is unknown. However, the quality and availability of nursery habitat and inshore estuarine habitat for juveniles and adults would likely be negatively affected by climate change. Reductions in these habitats could lead to reduced productivity of the affected stocks. Growth and migration patterns may be affected as well by climate change, but the anticipated direction and magnitude of that change is unclear at this time.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

In many ecosystems, dogfish contribute significant predation pressure. If dogfish are affected by climate change, ripples could be felt among multiple prey stocks and throughout the ecosystem. However, the effects of disturbing predator-prey interactions are complicated and thus difficult to predict.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

If spiny dogfish’s range is reduced, fishermen in the New England region would likely switch their effort to other species in the area (groundfish, most notably).

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

It is suspected that changes in the Atlantic cod fishery have forced fishermen to focus their effort on spiny dogfish. As other species’ ranges are reduced due to climate change, fishermen may target spiny dogfish more.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

None.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

None.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

Spiny dogfish management is capable of responding to climate change due to annual specification-setting processes.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

Regional and state quotas and possession limits

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

Management is adaptive and based on stock status updates, which are conducted every year based on the best available science.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

The MAFMC, NEFMC and ASMFC coordinate management of spiny dogfish. The Councils (MAFMC and NEFMC) jointly determine quotas annually; ASMFC adopts the same quotas.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
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|  | American Eel |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC SC, GA, FL
* Inter-state: ASMFC
* Federal: No Federal management
* Other: Canada Department of Fisheries and Oceans

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

American eel may be highly vulnerable to climate change. Changing oceanic conditions would likely affect the ability of out-migrating silver (mature) eels to reach breeding grounds in the Sargasso Sea. In addition, changes in ocean current and temperatures could impact the return of passively-dispersed larvae to estuaries along the entire Atlantic coast. Changes in the temperature, salinity, and habitat composition of estuarine and freshwater habitats could also impact the growth, morbidity, and maturity rates of American eel.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

For habitat considerations, see above. Eels serve as both predator and prey in the myriad of ecosystems in which they are found throughout their range and life cycle. However, disturbances to these predator-prey interactions are complicated and thus difficult to predict.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

Eels are one of the preferred baits for the striped bass recreational fishery. The recreational striped bass fishery has already seen a reduction in availability of river herring - another preferred bait - due to the closure of state fisheries because of population declines. Eels are also predated upon by striped bass, bluefish, and catfish and decreases in eel populations could contribute to declines in these commercial and recreational fisheries.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Horseshoe crabs are the preferred bait in the yellow eel pot fishery. Reductions in horseshoe crab harvest have already impacted the eel fishery through reduced landings. If there is a continued reduction in horseshoe crab availability as a result of climate change it will further influence the eel fishery. There has been some progress in developing artificial baits, which until recently has not been very successful.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

* There is a concern over changes in oceanographic temperatures, which could influence the dispersal of the leptocephali larvae. This is a long term concern. Additionally, climate related concerns have been expressed for the decline in European eel stocks.
* The concern of a changing climate on American eels was one of the main reasons the USFWS is considering listing eels under the Endangered Species Act.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

Water temperature influences the arrival of glass eels to East Coast Rivers. Huge swings in the winter temperature could result in an unstable economics in the glass eel fishery if the eels recruit much earlier or later than when the fishing season is open.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

* Unknown. American eel has one of the most unique life histories. Recruitment is at random throughout the range (Canada to Brazil). Any conservation efforts made in the US may not necessarily benefit US stocks of American eels.
* If range consolidation caused by shifting oceanographic conditions is mistaken for increasing population trends and is followed by increasing fishing pressure then the result could be detrimental to the entire range.
* Warmer water temperatures and decreasing salinity in eel habitats may also be associated with increased prevalence of the non-native swim bladder nematode, A. crassus. The parasite can increase stress response that may cause secondary bacterial infections and mass mortalities. Swim bladders are irreversibly damaged by the parasite, and infections can result in early migration failure because of reduced swimming performance and inability to regulate depth during migration.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Yellow Eel Fishery – Size limits, mesh restrictions, and licensing requirements (coastwide). Area and time closures, gear restrictions (river specific)
* Glass Eel fishery – mesh restrictions, area closures, time closures, licensing requirements
* Silver Eel Fishery – gear restrictions to prohibit harvest during peak outmigration

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

The size limits are an easily adaptable tool. However, size limits are difficult to enforce with eels as measuring an eel is difficult. To better enforce size limits, management of the yellow eel fishery is also constrained by mesh requirements. It is very difficult and costly to replace the mesh in gear such as pots, traps, and weirs. Fishermen would need at least a three year lead time to do so without financial assistance.

Additionally, the mesh and minimum size restrictions in place only protect smaller eels and therefore only delay mortality on the population. Restrictions to provide additional protection to the spawning stock could be as simple as requiring grading in order to return the larger fish, but these measures have received mixed support in the past.

