Amendment 9

to the Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region

Environmental Assessment   Regulatory Flexibility Act Analysis   Regulatory Impact Review

Fishery Impact Statement

November 2012

Abbreviations and Acronyms Used in the FMP

ABC acceptable biological catch

ACL annual catch limits

AM accountability measures

ACT annual catch target

B a measure of stock biomass in either weight or other appropriate unit

B_{MSY} the stock biomass expected to exist under equilibrium conditions when fishing at F_{MSY}

B_{OY} the stock biomass expected to exist under equilibrium conditions when fishing at F_{OY}

B_{CURR} The current stock biomass

CPUE catch per unit effort

DEIS draft environmental impact statement

EA environmental assessment

EEZ exclusive economic zone

EFH essential fish habitat

F a measure of the instantaneous rate of fishing mortality

$F_{30\%SPR}$ fishing mortality that will produce a static SPR = 30%

F_{CURR} the current instantaneous rate of fishing mortality

F_{MSY} the rate of fishing mortality expected to achieve MSY under equilibrium conditions and a corresponding biomass of B_{MSY}

F_{OY} the rate of fishing mortality expected to achieve OY under equilibrium conditions and a corresponding biomass of B_{OY}

FEIS final environmental impact statement

FMP fishery management plan

FMU fishery management unit

M natural mortality rate

MARMAP Marine Resources Monitoring Assessment and Prediction Program

MFMT maximum fishing mortality threshold

MMPA Marine Mammal Protection Act

MRFSS Marine Recreational Fisheries Statistics Survey

MRIP Marine Recreational Information Program

MSFCMA Magnuson-Stevens Fishery Conservation and Management Act

MSST minimum stock size threshold

MSY maximum sustainable yield

NEPA National Environmental Policy Act

NMFS National Marine Fisheries Service

NOAA National Oceanic and Atmospheric Administration

OFL overfishing limit

OY optimum yield

RIR regulatory impact review

SAMFC South Atlantic Fishery Management Council

SEDAR Southeast Data Assessment and Review

SEFSC Southeast Fisheries Science Center

SERO Southeast Regional Office

SIA social impact assessment

SPR spawning potential ratio

SSC Scientific and Statistical Committee

Abstract

The Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region (Shrimp FMP) includes a process through which a state can request a concurrent closure of the exclusive economic zone (EEZ) to penaeid shrimp harvest when state waters close after a cold weather event. This is a multi-step process, which includes satisfying criteria for a decrease in shrimp abundance, review, and recommendation by the South Atlantic Fishery Management Council (South Atlantic Council), followed by a closure notice published by the National Marine Fisheries Service Regional Administrator. The South Atlantic Council is concerned this administratively burdensome process may unintentionally hinder protections for the overwintering stock affected by cold weather. Therefore, the South Atlantic Council is proposing an alternate closure request process to improve the timeliness and effectiveness of a concurrent closure of federal waters with state waters for harvest of shrimp.

Additionally, the South Atlantic Council is proposing modifications to the B_{MSY} proxy for pink shrimp, which is a component of the definition for overfished and overfishing status determination criteria. Currently, pink shrimp biomass information is captured through the Southeast Area Monitoring and Assessment Program (SEAMAP) survey program, which does not cover the complete geographic range of pink shrimp in the South Atlantic. Unlike brown and white shrimp, larvae produced by overwintering pink shrimp in North Carolina may be carried north beyond the SEAMAP sampling range by prevailing currents, and SEAMAP does not sample south of Cape Canaveral, Florida where pink shrimp are also known to exist. B_{MSY} for pink shrimp was last addressed in Amendment 6 to the Shrimp FMP in 2004 (SAFMC 2004). Amendment 6 established a B_{MSY} proxy for pink shrimp based on two thresholds: (a) if the stock diminishes to ½ maximum sustainable yield (MSY) abundance (½ B_{MSY}) in one year, or (b) if the stock is diminished below MSY abundance (B_{MSY}) for two consecutive years. A proxy for B_{MSY} was established for pink shrimp using catch per unit effort information from SEAMAP data as the lowest values in the 1990-2003 time period that produced catches meeting MSY the following year. In this amendment, the South Atlantic Council considered other methods of determining B_{MSY} for pink shrimp and revising the overfished proxy value as appropriate.

Actions in Amendment 9 to the Shrimp FMP would:

- Specify criteria that triggers a states' ability to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

- Modify the process for a state to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

- Revise the overfished status determination criteria (B_{MSY} proxy) for the pink shrimp stock

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SUMMARY

of

AMENDMENT 9

to the Fishery Management Plan

for the Shrimp Fishery

of the South Atlantic Region

November 2012

Why is the South Atlantic Council taking Action?

Currently, the process to request a closure of the exclusive economic zone (EEZ) concurrent with state waters for shrimp species due to cold weather requires a state to provide data to demonstrate an 80% decrease in abundance of overwintering white shrimp to a review panel, and the panel's recommendations are reviewed at the next South Atlantic Fishery Management Council (South Atlantic Council) meeting (usually in March). After approval by the South Atlantic Council, a letter is sent to the National Marine Fisheries Service Southeast Regional Administrator requesting that the EEZ for the states be closed to penaeid shrimp harvest. The Regional Administrator then publishes an official notice of closure. Although the process takes only about a week to implement the closure after the South Atlantic Council approves the state's request, it is likely that the severe weather event has occurred weeks or even months earlier. The South Atlantic Council is concerned that the length of the closure process may not be as helpful in protecting the overwintering stock affected by cold weather as it could be and is considering action to improve the timeliness and effectiveness of the concurrent closures.

For the action to revise the B_{MSY} proxy for pink shrimp, the South Atlantic Council discussed that the biological parameters used in pink shrimp management can be improved through different surveys and modification to the B_{MSY} proxy that is used in the minimum stock size threshold (MSST) definition for an overfished status. Currently, data from the Southeast Area Monitoring and Assessment Program (SEAMAP) survey are used to determine the B_{MSY} proxy for pink shrimp. According to SEAMAP sampling data, the stock of South Atlantic pink shrimp has been below the B_{MSY} proxy (0.461 shrimp/hectare) in recent years, which translates into an overfished status for pink shrimp. However, the Shrimp Review Panel (a group made up of scientists from North Carolina Division of Marine Fisheries, South Carolina Department of Natural Resources, Georgia Department of Natural Resources, Florida Fish and Wildlife Conservation Commission, and National Marine Fisheries Service) reviewed information about pink shrimp and concluded that environmental factors likely are affecting the pink shrimp stock rather than fishing mortality.

What Are the Proposed Actions?

There are three actions being proposed in Amendment 9. Each *action* has a range of *alternatives*, including a 'no action alternative' and a 'preferred alternative'.

Proposed Actions in Amendment 9

1. Specify criteria that triggers a states' ability to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

2. Modify the process for a state to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

3. Revise the overfished status determination criteria (B_{MSY} proxy) for the pink shrimp stock

What Are the Alternatives?

<u>Action 1.</u> Specify criteria that triggers a state's ability to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

Alternative 1. No Action. Currently, as defined under the fishery management plan for the South Atlantic shrimp fishery, states may request a concurrent closure of the EEZ adjacent to their closed state waters following severe winter weather upon providing information that demonstrates an 80% or greater reduction in the population of overwintering white shrimp.

Alternative 2. A state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 7°C (45°F) or below for at least one week.

Alternative 3. A state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 8°C (46°F) or below for at least one week.

Alternative 4. A state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 9°C (48°F) or below for at least one week.

Proposed Actions in Amendment 9

1. Specify criteria that triggers a state's ability to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

2. Modify the process for a state to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

3. Revise the overfished status determination criteria (B_{MSY} proxy) for the pink shrimp stock

Preferred Alternative 5. States may request a concurrent closure of the EEZ adjacent to their closed state waters following severe winter weather upon providing information that demonstrates an 80% or greater reduction in the population of overwintering white shrimp, or, a state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 9°C (48°F) or below for at least one week.

__Action 1: Summary of Effects__

Biological: The lower the temperature threshold is set, the less likely the temperature criterion would be met for requesting a concurrent closure Therefore, the option with the lowest temperature threshold (**Alternative 2)** would be expected to have the smallest biological benefit to shrimp species of the action alternatives considered. Alternately, **Alternative 4** would be most biologically beneficial because it is the highest temperature option under consideration, and the concurrent closure criteria would more easily be met than under **Alternatives 2** and **3**. **Alternative 3** represents a mid-point between **Alternatives 2** and **4**, and would likely result in biological benefits greater than **Alternative 2**, but less than **Alternative 4**. **Preferred Alternative 5** would provide the most flexibility to states for determining what type of data they could use as triggering criteria to request a concurrent closure of federal waters. The ability to use either a temperature trigger or an abundance decrease trigger would be biologically beneficial since it would allow each state to utilize which criteria is most appropriate according to their environmental sampling programs, and thus make it easier for them to present evidence that a trigger has been met for requesting concurrent closures of federal waters.

Economic: Status quo, **Alternative 1 (No Action),** is not expected to generate any indirect economic effects since the harvest of shrimp would be expected to occur later into the winter and spring seasons, as it has in the past when cold weather events occurred, relative to the other alternatives for this action. **Alternatives 2-5 (Preferred)** would be expected to generate positive, indirect economic effects since all of these alternatives would speed up the process for closing the fishery compared to **Alternative 1 (No Action)**. While closing the fishery early might have immediate negative economic effects for fishermen harvesting in the winter and spring, preserving the remaining spawning biomass for the following fall fishing season would be expected to generate greater, positive economic effects by providing for a more abundant stock, thereby making more shrimp available for harvest and to the consumer over the course of the fishing year. **Preferred Alternative 5** gives states the greatest flexibility in deciding whether to use a water temperature threshold of 9°C (48°F) or below for at least one week or demonstrating an 80% or greater reduction in the population of overwintering white shrimp when requesting a closure of federal waters. As such, **Preferred Alternative 5** is expected to generate the greatest, positive indirect economic effects in the shrimp fishery over the course of the fishing year.

Social: The social effects from **Alternative 1 (No Action)** would depend upon whether shrimp stocks were significantly affected by the present closure system, which may not be as timely as that outlined in other alternatives. **Alternative 2** uses a water temperature threshold that would make the determination easier and more timely and may reduce the risk of negative social effects by protecting the shrimp stock. **Alternatives 3** and **4** each use a one-degree centigrade increase in temperature threshold respectively and the social effects would be determined by the ability of the alternative to provide sufficient protection to the stock. Overall, if **Preferred Alternative 5** provides increased protection for the shrimp stock there should be positive social effects that should outweigh any short-term negative impacts. This alternative gives the state more flexibility in determining a trigger. With greater protection and an anticipated improvement in stock the next year, there should be positive social effects in general as a more stable fishery should result, especially for those fishermen who rely solely on penaeid shrimp as they are the most vulnerable.

Administrative: The specification of criteria as identified through **Alternatives 2-5 (Preferred)** would not result in increased administrative impacts on the agency from the status quo (**Alternative 1 No Action**). A state would bear most of the administrative burden associated with this measure. Under **Alternatives 2-4**, states would be required to demonstrate that data (from a state-level monitoring program) indicate an exceeded threshold in water temperatures. Under **Preferred Alternative 5 (Preferred)**, states would be afforded flexibility in determining the most appropriate criterion in which to demonstrate data, indicating either an exceeded threshold for water temperature, or an 80% or greater decrease in abundance of overwintering white shrimp. With a change in the required criterion that a state would need to demonstrate to request a closure in federal waters concurrent with state waters (**Alternatives 2-5 (Preferred)**), modifications may occur at the state-level in how such a request is administered.

<u>Action 2.</u> Modify the process for a state to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

Alternative 1. No Action. Currently, the process requires any state requesting a concurrent closure to provide data to demonstrate an 80% decrease in abundance of overwintering white shrimp to a review panel, and the panel's recommendations are reviewed at the next South Atlantic Council meeting. After approval by the South Atlantic Council, a letter is sent to the National Marine Fisheries Service Southeast Regional Administrator requesting that the EEZ adjacent to the state be closed to penaeid shrimp harvest. The Regional Administrator then publishes an official notice of closure in the *Federal Register*.

Preferred Alternative 2. A state requesting a concurrent closure would send a letter directly to the National Marine Fisheries Service with the request and necessary data to demonstrate that criterion has been met.

Alternative 3. A state requesting a concurrent closure would send a letter directly to the National Marine Fisheries Service Southeast Regional Administrator with the request and necessary data to demonstrate that criterion has been met. The requesting state would also submit data to the Shrimp Review Panel, who would review data and make a recommendation to National Marine Fisheries Service. This option would require a notice to be published in the *Federal Register* at least 23 days prior to the convening of the Shrimp Review Panel.

Proposed Actions in Amendment 9

1. Specify criteria that triggers a states' ability to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

2. Modify the process for a state to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

3. Revise the overfished status determination criteria (B_{MSY} proxy) for the pink shrimp stock

Action 2: Summary of Effects

Biological: Preferred Alternative 2 represents the most streamlined process by which South Atlantic states may request concurrent closures of federal waters to protect overwintering shrimp stocks. **Preferred Alternative 2** would, theoretically also require the least amount of time to implement the concurrent closure and is thus considered the most biologically beneficial alternative under this action. In contrast, **Alternative 1 (No Action)** and **Alternative 3** would both require review by at least one entity (the Council and/or the Shrimp Review Panel) before the agency could take action to implement a concurrent closure of federal waters, which would be less biologically beneficial when compared to **Preferred Alternative 2**.

Economic: Action 2 is largely an administrative action, however, the timeliness of implementing a closure could have economic effects. Given the South Atlantic Council's current meeting schedule, **Alternative 1 (No Action)** prohibits a closure prior to March each year, frequently long after the cold weather event has occurred. The longer the delay in closing the fishery, the greater the potential for negative long-term economic impacts. **Preferred Alternative 2** would have the shortest delay between the time of a cold weather event and a closure as the state could make a direct request to NMFS immediately to close the fishery, and thus has the greatest potential for long-term economic gain. The negative economic impacts of **Alternative 3** fall between those of **Alternative 1 (No Action)** and **Preferred Alternative 2**. As with **Action 1**, long-term economic gains come potentially with greater short-term economic losses due to a season that would be closed sooner than otherwise might have occurred.

Social: Under **Alternative 1** (**No Action**) the current process may not provide sufficient protection and therefore could have negative social effects. Under **Alternative 3**, review by the Shrimp Review Panel could delay the action more than **Preferred Alternative 2** that would be a more direct and timely approach. The social effects would depend upon the effect of any delay on a closure and its impact upon the stock. It is assumed that a more timely closure will have beneficial effects upon the stock which should have positive long-term social effects.

Administrative: Under **Preferred Alternative 2**, convening the Shrimp Review Panel following a state's concurrent closure request would no longer be required. From an administrative perspective for the agency, this often lengthy and multi-step process would be streamlined under **Preferred Alternative 2**. **Preferred Alternative 2** would also eliminate the need for discussion and review of this issue during the Shrimp Committee at a South Atlantic Council meeting.

Under **Alternative 3**, the agency would still be required to develop and publish a notice in the *Federal Register* to convene a meeting of the Shrimp Review Panel in order for a state's data to be reviewed, but the need to wait for review and discussion during a South Atlantic Council meeting would be eliminated. The intent of Action 2, to expedite the current process, would likely still be achieved under **Alternative 3**, but the process would require additional administrative steps and time compared to those identified in **Preferred Alternative 2**.

<u>Action 3.</u> Revise the overfished status determination criteria (B_{MSY} proxy) for the pink shrimp stock

Alternative 1. No Action. A proxy for B_{MSY} (0.461 individuals per hectare) has been established for pink shrimp using CPUE information from SEAMAP-SA data as the lowest value in the 1990-2003 time period that produced catches meeting MSY the following year.

Alternative 2. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from SEAMAP-SA data during the 2007-2011 time period (0.273 individuals per hectare).

Alternative 3. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from SEAMAP-SA during the 2009-2011 time period (0.292 individuals per hectare).

Preferred Alternative 4. Establish a proxy for B_{MSY} for pink shrimp using the lowest CPUE value from SEAMAP-SA during the 1990-2011 time period (0.089 individuals per hectare).

Alternative 5. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from Pamlico Sound Survey data during the 2007-2011 time period (5.143 individuals per hectare).

Alternative 6. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from Pamlico Sound Survey data during the 2009-2011 time period (1.526 individuals per hectare).

Proposed Actions in Amendment 9

1. Specify criteria that triggers a states' ability to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

2. Modify the process for a state to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

3. Revise the overfished status determination criteria (B_{MSY} proxy) for the pink shrimp stock

Summary of Effects

Biological: None of the alternatives under consideration address the issue of survey data not capturing the entire geographical range of pink shrimp abundance; however, **Alternatives 2-6** do use the most recent data available, which is a more accurate representation of current stock conditions relative to how the pink shrimp fishery is prosecuted now between Cape Hatteras, North Carolina and Cape Canaveral, Florida. The higher the B_{MSY} proxy, the greater the chance that catch per unit effort (CPUE) would fall below B_{MSY} in any given year and require administrative action to limit harvest. Therefore, if the B_{MSY} proxy is set too high, the probability of implementing corrective action when it may not be biologically necessary is higher relative other alternatives with low B_{MSY} values. Conversely, if the B_{MSY} proxy is set very low, the risk that CPUE would fall below B_{MSY} and corrective action may not be triggered when it is actually needed would be greater. **Alternatives 2-4 (Preferred)** would use a different time series of data from the SEAMAP survey than currently used to define the B_{MSY} proxy for pink shrimp. As the Shrimp Review Panel has indicated, low CPUE in recent years is a function of environmental conditions rather than fishing pressure. These alternatives may be a more accurate representation of current stock conditions relative to how the shrimp fishery is prosecuted today between Cape Hatteras, North Carolina and Cape Canaveral, Florida.

Economic: **Action 3** is a biological action that has indeterminate economic effects. Presumably, any alternative that would set an overfished or overfishing level for pink shrimp that would lead to subsequent measures that might close the fishery early could have a short-term negative economic effect. The higher the overfished/overfishing threshold is set, the greater the probability the fishery could close early. However, such negative economic effects theoretically would only be short lived. Setting a lower overfished/overfishing threshold could have positive economic effects for future fishing seasons.

Social: Establishing the best proxy of overfished status for pink shrimp should have beneficial social effects, as it would provide the best protection for the stock without imposing unnecessary regulatory burdens on fishermen, their families, and communities. Currently, under **Alternative 1 (No Action)**, negative social effects could occur if the fishery is declared overfished when the current proxy may not be an accurate portrayal of stock status. **Alternative 2** through **Preferred Alternative 4** offer a B_{MSY} proxy utilizing SEAMAP-SA data with differing time frames. Each timeframe equates to a different measure of individual shrimp per hectare with the smallest threshold of .089 in **Preferred Alternative 4** and the highest threshold being 0.292 under **Alternative 3** using SEAMAP data. In any case, utilizing SEAMAP-SA data could add additional confidence regarding the proxy B_{MSY} for pink shrimp. While primarily a biological decision, it could improve the overall assessment and be beneficial to the overall process that could result in positive social effects by ensuring the most accurate information to base management decisions. Whichever alternative is chosen as preferred, as long as it reflects the best estimate of stock status, it should have beneficial social effects in the long-term as mentioned in previous alternatives.

Administrative: **Alternatives 2-4 (Preferred)** would establish a new proxy for B_{MSY} based on more recent time series data from the SEAMAP program. **Alternatives 5** and **6** would establish a new proxy for B_{MSY} based on more recent time series data from the Pamlico Sound Survey data. The South Atlantic Council has the option to add the Pamlico Sound Survey data into consideration of the B_{MSY} proxy for pink shrimp, or reference these data in replacement of the SEAMAP program data. For the agency, administrative impacts associated with **Alternatives 2-4 (Preferred)** would not differ from the status quo (**Alternative 1 (No Action))**. **Alternatives 5** and **6** would require agency review of the Pamlico Sound Survey data on an annual cycle.

Chapter 1. Introduction

1.1 What Actions Are Being Proposed?

Fishery managers are proposing changes to regulations through Amendment 9 to the Fishery Management Plan (FMP) for the Shrimp Fishery of the South Atlantic Region (Amendment 9). One action would specify criteria that triggers a states' ability to request a concurrent closure of the adjacent exclusive economic zone (EEZ) during cold weather events for the overwintering shrimp stock. A second action would modify the process through which states formally request a concurrent closure in the adjacent EEZ. The third action proposes to revise the methodology used to determine the B_{MSY} proxy for pink shrimp.

South Atlantic Fishery Management Council

- Responsible for conservation and management of fish stocks
- Consists of 13 voting members who are appointed by the Secretary of Commerce
- Management area is from 3 to 200 miles off the coasts of North Carolina, South Carolina, Georgia, and east Florida through Key West
- Develops management plans and recommends regulations to the National Marine Fisheries Service for implementation

1.2 Who is Proposing the Actions?

The South Atlantic Fishery Management Council (South Atlantic Council) is recommending management measures contained within this document. The South Atlantic Council recommends management measures and regulations to the National Marine Fisheries Service (NMFS) who ultimately approves, disapproves, or partially approves, and implements the actions in the amendment on behalf of the Secretary of Commerce. NMFS is an agency in the National Oceanic and Atmospheric Administration within the Department of Commerce.

1.3 Where would the proposed actions be effective?

Management of the federal shrimp fishery located off the South Atlantic in the 3-200 nautical mile (nm) U.S. EEZ is conducted under the FMP for the Shrimp Fishery of the South Atlantic Region (SAFMC 1993) (**Figure 1-1**).

1.4 Why is the South Atlantic Council Considering Action?

Currently, the process to request a concurrent closure of the EEZ due to cold weather requires a state to provide data to demonstrate an 80% decrease in abundance of overwintering white shrimp to a review panel, and the panel's recommendations are reviewed at the next South Atlantic Council meeting (usually in March). After approval by the South Atlantic Council, a letter is sent to the National Marine Fisheries Service (NMFS) Regional Administrator requesting that the EEZ for the state be closed to penaeid shrimp harvest. The Regional Administrator then publishes an official notice of closure. Although the process takes only a week or so to implement the closure after the South Atlantic Council approves the state's request, it is likely that the severe weather event has occurred weeks or even months earlier. The South Atlantic Council is concerned that the process may not be as helpful in protecting the overwintering stock affected by cold weather and wanted to consider modifications to improve the timeliness and effectiveness of the concurrent closures.

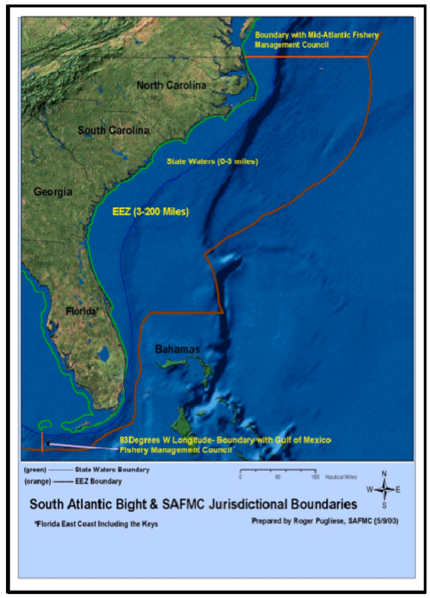


Figure 1-1. Jurisdictional boundaries of the South Atlantic Council.

For the action to revise B_{MSY} proxy for pink shrimp, the South Atlantic Council discussed that the biological parameters used in pink shrimp management can be improved through different surveys and modification to the B_{MSY} proxy that is used in the minimum stock size threshold (MSST) definition for an overfished status. Currently, data from the Southeast Area Monitoring and Assessment Program (SEAMAP) survey are used to determine the B_{MSY} proxy for pink shrimp. According to SEAMAP sampling data, the stock of South Atlantic pink shrimp has been below the B_{MSY} proxy (0.461 shrimp/hectare) in recent years, which translates into an overfished status. However, the Shrimp Review Panel (a group made up of scientists from North Carolina Division of Marine Fisheries, South Carolina Department of Natural Resources, Georgia Department of Natural Resources, Florida Fish and Wildlife Conservation Commission, and NMFS) reviewed information about pink shrimp and concluded that environmental factors likely affect the pink shrimp stock rather than fishing mortality.

Purpose for Action

The ***purpose*** of Amendment 9 is to modify the criteria for South Atlantic states requesting a concurrent closure to protect overwintering white shrimp, streamline the process by which a state can request a concurrent closure, and revise the B_{MSY} proxy for pink shrimp, which is used in determining the overfished status.

Need for Action

The ***need*** for action in Amendment 9 is to allow for a more efficient process to facilitate timely concurrent closure requests to maximize protection of overwintering white shrimp during cold weather events, and to improve the accuracy of the biological parameters for pink shrimp management.

Chapter 2. Proposed Actions

This section contains the proposed actions being considered to meet the purpose and need. Each action contains a range of alternatives, including the no action (the current regulations). Alternatives the South Atlantic Fishery Management Council (South Atlantic Council) considered but eliminated from detailed study during the development of this amendment are described in **Appendix A**.

Proposed Actions in Amendment 9

1. Specify criteria that triggers a state's ability to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

2. Modify the process for a state to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

3. Revise the overfished status determination criteria (B_{MSY} proxy) for the pink shrimp stock

2.1 Action 1. Specify criteria that triggers a state's ability to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

Alternative 1. No Action. Currently, as defined under the Fishery Management Plan (FMP) fishery management plan for the South Atlantic shrimp fishery, states may request a concurrent closure of the exclusive economic zone (EEZ) adjacent to their closed state waters following severe winter weather upon providing information that demonstrates an 80% or greater reduction in the population of overwintering white shrimp.

Alternative 2. A state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 7°C (45°F) or below for at least one week.

Alternative 3. A state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 8°C (46°F) or below for at least one week.

Alternative 4. A state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 9°C (48°F) or below for at least one week.

Preferred Alternative 5. States may request a concurrent closure of the EEZ adjacent to their closed state waters following severe winter weather upon providing information that demonstrates an 80% or greater reduction in the population of overwintering white shrimp, or, a state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 9°C (48°F) or below for at least one week.

