

# 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

Mid-Atlantic Fishery Management Council

## **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 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](mailto: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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**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: MAFMC and 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 likely have moderate vulnerability to climate change. They are highly migratory and distributional shifts are the most likely response to changes in localized conditions.

**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 are generalist predators and are likely to respond to changes in forage availability by shifting diet or by relocating.

**Linkages to other fisheries - Climate change can influence human behavior. There may be 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 bluefish fishery provides supplemental income for operators that make most of their income in other fisheries. If bluefish stock conditions improve, whether from climate change or any other cause, then there is likely to be more supplemental income for those operators. If stock conditions worsen or the stock shifts such that is less available to U.S. vessels, then that portion of their income will decrease and their dependence on other fisheries will increase.

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

If changes in other fisheries cause increased political pressure to allow for currently prohibited relaxation of harvest controls on bluefish, then it is conceivable that the resulting diminished stock size would correspond to increased vulnerability to environmental stressors, e.g., climate change.

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

As stated above, the bluefish fishery provides supplemental income to operators involved in more profitable fisheries. If climate change is the basis for changing the relative importance of this fishery in communities, then there will be social and economic impacts.

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

Bluefish are associated with warm water temperatures (generally above 14° C). Water temperature has been implicated as being an important short-term influence on the availability of bluefish to the fisheries for bluefish (rec. and commercial).

**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?*

I believe that the current governance system could accommodate and effectively respond to climate change impacts in a timely manner.

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

Open access permit, annual coastwide commercial quota, coastwide recreational harvest limit, daily recreational possession limit, and accountability measures.

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

Existing management measures allow for timely adaptive management. Reduction in bluefish numbers from fisheries exploitation can be increased or decreased quickly and as needed under the 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.)*

They are all in direct communication and generally effective at coordinating management of species that cross jurisdictional boundaries.

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

**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: MAFMC, NEFMC and NOAA Fisheries  
Other: Canada, NAFO

**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.*

Spiny dogfish likely have low vulnerability to climate change. They are highly migratory and distributional shifts are the most likely response to changes in localized conditions.

**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.*

Spiny dogfish are generalist predators and are likely to respond to changes in forage availability by shifting diet or by relocating.

**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 spiny dogfish fishery is a low value fishery that provides supplemental income for operators that make most of their income in other fisheries. If spiny dogfish stock conditions improve, whether from climate change or any other cause, then there is likely to be more supplemental income for those operators. If stock conditions worsen or the stock shifts such that is less available to U.S. vessels, then that portion of their income will decrease and their dependence on other fisheries will increase.

***Could changes in other fisheries influence the vulnerability of this species to***



***climate change? If yes, please explain.***

If changes in other fisheries cause increased political pressure to allow for currently prohibited relaxation of harvest controls on spiny dogfish, then it is conceivable that the resulting diminished stock size would correspond to increased vulnerability to environmental stressors, e.g., 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?*

Nearshore water temperature has been implicated as being an important short-term influence on the availability of spiny dogfish to the commercial fishery.

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

As stated above, the spiny dogfish fishery provides supplemental income to operators involved in more profitable fisheries. If climate change is the basis for changing the relative importance of this fishery in communities, then there will be 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?*

I believe that the current governance system could accommodate and effectively respond to climate change impacts in a timely manner.

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

Open access permit, annual coastwide commercial quota, daily commercial possession limit, and accountability measures.

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

Existing management measures allow for timely adaptive

management. Reduction in spiny dogfish numbers from fisheries exploitation can be increased or decreased quickly and as needed under the 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.)*

They are all in direct communication and generally effective at coordinating management of species that cross-jurisdictional boundaries.

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

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

States: States may institute landing requirements for the fisheries.  
Federal: MAFMC and 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.*

Mackerel, squid and butterfish likely have low to medium vulnerability to climate change. These species are migratory and I think their primary response to climate change will be to shift their distribution.

**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.*

Medium-Low: These species are migratory and I think their primary response to climate change will be to shift their distribution. Ocean acidification may affect prey abundance.

**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 participants cannot target MSB species, they may target other species, increasing effort in other fisheries.

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

There is considerable latent MSB capacity, and if participants in other fisheries cannot economically prosecute those fisheries, they may target MSB fisheries, which could dilute catch/vessel.

**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?*

Some parties have suggested that it may make sense to leave more MSB in the water as prey to buffer other changes that are occurring.

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

Related to MSB not sure. MSB species vary greatly in terms of their abundance and availability by their inherent nature.