Colder winters influence the arrival of glass eels to East Coast Rivers. Changes to the start date of the glass eel fishery would be easy to implement.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

While ASMFC and the states are the only management authority, given the importance of freshwater habitat and the wide range of the species there is a need for cooperative efforts by the federal (NOAA Fisheries and USFWS) and international (Canada DFO) governments. Communication is done through the ASMFC's American Eel Management Board which NOAA Fisheries and USFWS are a member of. Representatives from USFWS, NMFS, and Canada DFO are part of the Technical Committee.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Atlantic Herring |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ
* Inter-state: ASMFC
* Regional: NEFMC, MAFMC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Spawning is highly influenced by temperature: timing of spawning events and spawning population structure (age and size of fish that mature in a season). Incubation period for eggs depends on temperature. Egg mortality increases if much cooler or warmer than the optimum (about 59° F/ 15° C). Historical references indicate that Atlantic herring populations may migrate between different coastal regions based on a decadal cycle that is influenced by climate.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

As a forage species that supports marine mammals, birds, and fish, changes in predator-prey interactions will impact sea herring.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

Availability of bait for lobster and tuna fishermen. Interactions with shad and river herring (bycatch) if those species shift behaviors.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Currently, there is 0% quota allocated to the first trimester of the year in the inshore GOM area because demand is greatest during later in the year. If other fisheries shift earlier, then there could be a redistribution of fishing effort throughout the year.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Spawning closures (short-term): actual closure dates vary significantly from the default dates in some spawning areas. Fixed gear set-aside (short-term): fishermen want available quota in the anticipation of a stronger lobster season.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

Availability of sea herring as bait when other fisheries (lobster, tuna) are productive. Whale watch tourism industry may be impacted if range of herring changes in response to climate change.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

If spawning regulations are not appropriate to actual spawning events, then fishermen might lose fishing opportunities due to default closures.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

Commercial regulations: annual catch limits allocated across four management areas (inshore and offshore), days-out (number of landing days allowed per week), harvest control measures (trip limit triggers that, when reached, will close directed fisheries in management area(s), spawning area closures based on commercial sampling of mature female herring during the fall, gear restrictions.

***Do these measures facilitate or constrain adaption? Will they allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

Currently, there are set default spawning area closure dates that may need to be adapted to shifting spawning behaviors. However, specifications and days out controls are set each year or season, and can respond more timely.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Staff from ASMFC, NEFMC, MAFMC, and NOAA Fisheries are in close communications for this complementary FMP.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Horseshoe Crab |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: NH, MA, RI, CT, NY, NJ, DE, MD, DC, PRFC, VA, NC, SC, GA, FL
* Inter-state: ASMFC
* Federal: NOAA Fisheries, USFWS

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

The extent to which horseshoe crabs would be affected by climate change is unknown yet likely to be small in comparison with other fish stocks. However, sea-level rise could change the quality, extent, and availability of beach spawning habitat, which could in turn influence the productivity of the stock.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

For habitat considerations, see above. Small and molting horseshoe crab are subject to predation, but the extent to which changes in the horseshoe crab population would affect other fish stocks is unknown. Shorebirds that rely on horseshoe crab eggs for a primary food source during migration would be affected by any changes in the horseshoe crab population.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

None expected.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Changes in the eel or conch fisheries could increase the demand for horseshoe crabs as bait, and increase the effort on the horseshoe crab fishery. Since the quota is not currently being harvested, this is not a large concern.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

None.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

None.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

None.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

Adaptive management will allow any changes to be addressed in a timely manner if effort in the horseshoe crab fishery increases.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

ASMFC sets quotas for each state; states may set trip limits or gear- specific measures based on their individual needs.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

None.

|  |  |
| --- | --- |
|  | American Lobster |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, DE, MD, VA, NC
* Inter-state: ASMFC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

American lobster is highly vulnerable to climate change. Egg development, growth, maturity, and sensitivity to disease may all be affected by water temperature. In addition, larvae are distributed on ocean currents. If oceanic patterns change over time, larval survival and species density patterns would likely be affected.

Lobsters prefer exposure to both warm and cool temperatures throughout the year. Cooler waters are required for egg development, whereas warmer temperatures can facilitate faster growth and earlier maturity. However, when temperatures have been sustained at high levels for extended periods of time, increased sensitivity to disease and lower recruitment has been observed.