Comparison of Alternatives (Summary shown in Table 2-1)

Biological: The lower the temperature threshold is set, the less likely the temperature criterion would be met for requesting a concurrent closure of penaeid shrimp harvest in the exclusive economic zone when state waters close. Therefore, the option with the lowest temperature threshold **(Alternative 2)** would be expected to have the smallest biological benefit to shrimp species of the action alternatives considered. Alternately, **Alternative 4** would be most biologically beneficial because it is the highest temperature option under consideration, and the concurrent closure criterion would more easily be met than under **Alternatives 2** and **3**. **Alternative 3** represents a mid-point between **Alternatives 2** and **4**, and would likely result in biological benefits greater than **Alternative 2**, but less than **Alternative 4**. **Preferred Alternative 5** would provide the most flexibility to states for determining what type of data they could use as triggering criteria to request a concurrent closure of federal waters with state waters. The ability to use either a temperature trigger or an abundance trigger would be biologically beneficial since it would allow each state to utilize which criteria are most appropriate according to their environmental sampling programs, and thus make it easier for them to present evidence that a trigger has been met for requesting a closure of federal waters to penaeid shrimp harvest concurrent with a harvest prohibition in state waters.

Economic: Status quo, **Alternative 1 (No Action)**, is not expected to generate any indirect economic effects since the harvest of shrimp would be expected to occur later into the winter and spring seasons, as it has in the past when cold weather events occurred, relative to the other alternatives for this action. **Alternatives 2-5 (Preferred**) would be expected to generate positive, indirect economic effects since all of these alternatives would speed up the process for closing the fishery compared to **Alternative 1 (No Action)**. While closing the fishery early might have immediate negative economic effects for fishermen harvesting in the winter and spring, preserving the remaining spawning biomass for the following fall fishing season would be expected to generate greater, positive economic effects by providing for a more abundant stock, thereby making more shrimp available for harvest and to the consumer over the course of the fishing year. **Preferred Alternative 5** gives states the greatest flexibility in deciding whether to use a water temperature threshold of 9°C (48°F) or below for at least one week or demonstrate an 80% or greater reduction in the population of overwintering white shrimp when requesting a closure of federal waters to penaeid shrimp harvest. As such, **Preferred Alternative 5** is expected to generate the greatest, positive indirect economic effects in the shrimp fishery over the course of the fishing year.

Social: The social effects from **Alternative 1 (No Action)** would depend upon whether shrimp stocks were significantly affected by the present closure system, which may not be as timely as that outlined in other alternatives. **Alternative 2** uses a water temperature threshold that would make the determination easier and more timely and may reduce the risk of negative social effects by protecting the shrimp stock. **Alternatives 3** and **4** each use a one-degree centigrade increase in temperature threshold respectively and the social effects would be the same as those described above, being determined by the ability of the alternative to provide sufficient protection to the stock. Overall, if **Preferred Alternative 5** provides increased protection for the shrimp stock there should be positive social effects that should outweigh any short-term negative impacts. This alternative gives the state more flexibility in determining a trigger. With greater protection and an anticipated improvement in stock the next year, there should be positive social effects in general as a more stable fishery should result, especially for those fishermen who rely solely on penaeid shrimp as they are the most vulnerable.

Administrative: The specification of criteria as identified through **Alternatives 2-4** would not result in increased administrative impacts on the agency from the status quo **(Alternative 1 No Action)**. A state would bear most of the administrative burden associated with this measure. Under **Alternatives 2-4**, states would be required to demonstrate that data (from a state-level monitoring program) indicate an exceeded threshold in water temperatures. Under **Preferred Alternative 5**, states would be afforded flexibility in determining if a harvest prohibition of penaeid shrimp in federal waters concurrent with one in state waters is needed. These criteria would indicate either a threshold for water temperature had been exceeded, or an 80% or greater decrease in abundance of overwintering white shrimp had occurred. With a change in the required criterion that a state would need to demonstrate to request a closure in federal waters concurrent with state waters **(Alternatives 2-5 (Preferred))**, modifications may occur at the state-level in how such a request is administered.

Table 2-1. Summary of effects under Action 1.

Alternatives	Biological Effects	Socioeconomic/Administrative Effects
Alternative 1 (No Action)	Possible negative effects to stocks resulting from time lag associated with collection of population data	Possible indirect negative effects if intended outcome of closures is not protecting stocks effectively
Alternative 2	Less biological benefit to stocks than other alternatives	Short-term negative effects; long-term positive impacts
Alternative 3	Greater biological benefit to stocks than Alternative 2, but less than Alternative 4	Short-term negative effects; long-term positive impacts
Alternative 4	Greater biological benefit to stocks than Alternatives 1-3	Short-term negative effects; long-term positive impacts
Preferred Alternative 5	Greatest biological benefit as a result of level of flexibility afforded to states	Greatest long-term positive indirect socioeconomic effects

2.2 Action 2. Modify the process for a state to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

Alternative 1. No Action. Currently, the process requires any state requesting a concurrent closure to provide data to demonstrate an 80% decrease in abundance of overwintering white shrimp to a review panel, and the panel's recommendations are reviewed at the next South Atlantic Council meeting. After approval by the South Atlantic Council, a letter is sent to the National Marine Fisheries Service Southeast Regional Administrator requesting that the EEZ adjacent to the state be closed to penaeid shrimp harvest. The Regional Administrator then publishes an official notice of closure in the *Federal Register*.

Preferred Alternative 2. Any state requesting a concurrent closure would send a letter directly to the National Marine Fisheries Service with the request and necessary data to demonstrate that criterion has been met.

Alternative 3. Any state requesting a concurrent closure would send a letter directly to the National Marine Fisheries Service Southeast Regional Administrator with the request and necessary data to demonstrate that criterion has been met. The requesting state would also submit data to the Shrimp Review Panel, who would review data and make a recommendation to the National Marine Fisheries Service. This option would require a notice to be published in the *Federal Register* at least 23 days prior to the convening of the Shrimp Review Panel.

Comparison of Alternatives (Summary shown in Table 2-2)

Biological: Preferred Alternative 2 represents the most streamlined process by which South Atlantic states may request concurrent closures of federal waters to protect overwintering shrimp stocks. **Preferred Alternative 2** would, theoretically, also require the least amount of time to implement the concurrent closure and is thus considered the most biologically beneficial alternative under this action. In contrast, **Alternative 1 (No Action)** and **Alternative 3** would both require review by at least one entity (the South Atlantic Council and/or the Shrimp Review Panel) before the agency could take action to implement a concurrent closure of federal waters, which would be less biologically beneficial when compared to **Preferred Alternative 2**.

Economic: Action 2 is an administrative action; however, changing the timeliness of implementing a closure would be expected to have indirect economic effects. Given the South Atlantic Council's current meeting schedule, **Alternative 1 (No Action)** prohibits a closure prior to March each year, possibly long after a cold weather event has occurred. No indirect economic effects are expected under **Alternative 1 (No Action)**, given that the current process for requesting a closure would remain unchanged. As with **Action 1**, while closing federal waters more quickly may generate adverse economic effects in the winter and spring seasons, the positive economic effects resulting from greater abundance and harvests in the peak fall season would outweigh those effects. Thus, the longer the delay in closing the fishery in federal waters, the greater is the potential for adverse economic effects over the course of the fishing year. **Preferred Alternative 2** would have the shortest delay between the time of a cold weather event and a closure as the state could directly request NMFS immediately close federal waters, and thus would be expected to generate the greatest positive, indirect economic effects. Although **Alternative 3** would reduce the delay in implementing a closure of federal waters relative to **Alternative 1 (No Action)**, the delay would be longer than under **Preferred Alternative 2** and thus the positive, indirect economic effects would be less as well.

Social: Under **Alternative 1** (**No Action)** the current process may not provide sufficient protection and therefore could have negative social effects. Under **Alternative 3**, review by the Shrimp Review Panel could delay the action more than **Preferred Alternative 2**, which would be a more direct and timely approach. The social effects would depend upon the effect of any delay of a closure and its impact upon the stock. It is assumed that a more timely closure would have beneficial effects upon the stock which should have positive long-term social effects.

Administrative: Preferred Alternative 2 and **Alternative 3** identify two different processes for implementation of a concurrent closure, with a different timeframe stipulated under each scenario. Under **Preferred Alternative 2**, convening the Shrimp Review Panel following a state's concurrent closure request would no longer be required, nor would discussion and review of this issue at a South Atlantic Council meeting. Unlike **Alternative 1 (No Action)**, **Alternative 3** eliminates the requirement for review and discussion of this issue at a South Atlantic Council meeting, but still requires input from the Shrimp Review Panel before a final determination is made at the agency level.

Table 2-2. Summary of effects under Action 2.

Alternatives	**Biological Effects**	**Socioeconomic/Administrative Effects**
Alternative 1 (No Action)	Least biological benefit	Indirect negative effects
Preferred Alternative 2	Greatest biological benefit	Streamlined administrative process, less administrative impacts; short-term socioeconomic impacts over status quo offset by benefits resulting from a larger fall crop
Alternative 3	Greater biological benefit than Alternative 1, but less than Preferred Alternative 2	Administrative impacts less than status quo, but greater than Preferred Alternative 2; short-term socioeconomic impacts over status quo offset by benefits resulting from a larger fall crop

2.3 Action 3. Revise the overfished status determination criteria (B_{MSY} proxy) for the pink shrimp stock

Alternative 1. No Action. A proxy for B_{MSY} (0.461 individuals per hectare) has been established for pink shrimp using CPUE information from SEAMAP-SA data as the lowest value in the 1990-2003 time period that produced catches meeting MSY the following year.

Alternative 2. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from SEAMAP-SA data during the 2007-2011 time period (0.273 individuals per hectare).

Alternative 3. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from SEAMAP-SA during the 2009-2011 time period (0.292 individuals per hectare).

Preferred Alternative 4. Establish a proxy for B_{MSY} for pink shrimp using the lowest CPUE value from SEAMAP-SA during the 1990-2011 time period (0.089 individuals per hectare).

Alternative 5. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from Pamlico Sound Survey data during the 2007-2011 time period (5.143 individuals per hectare).

Alternative 6. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from Pamlico Sound Survey data during the 2009-2011 time period (1.526 individuals per hectare).

Comparison of Alternatives (Summary shown in Table 2-3)

Biological: None of the alternatives under consideration address the issue of survey data not capturing the entire geographical range of pink shrimp abundance; however, **Alternatives 2-6** do use the most recent data available, which is a more accurate representation of current stock conditions relative to how the pink shrimp fishery is prosecuted now between Cape Hatteras, North Carolina and Cape Canaveral, Florida. The higher the B_{MSY} proxy, the greater the chance that catch per unit effort (CPUE) would fall below B_{MSY} in any given year and require administrative action to limit harvest. Therefore, if the B_{MSY} proxy is set too high, the probability of implementing corrective action when it may not be biologically necessary is higher relative other alternatives with low B_{MSY} values. Conversely, if the B_{MSY} proxy is set very low, the risk that CPUE would fall below B_{MSY} and corrective action may not be triggered when it is actually needed would be greater. **Alternatives 2-4 (Preferred)** would use a different time series of data from the SEAMAP survey than currently used to define the B_{MSY} proxy for pink shrimp. As the Shrimp Review Panel has indicated low CPUE in recent years is a function of environmental conditions rather than fishing pressure, these alternatives may be a more accurate representation of current stock conditions relative to how the shrimp fishery is prosecuted today between Cape Hatteras, North Carolina and Cape Canaveral, Florida. Despite the limitations of the SEAMAP survey, it captures a broader geographic area in deeper water than the Pamlico Sound Survey, and may better represent the pink shrimp stock. Furthermore, the Pamlico Sound Survey shows much more variability in CPUE than the SEAMAP survey suggesting the Pamlico Sound Survey may not represent pink shrimp abundance as well as the SEAMAP survey and could unnecessarily trigger an overfished/overfishing determination or fail to trigger such a determination when needed. The most accurate representation of biomass is likely to fall somewhere between the lowest and the highest B_{MSY} proxy alternatives (**Preferred Alternative 4** and **Alternative 5**, respectively), and a B_{MSY} proxy that is closer to a mid-point between the highest and lowest CPUE averages is less likely to trigger corrective action when it would not be needed, or fail to trigger corrective action when it is needed.

Economic: Action 3 establishes a biological reference point for determining whether pink shrimp are overfished or experiencing overfishing and thus will result in indirect economic effects on the shrimp fishery. Presumably, any alternative that would set an overfished/overfishing level for pink shrimp that would increase the probability of closing the fishery relative to the status quo would be expected to generate indirect, adverse economic effects. Conversely, any alternative that would set an overfished/overfishing level for pink shrimp that would decrease the probability of closing the fishery, and relative to the status quo, would be expected to generate indirect, positive economic effects. Relative to **Alternative 1 (No Action), Alternative 5** would be expected to generate the greatest adverse, indirect economic effects, followed by **Alternative 6**. Conversely, **Preferred Alternative 4** would be expected to generate the least adverse, indirect economic effects, followed by **Alternatives 2** and **3**, relative to **Alternative 1 (No Action)**.

Social: Establishing the best proxy of overfished/overfishing status for pink shrimp should have beneficial social effects, as it would provide the best protection for the stock without imposing unnecessary regulatory burdens on fishermen, their families, and communities. Currently, under **Alternative 1**, the no action alternative, negative social effects could occur if the fishery is declared overfished when the current proxy may not be an accurate portrayal of stock status. **Alternative 2** through **Preferred Alternative 4** offer a B_{MSY} proxy utilizing SEAMAP-SA data with differing time frames. Each time frame equates to a different measure of individual shrimp per hectare with the smallest threshold of 0.089 in **Preferred Alternative 4** and the highest threshold being 0.292 under **Alternative 3** using SEAMAP data. In any case, utilizing SEAMAP-SA data could add additional confidence regarding the proxy B_{MSY} for pink shrimp. While primarily a biological decision, it could improve the overall assessment and be beneficial to the overall process that could result in positive social effects by ensuring the most accurate information to base management decisions. Whichever alternative is chosen as preferred, as long as it reflects the best estimate of stock status, it should have beneficial social effects in the long-term as mentioned in previous alternatives. However, it is not clear whether an offshore (SEAMAP-SA data) or inshore (Pamlico Sound Survey data) proxy would be better. If both together are thought to present the best overall picture of stock status, then some provision for review and determination of an overall proxy would be needed.

Administrative: Alternatives 2-4 (Preferred) establish a new proxy for B_{MSY} based on more recent time series data from the SEAMAP program. **Alternatives 5** and **6** establish a new proxy for B_{MSY} based on more recent time series data from the Pamlico Sound Survey data. The South

Atlantic Council has the option to add the Pamlico Sound Survey data into consideration of the B_{MSY} proxy for pink shrimp, or reference these data in replacement of the SEAMAP program data. For the agency, administrative impacts associated with **Alternatives 2-4 (Preferred)** would not differ from the status quo **(Alternative 1 (No Action))**. **Alternatives 5** and **6** would require agency review of the Pamlico Sound Survey data on an annual cycle.

Table 2-3. Summary of effects under Action 3.

Alternatives	Biological Effects	Socioeconomic/Administrative Effects
Alternative 1 (No Action)	No direct biological effects; possible negative effects if SEAMAP data are not providing an accurate portrayal of stock	Negative administrative effects could be associated with triggering overfished status unnecessarily; possible negative socioeconomic effects if fishery is overfished when proxy isn't accurate portrayal of stock
Alternative 2	Possible greater indirect biological impact than status quo	Negative administrative effects would be associated with triggering overfished status unnecessarily; possible negative socioeconomic effects if fishery is overfished when proxy isn't accurate portrayal of stock; the lower a B_{MSY} proxy is set (Alternative 2 establishes the second lowest proxy), the greater probability there is for negative economic effects associated with a fishery closure
Alternative 3	Possible greater indirect biological impact than status quo	Negative administrative effects would be associated with triggering overfished status unnecessarily; possible negative socioeconomic effects if fishery is overfished when proxy isn't accurate portrayal of stock; the lower a B_{MSY} proxy is set (Alternative 3 establishes the third lowest proxy), the greater probability there is for negative economic effects associated with a fishery closure

Preferred Alternative 4	Possible greater indirect biological impact than status quo; most accurate representation of biomass likely between proxies established in Preferred Alternative 4 and Alternative 5	Negative administrative effects would be associated with triggering overfished status unnecessarily; possible negative socioeconomic effects if fishery is overfished when proxy isn't accurate portrayal of stock; the lower a B_{MSY} proxy is set (Preferred Alternative 4 establishes the lowest proxy), the greater probability there is for negative economic effects associated with a fishery closure
Alternative 5	Possible greater indirect biological impact than status quo; most accurate representation of biomass likely between proxies established in Preferred Alternative 4 and Alternative 5	Negative administrative effects could be associated with triggering overfished status unnecessarily; possible negative socioeconomic effects if fishery is overfished when proxy isn't accurate portrayal of stock
Alternative 6	Possible greater indirect biological impact than status quo	Negative administrative effects could be associated with triggering overfished status unnecessarily; possible negative socioeconomic effects if fishery is overfished when proxy isn't accurate portrayal of stock

Chapter 3. Affected Environment

This section describes the affected environment in the proposed project area. The affected environment is divided into four major components:

- **Habitat** (Section 3.1)

  Examples include coral reefs and sea grass beds

- **Biological environment** (Section 3.2)

  Examples include populations of shrimp, corals, turtles

- **Human environment** (Sections 3.3)

  Examples include fishing communities and economic descriptions of the fisheries

- **Administrative environment** (Section 3.4)

  Examples include the fishery management process and enforcement activities

3.1 Habitat Environment

3.1.1 Essential Fish Habitat

For penaeid shrimp, Essential Fish Habitat (EFH) includes inshore estuarine nursery areas, offshore marine habitats used for spawning and growth to maturity, and all interconnecting water bodies as described in the Habitat Plan (SAFMC 1998b). Inshore nursery areas include tidal freshwater (palustrine), estuarine, and marine emergent wetlands (e.g., intertidal marshes); tidal palustrine forested areas; mangroves; tidal freshwater, estuarine, and marine submerged aquatic vegetation (e.g., seagrass); and sub-tidal and intertidal non-vegetated flats. This applies from North Carolina through the Florida Keys.

Juvenile shrimp appear to be most abundant at the *Spartina* grass-water interface. This "estuarine edge" is the most productive zone in many estuaries. Because there is a minimum of wind generated turbulence and stabilization of sediments, rich bands of organic material are found along the edges of marshes (Odum 1970). Furthermore, Odum (1970) found the percentages of organic detritus in sediments along the shore in the Everglades estuary are several times greater than a few meters offshore. Mock (1967) examined two estuarine habitats, one natural and one altered by bulkheading. He found a 2 ft (0.6 m) band of rich organic material along the natural shore and very little organic material along the bulkheaded shore. White shrimp were 12.5 times and brown shrimp 2.5 times more numerous in the natural area as in the altered area. Loesch (1965) found that juvenile white shrimp in Mobile Bay were most abundant nearshore in water less than 2 ft (0.6 m) deep containing large amounts of organic detritus. Brown shrimp were congregated in water 2-3 ft (0.6 to 0.9 m) deep where there was attached vegetation.

Along the Florida Atlantic coast, the predominant substrate inside of the 656 ft (200 m) depth contour is fine to medium sand with small patches of silt and clay (Milliman 1972). White shrimp appear to prefer muddy or peaty bottoms rich in organic matter and decaying vegetation when in inshore waters. Offshore they are most abundant on soft muddy bottoms. Brown shrimp appear to prefer a similar bottom type and as adults may also be found in areas where the bottom consists of mud, sand, and shell. Pink shrimp are found most commonly on hard sand and calcareous shell bottom. Both brown and pink shrimp generally bury in the substrate during daylight and are active at night. White shrimp do not bury with the regularity of pink shrimp or brown shrimp (SAFMC 1996b). These temporal and spatial shifts by brown shrimp, white shrimp, and pink shrimp help reduce direct interspecific competition especially for certain substrates (Lassuy 1983). Staggered seasonal recruitment of brown and white shrimp into the South Atlantic estuaries would also reduce competition (Baisden 1983).

Estuarine tidal creeks and salt marshes that serve as nursery grounds are perhaps the most important habitats occupied by penaeid shrimp. In a study conducted by Lorido and Sanchez (2010), density of sea grasses and complexity of habitat play key roles in pink shrimp predation by crab species such as blue crab. The major factor controlling shrimp growth and production is the availability of nursery habitat. Remaining wetland habitat must be protected if present production levels are to be maintained. In addition, impacted habitats must be restored if future production is to be increased. Other areas of specific concern are the barrier islands as these land masses are vital to the maintenance of estuarine conditions needed by shrimp during their juvenile stage. Passes between barrier islands into estuaries allow the mixing of sea water and fresh water which is of prime importance to estuarine productivity.

3.1.2 Habitat Areas of Particular Concern

Areas that meet the criteria for Essential Fish Habitat-Habitat Areas of Particular Concern (EFH-HAPCs) for penaeid shrimp include all coastal inlets, all state-designated nursery habitats of particular importance to shrimp (for example, in North Carolina this would include all Primary Nursery Areas and all Secondary Nursery Areas) and state-identified overwintering areas. Juvenile brown and white shrimp require estuarine environments for development, while adults live and spawn offshore in areas with abundant marine plants and muddy substrates (McMillen-Jackcon 2003).

In North Carolina, EFH-HAPCs include estuarine shoreline habitats as juvenile shrimp congregate in these areas. Seagrass beds, prevalent in the sounds and bays of North Carolina and Florida, are particularly critical areas. Core Sound and eastern Pamlico Sound have approximately 200,000 acres of seagrass beds making North Carolina second only to Florida in abundance of this type of habitat (Department of Commerce 1988). In subtropical and tropical regions shrimp postlarvae recruit into seagrass beds from distant offshore spawning grounds (Fonseca et al. 1992).

South Carolina and Georgia lack substantial amounts of seagrass beds. Here, the nursery habitat of shrimp is the high marsh areas that offer shell hash and mud bottoms. In addition, there is seasonal movement out of the marsh into deep holes and creek channels adjoining the marsh system during winter. Therefore, the area of particular concern for early growth and development encompasses the entire estuarine system from the lower salinity portions of the river systems through the inlet mouths.

3.2 Biological and Ecological Environment

3.2.1 Protected Species

There are 40 species protected by federal law that may occur in the exclusive economic zone (EEZ) of the South Atlantic Region that are under the purview of NMFS. Thirty-one of these species are marine mammals protected under the Marine Mammal Protection Act (MMPA) and six are also listed as endangered under the Endangered Species Act (ESA) (i.e., sperm, sei, fin, blue, humpback, and North Atlantic right whales). In addition to those six marine mammals, five species of sea turtles (green, hawksbill, Kemp’s ridley, leatherback, and loggerhead); the smalltooth sawfish; the Atlantic sturgeon; and two *Acropora* coral species (elkhorn [*Acropora palmata*] and staghorn [*A. cervicornis*]) are also protected under the ESA. Portions of designated critical habitat for North Atlantic right whales and *Acropora* corals also occur within the South Atlantic Council’s jurisdiction. Section 3.5 in the Comprehensive Annual Catch Limit (ACL)

Amendment (SAFMC 2011a) describes the life history characteristics of these ESA-listed species, with the exception of Atlantic sturgeon, and discusses the features essential for conservation found in each critical habitat area. The Carolina and South Atlantic DPSs of the Atlantic sturgeon occur in the South Atlantic region. The following sections briefly describe the general life history characteristics of animals from these DPSs. Because Atlantic sturgeon spawn in freshwater rivers, federal fisheries of the South Atlantic generally do not interact with spawning sturgeon. However, the populations of Atlantic sturgeon in spawning rivers and threats to animals occurring in those rivers are of significant importance to the species' overall survival and recovery. Additional information on specific river systems where Atlantic sturgeon spawn, and the threats to animals in those systems, can be found in ASSRT (2007).

Atlantic sturgeon are long lived (approximately 60 years), late maturing, relatively large, anadromous fish (Bigelow and Schroeder 1953, Vladykov and Greeley 1963, Mangin 1964, Pikitch et al. 2005, Dadswell 2006, ASSRT 2007). Atlantic sturgeon may reach lengths up to 14 feet and weigh over 800 pounds. They have armor-like plates and a long protruding snout that is ventrally located. Atlantic sturgeons are bottom feeders that use four barbels in front of the mouth to assist in locating prey (Bigelow and Schroeder 1953). Adults and sub-adults eat mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Bigelow and Schroeder 1953, ASSRT 2007, Guilbard et al. 2007, Savoy 2007), while juveniles feed on aquatic insects, insect larvae, and other invertebrates (Bigelow and Schroeder 1953, ASSRT 2007, Guilbard et al. 2007). Sturgeon are commonly found in less than 200 feet of water, but have been captured in water as deep as 3,000 feet (Stein et al. 2004, ASMFC 2007) and 40 miles offshore.

Atlantic sturgeon mature between the ages of 5 and 19 years in South Carolina (Smith et al. 1982). The age of maturity is unknown for animals originating in Florida, Georgia, and North Carolina rivers. In general, male Atlantic sturgeons grow faster than females and attain larger sizes (Smith et al. 1982, Smith and Dingley 1984, Smith 1985, Scott and Scott 1988, Young et al. 1998, Collins et al. 2000, Caron et al. 2002, Dadswell 2006, ASSRT 2007, Kahnle et al. 2007, DFO 2011). Females can produce between 400,000 to 4 million eggs per spawning year, but only spawn every 2-5 years; males spawn every 1-5 years (Vladykov and Greeley 1963, Smith et al. 1982, Smith 1985, Van Eenennaam et al. 1996, Van Eenennaam and Doroshov 1998, Stevenson and Secor 1999, Collins et al. 2000, Caron et al. 2002, Dadswell 2006). In the South Atlantic region, spawning occurs in specific, freshwater rivers in North Carolina, South Carolina, and Georgia. Water temperature appears to trigger spawning migrations (ASMFC 2009), which generally occur during February-March in the South Atlantic region (Murawski and Pacheco 1977, Smith 1985, Bain 1997, Smith and Clugston 1997, Caron et al. 2002).