**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?*

I think the current governance structure can deal with climate change impacts for the MSB fisheries. MSA is very flexible.

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

Limited access, quotas, and restrictions to reduce bycatch and habitat impacts. See <http://www.nero.noaa.gov/regs/info.html> for summaries of management measures for each fishery.

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

Existing management measures will facilitate timely adaptive management. Almost all measures can be amended as necessary.

**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.)*

NEFMC and ASMFC both have membership on the MSB committee. Staffs coordinate between these management groups, and there is also public communications about upcoming actions.

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

First we need to know what change is occurring when, and re: MSB I'm not sure that anyone knows that. But the plan can be amended as needed if changes are identified.

## Summer Flounder, Scup, Black Sea Bass

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

States: ME, NH, MA, RI, CT, NY, NJ, PA, DE, M, VA, NC  
(FMP management unit for SF, Scup, BSB northern stock)  
Inter-state: ASMFC  
Federal: MAFMC, NEFMC and 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, scup and black sea bass are likely to have medium-high vulnerability to climate change.  
Summer flounder - Observed shifts in distribution that may be due in part to climate related changes;  
Scup - Distribution tied to water temperatures;  
Black sea bass - Observed shifts in abundance; structure-associated species whose distribution will be affected by overlap between available suitable habitat and areas of suitable water temperatures.

**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 all three species, ecosystem considerations may make the species more vulnerable to climate change, depending on effects on predator and prey. For black sea bass, as a strongly structure-associated species, distribution will be affected by overlap between available suitable habitat and areas of suitable water temperatures. Competition for these habitats may also become an issue if the species distribution shifts.

**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?***

Effort shifts to other species in areas with less SF, Scup, BSB;  
Effort shifts from other species in areas with increased SF,

Scup, BSB abundance; Changes in bycatch composition and/or interactions with protected resources

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

This is very possible, given predator/prey relationships and potential shifts in fishery effort. Decreased prey or increased predator abundance within the range of SF, Scup, and BSB could increase the vulnerability of these species to climate change. Likewise, increased prey or decreased predator abundance could have the opposite effect. Climate change could lead to effort shifts as mentioned, which may cause increased or decreased fishing pressure on SF, Scup, BSB.

***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?***

Summer flounder - recent stock assessment results and on-the-water observations suggest that the summer flounder stock has shifted to the northeast in recent years. This shift may represent either a range expansion or a range shift, or both. This may be related to climate change and/or expansion due to rebuilding, etc.;

Scup - availability and distribution related to water temperatures;

Black sea bass - shifts in biomass and changes in availability

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

Summer flounder has been managed under "conservation equivalency" since the early 2000s, resulting in state-by-state targets as a percentage of the total harvest limit, using 1998 as the allocation base year. Although this approach is currently being re-evaluated and the Commission has moved to regional targets for 2014, stakeholders have become accustomed to each state receiving a certain percentage of the harvest limits. Changes to this management approach and to the 1998 base year have been suggested to address changes in fish distribution and availability; however, there is resistance to potential changes due to perceived socioeconomic impacts to some states. Certain states or regions may benefit from shifts in distribution, while other states may experience detrimental socioeconomic effects. Similarly for black sea bass, shifts in abundance and distribution may be occurring to the

benefit of some states and the detriment of others.

Shifts in species distribution/abundance can lead to increased search costs for fishermen and/or having to travel farther to find fish. This can greatly increase costs of trips, especially given the high price of fuel.

Similarly, regulations and state-specific quotas restricting where fish can be landed (i.e., summer flounder commercial fishery) can lead to fishermen having to travel farther to find fish and bring them to a port where they can be landed.

**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?*

Overfishing could result from a variety of causes related to ineffective response to climate change. For example, assessments could overestimate biomass, or changes in distribution combined with outdated regional or state-by-state management measures and quotas could result in increased fishing mortality in areas of increased abundance.

Underfishing (socioeconomic consequences) could result from causes similar to those described above. If the management system includes barriers to efficient targeting of fish where they are currently distributed, this could result in economic/social losses.

Similarly, increased costs of operation could be amplified by insufficient response to climate related changes (especially with inflexible landings structure, high search costs, etc.).

Political and legal conflicts are already occurring as the result of changes in distribution, availability, and abundance. Allocation conflicts are and will be a huge issue. An inability to react in a timely manner to the changing needs of the fishery will exacerbate this problem.