The Southern New England stock (south of Cape Cod, MA to Cape Hatteras, NC) represents the southernmost portion of the species’ range. Negative effects of rising water temperatures on recruitment have already been documented and likely contributed to the currently depleted stock status. Effects have been most severe in inshore waters such as Long Island Sound and Buzzard’s Bay.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Diet data indicate that larval and juvenile lobsters are prey for several species of groundfish, dogfish, and skates. Predators may be impacted if the spatiotemporal overlap between predators, lobster, and alternative prey species for those predator changes.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

If lobster are no longer available in an area because water temperatures have increased, then fishermen will likely switch effort into other fisheries. This is currently occurring in Long Island Sound where lobstermen have moved into the whelk fishery. If this happens on a large enough scale it could impact the bait supply (having more on the market) but currently this is not an issue due to the large volume lobster fishery in Maine.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Lobster fishermen are dependent on other fisheries for bait, e.g. herring and menhaden. If those species are impacted by climate change and become less available, then bait prices will likely increase. If other fisheries are impacted fisherman may switch effort into the lobster fishery if they buy a permit or already have a lobster permit.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

There is a concern that has now been raised by stakeholders, mangers and science that water temperatures in parts of the southern range of the stock have approached levels that are not hospitable habitat for lobster. This is a long-term concern. Scientist have a concern that ocean acidification could impact lobster. With increased acidification, shells become more vulnerable, impacting resistance to disease, growth, larval development, etc.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

Shifts in lobster abundance have the potential to greatly influence long established lobster fishing fleets and their associated communities.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

A governance system that is inflexible to rapid shifts in environmental conditions due to climate change would likely have a negative impact on the American lobster population.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Size limit
* Biological protection (egg bearing females and v-notching)
* Trap limits
* Seasons
* Limited permits

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

While the ASMFC's FMP facilitates adaption, NOAA Fisheries regulatory process to change regulations has taken many years to follow up. While all regulatory changes do not take this long in the Federal process many have.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Communication is done through the ASMFC's American Lobster Management Board, which NOAA Fisheries is a member. Staff from NOAA and ASMFC coordinate on a regular basis.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Atlantic Menhaden |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, DE, MD, DC, PRFC, VA, NC, SC GA, FL
* Inter-state: ASMFC
* Federal: None

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Atlantic menhaden may display range shifts and changes in timing and spatial pattern of seasonal migration in response to climate change. Menhaden exhibit highly variable pelagic recruitment events, which may be influenced by environmental conditions. Should climate and oceanic current conditions change, productivity of the stock could be affected. In addition, menhaden exhibit time-varying growth; if this growth pattern includes an environmental component, menhaden growth could be influenced by climate change as well.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Climate-induced changes to estuarine habitat may affect growth, maturity, and subsequent productivity of the stock. Also, menhaden are an important forage fish for many Atlantic coast predators. If Atlantic menhaden are affected by climate change, ripples could be felt among multiple predator stocks and throughout the ecosystem. However, the effects of disturbing predator-prey interactions are complicated and thus difficult to predict.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

If menhaden are no longer available in an area because water temperatures have increased then fishermen will likely switch effort into other fisheries.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

If other bait fisheries are influenced by climate change fishing pressure on menhaden could increase or decrease.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

None.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

If climate has impacted menhaden stock productivity, it could directly impact harvesters, dealers and processors, and secondarily consumers. If climate is contributing to lost productivity and/or availability, the economic impacts have the potential to be significant.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

A governance system that is inflexible to rapid shifts in environmental conditions due to climate change would likely have a negative impact on the menhaden population.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Total Allowable Catch for each state for bait and non-bait harvest
* Trip limits are set in some states

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

Adaptive management will allow any changes to be addressed in a timely manner.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Communication via the Atlantic Menhaden Board, which is coordinated by ASMFC FMP staff.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

None.

|  |  |
| --- | --- |
|  | Northern Shrimp |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, FL
* Inter-state: ASMFC

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Northern Shrimp is very vulnerable. It’s a cold water species whose productivity is sensitive to water temperatures. Gulf of Maine is the southernmost point of the species ranges so this stock will likely be the least resilient to climate change. The Gulf of Maine has warmed considerably, contributing to the stock’s recent decline in productivity and geographic shift to the northeast and offshore. Recruitment is highly dependent on temperature and at warmer temperatures recruitment is poor. It is possible that growth, maturity and disease may be impacted by temperature flux but it has not been investigated in the field.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Shrimp are prey for a number of species including dogfish, silver hake, and cod. There likely will be impacts to predators if the spatiotemporal overlap between shrimp and predators is reduced. There are habitat concerns in the form of water temperature constraints (see above). Shrimp are dependent on phytoplankton and zooplankton for food; climate change that alters the patterns of phyto and zooplankton blooms will impact shrimp. Shrimp may be competing with other shrimp species and other species larvae but there is not a good understanding of these interactions.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

The shrimp stock is overfished and currently under moratorium. It is unlikely boats from other fisheries will move into the shrimp fishery.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Effort that was once in the shrimp fishery could shift to other species including lobster and groundfish.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Managers and the industry suspect climate change has contributed to the recent decline in stock productivity.

