Atlantic States Marine Fisheries Commission

DRAFT AMENDMENT 3 TO THE NORTHERN SHRIMP FISHERY MANAGEMENT PLAN FOR PUBLIC COMMENT

March 2017

Vision: Sustainably Managing Atlantic Coastal Fisheries

Draft Amendment 3 to the Interstate Fishery Management Plan for Northern Shrimp

Prepared by

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Public Comment Process and Proposed Timeline

In June 2014, the Atlantic States Marine Fisheries Commission's Northern Shrimp Section initiated development of an amendment to the Interstate Fishery Management Plan (FMP) for Northern Shrimp to consider establishing a limited entry program. However, during the initial scoping process, the Section removed limited entry from the Draft Amendment. Draft Amendment 3 now focuses on total allowable catch allocation programs, gear requirements, and other measures to improve management of the northern shrimp fishery and resource. This Draft Amendment would replace Amendment 2 and Addendum I to the Northern Shrimp FMP. **While the Section welcomes comment on all parts of the document, public consideration and comment is specifically sought on the proposed alternative management options included in *Sections 2.3, 2.5, 3.1.1, 3.1.2, 4.1.1 – 4.1.3 and 4.1.12*.**

Fishermen and interested stakeholders are encouraged to submit comments regarding this document at any time during the public comment period. The final date comments will be accepted is **June 21, 2017 at 5:00 p.m**. You may submit public comment in one or more of the following ways:

1. Attend public hearings in your state or jurisdiction.
2. Refer comments to your state's members on the Northern Shrimp Section or Advisory Panel, if applicable.
3. Mail, fax or email written comment to the following address:

Mail: Max Appelman
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Commission's Process and Timeline

Winter 2017	Draft Amendment for Public Comment Developed
March 2017	Section Reviews Draft Amendment and Considers its Approval for Public Comment
April – June 2017	**Section Solicits Public Comment and States Conduct Public Hearings**
July 2017	Section Reviews Public Comment, Selects Management Options and Considers Final Approval of Amendment 3
August 2017	Commission Considers Final Approval of Amendment 3
TBD	Provisions of Amendment 3 are Implemented

Executive Summary

[*To be completed following final approval*]

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 BACKGROUND INFORMATION 1
1.1.1 Statement of the Problem 1
1.1.2 Benefits of Implementation 2
1.1.3 Ecological Benefits 2
1.2 DESCRIPTION OF THE RESOURCE 2
1.2.1 Northern Shrimp Life History 2
1.2.2 Stock Assessment Summary 3
1.2.3 Present condition of the stock 4
1.3 DESCRIPTION OF THE FISHERY 7
1.3.1 Commercial Fishery 7
1.3.2 Recreational Fishery 9
1.3.3 Subsistence Fishing 9
1.3.4 Non-Consumptive Factors 9
1.3.5 Interactions with Other Fisheries, Species, or Users 9
1.4 HABITAT CONSIDERATIONS 11
1.4.1 Habitat Important to the Stocks 11
1.5 IMPACTS OF THE FISHERY MANAGEMENT PROGRAM 16
1.5.1 Biological and Environmental Impacts 16
1.5.2 Social Impacts 17
1.5.3 Economic Impacts 19
1.5.4 Other Resource Management Efforts 21
1.6 LOCATION OF TECHNICAL DOCUMENTATION FOR FMP 23
1.6.1 Review of Resource Life History and Biological Relationships 23
1.6.2 Stock Assessment Document 23
1.6.3 Social Assessment Documents 23
1.6.4 Economic Assessment Document 23
1.6.5 Law Enforcement Assessment Document 24
1.6.6 Habitat Background Document 24
2.0 GOALS AND OBJECTIVES 24
2.1 HISTORY AND PURPOSE OF THE PLAN 24
2.1.1 History of Prior Management Actions 24
2.1.2 Purpose and Need for Action 26
2.2 GOAL 27
2.3 OBJECTIVES 28
2.4 SPECIFICATION OF MANAGEMENT UNIT 29
2.5 DEFINITION OF OVERFISHING 29
2.6 STOCK REBUILDING PROGRAM 32
2.7 RESOURCE COMMUNITY ASPECTS 32
2.8 IMPLEMENTATION SCHEDULE 33

3.0 MONITORING PROGRAM SPECIFICATIONS/ELEMENTS 33
3.1 SUMMARY OF MONITORING PROGRAMS 33
3.1.1 Catch and Landings Information 33
3.1.2 Fishery-Dependent Monitoring 34
3.1.3 Biological Information 34
3.1.4 Social Information 34
3.1.5 Economic Information 34
3.1.6 Observer Programs 36
3.2 ANNUAL ASSESSMENT 36
3.2.1 Assessment of Fishing Mortality Target and Measurement 36
3.2.2 Assessment of Annual Recruitment 37
3.2.3 Assessment of Spawning Stock Biomass 37
3.3 BYCATCH MONITORING PROGRAM 37
3.4 HABITAT PROGRAM 37
4.0 MANAGEMENT PROGRAM IMPLEMENTATION 38
4.1 COMMERCIAL FISHERIES MANAGEMENT MEASURES 38
4.1.1 Annual Fishery Specifications and the Total Allowable Catch 38
4.1.2 Total Allowable Catch Allocation Program 41
4.1.2.1 Research Set Aside Program 44
4.1.2.2 Total Allowable Catch Accountability Measures 44
4.1.3 Fishing Season 45
4.1.3.1 Projected season closure 46
4.1.4 Trip Limits 46
4.1.5 Trap Limits 46
4.1.6 Days Out of the Fishery 47
4.1.7 Minimum Mesh Size 47
4.1.8 Fishing Gear 47
4.1.9 Cod End Strengthener 48
4.1.10 Mechanical “Shaking” Devices 48
4.1.11 Finfish Excluder Devices 48
4.1.12 Size Sorting Grate Systems and Count per Pound Provisions 49
4.2 RECREATIONAL FISHERIES MANAGEMENT MEASURES 55
4.3 HABITAT CONSERVATION AND RESTORATION 55
4.3.1 Preservation of Existing Habitat 55
4.3.2 Habitat Restoration, Improvement, and Enhancement 56
4.4 ALTERNATIVE STATE MANAGEMENT REGIMES 56
4.4.1 General Procedures 56
4.4.2 Management Program Equivalency 57
4.5 ADAPTIVE MANAGEMENT 57
4.5.1 General Procedures 57
4.5.2 Measures Subject to Change 58
4.6 EMERGENCY PROCEDURES 58
4.7 MANAGEMENT INSTITUTIONS 59

4.7.1 Atlantic States Marine Fisheries Commission and ISFMP Policy Board 59
4.7.2 Northern Shrimp Section 59
4.7.3 Northern Shrimp Plan Development/Review Team 59
4.7.4 Northern Shrimp Technical Committee 60
4.7.5 Northern Shrimp Advisory Panel 60
4.8 RECOMMENDATIONS TO THE SECRETARY FOR COMPLEMENTARY ACTIONS IN FEDERAL JURISDICTIONS ... 60
4.9 COOPERATION WITH OTHER MANAGEMENT INSTITUTIONS 60

5.0 COMPLIANCE 61

5.1 MANDATORY COMPLIANCE ELEMENTS FOR STATES 61
5.1.1 Mandatory Elements of State Programs 61
5.1.2 Compliance Schedule 62
5.2 PROCEDURES FOR DETERMINING COMPLIANCE 62
5.3 ANALYSIS OF THE ENFORCEABILITY OF PROPOSED MEASURES 63

6.0 MANAGEMENT AND RESEARCH NEEDS 63

6.1 RESEARCH AND DATA NEEDS 63

7.0 PROTECTED SPECIES 65

7.1 SPECIES PRESENT IN THE AREA 65
7.2 SPECIES AND CRITICAL HABITAT NOT LIKELY AFFECTED BY THE PROPOSED ACTION 66
7.3 SPECIES POTENTIALLY AFFECTED BY THE PROPOSED ACTION 66
7.4 INTERACTIONS BETWEEN GEAR AND PROTECTED RESOURCES 69

8.0 WORK CITED 75

9.0 TABLES AND FIGURES 87

10.0 APPENDIX 1 110

LIST OF TABLES

Table 1. Management of the Gulf of Maine Northern Shrimp Resource, 1973 – 2017.

Table 2: U.S. commercial landings of northern shrimp in the Gulf of Maine, 1958–2016.

Table 3: ASMFC summer trawl survey indices for northern shrimp.

Table 4: Price per pound and value of U.S. commercial landings of northern shrimp in the Gulf of Maine

Table 5: Estimated numbers of vessels in the Gulf of Maine Northern Shrimp fishery

Table 6. Species protected under the ESA and/or MMPA that may occur in the affected environment of the northern shrimp fishery

Table 7. Large whale occurrence in the area of operation for the northern shrimp fishery.

Table 8. Small cetacean occurrence in the area of operation of the northern shrimp fishery.

Table 9. Pinniped occurrence in the area of operation of the northern shrimp fishery.

Table 10. Summary of confirmed human-caused injury or mortality to fin, minke, humpback, sei, and North Atlantic right whales from 2010-2014 due to entanglement in fishing gear.

Table 11. Small cetacean and pinniped species observed seriously injured and/or killed by Category II Northeast bottom trawl fisheries in the affected environment of the northern shrimp fishery

LIST OF FIGURES

Figure 1. Schematic diagram of the life cycle of *Pandalus borealis* in the Gulf of Maine

Figure 2. Distribution and migration of adult female shrimp in the Gulf of Maine

Figure 3. Heat map of average shrimp abundance from the ASMFC summer trawl survey, 1984-2016.

Figure 4: Strict Traffic Light Approach results

Figure 5: Gulf of Maine northern shrimp Fuzzy Traffic Light Approach indicator values relative to reference levels

Figure 6: Gulf of Maine northern shrimp Fuzzy Traffic Light Approach environmental indicator values relative to reference levels

Figure 7: Ocean temperature anomalies in the Gulf of Maine

Figure 8. Habitat map for the Gulf of Maine

1.0 INTRODUCTION

The Atlantic States Marine Fisheries Commission (Commission) is developing an amendment to its Interstate Fishery Management Plan (FMP) for Northern Shrimp under the authority of the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA). The Commission, through the coastal states of Maine, New Hampshire, and Massachusetts is responsible for managing northern shrimp in the Gulf of Maine in state waters (0-3 miles from shore). Management authority in the Exclusive Economic Zone (EEZ, 3-200 miles from shore) lies with the Secretary of Commerce through ACFCMA in the absence of a federal fishery management plan. This amendment will completely replace Amendment 2 and Addendum I to the Northern Shrimp FMP if approved for management.

1.1 BACKGROUND INFORMATION

1.1.1 Statement of the Problem

The Gulf of Maine northern shrimp fishery is currently managed under Amendment 2 (2011) and Addendum I (2012). Amendment 2 implemented a more timely reporting system and expanded the tools available to manage northern shrimp including trip limits, trap limits, and days out of the fishery (i.e., days where it is unlawful to land shrimp). Addendum I refined the annual specifications process and implemented gear-specific total allowable catch (TAC) allocations. However, the northern shrimp fishery and population has experienced significant changes since the implementation of these management documents.

Beginning with the 2014 season, the Northern Shrimp Section (Section) imposed a moratorium on the fishery. The Section considered several factors prior to closing the fishery. Results of the 2013 stock status report indicated the abundance and recruitment indices in the western Gulf of Maine had declined steadily since 2006, and 2012 and 2013 were the lowest on record. Furthermore, long term trends in environmental conditions have not been favorable for northern shrimp survival in the Gulf of Maine amplifying the need to conserve spawning stock biomass. Results of each subsequent stock status report have indicated continued poor trends in biomass, recruitment, and environmental indices which prompted the Section to extend the moratorium each year through 2017. Although short-term prospects for a commercial fishery remain poor, there was a slight improvement in recruitment observed in 2016, although still below average.

As an open access fishery, participation is impacted by market demand, season length, and displaced harvesters from other fisheries. For example, substantial changes in other Northeast fisheries (e.g., limited entry and effort restrictions in the Gulf of Maine groundfish fisheries) have resulted in increased effort in the northern shrimp fishery. Also, early season closures occurred in the 2010 and 2011 fishing seasons due to untimely reporting and an overharvest of the target total allowable catch. Given shrimp biomass has decreased, there are concerns the capacity of the fleet vastly exceeds the resources potential to sustain a viable fishery.

The potential for increased fishing pressure, coupled with failed recruitment, the lowest abundance indices on record, and unfavorable environmental conditions have resulted in uncertainties in the future status of the northern shrimp resource. To address these uncertainties, an amendment to the FMP was initiated to implement measures to control effort and protect the spawning stock.

1.1.2 Benefits of Implementation

Draft Amendment 3 is designed to maintain an efficient management structure that is flexible and encourages public involvement in the management process. It provides mechanisms to improve the Section's ability to effectively assess the status of the resource, and to predict its responses to both changes in environmental conditions and to various management actions. Draft Amendment 3 includes options for state-by-state, seasonal- and area-based effort management, payback provisions for when a fishery exceeds its quota allocations, mandatory use of a size sorting grate systems, as well as timelier harvest and dealer reporting requirements among others. Specific benefits to these measures include minimizing the potential to exceed the target TAC, improving fishery monitoring, and minimizing the catch of small shrimp to improve sustainability of the resource.

Sustaining a viable shrimp fishery benefits the region by helping maintain diversity in fishing opportunities and providing opportunities to harvest, process, and further support fishing communities throughout the Gulf of Maine. Ultimately, specific benefits associated with the amendment will vary depending upon the final measures selected by the Section.

1.1.3 Ecological Benefits

Northern shrimp is an important link in marine food chains, preying on both planktonic and benthic invertebrates, and are in turn consumed by many commercially important fish species, such as cod, redfish, and silver and white hake. Therefore, maintaining a healthy northern shrimp population will contribute to the Gulf of Maine ecosystem. Shrimp will continue to play a role in controlling the populations of its prey, while simultaneously providing fodder for carnivorous vertebrates throughout the Gulf. *Pandalus borealis* diet was well documented by Weinberg (1981). Many species prey on *P. borealis* as a component of their diet (Shumway et al. 1985; Worm and Myers 2003; Savenkoff et al. 2006). Over many years, Wigley, Langton and Bowman from NOAA Fisheries have conducted many predator-prey studies showing the importance of *P. borealis* in the food web of the Gulf of Maine. The consideration of additional regulatory measures, such as regional-based TAC allocations to minimize the potential of exceed the annual TAC coupled with timely reporting procedures, or minimizing the harvest of smaller shrimp through mandatory use of size-sorting grate systems (i.e., double-Nordmore or compound), may improve the population of northern shrimp.

1.2 DESCRIPTION OF THE RESOURCE

1.2.1 Northern Shrimp Life History

The biology of the genetic distinct northern shrimp population (Jorde et al. 2014) in the Gulf of Maine has been studied extensively (Apollonio and Dunton 1969; Apollonio et al. 1986; Haynes and Wigley 1969), and reviewed by Shumway et al. (1985) and Bergström (2000). The species are protandrous hermaphrodites, maturing first as male and then transitioning to female. Ocean temperature has an important influence on northern shrimp in the Gulf of Maine (Apollonio et al. 1986; Richards et al. 1996; Richards et al. 2012).

1.2.1.1 Age and Growth

There is considerable information on growth of the Gulf of Maine northern shrimp stocks (Haynes and Wigley 1969; Apollonio et al. 1986; Terceiro and Idoine 1990; and Fournier at al. 1991). Differences in size at age by area and season can be ascribed to temperature effects, with more rapid growth rates at higher temperatures (Apollonio et al. 1986). Differences in size at age from year to year, and in size at sex transition, have been attributed to both environmental and stock density effects (Koeller et al. 2000, Koeller et al. 2007).

1.2.1.2 Stock Structure, Spawning and Reproduction

The species develop first as males at roughly 2½ years of age and then pass through a series of transitional stages to mature into females at roughly 3½ years of age (Figure). Northern shrimp spawn in offshore waters beginning in late July. By early fall, most adult females extrude their eggs onto the abdomen. Egg bearing females move inshore in late autumn and winter, where the eggs hatch (Figure 2). Juveniles remain in coastal waters for a year or more before migrating to deeper offshore waters, where they mature as males. Some females may survive to repeat the spawning process in succeeding years, and may live to be five or perhaps six years old.

Recruitment of northern shrimp is related to both spawning biomass and ocean temperatures, with higher spawning biomass and colder temperatures producing stronger recruitment. Experiments have shown that increased water temperatures, such as the Gulf of Maine is experiencing (Figure 7), can negatively affect the incubation of eggs in ovigerous females resulting in poor egg survival, embryonic development and larval hatching (Brillon et al. 2005).

1.2.1.3 Mortality

Instantaneous natural mortality (M) for this stock has been estimated at 0.25 based on regressions of instantaneous total mortality (Z) estimate from research vessel surveys for 1968-1972 on total effort (Rinaldo 1981). The estimates of Z for 1978 (when the fishery was closed) from the State of Maine survey data was 0.17 (Clark 1982). Therefore it appears that M is low in the Gulf of Maine relative to other northern shrimp stocks, which have been estimated at a range from 0.25-1.0 (Shumway et al 1985). The 45th Northeast Regional Stock Assessment Review Committee suggested that an M at 0.6 was likely more realistic for this population (NEFSC 2007a and 2007b). Additionally, Link and Idoine (2009) have suggested that natural mortality in the Gulf of Maine may be higher than 0.25, based on fish predation data, and more research on this topic is needed. However, while higher values of M are considered more realistic, using a higher constant value for M does not generally alter conclusions about stock status because the increased M scales the entire assessment (ASMFC 2016).

1.2.2 Stock Assessment Summary

The first analytical assessment was completed in 1997 and peer-reviewed at the 25th Northeast Regional Stock Assessment Workshop (NEFSC 1997). In addition to previously used traditional methods of assessing the stock (i.e., landings data, commercial effort and CPUE estimates, indices of abundance, etc.) quantitative tools like the Collie-Sissenwine, or Catch-Survey Analysis (CSA), the ASPIC surplus production, and yield per recruit and eggs per recruit models were introduced and continued to be used to provide guidance for management of the stock.

A benchmark assessment review in 2014 revealed issues with model performance in recent years for the Gulf of Maine northern shrimp (NEFSC 2014). The problems were thought to be due primarily to recent extreme fluctuations in abundance. No models were accepted for use in shrimp assessment and management. The current assessment therefore uses an index-based approach to evaluate the condition of the stock. A benchmark assessment which will explore alternative modeling approaches is expected to be peer-reviewed in 2018.

Since the implementation of Amendment 1 in 2004, stock status for northern shrimp in the Gulf of Maine has been determined via comparison of terminal year estimates of fishing mortality (F) and biomass (B) to F and B-based reference points (i.e., biological reference points, or BRPs). The BRPs defined in Amendment 2 (2011) were developed via the CSA assessment model (Cadrin et al 1999), which was peer-reviewed and accepted for management use in 2007, but was not approved for management use following the 2014 benchmark assessment. Amendment 2 continues to define the BRPs (and values) used to determine stock status for northern shrimp in the Gulf of Maine. However, the northern shrimp stock assessment undergoes a formal scientific peer-review process (i.e., a benchmark) about every five years which may result in revised or different stock status determination criteria.

1.2.2.1 Fishery-Independent Data

Trends in abundance and recruitment, among other stock assessment variables (e.g., early life stage survival) have been monitored using various fishery independent surveys conducted in the Gulf of Maine including the Northeast Fisheries Science Center (NEFSC) autumn bottom trawl survey (since the late 1960's); the Maine-New Hampshire annual spring inshore trawl survey which has been collecting data in depths greater than 55 fathoms (100 m) since 2003 and have been used in shrimp assessment since 2008; the summer surveys conducted by the State of Maine (discontinued in 1983), and the ASMFC shrimp survey initiated by the NSTC in 1984 to specifically assess the shrimp resource in the western Gulf of Maine. The ASMFC survey is coordinated by the NEFSC and conducted each summer aboard the *R/V Gloria Michelle*. The survey employs a stratified random sampling design and uses gear specifically designed for Gulf of Maine conditions. This survey is considered to provide the most reliable information available on abundance, distribution, population age structure, and other biological parameters of the Gulf of Maine northern shrimp resource (Table 3 and Figure 3).

1.2.3 Present Condition of the Stock

Since no models were accepted for management from the 2014 benchmark assessment, the NSTC currently utilizes an index-based Strict Traffic Light Approach (STLA), developed by Caddy (1999*a*, 1999*b*, 2004) and extended by McDonough and Rickabaugh (2014), to annually assess stock status of Gulf of Maine northern shrimp (ASMFC 2016). The approach categorizes annual values of each index as one of three colors (red, yellow, or green) to illustrate the state of the population, environmental conditions, and fishery. The greater the proportion of green or red in each stacked bar, the further that year's index is in a favorable or unfavorable direction, respectively.

The NSTC has used the STLA to characterize a suite of fishery independent indices including total abundance and biomass estimated from the ASMFC summer shrimp and NEFSC fall surveys, and harvestable biomass, spawning stock biomass, recruitment, and early life survival estimated from the ASMFC summer shrimp survey; fishery dependent indices include commercial catch per unit effort (CPUE), price per pound, and annual landings value (price per pound and annual landings values were standardized to 2016 US dollars; www.bls.gov). Environmental indices include predation pressure on Gulf of Maine northern shrimp that was developed for the benchmark assessment (NEFSC 2014; Richards and Jacobson 2016), and several sources of temperature data for the northern shrimp resource area. Trends have been characterized from 1984 to present (Figure 4).

The NSTC also examined a subset of key indicators using the Fuzzy Traffic Light Approach (FTLA; McDonough and Rickabaugh 2014). The FTLA gives a finer view of the classification of each indicator in each year. The NSTC evaluates total biomass, recruit abundance, spawning biomass, harvestable biomass, commercial fishery CPUE, early life survival, predation pressure index, spring sea surface temperature at Boothbay Harbor, Maine, the spring bottom temperature anomaly from NEFSC surveys in shrimp resource areas, and the summer bottom temperature from the ASMFC summer shrimp survey (Figure 5 and Figure 6).

Two qualitative stock status reference levels were developed for the traffic light approaches: 1) based on the 'stable period' mean (SPM, 1985-1994), which was the time period used to define the reference points in Amendment 2, and 2) the qualitative status indicator based on the entire time series of observations (i.e., a percentile-based reference level) (ASMFC 16). The 20th percentile of the time series (1984-2016) was considered to delineate an extremely adverse state. For fishery dependent and fishery independent indices, red denotes values at or below the 20th percentile, while green denotes values at or above the SPM. For environmental indices, red denotes values at or above the 80th percentile and green denotes values at or below the SPM. These reference levels are not management triggers, as they are not defined in the ASMFC Northern Shrimp FMP. The levels are used to illustrate the current condition of the stock relative to earlier time periods.