The Carolina DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) from Albemarle Sound, North Carolina south to Charleston Harbor, South Carolina. The marine range of Atlantic sturgeon from the Carolina DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the Carolina DPS and the adjacent portion of the marine range are shown in **Figure 3-1**. Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Pee Dee Rivers. There may also be spawning populations in the Neuse, Santee and Cooper Rivers, though it is uncertain. Both rivers may be used as nursery habitat by young Atlantic sturgeon originating from other spawning populations.

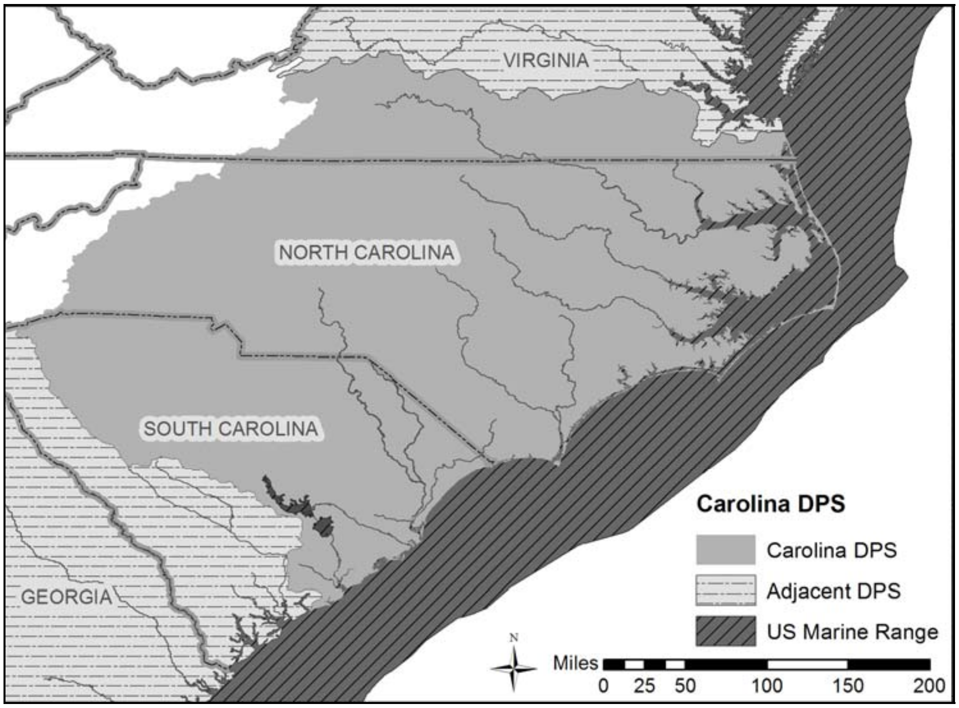


Figure 3-1. The Carolina DPS, Including the Marine Portion of the Range.

The South Atlantic DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto Rivers southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. The marine range of Atlantic sturgeon from the South Atlantic DPS extends from the Hamilton Inlet, Labrador, Canada to Cape Canaveral, Florida. The riverine range of the South Atlantic DPS and the adjacent portion of the marine range are shown in **Figure 3-2**. Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers.

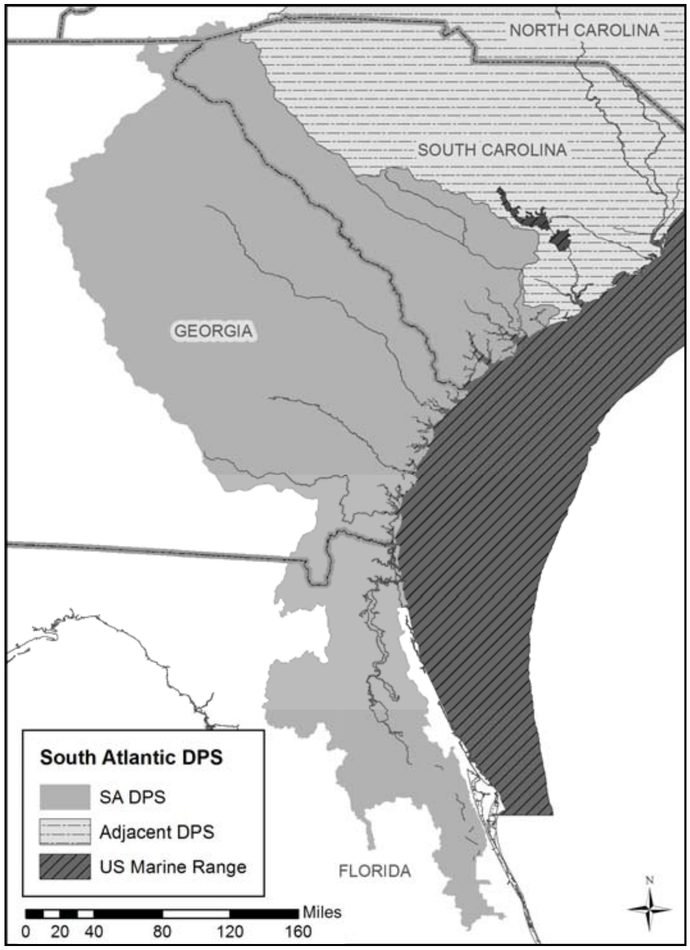


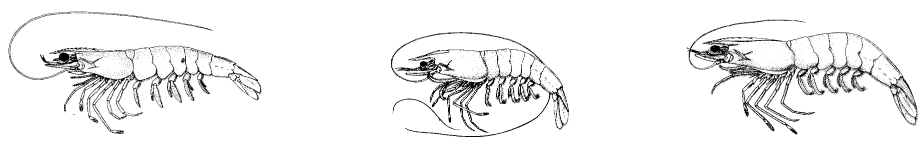
Figure 3-2. The South Atlantic DPS, Including the Marine Portion of the Range.

Currently, only 16 U.S. rivers are known to support spawning based on available evidence (ASSRT 2007). The number of rivers supporting spawning of Atlantic sturgeon are approximately half of what they were historically. Between 7,000 and 10,500 adult female Atlantic sturgeon may have been present in North Carolina prior to 1890 (Armstrong and Hightower 2002, Secor 2002). Secor (2002) estimated that 8,000 adult females were present in South Carolina during that same time. However, past threats from commercial fishing and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the Carolina and South Atlantic DPSs. The abundances of the remaining river populations within these DPSs, each estimated to have fewer than 300 spawning adults, is estimated to range from less than 6 to less than 1 percent of what they were historically (ASSRT 2007).

3.2.2 Biological Description of Affected Shrimp Species

Much of the information in this section is taken from the synoptic reviews on the biology of the various shrimp species by Bielsa et al. (1983), Lassuy (1983), Muncy (1984) and Larson et al. (1989). Additional source references are cited in these synopses. Penaeid shrimp are distributed worldwide in tropical and temperate waters. In the southeastern United States, the shrimp industry is based almost entirely on three shallow-water species of the family Penaeidae: the white shrimp, *Litopenaeus setiferus*, the brown shrimp, *Farfantepenaeus aztecus* and the pink shrimp, *Farfantepenaeus duorarum*.

Common names for *Litopenaeus setiferus* (**Figure 3-3**) include white shrimp, gray shrimp, lake shrimp, green shrimp, green-tailed shrimp, blue tailed shrimp, rainbow shrimp, Daytona shrimp, common shrimp and southern shrimp. *F. aztecus* (**Figure 3-3**) is known as brown shrimp, brownie, green lake shrimp, red shrimp, redtail shrimp, golden shrimp, native shrimp and also the summer shrimp in North Carolina. Common names for *F. duorarum* (**Figure 3-3**) include pink shrimp, spotted shrimp, hopper, pink spotted shrimp, brown spotted shrimp, grooved shrimp, green shrimp, pink night shrimp, red shrimp, skipper and pushed shrimp.



Pink shrimp White shrimp Brown shrimp

Figure 3-3. Illustrations of white, brown and pink shrimp.

The affected environment, including a description of the shrimp fishery in the South Atlantic region, is presented in detail in the original shrimp plan (SAFMC 1993). A description of South Atlantic Council concerns and recommendations on protecting shrimp habitat is also included in the original Shrimp FMP (SAFMC 1993).

Juvenile and adult penaeid shrimp are omnivorous (eating both plants and animals) bottom feeders with most feeding activity occurring at night although daytime feeding may occur in turbid waters. Food items may consist of polychaetes, amphipods, nematodes, caridean shrimp, mysids, copepods, isopods, amphipods, ostracods, mollusks, foraminiferans, chironomid larvae and various types of organic debris (SAFMC 1996a). Shrimp are preyed on by a wide variety of species at virtually all stages in their life history. Postlarvae are prey for sheepshead minnows, water boatmen, and insect larvae. Grass shrimp, killifishes, and blue crabs prey on young penaeid shrimp. Also, a wide variety of finfish are known to prey heavily on juvenile and adult penaeid shrimp (SAFMC 1996b).

White shrimp range from Fire Island, New York to St. Lucie Inlet on the Atlantic Coast of Florida, and from the Ochlochonee River on the Gulf Coast of Florida to Ciudad, Campeche, Mexico. Along the Atlantic Coast of the U.S., the white shrimp is more common off South Carolina, Georgia and northeast Florida. White shrimp are generally concentrated on the continental shelf where water depths are 89 ft (27 m) or less, although occasionally they are found much deeper (up to 270 ft) (SAFMC 1996b).

Brown shrimp occur from Martha's Vineyard, Massachusetts to the Florida Keys and northward into the Gulf to the Sanibel grounds. The species reappears near Apalachicola Bay and occurs around the Gulf Coast to northwestern Yucatan. Although brown shrimp may occur seasonally along the Mid-Atlantic states, breeding populations apparently do not range north of North Carolina. Brown shrimp may occur in commercial quantities in areas where water depth is as great as 361 ft (110 m), but they are most abundant in areas where the water depth is less than 180 ft (55 m) (SAFMC 1996b). Brown shrimp are less tolerant of low salinities and high temperatures when compared to white shrimp, and brown shrimp rely more heavily on infauna for food (McMillen-Jackson and Bert 2003).

Pink shrimp occur from southern Chesapeake Bay to the Florida Keys and around the coast of the Gulf of Mexico to Yucatan south of Cabo Catoche. Maximum abundance is reached off southwestern Florida and the southeastern Golfo de Campeche. Along the Atlantic coast of the U.S., pink shrimp occur in sufficient abundance to be of major commercial significance only in North Carolina and the Florida Keys. Pink shrimp are most abundant in areas where water depth is 36-121 ft (11-37 m) although in some areas they may be abundant where water depth is as much as 213 ft (65 m) (SAFMC 1996b).

Reproduction and Development

All three species of penaeid shrimp are dioecious (separate sexes). White shrimp attain sexual maturity at about 5.3-5.5 in (35-140 mm) total length (TL). Brown shrimp also reach sexual maturity at about 5.5 in TL (140 mm), whereas pink shrimp reach sexual maturity at about 3.3 in TL (85 mm). Fecundity for all penaeid species ranges from 500,000 to 1,000,000 ova. Eggs are demersal, measuring 0.28 mm, 0.26 mm, and 0.31-0.33 mm in diameter for white, brown, and pink shrimp respectively (SAFMC 1996b).

Off Georgia and northern Florida, some white shrimp spawning may occur inshore, although most spawning occurs more than 1.2 miles from the coastline. Off Florida, spawning occasionally takes place inshore, at or near inlets, but most occurs offshore in depths of 20-80 ft (6.1-24.4 m). In South Carolina, most spawning occurs within about four miles of the coast. Spawning is correlated with bottom water temperatures of 62.6 to 84.2° F (17° to 29°C) although spawning generally occurs between 71.6 and 84.2° F (22° and 29°C). White shrimp begin spawning during April off Florida and Georgia, and late April or May off South Carolina. Spawning may continue into September or October (SAFMC 1996b).

Brown shrimp spawn at greater depths than white shrimp, and their postlarvae recruit to estuaries earlier in the spring with shorter seasonal migrations (McMillen-Jackson and Bert 2003). In the Gulf of Mexico, it was concluded that brown shrimp did not spawn in water less than 45 ft (13.7 m) deep and the greatest percentage of ripe females were at 150 ft (45.7 m). Spawning season for brown shrimp is uncertain, although there is an influx of postlarvae into the estuaries during February and March. Mature males and females have been found off South Carolina during October and November (SAFMC 1996b).

Pink shrimp apparently spawn at depths of 12 to 52 ft (3.7 to 15.8 m). Off eastern Florida, peak spawning activity probably occurs during the summer. In North Carolina, roe-bearing females are found as early as May, and by June, most pink shrimp are sexually mature (SAFMC 1996b).

All three penaeid species have 11 larval stages before developing into postlarvae. Duration of the larval period is dependent on temperature, food, and habitat. Records suggest larval periods of 10-12 days for white shrimp, 11-17 days for brown shrimp, and 15-25 days for pink shrimp. Brown shrimp postlarvae appear to overwinter in offshore bottom sediments. Postlarval sizes are similar for white and pink shrimp ranging from approximately 0.1-0.5 in (2.9 to 12 mm) TL; brown shrimp are usually larger (SAFMC 1996b).

The mechanisms that transport penaeid shrimp postlarvae from distant spawning areas to inside estuaries are not well known. Shoreward countercurrents north of Cape Canaveral, Florida have been suggested as a mechanism for transport of pink shrimp postlarvae from spawning areas to nursery areas along the northeast Florida coast. Movement of white shrimp postlarvae into the estuary is most likely a result of nearshore tidal currents as white shrimp spawn relatively close to shore. Brown shrimp may overwinter in offshore waters and migrate into estuaries the following spring. The inshore phase of the penaeid life cycle is perhaps the most critical because this is a period of rapid growth. These estuarine nursery areas, dominated by the marsh grass, *Spartina alterniflora*, provide abundant food, suitable substrate, and shelter from predators for postlarval shrimp. In the South Atlantic, white and pink shrimp enter the estuaries at about the same time, usually beginning in April and early May in the southern part of their range and in June and July in North Carolina sounds (white shrimp are uncommon in this northern area).

Large white shrimp begin emigrating out of the estuary to the commercial fishing areas in mid-summer. In North Carolina, white shrimp begin entering the commercial fishery in July and continue to be caught through December. In Florida, white shrimp leave inshore waters at about 4.7 in TL (120 mm). This movement to offshore waters may be caused by cold weather, storms, high tides, and/or large influxes of fresh water, but size is the principal determinant (SAFMC 1996b).

Brown shrimp first enter the commercial fishery in North Carolina in June at about 4 in TL (100 mm). Movement of brown shrimp appears to take place primarily at night with peak movement at or shortly after dusk. In the South Atlantic, juvenile and adult brown shrimp are rarely affected by severe winter weather because most surviving shrimp have moved offshore prior to the onset of cold weather (SAFMC 1996b).

Pink shrimp leave Florida estuaries two to six months after having arrived as postlarvae. In North Carolina, young pink shrimp enter the commercial catch in August. Recruitment to the area offshore of Cape Canaveral begins in April and May and again during October and November (SAFMC 1996b).

Smaller white and pink shrimp may remain in the estuary during winter and are termed overwintering stocks (SAFMC 1996b). When compared with brown shrimp, white shrimp recruit to estuaries with warmer water temperatures and are more abundant than brown shrimp in estuaries in the winter because they are less cold tolerant and more susceptible to cold-weather related mortality (McMillen-Jackson and Bert 2003). Harsh winter conditions such as cold water temperatures and rainfall can affect the survival of overwintering stocks and subsequent year-class strength. Pink shrimp bury deeply in the substrate with the onset of cold weather and are protected to some extent from winter mortalities. Pink and white shrimp that survive the winter grow rapidly in late winter and early spring before migrating to the ocean. The migrating white shrimp, called roe shrimp, make up the spring fishery and also produce the summer and fall crops of shrimp. When a majority of white shrimp do not survive the winter, the North Carolina and South Carolina fisheries are believed to be dependent on a northward spring migration of white shrimp from more southerly areas to form the spawning stock. However, tagging data are inconclusive on the extent of this northward movement. Pink shrimp that overwinter in estuaries migrate to sea in May and June, at which time spawning takes place. Recruitment to the area offshore of Cape Canaveral, Florida begins in April and May and again during October and November (SAFMC 1996b).

Salinity is a factor determining growth rate in white and brown shrimp. Although field studies indicate that juvenile white shrimp prefer low salinities, laboratory studies have revealed that they tolerate a wide range of salinities; they have been successfully reared at salinities of 18 to 34 ppt (Perez-Farfante 1969). Nevertheless, McKenzie and Whitaker (1981) cited several studies in which fast growth was reported for white shrimp at lower salinities of 7 to 15 ppt. The lowest salinity in which white shrimp were recorded in the northern Gulf of Mexico was 0.42 ppt (Perez-Farfante 1969). High salinities appear to inhibit growth in white shrimp, but for brown shrimp, salinities in excess of 10 ppt seem to enhance growth rate. However, Zein-Eldin and Aldrich (1965) and Zein-Eldin and Griffith (1970) found that salinity did not affect the growth of postlarval shrimp. During years of low densities, the average size of white shrimp is generally larger.

Water temperature directly or indirectly influences white shrimp spawning, growth, habitat selection, osmoregulation, movement, migration, and mortality (Muncy 1984). Spring water temperature increases trigger spawning, and rapid water temperature declines in fall portend the end of spawning (Lindner and Anderson 1956). Growth is fastest in summer and slowest or negligible in winter. Water temperatures below 68°F (20°C) inhibit growth of juvenile shrimp (Etzold and Christmas 1977) and growth is virtually nil at 61°F (16°C) (St. Amant and Lindner 1966). Growth rates increase rapidly as temperatures increase above 68°F (20°C). Increased water temperatures affects molting rate (Perez-Farfante 1969). Good correlation between heating-degree-days and catch/effort ratio for penaeid shrimp was similar to correlations of yield-per-hectare versus latitude (Turner 1977). Temperature and food supply limited the growth of white shrimp postlarvae more than did salinity differences between 2 and 35 ppt (Zein-Eldin 1964). Freshwater inflow may affect coastal water temperatures, which in turn affect the growth rates (White and Boudreaux 1977) and migration of white shrimp (Shipman 1983). White shrimp are more tolerant of high temperatures and less tolerant of low temperatures than either brown or pink shrimp (Etzold and Christmas 1977). Temperature also affects brown and pink shrimp growth rates, with rates as high as 0.13 in (3.3 mm) per day recorded when temperature exceeded 77° F (25° C) but less than 0.04 in (1.0 mm) per day when water temperature was below 68° F (20° C). Gaidry and White (1973) stated that years of low commercial landings of brown shrimp were associated with prolonged estuarine temperatures of less than 68°F (20° C) at the time of postlarval immigration into the estuary. Aldrich et al. (1968) demonstrated in laboratory experiments that brown shrimp postlarvae burrowed in the sediment when water temperature was reduced to 54°-62°F (12°-16.5°C).

Pink shrimp in Florida Bay were found to grow 0.14 in (3.5 mm) CL in winter and only 0.07 in (1.9 mm) CL in spring. In North Carolina, maximum pink shrimp growth rates were recorded in summer (Tables 1 and 2 in SAFMC 1993).

Population Dynamics

Population size of brown, pink, and white shrimp is believed to be primarily regulated by environmental conditions and available habitat. Penaeid (brown, pink, and white) shrimp have an annual life cycle, where adults spawn offshore and the larvae are transported to coastal estuaries. Recruitment to the estuaries and eventually to the fishing grounds is extremely dependent on fluctuations of environmental conditions within estuaries. Poor recruitment to the fishery may occur because of excessively cold winters or heavy rains that reduce salinities and cause high mortality of post-larvae. Conversely, high recruitment to the fishery may occur when environmental conditions are favorable for postlarval development.

Although shrimp trawling certainly reduces population size over the course of a season, the impact of fishing on subsequent year-class strength is unknown (see landings information in **Tables 3-1**, **3-2**, and **3-3**). Spawning stock size is associated with the survival of recruits of the same year (Yimin 2000); however, a study conducted by Yimin (2000) indicates that fishing effort plays a more significant role in controlling spawning stock size than recruitment. Natural mortality rates are very high, and coupled with fishing mortality, most of the year class may be removed by the end of a season. Because annual variation in catch is presumed to be due to a combination of prevailing environmental conditions, fishing effort, price, and relative abundance of shrimp (SAFMC 1996b), fishing is not believed to have any impact on subsequent year class strength unless the spawning stock has been reduced below a minimum threshold level by environmental conditions. Nevertheless, due to high fecundity and migratory behavior, the three penaeid species are capable of rebounding from very low population sizes in one year to large population sizes in the next, provided environmental conditions are favorable (SAFMC 1996b).

Fluctuations in abundance resulting from changes in environmental conditions will continue to occur. Perhaps the most serious potential threat to the stocks is loss of habitat due to pollution or physical alteration. For white and brown shrimp, salt marsh habitat is especially important as juvenile nursery areas. Inshore seagrass beds are important nursery areas for juvenile pink shrimp. The quality and availability of these habitat areas to the juvenile penaeid shrimp species is critical to overall shrimp production (SAFMC 1996b).

During years when inshore overwintering white shrimp stocks are greatly reduced due to cold water temperature or heavy rain, management action may accelerate recovery of the stocks and increase fall production by protecting the few remaining spawners that survive a freeze. Also, elimination of winter and spring fishing mortality off southern Georgia and Florida may enable a greater quantity of potential spawners to move north, possibly resulting in larger regional white shrimp stocks the following fall. An offshore or deep estuarine water reserve of overwintering white shrimp may also contribute significantly to the spawning stock. In either case, while fishing does not by itself appear to be a factor in determining subsequent year class strength for white shrimp, in years when the overwintering adult population is significantly reduced due to severe winter weather, the additional mortality caused by fishing can result in a further reduction in subsequent fall production (SAFMC 1996b).

Landings information for penaeid species is provided below in **Tables 3-1**, **3-2**, and **3-3**.

Table 3-1. Pink shrimp landings* information by state in live pounds from 1990- 2011 (Source Southeast Fisheries Science Center ALS data 2011).

	Florida	Georgia	South Carolina	North Carolina
1990	226,679	9,124	1,037	1,502,311
1991	135,558	13,384	3,395	2,548,004
1992	174,756	10,204	8,791	1,983,357
1993	308,826	3,541	1,265	1,382,841
1994	352,950	6,458	11,084	646,132
1995	292,510	15,272	5,656	768,871
1996	934,672	6,076	10,029	466,632
1997	1,322,813	1,439	13,455	619,829
1998	924,958	6,302	0	411,123
1999	1,213,113	10,973	8,744	334,864
2000	1,347,278	0	1,880	203,034
2001	990,209	4,295	1,499	234,533
2002	1,255,912	0	930	928,291
2003	5,066,943	0	204	220,761
2004	1,280,898	0	508	149,670
2005	4,653,566	0	180	44,453
2006	5,080,209	0	84	69,181
2007	2,387,377	0	60	84,428
2008	1,925,196	0	91	830,907
2009	869,121	9,552	258	250,679
2010	1,315,309	0	164	53,618
2011	960,086	0	372	11,540

*Includes unclassified shrimp landings. Unclassified shrimp landings assigned to species based on the proportion of classified landings during 1990-2011.
Note: Landings data are restricted to shrimp with a capture area in the South Atlantic or if capture area was unknown, then landed in Miami/Dade County to the North Carolina/Virginia line.

Table 3-2. Brown shrimp landings* information by state in live pounds from 1990-2011 (Source Southeast Fisheries Science Center ALS data 2011).

	Florida	Georgia	South Carolina	North Carolina
1990	859,392	1,199,544	1,575,973	5,147,247
1991	471,492	1,182,894	2,337,336	6,772,076
1992	370,303	698,463	1,259,450	2,639,290
1993	800,169	1,635,431	3,185,894	3,674,040
1994	786,654	874,221	1,597,893	4,260,335
1995	740,631	1,425,550	1,908,128	5,069,628
1996	1,026,530	1,229,612	1,875,017	3,076,783
1997	850,661	947,549	1,105,876	4,086,905
1998	606,692	984,720	744,875	2,710,781
1999	797,959	1,352,545	2,018,660	3,814,585
2000	567,656	772,932	1,428,585	6,763,872
2001	1,225,421	1,471,975	2,344,665	4,073,020
2002	1,026,974	683,818	1,418,961	6,348,281
2003	892,375	1,407,018	2,323,539	4,840,053
2004	1,042,895	568,241	1,069,367	2,786,675
2005	474,130	1,422,010	1,175,538	1,529,370
2006	648,231	207,816	326,595	1,970,406
2007	1,311,877	510,169	840,919	3,111,971
2008	644,630	378,332	618,449	5,508,253
2009	909,342	326,382	274,895	3,807,763
2010	1,124,988	599,068	929,508	4,239,512
2011	1,729,806	803,705	745,433	4,398,598

*Includes unclassified shrimp landings. Unclassified shrimp landings assigned to species based on the proportion of classified landings during 1990-2011.
Note: Landings data are restricted to shrimp with a capture area in the South Atlantic or if capture area was unknown, then landed in Miami/Dade County to the North Carolina/Virginia line.

Table 3-3. White shrimp landings* information by state in live pounds from 1990-2011 (Source Southeast Fisheries Science Center ALS data 2011).