Industry has voiced concerns the increasing Gulf of Maine water temperatures have caused shrimp to move northeast and/or offshore to colder water, yet current survey data does not support this.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

If climate has impacted shrimp stock productivity, it has directly impacted harvesters, dealers and processors, and secondarily consumers. If climate is contributing to lost productivity and/or availability, the economic impacts have the potential to be significant.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

There is little risk to the fishery if climate is impacting the stock because management can adapt quickly.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Soft TAC with trip limits, season, and days out
* Quota divided by gear type (trawl, trap)
* Currently under moratorium for 2014 season

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

Primary management measures can be readily adapted prior to and during the season to match shrimp availability and fishery demands.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Communication via the Northern Shrimp Section, which is coordinated by ASMFC FMP staff. Communication with NOAA Fisheries when necessary.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

The current governance system in state waters is sufficiently adaptable, with the ability to change the TAC annually if climate is driving inter-annual changes in productivity.

If it is found shrimp are moving due to climate from U.S. waters to Canadian waters it may call for communication and coordination with DFO on shrimp management. A stock-recruitment dynamic between Canadian and U.S. waters would also call for greater coordination.

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|  | Red Drum |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC SC, GA, FL
* Inter-state: ASMFC
* Regional: NEFMC, MAFMC, SAFMC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Red drum is a widely distributed species that is tolerant of a wide range of temperatures and salinities. In recent years, red drum have been observed more frequently during summer months in the northernmost end of their range, though it is unclear if this is due to a shift in distribution. Larval and juvenile red drum do have more narrow temperature and salinity preferences than adults and changes to these environmental conditions during critical developmental stages are likely to impact survival and recruitment.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Ecosystem changes have the potential to make red drum more vulnerable to climate change. Climate change-related declines in prey species of many other competing predators, such as menhaden and shrimp, are likely to increase competition and decrease survival.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

Decreases in abundance may influence anglers to target other species.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Impacts to other estuarine species and habitat, such as loss of habitat, degradation of water quality, and prey to climate related changes could impact vulnerability, but this currently is not a significant concern.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Ecosystem changes.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

There is little knowledge of any unique social or economic concerns regarding the spotted seatrout fishery. Any concerns would like be similar to other predominately recreational fisheries, such as expenditures associated with recreational trips.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

Ecosystem changes in estuarine habitats could impact species at juvenile and larval stages.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

Size slot limits and possession limits in both the commercial and recreational sectors that must maintain a certain spawning stock ratio of approximately 40% or greater.

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

Slot limits and low possession limits allow for adequate measures to maintain spawning stock, while adaptive management is flexible enough to address trends in the fishery.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.*

Staff coordination between the Technical Committee, Plan Review Team, and Management Board for the states within the management unit.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

None.

|  |  |
| --- | --- |
|  | RiverHerring |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC, SC, GA, FL
* Inter-state: ASMFC
* Regional: NEFMC, MAFMC, SAFMC
* Federal: NOAA Fisheries, USFWS

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

River herring recruitment is affected by the flow levels of the rivers where they spawn, as well as water quality. Climate change induced changes in precipitation patterns may have a large impact on river herring recruitment and juvenile survival, some of which may be positive, depending on the river system. Additionally, mismatches between ocean and river temperatures may have an impact on the timing and success of spawning. Recruitment may also be negatively affected by warmer river temperatures during egg deposition, incubation, hatching, and juvenile growth prior to migration.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

River herring feed predominantly on plankton, and are thus vulnerable to climate change induced changes in the timing and magnitude of plankton blooms in both marine and freshwater systems. In addition, river herring are an important prey species for both riverine and marine species.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

River herring fisheries are not likely to be impacted by climate change.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Changes in other fisheries is not likely to influence the vulnerability of river herring.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Increased water temperatures and changes in peak flow are thought to impact spawning and recruitment. As these factors become more erratic, it is thought that recruitment failure will become more common.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

None.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

None.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Moratorium in place on the East Coast, except for in states where a sustainability plan is in place
* State-specific management – Maine harvests the majority of river herring

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

Due to a moratorium in many states, there may be some lag time between the needs for management and the state’s ability to implement that management. However, due to the low vulnerability of the species to climate change, this is not a large concern.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

States determine their management based on a sustainability plan, which is submitted to ASMFC. There is coordination between both the MAFMC and the NEFMC via staff communication and updates to the Board and council.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

None.

|  |  |
| --- | --- |
|  | Scup |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: MA, RI, CT, NY, NJ, DE, MD, PRFC, VA, NC
* Inter-state: ASMFC
* Regional: MAFMC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Scup may display range shifts and changes in timing and spatial pattern of seasonal migration in response to climate change. Whether or not these changes will result in overall increased or decreased productivity across the entire stock is unclear.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Climate-induced changes to estuarine nursery and other inshore habitats may affect growth, maturity, and subsequent productivity of the stock.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

Other demersal species may be targeted depending on abundance and distribution.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

The abundance and distribution of juvenile and larval crustaceans such as lobster may influence vulnerability to climate change.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Unsure.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