Taken together, the STLA and FTLA indicators demonstrate that the Gulf of Maine northern shrimp stock status continues to be critically poor. Recruitment indices (catch per tow in numbers of 1.5-year old shrimp) for the 2010-2015 year classes are poor and include the three smallest year classes on record. As a result, total biomass, spawning biomass and harvestable biomass have remained at unprecedented lows for five consecutive years. The survival index for the 2015 year class was very high suggesting that an unusually high proportion of the eggs produced in 2015 survived to age 1.5; however recruitment of that year class was weak. The recruitment index increased in 2016 but is still well below the stable period mean (13th lowest value on record).

Trends in the four environmental indicators suggest that conditions have not been favorable for northern shrimp in recent years (Figure 4 and 6). Predation pressure has generally increased since the late 1990s. Sea surface and bottom temperatures were colder in 2015 than in recent years, however an overall rise in temperature since the stable period is evident (Figure 7).

Current harvestable biomass is almost entirely composed of the 2013 year class (ASMFC 2016). Higher survival of the 2013 year class may have reflected reduced fishing effort on the spawning stock. Although the stock remains in critically poor condition, the protection of the 2013 year class and the small increase in recruitment in 2016 could provide a foundation for stock recovery if these year classes survive to spawn successfully. Recruits from the 2015 and 2016 year classes are not expected to reach exploitable size until 2018 and 2019, respectively.

Accepted definitions of stock collapse include a population at 10% of un-fished biomass (Worm et al. 2009) or at 20% of B_{MSY} (Pinsky et al. 2011). Using summer survey biomass indices and the 1984-1993 “stable period” survey mean as a highly conservative proxy for un-fished biomass, the Gulf of Maine northern shrimp stock was considered collapsed during 2012-2015, but was slightly above this threshold in 2016. Using the stable period mean as a proxy for B_{MSY} instead, the stock remains in a collapsed state.

1.2.3.1 *Peer Review Panel Results from the 58th SAW*

The northern shrimp stock assessment was peer-reviewed at the 58th Northeast Regional Stock Assessment Workshop (58th SAW) in January 2014, and included data through the 2013 summer survey. The SARC reviewed seven terms of references (TOR) for the Northern Shrimp stock assessment processes:

1. Present the Gulf of Maine northern shrimp landings, discards, effort, and fishery-independent data used in the assessment. Characterize the precision and accuracy of the data and justify inclusion or elimination of data sources.
2. Estimate population parameters (fishing mortality, biomass, and abundance) using assessment models. Evaluate model performance and stability through sensitivity analyses and retrospective analysis, including alternative natural mortality (M) scenarios. Include consideration of environmental effects where possible. Discuss the effects of data strengths and weaknesses on model results and performance.
3. Update or redefine biological reference points (BRPs; point estimates or proxies for B_{MSY}, SSB_{MSY}, F_{MSY}, or MSY). Evaluate stock status based on BRPs.
4. Characterize uncertainty of model estimates of fishing mortality, biomass and recruitment, and biological reference points.
5. Review the methods used to calculate the annual target catch and characterize uncertainty of target catch estimates.
6. Develop detailed short and long-term prioritized lists of recommendations for future research, data collection, and assessment methodology. Highlight improvements to be made before the next benchmark assessment.
7. Based on the biology of species, and potential scientific advances, comment on the appropriate timing of the next benchmark assessment and intermediate updates.

Resulting in the Panel drafting the following conclusion (NEFSC 2014):

The SARC58 peer review panel concluded that the northern shrimp stock assessment models presented to them were not acceptable to serve as a basis for fishery management advice. Specifically, the SARC58 concluded that shrimp assessment Terms of Reference #2, #3, #4, and #5 were not met. These particular sections are included in this report to document the analyses that were done for the peer review, but they are not recommended by SARC58 as a basis for management."

1.3 DESCRIPTION OF THE FISHERY

1.3.1 Commercial Fishery

Northern shrimp occur in boreal and sub-arctic waters throughout the North Atlantic and North Pacific, where they support important commercial fisheries. In the western North Atlantic, commercial concentrations occur off Greenland, Labrador, and Newfoundland, in the Gulf of St. Lawrence, and on the Scotian Shelf. The Gulf of Maine marks the southernmost extent of its Atlantic range. Primary concentrations occur in the western Gulf where bottom temperatures are coldest. In summer, adults are most common at depths of 90-120 meters (Haynes and Wigley, 1969).

The fishery has been seasonal in nature, peaking in late winter when egg-bearing females move into inshore waters and terminating in spring under a regulatory closure. Table 1 identifies the season length and regulations for the northern shrimp fishery since 1973. Northern shrimp has been an accessible and important resource to fishermen working inshore areas in smaller vessels who otherwise have few options due to seasonal changes in availability of groundfish, lobsters and other species.

The fishery formally began in 1938, and during the 1940s and 1950s almost all of the landings were by Maine vessels from Portland and smaller Maine ports further east. This was an inshore winter fishery, directed towards egg-bearing females in inshore waters (Scattergood 1952). Landings reached a peak of 255 tons in 1945, but then declined into the 1950s and during 1954-1957 no commercial landings of shrimp were recorded (Apollonio et al. 1986).

In the late 1950s, the fishery began to recover due to the efforts of commercial interests in Portland, Maine, and presumably to improving resource conditions. Landings (Table 2) increased to a peak of 12,800 tons in 1969, of which 11,000 tons were taken by Maine vessels. New Hampshire vessels entered the fishery in 1966, but throughout the 1960s and 1970s New Hampshire landings were less than 100 mt. Landings by Massachusetts vessels were insignificant until 1969, but in the early 1970s the fishery developed rapidly, with landings increasing from 14% of the total catch to about 40% in 1973-1975. In contrast to the historical wintertime Maine fishery, these vessels fished continually throughout the year and made significant catches during summer months. Total landings averaged 11,000 tons from

1970-1972 and then declined rapidly until 1977 when only 400 tons were landed. The fishery was closed from mid-May of 1977 to February 1979.

Between 1980 and 1998, landings and effort recovered, and then fluctuated considerably in response to recruitment from several strong year classes, varying from 2,300 tons in 1993 to 9,500 tons in 1996. In keeping with historic trends, the majority of the catch in those years had been taken by Maine vessels (76%), with Massachusetts vessels accounting for most of the remainder (17%). Numbers of participating vessels fluctuated considerably, switching to shrimp trawling if the season's length, shrimp's price and accessibility warranted the effort. After 1998, landings declined, reaching a low of 400 tons in 2002, due to stock declines and management actions (shorter fishing seasons). Landings then increased steadily, peaking at 6,400 tons in 2011. Maine boats landed 87%, Massachusetts 3% and New Hampshire 10% of this total. Eighty-five percent of Maine's landings occurred between Portland and Rockland (inclusive). After 2011, landings declined and the fishery was closed after the 2013 season and has not reopened, except for small research fisheries in 2015-2017.

Size composition collected from catches since the early 1980s indicate that trends in landings have been determined primarily by recruitment of strong year classes. According to indices from the annual joint ASMFC summer shrimp survey, strong year classes include those assumed to have been hatched in 1982, 1987, 1992, 2001, and 2004, which all exhibited 750 or more shrimp per survey tow (Table 3). Conversely, the indices for the presumed 1983, 2000, 2002, 2011, 2012, and 2014 year classes were low, fewer than 20 shrimp per tow. In addition, below-average indices for the 2010, 2013, and 2015 year classes have contributed to the recent, unprecedented six years (2010-2015) of below-average recruitment for the Gulf of Maine shrimp stock.

A wide variety of vessels have been used in the fishery (Bruce 1971; Wigley 1973). The predominant type during the 1960s and 1970s appears to have been side-rigged trawlers in the 14-23 m range. During the 1980s and 1990s, side trawlers either re-rigged to stern trawling, or retired from the fleet. Recently, the shrimp fleet was comprised of lobster vessels in the 9-14 m range that seasonally rig for shrimp fishing, small to mid-sized stern trawlers in the 12-17 m range, and larger trawlers primarily in the 17-24 m range. Otter trawl remains the primary gear employed and is typically chain or roller-rigged, depending on area and bottom fished. There has been a trend in recent years towards the use of heavier, larger roller and/or rockhopper gear. These innovations, in concert with substantial improvements in electronic equipment, have allowed for much more accurate positioning and towing in formerly unfishable grounds, thus greatly increasing the fishing power of the Gulf of Maine fleet.

A shrimp pot fishery has existed in mid-coastal Maine since the 1970s, where in many areas bottom topography provides favorable shrimp habitat that might be too rough or restricted for trawling. The trapped product is of good quality, as the traps target only female shrimp once they have migrated inshore. Maine trappers land fewer small shrimp, and generally are more apt to catch females after egg hatch, than trawlers (ASMFC 2010). As the trap fishery is dependent on the availability of shrimp in a specific area, there is a shorter season for traps than for trawlers. The majority of the shrimp trappers also catch lobster, so shrimp is a supplemental portion of their annual production and income. Maine trapping operations accounted for 4% to 8% of the state's trips from 1987 to 1994 (ASMFC 2000). There is some indication that trap fishing for shrimp has grown in areas such as South Bristol and Boothbay Harbor (mid-coast Maine). According to federal and state of Maine Vessel Trip Reports (VTRs), trappers averaged 12% of Maine's landings during 2001 to 2007, 18% during 2008 to 2011, 9% in 2012, and 6% in 2013. Trapping effort had been increasing in recent years, accounting for 22% of Maine's landings in 2010, but may have been lower relative to trawling in 2011 (17%) and 2012 (9%) because of the early closure of the seasons (ASMFC 2013).

Currently, the Section implements a combination of effort controls including trip limits, trap limits, and days out of the fishery to manage the commercial fishery. The FMP also allows for a research set-aside program (RSA), mandatory reporting requirements integrated through the coastwide Atlantic Coastal Cooperative Statistics Program's (ACCSP) Standard Atlantic Fisheries Information System (SAFIS), and allocation of the total allowable catch (TAC) by gear type with 87% allocated to the trawl fishery and 13% to the trap fishery.

1.3.2 Recreational Fishery
A very limited recreational fishery exists for northern shrimp. This fishery, using traps, has been for personal use and has not been licensed.

1.3.3 Subsistence Fishing
No significant subsistence fisheries for northern shrimp have been identified at this time; however, fishermen reportedly harvest 10 or 20 pounds of shrimp for personal consumption or non-sale distribution on a regular basis.

1.3.4 Non-Consumptive Factors
Some Gulf of Maine shrimp processors have been composting shrimp waste for use as garden fertilizer. There has also been experimentation in Canada with extracting chitin from shrimp for medical purposes, and in Norway with extracting carotenoids for salmon feed (Spencer Fuller, personal communication)

1.3.5 Interactions with Other Fisheries, Species, or Users

1.3.5.1 Other Species
Northern shrimp is an important link in marine food chains, preying on both plankton and benthic invertebrates and, in turn, being consumed by many commercially important fish species, such as cod, redfish, dogfish, and silver and white hake. *P. borealis* diet was well documented by Weinberg (1981). Species that include *P. borealis* in their diet are documented by many authors (Shumway et al. 1985; Worm and Myers 2003; Savenkoff et al. 2006; Link and Idoine 2009; Richards and Jacobson 2016).

1.3.5.2 Other Fisheries

In recent history, the northern shrimp fishery has been prosecuted in the winter months from December through May at a time when many other fishing activities in the Gulf of Maine are marginal or out of season.

Dunham and Mueller (1976) note that in response to shrimp harvest restrictions such as a closed season, most respondents indicated that they would fish for other species. Additionally, most would fish for species they typically target at other times of the year. These included lobster, scallop, or groundfish (mostly redfish, cod, and whiting). During the period this study took place, shrimp stock levels were extremely low, ultimately leading to the closure of the fishery in April 1977. Harvesters responded by spending more time prosecuting fisheries that they had historically participated in. This is indicated by notable increases in the landings for whiting and squid during the period.

Similarly, most shrimp harvesters today fish for other species during the year. However, the ability to switch between fisheries has decreased since the implementation of limited entry and effort restrictions in the northeast multispecies (groundfish) fishery, and Maine’s lobster and scallop fisheries.

From a processor’s standpoint, plants may switch between shrimp and lobster over the course of a year. However, the facilities and skills of the workers are specialized for the two species so switching can be expensive. Shrimp is highly perishable and proper handling is a requisite for a quality product.

The potential for interaction between mobile gear and fixed gear does exist. If the shrimp fishery begins in December or early January, coastal lobster harvesters have to remove their gear at the end of their season before the mobile gear vessels begin trawling for shrimp. In January through April, the fixed gear (traps) shrimp harvesters must be careful to avoid bottom where trawling gear is fished. Trap harvesters often set in and around hard bottom coves and holes where mobile gear can’t reach. During the experimental shrimp fisheries in 2015 and 2016, participants reported an increase in the abundance of lobster gear in traditional shrimp trawl areas, as the lobster industry took advantage of the shrimp fishing moratorium to expand their winter range.

1.4 HABITAT CONSIDERATIONS

1.4.1 Habitat Important to the Stocks

1.4.1.1 *Description of the Habitat*

Northern shrimp has a discontinuous distribution throughout the North Atlantic, North Pacific, and Arctic Oceans. The Gulf of Maine marks the southern extent of this species' range. Water temperature, depth, and sediment type have all been cited as important factors governing shrimp distribution in the Gulf of Maine (Haynes and Wigley 1969; Apollonio et al. 1986; Clark et al. 1999).

1.4.1.1.1 Temperature

The most common temperature range for this species is 0-5˚C (Shumway et al. 1985), but adult northern shrimp have been reported to live in waters from 1.6˚C (Gorbunow 1934; Ingraham 1981) up to around 12˚C (Bjork 1913; Allen 1959), and larvae can tolerate temperatures up to at least 14˚C (Poulson 1946). During the spring, fall, and especially summer months, adult shrimp are most abundant in cold 4-6˚C waters found mainly in the deeper basins (90-180 m) in the southwestern Gulf of Maine (Haynes and Wigley 1969, Apollonio et al. 1986, Clark et al. 2000). Seasonal water temperatures in many areas of the Gulf of Maine regularly exceed the upper physiological limit for northern shrimp. In particular, available habitat is limited to the western region of the Gulf (west of 68˚W) where bottom topography and oceanographic conditions create submarine basins protected via thermal stratification from seasonal warming. In northeastern regions of the Gulf of Maine, bottom waters are not protected from seasonal warming due to continual mixing from intense tidal currents nearer the Bay of Fundy, and large shrimp populations do not persist.

Apollonio et al. (1986) suggest that the northern shrimp resource is expected to be unstable because it is at the southernmost extent of its Atlantic range and is susceptible to environmental influences. Dow (1977) found that abundance is higher with lower sea surface temperatures, and this relationship has since been corroborated by other authors, including Richards et al*.* (1996). While the manner by which temperature affects recruitment and abundance has not been precisely determined, record high sea surface temperatures during the early 1950s correlate with complete failure of the fishery from 1954-1957 (Clark et al. 2000). Conversely, the cold temperature years of the early to mid-1960s appear to have been very favorable for recruitment, with rapid increases in abundance and record landings from 1969-1972 (Clark et al. 2000). Determining the reason for collapse of the fishery during the 1970s is more problematic as it occurred during a period of warming temperatures combined with high and increasing levels of fishing mortality rate (Clark et al. 2000). In this case, overfishing has been strongly implicated for the collapse, but both factors were likely influential. During the next two decades, significant recruitment events have coincided with normal to below normal spring sea surface temperature anomalies. This stock appears to be one of the few for which previous relationships between environmental influences and abundance trends remained statistically significant when reexamined (Myers 1998). Richards et al. (2012) found an inverse relationship between temperature and recruitment between 1968 and 2011. Recruitment variability increased after 1999, coincident with a shift to a warmer temperature regime. Reproductive output (i.e. spawner biomass) and recruitment were positively correlated over the entire time series, but not related during the most recent and warmer period of 1999-2011.

1.4.1.1.2 Salinity

Northern shrimp have a narrow salinity tolerance (stenohaline) and are restricted to water with moderately high salinities (Allen 1959). Their occurrence has been noted in waters with salinities ranging from a low of 23.4 up to 35.7 (Shumway et al. 1985). Given that average salinity values in the Gulf of Maine are within this range and well above the minimum (e.g., see 2001-2008 data in Deese-Riordan 2009), salinity is not likely to be a limiting factor in the distribution of the species.

1.4.1.1.3 Depth

Northern shrimp are found throughout the range of water depths occurring in the Gulf of Maine, from about 10 meters to over 300 meters (Haynes and Wigley 1969). For most of the year, juveniles and immature males occupy shallower, inshore waters and mature males and females occupy cooler, deeper offshore waters (Apollonio and Dunton 1969; Haynes and Wigley 1969, Apollonio et al. 1986). However, northern shrimp, particularly the females, undertake seasonal migrations related to temperature and their reproductive cycles.

In addition to age and seasonally correlated horizontal migrations, northern shrimp exhibit diel vertical migration in the water column. There is strong evidence that northern shrimp leave the bottom at night and distribute themselves throughout the water column, presumably to feed (Wollebaek 1903; Hjort and Ruud 1938; Barr 1970). Gut contents have been shown to include planktonic crustaceans (Horsted and Smidt 1956). In thermally stratified waters, northern shrimp will migrate up to, but not penetrate the thermocline (Apollonio and Dunton 1969). After spending the night dispersed in the water column, shrimp return to the bottom around dawn where they feed on a wide variety of soft bottom benthic invertebrates (Wienberg 1981).

1.4.1.1.4 Substrate

The winter fishery for northern shrimp extends as far south as the outer arm of Cape Cod and as far north as Jonesport, Maine (D. Schick, personal communication). Figure 8 shows the locations of these basins, mud vs. gravel and bedrock habitats, and average bottom temperatures.

Within its preferred temperature range, northern shrimp most commonly inhabit organic-rich, mud bottoms or near-bottom waters (Wollebaek 1908; Hjort and Rund 1938; Horsted and Smidt 1956; Warren and Sheldon 1968, Haynes and Wigley 1969, Clark et al. 1999). Examples include Cashes Basin, Scantum Basin (D. Schick, personal communication), and the region southeast of Mount Desert Island, Maine (Haynes and Wigley 1969). Anecdotal evidence also suggests there is small populations in deep, cold water pockets in Penobscot Bay (D. Schick, personal communication) and in the Sheepscot River (L. Watling, personal communication).

During the winter and spring, when nearshore and offshore surface waters have cooled to the temperature range of shrimp, the amount of habitat available to adult shrimp increases.

Bigelow and Schroeder (1939) and Wigley (1960) found a direct correlation between shrimp abundance and sediment organic matter content, while Apollonio et al. (1986) argue that temperature, not benthic habitat type, is the most important factor driving the distributional patterns of shrimp.

However, shrimp is not limited to fine sediment substrate and have been observed on rocky substrates (Berkeley 1930; Balsiger 1981). Shrimp are also often associated with biotic or abiotic structures such as cerianthid anemone tubes (Langton and Uzmann 1989) and occasional boulders (D. Schick, personal communication).

1.4.1.1.5 Spawning Habitat

Northern shrimp populations in the Gulf of Maine comprise a single stock (Clark and Anthony 1981) that spawns in offshore waters beginning in late summer (Haynes and Wigley 1969). The precise locations of spawning grounds are not well documented, but it is reasonable to conclude that spawning occurs in offshore summer population centers in deep mud basins in the southwestern Gulf of Maine (Haynes and Wigley 1969; Apollonio et al. 1986). Ovigerous females remain in cold, stratified, bottom waters through the fall until nearshore waters have cooled at which time they begin an inshore migration to release their eggs (Haynes and Wigley 1969; Apollonio et al. 1986, Clark et al. 1999). Female shrimp are thus found in abundance in nearshore waters only during the late winter and spring when coastal waters are coldest (Clark et al. 1999). Inshore migration routes followed by the northern shrimp are not well known, but due to their well-established preference for organic-rich mud bottoms, it has been suggested that female shrimp probably move inshore over muddy substrates and are eventually concentrated in, but not limited to, mud-bottom channels nearshore (D. Schick, personal communication).

After their arrival in nearshore waters, the female shrimp's mature eggs begin to hatch. Hatching occurs as early as February and lasts through April (Haynes and Wigley 1969; Stickney and Perkins 1979), after which time female shrimp return to offshore waters in the western Gulf of Maine. The pelagic larvae are planktotrophic, feeding primarily on diatoms and zooplankton (Stickney 1980). A survey of larval shrimp distribution conducted by Apollonio and Dunton (1969) showed that larvae were abundant almost exclusively within 10 miles of shore. Little is known about the vertical distribution of larval shrimp within the water column. While in the plankton, northern shrimp pass through six larval stages (Berkeley 1930; Stickney and Perkins 1979) before completing a final metamorphosis to a juvenile stage and settling to the bottom in nearshore waters after about 30 to 60 days (Rinaldo 1981). The timing of egg release and larval development rate are temperature-related, with colder water temperatures resulting in slower development (Allen 1959). Thus, the timing of egg release and length of pelagic larval stages may vary from year to year as a result of temperature fluctuations (Koeller et al. 2009).

1.4.1.1.6 Eggs and Larval Habitat

Koeller et al. (2009) suggested that the winter inshore migration of egg-bearing females in the Gulf of Maine may be a behavioral adaptation to delay egg development and bring hatching time closer to the time of spring phytoplankton bloom. While studies of several shrimp populations support the association between spring bloom and shrimp hatching period, there is not a match in the Gulf of Maine stock. Richards et al. (2016) compared shrimp survey and environmental data to elucidate potential mechanisms behind the relationship between cooler temperatures and better northern shrimp recruitment. Rather than assuming time periods important to larval survival, they used a rolling window analysis to reveal environmental conditions (sea surface temperature and/or chlorophyll-a) associated with hatch timing. Chlorophyll-a was negatively correlated with survival during a period about 40 days before median hatch, and again around the time of juvenile settlement. It did not appear that phytoplankton biomass was a controlling factor on survival during the study time series. Hatch period preceded the spring bloom by about two months, aligning more closely (although correlations were not statistically significant) with the smaller winter phytoplankton bloom. Sea surface temperature was negatively correlated with survival during final embryo maturation/early larval stages, and approximately two months after juvenile settlement on the seabed, i.e., lower temperatures were related to higher survival. While the causal mechanism between lower temperature and higher survival remains unclear, knowing the sensitive period should aid further studies. The first sea surface temperature correlation occurs during the coldest time of year, and the authors speculate that northern shrimp metabolism may be optimized for these low temperatures. The other sea surface temperature correlation occurs when bottom temperatures are higher, and the difference between sea surface temperatures and bottom temperatures approaches the annual maxima. Thus, lower than typical temperatures during the late summer, when shrimp are metabolically stressed, may increase survival in those years.