	Florida	Georgia	South Carolina	North Carolina*
1990	2,139,584	3,898,434	4,208,307	1,149,209
1991	2,859,029	7,469,208	6,884,510	1,411,007
1992	2,614,595	6,594,870	5,353,385	873,173
1993	1,987,687	5,680,830	5,098,757	1,721,841
1994	2,833,558	5,825,548	3,817,498	2,243,554
1995	4,171,971	9,472,533	8,733,833	2,669,739
1996	2,523,620	4,584,273	3,489,943	1,620,279
1997	2,196,296	5,686,421	5,512,393	2,152,223
1998	2,880,951	5,584,036	5,559,925	1,427,536
1999	3,606,480	5,340,885	5,949,805	4,787,127
2000	2,386,938	4,599,183	4,608,530	3,359,369
2001	2,430,608	2,735,784	2,144,441	941,872
2002	3,257,870	4,165,422	3,701,828	2,682,367
2003	2,102,960	3,939,128	3,593,465	1,106,209
2004	3,807,011	4,327,046	4,557,034	1,943,304
2005	3,807,339	3,012,736	2,781,042	783,513
2006	3,978,147	3,467,257	3,323,170	3,696,251
2007	3,632,766	2,211,691	1,885,913	6,340,791
2008	3,956,091	2,642,896	2,543,791	3,077,898
2009	3,124,028	2,594,351	2,440,867	1,349,185
2010	4,246,779	3,869,213	3,021,289	1,662,026
2011	6,028,565	3,373,483	2,143,247	728,300

*Includes unclassified shrimp landings. Unclassified shrimp landings assigned to species based on the proportion of classified landings during 1990-2011.
Note: Landings data are restricted to shrimp with a capture area in the South Atlantic or if capture area was unknown, then landed in Miami/Dade County to the North Carolina/Virginia line.

Targets and Thresholds for Penaeid Shrimp

A complete discussion of targets and thresholds for brown and white shrimp is contained in Shrimp Amendment 6 (SAFMC 2004), which is hereby incorporated by reference. Because Amendment 6 specifically modifies the overfished criteria for pink shrimp a detailed discussion of population benchmark and harvest parameters for pink shrimp is included below.

Maximum Sustainable Yield
The existing definition of MSY established by the original Shrimp Plan was calculated as mean total landings for the South Atlantic during 1957 to 1991 adjusted for recreational landings. In calculating total landings, an additional ten percent (an estimate provided by state shrimp biologists) was added to the commercial catch to account for recreational landings that are unreported. Using this methodology, MSY was estimated to be 1.8 million pounds for pink shrimp (SAFMC 1993).

Optimum Yield
OY for pink shrimp was defined as the amount of harvest that can be taken by U.S. fishermen without annual landings falling two standard deviations below the mean landings during 1957 through 1993 for three consecutive years. This value is 286,293 pounds (heads on) for pink shrimp (SAFMC 1996b).

Overfished/Overfishing Definition
Amendment 6 to the FMP (SAFMC 2004) established overfished and overfishing criteria for pink shrimp. Overfishing (MFMT) for all penaeid species is a fishing mortality rate that diminishes the stock below the designated MSY stock abundance (B_{MSY}) for two consecutive years and MSST is established with two thresholds: (a) if the stock diminishes to ½ MSY abundance (½ B_{MSY}) in one year, or (b) if the stock is diminished below MSY abundance (B_{MSY}) for two consecutive years. A proxy for B_{MSY} (0.461 individuals per hectare) has been established for pink shrimp using CPUE information from SEAMAP data as the lowest values in the 1990-2003 time period that produced catches meeting MSY the following year.

3.2.2.1 Current Data Sources Used to Monitor and Assess Penaeid Shrimp Populations

For the South Atlantic shrimp fishery, only historical catch records and limited effort information is available. Furthermore, because of high fluctuations in annual recruitment and landings, F_{MSY}, or even F_{CURR}, cannot be estimated. This limited information makes it difficult to use standard procedures to establish an overfishing threshold based on F_{MSY}. Nevertheless, the South Atlantic Council has stated, in previous portions of the FMP, that although estimates of population size are not available, effort in the fishery is known to be high and the fishery may be fishing at near-maximum levels. Therefore, it can be assumed to be operating at or near B_{MSY} and F_{MSY}. Based on that assumption, the South Atlantic Council has established targets and thresholds using annual landings as an indication of relative abundance (health) of the parent stock.

The limitation to this approach, especially for species such as shrimp, which live for only one year, is its total dependence on catch, without accounting for external factors such as economic or social conditions that might influence the overall annual landings of a particular species. It is possible that the fishery might not target a species to the extent possible during a given year, and low landings could result from a lack of effort instead of a reduced stock size. Similarly, a stock might undergo a poor recruitment year, but still be relatively healthy, but reduced catch rates combined with economic or social factors might inhibit fishery effort on that stock, and annual landings would decline. Conversely, because of good prices or exceptionally good recruitment, landings might be exceptionally high during a given year, or two-year period. In either situation, the South Atlantic Council would want to further evaluate all the conditions before making a determination regarding the status of the stock, which could delay effective remedial action.

SEAMAP South Atlantic Survey

In accordance with the Technical Guidelines (Restrepo et al. 1998), CPUE data can be used as a proxy for biomass-based parameters including B_{MSY} and current biomass. Until those data become available from the fishery, CPUE-based abundance estimates from fishery-independent Southeast Area Monitoring and Assessment Program - South Atlantic (SEAMAP) data can serve as a proxy to indicate parent stock (escapement). A complete discussion of the SEAMAP Shallow Water Trawl Survey is included in Section 3.1.6 of Amendment 6 to the FMP (SAFMC 2004) and is hereby incorporated by reference. In summary, the SEAMAP survey is funded by the National Marine Fisheries Service and conducted by the South Carolina Department of Natural Resources - Marine Resources Division. This survey provides long-term, fishery-independent data on seasonal abundance and biomass of all finfish, elasmobranchs, decapod and stomatopod crustaceans, sea turtles, horseshoe crabs and cephalopods that are accessible by high-rise trawls. Samples are taken by trawl from Cape Hatteras, North Carolina to Cape Canaveral, Florida. Cruises are conducted in spring (early April - mid-May), summer (mid-July - early August) and fall (October - mid-November).

Current (1990-2011) SEAMAP data indicate that the average escapement results in annual abundance estimates ranging from 21.613 to 1.975 shrimp per hectare for brown shrimp, 1.725 to .089 shrimp per hectare for pink shrimp, and 37.331 to 5.665 shrimp per hectare for white shrimp (**Table 3-4**).

Because of their high sensitivity to certain environmental factors, South Atlantic shrimp show extreme fluctuations in population size. Annual sampling of shrimp from the southeast region indicate that density per hectare have varied by a factor of 5 to 10 and can more than double from one year to the next (**Table 3-4**).

Table 3-4. Annual CPUE (nos/ha) estimates derived from the SEAMAP Shallow water Trawl Survey.

Year	Brown Shrimp	Pink Shrimp	White Shrimp
1990	4.022	0.566	9.028
1991	2.469	0.872	12.880
1992	2.000	0.511	5.868
1993	5.899	0.671	5.665
1994	5.568	0.594	10.606
1995	3.104	1.725	17.535
1996	10.277	0.461	12.913
1997	2.275	0.949	7.447
1998	1.975	0.853	18.256
1999	2.972	0.450	34.799
2000	7.697	0.211	13.060
2001	8.637	0.502	10.454
2002	3.347	0.908	9.186
2003	9.640	0.418	7.372
2004	8.788	0.383	26.492
2005	17.118	0.103	31.036
2006	10.934	0.218	22.385
2007	7.852	0.149	21.044
2008	6.275	0.340	37.331
2009	9.587	0.296	32.330
2010	8.145	0.089	23.302
2011	21.613	0.490	30.022

3.2.2.2 Pamlico Sound Survey as potential data source for development of status determination criteria for pink shrimp stocks

In this Amendment 9 to the Shrimp FMP, the Pamlico Sound Survey data were considered for use in developing status determination criteria for pink shrimp stocks (see **Table 3-5**). (Pamlico Sound Survey methodology and background information in section 3.2.2.2 provided via pers. communication, Jason Rock, Marine Biologist, North Carolina Division of Marine Fisheries.)

The original Pamlico Sound Survey began in March 1987 and has received funding from the North Carolina Division of Marine Fisheries with additional federal funds provided by the SEAMAP program. Beginning in July 2011, the survey is funded through the federal Sport Fish Restoration grant. The primary objective of the Pamlico Sound Survey is to survey population parameters of marine recreational fish stocks in North Carolina. Data collected from the survey have provided juvenile abundance indices and long-term population parameters for interstate and statewide stock assessments of recreationally and commercially important fish stocks.

The survey was initially designed to provide a long-term fishery-independent database for the waters of Pamlico Sound, eastern Albemarle Sound, the lower Neuse, and Pamlico rivers. However, in 1990 all Albemarle Sound sampling was eliminated and the Pungo River was added. Sampling now occurs only in Pamlico Sound and associated rivers and bays in June and September (**Figure 3-4**).

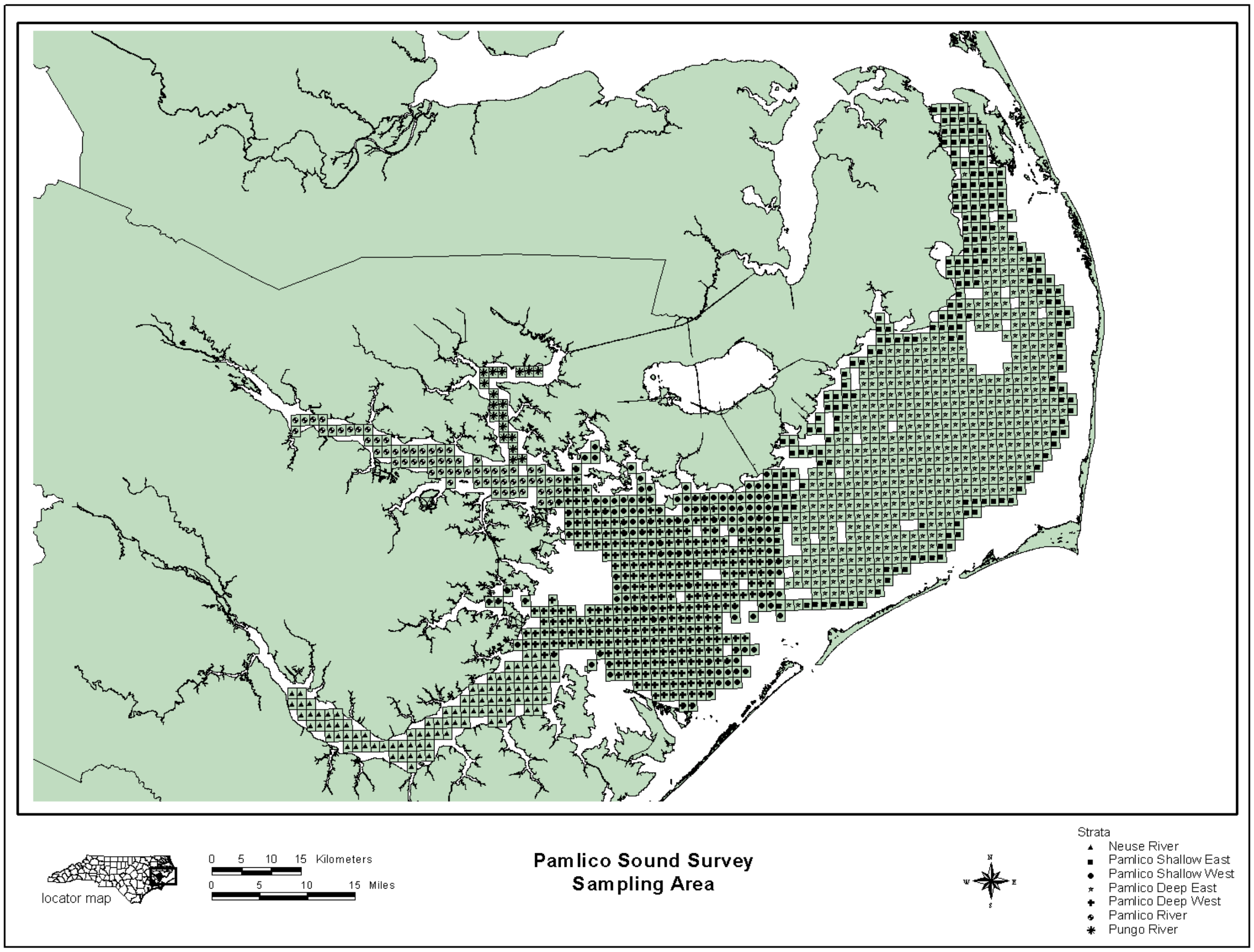


Figure 3-4. Current location and grids of the Pamlico Sound Survey area of eastern North Carolina. Each grid represents a potential sampling station.

From 1991 to the present, the Pamlico Sound Survey has been conducted annually over two weeks in June and September. As a result of scheduling conflicts or adverse weather conditions, there have been four years in which the survey did not occur over the same time two week time series: 1988, 1999, 2003, and 2009.

Pamlico Sound Survey Study Area

From 1987-1989, the survey's sample area covered Pamlico Sound and its bays: Croatan Sound, Roanoke Sound, Albemarle Sound east of a line from the mouth of Alligator River to the mouth of North River, the Pamlico River up to Bath Creek, and the Neuse River up to Minnesott Beach. From 1990 to present, the sample area covers inshore waters of the Pamlico Sound and its bays, the Pamlico River up to Blounts Bay, the Pungo River up to Smith Creek, and the Neuse River up to Upper Broad Creek.

Pamlico Sound Survey Site Selection

Initially survey site stations were allocated in proportion to the size of the strata. Each station is a unique one-minute by one-minute grid (approximately one square nautical mile). One sample is taken per station/grid. The number of stations per strata was determined by the following formula:

$$N_S = N_T*(F_S / F_T)$$ (Cornus 1984)

Where N_S = number of samples per stratum
N_T = total number of samples
F_S = area of stratums
F_T = total survey area

Beginning in March 1989, the randomly drawn stations were optimally allocated among the strata based upon all the previous sampling in order to provide the most accurate abundance estimates (PSE <20) for selected species. A minimum of three stations (replicates) are maintained in each strata, and 5 stations each are set for Neuse and Pamlico rivers and 3 stations for the Pungo River (added in 1990).

From 1990 to 2007, 52-54 randomly selected stations were sampled over a two week period, usually the second and third week of the month in both June and September. The stations sampled are randomly selected from strata based upon depth and geographic location. The seven designated strata are: Neuse River (NR); Pamlico River (PR); Pungo River (PUR); Pamlico Sound east of Bluff Shoal, shallow (PSE) and deep (PDE); and Pamlico Sound west of Bluff Shoal, shallow (PSW) and deep (PDW). Shallow water is considered water depth from 6-12 feet and deep water is considered water greater than 12 feet depth. A minimum of 104 stations were trawled per year. This was done each year so that maximum coverage of area was achieved.

Currently, 108 stations are sampled each year (54 per cruise).

Summary of Data Collected

Environmental and Habitat Data

Physical and environmental conditions such as temperature (^{o}C), salinity (ppt), dissolved oxygen (mg/L), bottom composition, a qualitative assessment of sediment size, and water clarity (began 2008) are recorded at the end of each tow.

Catch Data

The lead biologist inspects the catch to identify modal size categories for species present in high numbers (e.g., greater than 50 individuals of a species). The modal size categories are determined by eye on a tow-to-tow basis rather than a set range of lengths. This procedure is used in lieu of pre-set size ranges to ensure all size classes of a species are adequately sampled at each tow. Biologists sort all of the catch to species (spot, blue crab, Atlantic croaker, etc.) and size class (if applicable) with each species/size in its own fish basket. Once the catch is sorted, all baskets are organized so those of the same species/size class are together and combined when possible.

For finfish, each species is enumerated and a total weight is taken for each species/size class. Individuals of each target species are measured. If present in large numbers, a sub-sample of 30-60 individuals of each target species/size class is measured and a total weight is taken of the measured individuals for each species/size class. If not on the target species list, the species is enumerated and a total weight taken.

For invertebrates, the total weight of all penaeid shrimp and blue crabs is taken for each species. Penaeid shrimp are assessed in the same manner as target finfish species. Other invertebrates will have a total weight for each species group taken and are enumerated. A separate sub-sampling protocol was started in September 2002 (modified 2005) for blue crabs.

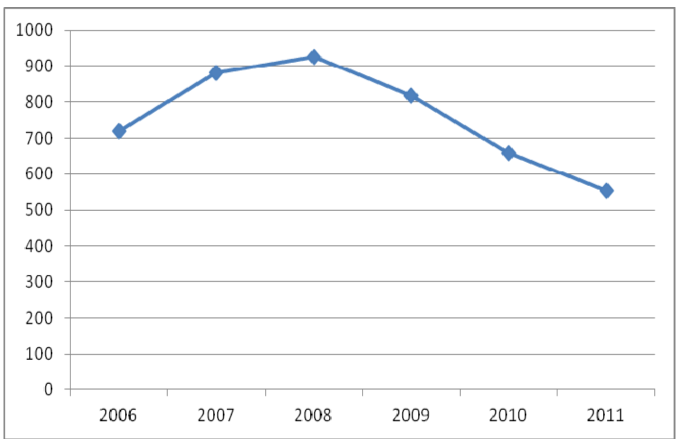
Table 3-5. Annual CPUE estimates (#/ha) for pink shrimp derived from the Pamlico Sound Survey. The annual Pamlico Sound Survey CPUE is the arithmetic weighted mean of the number per tow, a tow equates to 1.951 hectares (NC Division of Marine Fisheries, 2012).

Year	Pink Shrimp
1990	1.030
1991	3.624
1992	9.810
1993	4.695
1994	9.231
1995	18.309
1996	9.462
1997	0.964
1998	13.060
1999	15.141
2000	4.367
2001	1.902
2002	11.266
2003	1.133
2004	2.225
2005	0.492
2006	6.986
2007	3.352
2008	17.786
2009	3.465
2010	0.584
2011	0.528

3.3 Human Environment

3.3.1 Social and Cultural Environment

Because recent South Atlantic shrimp amendments do not address penaeid shrimp, contemporary descriptions of the social environment of this particular fishery are lacking. Blount (2007) documents changes in the Georgia shrimp fishery highlighting the effects of an increasing global market for shrimp and the stresses placed upon fishermen and their communities. Whether all South Atlantic penaeid shrimp fishermen are experiencing the same types of stress is unknown. Yet, because they are exposed to the same market pressures, it is likely that those same factors are having similar impacts on South Atlantic shrimpers from other states. In fact, Griffith (2011) describes South Carolina shrimp fishermen as experiencing comparable effects from increasing imports and utilizing similar marketing strategies as those used by Georgia shrimp fishermen to combat lower prices and increase sales. These same issues were reflected in recent surveys conducted among North Carolina fishermen who cited rising fuel costs and low prices for seafood as their primary challenges (Crosson 2007a, 2007b).



Total South Atlantic Shrimp Permits 2006-2011 (SERO 2011)

Figure 3-5. Total number of South Atlantic Shrimp Permits 2006-2011 (SERO 2011).

While it is difficult to ascertain the current condition of the South Atlantic shrimp fishery from secondary data, over the past few years there has been a decline in the number of permits (**Figure 3-5**). Whether this is due to current market forces or the more general economic downturn that has affected the economy overall is unknown, however, the industry is likely facing difficult times as the economy recovers at a slow pace and it still faces high fuel prices and continuing competition from imports for market share. The economic surveys of recent years indicate that those fishermen who are flexible and able to fish other species are better off economically, but those who primarily fish South Atlantic penaeid shrimp are operating at a loss (NMFS 2011a). With such a precarious economic climate, the South Atlantic shrimp fleet may be economically vulnerable to fluctuations in resource availability that could have further social impacts on the industry overall. Whether that vulnerability would be affected by short-term closures of the fishery due to cold weather is not known, but the longer-term effects of a reduced stock the next year could certainly have important social effects.

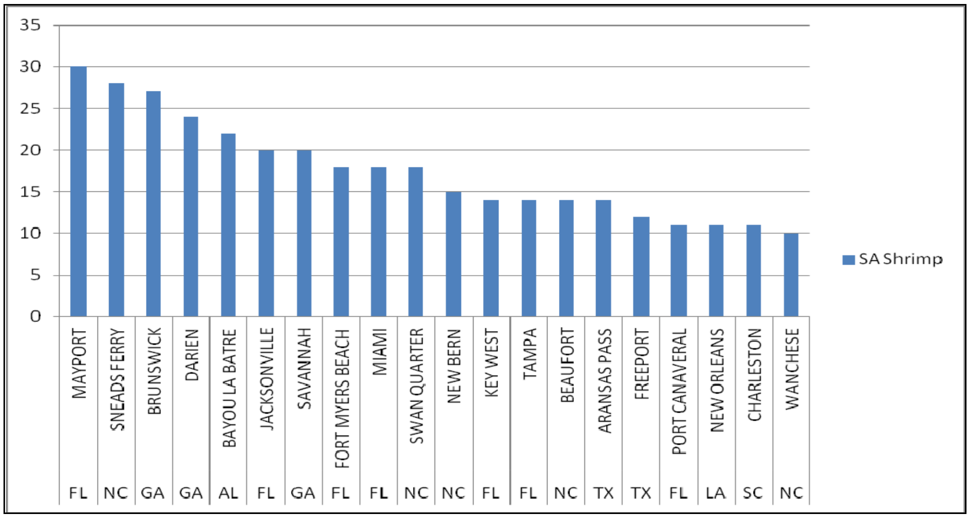


Figure 3-6. The top twenty fishing communities with South Atlantic shrimp permits in 2010 (SERO 2010).

As seen in **Figure 3-6**, fishing communities with the majority of South Atlantic shrimp permits are not confined to this region. Several communities located in the Gulf of Mexico region are among the top twenty communities with South Atlantic shrimp permits. These Gulf of Mexico vessels are likely participants in the rock shrimp fishery who seasonally migrate to South Atlantic waters and have so since the mid-1990s and are limited participants in the South Atlantic penaeid shrimp fishery. For South Atlantic states, the majority of permits are in located in Florida, North Carolina, and Georgia.

Table 3-6. South Atlantic shrimp permits for top ten communities by South Atlantic state (SERO 2010).

South Carolina	Sum	North Carolina	Sum	Georgia	Sum	Florida	Sum
Charleston	11	Sneads Ferry	28	Brunswick	27	Jacksonville	20
McClellanville	9	Swan Quarter	18	Darien	24	Fort Myers Beach	18
Frogmore	4	New Bern	15	Savannah	20	Miami	18
Georgetown	4	Beaufort	14	Townsend	7	Key West	14
Mount Pleasant	4	Wanchese	10	Valona	4	Tampa	14
Bluffton	3	Belhaven	8	Sunbury	3	Port Canaveral	11
Hilton Head	3	Lowland	8	Lyons	2	Fernandina Beach	9
Edisto Beach	2	Supply	7	Meridian	2	Fort Myers	7
Murrells Inlet	2	Engelhard	5	Saint Marys	2	Hickory Island	5
Port Royal	2	Southport	5	Saint Simons Isl	2	Tarpon Springs	5

The top communities within each state for South Atlantic shrimp permits are listed in **Table 3-6**, although these are not necessarily vessels who actively land shrimp. In fact, it is only when landings by species are reported that those communities most actively involved become apparent.

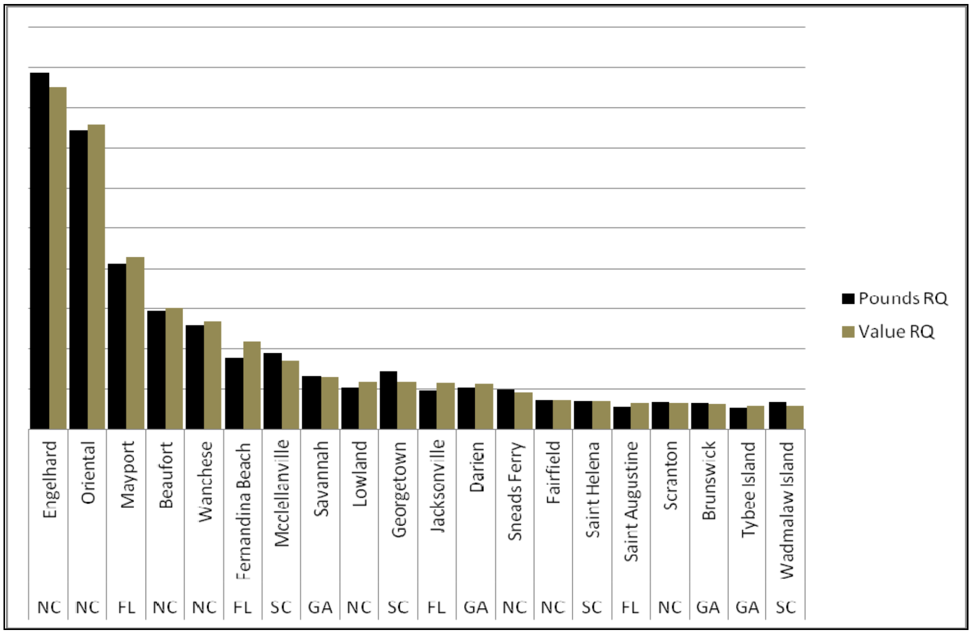


Figure 3-7. Top twenty fishing communities in the South Atlantic by regional quotient (RQ) of brown shrimp landings and value in 2010 (ALS 2011).

Most brown shrimp in the South Atlantic are landed in North Carolina with four communities having the highest regional quotients[1] (**Figure 3-7**). Engelhard and Oriental have the highest RQs for pounds and value respectively. Mayport, FL is next while both Beaufort, North Carolina and Wanchese, North Carolina complete the top five. The rest of the communities have less than 5% of the regional quotient of landings and value for brown shrimp.

For white shrimp, the communities with the highest regional quotient tend to be further south in Florida and Georgia as shown in **Figure 3-8**. Mayport, FL has the highest RQ of pounds and value of white shrimp landed for the region. The next closest communities are Savannah, Georgia and Darien, Georgia. McClellanville, South Carolina is fourth with Fernandina Beach, Florida and Jacksonville, Florida even with regard to value of landed pounds but Jacksonville has a higher pounds RQ than Fernandina.

[1] Regional quotient is the share of pounds and value landed for a particular species within a community in relation to all landings and value in the region.