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

- All: Overall catch limits, split into recreational harvest limits and commercial quotas



- All: Recreational size limits, bag limits, and seasons
- All: allocation of Annual Catch Limit between commercial and recreational fisheries
- Summer flounder recreational: Conservation Equivalency. The Council and ASMFC vote on either coastwide measures or conservation equivalency, the latter of which allows for state-by-state or regional measures that are 'equivalent' to a set of non-preferred coastwide measures. Under Conservation Equivalency, federal recreational regulations are waived and participants are subject to the measures in the state in which they land.
- Commercial: gear requirements (primarily mesh size), possession limits, seasonal restrictions, seasonal quotas (scup), state-by-state quotas (summer flounder)
- Research-set-aside program

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

Some of the measures will probably not hinder adaptive management, while others present a barrier (i.e., state-by-state quotas or targets, seasonal quotas).

**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.)*

FMP is joint with ASMFC; Fairly large degree of staff communication and coordination between MAFMC and ASMFC; For annual or multi-year specifications, the Council has two joint meetings with the ASMFC Board (typically in August and December) to vote on catch and landings limits, commercial measures, and recreational measures; Large overlap in membership between the Council's Summer Flounder, Scup, and Black Sea Bass Monitoring Committee and the ASFMC's Summer Flounder, Scup, and Black Sea Bass Technical Committee; Between NEFMC and MAFMC – MAFNC has a liaison and NEFMC has representative on MAFMC

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

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

States: NY and NJ

Federal: NOAA Fisheries and MAFMC

**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.*

Surfclams and Ocean Quahogs likely have high vulnerability to climate change. Temperature plays a strong role in larval growth, settlement, metamorphosis, and survival to juveniles for both surfclams and ocean quahogs. For both juvenile and adult surfclams and ocean quahogs temperature significantly affects growth and physiology. Because of the sessile (non-mobile) nature of these species, they are particularly sensitive to changes in environmental factors, and may be negatively impacted by climate change.

**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.*

Carrying capacity for both these species has likely changed over time, and while surfclams and ocean quahogs are planktivorous siphon feeders, they are a food source for many other species in the ecosystem. Surfclams are preyed upon by a variety of species such as snails (moon snails), sea stars, shrimps, crabs, and fish predators (such as cod and haddock). Quahogs are preyed upon by rock crabs, sea stars, and fish predators (such as cod, haddock, sculpins, and ocean pout). As ranges have started to shift, fishermen have indicated increased overlap in surfclam and ocean quahog distribution.

**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 surfclam and ocean quahog fisheries are highly specialized in processing/vessels/gear, and fishery product is not highly substituted.

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

It is unlikely boats from other fisheries will move into the surfclam and ocean quahog fisheries, given its specialized nature. A large capital investment is needed to retrofit vessels to participate in these fisheries. In addition, the fisheries have already been consolidating participation and ownership as a result of ITQ implementation.

**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?*

Yes. Surfclams are experiencing a range contraction as habitat degrades in the southern extreme of the historical species extent, likely due to climate change and ocean acidification among other factors. Quahogs range is also shifting northward and offshore to cooler, deeper waters.

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

As the distribution of the surfclam and ocean quahogs stocks shift, the fisheries will need to follow the distribution of the stocks. It could happen in one of two ways. Vessels, ports, and processors could shift as the species distributions shifts. This would be costly, given large capital investment in processing facilities and homeports. If processors and vessel ports do not shift in response to the stocks distribution changing, transportations costs would increase as vessels must travel further to catch and return surfclams and ocean quahogs to their processors and homeports.

**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 risk of not having a responsive, adaptive governance system is an inability to respond to crisis in these fisheries. This may result in

significant biological or social and economic harm.

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

An individual transferable quota (ITQ) system was established in 1990 by the Mid-Atlantic Fishery Management Council; the first ITQ program in a federal U.S. fishery. Annual catch limits are used in this fishery.

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

Management measures might both facilitate and constrain adaptation. While economic efficiency improved as a result, the ITQ program led to a substantial reduction in fleet size and increased capacity utilization for surfclams ocean quahogs. Because of this ownership consolidation, the specialization and capitalization of this fishery (vessels and processing facilities), and the fact the fishery product is not highly substituted, the current management tools may not provide sufficient flexibility to manage/respond efficiently and sustainably in light of climate change. While ACLs can be adjusted annually, ITQ shares must be bought or leased to participate in the fishery. There is large capital investment in processing facilities, making them difficult to move or relocate. Processing facilities are not managed by the MAFMC, but their location and the economic solvency of their operations directly affects the range of fishing vessels activities and the economic viability of these fisheries.