1.4.1.1.7 Juvenile Habitat

Regardless of the mechanisms that influence hatch success, by late summer, nearly all newly metamorphosed juveniles have settled to the bottom in relatively shallow, near-shore areas usually within 10 miles of the coast (Apollonio and Dunton 1969). These immature shrimp remain inshore for up to 20 months as they grow and develop into mature males (Apollonio and Dunton 1969). Relatively little is known about the distribution and habitat requirements of this life history stage. After as little as a year, some juveniles begin to migrate offshore to deeper waters. Eventually, all juveniles will migrate offshore where they will complete their development into mature males around 29-30 months old (Apollonio and Dunton 1969; Haynes and Wigley 1969). Their migration routes and factors triggering migration to deep, offshore, muddy basins are not well known.

1.4.1.2 *Identification and Distribution of Habitat Areas of Particular Concern*

Nearshore waters (out to 10 miles)

Nearshore waters provide habitat for the larval and juvenile stages of northern shrimp. The survival of these early life-history stages is essential to the success of the species. Nearshore habitats are impacted by a myriad of anthropogenic activities including coastal development, pollutant run-off, harbor dredging, etc. The effects of these and other human activities on habitat quality for larval and juvenile northern shrimp are not known at this time.

Deep, muddy basins in the southern region of the Gulf of Maine

Deep, muddy basins in the southwestern Gulf of Maine act as cold water refuges for adult shrimp during periods when most water in the Gulf reaches temperatures that are lethal to this arctic/sub-arctic species. Fluctuations in the oceanographic conditions due to the North Atlantic Oscillation, climate change, or other natural factors may cause warm water to intrude into some of the deep basins in the southwestern Gulf rendering this habitat unsuitable for shrimp and possibly resulting extirpation of local populations.

In addition to naturally occurring environmental changes, bottom otter trawls used to harvest groundfish can impact deep, muddy bottom habitats. Relative to shrimp trawl gear, groundfish trawls are typically fished at higher speeds, have longer sweeps, and may use larger rollers or rockhoppers. The use of mobile fishing gear has been shown to reduce structural complexity of bottom habitats (Auster et al. 1996, NEFMC 2011, and studies referenced therein). Reducing habitat structural complexity could potentially reduce the survival of adult shrimp, which may use biotic and abiotic structures on mud bottoms to avoid predation. Simpson and Watling (2006) suggested that seasonal trawling with shrimp gear on mud bottoms at approximately 100 m depth produced at least short-term changes (<3 months) in macrofaunal community structure, but did not appear to result in long-term cumulative changes.

1.4.1.3 *Present Conditions of Habitats and Habitat Areas of Particular Concern*

Near-shore waters

Near-shore habitats are impacted by a myriad of anthropogenic activities including coastal development, pollutant run-off, harbor dredging, and others. Because detailed maps of inshore habitats occupied by larval and juvenile shrimp are not available, it is not possible to identify the condition of, or specific anthropogenic threats to, these habitats.

Deep, muddy basins

The effects of temperature on shrimp abundance have long been a subject of study, however, more information is required before it is possible to predict the effect of large-scale climatic events (e.g., the North Atlantic oscillation or climate change) on the amount of suitable habitat available to adult shrimp. While the effects of mobile fishing gear on bottom habitats have been a subject of study for over two decades; the long-term impacts of trawling on shrimp habitat in deep, muddy basins is not well understood.

1.4.1.4 *Ecosystem Considerations*

The Commission, NOAA Fisheries, and several Fishery Management Councils have been incorporating Ecosystem-Based Fisheries Management (EBFM) strategies into their fishery management programs. In general, EBFM strategies are adaptive management approaches that are specific to a geographic region, account for environmental influences and uncertainties, and strive to balance diverse ecological, social, and economic objectives.

By developing EBFM strategies, the Commission and its partner agencies are attempting to move beyond the traditional focus on single-species dynamics by considering environmental and human influences on fish populations and their sustainable harvest (e.g., multispecies interactions, climate change, and coastal development). EBFM strives to integrate ecological, social, and economic goals, and engage a diverse group of stakeholders to define problems and find solutions providing mutual benefit.

Although an EBFM strategy has not been developed for northern shrimp, its distribution throughout the Gulf of Maine and importance to the marine food web make it a good candidate for consideration (Link and Idoine 2009). Predator-prey interactions with several demersal finfish species (e.g., Atlantic cod, redfish) exist throughout the northern shrimp range (Worm and Myers 2003; Savenkoff et al. 2006). Given the data requirements necessary to incorporate multi-species interactions appropriately, it would be a challenge to use an EBFM strategy for northern shrimp. However, the Commission's Multispecies Technical Committee and Northern Shrimp Technical Committee continue to work on refining multi-species modeling approaches to be used in future assessments of managed species, including northern shrimp.

1.5 IMPACTS OF THE FISHERY MANAGEMENT PROGRAM

1.5.1 Biological and Environmental Impacts

Draft Amendment 3 provides an extensive list of management tools for managers to regulate the species in a biologically sustainable manner. Depending on the tool or combination of tools chosen, the action may have varying impacts on the Gulf of Maine northern shrimp stock.

Despite the number of tools available for management, the fishery has been subject to emergency closures from high catch rates and low allocations, often leading to harvest overages. This is problematic as the fishery has been closed over the past several years due to deteriorating stock conditions exacerbated by warming waters and other environmental factors. If conditions improve and the fishery re-opens, Draft Amendment 3 offers additional management tools to be used to further control harvest in the fishery while protecting small and egg-bearing shrimp.

To address harvest overages, Draft Amendment 3 provides an alternative approach for allocating the TAC by state. The intent of this option is to determine the optimal way to restrict catch throughout the season in a way that can provide a fair system that allows access to and allocation of the resource that aligns with historical practices. Options allowing for the transfer of quota between states, or status quo (gear types), provides flexibility to optimize harvest opportunities.

Accountability measures in the form of payback provisions provide options for the Section to consider when a fishery exceeds the TAC in a fishing year. These options include percentage payback requirements that could be applied as reductions in a future season. The intent is to provide an incentive for harvesters to maintain harvest levels within the established TAC and apply future reductions to protect the stock if the TAC is exceeded.

If stock biomass or fishing mortality do not meet their respective targets (as defined in Section 2.5), the biological sustainability of northern shrimp is threatened. In either case, managers are required to take action to get biomass above the threshold or fishing mortality at or below the target.

Protection of small (presumably male) shrimp is an issue the Section intends to consider in Draft Amendment 3. Specifically, the draft amendment offers several options to establish a count per pound requirement, whereby shrimp may not be landed with a count per pound that is higher than the established threshold. Count per pound is influenced by several factors including time of year and location, gear configuration, and ratio of males to females in the catch. The count per pound is a means of protecting small shrimp, but could lead to increased discards of small shrimp if harvesters and markets are adjusted to require a minimum count per pound requirement.

Draft Amendment 3 also considers the use of a second Nordmore grate or comparable size sorting grate system installed in the gear. Currently, shrimp harvesters must use a single Nordmore grate, designed to reduce finfish bycatch. A second Nordmore grate, designed to allow for the release of small shrimp, is used on a voluntary basis, with some success. The draft amendment allows the Section to consider mandating a second Nordmore grate to protect small shrimp.

1.5.2 Social Impacts

Trawls and traps are the two gears used to harvest northern shrimp. Slightly over half the boats in the Maine fishery in 2009 used traps, but trawlers landed a larger percentage of the catch (80% in 2009). The northern shrimp fishery is one of the last open access fisheries in the region and thus, as other fisheries are restricted, may be regarded as a fishery of last resort. Asked about limited entry in 2009, 62% of respondents who participate in the trap fishery opposed a controlled access management program, as did 43% of trawlers (Moffett & Wilson, 2010). A very small sample of harvesters queried in 2016 suggested that the numbers might be different if this study was conducted again, with individuals suggesting that limited entry is needed, some adding the caveat that the states should retain ownership of the permits, others suggesting that individual transferrable quotas might be preferable.

For a variety of reasons, cold-water shrimp has been primarily a secondary fishery for lobster and groundfish harvesters. It was regarded as an important winter fishery that allowed harvesters to supplement their income when lobstering was slow and/or weather and quota constraints limited groundfishing. It is not only revenue that is important, however, being able to stay active in a fishery is important to both harvesters and their vessels. Trapping had been steadily growing in Maine, from an average of about 31% of the Maine vessels and 13% of the Maine landings during 2001-2005, to 47% of vessels and 14% of landings in 2005-2009, to 48% of vessels and 23% of landings in 2010 (preliminary data, Maine only). Also in 2009, lobster harvesters in the region faced a serious drop in prices for their product compared to the prior three years, so it is a reasonable supposition that shrimp trapping was attempted to make up for the lost income. Even when the lobster prices and/or quantities increased, Northern shrimp was a popular fishery over the long winter.

Fluctuations in abundance, size, cost, and seasonal availability pose significant marketing challenges to the industry. In fact, in 2009, 83% of trap gear respondents and 97% of trawl gear respondents noted that their efforts in shrimp fishing were limited by the market (Moffett & Wilson 2010). This implies that should the market improve (higher prices and quantities sold), additional effort would move into the shrimp fishery. This effect was demonstrated in the 2010 and 2011 seasons when prices rose and participation and effort increased (ASMFC 2010, ASMFC 2011).

Those who formerly fished for shrimp and are still actively trawling for groundfish would most likely return to shrimp fishing if the season opened. However, there are far fewer trawlers than before due largely to the changes in groundfish regulations. Lobster harvesters might also trap shrimp. Though Rockport, Massachusetts was an active shrimp port in the past, the vessels there have removed their net reels and winches and generally use their boats for lobster fishing.

One major challenge in attempting to return to shrimp trawling is that lobster gear has moved into traditional shrimp trawling grounds. In the past, there were agreements among trawlers and lobster harvesters to keep these traditional grounds open for trawling, but there is less confidence now that those agreements could be honored.

Shrimp fishing, a winter fishery, is also problematic due to weather. New Hampshire harvesters are in the open ocean, so if the season is short, they may not have a suitable weather window to safely fish. Maine havesters have a little more flexibility since they can “hide behind on island,” if the weather closes in. t might be reasonable to have a 14-day season, but allow the harvester to select their active shrimp days depending on weather.

Northern shrimp was often purchased initially by fishermen’s coops, in both New Hampshire and Maine, then frequently sold to a major processor in Portland, ME. When shrimp fishing was consistent, there were also a few small-scale processors and a variety of roadside vendors, particularly in Maine. As the short-to-no seasons continued, both the small-scale processors and vendors sold out and/or went out of business. Some respondents in 2017 noted that roadside vendors also fell afoul of increased public health scrutiny and regulations that insisted on stainless steel sinks and bathrooms. However, some roadside vendors have been seen recently, likely selling shrimp landed as part of the RSA Program.

The fishermen’s cooperatives lost markets for shrimp, rebuilt them when shrimp returned, only to lose them again when the shrimp season was shortened or closed. When there was an open shrimp season, Portland Fish Exchange held a special Northern shrimp auction. Even now, they provide a landing facility for the shrimp boats, advising them to land in the late afternoon, so the catch can be transported to the Fulton Market in New York by midnight and bought in the morning by those supplying the Asian restaurant markets.

In the past, reduced landings, whether due to regulations or biology, had a significant impact on processors who need a steady supply of product to maintain their work force and market share. Because both the equipment and labor (grading, peeling, cooking) is specialized, it is expensive for processors to switch to processing shrimp from processing other product such as lobster. Without a predictable shrimp season or product, processors might choose not to change their operation.

While shorter seasons, trip limits and days-out restrictions limit fishing opportunities and landings, the impact of such measures on harvesters depends on what alternatives exist. Such alternatives are determined by the other permits held by the harvester but are also constrained by regulations, weather, and markets.

Since shrimp fishing was usually out of smaller ports in the region, regulations that limited access and effort had noticeable short-term negative impacts on the associated communities. Shore-side businesses such as providers of fuel and gear, in particular, were affected. However, if management is successful in ensuring a predictable and sustainable harvest, all sectors will have the opportunity to benefit over time.

The Northern shrimp fishery is not sufficiently homogeneous to accurately predict and describe the impacts of proposed regulations. What might be a minor inconvenience to one diversified multiple vessel owner could be a disaster to smaller single vessel owner. Nevertheless, a study conducted in 2009 found that on average, harvesters who responded depended on shrimp for 25% of their annual income. Furthermore, the actual impacts of regulations are not felt in isolation but are experienced in the larger context of the regulatory and economic environment of each operator and are cumulative over time. The lack of flexibility to change target species, as well as timing and geospatial decisions associated with fishing, is a negative impact commonly cited in social impact assessments of regulations that limit access. Nevertheless, if entry is not limited, it is more difficult for managers to assure that annual fishing caps are not exceeded, particularly if other fishing opportunities are limited.

As noted, the TAC was exceeded in 2010-2012 fishing years. However, recent innovations in cell phone technology, applications (apps), etc., may provide improved monitoring of catches and faster responses to avoid quota overages. Swipe cards in the American eel (elver) fishery in Maine have been very successful in monitoring the catch, as has a cell phone app in the fluke fishery in Massachusetts. Furthermore, far fewer trawlers are active due to changes in groundfish regulations, which could limit the numbers of vessels able to move into shrimp fishing.

1.5.3 Economic Impacts

The impact of management regulations will vary in relation to the dependence upon the fishery. A harvester with one vessel may be unable to cover the costs of operation in the face of a significant reduction in effort, while a more diversified harvester with multiple vessels may be able to compensate. On a larger scale, a reduction in effort is likely to have a negative short-term economic impact on a community where the fishing industry is a primary source of revenue. However, a recovery of the shrimp stock will result in the opportunity for all sectors (e.g., harvesters, processors, and dealers) to participate in the fishery for a longer term.

The small ports where shrimp constituted a significant proportion of landings consider fishing an important feature of their economy. It contributes to the overall productivity and total capital flow even if it is not the dominant industry in the community. It is often community members of the small ports who emphasize the importance of maximizing the numbers of jobs rather than maximizing income for a few individuals when choices among regulations are being made. Each of these ports, though, also face gentrification and increased competition for waterfront use.

Harvesters commonly point out that fishing has always been cyclical. A typical annual fishing season for harvesters in the smaller ports is to participate in other Northeast fisheries (e.g., lobster and groundfish) in the spring, summer and fall and then turn to shrimp fishing in winter (December-May). It is this ability to freely move in and out of the shrimp fishery in response to the relative availability of shrimp, other commercial species, market demand, the weather, and other factors that makes the shrimp fishery more valuable than the raw landings and income data may suggest. For some harvesters, even a limited shrimp harvest is sufficient to make the difference between financial stability and failure.

Both Gloucester and Portland are urban areas that have retained strong support for their fishing industry including working waterfront zoning and fisheries administrators with recognized roles in city government. By a variety of indices, Portland is classified as a primary port and "essential provider." Gloucester ranks third (behind New Bedford and Portland) in fishing infrastructure differentiation, and low on the gentrification scale.

While the fishing industry in Portsmouth is dwarfed by the tourist industry, the city has retained a small, but complete infrastructure for the industry. When the season was open, shrimp was an essential component of the year's fishing returns for individual vessels from Rye, Hampton and Portsmouth and for New Hampshire's fishermen's cooperative. Furthermore, vessels from Newburyport (Massachusetts) and York (Maine) were shrimp-landing members of the Yankee Fisherman's Cooperatives, so the shrimp networks clearly extended beyond the borders of states and sub-regions in New England. In several of these small ports, the numbers of vessels capable of shrimp trawling, however, have been severely diminished by their inability to continue groundfish fishing. Where there were eight or nine vessels in the past, now one or two may remain active. With the increases in size and horsepower of lobster boats, there is potential untapped capacity.

Price depends on the size and quality of the shrimp. For example, the Japanese market pays a premium for larger, raw, frozen-at-sea product often available from Canada, but Japanese dealers will also purchase from the Portland auction when medium to large size, firm shrimp is available. The value of the shrimp landings in Maine in 1998-99 hovered at $0.96 per pound (Table 4), though in 1997 and 2000, the average price was estimated as $0.81 and $0.80 per pound, respectively. Average price per pound of shrimp for 2001 and 2002 was $0.86 and $1.07, respectively. Prices dropped precipitously in 2006, averaging $0.37/lb. In 2009, the season ended with $0.27/lb prices. However, prices began to recover in 2010 ($0.54/lb) and 2011 ($0.75). In 2012, in a shortened season, landings dropped down to 2185 metric tons and the price rose to $0.95/lb. In 2013, landings were only 255.51 metric tons and the price average for the year was $1.79. Without an open season, the vessel fishing under the RSA program bring in small quantities of shrimp, and the prices can be extraordinarily high for some sales, ranging from $7-$10/lb. The Asian restaurant market in New York City creates high demand.

Price is dependent on a suite of factors. The size and quality of the shrimp is important, but the quantity available also affects the market. For example, Canadian buyers need sufficient quantity to justify the expense of transporting the product. In 2000 harvesters received $.65/lb at the dock ($1.00 if they trucked it to the Portland auction) at the beginning of the season and $1/lb at the end of the season ($1.10-1.20 if trucked). Price is also affected by the size of the markets for northern shrimp.

Small-scale dealers play a significant role in the distribution of the shrimp catch. One informant estimated that a third of the product from Maine shrimp harvesters passed through the hands of small businesses. Some of these were small-processors who peeled and sold the raw product. Direct retail sale via roadside vending was common in Maine when the northern shrimp season was open. Community-supported fisheries in Maine and Massachusetts have also increased the market for northern shrimp. Tourism can affect the success of these small-scale operations and ultimately, the price, with fluctuating demand.

It is the processing sector that is apparently the most vulnerable to variability in supply and unpredictability, whether due to the diminishment of the stock size or as an artifact of regulations. The costs of preparing the facility, engaging labor, and identifying markets is significant, so this sector is less able to reconfigure in the short-term than is the harvesting sector.

Prior to the institution of the Food and Drug Administration’s Hazard Analysis Critical Control Point (HACCP) regulations, when home processing was easier to pursue, the flexibility of the “cottage” industry could more easily accommodate flexibility in the harvesting sector.

1.5.4 Other Resource Management Efforts

1.5.4.1 Artificial Reef Development/Management

There are currently no artificial reefs in place in the Gulf of Maine used by the northern shrimp fishery.

1.5.4.2 Bycatch

The Northern Shrimp Section made the fishery a zero bycatch fishery in 1993. The fishery remained a zero bycatch fishery until 2001, when a limited amount of silver hake was allowed as bycatch. Federal multispecies regulations allow for the incidental catch of longhorn sculpin, and combined silver and offshore hake, up to an amount equal to the weight of shrimp possessed onboard or landed, but not in excess of 3,500 lbs (1,588 kg). Those vessel that also have a Federal lobster permit may keep lobster consistent with Federal lobster possession limits in 50 CFR 697.17.

Bycatch reduction improved radically with the advent of the Nordmore grate in the late 1980s. Developed in Nordmore County, Norway, this device is a grating of parallel bars mounted in the extension with an escape hole in the net in front of the grate. Testing of the Nordmore grate system by the NOAA Fisheries-Northeast Region's Fisheries Engineering Group during 1991 and 1992 proved the grate's effectiveness for the fish assemblage present in the Gulf of Maine. The results showed over 95% loss of finfish by weight and over 95% retention of shrimp (Kenney et al, 1992). The excellent escapement of finfish is seen across the length spectrum for flatfish, with a high percentage of even small flatfish escaping the net. The grate was implemented into the northern shrimp fishery for April and May 1992. Beginning in December 1992, the grate was required for the whole season.

As effective as the Nordmore grate is, an examination of male shrimp length frequency, around 15 to 20mm carapace length, reveals more shrimp of that size range retained by the cod ends behind the grates. The increased retention of these smaller shrimp is a concern because they are below the target size for shrimp of ≥22mm that the current minimum mesh size regulation controls. This indicates that the Nordmore grate may be affecting the mesh selection curve for shrimp in the cod end. Square mesh in the cod end may resolve shifts in selectivity produced by the Nordmore grate as many recent trials have indicated. Trials conducted in the Gulf of Maine by Maine Department of Marine Resources over several years have shown that square mesh of 1-5/8" produces a selectivity curve similar to 1-3/4" diamond mesh, but does release slightly more small shrimp.

A double Nordmore grate system was tested for reducing the amount of small shrimp caught with the single Nordmore grate. The second grate aids in releasing small shrimp and small fish that the cod end mesh size selection doesn't do very effectively. The Northern Shrimp Section approved the double Nordmore grate for use in the shrimp fishery in 1999. In 2007, He and Balzano (2007) tested a modification to the double grate system that used a size sorting grid and funnel system in front of the Nordmore grate to minimize the retention of small shrimp. The gear with the funnel increased mean size and reduced counts per pound in 13 of 14 paired 1-hr tows from mid-March and late June 2006.

There have also been research trials with various combination grate systems that combine the functions of the two grates in the double grate system into one unit (Pinkham et al 2006), Documentation of the bycatch/discard problem has occurred through a sea sampling program whereby samplers are placed aboard commercial vessels and all fish caught are recorded, whether they are landed or not. The percentage of bycatch in observed tows declined from almost 50% before the Nordmore grate was required, to about 15% afterward (Richards and Hendrickson, 2006). A more recent study by the Gulf of Maine Research Institute (GMRI) and NOAA at-sea observers documented bycatch in the northern shrimp fishery using a Nordmore grate. Eayrs et al. (2009) found only 2% of the total catch weight was bycatch of regulated species (n=243 hauls), and shrimp comprised greater than 92% of total catch by weight. This is a notable improvement considering that prior to the Nordmore grate bycatch comprised more than half of the total catch by weight (Howell and Langan 1992).

Information on the bycatch of protected species (e.g., marine mammals, sea turtles) can be found in *Section* 7.

1.5.4.3 Land/Seabed Use Permitting

There is no impact of land or seabed use permitting on the northern shrimp fishery.

1.6 LOCATION OF TECHNICAL DOCUMENTATION FOR FMP

1.6.1 Review of Resource Life History and Biological Relationships

Northern shrimp life history information was summarized by Apollonio and Dunton 1969, Haynes and Wigley 1969, Shumway et al. 1985, Apollonio *et al.* 1986, Clark et al. 2000, and Bergstrom 2000.

1.6.2 Stock Assessment Document

Detailed information pertaining to the northern shrimp stock assessment can be found in the 58th Northeast Regional Stock Assessment Workshop report (NEFSC 2014). Annual assessment updates were prepared. The 2016 Stock Status Report for Gulf of Maine Northern Shrimp is the most recent report of the ASMFC Northern Shrimp Technical Committee and can be found on the ASMFC website. It is anticipated that the next Benchmark Stock Assessment for Northern Shrimp will be peer-reviewed in 2018.

1.6.3 Social Assessment Documents

The most recent survey of Gulf of Maine northern shrimp harvesters was conducted and published in 2010 by Moffett and Wilson.

1.6.4 Economic Assessment Document

Apart from the information in the Moffett and Wilson (2010) report, no recent studies have been conducted to assess the economic characteristics of the northern shrimp fishery. The most recent information is included in the 1986 FMP (ASMFC 1986).