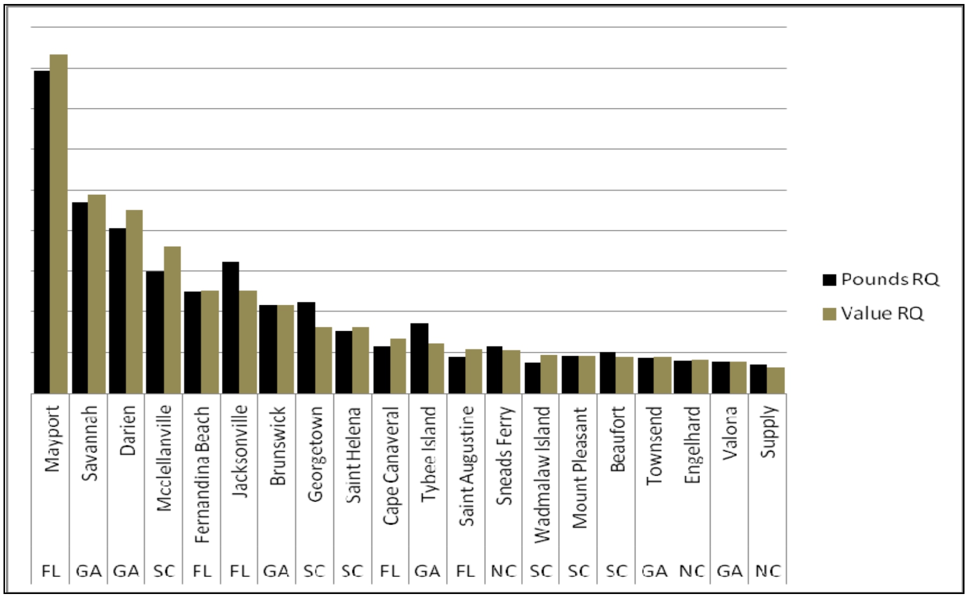


Figure 3-8. Top twenty fishing communities in the South Atlantic by Regional Quotient of white shrimp landings and value (ALS 2011).

For pink shrimp, it is not possible to separate Gulf of Mexico landings from South Atlantic landings at the community level; therefore, **Figure 3-9** shows Key West, Florida as leading all communities in pounds landed and value for regional quotient of pink shrimp. Opa-Locka, Florida, near north Miami, is a distant second.

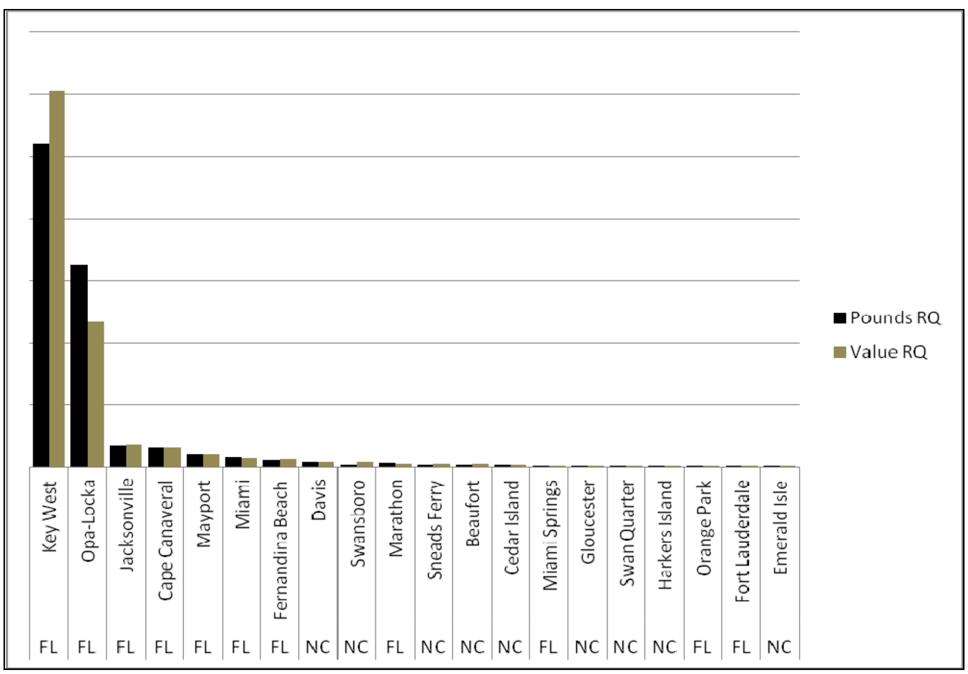


Figure 3-9. Top twenty fishing communities in the South Atlantic by Regional Quotient of pink shrimp landings and value (ALS 2011).

To examine South Atlantic shrimp fishing communities in terms of their fishing engagement and reliance, an index was created for both categories of fishing activity (Colburn and Jepson 2012; Jacob et al. 2012). Using a principal component, single solution factor analysis on the variables numbers of commercial permits, value and pounds of landings, two indices were created for each community, which can be ranked on factor scores for each index. Fishing reliance has many of the same variables as engagement but population divides each variable. Each community's factor score is located on the axis radiating out from the center of the graph to its name. Factor scores are connected by colored lines and are standardized, therefore the mean is zero. A threshold of one standard deviation above the mean was chosen. Although most communities are near the threshold in **Figure 3-10**, several communities have factor scores on both indices that exceed 1 standard deviation above the mean. The communities of Key West, Florida; Marathon, Florida; Darien, Georgia; Beaufort, North Carolina; Wanchese, North Carolina; and McClellanville, South Carolina all exceed the threshold of 1 standard deviation above the mean for both commercial fishing engagement and reliance. These communities can be considered dependent upon commercial fishing and therefore more reactive to changes in fishing regulations.

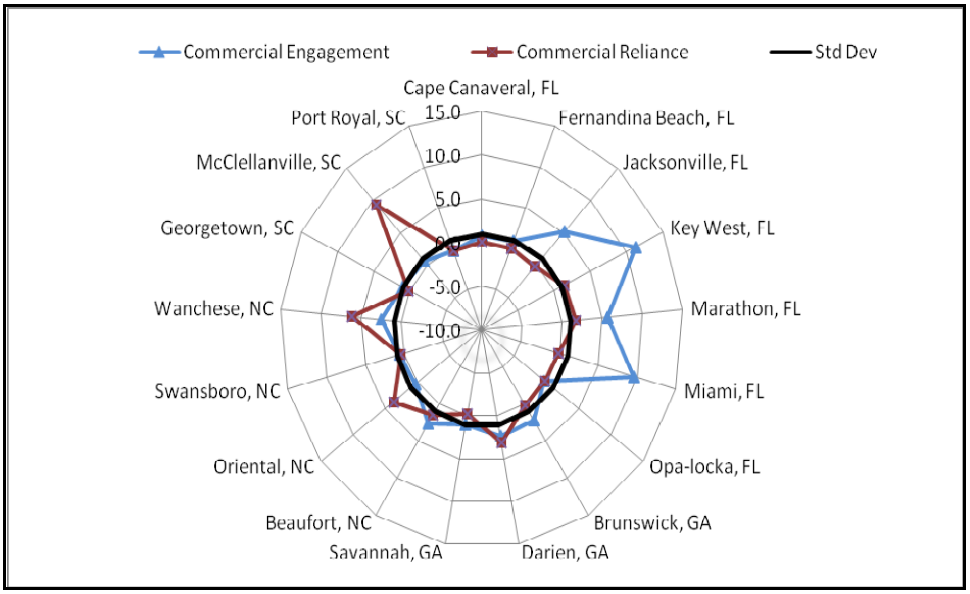


Figure 3-10. Commercial engagement and reliance for the top South Atlantic shrimp communities (SERO 2012).

Another suite of indices were created to examine the social vulnerability/resilience of coastal communities and is depicted in **Figure 3-11**. The three indices are poverty, population composition, and personal disruptions. The variables included in each of these indices have been identified through the literature as being important components that contribute to a community's vulnerability. Again, for those communities that exceed the threshold it would be expected that they would exhibit vulnerabilities to sudden changes or social disruption that might accrue from regulatory change.

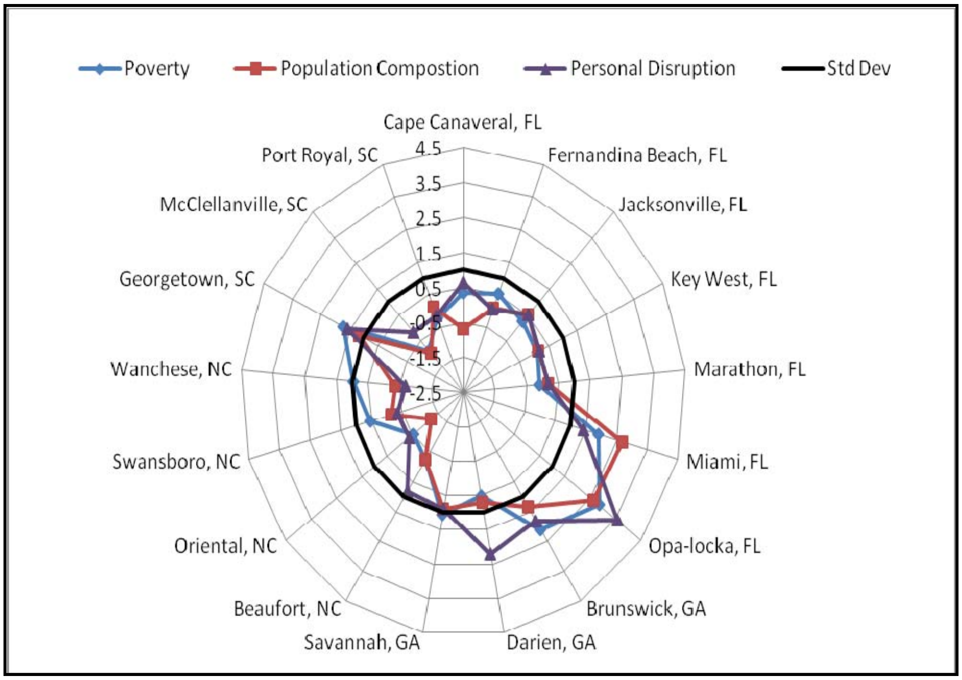


Figure 3-11. Social vulnerability and resilience for the top South Atlantic shrimp communities (SERO 2012).

As shown in **Figure 3-11** the communities of Miami, Florida; Opa-Locka, Florida; Brunswick, Georgia; Darien, Georgia; Savannah, Georgia; and Georgetown, South Carolina all exceed the threshold for social vulnerability of one standard deviation above the mean. It would be expected that these communities would be especially vulnerable to any social or economic disruption as a result of regulatory change.

Environmental Justice

Executive Order 12898 requires federal agencies conduct their programs, policies, and activities in a manner to ensure individuals or populations are not excluded from participation in, or denied the benefits of, or subjected to discrimination because of their race, color, or national origin. In addition, and specifically with respect to subsistence consumption of fish and wildlife, federal agencies are required to collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence. This executive order is generally referred to as environmental justice (EJ).

Information on the communities discussed above was examined to identify the potential for EJ concern. Specifically, the rates of minority populations and the percentage of the population below the poverty line were examined. The threshold for comparison used was 1.2 times the state average such that, if the value for the community was greater than or equal to 1.2 times the state average, then the community was considered an area of potential environmental justice concern. Census data for the year 2010 were used for this analysis.

Based on the demographic information for each community, the communities of Opa-Locka, Florida; Brunswick, Georgia; Savannah, Georgia; and Georgetown, South Carolina all exceed the threshold for minority populations. The communities of Miami, Florida; Opa-Locka, Florida; Brunswick, Georgia; Darien, Georgia; Savannah, Georgia and Georgetown, South Carolina all exceed the threshold for poverty. These thresholds are highly correlated with the social vulnerability indices discussed above. These communities are considered vulnerable if regulatory action were to cause some type of social disruption.

3.3.2 Economic Environment

Permit Totals and Average Vessel Revenue

A description of the economics of the 2009 federal South Atlantic shrimp fishery is contained in NMFS (2011a) and is incorporated herein by reference. The report can be found at: http://www.sefsc.noaa.gov/docs/2009%20SA%20shrimp%20econ%20report.pdf. A report on the 2010 fishery is not currently available. Information on South Atlantic shrimp landings through 2010, ex-vessel values, and shrimp imports is available at http://www.st.nmfs.noaa.gov/st1/index.html. The following provides a brief summary of select information from NMFS (2011a) and estimates of business activity (economic impacts) associated with shrimp revenues in 2009. Both penaeid and rock shrimp are harvested in the South Atlantic shrimp fishery. However, because the focus of this proposed amendment is on penaeid shrimp, the following information primarily relates to activity associated with penaeid harvest.

A federal permit is required to commercially harvest shrimp in federal South Atlantic waters. Three South Atlantic federal shrimp permits exist: an open access penaeid shrimp permit, an open access rock shrimp permit (allows the harvest of rock shrimp in federal waters north of the South Carolina-Georgia border), and a limited access rock shrimp permit (allows the harvest of rock shrimp in federal waters south of the South Carolina-Georgia border). In 2009, an estimated 733 vessels held one or more South Atlantic shrimp permits, of which 692 held a permit for penaeid shrimp. However, only 324 of these vessels landed South Atlantic penaeid shrimp (penaeid shrimp harvested in South Atlantic waters) in 2009. Although information on more recent harvest activity is not available, on April 13, 2012, there were 546 valid (non-expired or renewable) South Atlantic federal penaeid shrimp permits (NMFS, Southeast Regional Office).

Vessels with South Atlantic federal penaeid shrimp permits often harvest shrimp in the Gulf of Mexico and South Atlantic and non-shrimp species in the Gulf of Mexico, South Atlantic, and Northeast region. In 2009, among the 692 vessels with a federal penaeid shrimp permit, the average vessel (total revenues averaged across all 692 vessels) received approximately $35,100 from penaeid shrimp harvested in the South Atlantic; $85,100 from penaeid shrimp harvested in the Gulf of Mexico; $4,500 from rock shrimp harvested in the South Atlantic; $73,400 from non-shrimp species harvested in the South Atlantic, Gulf of Mexico, and Northeast region; and $3,200 from government payments (e.g., distribution of monies collected from imports on imported shrimp), or a total of approximately $201,300 (2009 dollars). Average profit for these 692 vessels in 2009 was approximately $9,000.

For the 324 vessels with South Atlantic penaeid shrimp landings, the average vessel received approximately $75,900 from penaeid shrimp harvested in the South Atlantic; $3,200 from penaeid shrimp harvested in the Gulf of Mexico; $9,700 from rock shrimp harvested in the South Atlantic; and $68,100 from non-shrimp species harvested in the South Atlantic, Gulf of Mexico, and Northeast region; and $1,200 from government payments, or a total of approximately $158,000 (2009 dollars). Average profit for these 324 vessels in 2009 was approximately $5,400.

A comparison of the results of the two groups of vessels suggests that vessels that actually harvested South Atlantic penaeid shrimp were more dependent on revenue from these species (approximately 48% of total average annual revenue) than all permit holders (approximately 18% of total average annual revenue) and more dependent on non-shrimp revenue (approximately 43% of total average annual revenue) than all permit holders (approximately 37% of total average annual revenue).

Business Activity

Estimates of the business activity (economic impacts) in the U.S. associated with shrimp harvests by vessels landing South Atlantic penaeid shrimp were derived using the model developed for and applied in NMFS (2011b). Business activity for the commercial sector is characterized in the form of full-time equivalent (FTE) jobs, income impacts (wages, salaries, and self-employed income), and output (sales) impacts (gross business sales). Income impacts should not be added to output (sales) impacts because this would result in double counting. The estimates of economic activity include the direct effects (effects in the sector where an expenditure is actually made), indirect effects (effects in sectors providing goods and services to directly affected sectors), and induced effects (effects induced by the personal consumption expenditures of employees in the direct and indirectly affected sectors).

The estimates of business activity were based on revenue from all shrimp landings, regardless of species (penaeid or rock shrimp) or area fished (South Atlantic or Gulf of Mexico). Total revenue in 2009 for all shrimp harvested by vessels with a South Atlantic shrimp permit was approximately $28.75 million (2009 dollars). The business activity associated with this revenue is estimated to be 7,021 FTE jobs (661 harvester jobs), approximately $208.75 million in income impacts, and approximately $495.06 million in output (sales) impacts. Comparable estimates for the business activity associated with revenue from non-shrimp species harvested in 2009 by these vessels (approximately $22.06 million, 2009 dollars) are not available because the species harvested were not identified in the summary report (NMFS 2011a).

3.4 Administrative Environment

3.4.1 The Fishery Management Process and Applicable Laws

3.4.1.1 Federal Fishery Management

Federal fishery management is conducted under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (16 U.S.C. 1801 et seq.), originally enacted in 1976 as the Fishery Conservation and Management Act. The Magnuson-Stevens Act claims sovereign rights and exclusive fishery management authority over most fishery resources within the U.S. EEZ, an area extending 200 nautical miles from the seaward boundary of each of the coastal states, and authority over U.S. anadromous species and continental shelf resources that occur beyond the U.S. EEZ.

Responsibility for federal fishery management decision-making is divided between the U.S. Secretary of Commerce and eight regional fishery management councils that represent the expertise and interests of constituent states. Regional councils are responsible for preparing, monitoring, and revising management plans for fisheries needing management within their jurisdiction. The Secretary of Commerce (Secretary) is responsible for collecting and providing the data necessary for the councils to prepare fishery management plans and for promulgating regulations to implement proposed plans and amendments after ensuring that management measures are consistent with the Magnuson-Stevens Act and with other applicable laws. In most cases, the Secretary has delegated this authority to the National Marine Fisheries Service.

The South Atlantic Council is responsible for conservation and management of fishery resources in Federal waters of the U.S. South Atlantic. These waters extend from 3 to 200 miles offshore from the seaward boundary of the States of North Carolina, South Carolina, Georgia, and east Florida to Key West. The South Atlantic Council has thirteen voting members: one from the National Marine Fisheries Service; one each from the state fishery agencies of North Carolina, South Carolina, Georgia, and Florida; and eight public members appointed by the Secretary. On the South Atlantic Council, there are two public members from each of the four South Atlantic States. Non-voting members include representatives of the U.S. Fish and Wildlife Service, U.S. Coast Guard, State Department, and Atlantic States Marine Fisheries Commission (ASMFC). The South Atlantic Council has adopted procedures whereby the non-voting members serving on the Council Committees have full voting rights at the Committee level but not at the full Council level. South Atlantic Council members serve three-year terms and are recommended by State Governors and appointed by the Secretary of Commerce from lists of nominees submitted by State governors. Appointed members may serve a maximum of three consecutive terms.

Public interests also are involved in the fishery management process through participation on Advisory Panels and through council meetings, which, with few exceptions for discussing personnel matters, are open to the public. The South Atlantic Council uses a Scientific and Statistical Committee to review the data and science being used in assessments and fishery management plans/amendments. In addition, the regulatory process is in accordance with the Administrative Procedures Act, in the form of “notice and comment” rulemaking.

3.4.1.2 State Fishery Management

The state governments of North Carolina, South Carolina, Georgia, and Florida have the authority to manage fisheries that occur in waters extending three nautical miles from their respective shorelines. North Carolina's marine fisheries are managed by the Marine Fisheries Division of the North Carolina Department of Environment and Natural Resources. The Marine Resources Division of the South Carolina Department of Natural Resources regulates South Carolina's marine fisheries. Georgia's marine fisheries are managed by the Coastal Resources Division of the Department of Natural Resources. The Marine Fisheries Division of the Florida Fish and Wildlife Conservation Commission is responsible for managing Florida's marine fisheries. Each state fishery management agency has a designated seat on the South Atlantic Council. The purpose of state representation at the Council level is to ensure state participation in Federal fishery management decision-making and to promote the development of compatible regulations in state and Federal waters.

The South Atlantic States are also involved through the Atlantic States Marine Fisheries Commission (ASMFC) in management of marine fisheries. This commission was created to coordinate state regulations and develop management plans for interstate fisheries. It has significant authority, through the Atlantic Striped Bass Conservation Act and the Atlantic Coastal Fisheries Cooperative Management Act, to compel adoption of consistent state regulations to conserve coastal species. The ASFMC is also represented at the South Atlantic Council level, but does not have voting authority at the South Atlantic Council level.

The National Marine Fisheries Service's State-Federal Fisheries Division is responsible for building cooperative partnerships to strengthen marine fisheries management and conservation at the state, inter-regional, and national levels. This division implements and oversees the distribution of grants for two national (Inter-jurisdictional Fisheries Act and Anadromous Fish Conservation Act) and two regional (Atlantic Coastal Fisheries Cooperative Management Act and Atlantic Striped Bass Conservation Act) programs. Additionally, it works with the ASMFC to develop and implement cooperative State-Federal fisheries regulations.

3.4.1.3 Enforcement

Both the National Oceanic and Atmospheric Administration (NOAA) Fisheries Office for Law Enforcement (NOAA/OLE) and the United States Coast Guard (USCG) have the authority and the responsibility to enforce South Atlantic Council regulations. NOAA/OLE agents, who specialize in living marine resource violations, provide fisheries expertise and investigative support for the overall fisheries mission. The USCG is a multi-mission agency, which provides at sea patrol services for the fisheries mission.

Neither NOAA/OLE nor the USCG can provide a continuous law enforcement presence in all areas due to the limited resources of NOAA/OLE and the priority tasking of the USCG. To supplement at sea and dockside inspections of fishing vessels, NOAA entered into Cooperative Enforcement Agreements with all but one of the States in the Southeast Region (North Carolina), which granted authority to State officers to enforce the laws for which NOAA/OLE has jurisdiction. In recent years, the level of involvement by the States has increased through Joint Enforcement Agreements, whereby States conduct patrols that focus on Federal priorities and, in some circumstances, prosecute resultant violators through the State when a state violation has occurred.

NOAA General Counsel issued a revised Southeast Region Magnuson-Stevens Act Penalty Schedule in June 2003, which addresses all Magnuson-Stevens Act violations in the Southeast Region. In general, this Penalty Schedule increases the amount of civil administrative penalties that a violator may be subject to up to the current statutory maximum of $120,000 per violation. NOAA General Counsel requested public comment through December 20 2010, on a new draft policy.

Chapter 4. Environmental Consequences

4.1 Action 1. Specify criteria that triggers a state's ability to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

Alternative 1. No Action. Currently, as defined under the fishery management plan (FMP) for the South Atlantic shrimp fishery, states may request a concurrent closure of the exclusive economic zone (EEZ) adjacent to their closed state waters following severe winter weather upon providing information that demonstrates an 80% or greater reduction in the population of overwintering white shrimp.

Alternative 2. A state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 7°C (45°F) or below for at least one week.

Alternative 3. A state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 8°C (46°F) or below for at least one week.

Alternative 4. A state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 9°C (48°F) or below for at least one week.

Preferred Alternative 5. States may request a concurrent closure of the EEZ adjacent to their closed state waters following severe winter weather upon providing information that demonstrates an 80% or greater reduction in the population of overwintering white shrimp, or, a state may request a concurrent closure upon providing information that demonstrates an exceeded threshold for water temperature. Water temperature must be 9°C (48°F) or below for at least one week.

4.1.1 Biological Effects

As stated in Section 3.2 of this document, penaeid shrimp, especially white shrimp, are highly vulnerable to fluctuations in water temperature. Water temperature directly or indirectly influences white shrimp spawning, growth, habitat selection, osmoregulation, movement, migration, and mortality (Muncy 1984). Spring water temperature increases trigger spawning, and rapid water temperature declines in fall portend the end of spawning (Lindner and Anderson 1956). Growth is fastest in summer and slowest or negligible in winter. Water temperatures below 68°F (20°C) inhibit growth of juvenile shrimp (Etzold and Christmas 1977) and growth is virtually nil at 61°F (16°C) (St. Amant and Lindner 1966). Growth rates increase rapidly as temperatures increase above 68°F (20°C).

During years when inshore overwintering white shrimp stocks are greatly reduced due to cold water temperature or heavy rain, management action may accelerate recovery of the stocks and increase fall production by protecting the few remaining spawners that survive a freeze. Also, elimination of winter and spring fishing mortality off southern Georgia and Florida may enable a greater quantity of potential spawners to move north, possibly resulting in larger regional white shrimp stocks the following fall. In years when the overwintering adult population is significantly reduced due to severe winter weather, the additional mortality caused by fishing can result in a further reduction in subsequent fall production (SAFMC 1996b).

Under **Alternative 1 (No Action)**, white shrimp relative abundance following a winter kill is compared with the historical long-term mean catch per unit effort (CPUE) for that month, or the average CPUE in samples taken prior to the onset of the cold weather are compared to CPUE in samples taken immediately after and within two weeks of the winter kill to determine if the overwintering population has decreased by 80% or more. If this criterion is met, then the affected state could request a closure of the penaeid shrimp fishery in federal waters concurrent with a closure of adjacent state waters to penaeid shrimp harvest.

The rationale for allowing states to request concurrent closures of federal waters for overwintering shrimp (**Alternative 1; No Action**) according to the Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region (SAFMC 1993) was to protect the small portion of overwintering shrimp that could survive a cold weather event by moving offshore and south. In the spring, some remaining adult white shrimp are thought to move north to spawn, providing some postlarval recruitment for northern Georgia, South Carolina, and lower North Carolina. If federal waters were not closed to harvest of penaeid shrimp, vessels could continue to fish on the roe shrimp, legally in federal water and illegally in state waters, causing enforcement difficulties. At the time the FMP was developed, available data suggested that in years when cold water events occurred, continued fishing on the roe shrimp could significantly reduce the capacity of the fall white shrimp crop to rebound. Furthermore, revenue generated by the increased abundance of white shrimp in the fall is greater than what is generated by the smaller spring harvest of roe shrimp in the absence of a concurrent closure.

Each South Atlantic state monitors shrimp abundance and water temperature. North Carolina Division of Marine Fisheries (NC DMF) conducts several monitoring programs throughout the year where water temperature is taken. Monthly sampling locations include the near-shore ocean off the southern coast of North Carolina, several riverine systems, Pamlico Sound, and Albemarle Sound. Water temperature, salinity, and dissolved oxygen are recorded on the surface and bottom during each gill net set. Other data sources for temperature include Albemarle Sound Water Quality Monitoring and NOAA Ocean Buoy data (Personal communication Trish Murphey 2012). North Carolina does not collect penaeid shrimp mortality data relative to temperature.