Scup is a valuable commercial and recreational fishery that many within the fishery are significantly depend on. As such changes to the fishery due to climate change could have significant social and economic impacts.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

N/A

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Commercial: Quota for the coast and state specific, size limit, net configuration (mesh size), traps configuration including vent size
* Recreational: quota for the coast, size limit, season, and possession limit

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change?***

As a stock assessment is vital to understanding changes in abundance and distribution, and in turn management needs, delays in scheduling and timing of stock assessments may influence the ability to adequate address changes in the fishery in spite of close monitoring and current management measures.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Scup is jointly managed by the Commission and the Mid-Atlantic Council, allowing for communication through joint board meetings. Joint management is done through staff coordination of technical committees, stock assessment committees, advisory panels, and plan review teams on an annual basis.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Shad |

Management authorities - *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC, SC, GA, FL
* Inter-state: ASMFC
* Regional: NEFMC, MAFMC
* Federal: NOAA Fisheries, USFWS

**Climate vulnerability of species *- Climate change can influence the biology of a species (i.e. growth, maturity,*** *reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Shad recruitment is affected by the flow levels of the rivers where they spawn, as well as the water quality. Climate change induced changes in precipitation patterns may have a large impact on shad recruitment and juvenile survival, some of which may be positive, depending on the river system. Additionally, mismatches between ocean and river temperatures may have an impact on the timing and success of spawning. Recruitment may also be negatively affected by warmer river temperatures during egg deposition, incubation, hatching, and juvenile growth prior to migration.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Shad feed predominantly on plankton, and are thus vulnerable to climate change induced changes in the timing and magnitude of plankton blooms in both marine and freshwater systems. In addition, they are an important prey species for both riverine and marine species.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

None based on human behavior.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

None based on human behavior.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Increased water temperatures and changes in peak flow are thought to impact spawning and recruitment. As these factors become more erratic, it is thought that recruitment failure will become more common.

Social and economic concerns - *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

None.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

None.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

State-specific regulations based on sustainability plans

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

Due to a moratorium in many states, there may be some lag time between the needs for management and the state’s ability to implement that management. However, due to the low vulnerability of the species to climate change, this is not a large concern.

Communication and coordination - *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

States determine their management based on a sustainability plan which, was approved by ASMFC. Coordination between the states via the Shad and River Herring Management Board. There is also Communication between the Councils and the Commissions via council meetings.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

None.

|  |  |
| --- | --- |
|  | Spanish Mackerel |

Management authorities **-** *Who has the authority or obligation to manage the species?*

* States: NY, NJ, PA, DE, MD, DC, PRFC, VA, NC, SC, GA, FL
* Inter-state: ASMFC
* Regional: SAFMC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Spanish mackerel are a warm water, highly migratory species. There is no evidence that their growth, recruitment, or productivity are highly sensitive to temperature or ocean acidification. Warming ocean temperatures may cause a northward range shift.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Spanish mackerel abundance will be affected by changes in forage fish populations.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

Potential cascade effects could happen through changes in forage fish populations, which in turn could affect species that prey on Spanish Mackerel such as coastal sharks and dolphins.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Climate change impacts on squid, shrimp, and forage fisheries could impact the Spanish mackerel fisheries.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

As mentioned before, increased range expansion due to water waters could increase fishing pressure, but at this point is of little concern.

Social and economic concerns **-** *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

Spanish mackerel may make up a significant portion of catch for some within the fishery, and in turn may account for a higher portion of income for some, possibly having moderate economic impacts for those in the fishery.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

There is little risk given the current governance system and status of the stock.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

Minimum size limits, possession limits & trip limits, as well as decreases in quota if allowable catch limit is exceeded and the stock is deemed over fish

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

Complimentary management exists between the South Atlantic Fishery Management Council (SAFMC) and the Atlantic States Marine Fisheries Commission on the management measures. Adaptive management is more complicated because both bodies must go through their individual management process.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

As mentioned above, Spanish Mackerel is a managed by both the ASMFC, the states, and the SAFMC. As such, there is communication between technical committees, plan review teams, and the Management Board throughout the year on the FMP.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

None.

|  |  |
| --- | --- |
|  | Spot |

Management authorities **-** *Who has the authority or obligation to manage the species?*

* States: NJ, PA, DE, MD, DC, PRFC, VA, NC, SC, GA, FL
* Inter-state: ASMFC
* Regional: SAFMC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Spot may display range shifts and changes in timing and spatial pattern of seasonal migration in response to climate change. Whether or not these changes will result in overall increased or decreased productivity across the entire stock is unclear.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Climate-induced changes to estuarine nursery and other inshore habitats may affect growth, maturity, and subsequent productivity of the stock.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

As spot can be considered a forage fish similar to croaker, impacts to croaker habitat and abundance could impact the abundance other commercial important species.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

As there is evidence of bycatch of spot in shrimp fisheries, changes to the shrimp trawl fishery may have impacts on abundance.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Possible impacts to the species is annual rainfall and freshwater flows to estuarine habitats, as well as coastal development and loss of habitat in coastal areas.