1.6.5 Law Enforcement Assessment Document

The Commission's Law Enforcement Committee has prepared a document entitled "Guidelines for Resource Managers on the Enforceability of Fishery Management Measures, Second Edition" (2015) which can be used to evaluate the effectiveness of future measures.

1.6.6 Habitat Background Document

The background for habitat of northern shrimp is compiled in Section 1.4 of this amendment. You can also refer to the 2016 stock status report for Gulf of Maine northern shrimp (ASMFC 2016) for habitat and other environmental condition information.

2.0 GOALS AND OBJECTIVES

2.1 HISTORY AND PURPOSE OF THE PLAN

2.1.1 History of Prior Management Actions

The Northern Shrimp Section, consisting of representatives from Maine, New Hampshire and Massachusetts, is responsible for management based on input from the Northern Shrimp Technical Committee and industry Advisory Panel. This arrangement is one of the longest running instances of interstate cooperation in the history of fishery management in the United States.

In 1972, industry concerns over declining abundance and product quality led to exploration of options for cooperative management. Initial interest centered on curtailing harvest of small, non-marketable shrimp, which led to gear evaluation studies and implementation of a uniform stretched mesh size regulation of 44 mm (1.75 inches) in the body and cod end of the trawl. The Technical Committee also conducted a series of stock assessments beginning in 1974, which documented that the resource was overfished and that abundance was declining rapidly. As the stock deteriorated further, management became increasingly restrictive, finally culminating in closure of the fishery from May 1977 to February 1979.

In 1979, the Technical Committee prepared and submitted a draft management plan and environmental impact statement for the fishery, which recommended regulatory measures including mesh size limits, closed seasons, catch quotas and statistical reporting. Such regulations were to be implemented by the participating states through the Northern Shrimp Section, and ultimately by the Secretary of Commerce through the Fishery Conservation and Management Act of 1976 (NSSC 1979). A revised plan reflecting public comment was accepted at the November 1979 Section meeting.

In 1981, the State-Federal Fishery Management Program in the Northeast Region was restructured as the Interstate Fisheries Management Program (ISFMP) of the Commission. The Section adopted a "Statement of Policy" which (1) stated its position relative to environmental issues, i.e., that despite natural fluctuations in abundance, the northern shrimp fishery is manageable; and (2) affirmed that it would provide for a continuing management program based on Technical Committee recommendations to maintain and rebuild the stock so as to "assure a viable northern shrimp fishery over time." The Section further stated its intent to allow a fishery through the mechanism of an annual open season, with the following regulatory measures endorsed as appropriate:

1. Gear limitations, conforming to the uniform mesh size regulation (44.5 mm, 1.75 inches stretched mesh in body and cod end);
2. Seasonal limitations, open season to be set within a 183-day window beginning not earlier than December 1 and ending not later than May 31 for any one year;
3. Possession limitations; and
4. Information collection provisions, i.e., determination of participants, dealer and processor reporting, and dockside and sea sampling.

The above measures, and biological and socioeconomic research requirements for management, are embodied in the *Interstate Fishery Management Plan for the Northern Shrimp* (Pandalus borealis *Kroyer*) *Fishery in the Western Gulf of Maine* rewritten from the 1979 version (McInnes 1986). Included is substantial background information on stock assessment and survey data collection methods (Clark and Anthony 1981; Cadrin *et al*. 1999; and others). The FMP remained in effect until the passage of Amendment 1 (2004).

In the mid-1980s, with a resurgence of the resource, the Section was able to implement a gradual extension of the open season for 1982-1985 culminating in the maximum duration allowable for the 1986 and 1987 seasons. With good recruitment and continued moderate levels of exploitation, the Section was able to manage the resource effectively through closed seasons, monitoring resource trends using annual index-based assessments.

In 1993, the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) was enacted, which gave the ASMFC considerably more influence over management of coastal marine resources. ACFCMA obligated individual states to implement ASMFC-approved measures; and it authorized the Secretary of Commerce to declare a moratorium on a state's fishery for failure to comply with ASMFC plan provisions.

During the mid-1990s, effort increased rapidly, and landings reached 9,200 mt during the 1996 season – a level not seen since the early 1970s. The first analytical assessment, completed and peer-reviewed at the 25th Northeast Regional Stock Assessment Workshop (SAW) in July 1997 (NEFSC MS 1997) revealed sharp increases in fishing mortality rates and reductions in biomass in 1996 (Cadrin *et al*. 1999). Subsequent assessments indicated substantially higher levels of fishing mortality rates and sharp declines in stock biomass and recruiting year-class size.

The Section adopted Amendment 1 in 2004 to implement biological reference points to rebuild the resource. Provisions in Amendment 1 helped decrease fishing mortality rates and increase biomass through the use of a soft harvest target (i.e., total allowable catch, or TAC) and closed season. Under Amendment 1, biomass began to recover.

Despite the recovery of the stock, early season closures occurred in 2010 and 2011 because of increases in participation levels in response to good market price. Furthermore, monthly reporting led to short notice of the closures and an overharvest of the target by 28% in 2010 and 59% in 2011. In response to these issues, Amendment 2, which completely replaced Amendment 1, was approved in October 2011. In addition to establishing a more timely and comprehensive reporting system, Amendment 2 further expanded the tools available to manage northern shrimp, including options to slow catch rates throughout the season (i.e., trip limits, trap limits, and days out of the fishery). Also, Amendment 2 allowed for the initiation of a limited entry program to be pursued through the adaptive management addendum process. In November 2012, the Section approved Addendum I to Amendment 2 which refined the annual specification process, and allocated 87% of the coastwide TAC to the trawl fishery and 13% to the trap fishery based on historical landings.

Following review of the 2013 stock status report, the Northern Shrimp Section imposed a moratorium on the fishery for the 2014 season. The Section considered several factors prior to closing the fishery in 2014. Northern shrimp abundance in the western Gulf of Maine had declined steadily since 2006 and the 2012 and 2013 survey biomass indices were the lowest on record. Additionally, the stock experienced an unprecedented three consecutive years of failed recruitment (2010–2012 year classes). Subsequent stock status reports (i.e., 2014, 2015 and 2016) indicated continued poor trends in biomass, recruitment, and environmental indices which prompted the Section to maintain the moratorium, each year, through 2017. Winter sampling via selected commercial shrimp vessels has occurred in each year of the moratorium to continue the time series of biological samples collected from the fishery.

2.1.2 Purpose and Need for Action

The purpose of this Amendment is to address long-term scientific, management and policy issues relative to Gulf of Maine northern shrimp fisheries. There is growing concern the management program contained in Amendment 2 and Addendum I may not be appropriate to effectively manage the fishery.

The northern shrimp fishery is currently open access and has experienced significant fluctuations in participation over the last 30 years (Table 5). Interest and participation in the fishery generally increases as the season length or market price increases. As one of the last open access fisheries in the region, the fishery has provided opportunities to target an alternative species when other fishing is unavailable or not economically viable. However, as shrimp biomass has decreased, concern has been raised over the influx of boats into the fishery when shrimp are available inshore and markets warrant. Harvesters and managers have noted reduced fishing opportunities in other fisheries, such as the New England groundfish fishery, and are concerned about the impact of shifting effort entering the shrimp fishery. More effort in the fishery would result in increased pressure on the shrimp population. This concern has led to the suggestion that access to the shrimp fishery should be restricted.

Limited access has been used in a number of fisheries along the Atlantic coast to control effort while maintaining access by harvesters who have demonstrated a history in the fishery. The

Section has considered the development of a limited entry program, and Amendment 2 provided a mechanism for the Section to implement such a program through the adaptive management process. However, during the scoping process for Amendment 3, the Section decided not to pursue limited entry as a means of controlling effort and stabilizing the fishery. Alternatively, Draft Amendment 3 proposes state-specific TAC allocations, and other management options, to control effort in the fishery. Amendment 3 will maintain the Section's ability to pursue the implementation of a limited entry program through the adaptive management process, and the June 7, 2011, control date.

Amendment 2 includes biological reference points (i.e., management targets, thresholds, and limits) designed to provide managers with a guide to determine if changes in the regulations are necessary – given the current status of the stock – to sustain the resource over time. However, the assessment model for northern shrimp went through peer-review in January 2014 at the 58th Northeast Fisheries Science Center SAW/SARC (NEFSC 2014) and was not approved for management use. Due to the uncertainties raised by the benchmark review, the biological reference points contained in Amendment 2 may no longer be applicable to the Gulf of Maine northern shrimp population. Furthermore, Addendum I to Amendment 2 implemented a strict methodology, which requires an estimate of population abundance, for the Technical Committee to follow when recommending a target TAC during annual specification. Accordingly, Draft Amendment 3 proposes broadening the criteria for stock status determination using the best available, peer-reviewed science and providing the Technical Committee with a flexible TAC recommendation process for annual specifications.

Long-term sustainability of the northern shrimp resource and fishery is highly dependent on the recruitment of year classes into the spawning biomass. In other words, protecting small male shrimp is essential for stabilizing the fishery, as they will inevitably contribute to the spawning biomass as they grow and mature into females. Furthermore, size composition data collected from port samples of fishery landings indicate trends in landings have been determined primarily by recruitment of strong year classes. Size-sorting grate systems (e.g., double-Nordmore grate or compound grate), which are designed to release small shrimp (and fish) from the trawl net, have proven to reduce counts per pound (i.e., catching only big shrimp means fewer shrimp are needed for a pound of product) (He and Balzano 2007, 2012). The Section approved the use of such systems in the northern shrimp fishery, but did not make it a requirement. However, considering the fishery has experienced six consecutive years of poor or failed recruitment, management and industry are interested in exploring mandatory use of these gears to minimize catch of small (male) shrimp and improve resource and fishery sustainability.

2.2 GOAL

The Northern Shrimp Section agrees, despite natural fluctuations in stock abundance, the northern shrimp fishery can be managed. In addition, the management program, which includes recommendations of the Technical Committee and the Advisory Panel, is designed to ensure a viable northern shrimp fishery in the Gulf of Maine over time.

The amendment's goal is to manage the northern shrimp fishery in a manner that is biologically, economically, and socially sound, while protecting the resource, its users, and opportunities for participation.

2.3 OBJECTIVES

The following objectives are selected to support the goal of this amendment:

Option A: Status Quo

No changes to the current objectives described below and in Amendment 2, *Section 2.3.*

- Protect and maintain the northern shrimp stock at levels that will support a viable fishery on a sustainable resource
- Optimize utilization of the resource within the constraints imposed by natural distribution of the resource, available fishing areas, and harvesting, processing and marketing capacity
- Maintain the flexibility and timeliness of public involvement in the northern shrimp management program
- Maintain existing social and cultural features of the fishery to the extent possible
- Minimize the adverse impacts the shrimp fishery may have on other natural resources
- Minimize the adverse impacts of regulations, including increased cost to the shrimp industry and the associated coastal communities
- Promote research and improve the collection of information to better understand northern shrimp biology, ecology, and population dynamics
- Achieve compatible and equitable management measures through coordinated monitoring and law enforcement among jurisdictions throughout the fishery management unit

Option B: replace *Section 2.3* with the following objectives:

- Protect and maintain the northern shrimp stock at sustainable levels that will support a **viable fishery**
- Optimize utilization of the resource within the constraints imposed by natural distribution of the resource, available fishing areas, **changing environmental conditions,** and harvesting, processing and marketing capacity
- **Provide a mechanism for unique state level management of fishing effort**

- Maintain the flexibility and timeliness of public involvement in the northern shrimp management program
- Maintain existing social and cultural features of the fishery to the extent possible
- Minimize the adverse impacts the shrimp fishery may have on other natural resources
- Minimize the adverse impacts of regulations, including increased cost to the shrimp industry and the associated coastal communities
- Promote research and improve the collection of information to better understand northern shrimp biology, ecology, population dynamics, **and responses to changing environmental conditions**
- Achieve compatible and equitable management measures through coordinated monitoring and law enforcement among jurisdictions throughout the fishery management unit

2.4 SPECIFICATION OF MANAGEMENT UNIT

The management unit is defined as the northern shrimp resource throughout the range of the species within U.S. waters of the northwest Atlantic Ocean from the shoreline to the seaward boundary of the Exclusive Economic Zone (EEZ). It is also recognized that the northern shrimp fishery, as defined here, is interstate and state-federal in nature, and that effective assessment and management can be enhanced through cooperative efforts with state and federal scientists and fishery managers.

2.5 DEFINITION OF OVERFISHING

Since the implementation of Amendment 1 in 2004, stock status for northern shrimp in the Gulf of Maine has been determined via comparison of terminal year estimates of fishing mortality and biomass to fishing mortality- and biomass-based reference points (i.e., biological reference points, or BRPs). These management targets, thresholds, and limits are designed to provide managers with a guide to determine if changes in the regulations are necessary, given the current status of the stock, to sustain the resource over time.

The target reference point represents an acceptable level of fishing effort or biomass that balances the need to sustain the stock and the desire to provide fishing opportunities. A threshold, on the other hand, defines a point of caution where regulations should become significantly more restrictive. At the very extreme is a limit, which represents the point where immediate and perhaps drastic action is necessary to protect and restore the resource.

The BRPs defined in Amendment 2 were developed via the Collie-Sissenwine Analysis (CSA) assessment model (Cadrin et al. 1999), which was peer-reviewed and accepted for management use in 2007. In 2014, a benchmark stock assessment explored new analytic methods, including a new model and modifications to the accepted CSA model. The benchmark assessment went through peer-review and the new approaches were not approved for management use. Therefore, the current BRPs in Amendment 2 (developed via the CSA that failed peer-review in 2014) may no longer be applicable to northern shrimp management.

Additionally, the Gulf of Maine northern shrimp stock undergoes a formal scientific peer-review process about every five years which may result in revised or different stock status determination criteria. The next benchmark assessment is expected to be peer-reviewed in 2018. Currently, to incorporate new stock status determination criteria (overfishing/depleted status) that may result from updated, peer-reviewed science, the Section must enact an addendum adjustment or amendment to the Northern Shrimp FMP. The addendum process typically requires a minimum of five months from initiation to implementation, while amendments take longer (eight months to a year, or more). Therefore, the timing of updated survey information, subsequent analysis and peer-review, the addendum or amendment process, and setting annual specifications means that the availability of the best available scientific information could be significantly delayed from entering the management process and responding to changing stock status.

Option A: Status Quo

The biomass reference points are based on historical abundance estimates via the CSA model, and remain unchanged from Amendment 2. The stock biomass threshold ($B_{Threshold}$) is 9,000 metric tons and the biomass limit (B_{Limit}) is 6,000 metric tons. The limit was set at 2,000 metric tons higher than the lowest observed biomass. If biomass falls below threshold, then the stock is considered overfished/depleted. There is no biomass target for the stock because the Section did not want to set unlikely goals for a species whose biomass can easily be affected by environmental conditions. However, the Section stresses that the threshold is not a substitute for a target, and it will manage the fishery to maintain biomass above the threshold. Furthermore, the Section's management decisions will be affected by the year class composition of the stock.

The fishing mortality reference points were developed via the CSA model, and remain unchanged from Amendment 2. The fishing mortality target ($F_{1985-94}$) is 0.29, and is the average fishing mortality rate from fishing seasons 1985 to 1994 when biomass and landings were "stable", as estimated by the NSTC in 2010. The fishing mortality threshold (F_{1987}) is 0.37, and is the maximum annual F during the same stable period (1985-94). The fishing mortality limit is F = 0.6, and is based on the value that was exceeded in the early to mid-1970s and in the mid-1990s when the stock collapsed. Overfishing is occurring if the threshold is exceeded. The fishing mortality target, threshold and limit may be updated as the best scientific information becomes available through updated stock assessments.

Option B: Best Available Science

Draft Amendment 3 to the Northern Shrimp FMP proposes to allow for the incorporation of new, peer-reviewed stock status determination criteria (both the methods used to set reference points, and the reference point values), when available, through Section action. Specifically, Draft Amendment 3 proposes broadening the descriptions of stock status determination criteria contained within the Northern Shrimp FMP to allow for greater flexibility in those definitions, while maintaining objective and measureable status determination criteria for identifying when the stock is overfished. Similar actions have been taken with other Commission-managed species' FMPs (e.g., Addendum XIX to the FMP for Summer Flounder, Scup and Black Sea Bass, and Addendum XVI to the FMP for American Lobster).

In essence, this action would allow for the incorporation of new, peer-reviewed stock status determination criteria, when available, through the annual specifications process, thus significantly improving the timeliness of incorporating the best available scientific information in the management of northern shrimp. This action does not have a direct influence on fishing effort or fishery removals but instead facilitates use of the most current scientific information available to define the status determination criteria for the stock, so that the stock can be managed to prevent overfishing and managed such that it is not overfished.

The definitions for status determination criteria for Gulf of Maine northern shrimp is broadened under this option to allow for greater flexibility in incorporating changes to the definitions of the maximum fishing mortality threshold and/or minimum stock size threshold as the best scientific information becomes available. As such, the following describes the potential sources of peer-reviewed scientific advice on status determination criteria and the current process of how that scientific advice will move forward in the development of management advice through the Section's annual specification process.

Specific definitions or modifications to the status determinations criteria, and their associated values, would result from the most recent peer-reviewed stock assessments and their panelist recommendations. The primary peer-review processes for Gulf of Maine northern shrimp that may be used are:

- The Northeast Regional Stock Assessment Workshop/ Stock Assessment Review Committee (SAW/SARC) process which is the primary mechanism utilized in the Northeast Region at present to review scientific stock assessment advice, including status determination criteria, for ASMFC- and federally-managed species.
- ASMFC Externally Contracted Reviews with Independent Experts (e.g., Center for Independent Experts - CIE) which is also subject to rigorous peer-review and may result in scientific advice to modify or change the existing stock status determination criteria.

The above list of peer-review entities does not preclude groups from bringing independent stock assessments performed for the Gulf of Maine northern shrimp stock forward to the attention of the Commission. The ASMFC may recommend that non-Commission reviewed stock assessments pass through either of the peer-review processes above, to ensure that sufficient peer-review of the information occurs before the scientific advice can be utilized within the management process.

The scientific advice provided with respect to status determination criteria could follow three scenarios. First, it is possible that the panelists participating in the peer-review reach consensus with respect to maintaining the current definitions of status determination criteria for northern shrimp. There may be updates to the values associated with those same definitions based on the input of more recent (i.e., additional year's data) or updated information as well; however, the Section is not required to undertake any specific action when this occurs, as using the updated values is implied in this provision of the FMP. In this case the scientific advice can then move forward such that management advice can be developed. Under the second potential scenario for scientific advice, the peer-review recommends changes or different definitions of the status determination criteria, and the panelists reach consensus as to how these status determination criteria should be modified or changed. This scientific advice can move forward such that management advice can be developed. Under these first two potential scenarios, consensus has been reached and therefore the scientific advice moving forward to the Section's management advisory groups should be clear.

The third potential scenario is the peer review scientific advice with respect to the incorporation to status determination criteria are split (consensus is not reached) or uncertain recommendations are provided (weak consensus). The scientific advice provided by the reviewers may be particularly controversial. In addition, the scientific advice may not be specific enough to provide adequate guidance as to how the maximum fishing mortality threshold and/or minimum stock size threshold should be defined or what resulting management advice should be developed from these changes. Under these circumstances, or at any time, the Section may engage their TC to review the information and recommendations provided by the peer-review group. Based on the terms of reference provided to the TC, which may include reevaluation of stock status determination criteria in light of changing environmental conditions, they may prepare a consensus report clarifying the scientific advice for the Section as to what the status determination criteria should be (e.g., modify, change, or maintain the same definitions). At that point the scientific advice on how the status determination criteria should be defined will be clear, and can move forward such that management advice can be developed.

2.6 STOCK REBUILDING PROGRAM

Based on the definition of overfished status as defined in *Section 2.5*, and should the stock biomass go below the threshold as determined by the annual stock assessment, the stock is defined as overfished and the Section is required to take action to recover the stock above the threshold. Based on the definition of overfishing status as defined in *Section 2.5*, and should fishing mortality go above the threshold as determined by the annual stock assessment, overfishing is then occurring and the Section is required to take action to reduce the fishing mortality to the target level. If fishing mortality exceeds the limit level and biomass is less than the threshold level, the Section must act immediately to reduce fishing mortality.

The Section chose not to set specific rebuilding timeframes. It maintains the flexibility to rebuild stocks within a reasonable amount of time. This flexibility is necessary for the Section to manage a species that is volatile and easily affected by change in environmental conditions.

2.7 RESOURCE COMMUNITY ASPECTS

See *Section 1.4.1* for the role northern shrimp play in ecosystem dynamics.

2.8 IMPLEMENTATION SCHEDULE

[*TBD if approved*]

3.0 MONITORING PROGRAM SPECIFICATIONS/ELEMENTS

3.1 SUMMARY OF MONITORING PROGRAMS

In order to achieve the goals and objectives of Amendment 3, the collection and maintenance of quality data continues to be necessary.

Commercial landings by state, month, and gear (trawl vs. trap) were compiled by NOAA Fisheries port agents from dealer reports until the mid-late 1990's, and are available electronically back to 1964. A dealer reporting system became mandatory in 1982 but was repealed in 1991, and NOAA Fisheries began collecting the data again. In 2004, shrimp reporting for federally permitted dealers buying from federally permitted harvesters became mandatory, but "state-only" dealers, mostly in Maine, continued to report voluntarily. Trip level reporting became mandatory for all licensed Maine shrimp dealers in 2008, although "peddlers" selling directly to the public only were not required to have a license, so catches sold in the peddler market were mostly unreported on the dealer side. This was remedied in 2013, and during the next shrimp season, anyone buying shrimp for resale will need to be licensed in Maine and report landings.

In 1994, a Vessel Trip Report (VTR) system was implemented for many federally permitted harvesters and in 1999 (but not implemented until the 2000 season), reporting became mandatory for all shrimp harvesters landing in Maine.

3.1.1 Catch and Landings Information

The need for accurate and timely reporting **of _all_ catch and landings** is imperative for successful monitoring of the fishery and the TAC, and is a prerequisite for effective implementation of trip limits and days out to slow catch rates.

Option A: Status Quo; weekly reporting by all dealers

All states are required to implement weekly reporting by all primary purchasers which is the first point of sale on land. States must use electronic reporting through the Standard Atlantic Fisheries Information System (SAFIS) maintained by the Atlantic Coastal Cooperative Statistics Program (ACCSP). Negative reports (reporting did not deal) are required. Landing and trip information should be collected consistent with the established ACCSP data elements.

Option B: Weekly reporting of all sale at first point of contact

All states are required to implement **weekly reporting of all daily sales at first point of contact (i.e., dealers, including harvester direct sales to the consumer, i.e., "peddlers")**. States must require the use of electronic reporting through the Standard Atlantic Fisheries Information System (SAFIS) maintained by the Atlantic Coastal Cooperative Statistics

Program (ACCSP). Negative reports **(no shrimp were purchased or received during a reporting week)** are required. Landing and trip information should be collected consistent with the established ACCSP data elements.