South Carolina currently collects water temperature information. The South Carolina Department of Natural Resources (SC DNR) uses the U.S. Geological Service (USGS) data found at http://waterdata.usgs.gov/sc/nwis/uv?021720710. USGS takes readings every 15 minutes, and SC DNR calculates a daily average for the temperatures (Personal communication Larry DeLancey 2012). South Carolina is the state that requests concurrent closure of federal waters for overwintering shrimp most frequently. The SC DNR uses 8°C (46°F) (**Preferred Alternative 3**) as a critical water temperature threshold. In years where the water temperature off South Carolina has dipped below 8°C (46°F), high penaeid shrimp mortality rates have been observed. Fall production in the South Carolina commercial shrimp fishery after a winter freeze is approximately 1.0 million pounds compared to 2.5-3.0 million pounds in years with no winter freeze (SC DNR 2012) (**Figure 4-1**). When the temperature falls below 7°C (45°F) acute mortalities have been observed. In the temperature range of 8°C (46°F) to 7°C (45°F) shrimp become torpid and may be swept along the bottom by currents; these shrimp are likely to perish due to entanglement, physical damage, and starvation (Lam et al. 1989).

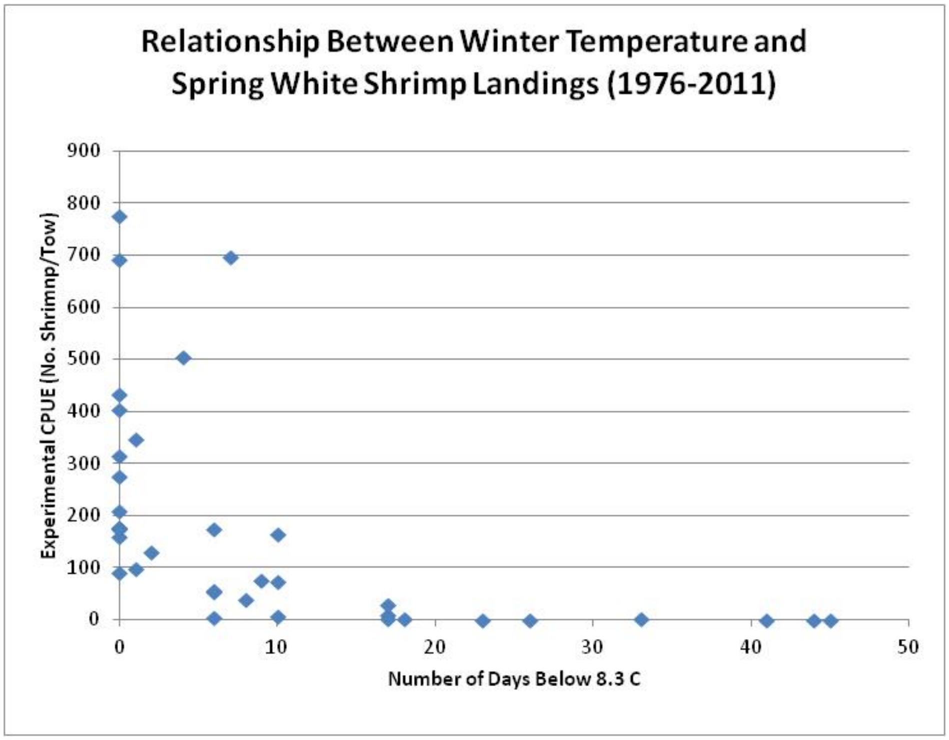


Figure 4-1. Relationship between winter temperature and spring white shrimp landings for 1976-2011 (SC DNR 2012).

Table 4-1. History of winter temperatures and related white shrimp catch per unit effort (CPUE) from 1976-2011 (SC DNR 2012).

	Highlighted years are those with low CPUE's (<10 shrimp per tow)							
			Charleston Harbor Water Temperature					
	March Fishery Independent CPUE mean/tow	Spring White Shrimp Commercial Landings x 1000 lbs	Number of Days < 7.0 °C	Number of Days < 8.0 °C	Number of Days < 8.3 °C	Number of Days < 9.0 °C	Number of Days < 10 °C	Number of Days < 12 °C
1976	504	666	1	3	4	11	31	54
1977	0	0	28	41	44	58	65	91
1978	0	0	20	38	45	60	63	93
1979	1	28	1	16	18	35	49	77
1980	163	243	3	8	10	19	26	84
1981	0	2	19	35	41	51	53	64
1982	6	35	1	6	10	20	31	81
1983	174	230	0	4	6	19	35	68
1984	1	1	8	32	33	42	49	71
1985	0	3	10	16	23	30	39	54
1986	3	21	0	4	6	7	21	64
1987	98	304	0	0	1	3	19	71
1988	9	5	6	14	17	23	38	64
1989	159	398	0	0	0	0	2	39
1990	29	25	12	16	17	20	28	49
1991	177	837	0	0	0	1	2	23
1992	692	618	0	0	0	0	3	40
1993	432	826	0	0	0	1	6	54
1994	37	92	2	7	8	14	37	63
1995	346	890	0	0	1	3	11	42
1996	52	62	0	1	6	11	34	71
1997	208	462	0	0	0	2	6	45
1998	775	800	0	0	0	0	0	32
1999	276	600	0	0	0	0	2	21
2000	698	875	0	6	7	15	18	34
2001	0	1	6	16	17	27	37	69
2002	90	296	0	0	0	0	6	20
2003	56	100	2	5	6	13	31	72
2004	129	400	0	0	2	7	31	76
2005	74	80	0	9	10	18	32	69
2006	404	458	0	0	0	0	0	33
2007	175	364	0	0	0	0	4	31
2008	315	352	0	0	0	0	7	26
2009	177	320	0	0	0	0	4	49
2010	76	202	3	8	9	21	44	74
2011	0	20	4	20	26	47	61	74
2012	210	627	0	0	0	0	0	11
cpue <10	Averages	10.5	9.4	21.6	25.5		46	72.9
cpue >10	Averages	420	0.9	2.7	3.5		16.8	49.6

Table 4-1 highlights the years when white shrimp CPUE declined due to cold weather events with temperatures between 12°C (53.6°F) and 7°C (45°F).

Once the water temperature falls below 10°C (50°F), shrimp that would typically have remained in the estuary over the winter tend to migrate seaward into the EEZ where they can be captured by federally permitted shrimpers (SC DNR 2012). As the temperature decreases this migration into federal waters becomes more pronounced and more shrimp become vulnerable to fishing pressure, which is why it is important for the National Marine Fisheries Service (NMFS) to be able to expeditiously close federal waters to penaeid shrimping when needed. Other factors such as how quickly the temperature decreases, winds, tides, salinity and rainfall may also affect penaeid shrimp mortality; therefore, temperature alone may not be the most appropriate trigger for states to request concurrent closures of federal waters. However, the SC DNR is concerned that the current closure criterion of 80% mortality, which requires several courses of sample trawls, uses critical time that could be dedicated to implementing a concurrent closure in federal waters resulting in more expedient protections for overwintering shrimp.

The Georgia Department of Natural Resources (GA DNR) conducts a monthly Ecological Monitoring Trawl Survey that collects data on water temperature in 6 different estuaries along the coast. Trawl locations include large creeks and rivers, open sounds, and nearshore ocean waters associated with the state's territorial waters from the beaches to three miles offshore. Forty two stations are sampled each month with standardized 15-minute tow times using a 40 ft (12.2 m) flat trawl with $1^{7/8}$ in (4.8 cm) stretch-mesh. GA DNR collects surface and bottom temperature data at each station (Personal communication Jim Page 2012).

Georgia sampling cruises are conducted during the first half of the month on neap tides when possible. Three northern estuaries are sampled together within a two-three day window. Three southern estuaries are typically sampled within the same week but may not occur on a week adjacent to sampling in the northern half of the coast. The catch for each tow is brought onboard and identified to the species level, and data such as length, weight, and total numbers are collected for each species. GA DNR reports that for years where the water temperature fell below 7°C (45°F) and 8°C (46°F) no penaeid shrimp mortality was observed. However, when the water temperature fell below 9°C (48°F) mortality was 0.17%, and in 2010, the last year Georgia reported cold weather mortality, the mortality rates ranged between 43% to 100% (Personal communication Jim Page 2012).

Florida Fish and Wildlife Conservation Commission (FL FWCC) collects water quality data as part of routine monthly fisheries-independent monitoring. Along the Atlantic coast of Florida this survey is conducted in northeast Florida and in the Indian River Lagoon in central Florida. FL FWCC collects water quality data monthly and readings are taken at the surface and bottom. If the water depth is greater than 1.0 m, readings are taken at the surface each 1 m interval, and at the bottom (Personal communication, Richard Paperno 2012).

Because water temperature is such an important factor in protecting and assessing white shrimp populations throughout the year, the South Atlantic Fishery Management Council (South Atlantic Council) determined it would be appropriate to use a temperature parameter (**Alternatives 2-4**), in lieu of the abundance reduction criteria for states requesting concurrent closures of federal waters for overwintering shrimp. However, many other factors may also influence shrimp mortality including winds, tides, and weather events such as hurricanes. Therefore, using temperature alone as the trigger used by states to request concurrent closures of federal water to protect overwintering shrimp may inadvertently exclude other reasonable triggers that could be used to request concurrent closures. However, if there is a foul weather event, or some anomalous condition resulting in high penaeid shrimp mortality, other options for implementing a concurrent closure of federal waters are available. Emergency action could be taken by the NMFS if an emergency situation were to present itself; however, emergency actions taken under the Magnuson-Stevens Fishery Conservation and Management Act may require more time to implement than the time it would take the states to draft a letter to the agency and for the NMFS to act on the request.

The range of temperatures in **Alternatives 2-4** represents input from the Shrimp Advisory Panel as well as the Shrimp Review Panel. The lower the temperature threshold is set, the less likely the temperature criterion would be met for a state requesting a closure of federal waters to penaeid shrimp harvest when state waters close. Therefore, **Alternative 2** would have the smallest biological benefit since a federal closure of the shrimp fishery would be less likely than under **Alternative 3** or **Alternative 4**. Alternately, **Alternative 4** would be most biologically beneficial because it is the highest temperature option under consideration, and the concurrent closure criteria for federal waters would more easily be met. **Alternative 3** represents a mid-point between **Alternatives 2** and **4**, and would likely result in biological benefits greater than **Alternative 2**, but less than **Alternative 4**.

Preferred Alternative 5 would allow the states to choose which triggering criterion, either temperature or abundance, it would use to determine if it is appropriate to request a closure of federal waters, concurrent with a state closure to penaeid shrimp fishing to protect overwintering shrimp stocks. This option is likely to be the most biologically beneficial of all the alternatives considered because it does not limit or force states to use triggering criteria that may not be ideally captured in their current environmental sampling programs. Allowing states to utilize the triggering criterion of their choice would possibly minimize their burden to develop a monitoring system designed to assess a criterion not previously measured, or to use data from a sampling program that may not truly represent the current condition of the stock. All of these factors would aid in expediting a state’s ability to gather and assess either temperature or abundance data and quickly request a closure of federal waters concurrent with closing state waters to penaeid shrimp harvest, if needed.

It is important to note that this action would not modify the criteria under which a closure is lifted and areas are reopened to penaeid shrimp fishing.

4.1.2 Economic Effects

Alternative 1 (No Action) allows states to request a closure in the EEZ off their state, presuming the state has already closed state waters and can provide evidence demonstrating a reduction of at least 80% in the population of overwintering white shrimp. The evidence provided to request a closure to penaeid shrimp harvest in federal waters is up to the state and could vary across states. **Alternatives 2–5 (Preferred)** would establish a different standardized method using a water temperature and/or population reduction threshold for determining when a state can ask for a concurrent prohibition of penaeid shrimp harvest in adjacent federal waters. A change in methodology would be expected to generate negative, indirect economic effects on fishermen in the winter and spring seasons due to an earlier closure of penaeid shrimp in federal waters after severe winter weather. However, preserving relatively more of the remaining spawning biomass will enhance stock size and production in the following fall season, which would in turn generate greater, positive indirect economic effects over the course of the fishing year since fall is the peak harvesting season for white shrimp (see **Table 4-2**).

Status quo, **Alternative 1 (No Action)**, is not expected to generate any indirect economic effects since the harvest of shrimp would be expected to occur later into the winter and spring seasons, as it has in the past when cold weather events occurred, relative to the other alternatives for this action. While keeping the season open longer allows fishermen to catch shrimp longer in the winter and spring seasons, it is also expected to result in the lowest biomass and harvest in the peak fall season relative to the other alternatives for this action.

For example, **Table 4-2** shows white shrimp landings by month for 2010. The winter months generated less income per month than did the fall months by a large amount.

Table 4-2. South Atlantic white shrimp landings and ex-vessel revenue by month, 2010.*

Month	Landings (lbs ww)	Revenue
Jan	825,719	$1,431,721
Feb	198,739	$426,741
Mar	42,691	$116,143
Apr	28,237	$83,806
May	430,619	$1,386,304
Jun	688,678	$2,344,031
Jul	275,221	$660,503
Aug	737,878	$1,138,138
Sep	2,984,102	$5,481,388
Oct	2,944,019	$6,164,636
Nov	1,606,552	$3,843,387
Dec	1,773,614	$4,094,652

*Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, Silver Spring, MD.

Preferred Alternative 5, Alternative 4, Alternative 3, and **Alternative 2** would be expected to generate positive, indirect economic effects since all of these alternatives would speed up the process for closing the fishery in federal waters due to cold water events compared to **Alternative 1 (No Action)**. While closing the fishery early might have immediate negative economic effects for fishermen harvesting penaeid shrimp in the winter and spring, preserving the remaining spawning biomass for the following fall fishing season would be expected to generate greater, positive economic effects by providing for a more abundant stock, thereby making more shrimp available for harvest and to the consumer over the course of the fishing year.

Presumably, the higher the temperature threshold for determining a closure for penaeid shrimp harvest, the sooner fishing pressure on the stock may end, and thus more of the spawning biomass would be preserved for the subsequent fall season. Because **Preferred Alternative 5** and **Alternative 4** would establish a higher water temperature threshold, they would yield greater positive indirect economic effects relative to **Alternative 2** and **Alternative 3**. In general, the requirement to show a reduction in biomass takes more time to determine than measuring and reporting water temperature. However, Georgia DNR's system for tracking changes in water temperature is not as sophisticated as South Carolina DNR's system and thus it would be more difficult for Georgia to render a determination of whether the water temperature threshold had been met and request a closure of federal waters adjacent to their state waters in a timely manner. **Preferred Alternative 5** also gives states the greatest flexibility in deciding whether to use a water temperature threshold of 9°C (48°F) or below for at least one week or demonstrate an 80% or greater reduction in the population of overwintering white shrimp in a request to close federal waters to penaeid shrimp harvest. As such, **Preferred Alternative 5** is expected to generate the greatest, positive indirect economic effects in the shrimp fishery over the course of the fishing year.

4.1.3 Social Effects

The social effects from **Alternative 1 (No Action)** would depend upon whether shrimp stocks were significantly affected by the present system of closing federal waters to penaeid shrimp harvest, which may not be as timely as that outlined in other alternatives. If the cold weather event has had a significant detrimental effect on the stock then there could be negative social effects from **No Action (Alternative 1)** if the next year's annual crop is substantially reduced. The likely negative effects would depend upon the severity of impacts upon the stock and could range from a slight decrease in income that may have little effect or a larger decrease that may require more important changes to fishing patterns or household labor structure/pattern for fishing families involved. Any substantial negative social effect could have compounding effects for those communities that show social vulnerabilities and a dependence upon that particular shrimp fishery as documented in Section 3.3.1. Rather than continue to risk such depletions, **Alternative 2** uses a water temperature threshold that would make the determination easier and more timely and may reduce the risk of negative social effects by protecting the shrimp stock. **Alternatives 3** and **4** each use an increased temperature threshold and the social effects would be the same as those described above, being determined by the ability of the alternative to provide sufficient protection to the stock. Overall, if **Preferred Alternative 5** provides increased protection for the shrimp stock there should be positive social effects that should outweigh any short-term negative impacts. This alternative gives the state more flexibility in determining a trigger. With greater protection and an anticipated improvement in stock the next year, there should be positive social effects in general as a more stable fishery should result, especially for those fishermen who rely solely on penaeid shrimp as they are the most vulnerable.

4.1.4 Administrative Effects

The Shrimp FMP (SAFMC 1993) provided states with the ability to request a concurrent closure of the EEZ adjacent to their closed state waters following severe winter cold weather in an effort to eliminate fishing mortality on over-wintering white shrimp following severe winter cold kills. The Shrimp FMP also established the overfishing criterion for white shrimp as "overfishing is indicated when the overwintering white shrimp population within a state's waters declines by 80% or more following severe winter weather resulting in prolonged cold water temperatures".

The specification of criteria as identified through **Alternatives 2-4** would not result in increased administrative impacts on the agency from the status quo (**Alternative 1, No Action**). A state would bear most of the administrative burden associated with this measure. Some states would incur relatively greater administrative costs than others by switching to the water temperature based trigger. Under **Alternatives 2-4**, states would be required to demonstrate that water temperature (from a state-level monitoring program) had fallen below minimum threshold. Under **Preferred Alternative 5**, states would be afforded flexibility in determining the most appropriate criterion to demonstrate that a closure of federal waters to penaeid shrimp harvest is needed. The criterion would indicate a minimum threshold for water temperature had been met, or an 80% or greater decrease in abundance of overwintering white shrimp had occurred. With a change in the required criterion that a state would need to demonstrate to request a closure in federal waters concurrent with state waters (**Alternatives 2-4**), modifications may occur at the state-level in how such a request is administered.

4.2 Action 2. Modify the process for a state to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

Alternative 1. No Action. Currently, the process requires any state requesting a concurrent closure to provide data to demonstrate an 80% decrease in abundance of overwintering white shrimp to a review panel, and the panel's recommendations are reviewed at the next South Atlantic Council meeting. After approval by the South Atlantic Council, a letter is sent to the National Marine Fisheries Service Southeast Regional Administrator requesting that the EEZ adjacent to the state be closed to penaeid shrimp harvest. The Regional Administrator then publishes an official notice of closure in the *Federal Register*.

Preferred Alternative 2. Any state requesting a concurrent closure would send a letter directly to the National Marine Fisheries Service with the request and necessary data to demonstrate that criterion has been met.

Alternative 3. Any state requesting a concurrent closure would send a letter directly to the National Marine Fisheries Service Southeast Regional Administrator with the request and necessary data to demonstrate that criterion has been met. The requesting state would also submit data to the Shrimp Review Panel, who would review data and make a recommendation to the National Marine Fisheries Service. This option would require a notice to be published in the *Federal Register* at least 23 days prior to the convening of the Shrimp Review Panel.

4.2.1 Biological Effects

The Shrimp FMP (SAFMC 1993) established the procedure by which states may request a closure of federal waters concurrent with a state closure to protect overwintering white shrimp. The Shrimp FMP also formed a Shrimp Review Panel, which is comprised of one South Atlantic Council staff member, one Southeast Fisheries Science Center scientist, one member of the South Atlantic Council's Scientific and Statistical Committee, and one state shrimp biologist from each of the states in the South Atlantic Council's area of jurisdiction (SAFMC 1993). The procedure outlined in the original Shrimp FMP constitutes **Alternative 1 (No Action)**, which is considered the least biologically beneficial because it requires the most amount of time to implement a closure of federal waters to penaeid shrimp harvest among all alternatives in Action 2. Under **Alternative 1 (No Action)**, not only is the Shrimp Review Panel required to convene to examine the data supporting the closure request of penaeid shrimp harvest in federal waters, but the South Atlantic Council must also review the subject data. Because the South Atlantic Council only meets four times per year (December, March, June, and September) the requirement that the South Atlantic Council also review the state's data often means the state may be have to wait several months before the South Atlantic Council can consider the state's information.

Preferred Alternative 2 represents the most streamlined process by which South Atlantic states may request a closure of federal waters concurrent with a state closure to protect overwintering shrimp stocks. **Preferred Alternative 2** would, theoretically also require the least amount of time to actually implement the concurrent closure of penaeid shrimp harvest in federal waters and is thus considered the most biologically beneficial alternative under this action. Because the states would still be required to provide information demonstrating the closure criteria have been met to request a closure to penaeid shrimp harvest in federal waters, and the NMFS would examine that information before making a final determination to implement a closure, there is a low probability that a closure to harvest of penaeid shrimp species in federal waters would unnecessarily be implemented based on inaccurate information provided by the states.

The biological benefit of **Alternative 3** is likely to fall between **Alternative 1 (No Action)** and **Preferred Alternative 2** given the length of time it would take to implement a closure of harvest to penaeid shrimp species in federal waters concurrent with a state closure. Based on the assumption that the sooner a concurrent closure could be implemented the longer overwintering penaeid shrimp would be protected from fishing in federal waters, the option that would require the least amount of time to implement would be considered the most biologically advantageous. **Alternative 3** would eliminate the need for states to wait until the next South Atlantic Council meeting to implement a closure to penaeid shrimp harvest in federal waters, but there would still be a one month wait period to accommodate the *Federal Register* notice period required prior to the convening of the Shrimp Review Panel.

4.2.2 Economic Effects

Action 2 is an administrative action; however, changing the timeliness of implementing a closure to penaeid shrimp harvest in federal waters would be expected to have indirect economic effects. Given the South Atlantic Council's current meeting schedule, **Alternative 1 (No Action)** prohibits a closure of federal waters prior to March each year, possibly long after a cold weather event has occurred. No indirect economic effects are expected under **Alternative 1 (No Action),** given that the current process for requesting a closure would remain unchanged. As with **Action 1**, while closing federal waters more quickly may generate adverse economic effects in the winter and spring seasons, the positive economic effects resulting from greater abundance and harvests in the peak fall season would outweigh those effects. Thus, the longer the delay in closing the fishery, the greater is the potential for adverse economic effects over the course of the fishing year. **Preferred Alternative 2** would have the shortest delay between the time of a cold weather event and a closure to penaeid shrimp harvest in federal waters as the state could directly request NMFS immediately close federal waters to penaeid shrimp harvest, and thus would be expected to generate the greatest positive, indirect economic effects. Although **Alternative 3** would reduce the delay in implementing a closure of federal waters to penaeid shrimp harvest relative to **Alternative 1 (No Action)**, the delay would be longer than under **Preferred Alternative 2** and thus the positive, indirect economic effects would be less as well.

4.2.3 Social Effects

Modifying the process of requesting a concurrent closure may have positive social effects similar to those described in Action 1 as there may be increased protection for shrimp stocks provided through more timely action. Under **Alternative 1** (**No Action**) the current process may not provide sufficient protection and therefore could have negative social effects. Under **Alternative 3**, review by the Shrimp Review Panel could delay the action more than **Preferred Alternative 2** that would be a more direct and timely approach. Again, the social effects would depend upon the effect of a delayed closure and its impact upon the stock. It is assumed that a more timely closure would have beneficial effects by ensuring there is less of an impact on the wintering stocks, which should have positive long-term social effects.

4.2.4 Administrative Effects

Pursuant to the Shrimp FMP (SAFMC 2003), when an EEZ closure to penaeid shrimp harvest (adjacent to a harvest prohibition in state waters) is requested by a state due to cold weather events, the South Atlantic Council evaluates the request based on the specific criteria as identified under Action 1, **Alternative 1 (No Action)**. Upon receiving a request to close federal waters to penaeid shrimp harvest from one or more states (typically in January or February), the South Atlantic Council convenes the Shrimp Review Panel to evaluate data supporting the request to determine compliance with the criteria. After receiving the report of the Shrimp Review Panel, the Shrimp Committee reviews (typically at the March South Atlantic Council meeting) the state's request and makes recommendations to the South Atlantic Council. The South Atlantic Council then determines if a request is warranted, and if so, recommends that the Regional Administrator proceed with an EEZ closure by Notice Action. Requests for an EEZ closure are on a state-by-state basis and efforts are made to coordinate requests among states.

Action 2 is primarily an administrative action, and the alternatives correlate to an accelerated timeframe for the agency in implementing a concurrent closure. **Preferred Alternative 2** and **Alternative 3** identify two different processes for implementation of a closure of federal waters to penaeid shrimp harvest concurrent with state waters, with a different timeframe stipulated under each scenario.

Under **Preferred Alternative 2**, convening the Shrimp Review Panel following a state's concurrent closure request of federal waters to shrimp harvest with state waters would no longer be required. Convening the Shrimp Review Panel requires noticing in the *Federal Register*, with 23 days, at a minimum, as a pre-requisite for holding a meeting. From an administrative perspective for the agency, this often lengthy and multi-step process would be streamlined under **Preferred Alternative 2**, eliminating several steps in the current process. **Preferred Alternative 2** would also eliminate the need for discussion and review of this issue during the Shrimp Committee at a South Atlantic Council meeting. As noted above, due to the limitations of a quarterly South Atlantic Council meeting schedule, **Alternative 1 (No Action)** often results in a significant lapse in time between a state's request for a concurrent closure of the adjacent

EEZ during severe winter weather and the pending implementation of a closure by the Regional Administrator. **Preferred Alternative 2** would expedite the process currently in place.

Administrative impacts associated with **Alternative 3** would be greater than those under **Preferred Alternative 2**; however, they would be less than those currently in place with the status quo (**No Action**). Under **Alternative 3**, the agency would still be required to develop and publish a notice in the *Federal Register* to convene a meeting of the Shrimp Review Panel in order for a state's data to be reviewed, but the need to wait for review and discussion during a South Atlantic Council meeting would be eliminated. The intent of Action 2, to expedite the current process, would likely still be achieved under **Alternative 3**, but the process would require additional administrative steps compared to those identified in **Preferred Alternative 2**. Unlike **Alternative 1** (**No Action**), **Alternative 3** eliminates the requirement for review and discussion of this issue at a South Atlantic Council meeting, but still requires input from the Shrimp Review Panel before a final determination is made at the agency level.

4.3 Action 3. Revise the overfished status determination criteria (B_{MSY} proxy) for the pink shrimp stock

Alternative 1. No Action. A proxy for B_{MSY} (0.461 individuals per hectare) has been established for pink shrimp using CPUE information from SEAMAP-SA data as the lowest value in the 1990-2003 time period that produced catches meeting maximum sustainable yield (MSY) the following year.