Social and economic concerns **-** *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

Primarily a near-shore recreational fishery, in some instances primarily for bait.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

Possible concerns center on the need for more updated stock assessment and lack of management measures along the coast, and the ability to response effectively to changes to the stock.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

There are no minimum size or possession limits for spot in either the recreational and commercial sectors, but there is annual trigger exercises that can prompt management action.

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

Given some concerns over no regulations along the management unit in combination with the short lived nature of the species, makes spot more vulnerable to climate change.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Staff coordination between the Plan Review Team and the Management Board for the states within the management unit.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Spotted Seatrout |

Management authorities **-** *Who has the authority or obligation to manage the species?*

* States: NJ, PA, DE, MD, DC, PRFC, VA, NC, SC, GA, FL
* Inter-state: ASMFC
* Regional: SAFMC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Spotted seatrout are a warm-water species and at the northern extent of their range often experience “cold kill” events, which will be reduced as those areas experience fewer winter extreme temperatures. Warming water temperatures may allow seatrout to expand their range northward, although they are not a highly migratory species.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Spotted seatrout will be affected by climate change induced changes in their forage base.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

Outside of bycatch in commercial fishing, declines in abundance of spotted seatrout in the recreational sector may cause increased interest among angler for other estuarine finfish.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Decreases in abundance of other similar estuarine fish may increase targeting of spotted seatrout by anglers.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

None.

Social and economic concerns **-** *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

There is little knowledge of any unique social or economic concerns regarding the spotted seatrout fishery. Any concerns would like be similar to other predominately recreational fisheries, such as expenditures associated with recreational trips.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

N/A.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

Size and possession limit in the recreational fishery, size, possession and gear restrictions in the commercial sector

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

Through the Omnibus Amendment, states are able to enact adaptive management regimes given trends in the fishery, and as most states within the management unit have a monitoring program in place to review these trends, there is little concern.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Staff coordination between the Technical Committee, Plan Review Team, and Management Board for the states within the management unit.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Atlantic Striped Bass |

Management authorities **-** *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC, SC, GA, FL
* Inter-state: ASMFC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Environment effects have been shown to be correlated with recruitment success in striped bass, including over-winter temperatures, hydrological conditions, and zooplankton prey availability, all of which may be influenced by climate change. Warmer water temperatures may also be associated with increased prevalence of mycobacteriosis in the Chesapeake Bay.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Striped bass recruitment and adult abundance will be affected by changes in the zooplankton and forage fish populations induced by climate change.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

If climate change negatively impacts striped bass stocks, the forage fish that are predated upon by striped bass could be positively influenced. An increased forage base could be beneficial to other fisheries. If climate change causes range consolidation then it could regionally deplete the forage base and the fisheries that depend on them. If striped bass are no longer available in an area because water temperatures have increased then fishermen will likely switch effort into other fisheries.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

If climate change decreases the availability of forage fish and other prey then there would be a reduction in stock health, which could amplify climate change impacts.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

* Long term - Range contraction as a result of changing ocean temperatures.
* Immediate – Decreased availability of fish inshore/ fish offshore in federal waters as a result of changing winter water temperatures.

Social and economic concerns **-** *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

Shifts in striped bass abundance have the potential to greatly influence long established fisheries and their associated communities.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

If climate change negatively impacts Atlantic striped bass stocks, and governance is not capable of responding effectively or in a timely manner, then the coastwide population could decline.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Commercial – quota system, size limits, gear restrictions, time/area closures to protect spawning stock.
* Recreational – bag limit, gear restrictions, time/area closures to protect spawning stock.

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

If permanent changes needed to be made to the commercial quota and allocation system, it could potentially be a long process. States have the ability to close the commercial fishery quickly through emergency action if needed.

Annual changes to the recreational size and bag limit can be implemented if needed.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Communication is done through the ASMFC's Atlantic Striped Bass Management Board which NOAA Fisheries and USFWS are members. Staff from NOAA, USFWS, and ASMFC coordinate on a regular basis.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

N/A.

|  |  |
| --- | --- |
|  | Atlantic Sturgeon |

Management authorities **-** *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC SC, GA, FL
* Inter-state: ASMFC
* Regional: NEFMC, MAFMC, SAFMC
* Federal: NOAA Fisheries , USFWS

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Atlantic sturgeon distribution spans most of the Atlantic Coast of North America from Canada to Florida. As a species, adult Atlantic sturgeon are tolerant of a wide range of temperatures and salinities. Atlantic sturgeon are anadromous and return to natal rivers to spawn in freshwater, forming genetically distinct populations. Research indicates that optimal spawning habitat is dependent on distance to the salt front between brackish and fresh water and inland shifts in the salt front due to climate change could reduce optimal spawning habitat. Atlantic sturgeon is a late-maturing species and any loss in spawning habitat will be particularly detrimental to the recruitment of this species. Increasing temperatures also have the potential to reduce suitable riverine habitat for spawning and growth during early life stages.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Ecosystem changes have the potential to make Atlantic sturgeon more vulnerable to climate change. Larval and immature sturgeon and spawning adults utilize limited, riverine and estuarine habitat where any climate change-related declines in prey species and/or habitat has the potential to increase competition and decrease survival.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