3.1.2 Fishery-Dependent Monitoring

Approximately 2-5% of commercial shrimp landings from Maine, New Hampshire and Massachusetts, have been subsampled for size and sex-stage composition data since the early 1980s (SAW/SARC 58, 2014). These data are essential for annual stock assessment, and subsequent management actions.

Option A: Status Quo; port sampling of commercial landings is encouraged

The states of Maine, New Hampshire, and Massachusetts are encouraged, **but not required**, to collect size and sex-stage composition data from subsamples with a target of at least 2% of commercial landings in that state to inform annual stock assessment.

Option B: Port sampling of commercial landings is required

The states of Maine, New Hampshire, and Massachusetts are **required** to collect size and sex-stage composition data from subsamples with a target of at least 2% of commercial landings in that state to inform annual stock assessment.

3.1.3 Biological Information

The ACCSP provides standardized data elements and reporting medium for collected biological data on commercial, for-hire, and recreational fisheries. Biological data for commercial fisheries can be collected through port sampling programs and at-sea observers Refer to the ACCSP Program Design document for details. Priorities and target sampling levels are determined by the ACCSP Biological Review Panel, in coordination with the Bycatch Prioritization Committee.

3.1.4 Social Information

In New England today, there is no consistent, long-term monitoring program focused either on the collection and analysis of social and economic data or on the social and economic impacts of regulatory change. However, there are several steps being taken that may eventually lead to such a program. ACCSP is currently conducting a pilot project for the collection and analysis of such data from a random sample of harvesters involved in summer flounder or blue crab fisheries. Hall-Arber et al. (2001) collected a wealth of information to serve as a baseline for such data collection in New England. A few towns in Maine have, or are in the process of developing, planning processes that include analyses of their fishing industry's current and anticipated needs. Conduct of needed research and analyses identified in this amendment would help place the necessary decision-making on a more objective foundation.

3.1.5 Economic Information

There is very little direct monitoring of economic conditions in the Gulf of Maine northern shrimp fishery for either harvesters or processors. Ex-vessel value of shrimp landings is collected for northern shrimp through mandatory electronic dealer reporting.

The 2011 through 2013 shrimp harvest seasons have closed early due to landings in excess or reaching the coastwide TAC. In 2011, a total of 6,397 mt of shrimp were landed, exceeding the recommended TAC of 4,000 mt by approximately 2,400 mt (Table 2). The average price per pound was $0.75 and the estimated landed value of the catch was $10.6 million (Table 4). In 2012, the season was further restricted by having trawlers begin on January 2 with three landings days per week and trappers begin on February 1 with a 1,000 pound limit per vessel per day. The TAC was set at 2,000 mt (later increased to 2,211 mt on January 20th) and would close when the projected landings reached 95%. The season was closed on February 17; trawlers had a 21-day season and trappers had a 17-day season. Landings for 2012 were 2,485 mt and the average price per pound was $0.95 with an estimated landing value of $5.2 million. In 2013, the TAC was set at 625 mt (with 5.44 mt set aside for research tows) and would close when the projected landings reached 85% of the TAC in each fishery (trap and trawl). The trawl fishery was allocated a 539.02 mt TAC and the trap fishery was allocated an 80.54 mt TAC. Trawlers fished for 54 days and trappers fished 62 days culminating in 345.5 mt landed, which is 280 mt under the TAC. The average price per pound was $1.81 and is the highest observed since 1989 (inflation-adjusted values, Table 4) with an estimated value of $1,375,788.

With a moratorium on the northern shrimp fishery since 2014 the only landings that have been allowed have been through the research set aside (RSA) program allowing selected harvesters to conduct cooperative winter sampling of northern shrimp and provide biological samples to maintain the biological data time series (Table 2).

Vessels in the shrimp fleet complete the NOAA Fisheries Vessel Trip Reports for each trip providing fishing effort and crew size information. There is no direct source of cost data for this fleet except where a particular vessel has supplied these data to another NOAA Fisheries program such as the Capital Construction Fund or the MARFIN survey of groundfish trawlers.

Historically, there has been a modest level of at-sea sampling of the shrimp fleet by the NOAA Fisheries and state agencies. Up until about 1998, the NOAA Fisheries funded shrimp sampling trips through the observer program at the Manomet Center for Conservation Science. State agencies also conduct routine port sampling and sea sampling programs. While aboard, both state and Federal sea samplers follow the same sampling protocols that do include some economic data gathering. Observers note many physical characteristics of the vessel and the gear including gear quantity and size and the amount of electronics in the wheelhouse. If time permits there are additional economic questions in the sea sampling forms although it is expected that very few of these interviews are conducted on day trips.

As noted above, dealers and processors provide the ex-vessel price paid to boats at the first point of sale. After this point there is very little economic monitoring of the processing sector. Much of the New England shrimp production is sold to Canada, Europe and Asia, hence U.S Customs documentation of shipments abroad is available including product form and declared value. Unfortunately, shrimp shipments leaving through a New England port of departure do not necessarily indicate that this domestic product was landed in the Gulf of Maine Pandalid fishery and further distinction of the product to the species level is not required on Customs paperwork.

Any socioeconomic data collection programs utilizing ACCP standards are quite capable of overcoming these gaps in data for this fishery. Industry acceptance of an expanded and more focused data collection program would be key to its success. Funding and the sheer scale of implementation for a northern shrimp socioeconomic study have slowed down the implementation of a socioeconomic data collection program for this fishery.

3.1.6 Observer Programs

As a condition of state and/or federal permitting, vessels should be required to carry at-sea observers when requested. The ACCSP has adopted the NOAA Fisheries National Observer Program as the standard for training and certifying at-sea observers. The ACCSP standards for commercial fisheries observer coverage is 5% of total trips for high priority fisheries, or achieving a 20-30% PSE, and 2% of total trips for all other fisheries. These target sampling-levels should be evaluated annually by fishery to determine where the variance stabilizes and to meet desired goals. A minimum set of standard data elements is defined through the ACCSP for biological or bycatch sampling data (refer to the ACCSP Program Design document for details). Specific fish species and fisheries are prioritized for sampling as well as sampling levels through the ACCSP Biological and the Discard Prioritization Committees. The ACCSP is developing a target tracking system to track the number of observed trips so that observer effort may be reallocated as targets are met. Partners should upload minimum data elements to the ACCSP tracking system before the tenth of the month following data collection. The submission timeline will allow two effort reallocations per calendar quarter. ACCSP Partners are encouraged to monitor the tracking system as required to complete targets.

3.2 ANNUAL ASSESSMENT

3.2.1 Assessment of Fishing Mortality Target and Measurement

Fishing mortality estimates for the Gulf of Maine northern shrimp fishery in the past have been generated by two separate models; the Collie-Sissenwine, or Catch-Survey Analysis (CSA), and a surplus production model (ASPIC). The CSA tracked the removals of shrimp using summer survey indices of recruits and fully recruited shrimp scaled to total catch in numbers. The surplus production analysis modeled the biomass dynamics of the stock with a longer time series of total landings and several survey indices of stock biomass. The CSA estimates of fishing mortality were used as the primary point estimates for managing the fishery, while the surplus production estimates of fishing mortality were used to corroborate results from the CSA and provide historical perspective. However, in 2014, a benchmark stock assessment explored new analytic methods, including a new model and modifications to the accepted CSA model. The benchmark assessment went through peer-review and the new approaches were not approved for management use. As a result, the current BRPs in Amendment 2 may no longer be applicable to northern shrimp management. Accordingly, Draft Amendment 3 proposes alternative approaches to incorporate the most recent peer-reviewed and approved stock status determination criteria for management use (see *Section 2.5*).

The Northern Shrimp Technical Committee will perform a northern shrimp stock assessment on an annual basis. The Technical Committee and Advisory Panel will meet to review the stock assessment and all other relevant data sources. An annual stock status assessment report will be prepared for the Section in order to make annual adjustments to the management program as necessary. Several primary surveys are examined, including the ASMFC summer shrimp survey and the NOAA Fisheries fall ground fish survey. The stock assessment report will include at least landings, effort, and survey indices of abundance, biomass, and recruitment. Estimates of fishing mortality, yield-per-recruit and spawning potential will be provided when possible. If major changes are made to the stock assessment models used in the management process, or the Section requests a higher level of review, the Section may recommend to the ISFMP Policy Board that an external review of the stock assessment be conducted.

3.2.2 Assessment of Annual Recruitment

The mean number per tow of 1.5 year old shrimp from the State-Federal Northern Shrimp Survey is used as a proxy for a recruitment index. Although the shrimp are not fully recruited to the survey gear at this age, it appears that this index is a sufficient representative of year class strength from the previous year.

3.2.3 Assessment of Spawning Stock Biomass

The stratified mean weight (kg) per tow of northern shrimp >= 22-mm dorsal carapace length (CL) from the state/federal northern shrimp survey provides the index of spawning stock biomass (SSB). Northern shrimp are protandric hermaphrodites, which start changing from male to female around 2.5 years of age, or 18 to 19 mm CL. The 22 mm dorsal carapace length is used as a cutoff point because at this size most shrimp are sexually mature females.

3.3 BYCATCH MONITORING PROGRAM

The ACCSP will require a combination of quantitative and qualitative methods for monitoring discard, release, and protected species interactions in the northern shrimp commercial. Commercial fisheries will be monitored through an at-sea observer program (see *Section 3.1.5*) and several qualitative programs, including strandings, entanglements, trend analysis of vessel trip and dealer reported data, and port sampling.

3.4 HABITAT PROGRAM

No habitat program is currently defined for the Gulf of Maine's Northern shrimp. Given the high uncertainty in the future prospects for the northern shrimp fishery and the current moratoriums due to the stock collapse, the long-term impacts of the fishery on shrimp habitats are highly uncertain. Current low levels of effort in the fishery likely have neutral or slightly positive habitat effects.

The New England Fisheries Management Council is finalizing the Omnibus Essential Fish Habitat Amendment 2 to review and revise Essential Fish Habitat (EFH) designations and develop actions needed to minimize adverse effects of fishing on EFH to address Magnuson Stevens Act Essential Fish Habitat requirements. The Council's evaluation considered the habitat impacts of all type of fishing occurring in federal waters in the Council's area of jurisdiction, not just fishing activities directly managed by the Council.

A major goal of the amendment is to avoid and minimize to the extent practicable the adverse effects of fishing on the seabed. The Council concluded that vulnerability to fishing impacts varies based on habitat characteristics and fishing intensity (NEFMC 2011). Most of the management measures in the draft omnibus EFH amendment are based on identifying specific locations where seafloor habitats are more vulnerable and implementing restrictions in these areas on gear types that have the most severe impacts. Although the total magnitude of adverse impacts has been reduced over time due to reductions in swept area in the multispecies groundfish fishery, this reduction may be rapidly reversed if the more vulnerable seafloor is not identified and protected from gear types that could impact it.

4.0 MANAGEMENT PROGRAM IMPLEMENTATION

4.1 COMMERCIAL FISHERIES MANAGEMENT MEASURES

4.1.1 Annual Fishery Specifications and the Total Allowable Catch

Option A: Status Quo; combines Addendum 2, Section 4.1 with Addendum I, Section 3.1.
To manage the northern shrimp stock at the biological reference points in Section 2.5, the Northern Shrimp Section shall adjust commercial fishery management measures based on recommendations from the Northern Shrimp Technical Committee (NSTC), Advisory Panel, and public input.

The Section has the flexibility to set a hard TAC annually that is associated with managing the Northern shrimp fishery

- At the F_{target}
- At the $F_{threshold}$
- Between the F_{target} and $F_{threshold}$

The NSTC will estimate a TAC associated with the above management flexibility using results from the most recent stock assessment.

The methodology used to establish the TAC is as follows: The NSTC recommends a TAC to the Section based on an assessment of current stock status, the biology of the species, and the stated management goal of protecting and maintaining the stock at levels that will support a viable fishery on a sustainable resource (Amendment 2 to the FMP, ASMFC 2011).

Catch in numbers (C) is a function of abundance (N) and exploitation rate (μ, which is a function of fishing mortality F and natural mortality M). Using this relationship, it is possible to estimate projected landings (in numbers) for a given year at various levels of F, using population estimates and an assumption of M.

To convert landings in numbers to landings in weight, an assumption must be made about the mean weight of the shrimp caught in the upcoming fishery. The NSTC uses the relationship between the mean carapace length (mm) of female shrimp during the summer survey, and the mean weight (g) of an individual shrimp in the next fishing season, to predict the fishery mean weight.

The Section will meet annually during a public meeting in the fall or early winter to review the Advisory Panel and NSTC recommendations, set a hard TAC **for the next fishing season**, and **may specify any combination of** the following management measures for the upcoming fishing season through a majority vote.

Annual ~~Fall~~ Meeting Specification Options:

a) Fishing Season (*Section 4.1.3)*
    1. Establish measures for projected season closure (4.1.3.1)
b) Trip Limits (*Section 4.1.4)*
c) Trap Limits (*Section 4.1.5*)
d) Days out of the Fishery (*Section 4.1.6*)
e) Research Set Aside (*Section 4.1.2.1*)

The Section may further specify all options above by gear type (e.g., trap and trawl) and may establish harvest triggers to automatically initiate or modify any option (except trap limits). Additionally, the Section may adjust the fishing season, trip limits, and days out of the fishery at any other time during the fishing season at a meeting or conference call. Meetings are preferable to calls, and conference calls will only be used as needed, most likely for time sensitive specification adjustments. The Section may also establish incentive-based programs at the annual specifications meeting.

Draft Amendment 3 provides the Section with a suite of management measures that can be modified through adaptive management. *Section 4.5.2* contains a list of management measures that may be implemented anytime throughout the year by the Section. However, modifications of any of the measures listed in *Section 4.5.2* must be implemented through the addendum process. See *Section 4.5.1* for details of the adaptive management process.

Once the Section approves management measures for the northern shrimp fishery, it is the individual state's responsibility to implement consistent regulations through its state agency.

Option B: remove language regarding TAC recommendation based on a catch equation and association with fishing mortality reference points from Section 4.1, and replace with the TAC recommendation and specification process language in Amendment 2.

Remove "the NSTC will estimate a TAC associated with the above management flexibility using results from the most recent stock assessment.

The methodology used to establish the TAC is as follows: The NSTC recommends a TAC to the Section based on an assessment of current stock status, the biology of the species, and the stated management goal of protecting and maintaining the stock at levels that will support a viable fishery on a sustainable resource (Amendment 2 to the FMP, ASMFC 2011).

Catch in numbers (C) is a function of abundance (N) and exploitation rate (μ, which is a function of fishing mortality F and natural mortality M). Using this relationship, it is possible to estimate projected landings (in numbers) for a given year at various levels of F, using population estimates and an assumption of M.

To convert landings in numbers to landings in weight, an assumption must be made about the mean weight of the shrimp caught in the upcoming fishery. The NSTC uses the relationship between the mean carapace length (mm) of female shrimp during the summer survey, and the mean weight (g) of an individual shrimp in the next fishing season, to predict the fishery mean weight."

And replace with "the general process for setting fishery specifications is as follows. The NSTC will annually review the best available data including, but not limited to, commercial and recreational catch/landing statistics, current estimates of fishing mortality, stock status, shrimp survey indices, assessment modeling results, and target mortality levels; and recommend a target TAC to maintain healthy stock status relative to peer reviewed biological reference points. The Section will meet annually during a public meeting in the fall or early winter to review the Advisory Panel and NSTC recommendations, set a target TAC, and may specify any combination of the following management measures for the upcoming fishing season through a majority vote."

Option C: replace Section 4.1 with the following language regarding annual TAC recommendation and specification based on the best available science.
"To manage at the biological reference points in Section 2.5, the Northern Shrimp Section shall adjust commercial fishery management measures based on Northern Shrimp Technical Committee (NSTC), Advisory Panel, and public input. The NSTC will annually review the best available data which may include, but are not limited to, catch and landing statistics, current estimates of fishing mortality, stock status, shrimp survey indices, assessment modeling results, and target and threshold mortality levels; and recommend a hard TAC to maintain or reach healthy stock status relative to peer reviewed biological reference points, if available.

The Section will meet annually during a public meeting in the fall or early winter to review the Advisory Panel and NSTC recommendations, set a hard TAC that is associated with managing the northern shrimp fishery at the F_{target}, at the $F_{threshold}$, or between the F_{target} and $F_{threshold}$, **when possible**, and specify any of the following management measures for the upcoming fishing season through a majority vote.

Annual Meeting Specification Options:

a) Fishing Season (*Section 4.1.3)*
    1. Establish measures for projected season closure (*Section 4.1.3.1*)
b) Trip Limits (*Section 4.1.4)*
c) Trap Limits (*Section 4.1.5*)
d) Days out of the Fishery (*Section 4.1.6*)
e) Research Set Aside (*Section 4.1.2.1*)

The Section may further specify options 1-4 above by gear type (e.g., trap and trawl) and may establish harvest triggers to automatically initiate or modify any option (except trap limits). Additionally, the Section may make adjustments to the fishing season, trip limits, and days out of the fishery at any time during the fishing season at an in-person meeting or conference call. Meetings are preferable to calls, and conference calls will only be used as needed, most likely for time sensitive specification adjustments

This amendment provides the Section with a suite of management measures that can be modified through adaptive management. Section 4.6.2 contains a list of management measures that may be implemented anytime throughout the year by the Section. However, adjustment or establishment of any of the measures listed in Section 4.6.2 must be implemented through the addendum process. See Section 4.6 for a description of how the Section is able to implement adaptive management through the addendum process.

Once the Section approves management measures for the northern shrimp fishery, it is the individual state's responsibility to implement consistent regulations through its state agency."

4.1.2 Total Allowable Catch (TAC) Allocation Program

The Section directed the PDT to explore and develop TAC allocation options as alternative means to manage effort in the fishery. The PDT chose not to revisit the current gear-specific allocation program because gear-specific TAC allocation percentages based on the time periods detailed below are essentially the same as status quo (i.e., 87% to the trawl fishery, and 13% to the trap fishery). Furthermore, under status quo any state can request a transfer of quota between gears and a decision would be made by the Section during an in-person meeting. The PDT also choose not to include regional-specific TAC allocation options primarily because the distribution of shrimp throughout the Gulf of Maine is variable, spatially and temporally, and strongly influences the amount of catch between regions in any given year (The AP concurred with the PDT on this point). Furthermore, current state reporting programs do not collect data on the location of catches in a manner timely enough to monitor the TAC by region.

Option A: Status Quo

The annual TAC as specified in *Section 4.1.1* will be allocated by gear, with 87% allocated to the trawl fishery and 13% allocated to the trap fishery. These allocation percentages were based on the average historical landings by gear in the northern shrimp fishery during the period following the implementation of new logbook reporting requirements for non-federal permits in 2000.

Any state can request a transfer of TAC between gear types, and a transfer decision would be made by the Section during an in person meeting. If a transfer occurs, the transfer does not permanently affect the gear allocation of the coastwide TAC, i.e., gear-specific shares remain fixed as specified above.

Option B: No allocation of the hard TAC
No TAC allocation program will be implemented in the northern shrimp fishery. The hard TAC as specified in *Section 4.1.1* will apply to the entire fishery, i.e., the TAC will not be allocated to states, gears or fisheries.

Option C: Allocate hard TAC by state
The coastwide TAC as specified in Section 4.1.1 will be allocated by state according to any one of the following options, or combination thereof. For states with historical trawl and trap fisheries, the state's annual allocation would be divided 87% to the trawl fishery and 13% to the trap fishery.

It is the responsibility of the states to implement appropriate measures to prevent quota overages. All northern shrimp landed will be applied against the state of the vessel(s) home port regardless of where the northern shrimp was harvested or landed. Individuals or vessels with commercial permits cannot land northern shrimp in any state that was not allocated a commercial quota. State quota allocations may be revisited at any time through the adaptive management process (*Section 4.5*).

Option	Timeline	Maine	New Hampshire	Massachusetts
C1	2001-2010	90.6%	8.4%	1.0%
C2	2003-2008	90.9%	8.1%	1.0%
C3	NA	82%	12%	6%
C4	NA	80%	10%	10%

Justification for Option C1 – C4 are as follows:

- *Option C1 (2001-2010)*: This time period represents landings after new logbook reporting requirements for non-federal permits were instituted in 2000, allowing for one year of quality assurance/quality control procedures to ensure full reporting and accountability. Emergency closures were implemented in late 2010 through 2012 seasons. As a result, catch and landings data from these years are not suitable for TAC allocation analysis and were excluded from the time period. The 2010 catch and landings data were not severely impacted by emergency closures (season timing and duration were that of a typical season), and therefore are included in the timeframe. These percentages are the result of the total landings in that state over the specified time period, divided by the total landings across all three states during the same time period.

- *Option C2 (2003-2008)*: This time period represents data three years after new logbook reporting requirements for non-federal permits were implemented in 2000. The terminal year was chosen to exclude the years when emergency closures were implemented (2010-2012), and when market conditions are thought to have disproportionately impacted northern shrimp fisheries across the region. These percentages are the result of the total landings in that state over the specified time period, divided by the total landings across all three states during the same time period.
- *Option C3:* Each state is allocated a minimum of 5% of the TAC and the remaining 85% of the TAC would be allocated proportionately by the average landings from 2001-2010 defined in Option C1 (i.e., 90.6% to Maine, 8.4% to New Hampshire and 1.0% to Massachusetts).
- *Option C4:* Each state is allocated a minimum of 10% of the TAC and the remaining 70% of the TAC would be allocated to Maine.

If selecting Option C, the following sub-options must also be considered:

Sub-option C1: Quotas Transfers
Two or more states, under mutual agreement, would be allowed to transfer or combine their northern shrimp quota. The Executive Director or designated ASMFC staff will review all transfer requests before the quota is transfer is finalized. Quota transfer agreements (from both the receiving and donor states) should be forwarded to the Section through Commission staff. If a transfer occurs, the transfer does not permanently affect the state allocation of the coastwide TAC, i.e., state-specific shares remain fixed.

Once quota has been transferred to a state, the state receiving quota becomes responsible for any overages of transferred quota. That is, the amount over the final quota (that state's quota plus any quota transferred to that state) for a state will be deducted from the corresponding state's quota the following fishing season. Additionally, any quota overages incurred by the donor state due to transfer of quota will be paid back by the state receiving transfer.

Sub-option C2: Quota reconciliation
At the end of each fishing season, any quota underages by one or more states will be pooled and proportionately allocated [according to the option chosen in the table above] to a state or states with overages to help reconcile any quota overages.

Sub-option C3: Quota roll over
If the states of New Hampshire or Massachusetts have not fully utilized their state quota by [*one of the sub options below*] of a fishing season, the remaining amount of the quota would be rolled over to the Maine quota.