Alternative 2. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from SEAMAP-SA data during the 2007-2011 time+ period (0.273 individuals per hectare).

Alternative 3. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from SEAMAP-SA during the 2009-2011 time period (0.292 individuals per hectare).

Preferred Alternative 4. Establish a proxy for B_{MSY} for pink shrimp using the lowest CPUE value from SEAMAP-SA during the 1990-2011 time period (0.089 individuals per hectare).

Alternative 5. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from Pamlico Sound Survey data during the 2007-2011 time period (5.143 individuals per hectare).

Alternative 6. Establish a proxy for B_{MSY} for pink shrimp using average CPUE values from Pamlico Sound Survey data during the 2009-2011 time period (1.526 individuals per hectare).

4.3.1 Biological Effects

B_{MSY} is a benchmark measure of a species' biomass, which can support harvest of the MSY over time, while maintaining the stock's productive capacity. The higher the B_{MSY} proxy, the more likely CPUE would fall below that level in any given year and trigger administrative action to limit harvest. Therefore, if the B_{MSY} proxy is set too high, there is a greater chance corrective action would be triggered when it may not be biologically necessary. Conversely, if the B_{MSY} proxy is set very low, corrective action may not be triggered when it is actually needed. There are no direct biological impacts from establishing benchmarks by which to assess the health of the stock. Indirectly, the establishment of overfished and overfishing thresholds sets the upper limit on catches, ensuring the biological stability of the resource. For species such as penaeid shrimp, which are annual crops dependent on a minimum parent stock size to produce sufficient recruits for the next fishing year, the concept of overfished and overfishing are distinctly linked. Unlike longer lived species where overfishing may occur without the stock becoming overfished, overfishing of an annual crop can more readily lead to an overfished condition.

Under **Alternative 1 (No Action)** CPUE data from the Southeast Monitoring Assessment and Prediction Program (SEAMAP) survey from 1990 through 2003 (**Table 4-3**) was used to determine a proxy for B_{MSY} (0.461). This B_{MSY} proxy is used in the definition to determine if pink shrimp is overfished or undergoing overfishing. Overfishing for all penaeid species is a fishing mortality rate that diminishes the stock below the designated MSY stock abundance (B_{MSY}) for two consecutive years. The overfished threshold is established with two thresholds: (a) if the stock diminishes to ½ MSY abundance (½ B_{MSY}) in one year, or (b) if the stock is diminished below MSY abundance (B_{MSY}) for two consecutive years. CPUE of pink shrimp has been below the B_{MSY} proxy in recent years (**Table 4-3**).

Table 4-3. Annual CPUE (#/ha) estimates derived from the SEAMAP Shallow water Trawl Survey.

Year	**Pink Shrimp**
1990	0.566
1991	0.872
1992	0.511
1993	0.671
1994	0.594
1995	1.725
1996	**0.461**
1997	0.949
1998	0.853
1999	0.450
2000	0.211
2001	0.502
2002	0.908
2003	0.418

The SEAMAP survey provides long-term, fishery-independent data on seasonal abundance and biomass of all finfish, elasmobranchs, decapod and stomatopod crustaceans, sea turtles, horseshoe crabs, and cephalopods that are accessible by high-rise trawls. Samples are taken by trawl from Cape Hatteras, North Carolina to Cape Canaveral, Florida. Cruises are conducted in spring (early April - mid-May), summer (mid-July - early August), and fall (October - mid-November). Stations are randomly selected from a pool of stations within each stratum. Strata are delineated by the 4 m depth contour inshore and the 10 m depth contour offshore. Trawls are towed for twenty minutes, excluding wire-out and haul-back time, exclusively during daylight hours (1 hour after sunrise to 1 hour before sunset). Contents of each net are sorted separately to species, and total biomass and number of individuals are recorded for all species of finfish, elasmobranchs, decapod and stomatopod crustaceans, cephalopods, sea turtles, xiphosurans, and cannonball jellies. The South Atlantic Bight is separated into six regions for data analysis. Data from the paired trawls are pooled for analysis to form a standard unit of effort (tow). The coefficient of variation, expressed as a proportion, is used to compare relative amounts of variation in abundance among years and among species. Density estimates, expressed as number of individuals or kilograms per hectare (ha), are standardized by dividing the mean catch per tow by the mean area (ha) swept by the combined trawls. Mean area swept by a net is calculated by multiplying the width of the net opening (13.5 m) by the distance (m) trawled and dividing the product by 10,000 m^2/ha (SEAMAP 2002).

Under **Alternative 1 (No Action)**, the following action is taken if an overfishing or overfished determination is made: the Shrimp Review Panel will evaluate the data upon which this determination was made and other relevant information to determine cause and effect, the geographical extent of the problem, and whether management action(s) is required. Any action would then need to be processed through the South Atlantic Council system.

Table 4-4 shows that CPUE was below the B_{MSY} proxy of 0.461 during 2007-2010. The Shrimp Review Panel and the South Atlantic Council met each of these years and determined that these values of CPUE for pink shrimp was a function of environmental conditions rather than fishing pressure affecting biomass of the stock. The Shrimp Advisory Panel has indicated no management measures were needed for pink shrimp. Therefore, the B_{MSY} proxy for pink shrimp identified in **Alternative 1 (No Action)** may not be appropriate for the stock and may be causing unnecessary administrative impacts.

Alternatives 2-6 consider different proxies that may better estimate B_{MSY} for pink shrimp than **Alternative 1 (No Action)**. Pink shrimp are found well beyond the northern and southern sampling area boundaries of the SEAMAP survey (Cape Hatteras, North Carolina to Cape Canaveral, Florida), and therefore, sampling may not be occurring in areas where some of the highest concentrations of pink shrimp are found. To address this issue, the South Atlantic Council determined it is appropriate to explore alternative means of calculating a proxy for B_{MSY} for pink shrimp. If **Alternative 1 (No Action)** were chosen as a preferred alternative, the B_{MSY} proxy for the overfished criterion would not be modified at this time.

Alternative 2 would establish a new B_{MSY} proxy for pink shrimp using the average CPUE from the SEAMAP survey results for the years of 2007-2011 (**Table 4-4**).

Table 4-4. Annual average CPUE (#/ha) estimates derived from the SEAMAP Shallow water Trawl Survey for the years of 2007-2011.

Year	Pink Shrimp
2007	0.149
2008	0.340
2009	0.296
2010	0.089
2011	0.490
Average	**0.273**

Alternative 3 would establish a new B_{MSY} proxy for pink shrimp using the average CPUE from the SEAMAP survey results from the years of 2009-2011 (**Table 4-5**).

Table 4-5. Annual average CPUE (#/ha) estimates derived from the SEAMAP Shallow water Trawl Survey for the years of 2009-2011.

Year	**Pink Shrimp**
2009	0.296
2010	0.089
2011	0.490
Average	**0.292**

Alternatives 2-4 (Preferred) do not address the issue of the SEAMAP survey not covering the entire geographical range of pink shrimp abundance; however, they do use the most recent SEAMAP data available. As the Shrimp Review Panel has indicated low CPUE in recent years is a function of environmental conditions rather than fishing pressure, these alternatives may be a more accurate representation of current stock conditions relative to how the shrimp fishery is prosecuted between Cape Hatteras, North Carolina and Cape Canaveral, Florida. The average CPUE under **Alternative 2** is roughly half of the B_{MSY} proxy under the no action alternative. The average CPUE for **Alternative 3** would be 0.292 individuals per hectare. **Preferred Alternative 4** uses the lowest CPUE values from SEAMAP data, but using the entire sampling time frame of the survey, which began in 1990 **(Table 4-6)**.

Preferred Alternative 4 would use the most comprehensive set of data available for pink shrimp and would account for all variability in CPUE data across all years since the SEAMAP survey began. Using SEAMAP CPUE data from 1990 through 2011 (**Table 4-6**) results in a B_{MSY} proxy of 0.089 individuals per hectare, the lowest biomass that can support harvest of MSY of all the alternatives being considered. However, **Table 4-6** reveals that following the value of 0.089 in 2010, CPUE rose to 0.490 in 2011. This rebound in stock levels in 2011 suggests that 0.089 could be a reasonable proxy for B_{MSY} because the long term capacity of the pink shrimp stock to produce MSY was not compromised. Furthermore, the Shrimp Review Panel has indicated decreased CPUE of pink shrimp in recent years is an environmental factor rather than a fishing effect, which suggests the B_{MSY} proxy of 0.461, which is based on SEAMAP data from 1999-2003 should be changed. Therefore, using information from more recent years could represent a more accurate B_{MSY} proxy for pink shrimp considering how the shrimp fishery is currently prosecuted.

Table 4-6. Annual CPUE (#/ha) estimates and the lowest CPUE for 1990-2011 derived from the SEAMAP Shallow water Trawl Survey.

Year	Pink Shrimp
1990	0.566
1991	0.872
1992	0.511
1993	0.671
1994	0.594
1995	1.725
1996	0.461
1997	0.949
1998	0.853
1999	0.450
2000	0.211
2001	0.502
2002	0.908
2003	0.418
2004	0.383
2005	0.103
2006	0.218
2007	0.149
2008	0.340
2009	0.296
2010	**0.089**
2011	0.490

Alternatives 5 and **6** would use data from the Pamlico Sound Survey to establish a new B_{MSY} proxy for pink shrimp. Section 3.2.2.2 of this document describes the Pamlico South Survey in detail. In summary, the Pamlico Sound Survey has been conducted since 1987 to the present over two weeks in June and September. As a result of scheduling conflicts or adverse weather conditions, there have been four years (1988, 1999, 2003, and 2009) in which the survey did not occur over the same time series. From 1990 to 2007, 52-54 randomly selected stations were sampled over a two-week period, usually the second and third week of the month in both June and September. The stations sampled are randomly selected from strata based upon depth and geographic location. The seven designated strata are: Neuse River; Pamlico River; Pungo River; Pamlico Sound east of Bluff Shoal, shallow and deep; and Pamlico Sound west of Bluff Shoal, shallow and deep. Shallow water is considered water depth from 6-12 feet and deep water is considered water greater than 12 feet. A minimum of 104 stations were trawled per year to achieve the maximum area coverage. Currently, 108 stations are sampled each year (54 per cruise). Physical and environmental conditions such as temperature (^{o}C), salinity (ppt), dissolved oxygen (mg/L), bottom composition, a qualitative assessment of sediment size, and water clarity (began 2008) are recorded at the end of each tow. The annual Pamlico Sound

Survey CPUE is the arithmetic weighted mean of the number per tow, a tow equates to 1.951 hectares (Personal communication Jason Rock 2012).

For invertebrates, the total weight of all penaeid shrimp is taken for each species. Penaeid shrimp are sorted to species with each species/size in its own fish basket. Once the catch is sorted, all baskets are organized so individuals of the same species/size class are together and combined when possible. Each species is enumerated and a total weight is taken for each species/size class. Individuals of each species are measured. If present in large numbers, a sub-sample of 30-60 individuals of each target species/size class is measured and a total weight is taken of the measured individuals for each species/size class.

Alternative 5 would use an average of the CPUE values from the Pamlico Sound Survey for the years of 2007-2011, which would result in a B_{MSY} proxy of 5.143 individuals per hectare (**Table 4-7**).

Table 4-7. Annual average CPUE estimates (#/ha) for pink shrimp derived from the Pamlico Sound Survey from 2007-2011. The annual Pamlico Sound Survey CPUE is the arithmetic weighted mean of the number per tow, a tow equates to 1.951 hectares (Personal communication Jason Rock 2012).

Year	Pink Shrimp
2007	3.352
2008	17.786
2009	3.465
2010	0.584
2011	0.528
Average	**5.143**

Alternative 6 would use an average of the CPUE values from the Pamlico Sound survey for the years of 2009-2011, which would result in a B_{MSY} proxy of 1.526 individuals per hectare (**Table 4-8**).

Table 4-8. Annual average CPUE estimates (#/ha) for pink shrimp derived from the Pamlico Sound Survey from 2009-2011. The annual Pamlico Sound Survey CPUE is the arithmetic weighted mean of the number per tow, a tow equates to 1.951 hectares (Personal communication Jason Rock 2012).

Year	Pink Shrimp
2009	3.465
2010	0.584
2011	0.528
Average	**1.526**

Under both **Alternatives 5** and **6**, similar geographical challenges are presented as those related to **Alternatives 2-4**. The Pamlico Sound Survey captures shrimp abundance information for inshore areas within the Pamlico Sound area, and thus does not address the issue of a lack of survey data south of Cape Canaveral, Florida, where pink shrimp abundance is thought to be high. Additionally, the data gathered by the Pamlico Sound Survey are somewhat different from that produced by the SEAMAP survey because it only samples inshore waters where shrimp abundance and size may vary greatly when compared to the depths surveyed through SEAMAP (15-30 feet).

Despite the limitations of the SEAMAP survey, it samples a broader geographic area in deeper water than the Pamlico Sound Survey, and may better represent the pink shrimp stock. Furthermore, the Pamlico Sound Survey shows much more variability in CPUE than the SEAMAP survey suggesting trends in the Pamlico Sound Survey may not represent pink shrimp abundance as well as the SEAMAP survey, and could unnecessarily trigger an overfished/overfishing determination or fail to trigger such a determination when needed. **Table 4-7** shows pink shrimp CPUE ranged from 17.786 in 2008 to 0.528 in 2011. In contrast, the CPUE over a similar time period from the SEAMAP survey ranged from 0.340 in 2008 to 0.089 in 2010 and to 0.490 in 2011. Therefore, the biological effects of **Alternatives 5** and **6** could be less than **Alternatives 2-4 (Preferred)**.

The lowest B_{MSY} proxy (**Preferred Alternative 4**) from the SEAMAP survey and the highest B_{MSY} proxy (**Alternative 5**) from the Pamlico Sound Survey represent the lowest and the highest B_{MSY} proxy alternatives under consideration. The stock size that produced the low CPUE value identified as the B_{MSY} proxy in **Preferred Alternative 4** does not compromise the long term capacity of the pink shrimp stock to produce MSY because the low stock size has produced a biomass the following year that is capable of producing MSY based on all the available data. Furthermore, the most accurate representation of biomass is most likely somewhere in between **Preferred Alternative 4** and **Alternative 5**, and a B_{MSY} proxy that is closer to a mid-point between the highest and lowest CPUE average values is less likely to trigger corrective action when it would not be needed, or fail to trigger corrective action when it is needed.

4.3.2 Economic Effects

Action 3 would establish a biological reference point for determining whether pink shrimp are overfished or undergoing overfishing and thus would result in indirect economic effects on the shrimp fishery. Presumably, any alternative that would set an overfished/overfishing level for pink shrimp that would increase the probability of closing the fishery relative to the status quo would be expected to generate indirect, adverse economic effects. Conversely, any alternative that would set an overfished level for pink shrimp that would decrease the probability of closing the fishery and relative to the status quo would be expected to generate indirect, positive economic effects. In general, the higher the overfished/overfishing threshold is set, the greater the probability the fishery would close. Since the threshold would be in place over an extended period of time, the expected indirect economic effects would also extend into the future and for as long as the threshold is in place. The overfished threshold under **Alternative 1 (No Action)** is 0.461 individuals per hectare. The overfished thresholds are 0.273, 0.292, 0.089, 5.143, and 1.526 individuals per hectare for **Alternative 2, Alternative 3, Preferred Alternative 4**, **Alternative 5**, and **Alternative 6**, respectively. Thus, relative to **Alternative 1 (No Action), Alternative 5** would be expected to generate the greatest adverse, indirect economic effects, followed by **Alternative 6**. Conversely, **Preferred Alternative 4** would be expected to generate the least adverse, indirect economic effects, followed by **Alternative 2** and **Alternative 3**, relative to **Alternative 1 (No Action)**.

4.3.3 Social Effects

Establishing the best proxy of overfished status for pink shrimp should have beneficial social effects, as it would provide the best protection for the stock without imposing unnecessary regulatory burdens on fishermen, their families and communities. Currently, under **Alternative 1 (No Action)** negative social effects could occur if the fishery is declared overfished or undergoing overfishing when the current proxy may not be an accurate portrayal of stock status. The ensuing regulatory actions because of overfished designation could trigger a number of negative social effects with a wide range of impacts that are not possible to determine at this time, although they could be similar to those mentioned in Action 1. **Alternative 2** through **Preferred Alternative 4** offer a B_{MSY} proxy utilizing SEAMAP-SA data with differing time frames. Each time frame equates to a different measure of individual shrimp per hectare with the smallest threshold of 0.089 in **Preferred Alternative 4** and the highest threshold being 0.292 under **Alternative 3** using SEAMAP data. In any case, utilizing SEAMAP-SA data could add additional confidence regarding the proxy B_{MSY} for pink shrimp. While primarily a biological decision, it could improve the overall assessment and be beneficial to the overall process that could result in positive social effects by ensuring the most accurate information to base management decisions. Management decisions that ultimately harm stock status could have numerous negative social effects similar to those discussed in **Alternative 1 (No Action)**. With **Alternative 5**, a proxy for B_{MSY} is determined from the Pamlico Sound Survey data. Primarily an inshore sample, it would provide an alternative perspective and offers a higher threshold (5.143 individuals per hectare) than **Alternative 6**. Whichever alternative is chosen as preferred, as long as it reflects the best estimate of stock status, it should have beneficial social effects in the long-term as mentioned in previous alternatives. However, it is not clear whether an offshore or inshore proxy would be better. If both together are thought to present the best overall picture of stock status, then some provision for review and determination of an overall proxy would be needed. Whatever the case, the communities in **Figure 3-9** are those that could be affected more than others as they have the most pink shrimp landings. The communities of Miami and Opa-Locka, Florida both may be exhibiting social vulnerabilities as they exceed thresholds on both the social vulnerability indices and environmental justice measures. Because these actions are primarily biological and should have positive social effects, neither community should experience negative social impacts as a result. It is always difficult to ascertain the social effects of biological thresholds as the impacts are often only apparent after implementation. The assumptions are usually that improved data collection improves scientific assessments, which improves management decisions; subsequently the overall impact should be positive for both fishermen and fishing communities.

4.3.4 Administrative Effects

Currently, the agency analyzes the trend of the SEAMAP program's fishery-independent CPUE data to gain insight into the South Atlantic pink shrimp population size. Through Amendment 6 to the Shrimp FMP (SAFMC 2004), a proxy for B_{MSY} has been established for pink shrimp using a CPUE-based proxy from SEAMAP data as the lowest values in the 1990-2003 time periods that produced catches meeting MSY the following year (0.461 individuals per hectare). SEAMAP CPUE fell below the B_{MSY} proxy of 0.461 individuals per hectare during 2004-2010. The Shrimp Review Panel has indicated the decrease in the SEAMAP CPUE is not due to fishing pressure but rather to natural environmental fluctuations. Furthermore, there are geographical sampling limitations of the SEAMAP program (limited data north or Cape Hatteras, North Carolina and south of Cape Canaveral, Florida). These factors warrant the need for a better estimate of the B_{MSY} proxy for pink shrimp.

Alternatives 2-4 (Preferred) establish a new proxy for B_{MSY} based on more recent time series data from the SEAMAP program. **Alternatives 5** and **6** establish a new proxy for B_{MSY} based on more recent time series data from the Pamlico Sound Survey data. For the agency, administrative impacts associated with **Alternatives 2-4 (Preferred)** would not differ from the status quo (**Alternative 1** (**No Action**)). **Alternatives 5** and **6** would require agency review of the Pamlico Sound Survey data on an annual cycle.

Chapter 5. Council's Choice for the Preferred Alternative

5.1 Specify criteria that triggers a states' ability to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

During the Shrimp Review Panel webinar on May 2, 2012, the South Carolina Department of Natural Resources (SC DNR) representative discussed that 46°F (8°C) water temperature is a suitable temperature threshold criterion for requesting a closure in federal waters. Further, the SC DNR representative discussed that with prolonged 8°C water temperatures, mortality rates of penaeid species are high. The Shrimp Review Panel, however, did not recommend a preferred alternative for this action.

During their September 2011 meeting, the Shrimp and Deepwater Shrimp Advisory Panels (APs) received a presentation from Mel Bell, Director of Office of Fisheries Management with SC DNR regarding the white shrimp stock's vulnerability to cold water temperatures in South Carolina. Bell discussed that 8°C is used as SC DNR's critical level and presented that in years where inshore water temperatures fell below 8°C, SC DNR observed high mortality rates of overwintering white shrimp. As a result of this discussion, the APs recommended that the South Atlantic Council move forward with modifying the protocol for a concurrent exclusive economic zone (EEZ) closure request during severe winter weather events through a formal amendment process. The APs noted their preference for a temperature threshold to be the criterion that triggers a state's concurrent closure request, and they endorsed **Alternative 3** (8°C) as a preferred for this Action at their April 20, 2012 meeting.

During their August 1, 2012 meeting, the South Atlantic Council's Scientific and Statistical Committee (SSC) recommended the inclusion of information in the document on mortality rates associated with each of the temperature thresholds identified in **Alternatives 2-4**. The SSC discussed that more data and analysis for this action are needed and requested review of this information at their October 2012 meeting. Following the SSC meeting in August 2012, additional data from SC DNR was included in the document (**Section 4.1.1**, **Table 4-1** and **Figure 4-1**).

The South Atlantic Council provided guidance for including this measure in Amendment 9 to the Shrimp Fishery Management Plan (FMP) during the September 2011 South Atlantic Council meeting. The South Atlantic Council was also presented the information from SC DNR regarding white shrimp stock's vulnerability to temperature. SC DNR discussed an interest in a more expeditious process for initiating a request to close federal waters to shrimp harvest concurrent with a state closure and recommended that temperature data be considered as a trigger to allow South Carolina a faster mechanism for such a request during a cold weather event to protect penaeid shrimp stocks. The South Atlantic Council recommended that alternatives be developed based on temperature as a trigger for this Action, and approved this document for the public scoping process in September 2011. Scoping meetings were held January 24, 26, and 30-February 2, 2012. During the March 2012 meeting, the South Atlantic Council reviewed public scoping comments and provided guidance on alternatives. Shrimp Amendment 9 was approved for public hearings during the June 2012 South Atlantic Council meeting. At the September 2012 meeting, the South Atlantic Council developed **Alternative 5** as a result of Georgia Department of Natural Resources' preference of maintaining **Alternative (No Action)** as a preferred to allow the states greater flexibility with an opportunity to initiate a request to close federal waters to penaeid shrimp harvest concurrent with a state closure during severe winter weather.

The South Atlantic Council proceeded in selecting **Alternative 5** as their preferred for this Action. The preferred alternative also best meets the objectives of the Fishery Management Plan to the Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region (Shrimp FMP), as amended, while complying with the requirements of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and other applicable law.

5.2 Modify the process for a state to request a concurrent prohibition on the harvest of South Atlantic penaeid stocks in the adjacent EEZ during severe winter weather

During their May 2, 2012 webinar, the Shrimp Review Panel discussed an interest in remaining a part of the process in reviewing states' data as identified in **Alternative 3**. The Shrimp Review Panel also discussed an interest in remaining involved in the process as a preference only if in so doing it is a more expeditious process that what is currently in place (i.e., no requirement to notice the convening of the Shrimp Review Panel in the *Federal Register*). NOAA General Counsel advised during the June 2012 Council meeting that convening a meeting of the Shrimp Review Panel would require noticing in the *Federal Register*.

During their September 2011 meeting, the Shrimp and Deepwater Shrimp APs supported amending the Shrimp FMP to allow a state to make a request directly to the National Marine Fisheries Service (NMFS) and eliminate the South Atlantic Council's review of states' data during a cold weather event. Further, the APs expressed support of **Preferred Alternative 2** for this Action during their April 20, 2012 meeting. The APs discussed their interest in streamlining the process as quickly as possible to allow the states appropriate protection of penaeid stocks when necessary without a lapse in time awaiting a South Atlantic Council meeting or the convening of the Shrimp Review Panel.

The SSC reviewed Shrimp Amendment 9 during their August 2012 meeting. The SSC discussed the administrative nature of this action and did not provide a specific recommendation.

The South Atlantic Council has discussed the lengthy process to address a state's request for a concurrent closure to harvest of penaeid stocks in the EEZ adjacent to state waters during a cold weather event on several occasions. During 2001, both the states of South Carolina and Georgia initiated a request to prohibit penaeid shrimp harvest in federal waters concurrent with a harvest prohibition in state waters due to prolonged winter temperatures. After review of the states' data by the Shrimp Review Panel, the South Atlantic Council approved the requests on March 8, 2001, and NMFS implemented a closure to harvest of penaeid shrimp in federal waters effective March 13, 2001. Both states also considered a similar request in 2010 but did not initiate a request. On January 10, 2011, SC DNR closed their state waters to penaeid harvest and initiated a closure request for penaeid shrimp in federal waters to the South Atlantic Council. The South Atlantic Council approved this request on March 8, 2011 and submitted a letter to the NMFS on March 10, 2011. The NMFS processed the request and implemented a closure to penaeid shrimp species in federal waters adjacent to South Carolina state waters effective March 22, 2011.

During the June 2012 South Atlantic Council meeting, after numerous discussions about the ineffective time lapse associated with the current process identified in **Alternative 1 (No Action)**, they selected **Alternative 2** as their preferred. The preferred alternative also best meets the objectives of the Shrimp FMP, as amended, while complying with the requirements of the Magnuson-Stevens Act and other applicable law.

5.3 Revise the overfished status determination criteria (B_{MSY} proxy) for the pink shrimp stock

During their webinar on May 2, 2012 the Shrimp Review Panel recommended the inclusion of the Pamlico Sound Trawl Survey (North Carolina inshore waters) as an additional data source in development of a B_{MSY} proxy for pink shrimp. During the last several meetings of the Shrimp Review Panel, they have concluded that the pink shrimp stocks in some areas along the southeast coast have diminished due to factors other than fishing, such as environmental and climatic factors. The Panel also discussed that the overfished/overfishing criteria for pink shrimp could be based on a more appropriate data set than the SEAMAP survey data alone (because pink shrimp commonly occur north of Cape Hatteras, North Carolina and south of Cape Canaveral, Florida), and one that is more geographically inclusive of pink shrimp areas of abundance. The Shrimp Review Panel recognized that currently a fishery-independent survey does not exist in Florida waters that could provide better data on pink shrimp south of Cape Canaveral, Florida. If the issue continues to occur with the pink shrimp stock falling below the overfished threshold, the Shrimp Review Panel recommends they revisit discussion of applying a new assessment model for penaeid stocks in the South Atlantic similar to Stock Synthesis Model (SS3) used for assessing penaeid stocks in the Gulf of Mexico.