There is no fishery for Atlantic sturgeon. Sturgeon have very few predators.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Sturgeon are by-caught in trawl and gillnet fisheries such as spiny dogfish, bluefish, mackerel, squid, butterfish, summer flounder, scup, and black sea bass. Changes to these fisheries as a result in climate change could increase or decrease bycatch interactions.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Sturgeon ascend coastal rivers on spawning runs and are therefore impacted by dams and water management facilities. If climate change results in a change in precipitation patterns, this may have an impact on spawning migrations as sturgeon rely on river flow to facilitate upstream migrations.

Social and economic concerns **-** *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

Unknown. There is no fishery for sturgeon.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

Sturgeon are a prehistoric species that are capable of adapting to a changing climate. However, additional human induced mortality through bycatch, ship strikes, and decreasing habitat may result in reduced stock health and resilience.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

There is a moratorium on the fishery. The species is listed as endangered or threatened under the Endangered Species Act.

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

Given the strict requirements of the ESA, timely adaptation would be difficult.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Communication is done through the ASMFC's Sturgeon Management Board which NOAA Fisheries and USFWS are a member of. ASMFC staff is in regular contact with NOAA Fisheries and USFWS. Representative from USFWS and NOAA Fisheries are part of the Technical Committee.

There needs to be additional integration and communication with agencies, such as the Federal Energy Regulatory Commission, on matters related to habitat access and water availability.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Summer Flounder |

Management authorities **-** *Who has the authority or obligation to manage the species?*

* States: MA, RI, CT, NY, NJ, DE, MD, PRFC, VA, NC
* Inter-state: ASMFC
* Regional: MAFMC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Summer flounder may display range shifts and changes in timing and spatial pattern of seasonal migration in response to climate change. Whether or not these changes will result in overall increased or decreased productivity across the entire stock is unclear.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Climate-induced changes to estuarine nursery and other inshore habitats may affect growth, maturity, and subsequent productivity of the stock.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

As summer flounder constitutes a significant commercial and recreational fishery, other valuable demersal species may be targeted in commercial sector, whereas striped bass, and black sea bass may be targeted more in the recreational sectors.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

The abundance and distribution of other valuable commercial and recreational species could impact fishing pressure on summer flounder.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

Expansion of biological range and distribution.

Social and economic concerns **-** *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

As mentioned earlier, Summer Flounder is a valuable commercial and recreational fishery that many within the fishery are significantly depend on. As such changes to the fishery due to climate change could have significant social and economic impacts.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

If management can not respond timely to climate change then fisheries may not be utilized to their full potential (coastwide quotas may not be fully harvested) and due to the political importance of the species other governance bodies may take over management.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

Size limits, possession limits, gear specifications, commercial and recreational quotas, seasonal closures (recreational)

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

Management measures are evaluated on annual basis, and given the high political and economic interest in the commercial and recreational fisheries, there is adequate ability to facilitate adaptive management but because there is a joint plan, some measures take longer to change.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Summer Flounder is jointly managed by the Commission and the Mid- Atlantic Council, allowing for communication through joint board meetings. Joint management is done through staff coordination of technical committees, stock assessment committees, advisory panels, and plan review teams on an annual basis.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Tautog |

Management authorities **-** *Who has the authority or obligation to manage the species?*

* States: MA, RI, CT, NY, NJ, DE, MD, VA, NC
* Inter-state: ASMFC

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Tautog are a cold water wrasse, but have a fairly wide range of distribution. They have a high degree of site fidelity as adults, which may limit their ability to migrate in response to temperature shifts. There is no evidence that their growth, recruitment, or productivity are highly sensitive to temperature or ocean acidification.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Availability of prey is a concern. Tautog diet includes crustaceans and shellfish, which may be impacted by ocean acidification.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

None.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

None.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

None.

Social and economic concerns **-** *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

None currently.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

None.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Commercial and recreational size limit
* possession limit
* seasons

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

Management measures are changed via new a addendum. Recent addenda are based on stock assessment results, and benchmark assessments are conducted every five years. Tautog is a data poor species, and most state monitoring surveys are designed for other species (that happen to encounter tautog).