Sub-option C3-1: February 1
Sub-option C3-2: February 15
Sub-option C3-3: March 1

4.1.2.1 Research Set Aside (RSA) Program

*Potential new language is in **bold**. Potential language to be removed has been struck-through.*

The Northern Shrimp Section may ~~establish a mechanism to~~ set aside a percentage of **the coastwide** TAC to help support research on the northern shrimp stock and fishery. **The** ~~A~~ percentage of the TAC ~~may be~~ set aside ~~for northern shrimp research purposes as approved by the Section when determining~~ **will be determined during** the annual specifications ~~for the northern shrimp fishery~~ **meeting, and will be deducted from the coastwide TAC before the TAC is allocated according to *Section 4.1.3*. The Section may set a RSA quota when there is no TAC as agreed by the Section, i.e., during years of a moratorium.** The research set aside program will be managed by the Northern Shrimp Section and ASMFC.

4.1.2.2 Total Allowable Catch (TAC) Accountability Measures

The following accountability measures are being considered by the Section to improve the quota monitoring and management of the northern shrimp fishery.

Option A: Status quo
No payback of overharvest of quota.

Option B: 100% payback

Sub-option B1: When the quota [allocated to a state or fishery] is exceeded in a fishing season, 100% of the overage amount will be deducted [from the corresponding state or fishery] in the next fishing season (e.g., 100 pounds overage = 100 pounds payback).

Sub-option B2: When the quota [allocated to a state or fishery] is exceeded in a fishing season, 100% of the overage amount will be deducted [from the corresponding state or fishery] in the next fishing season (e.g., 100 pounds overage = 100 pounds payback). *If the annual TAC is not exceeded, any [state or fishery] specific overages will be forgiven.*

Option C: 100% payback only if quota is exceeded by at least 3%

Sub-option C1: When the quota allocated to a [state or fishery] is exceeded by 3.0% in a fishing season, 100% of the overage amount will be deducted [from the corresponding state or fishery] in the next fishing season. If the quota [allocated to a state or fishery] is exceeded by less than 3.0%, a payback of the overage amount is not required.

Sub-option C2: When the quota allocated to a [state or fishery] is exceeded by 3.0% in a fishing season, 100% of the overage amount will be deducted [from the corresponding state or fishery] in the next fishing season. If the quota allocated to a [state or fishery] is exceeded by less than 3.0%, a payback of the overage amount is not required. *If the annual TAC is not exceeded, any [state or fishery] specific overages will be forgiven.*

4.1.3 Fishing Season

The Section directed the PDT to develop options for a defined fishing season. The PDT and the AP discussed that effective implementation of standard fishing seasons is undermined by the current provisions of the FMP, and may not contribute to improved management of the fishery. Specifically, the current quota management system, the Section's ability to set a closed season, annually, up to 366 days (i.e., impose a moratorium), projected season closure and days out of the fishery provisions are currently used management tools that affect fishing season timing and duration. Furthermore, the PDT choose not to include standard regional- or gear-based fishing season options because the availability of shrimp to different gear types and within regions of the Gulf of Maine is variable, spatially and temporally. All other options explored are included here for completeness.

Option A: Status Quo

During the annual specifications meeting, the Section may establish a fishing season or seasons to occur at any time during the year based on the best available science and stakeholder input. The Section has the ability to set a closed season annually up to 366 days (i.e., impose a moratorium). The Section may set different seasons for the harvesting and processing sectors of the fishery to accommodate for the lag time of processing shrimp harvested late in the season. The Section may close the fishery at any time at a public meeting or conference call.

Note: the following provision applies to Options B, C and D below:

The Section has the ability to set a closed season annually up to 366 days (i.e., impose a moratorium). The Section may set different seasons for the harvesting and processing sectors of the fishery to accommodate for the lag time of processing shrimp harvested late in the season. The Section may close the fishery at any time at a public meeting or conference call.

Option B: Maximum fishing season

The Section may establish a fishing season according to any one of the following options, or combination thereof. This will be the maximum season length if a fishing season is approved, i.e., the Section may establish a fishing season shorter than, but not longer than that specified.

Option	No earlier than	No later than
B1	December 1	May 31
B2	January 1	April 30

Option C: Minimum core season with flexibility to start earlier and extend later

The Section may establish a core fishing season according to any one of the follow options, or combination thereof. This will be the minimum season length if a fishing season is approved, i.e., the Section may establish a fishing season longer than, but not shorter than that specified.

Option	Start date	End date
C1	January 1	March 15
C2	January 1	February 28
C3	January 15	February 15

Option D. State-specific core season

The Section may establish state-specific core fishing seasons according to any one of the following options, or combination thereof. This will be the minimum season length if a fishing season is approved, i.e., the Section may establish a fishing season longer than, but not shorter than that specified.

Option	MA	NH	ME
D1	December 15 – February 28		January 1 – March 15
D2	January 1 – February 28		January 15 – March 15
D3	January 15 – February 15		January 30 – February 28

4.1.3.1 Projected season closure

The northern shrimp fishery will close when a percentage of the coastwide TAC is projected to have been caught. The exact percent, ranging between 80-95%, and the closure notification period (2-7 days) will be established by the Section during the annual specifications meeting. ASMFC will notify states when the selected percentage of the TAC is projected to be reached, and states must then close their fisheries within the specified notification period.

In projecting the season closure, the NSTC will consider these sources of uncertainty:

1. Future catch rates, which depend on weather, stock availability, catchability, gear type, location, and fishery participation. Catch rates can be expected to be high in January and February and lower in other months, with exceptions.
2. Late reporting. During the 2012 season, reporting compliance improved as the season progressed.
3. Unreported catches due to non-compliance, ~~or catches sold directly to consumers,~~ or kept for personal use ("peddled"). These account for 5-10% of landings, annually.

4.1.4 Trip Limits (*No changes proposed)*

The Section will vote on the start date, duration, and end date of trip limits, with the ability to initiate or modify trip limits during the season. The Section may use harvest triggers to automatically initiate or modify trip limits during the season. The Section may implement trip limits by day, week, or other time based landing limit to control the rate of landings. The Section may establish trip limits based on gear type, and an analysis of historical harvest data. Vessels are prohibited from landing more than the specified amount during a designated trip limit period. Refer to *Appendix 1* for the PDTs preliminary trip limit analysis.

4.1.5 Trap Limits (*No changes proposed)*

The Section may set trap limits during the annual specifications meeting through a majority vote. The Section may establish trap limits based on an analysis of historical harvest data. An individual permit holder is prohibited from fishing a number of traps in excess of the trap limit designated by the Section for that fishing year.

All traps fished, or aboard a vessel, must be tagged. A permanent, non-transferable trap tag shall be attached to each trap. Each trap tag shall be color-coded coastwide by fishing year and include the following information: issuing authority, year(s) tag is valid, and permit number. Trap tags must be permanently attached to the trap frame, and clearly visible for inspection. In state waters, the state licensing agency shall be the issuing authority. Each state shall issue tags to its own residents. In cases where license holders do not hold a license in their resident state, the state in which they fish shall issue tags.

4.1.6 Days Out of the Fishery (*No changes proposed)*

Days out of the fishery may be implemented to slow catch rates in order to prolong the harvest of the hard TAC, or make shrimp available when demand is greatest. The Section will vote on the start date, number of days out, and days of the week for days out. The Section may initiate or change days out specifications by taking another vote anytime during the rest of the fishing season during a meeting or conference call. All states will take the same days out of the fishery.

Days out during the fishing season are considered closed days, and it is unlawful to land any shrimp from 0001 hours to 2400 hours; and it shall be presumed that any shrimp landed or possessed by harvesters during the closed period were taken during a closed day.

4.1.7 Minimum Mesh Size (*No changes proposed)*

It is unlawful to fish for, take, transport or have in possession any northern shrimp on board any boat rigged for otter trawling with any net with a mesh opening of less than 1-3/4 inches stretched mesh opening between knots, or to have on board any net, netting or portions thereof, except an accelerator funnel of the size specified in Section 3(c), with an opening less than 1-3/4 inches stretched mesh opening between knots and except that a deflector panel of 1 inch mesh may be used in the cod end behind the second grate in a double grate system. The maximum length of the bottom legs of the bridle of any shrimp trawl shall not exceed 15 fathoms of uncovered or bare wire.

<u>Tolerance</u>. Due to the differences by net manufacturer, mesh measurements and other inherent variables used for enforcement of this regulation, a tolerance of 1/8 inch shall be applied to the average mesh size in the body and wings. No tolerance shall be applied to the mesh size in the cod end.

4.1.8 Fishing Gear (*No changes proposed)*

All netting used to catch shrimp shall be of one layer only, with no liners of any kind attached, except that a cod end strengthener may be used as specified, and except that an accelerator funnel may be used and must have a mesh size of no less than 1-3/8 inch stretched mesh. It shall be lawful to attach chafing gear to the lower half of the circumference of the cod end unless a cod end strengthener is used. Cod end shall mean the terminal portion of an otter trawl, pair trawl, beam trawl, Scottish seine or mid-water trawl in which the catch is normally retained.

4.1.9 Cod End Strengthener (*No changes proposed)*

An outer mesh may be used as a cod end strengthener while fishing for northern shrimp. The outer mesh must be a minimum of 6 inches and the outer mesh must be at least three times larger than the size of the inner mesh. The mesh may be single or double twine, and diamond or square in shape. The hanging ratio must be the same as the mesh size ratio. Hanging ratio shall mean the number of meshes in the circumference of the cod end to the number of meshes in the circumference of the strengthener. The mesh size ratio shall mean the number of inner meshes to the number of outer meshes. The outer mesh may only cover the cod end. No chafing gear may be used with a cod end strengthener.

Exception. Herring seines or purse seines may be transported from one location to another provided a permit is obtained from a fisheries enforcement officer or the state fishery agency.

Method of Measurements. Mesh sizes are measured by a flat wedge-shaped gauge having a taper of 4 cm in 20 cm and a thickness of 2.3 mm, inserted into the meshes under a pressure or pull of 1.90 kg. The mesh size of a net shall be taken to be the average of the measurements of a series of any 20 consecutive meshes, at least 10 meshes from the lacings, and when measured in the cod end of the net beginning at the after end and running parallel to the long axis.

4.1.10 Mechanical "Shaking" Devices (*No changes proposed)*

Mechanical "shakers" have been used to rid smaller shrimp from nets. It shall be unlawful to cull, grade, separate or shake shrimp, aboard any vessel, except by implements operated solely by hand. It is illegal to possess, aboard any vessel, any powered mechanical device used to cull, grade, separate or shake shrimp.

4.1.11 Finfish Excluder Devices (*No changes proposed)*

It shall be unlawful for any vessel rigged for otter trawling, to fish for, land or have in possession northern shrimp except by using trawls equipped with finfish excluder devices approved by the same agency that permits such vessels. Such finfish excluder devices (commonly referred to as the "Nordmore Grate System") shall consist of:

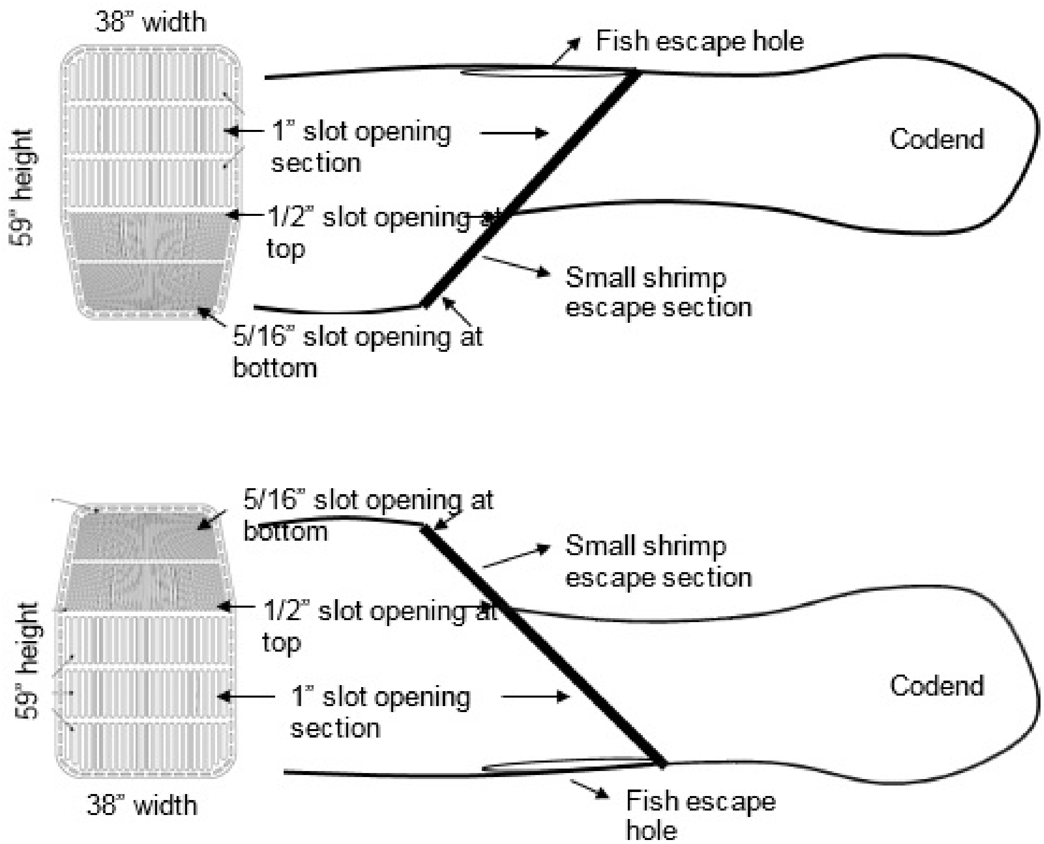
- A rigid or semi-rigid grate consisting of parallel bars attached to the frame with spaces between the bars not to exceed 1 inch in width;
- A fish outlet, or hole, in the extension of the trawl forward of the cod end and grate; and
- A webbing funnel installed in front of the grate designed to direct the catch toward the grate to maximize the retention of the shrimp may be used but may not have mesh less than 1-3/8 inch stretched mesh.
- Vessels fishing in the shrimp fishery may not possess regulated groundfish species.

4.1.12 Size Sorting Grate Systems and Count per Pound Provisions

The Section directed the PDT to explore and develop options to minimize the catch of small, presumably male shrimp, in order to improve resource and fishery sustainability. There is published literature (e.g., He and Balzano 2007) that supports the hypothesis that the double-Nordmore grating system described below minimizes catch of small shrimp. However, the PDT notes that data to support the effectiveness of the compound grate (described below) to minimize catch of small shrimp is limited. The Technical Committee is currently collecting data to explore this hypothesis. Also, count per pound provisions did not garner support from the Advisory Panel, however the PDT discussed that these provisions have proved effective in other count per pound fisheries (e.g., scallops) and, if implemented, could effectively minimize catch of small shrimp and improve sustainability of the resource and fishery. All options explored are included for completeness. Depending on the option selected, Section 4.1.11 and 4.1.12 may be combined into one section.

Compound Grate (See figures below)**:**
The grate is a rigid or semi-rigid planar device referred to as a "Compound Grate" because it has two different sections of parallel or non-parallel bars oriented vertically (up and down). The top section shall be configured as a Finfish Excluder Device and shall consist of parallel bars attached to the frame with spaces between the bars not to exceed 1 inch in width. A fish outlet, or hole, in the extension of the trawl shall exist forward of the cod end and compound grate. The bottom section will allow the escape of small shrimp and will consist of parallel or non-parallel tapered bars oriented up and down with spacing between bars of $^{5}/_{16}$ inch to ½ inch. The lower edge of the cod end will be attached to the grate at the juncture between the top section and the bottom section, creating a shrimp outlet similar to the fish outlet described above, that will allow the escape of shrimp that pass through the bars of the bottom section of the grate. The compound grate also has the following optional provisions:

- This grate may be fished "upside down", that is, with the Finfish Excluder section and outlet on the bottom and the shrimp size separator section and outlet on the top.
- A webbing funnel may be installed in front of the grate designed to direct the catch toward the grate to maximize the retention of the shrimp may be used but may not have mesh less than 1-3/8 inch stretched mesh.



Schematic diagram of the compound size sorting grate to minimize the retention of small shrimp. The top panel diagrams the small shrimp size sorting section of the grate at the bottom (ventral) side of the net. The bottom panel diagrams the small shrimp size sorting section of the grate at the top (dorsal) side of the net.

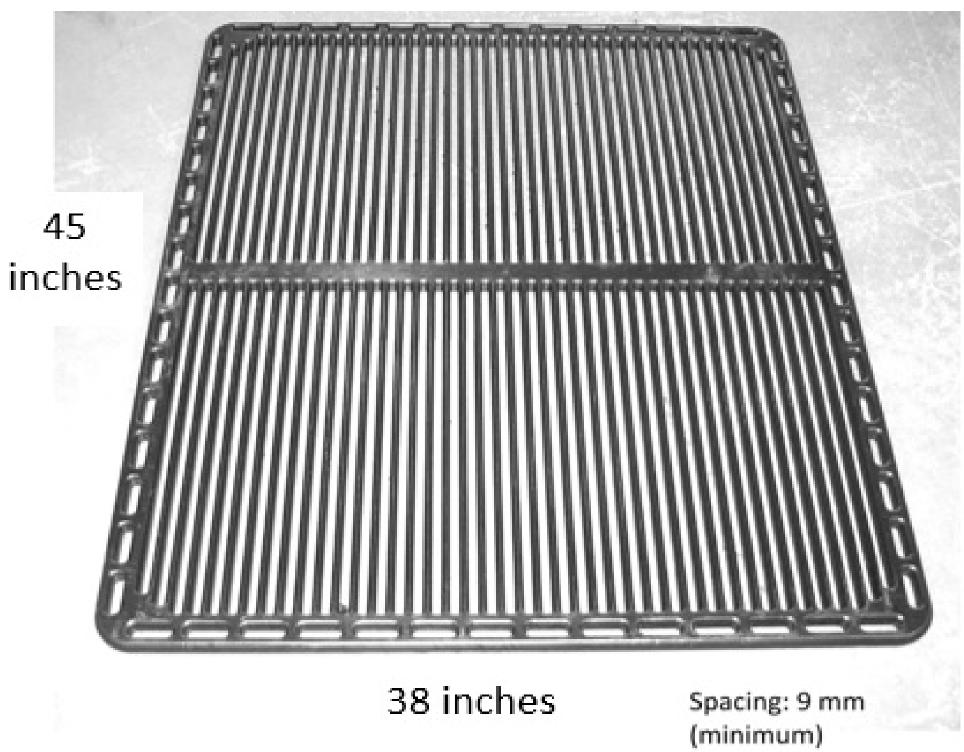
A Double-Nordmore Grate (See figures below)**:**

In this setup there are two separate grates; one of the grates must be a finfish excluder device (commonly referred to as the "Nordmore Grate System") and shall consist of:

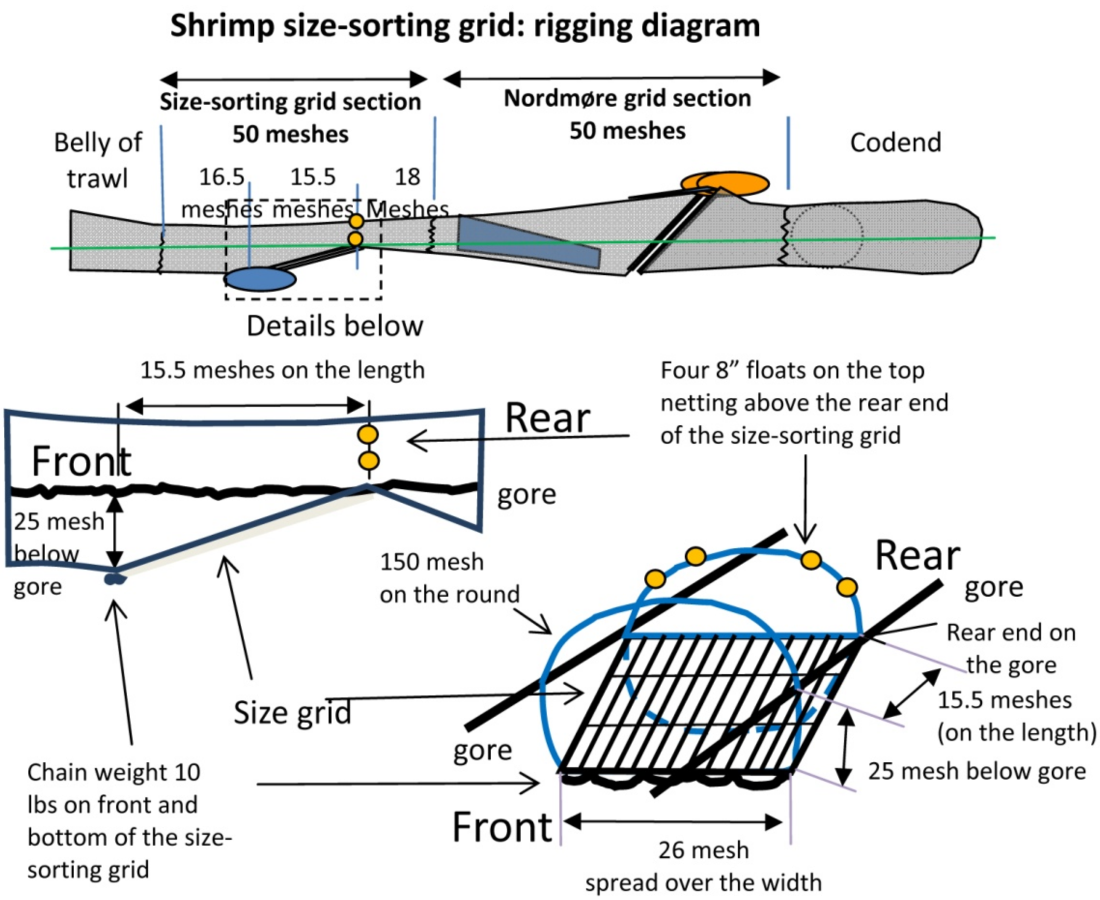
- A rigid or semi-rigid grate consisting of vertical parallel bars attached to the frame with spaces between the bars not to exceed 1 inch in width;
- A fish outlet, or hole, in the extension of the trawl forward of the cod end and grate; and
- A webbing funnel installed in front of the grate designed to direct the catch toward the grate to maximize the retention of the shrimp may be used but may not have mesh less than 1-3/8 inch stretched mesh.
- Vessels fishing in the shrimp fishery shall not be allowed to possess regulated groundfish species.

The second grate may be fished in front or behind the Nordmore grate. The second grate shall consist of:

- A rigid or semi-rigid planar device with vertical bar spacing of 7/16 of an inch (tolerance – must be greater than 5/16 inch but less than ½ inch).
- The exit holes to the cod end must be at the top and no more than 10% of the surface area.
- A funnel in front of the second grate designed to direct the catch toward the grate to maximize the escape of small shrimp may be used but may not have mesh less than 1-3/8 inch stretched mesh.



Recommended size-sorting grate for the double Nordmore grate configuration (He and Balzano 2012).