The Shrimp and Deepwater Shrimp APs support the Shrimp Review Panel's identification of additional sources of shrimp abundance data to either supplement or replace the SEAMAP survey. The APs made the following recommendations to the South Atlantic Council for defining overfishing/overfished status of the pink shrimp stock during their April 20, 2012 meeting:

- Must achieve the objective of preventing the triggering of statutory requirements to rebuild stocks through fishing mortality controls whenever fishing mortality is not the cause for the pink shrimp stock abundance to fall below the minimum stock size threshold (MSST)/maximum sustainable yield (MSY)
- Must be submitted for review and comment by the Shrimp and Deepwater Shrimp APs and the public at large prior to final South Atlantic Council consideration
- Consider whether the current definition of MSY for pink shrimp is appropriate and if a revision of the MSY definition should be part of the process to redefine MSST
- Consider and, if appropriate, incorporate new modeling methodologies developed by the NMFS' Southeast Fisheries Science Center for pink shrimp in the Gulf of Mexico which were specifically designed to address a similar problem
- Ensure data used for determining annual pink shrimp abundance relative to the MSST include the full range of the stock and is of sufficient quantity and quality to achieve the objective set forth in the first bullet above

The SSC provided recommendations for Action 3 during their August 2012 meeting. The SSC discussed that if there are no immediate consequences for leaving the status quo (**Alternative 1, No Action**) in place, the South Atlantic Council should wait to see the analytical results of the SS3 assessment model for penaeid shrimp species in the Gulf of Mexico. During their October 2012 meeting, the SSC received a presentation on the SS3 model and discussed assessment possibilities for penaeid stocks in the South Atlantic. The SSC recommended proceeding with an exploratory phase to tailor the SS3 model to each South Atlantic penaeid stock. The SSC also recommended further evaluation of the SS3 model and the South Atlantic data to determine if the model is an appropriate assessment tool for penaeid stocks in the South Atlantic. The SSC recommended proceeding with an assessment of shrimp through the Southeastern Data Assessment and Review (SEDAR) process utilizing the SS3 model presented at the October 2012 meeting.

The South Atlantic Council moved forward with developing this Action through Shrimp Amendment 9 during their September 2011 meeting. This Action carries over from Amendment 6 to the Shrimp FMP (SAFMC 2004). Alternatives were developed based on recommendations from the Shrimp Review Panel to incorporate the Pamlico Sound Survey data in developing a more recent B_{MSY} proxy for pink shrimp. At their June 2012 meeting, the South Atlantic Council discussed that pink shrimp are at their northern range in North Carolina waters and questioned the Pamlico Sound Survey dataset as being an appropriate substitute for the SEAMAP survey dataset. The South Atlantic Council noted the geographical limitations of this survey and discussed that it captures abundance information for inshore areas in North Carolina and does not address the issue of lack of pink shrimp abundance data south of Cape Canaveral, Florida. Shrimp Amendment 9 was approved for public hearings during the June 2012 meeting, but a preferred alternative was not selected prior to the hearings.

During their September 2012 meeting, the South Atlantic Council discussed that the stock size that produced the low catch per unit effort value identified as the B_{MSY} proxy in **Alternative 4** does not compromise the long-term capacity of the pink shrimp stock to produce MSY because the low stock size has produced a biomass the following year that is capable of producing MSY based on all the data at hand. As a result of this discussion, **Alternative 4** was selected as their preferred alternative. The preferred alternative also best meets the objectives of the Shrimp Fishery Management Plan, as amended, while complying with the requirements of the Magnuson-Stevens Act and other applicable law.

Chapter 6. Cumulative Effects

6.1 Biological

1. Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals.

The CEQ cumulative effects guidance states that this step is done through three activities. The three activities and their location in the document are as follows:

I. The direct and indirect effects of the proposed actions **(Section 4.0)**;
II. Which resources, ecosystems and human communities are affected **(Section 3.0)**; and
III. Which effects are important from a cumulative effects perspective **(this CEA)**.

2. Establish the geographic scope of the analysis.

Penaeid shrimp occur throughout the South Atlantic and Gulf of Mexico regions. However, the South Atlantic Fishery Management Council's (South Atlantic Council) area of jurisdiction is limited to federal waters of the South Atlantic between the North Carolina/Virginia border and the Gulf of Mexico Fishery Management Council's area of jurisdiction in the Florida Keys. Therefore, Amendment 9 to the Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region immediately affects penaeid shrimp species in the South Atlantic region. However, any positive or negative biological impacts of this amendment on penaeid shrimp species may be carried over into the Gulf of Mexico Region and north of North Carolina as shrimp in those areas may move in and out the South Atlantic Council area of jurisdiction.

3. Establish the timeframe for the analysis.

The shrimp fishery in the South Atlantic has been under federal management since 1993 when the original Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region (Shrimp FMP) was developed. However, catch per unit effort (CPUE) data from the Southeast Monitoring Assessment and Prediction Program (SEAMAP) Survey, which is used to monitor penaeid shrimp stocks, is currently available from 1990 through 2011. Therefore, this is the time series of data that is generally used in the impacts analysis for the amendment.

4. Identify the other actions affecting the resources, ecosystems, and human communities of concern (the cumulative effects to the human communities are discussed in Section 4).

Listed are other past, present, and reasonably foreseeable actions occurring in the South Atlantic region. These actions, when added to the proposed management measures, may result in cumulative effects on the biophysical environment.

I. Fishery-related actions affecting penaeid shrimp species:

A. Past

The reader is referred to **Appendix H. History of Management of the Penaeid Shrimp Fishery** for past regulatory activity for the fish species being impacted by this amendment.

B. Present

The National Marine Fisheries Service (NMFS) is considering modifications to turtle excluder device (TED) requirements.

C. Reasonably Foreseeable Future

Actions under development in Amendment 7 to the Coral FMP for Coral, Coral Reefs, and Live/Hardbottom Habitats of the South Atlantic Region consider modifications to the boundaries of the Oculina Bank HAPC, Stetson-Miami Terrace and Cape Lookout Coral HAPCs to incorporate areas of newly observed deepwater coral habitat and protect deepwater coral ecosystems in the South Atlantic. The HAPCs include gear restrictions that pertain to the deepwater shrimp fishery.

II. Non-Council and other non-fishery related actions, including natural events affecting penaeid shrimp species.

Several factors impact penaeid shrimp species in the South Atlantic. Some of these issues include weather events such as hurricanes, economic events such as the economic downturn of 2008, and environmental changes including pollution and climate change. Annual variability in natural conditions such as water temperature, currents, food availability, predator abundance, etc. can affect the abundance of penaeid shrimp. Furthermore, natural factors such as storms, red tide, cold water upwelling, etc. can affect the survival of shrimp roe and adult shrimp; however, it is very difficult to quantify the magnitude of mortality these factors may have on a stock. Alteration of preferred habitats for shrimp species could affect survival of fish at any stage in their life cycles.

Ocean acidification reduces the pH of seawater, which changes carbonate chemistry by reducing the amount of carbonate ions in the water negatively impacting invertebrates that use calcium carbonate to form shells (Bechmann et al. 2011). Bechmann et al. (2011) indicated that shrimp grown out in low pH (7.6) environments experience delayed development; however, overall survival of shrimp larvae in low pH (7.6) seawater was not affected. Juvenile shrimp reared in low pH seawater are significantly smaller than those reared in more neutral pH environments (Bechmann et al. 2011). Reduced development time for shrimp larvae may increase their risk of mortality from predation (Bechmann et al. 2011), and slower growing shrimp could negatively impact segments of the shrimp industry that rely on the harvest of large shrimp during certain times of the year.

Changes to predator-prey relationships caused by management measures affecting shrimp prey species may impact penaeid shrimp stock sizes. According to Ehrhardt et al. (2001), several commercially important fish species prey on migrating pink shrimp. If those species experience a sudden surge in population size and subsequently increase predation on pink shrimp, the pink shrimp population would be impacted by that shift in the predator prey relationship (Ehrhardt et al. 2001). Additionally, degradation of juvenile shrimp habitat via weather events and point and non-point source pollution could also affect juvenile shrimp density recruitment relationship (Ehrhardt et al. 2001).

Global climate changes could have significant effects on Atlantic fisheries. However, the extent of these effects is not known at this time, specifically for the South Atlantic. Possible impacts include temperature changes in coastal and marine ecosystems that can influence organism metabolism and alter ecological processes such as productivity and species interactions; changes in precipitation patterns and a rise in sea level which could change the water balance of coastal ecosystems; altering patterns of wind and water circulation in the ocean environment; and factors influencing the productivity of critical coastal ecosystems such as wetlands, estuaries, and coral reefs (IPCC 2007; Kennedy et al. 2002).

5. Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stress.

A characterization of the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stress is included in Section 3 of this document.

6. Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds.

Stresses affecting the shrimp fishery and the communities, which depend on the shrimp fishery, are discussed under Number 4 and Section II of this Cumulative Impacts Analysis. Additionally, a description of the fishery and penaeid stock status relative to current regulatory thresholds is contained in Section 3 of this document.

7. Define a baseline condition for the resources, ecosystems, and human communities.

Pink Shrimp

Maximum Sustainable Yield (MSY)

The existing definition of MSY established by the original Shrimp FMP was calculated as mean total landings for the South Atlantic during 1957 to 1991 adjusted for recreational landings. In calculating total landings, an additional ten percent (an estimate provided by state shrimp biologists) was added to the commercial catch to account for recreational landings that are unreported. Using this methodology, MSY was estimated to be 1.8 million pounds for pink shrimp (SAFMC 1993).

Optimum Yield (OY)

OY for pink shrimp was defined as the amount of harvest that can be taken by U.S. fishermen without annual landings falling two standard deviations below the mean landings during 1957 through 1993 for three consecutive years. This value is 286,293 pounds (heads on) for pink shrimp (SAFMC 1996b).

Overfished/Overfishing Definition

Amendment 6 to the Shrimp FMP (SAFMC 2004) established overfished and overfishing criteria for pink shrimp. The maximum fishing mortality threshold (MFMT) used to make an overfishing determination for all penaeid species is a fishing mortality rate that diminishes the stock below the designated MSY stock abundance (B_{MSY}) for two consecutive years and the minimum stock size threshold (MSST), which is used to make an overfished determination is established with two thresholds: (a) if the stock diminishes to ½ MSY abundance (½ B_{MSY}) in one year, or (b) if the stock is diminished below MSY abundance (B_{MSY}) for two consecutive years. A proxy for B_{MSY} (0.461 individuals per hectare) was established for pink shrimp using CPUE information from SEAMAP data as the lowest values in the 1990-2003 time period that produced catches meeting MSY the following year (SAFMC 2004).

White Shrimp

Maximum Sustainable Yield

The existing definition of MSY established by the original Shrimp FMP was calculated as mean total landings for the South Atlantic during 1957 to 1991 adjusted for recreational landings. In calculating total landings, an additional ten percent (an estimate made by state shrimp biologists) was added to the commercial catch to account for recreational landings that were unreported. There were other adjustments based on more accurate recreational landings information when the shrimp baiting permit went into effect in South Carolina. Using this methodology, MSY is estimated to be 14.5 million pounds for white shrimp (SAFMC 1993).

Optimum Yield

OY for the white shrimp fishery is defined as the amount of harvest that can be taken by U.S. fishermen without reducing the spawning stock below the level necessary to ensure adequate reproduction. This level has been estimated only for the central coastal area of South Carolina, and only in terms of subsequent fall production (assumed to represent recruitment). Therefore, in actual application, OY for the white shrimp fishery is the amount of harvest that can be taken by the U.S. fishery during the fishing season which may vary from year to year based on both state regulations and regulations promulgated pursuant to the Shrimp FMP (i.e., closures due to cold kills) (SAFMC 1993).

Overfished Definition

MSST is established with two thresholds: (a) if the stock diminishes to ½ MSY abundance (½ B_{MSY}) in one year, or (b) if the stock is diminished below MSY abundance (B_{MSY}) for two consecutive years. A proxy for B_{MSY} was established for white shrimp using CPUE information from SEAMAP data as the lowest values in the 1990-2003 time period that produced catches meeting MSY the following year. White shrimp = 5.868 individuals per hectare.

Overfishing Definition
MFMT for all penaeid species is a fishing mortality rate that diminishes the stock below the designated MSY stock abundance (B_{MSY}) for two consecutive years.

Brown Shrimp
Maximum Sustainable Yield
The existing definition of MSY established by the original Shrimp FMP was calculated as the mean total landings for the South Atlantic during 1957 to 1991 adjusted for recreational landings. In calculating total landings, an additional ten percent (an estimate provided by state shrimp biologists) was added to the commercial catch to account for recreational landings that are unreported. Using this methodology, MSY was estimated to be 9.2 million pounds for brown shrimp (SAFMC 1993).

Optimum Yield
OY for brown shrimp was defined in Amendment 2 to the Shrimp Plan as the amount of harvest that can be taken by U.S. fishermen without annual landings falling two standard deviations below the mean landings during 1957 through 1993 for three consecutive years (SAFMC 1996b). This value is 2,946,157 pounds (heads on).

Overfished Definition
MSST is established with two thresholds: (a) if the stock diminishes to ½ MSY abundance (½ B_{MSY}) in one year, or (b) if the stock is diminished below MSY abundance (B_{MSY}) for two consecutive years. A proxy for B_{MSY} was established for each species using CPUE information from SEAMAP-SA data as the lowest values in the 1990-2003 time period that produced catches meeting MSY the following year. Brown shrimp = 2.000 individuals per hectare.

Overfishing Definition
MFMT for all penaeid species is a fishing mortality rate that diminishes the stock below the designated MSY stock abundance (B_{MSY}) for two consecutive years.

Shrimp are annual crops that fluctuate considerably from year to year depending primarily on environmental factors. Population size is regulated by environmental condition, and while fishing certainly reduces the population size over the course of the season, fishing is not believed to have any impact on subsequent year class strength unless the spawning stock has been reduced below a minimum level by environmental conditions (SAFMC 1993). Because of this, one could consider the baseline to be reset every year. The current baseline conditions of the affected ecosystem and surrounding communities is discussed in Section 3 of this document.

8. Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities.

The relationship between human activities and biophysical ecosystems within the context of this CEA is solely related to extractive activities and the installment of regulations as outlined in **Table 6-1**.

Table 6-1. Installment of regulations pertaining to South Atlantic shrimp fisheries.

Time period/dates	Cause	Observed and/or Expected Effects
1993	SAFMC allowed concurrent closure of EEZ adjacent to closed state waters after cold winter kills. Restricted trawling areas and mesh size, and defined MSY, and OY for white shrimp, and established overfishing criterion for white shrimp. MSY for brown and pink shrimp was also specified. (South Atlantic Shrimp FMP 1993)	Reduced fishing effort during times of lower stock abundance. Reduced bycatch of unmarketable fish.
1996	Require federal rock shrimp permit, trawling area limited. (SAFMC 1996a)	Enhanced existing federal regulations for coral and snapper grouper by protecting EFH, coral, and the Oculina Bank HAPC from trawl related damage.
1996	Required use of BRDs in all penaeid shrimp trawls in the South Atlantic EEZ. (SAFMC 1996b)	BRDs reduced bycatch; standardized BRD certification criteria and testing protocol implemented.
1998	Defined EFH and EFH-HAPCs for South Atlantic shrimp resource. (SAFMC 1998a)	Created protections for South Atlantic shrimp EFH.
1998	Expanded the Oculina HAPC to include the area closed to rock shrimp harvest. (SAFMC 1998b)	No person may use bottom longline, bottom trawl, dredge, pot or trap, anchors and chains, or grapples and chains. No one may fish for rock shrimp or possess rock shrimp in or from the area on board a fishing vessel, or possess *Oculina* coral.
1999	Established a reporting requirement and designated biological reference points. (SAFMC 1998c)	Enhanced and supplemented existing data for the shrimp fishery, and helped to inform future management actions.

2002/2003	Established rock shrimp limited access program, required vessel operators permit, established minimum mesh size for tail bag, and required use of VMS in rock shrimp limited access fishery. (SAFMC 2002)	Reduced number of latent permits in the rock shrimp fishery, and helped rock shrimpers avoid catching small unmarketable shrimp. Use of VMS enhanced enforcement of the limited access rock shrimp fishery.
2004	Specified reduction in total weight of finfish of at least 30% for new BRDs to be certified; adopted the ACCSP release, discard, and protected species module; and required BRDs on all rock shrimp trips in the South Atlantic. (SAFMC 2004)	Reduced the level of catch allowed for a BRD to be certified, thereby reducing bycatch overall; will be able to more accurately assess bycatch mortality; and reduce bycatch in the rock shrimp fishery.
2008	Eliminate rock shrimp landing requirement for limited access endorsement; reinstate endorsement lost due to not meeting the rock shrimp landing requirement, reinstate endorsements lost due to failure to renew, change endorsement and permit names; require proof of VMS for endorsement renewal or transfer; and require the collection of economic data. (SAFMC 2008)	Helped maintain the rock shrimp fishery at a sustainable level, while still preventing overexploitation of the fishery. Clarified any confusion about the endorsement vs. permit names and application process, improved enforcement of closed areas, and ensured the collection of economic data to fill large economic data gaps for the rock shrimp fishery.

2009	Amend the Coral, Coral Reefs, and Live/Hardbottom Habitat FMP to establish Deepwater Coral Habitat Areas of Particular Concern (HAPC); create a Shrimp Fishery Access Area within the Stetson Reefs, Savannah and East Florida Lithoherms, and Miami Terrace Coral HAPC boundaries. (SAFMC 2009)	Provides protection to shrimp habitat from fishing impacts. Allows continued fishing within certain Coral HAPCs to reduce the negative socioeconomic impacts while protecting critical habitat.
2011	Amend the Coral Fishery Management Plan to designate Essential Fish Habitat-Habitat Areas of Particular Concern. (SAFMC 2011b)	Provides additional protection to shrimp habitat from non-fishing impacts.

9. Determine the magnitude and significance of cumulative effects.

Past, present, and reasonably foreseeable future actions probably have not and would not have a significant effect on the shrimp resource. As stated throughout this cumulative effects analysis, the abundance of the shrimp stock in the South Atlantic exclusive economic zone is largely determined by environmental variables, which have short-term effects (less than three years in duration).

Habitat loss may have an adverse effect on shrimp landings, however the connection has not been made between the loss and degradation of habitat essential to shrimp survival and shrimp landings in the South Atlantic. Thus, the magnitude of each of these effects is undeterminable without further studies.

Management actions in Amendment 9 to the Shrimp FMP would be expected to yield minimal cumulative effects on the biological environment. Those impacts could take the form of a more appropriate overfished threshold for pink shrimp and expedited implementation of protective concurrent closures of federal waters for overwintering shrimp.

10. Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects.

The cumulative effects on the biophysical environment are expected to be negligible. Therefore, avoidance, minimization, and mitigation are not necessary.

11. Monitor the cumulative effects of the selected alternative and adopt management.

The effects of the proposed action are, and will continue to be, monitored through collection of data by the National Marine Fisheries Service, the Pamlico Sound Trawl Survey, the SEAMAP Trawl Survey, as well as state landings information, and other scientific observations.

6.2 Socioeconomic

A description of the human environment and associated fishing communities is contained in **Section 3.3,** while detailed descriptions of the expected social and economic impacts of the actions in this amendment are located in **Section 4.0.** The actions contained in this amendment are expected to result in beneficial social and economic effects, in light of external factors that may affect performance in the fishery. Some of those external factors are discussed more extensively in Amendment 6 (SAFMC 2004) and Amendment 7 (SAFMC 2008) to the Shrimp FMP and is incorporated by reference.

While there have been negative effects from regulatory action in the past, the impacts of non-regulatory factors such as imports, increased fuel prices, coastal development and the closure of fish houses in the South Atlantic may have had more substantial impacts on the shrimp industry recently. Imports and declining prices have taken a toll on the South Atlantic shrimp fishery, affecting revenues early in 2000 (SAFMC 2004) and have continued to have an impact on the fishery as evidenced by recent economic surveys (NMFS 2011a). For those fishermen who fish South Atlantic penaeid shrimp exclusively, those impacts may have been more severe as they have exhibited revenue losses on average. Fishermen who are more diversified and fish other species inshore fare somewhat better in that they at least make a profit or break even. Whether those revenue streams are sustainable financially is unknown. However, harvesters have made adjustments and have become retail sellers of their product to reduce costs and obtain higher prices (SAFMC 2004). These and other adjustments have ramifications for support industries as vessel owners reduce inputs to lower costs which means economic losses for those businesses that provide services to the fleet which can have a multiplier effect that goes beyond the shrimp fishery and into the larger coastal economy.

The regulatory burden on the South Atlantic shrimp fishery has been relatively small with the most recent amendments (SAFMC 2004, 2008) having more positive impacts and fewer burdens. Much of that recent regulatory action has been directed toward the rock shrimp fishery. Actions here primarily affect the penaeid shrimp fishery that has some participation by rock shrimp vessels from both the Gulf and South Atlantic. However, as discussed elsewhere and under Section 4.0, it is the external factors that may play a larger role in determining the cumulative effects on both fishermen and fishing communities. Although the actions included here should provide added protection to overwintering stocks and a more realistic overfishing threshold for pink shrimp, even slight disruptions in social and economic welfare could have negative impacts on firms and the extended community network. Without continuous real time data, it is impossible to know how small perturbations in revenue streams might affect firms or their communities. While we know that the recent economic downturn has affected many businesses, households, and individuals, we are unable to measure the direct impact these factors have had on the fishing industry at this time. We can only assume that these outside influences have made it even more difficult for those working within and around the South Atlantic shrimp fishery to maintain profitability.

While these outside influences are recognized as having negative impacts, positive effects from regulatory action can provide socioeconomic benefits. It is assumed here that the long-term effects of the actions included here will be beneficial and if there are negative social and economic effects, that they will be less than if no action were taken.

Chapter 7. Research Needs

The South Atlantic pink shrimp stock (and the other South Atlantic penaeids) has not had a proper stock assessment. Recent concerns regarding possible overfishing have highlighted the need to accurately assess the status of this stock. A stock assessment incorporating both fishery dependent and independent data would aid in determining stock condition and allow for the establishment of refined overfished and overfishing indices. Recently the Gulf of Mexico pink shrimp stock assessments have been updated using the Stock Synthesis model. The Gulf of Mexico pink shrimp stocks are modeled using fishery catch per unit effort (CPUE) and catch, as well as Southeast Area Monitoring and Assessment Program (SEAMAP) survey data. The fishery dependent data include catch by size, year/month, and statistical zone, as well as catch rates by year/month and statistical zones. Fishery independent SEAMAP data include catch by size and season as well as catch rates by season. Similar data for the South Atlantic assessments would be beneficial for conducting a stock assessment using the Stock Synthesis model. However, if these data are not available at the same resolution as the Gulf of Mexico data, it could prohibit the use of the Stock Synthesis modeling approach for a South Atlantic assessment. Therefore, initial research for the South Atlantic pink shrimp assessment should focus on data types and availability. The utility of using this new modeling approach for the South Atlantic pink shrimp stocks should be investigated, however, research should initially focus on specific data needs and availability before a specific modeling approach is adopted for use (Personal communication Rick Hart 2012).

Chapter 8. List of Preparers

Table 8-1. List of Amendment 9 preparers.

Name	Agency/Division	Area of Amendment Responsibility
Kate Michie	NMFS/SF	IPT Lead/Fishery Biologist
Anna Martin	SAFMC	IPT Lead/Fishery Biologist
Jack McGovern	NMFS/SF	Fishery Scientist
David Dale	NMFS/HC	EFH Specialist
Andy Herndon	NMFS/PR	Biologist
Stephen Holiman	NMFS/SF	Economist
Mike Jepson	NMFS/SF	Social Scientist
Mike Travis	NMFS/SF	Economist
Otha Easley	NMFS/LE	Supervisory Criminal Investigator
Scott Sandorf	NMFS/SF	Regulations Writer
Monica Smit-Brunello	NOAA/GC	Attorney Advisor
David Keys	NMFS/SER	Regional NEPA Coordinator
Brian Cheuvront	SAFMC	Economist
Scott Crosson	SEFSC	Economist
Rick Hart	SEFSC	Biologist

NMFS = National Marine Fisheries Service, SAFMC = South Atlantic Fishery Management Council, SF = Sustainable Fisheries Division, PR = Protected Resources Division, SER = Southeast Regional Office, HC = Habitat Conservation Division, GC = General Counsel, Eco=Economics

Chapter 9. Agencies and Persons Consulted

Responsible Agency

Amendment 9:
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NMFS, Southeast Region
263 13th Avenue South
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List of Agencies, Organizations, and Persons Consulted
SAFMC Law Enforcement Advisory Panel
SAFMC Scientific and Statistical Committee
SAFMC Shrimp Advisory Panel
SAFMC Deepwater Shrimp Advisory Panel
North Carolina Coastal Zone Management Program
South Carolina Coastal Zone Management Program
Georgia Coastal Zone Management Program
Florida Coastal Zone Management Program
Florida Fish and Wildlife Conservation Commission
Georgia Department of Natural Resources
South Carolina Department of Natural Resources
North Carolina Division of Marine Fisheries
North Carolina Sea Grant
South Carolina Sea Grant
Georgia Sea Grant
Florida Sea Grant
Atlantic States Marine Fisheries Commission
Gulf and South Atlantic Fisheries Development Foundation
Gulf of Mexico Fishery Management Council
National Marine Fisheries Service
- Washington Office
- Office of Ecology and Conservation
- Southeast Regional Office
- Southeast Fisheries Science Center

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