**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.)*

NOAA Fisheries and MAFMC communicate with one another through the designated NMFS-Regional Administrator (RA) seat on the Council, and through staff coordination. The MAFMC provides recommendations to the NMFS-RA through the submission of documents/products.

**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 Federal waters seems to allow for some adaptation on an annual basis, by allowing for changing catch limits and other management measures through the specifications

process. However, modification of aspects of the fishery management plan through amendments and frameworks are not rapidly expedited because of the layers of statutory and regulatory requirements, applicable laws, extensive guidelines and formal processes, which create friction and slow the implementation process. Modification to management tools often takes years to complete, and cannot be considered a rapid or adaptive management process. Until the implementation process is expedited, managers will continue to struggle with the ability to respond effectively and rapidly to crisis in these fisheries. While the tools to manage in the face of climate change are accessible to this process, the ability to implement these management tools in a rapid and responsive manner is not.

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

States: VA (currently has recreational management measures in place)  
Federal: NOAA Fisheries and MAFMC (the South Atlantic population of golden tilefish is managed by SAFMC)

The management unit for this FMP is defined as all golden tilefish under United States jurisdiction in the Atlantic Ocean north of the Virginia/North Carolina border.

**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.*

Tilefish are likely quite vulnerable to climate change. Tilefish are considered to have an unique spatial and temporal behavior and generally restricted to a relatively narrow band of approximately 262-1771 feet deep and 46-62 °F, known as the "warm belt" on the outer continental shelf and upper slope of the northwest Atlantic coast. The productivity of this species is sensitive to water temperatures. Temperature plays a role in the distribution of eggs, larvae, juvenile, and adult distribution. Because tilefish migrate little or not at all, they are particularly sensitive to changes in environmental factors.

**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.*

Nothing is known about the diets and feeding habits of tilefish larvae, but they probably prey on zooplankton. Tilefish feed on a variety of food items such as species of crabs, mollusks, annelid worms, polychaetes, sea cucumbers, anemones, tunicates and fish bones, shrimp, sea urchins and several species of fishes. While tilefish are sometimes preyed upon by spiny dogfish and conger eels, by far the most important predator of tilefish is other tilefish. There will likely be impacts to tilefish if the spatiotemporal overlap between tilefish and prey, is reduced as tilefish appears to migrate little or not at all. Adult tilefish require sediments in which they can burrow within a stable, moderate temperature regime. Tilefish burrows provide habitat for numerous other species of fish and invertebrates and in this respect they are similar to "pueblo villages."

**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 directed commercial fishery for tilefish is prosecuted by longline gear. Incidental landings mostly by otter trawls and a few gillnet vessels also occur. Otter trawls have limited effectiveness in this fishery because of the habitat preferred by tilefish. Otter trawls are only effective where the bottom is firm, flat, and free of obstructions. Effort that was once in the tilefish fishery could potentially shift to other longline fisheries.

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

The tilefish fishery is managed using an IFQ program. Participation in the fishery would require the purchase of quota shares or lease of quota pounds.

**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?*

Yes, it has been recommended (SAW/SARC) that the influence of water temperature and other environmental factors on the trend in the commercial fishery CPUE index of stock abundance needs to be explored.

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

The current tilefish fishery is conducted by a relatively small number of vessels (10). A few of those vessels (5) account for more than 70 percent of the total tilefish landings and the bulk of their revenues is derived from tilefish fishing. If the stock distribution changes away from the typical fishing grounds, vessel may have to travel further to catch tilefish, which could increase fishing costs.

**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 risk of not having a responsive, adaptive governance system is an inability to respond to crisis in these fisheries. A failure to respond to crisis could result in biological or social and economic harm.

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

An individual transferable quota (ITQ) system was established in 2009 by the Mid-Atlantic Fishery Management Council. Annual catch and landings limits are utilized in this fishery. Quota allocated to ITQ vessels (95%) and incidental vessels (5%). Incidental vessels are restricted to an incidental trip limit.

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

Existing management measures will facilitate timely adaptive management. Primary management measures can be readily adapted prior to and during the season to match 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.)*

NOAA Fisheries and MAFMC communicate with one another through the designated NMFS-Regional Administrator seat on the Council, and through staff coordination.

**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 Federal water seems sufficiently adaptable for changing management measures on an annual basis via specifications process. However, modification to management tools/approaches to address potential crisis in the fishery may not be easily implemented due to existing legal and regulatory processes.