Shrimp size-sorting grid: rigging diagram (He and Balzano 2012)

Option A: Status Quo

A double-Nordmore grate may be used while fishing for northern shrimp. A double-Nordmore grate is a second grate placed in front or behind the currently required grate, whereby the second grate has the purpose of releasing small shrimp from the net while retaining larger shrimp. Such double-Nordmore grate devices shall consist of:

- A second grate must be 8 feet behind the first grate (tolerance of greater than 6 feet, but less than 10 feet).
- The second grate must be hung at the same orientation as the first grate.
- The space between the bars shall be 7/16 of an inch.
- The exit holes to the cod end must be at the top and no more than 10% of the surface area.
- A funnel in front of the second grate designed to direct the catch toward the grate to maximize the retention of the shrimp may be used but may not have mesh less than 1-3/8 inch stretched mesh.
- A 1-inch mesh panel behind the second grate, 45 degrees down from the top of bars to the bottom of cod end.
- An escape hole in the cod end in front of the 1-inch mesh panel.

Option B: Mandatory use of a size sorting grate system
It shall be unlawful for any vessel rigged for otter trawling to fish for, land, or have in possession, northern shrimp except by using trawls equipped with either a compound grate or a double-Nordmore grate as described above.

Option C. Count per pound provision
It shall be unlawful for any vessel to possess shrimp catch that exceeds any count per pound option selected below. This provision allows for the most flexibility in gear modifications, meaning several different gear configurations could be used to adhere to a count per pound provision.

Sub-option C1: Shrimp count per pound shall not exceed 55. In general, catches that have more than 55 count per pound (but less than 60) are 20-35% males (by count), and 40-45% are less than 22 mm carapace length.
Sub-option C2: Shrimp count per pound shall not exceed 60. In general, catches that have more than 60 count per pound (but less than 65) are 30-40% males (by count), and 45-50% are less than 22 mm carapace length.
Sub-option C3: Shrimp count per pound shall not exceed 65. In general, catches that have more than 65 count per pound are more than 40% males (by count), and more than 50% are less than 22 mm carapace length.

Note: Count per pound can be influenced by gear configuration, location, time of year, migrating behavior and separation between male (small) and female shrimp, the degree of egg hatch, the underlying size composition of the stock, and the abundance of striped shrimp (*P. montagui* and *D. leptocerus*). The table below shows the total number of catches sampled by the states' port sampling programs, and the number and percentages of those catches that had counts more than 55 per pound, more than 60 per pound, and more than 65 per pound, for each state, for the 2008 to 2013 fishing seasons. Note the large differences between states and years.

	Number of catches sampled that were….				Total
		> 55/lb	> 60/lb	> 65/lb	Samples
2008	Maine	19 9%	7 3%	1 0.5%	221
	Massachusetts	7 100%	4 57%	2 28.6%	7
	New Hampshire	5 31%	2 13%	1 6.3%	16
	Total	31 13%	13 5%	4 1.6%	244
2009	Maine	2 1%	2 1%	1 0.7%	144
	Massachusetts				0
	New Hampshire	1 13%	1 13%	1 12.5%	8
	Total	3 2%	3 2%	2 1.3%	152
2010	Maine	15 6%	8 3%	1 0.4%	249
	Massachusetts	2 33%	0 0%	0 0%	6
	New Hampshire	3 27%	1 9%	0 0%	11
	Total	20 8%	9 3%	1 0.4%	266
2011	Maine	17 7%	10 4%	4 1.5%	260
	Massachusetts	9 60%	6 40%	2 13.3%	15
	New Hampshire	3 27%	0 0%	0 0%	11
	Total	29 10%	16 6%	6 2.1%	286
2012	Maine	25 7%	4 1%	1 0.3%	353
	Massachusetts	12 44%	6 22%	1 3.7%	27
	New Hampshire	2 29%	0 0%	0 0%	7
	Total	39 10%	10 3%	2 0.5%	387
2013	Maine	2 2%	2 2%	2 2.0%	99
	Massachusetts	0 0%	0 0%	0 0%	8
	New Hampshire	1 11%	0 0%	0 0%	9
	Total	3 3%	2 2%	2 1.7%	116

4.2 RECREATIONAL FISHERIES MANAGEMENT MEASURES

No management measures are included for the recreational fisheries as this fishery is very limited, is usually carried out with the recreational lobster trap fishery, and is for personnel use.

4.3 HABITAT CONSERVATION AND RESTORATION

4.3.1 Preservation of Existing Habitat

The New England Fishery Management Council's Omnibus Habitat Amendment 2 will be published later this year, and management measures approved by the Council will be implemented following a public comment period, subject to approval by the National Marine Fisheries Service.

In the draft amendment, shrimp traps would not be restricted by any of the alternatives as there appears to have a low impact on habitat. The shrimp fishery, if available in a given year, typically begins on or around December 1, when many shrimp have already hatched their eggs for the breeding season. Therefore, no particular biological impacts are expected if the management alternatives lead to shifts in the distribution of shrimp trawling effort as the seasonality of the shrimp fishery already controls for impacts on shrimp spawning. While the fishery is open access in terms of participation, it is limited by a total allowable catch, which triggers closure of the fishery once harvested. There are also trip limits, trap limits, and days out which control the rate of harvest within the season. However, because shrimp undergo inshore/offshore migrations seasonally, the distribution of shrimp, and therefore shrimp fishing effort relative to habitat management areas, may vary from year to year.

Shrimp trawls are estimated to have an equivalent impact per unit area swept on vulnerable substrates to groundfish and other trawls. However, the fishery is conducted during a short winter season, often four to six weeks depending on how long it takes to catch the annual quota, and effort tends to occur on softer substrates given the distribution of northern shrimp. Although shrimp fishing may cause some damage to these soft sediment habitats, the short season allows for some recovery during the remainder of the year. Based on these considerations, the Council proposes to exempt shrimp trawl gear from bottom trawling restrictions in the northwestern corner of the Western Gulf of Maine Habitat Closure Area. The shrimp exemption area identified in the draft amendment lies west of Jeffreys Ledge in an area historically, although not recently, used by the shrimp fishery.

Additionally, spring and autumn distributions of northern shrimp appear to have a greater dependence on local temperature conditions as opposed to habitat bottom types. An inshore shift is evident in spring when temperatures are coldest; and data from state-federal summer surveys indicate a very strong preference for bottom temperatures between 4-6˚C, the coldest observed range in the survey region at this time of year (Clark *et al.*, 1999). Within this range, the species was found to be most common on fine-grained sediments (Clark et al., 1999). Highest concentrations, however, were clearly defined by the 6˚C isotherm; and to the east of

Cashes Ledge and Jeffreys Bank, where temperatures tended to exceed 6˚C, abundance was observed to decline sharply, even in areas where bottom conditions are favorable.

4.3.2 Habitat Restoration, Improvement, and Enhancement

As indicated previously, temperature appears to be one of the most critical habitat factors in all life stages of northern shrimp.

Changing climate conditions are reshaping ecosystems in ways that affect resources and ecosystem services. With water temperatures in the Gulf of Maine rising at a higher rate (0.03°C per year) than the global mean rate (0.01°C per year) and a clear relationship between northern shrimp population and temperature, habitat restoration may be moot and protection of the remaining population by regulating the fishery may be the only manner to preserve the population with the current climate conditions

4.4 ALTERNATIVE STATE MANAGEMENT REGIMES

Once approved by the Northern Shrimp Section, states are required to obtain prior approval from the Section of any changes to their management program for which a compliance requirement is in effect. Other non-compliance measures must be reported to the Section but may be implemented without prior approval from the Section. A state can request permission to implement an alternative to any mandatory compliance measure only if that state can show to the Section's satisfaction that its alternative proposal will have the same conservation value as the measure contained in this amendment or any addenda prepared under Adaptive Management (*Section 4.5*). States submitting alternative proposals must demonstrate that the proposed action will not contribute to overfishing of the resource. All changes in state plans must be submitted in writing to the Section and to the Commission either as part of the annual FMP Review process or the Annual Compliance Reports.

4.4.1 General Procedures

A state may submit a proposal for a change to its regulatory program or any mandatory compliance measure under this amendment to the Commission, including a proposal for *de minimis* status. Such changes shall be submitted to the Chair of the Plan Review Team, who shall distribute the proposal to the Section, the Plan Review Team, the Technical Committee and the Advisory Panel.

The Plan Review Team is responsible for gathering the comments of the Technical Committee and the Advisory Panel, and presenting these comments as soon as possible to the Section for decision.

The Section will decide whether to approve the state proposal for an alternative management program if it determines that it is consistent with the applicable target fishing mortality rate, and the goals and objectives of this amendment.

4.4.2 Management Program Equivalency

The Northern Shrimp Technical Committee will review any alternative state proposals under this section and provide its evaluation of the adequacy of such proposals to the Section.

4.5 ADAPTIVE MANAGEMENT

The Northern Shrimp Section may vary the requirements specified in this Amendment as a part of adaptive management in order to conserve the northern shrimp resource. The elements that can be modified by adaptive management are listed in Section 4.5.2.2. The process under which adaptive management can occur is provided below.

4.5.1 General Procedures

The Plan Review Team (PRT) will monitor the status of the fishery and the resource and report on that status to the Section annually, or when directed to do so by the Section. The PRT will consult with the Technical Committee and the Advisory Panel in making such review and report. The report will contain recommendations concerning proposed adaptive management revisions to the management program if necessary.

The Section will review the report of the PRT, and may consult further with the Technical Committee or the Advisory Panel. The Section may direct the PRT to prepare the documentation necessary to make any changes to the management program.

Should the Section deem that an addendum to the fishery management plan is necessary, the Plan Development Team (PDT) will prepare a draft addendum and shall distribute it to all states for review and comment. A public hearing will be held in any state that requests one. The PRT will also request comment from federal agencies and the public at large. After a 30-day review period, the PDT will summarize the comments and prepare a final version of the addendum for the Section.

The Section shall review the final version of the addendum prepared by the PDT, and shall also consider the public comments received and the recommendations of the Technical Committee, the Stock Assessment Subcommittee and the Advisory Panel; and shall then decide whether to adopt or revise and adopt the addendum.

Upon adoption of an addendum implementing adaptive management by the Section, states shall prepare proposals in which their plans to carry out the addendum are outlined and submit them to the Section for approval, according to a schedule to be contained in the addendum.

4.5.2 Measures Subject to Change

4.5.2.1 Limited Entry – Control Date

Draft Amendment 3 does not consider limited entry as means of controlling effort in the fishery. However, this amendment maintains the control date of June 7, 2011, established during the development of Amendment 2.

The Section established this control date for in the event that development of a limited entry program through the adaptive management process (refer *Section 4.5.1*) is warranted. The intention of the control date is to notify potential new entrants to the fishery that there is a strong possibility they will be treated differently from participants in the fishery prior to the control date. The Section may use historic landings and/or participation criteria for current and past participants as the limited entry system is established.

4.5.2.2 Measures Subject to Change through Adaptive Management

The following measures are subject to change under adaptive management upon approval by the Northern Shrimp Section. [*If Option B is selected under Section 2.5, including the following: Biological reference points can be changed through Section action (no addendum necessary) per Section 2.5 of this amendment*]:

(1) Biological Reference Points
(2) Rebuilding target and schedule
(3) Gear requirements or prohibitions
(4) Management areas
(5) Harvest set-asides
(6) Limited/controlled entry (including, but not limited to, days-at-sea and ITQs/IFQs and catch shares)
(7) Catch controls (quotas)
(8) Vessel limits
(9) Recommendations to the Secretary of Commerce for complementary action
(10) Research or monitoring requirements
(11) Frequency of stock assessments
(12) Any other management measures included in Amendment 3 that are not subject to annual specification
(13) Vessel monitoring programs

4.6 EMERGENCY PROCEDURES

Emergency procedures may be used by the Northern Shrimp Section to require any emergency action that is not covered by or is an exception or change to any provision in Amendment 3. Procedures for implementation are addressed in the ASMFC ISFMP Charter, Section 6(c)(10) (ASMFC 2016).

4.7 MANAGEMENT INSTITUTIONS

4.7.1 Atlantic States Marine Fisheries Commission and ISFMP Policy Board

The Atlantic States Marine Fisheries Commission and the ISFMP Policy Board are generally responsible for the oversight and management of the Commissions fisheries management activities. The Commission must approve all fishery management plans and amendments thereto, including this Amendment; and make all final determinations concerning state compliance or noncompliance. The ISFMP Policy Board reviews recommendations of the various Management Boards and Sections and, if it concurs, forwards them on to the Commission for action.

4.7.2 Northern Shrimp Section

The Northern Shrimp Section was established by the Commission's ISFMP Policy Board and is generally responsible for carrying out all activities under this Amendment. The Section is represented by appointed members from Maine, New Hampshire, and Massachusetts. Each state's delegation consists of the three representatives (commissioners), including the director of the state's marine fisheries agency, a governor's appointee, and a legislative appointee.

The Section is responsible for the management of the northern shrimp fishery and resource through the development and implementation of the Interstate Fishery Management Plan for Northern Shrimp. This responsibility involves soliciting public participation during the development of plan amendments and addenda, as well as during the annual fishery specification process. The Section establishes and oversees the activities of the Plan Review Team and the Technical Committee and appoints relevant and qualified industry representatives to the Commission's Northern Shrimp Advisory Panel. In addition, the Section adjusts and revises the management program under adaptive management and approves state programs implementing the plan amendments and alternative state programs. The Section reviews the status of state compliance with the FMP at least annually and, if it determines that a state is out of compliance, reports that determination to the ISFMP Policy Board under the terms of the ISFMP Charter.

4.7.3 Northern Shrimp Plan Development/Review Team

The Plan Development Team (PDT) and the Plan Review Team (PRT) are composed of a small group of scientists and managers whose responsibility is to provide all of the staff support necessary to carry out and document the decisions of the Section. The Commission's Northern Shrimp Management Plan Coordinator chairs both teams. The Northern Shrimp PRT is directly responsible to the Section for providing information and documentation concerning the implementation, review, monitoring and enforcement of the FMP. The Northern Shrimp PDT is comprised of personnel from state and federal agencies who have scientific and management ability, and knowledge of northern shrimp. The PDT prepared all documentation necessary for the development of Amendment 3, using the best scientific information available and the most current stock assessment information.

4.7.4 Northern Shrimp Technical Committee

The Northern Shrimp Technical Committee consists of, at a minimum, one representative from each state agency with an interest in the Northern Shrimp fishery and one representative from the National Marine Fisheries Service, and two social scientists. Its role is to act as a liaison to the individual state agencies, providing information to the management process and review and recommendations concerning the management program. The Technical Committee reports to the Section. The Section may appoint additional members to the Technical Committee, as needed.

4.7.5 Northern Shrimp Advisory Panel

Consistent with the Commission's Advisory Committee Charter, the Section appoints industry representatives to serve on the Northern Shrimp Advisory Panel. Members of the Advisory Panel are citizens who represent a cross-section of commercial fishing interests and provide guidance directly to the Section concerning the Commission's northern shrimp management program.

4.8 RECOMMENDATIONS TO THE SECRETARY FOR COMPLEMENTARY ACTIONS IN FEDERAL JURISDICTIONS

The Section may make recommendations to the Secretary of Commerce for complementary action in federal waters through the addendum or amendment process. There is no Federal representation on the Section and the Commission and states manage the fishery through the work of the Section. However, much of the fishery occurs in Federal waters and is prosecuted by fishermen with Federal fishery permits. To address this issue, NOAA Fisheries implemented exemptions to the Federal Northeast Multispecies (groundfish) Fishery to allow Federal groundfish vessels to participate in the small-mesh northern shrimp fishery. Those exemptions, set forth in 50 CFR 648.80(a)(5), allow Federal groundfish vessels to fish with a smaller mesh size when targeting shrimp, than what is allowable for the Multispecies fishery. Participants in the exemption program must also use a Nordmore grate system. Additionally, the exemption sets restrictions on incidental catch of other species such as whiting, hake, and lobster, and restricts participants to shrimping within the seasonal constraints adopted by the Commission.

4.9 COOPERATION WITH OTHER MANAGEMENT INSTITUTIONS

The Section will cooperate, when necessary, with other management institutions during the implementation of this amendment, including the National Marine Fisheries Service and the New England Fishery Management Council. There is no Federal fishery management plan for northern shrimp. Federal regulations exempt Federal groundfish vessels from the groundfish mesh sizes when participating in the shrimp fishery. The exemptions set forth incidental catch restrictions and require the use of a Nordmore grate. See Section 4.8 for additional information.

5.0 COMPLIANCE

Full implementation of the provisions of this amendment is necessary for the management program to be equitable, efficient, and effective. States are expected to implement these measures faithfully under state laws. The ASMFC will continually monitor the effectiveness of state implementation and determine whether states are in compliance with the provisions of this fishery management plan. The Section sets forth specific elements states must implement in order to be in compliance with this fishery management plan and the procedures that will govern the evaluation of compliance. Additional details of the procedures are found in the ASMFC Interstate Fishery Management Program Charter (ASMFC 2016).

5.1 MANDATORY COMPLIANCE ELEMENTS FOR STATES

A state will be determined to be out of compliance with the provision of this fishery management plan according to the terms of Section Seven of the ISFMP Charter if:

- Its regulatory and management programs to implement *Section 4* have not been approved by the Northern Shrimp Section; or
- It fails to meet any schedule required by *Section 5.1.2*, or any addendum prepared under adaptive management (*Section 4.5*); or
- It has failed to implement a change to its program when determined necessary by the Northern Shrimp Section; or
- It makes a change to its regulations required under *Section 4*, or any addendum prepared under adaptive management (*Section 4.5*), without prior approval of the Northern Shrimp Section.

5.1.1 Mandatory Elements of State Programs

To be considered in compliance with this fishery management plan, all state programs must include harvest controls on shrimp fisheries consistent with the requirements listed throughout *Section 4.0*, except that a state may propose an alternative management program under *Section 4.5*, which, if approved by the Section, may be implemented as an alternative regulatory requirement for compliance.

5.1.1.1 Regulatory Requirements

States may begin to implement Amendment 3 after final approval by the Commission. States may not implement any regulatory changes concerning northern shrimp, nor any management program changes that affect their responsibilities under this amendment, without first having those changes approved by the Section.

> [TBD: Regulatory requirements to be set should the draft amendment be approved for implementation.]

5.1.1.2 Monitoring Requirements
To be considered in compliance with this fishery management plan, all state programs must implement monitoring requirements consistent with *Section 3.1.1*.

5.1.1.3 Research Requirements
No mandatory research requirements have been identified at this time. However, elements of state plans may be added to address any needs identified through implementation of Amendment 3.

5.1.1.4 Law Enforcement Requirements
All state programs must include law enforcement capabilities adequate for successfully implementing the jurisdiction's northern shrimp regulations. The adequacy of a state's enforcement activity will be measured by annual report to the ASMFC Law Enforcement Committee and the PRT.

5.1.1.5 Habitat Requirements
No mandatory habitat requirements have been identified at this time. Habitat requirements could be added at any time through adaptive management (*Section 4.5*).

5.1.2 Compliance Schedule
States must implement the provisions of this amendment no later than [MM DD, YYYY; TBD if approved]. States may begin implementation prior to this date when approved by the full Commission.

Each state must submit an annual report concerning its northern shrimp fisheries and management program for the previous calendar year. Reports on compliance must be submitted to the Commission by each state no later than September 30 each year. A standard compliance report format has been prepared and adopted by the ISFMP Policy Board. States should follow the format provided when completing the annual compliance report.

5.2 PROCEDURES FOR DETERMINING COMPLIANCE
Detailed procedures regarding compliance determinations are contained in the ISFMP Charter, Section Seven (ASMFC 2016). The following summary is not meant in any way to replace the language found in the ISFMP Charter.

In brief, all states are responsible for the full and effective implementation and enforcement of fishery management plans in areas subject to their jurisdiction. Written compliance reports as specified in the Plan or Amendment must be submitted annually by each state with a declared interest. Compliance with Amendment 3 will be reviewed at least annually. The Section, Policy Board or the ASMFC may request the PRT to conduct a review of Plan implementation and compliance at any time.

The Northern Shrimp Section will review the written findings of the PRT within 60 days of receipt of a State's compliance report. Should the Section recommend to the Policy Board that a state be determined to be out of compliance, a rationale for the recommended noncompliance finding will be included addressing specifically the required measures of Amendment 3 that the state has not implemented or enforced, a statement of how failure to implement or enforce the required measures jeopardizes northern shrimp conservation, and the actions a state must take in order to comply with Amendment 3 requirements.

The ISFMP Policy Board will review any recommendation of noncompliance from the Northern Shrimp Section within 30 days. If it concurs in the recommendation, it shall recommend at that time to the ASMFC that a state be found out of compliance.

The Commission shall consider any noncompliance recommendation from the ISFMP Policy Board within 30 days. Any state that is the subject of a recommendation for a noncompliance finding is given an opportunity to present written and/or oral testimony concerning whether it should be found out of compliance. If the Commission agrees with the recommendation of the ISFMP Policy Board, it may determine that a state is not in compliance with Amendment 3, and specify the actions the state must take to come into compliance.

Any state that has been determined to be out of compliance may request that the Commission rescind its noncompliance findings, provided the state has revised its northern shrimp conservation measures or shown to the ISFMP Policy Board and/or Commission's satisfaction that actions taken by the state provide for conservation equivalency.

5.3 ANALYSIS OF THE ENFORCEABILITY OF PROPOSED MEASURES

The ASMFC Law Enforcement Committee will, during the implementation of this amendment, analyze the enforceability of new conservation and management measures as they are proposed.

6.0 MANAGEMENT AND RESEARCH NEEDS

6.1 RESEARCH AND DATA NEEDS

Research recommendations from the 58th Northeast Regional Stock Assessment Workshop (58th SAW) are provided below (NEFSC 2014c). In addition to these recommendations, the NSTC emphasizes the importance of continuing the summer shrimp survey despite the current low abundance of shrimp and the closure of the shrimp fishery from 2014 – present.

- Fishery-Dependent Priorities
  - Improve separator and excluder devices to reduce bycatch and discard of non-targeted species and small shrimp in the shrimp fishery and fisheries targeting other species.
  - Evaluate selectivity of shrimp by traps and trawls.
  - Evaluate commercial fishery sampling design. Increase and/or redistribute sampling of commercial catches as necessary, ensuring appropriate allocation of samples among ports and months, to provide better estimates of size composition.

- Continue to quantify the magnitude of bycatch of other species in the shrimp fishery by area and season and take steps necessary to limit negative impacts.
- Better characterize shrimp discards in the shrimp and other small mesh (i.e., herring and whiting) fisheries to provide more accurate estimates of shrimp removals for modeling.
- Continue sea sampling efforts.

- Fishery-Independent Priorities
  - Evaluate effectiveness of summer shrimp survey statistical design, including geographic coverage.
  - Explore ways to sample age-1 and younger shrimp.
  - Verify that summer shrimp survey tow bottom tending times have been consistent.