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Only ASMFC has an FMP for tautog at this time, but NOAA is a member of the Tautog Management Board.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

None.

|  |  |
| --- | --- |
|  | Weakfish |

Management authorities **-** *Who has the authority or obligation to manage the species?*

* States: MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC, SC, GA, FL
* Inter-state: ASMFC
* Regional: NEFMC, MAFMC, SAFMC
* Federal: NOAA Fisheries, USFWS

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

Weakfish recruitment and abundance have been linked to large scale climate cycles, and may be impacted if climate change alters those cycles. They are a migratory species that occur in moderate to warm waters, so they may have the opportunity to expand their range northward as water temperatures increase.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Weakfish recruitment and abundance will be affected by changes in the zooplankton and forage fish populations, particularly menhaden.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

Due to the decline in the fishery, weakfish have not been targeted much in the past decade. Any switching would have already occurred (most notably to menhaden or black drum).

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

Not expected.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

None currently.

Social and economic concerns **-** *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

None.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

There is little risk due to the low numbers of weakfish that are currently landed.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Trip limits
* Closed seasons, area closures, gear closures
* Size limits

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

Weakfish management has been stable for the past decade, until the next stock assessment comes out. When this occurs, management can adapt to any effects from climate change.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

State agencies and NOAA coordinate with ASMFC to ensure effective management through the Weakfish Management Board.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

|  |  |
| --- | --- |
|  | Winter Flounder |

Management authorities **-** *Who has the authority or obligation to manage the species?*

* States: ME, NH, MA, RI, CT, NY, NJ, DE
* Inter-state: ASMFC
* Regional: NEFMC
* Federal: NOAA Fisheries

**Climate vulnerability of species *-*** *Climate change can influence the biology of a species (i.e. growth, maturity, reproduction, productivity, etc.). How vulnerable is the species to climate change, based on its biology? Please explain.*

As an estuarine species, habitat and environmental conditions are very important to winter flounder’s life history. Winter flounder migrate between in- and offshore towards cooler waters (inshore in the winter, offshore and deeper water during the summer). Reproduction peaks during the coolest temperatures. Eggs require clean sand or seagrass bottom for attachment during the incubation period. Survival and growth rates from egg to recruitment depend on specific ranges of temperature, salinity, and water quality.

**Ecosystem considerations -** *Climate change can influence entire ecosystems. Do ecosystem considerations or changes make this species more or less vulnerable to climate change? (i.e. predator-prey interactions, competition between species, habitat, etc.). If yes, please explain.*

Climate change may alter predator-prey interactions. Adult winter flounder are prey to many species of fish (ex. striped bass, summer flounder, and spiny dogfish), while juveniles are prey to coastal birds and possibly blue crab. Young winter flounder are also susceptible to parasites, and vulnerability may be impacted by climate change.

**Linkages to other fisheries -** *Climate change can influence human behavior, such as changes in fisheries – direct fisheries, incidental fisheries, or other fisheries (i.e. changes in effort, bait supply, etc.).*

***If climate change affects the fishery for this species, what are the potential impacts to other fisheries?***

Little impact to other fisheries, as the winter flounder fishery has been reduced to a fraction of its historical productivity.

***Could changes in other fisheries influence the vulnerability of this species to climate change? If yes, please explain.***

If other groundfish are negatively impacted by climate change and fishermen need more fishing opportunity, effort may increase on winter flounder.

Known climate-related concerns – *Have any climate related concerns been raised in the management process (i.e. scientists, fisherman, managers, other stakeholders, etc.)? List any specific issues (i.e. productivity, distribution, acidification). Are they short-term, intermediate, or long-term concerns?*

From fishermen: no climate specific concerns besides reducing exploitation to allow the species to rebound. Currently, NEFMC is proposing new EFH designation for winter flounder (long-term).

Social and economic concerns **-** *Are there any social or economic considerations that are relevant to climate change? If yes, please explain.*

No, as the winter flounder fishery has been reduced to a fraction of its historical productivity, and many fishermen have stopped targeting this species.

What’s at risk? *Can you describe potential consequences of a governance system that is not capable of responding effectively to climate change impacts or within relevant timescales?*

For GOM and SNE/MA stocks: winter flounder’s ability to recover from overfished status if its habitats are negatively impacted by climate change.

Existing management measures **-** *What management measures are primarily used in the management of this species? Please list.*

* Commercial and recreational specifications (annually for state, up to 3 years for federal plan)
* trip limits
* quotas by sector
* size limits
* gear restrictions
* seasons

***Do these measures allow for timely adaptation that might be necessary given the species vulnerability to climate change? Explain.***

In the federal plan, winter flounder is included in groundfish with about two dozen species. Changes to management measures take more time with the federal process.

Communication and coordination **-** *How do management authorities communicate with one another about the management of the species? (i.e. Joint FMPs, designated seats, MOUs, staff coordination, etc.)*

Staff from ASMFC, NEFMC, and NOAA Fisheries are in communication via council meetings and on an issue basis (e.g. Essential fish habitat). NOAA also is a member of the Commission's Winter Flounder Management Board.

Anything else? *Are there other categories or considerations that would shed light on the ability of the governance system to respond to climate change?*

None.