- Modeling/Quantitative Priorities
  - Continue research to refine annual estimates of consumption by predators, and include in models as appropriate.
  - Explore explicit inclusion of temperature effects in stock assessment models.
  - Expand the time series of stock and recruitment data using catchability estimates from the production model.
  - Continue examination of methods for age determination to develop the possibility of using age based assessment methods.
  - Develop a bio-economic model to study the interactions between four variables: movements of shrimp, catchability of shrimp, days fished, and market price.
  - Continue to examine values of M. Revisit older work that established M=0.25 (Rinaldo 1973, 1976 and Clark 1981, 1982). Estimate M using various existing methods. Investigate annual and life history variation in M and potential causes.
  - The CSA model requires a parameter that is the ratio of catchabilities for the two age or size classes. Sensitivity analysis on the values used would contribute to a better understanding of model stability. A thorough evaluation of possible methods for improved estimation of this parameter could reduce uncertainty in the assessment.

- Life History, Biological, and Habitat Priorities
  - Investigate application of newly developed direct ageing methods to ground truth assumed ages based on size and stage compositions.
  - Evaluate larval and adult survival and growth, including frequency of molting and variation in growth rates, as a function of environmental factors and population density.
  - Study the effects of oceanographic and climatic variation (i.e., North Atlantic Oscillation) on the cold water refuges for shrimp in the Gulf of Maine.
  - Explore the mechanisms behind the stock-recruitment and temperature relationship for Gulf of Maine northern shrimp.
  - Determine the short and long-term effects of mobile fishing gear on shrimp habitat.

- Study specific habitat requirements and develop habitat maps for early life history stages.
- Evaluate effects of potential habitat loss/degradation on northern shrimp.
- Identify migration routes of immature males offshore and ovigerous females inshore.
- Evaluate maturation, fecundity, and lifetime spawning potential. Estimates of fecundity at length should be updated and the potential for annual variability should be explored.
- Examine variability of egg quality with female size and stage over time.
- Investigate changes in transition and maturation as a function of stock size and individual size and temperature.
- Investigate diet of northern shrimp for different life history stages.

- Management, Law Enforcement, and Socioeconomic Priorities
  - Explore new markets for Gulf of Maine shrimp, including community supported fisheries.
  - Develop a framework to aid evaluation of the impact of limited entry proposals on the Maine fishing industry.
  - Characterize demographics of the fishing fleet by area and season. Perform comparative analysis of fishing practices between areas.
  - Develop an understanding of product flow and utilization through the marketplace. Identify performance indicators for various sectors of the shrimp industry. Identify significant variables driving market prices and how their dynamic interactions result in the observed intra-annual and inter-annual fluctuations in market price for northern shrimp.
  - Develop a socioeconomic analysis assessing the importance of the northern shrimp fishery in annual activities of commercial fishing.
  - Determine the relative power relationships between the harvesting and processing sector and the larger markets for shrimp and shrimp products.
  - Develop an economic-management model to determine the most profitable times to fish, how harvest timing affects markets, and how the market affects the timing of harvesting.
  - Perform cost-benefit analyses to evaluate management measures.

7.0 PROTECTED SPECIES

7.1 SPECIES PRESENT IN THE AREA

Numerous protected species inhabit the affected environment within the northern shrimp FMP management unit (Table 6). These species are under NOAA Fisheries jurisdiction and are afforded protection under the Endangered Species Act (ESA) of 1973 and/or the Marine Mammal Protection Act (MMPA) of 1972.

Cusk is a NOAA Fisheries "candidate species" under the ESA. Candidate species are those petitioned species for which NOAA Fisheries has determined that listing may be warranted under the ESA and those species for which NOAA Fisheries has initiated an ESA status review through an announcement in the Federal Register. If a species is proposed for listing the conference provisions under Section 7 of the ESA apply (see 50 CFR 402.10); however, candidate species receive no substantive or procedural protection under the ESA. As a result these species will not be discussed further in this and the following sections; however, NOAA Fisheries recommends that project proponents consider implementing conservation actions to limit the potential for adverse effects on candidate species from any proposed action. Additional information on cusk's candidate listing can be found at http://www.nmfs.noaa.gov/pr/species/esa/candidate.htm.

7.2 SPECIES AND CRITICAL HABITAT NOT LIKELY AFFECTED BY THE PROPOSED ACTION

Based on available information, it has been determined that this action is not likely to affect multiple ESA listed species or any designated critical habitat (Table 6). This determination has been made because either the species (e.g., sea turtles) does not occur in the Gulf of Maine when the fishery operates (i.e., December to May) or there have never been documented interactions between the ESA listed species (e.g., shortnose sturgeon) and the primary gear type (i.e., bottom trawl and trap/pot) used to prosecute the northern shrimp fishery (Epperly et al. 1995a, 1995b, 1995c; Braun-McNeill and Epperly 2002; Morreale and Standora 2005; Griffin et al. 2013; Shoop and Kenney 1992; NOAA Fisheries NEFSC FSB 2015, 2016). In the case of critical habitat, this determination has been made because the action will not affect the essential physical and biological features of North Atlantic right whale critical habitat and therefore, will not result in the destruction or adverse modification to this species' critical habitat (NOAA Fisheries 2015a and 2015b).

7.3 SPECIES POTENTIALLY AFFECTED BY THE PROPOSED ACTION

Table 6 provides a list of marine mammal and fish species present in the affected environment of the northern shrimp fishery, and that may also be affected by the operation of this fishery. Of primary concern is the potential for the fishery to interact (e.g., bycatch, entanglement) with these species. To understand the potential risk of an interaction, it is necessary to consider (1) species occurrence in the affected environment of the fishery and how the fishery will overlap in time and space with this occurrence; and (2) data and observed records of protected species interaction with particular fishing gear types. Information on species occurrence in the affected environment of the northern shrimp fishery is provided in this section, while information on protected species interactions with specific fishery gear is provided in *Section 7.4*.

7.3.1 Marine Mammals

7.3.1.1 Large Whales

As provided in *Section 7.1*, North Atlantic right, humpback, fin, sei, and minke whales will occur in the affected environment of the northern shrimp fishery. In general, these species follow an annual pattern of migration between low latitude (south of 35^{o}N) wintering/calving grounds and high latitude spring/summer foraging grounds (primarily north of 41^{o}N; Waring et al. 2014; Waring et al. 2015; Waring et al. 2016; NOAA Fisheries 1991, 2005, 2010, 2011, 2012). This, however, is a simplification of whale movements, particularly as it relates to winter movements. It remains unknown if all individuals of a population migrate to low latitudes in the winter, although, increasing evidence suggests that for some species (e.g., right and humpback whales) a portion of the population remains in higher latitudes throughout the winter (Waring et al. 2014; Waring et al. 2015; Waring et al. 2016; Khan et al. 2009, 2010, 2011, 2012; Brown et al. 2002; NOAA 2008; Cole et al. 2013; Clapham et al. 1993; Swingle et al. 1993; Vu et al. 2012). Although further research is needed to provide a clearer understanding of large whale movements and distribution in the winter, the distribution and movements of large whales to foraging grounds in the spring/summer is better understood. Movements of whales into higher latitudes coincide with peak productivity in these waters. As a result, the distribution of large whales in higher latitudes is strongly governed by prey availability and distribution, with large numbers of whales coinciding with dense patches of preferred forage (Mayo and Marx 1990; Kenney et al. 1986, 1995; Baumgartner et al. 2003; Baumgartner and Mate 2003; Payne et al.1986, 1990; Brown et al. 2002; Kenney and Hartley 2001; Schilling et al. 1992). For additional information on the biology, status, and distribution of each whale species refer to: Waring et al. 2014; Waring et al. 2015; Waring et al. 2016; NOAA Fisheries 1991, 2005, 2010, 2011, and 2012.

To further assist in understanding how the northern shrimp fishery may overlap in time and space with the occurrence of large whales, a general overview on species occurrence and distribution in the area of operation for the northern shrimp fishery is provided in Table 7.

7.3.1.2 Small Cetacean

Per Table 6, Atlantic white sided dolphins, long- finned pilot whales, short beaked common dolphins, and harbor porpoise will occur in the affected environment of the northern shrimp fishery (Waring et al. 2014; Waring et al. 2015; Waring et al. 2016). Within this range; however, there are seasonal shifts in species distribution and abundance. To further assist in understanding how northern shrimp fishery may overlap in time and space with the occurrence of these small cetaceans, a general overview of species occurrence and distribution in the area of operation for the northern shrimp fishery is provided in Table 8. For additional information on the biology, status, and distribution of each small cetacean species refer to Waring et al. (2014), Waring et al. (2015), and Waring et al. (2016).

7.3.1.3 Pinnipeds

Per Table 6, harbor, gray, harp, and hooded seals will occur in the affected environment of the northern shrimp fishery. Specifically, pinnipeds are found in the nearshore, coastal waters of the Northwest Atlantic Ocean. They are primarily found throughout the year or seasonally from New Jersey to Maine; however, increasing evidence indicates that some species (e.g., harbor seals) may be extending their range seasonally into waters as far south as Cape Hatteras, North Carolina (35oN) (Waring et al. 2007, 2014, 2015, 2016). To further assist in understanding how the northern shrimp fishery may overlap in time and space with the occurrence of pinnipeds, a general overview of pinniped species occurrence and distribution in the area of operation of the northern shrimp fishery is provided in Table 9. For additional information on the biology, status, and distribution of each species of pinniped refer to Waring et al. (2007), Waring et al. (2014), Waring et al. (2015), and Waring et al. (2016).

7.3.2 Atlantic Sturgeon

Table 6 lists the five DPSs of Atlantic sturgeon that occur in the affected environment of the northern shrimp fishery and that may be affected by the operation of this fishery. The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. All five DPSs of Atlantic sturgeon have the potential to be located anywhere in this marine range; in fact, results from genetic studies show that, regardless of location, multiple DPSs can be found at any one location along the Northwest Atlantic coast (ASSRT 2007; Dovel and Berggren 1983; Dadswell et al. 1984; Kynard et al. 2000; Stein et al. 2004a; Dadswell 2006; Laney et al. 2007; Dunton et al. 2010; Dunton et al. 2012; Dunton et al. 2015; Erickson et al. 2011; Wirgin et al. 2012; O'Leary et al. 2014; Waldman et al. 2013; Wirgin et al. 2015a and 2015b).

Based on fishery-independent and -dependent data, as well as data collected from tracking and tagging studies, Atlantic sturgeon appear to primarily occur inshore of the 50-meter depth contour (Stein et al. 2004a and 2004b; Erickson et al. 2011; Dunton et al. 2010); however, Atlantic sturgeon are not restricted to these depths, as excursions into deeper continental shelf waters have been documented (Timoshkin 1968; Collins and Smith 1997; Stein et al. 2004a and 2004b; Dunton et al. 2010; Erickson et al. 2011). Data from fishery-independent surveys and tagging and tracking studies also indicate that Atlantic sturgeon undertake seasonal movements along the coast. For instance, satellite-tagged adult sturgeon from the Hudson River are found to have concentrated in the southern part of the Mid-Atlantic Bight, at depths greater than 20 meters, during winter and spring, while in the summer and fall, Atlantic sturgeon concentrations shifted to the northern portion of the Mid-Atlantic Bight at depths less than 20 meters (Erickson et al. 2011). A similar seasonal trend was found by Dunton et al. 2010. Analysis of fishery-independent survey data indicated a coastwide distribution of Atlantic sturgeon during the spring and fall; a southerly (e.g., North Carolina, Virginia) distribution during the winter; and a centrally located (e.g., Long Island to Delaware) distribution during the summer. Although studies such as Erickson et al. (2011) and Dunton et al. (2010) provide some indication that Atlantic sturgeon are undertaking seasonal movements horizontally and vertically along the U.S. eastern coastline, there is no evidence to date that all Atlantic sturgeon make these seasonal movements. For instance, during inshore surveys conducted by the Northeast Fisheries Science Center in the Gulf of Maine, Atlantic sturgeon have been caught in the fall, winter, and spring between the Saco and Kennebec Rivers (Dunton et al. 2010; Wipplehauser 2012).

Within the marine range of Atlantic sturgeon, several marine aggregation areas have been identified adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard. Depths in these areas are generally no greater than 25 meters (Stein et al. 2004a; Laney et al. 2007; Dunton et al. 2010; Erickson et al. 2011). Although additional studies are still needed to clarify why these particular sites are chosen by Atlantic sturgeon, there is some indication that they may serve as thermal refuges, wintering sites, or marine foraging areas (Stein et al. 2004a; Dunton et al. 2010; Erickson et al. 2011). The following are the currently known marine aggregation sites located within the operational range of the northern shrimp fishery:

- Massachusetts Bay (Stein et al. 2004a);
- and Kennebec River Estuary (Wipplehauser 2012; Whipplehauser and Squiers 2015)

In addition, since listing of the five Atlantic sturgeon DPSs, numerous genetic studies have addressed DPS distribution and composition in marine waters of the Northwest Atlantic (e.g., Wirgin et al. 2012; Wirgin et al. 2015a and 2015b; Waldman et al. 2013; O'Leary et al. 2014; Dunton et al. 2012)[1]. These studies show that Atlantic sturgeon from multiple DPSs can be found at any single location along the Northwest Atlantic coast, with the Mid-Atlantic locations consistently comprised of all five DPSs (Wirgin et al. 2012; Wirgin et al. 2015a,b;Waldman et al. 2013; O'Leary et al. 2014; Dunton et al. 2012; Damon-Randall et al. 2013). Although additional studies are needed to further clarify the DPS distribution and composition in non-natal estuaries and coastal locations, these studies provide some initial insight on DPS distribution and co-occurrence in particular areas along the U.S. eastern seaboard.

7.3.3 Atlantic Salmon (Gulf of Maine DPS)

The wild populations of Atlantic salmon are listed as endangered under the ESA. Their freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, while the marine range of the GOM DPS extends from the GOM (primarily northern portion of the GOM), to the coast of Greenland (Fay et al. 2006; NOAA Fisheries & USFWS 2005). In general, smolts, post-smolts, and adult Atlantic salmon may be present in the GOM and coastal waters of Maine in the spring (beginning in April), and adults may be present throughout the summer and fall months (Baum 1997; Fay et al. 2006; Hyvarinen et al. 2006; Lacroix & Knox 2005; Lacroix & McCurdy 1996; Lacroix et al. 2004; NOAA Fisheries & USFWS 2005; Reddin 1985; Reddin & Friedland 1993; Reddin & Short 1991). For additional information on the on the biology, status, and distribution of the GOM DPS of Atlantic salmon, refer to NOAA Fisheries and USFWS (2005) and Fay et al. (2006). Based on the above information, as the northern shrimp fishery operates in the GOM, it is possible that the fishery will overlap in time and space with Atlantic salmon migrating northeasterly between U.S. and Canadian waters.

7.4 INTERACTIONS BETWEEN GEAR AND PROTECTED RESOURCES

Protected species described in *Section 7.1* are all known to be vulnerable to interactions with various types of fishing gear. Available information on gear interactions with a given species (or species group) is provided in the sections below. These sections are not a comprehensive review of all fishing gear types known to interact with a given species; emphasis is only being placed on the primary gear types used to prosecute the northern shrimp fishery (i.e., bottom trawl gear and trap/pot).

[1] Genetic studies did not sample Atlantic sturgeon south of North Carolina.

7.4.1 Marine Mammals

Depending on species, marine mammals have been observed seriously injured or killed in bottom trawl and/or trap/pot gear. Pursuant to the MMPA, NOAA Fisheries publishes a List of Fisheries (LOF) annually, classifying U.S. commercial fisheries into one of three categories based on the relative frequency of incidental serious injuries and/or mortalities of marine mammals in each fishery (i.e., Category I=frequent; Category II=occasional; Category III=remote likelihood or no known interactions; 82 FR 3655 (January 12, 2017)). In the Northwest Atlantic, the 2017 MMPA LOF (82 FR 3655 (January 12, 2017) categorizes commercial northeast bottom trawl and Atlantic mixed species trap/pot fisheries as Category II fisheries[2].

7.4.1.1 Large Cetaceans

Bottom Trawl Gear

With the exception of minke whales, there have been no observed interactions with large whales and bottom trawl gear. To date, bottom trawl interactions with minke whales have only been observed in the MMPA LOF Category II northeast bottom trawl fisheries. From the period of 2008-2012, the estimated annual mortality attributed to this fishery was 7.8 minke whales for 2008, and zero minke whales from 2009-2012; no serious injuries were reported during this time (Waring et al. 2015). Based on this information, from 2008-2012, the estimated annual average minke whale mortality and serious injury attributed to the northeast bottom trawl fishery was 1.6 (CV=0.69) whales (Waring et al. 2015). Lyssikatos (2015) estimated that from 2008-2013, mean annual serious injuries and mortalities from the northeast bottom trawl fishery were 1.40 (CV=0.58) minke whales. Based on this information, bottom trawl gear is likely to pose a low interaction risk to any large whale species. However, should an interaction with a large whale occur, serious injury or mortality is possible.

Fixed Fishing Gear (e.g., Trap/Pot Gear)

The greatest entanglement risk to large whales is posed by fixed fishing gear (e.g., sink gillnet and trap/pot gear) comprised of lines (vertical or ground) that rise into the water column. Any line can become entangled in the mouth (baleen), flippers, and/or tail of the whale when the animal is transiting or foraging through the water column (Johnson et al. 2005; NOAA Fisheries 2014; Kenney and Hartley 2001; Hartley et al. 2003; Whittingham et al. 2005a and 2005b). For instance, in a study of right and humpback whale entanglements, Johnson et al. (2005) attributed: (1) 89% of entanglement cases, where gear could be identified, to fixed gear consisting of pot and gillnets and (2) entanglement of one or more body parts of large whales (e.g., mouth and/or tail regions) to four different types of line associated with fixed gear (the buoy line, groundline, floatline, and surface system lines)[3]. Although available data, such as

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[2] Atlantic mixed species trap/pot fisheries include, but are not limited to: crab (red, Jonah, and rock), hagfish, finfish (black sea bass, scup, tautog, cod, haddock, pollock, redfish (ocean perch), and white hake), conch/whelk, and shrimp

[3] Buoy line connects the gear at the bottom to the surface system. Groundline in trap/pot gear connects traps/pots to each other to form trawls; in gillnet gear, groundline connects a gillnet or gillnet bridle to an anchor or buoy line. Floatline is the portion of gillnet gear from which the

Johnson et al. (2005), provides insight into large whale entanglement risks with fixed fishing gear, to date, due to uncertainties surrounding the nature of the entanglement event, as well as unknown biases associated with reporting effort and the lack of information about the types and amounts of gear being used, determining which part of fixed gear creates the most entanglement risk for large whales is difficult (Johnson et al. 2005). As a result, any type or part of fixed gear is considered to create an entanglement risk to large whales and should be considered potentially dangerous to large whale species (Johnson et al. 2005).

The effects of entanglement to large whales range from no injury to death (NOAA Fisheries 2014; Johnson et al. 2005; Angliss and Demaster 1998; Moore and Van der Hoop 2012). The risk of injury or death in the event of an entanglement may depend on the characteristics of the whale involved (species, size, age, health, etc.), the nature of the gear (e.g., whether the gear incorporates weak links designed to help an entangled whale break free), human intervention (e.g., the feasibility or success of disentanglement efforts), or other variables (NOAA Fisheries 2014). Although the interrelationships among these factors are not fully understood, and the data needed to provide a more complete characterization of risk are not available, to date, available data indicates that entanglement in fixed fishing gear is a significant source of serious injury or mortality for Atlantic large whales (Table 10; Henry et al. 2016; Waring et al. 2016).

Table 10 summarizes confirmed human-caused injury and mortality to humpback, fin, sei, minke, and North Atlantic right whales along the Gulf of Mexico Coast, U.S. East Coast, and Atlantic Canadian Provinces from 2010 to 2014 (Henry et al. 2016); it is specific to confirmed injury or mortality to whales from entanglement in fishing gear. As many entanglement events go unobserved, and because the gear type, fishery, and/or country of origin for reported entanglement events are often not traceable, the information presented in Table 10 likely underestimates the rate of large whale serious injury and mortality due to entanglement. Studies looking at scar rates for right whales and humpbacks suggests that entanglements may be occurring more frequently than the observed incidences indicate (NOAA Fisheries 2014; Robbins 2009; Knowlton et al. 2012).

As noted in *Section 7.4.1*, pursuant to the MMPA, NOAA Fisheries publishes a LOF annually, classifying U.S. commercial fisheries into one of three categories based on the relative frequency of incidental serious injurious and mortalities of marine mammals in each fishery. Large whales, in particular, humpback, fin, minke, and North Atlantic right whales, are known to interact with Category I and II fisheries in the (Northwest) Atlantic Ocean. As Sei, fin, and North Atlantic right whales are listed as endangered under the ESA, these species are considered strategic stocks under the MMPA (see Table 6). Section 118(f)(1) of the MMPA requires the preparation and implementation of a Take Reduction Plan (TRP) for any strategic marine mammal stock that interacts with Category I or II fisheries. In response to its obligations under the MMPA, in 1996, NOAA Fisheries established the Atlantic Large Whale Take Reduction Team

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mesh portion of the net is hung. The surface system includes buoys and high-flyers, as well as the lines that connect these components to the buoy line.

(ALWTRT) to develop a plan (Atlantic Large Whale Take Reduction Plan (ALWTRP or Plan)) to reduce serious injury to, or mortality of large whales, specifically, humpback, fin, and North Atlantic right whales, due to incidental entanglement in U.S. commercial fishing gear[4]. In 1997, the ALWTRP was implemented; however, since 1997, the Plan has been modified; recent adjustments include the Sinking Groundline Rule and Vertical Line Rules (72 FR 57104, October 5, 2007; 79 FR 36586, June 27, 2014; 79 FR 73848, December 12, 2014; 80 FR 14345, March 19, 2015; 80 FR 30367, May 28, 2015).

The Plan consists of regulatory (e.g., universal gear requirements, modifications, and requirements; area- and season- specific gear modification requirements and restrictions; time/area closures) and non-regulatory measures (e.g., gear research and development, disentanglement, education and outreach) that, in combination, seek to assist in the recovery of North Atlantic right, humpback, and fin whales by addressing and mitigating the risk of entanglement in gear employed by commercial fisheries, specifically trap/pot and gillnet fisheries (http://www.greateratlantic.fisheries.noaa.gov/Protected/whaletrp/; 73 FR 51228; 79 FR 36586; 79 FR 73848; 80 FR 14345; 80 FR 30367). The Plan recognizes trap/pot and gillnet Management Areas in Northeast, Mid-Atlantic, and Southeast regions of the U.S, and identifies gear modification requirements and restrictions for Category I and II gillnet and trap/pot fisheries in these regions; these Category I and II fisheries must comply with all regulations of the Plan.

7.4.1.2 Small Cetaceans and Pinnipeds

Bottom Trawl Gear

Small cetaceans and pinnipeds are vulnerable to interactions with bottom trawl gear. Species that have been observed incidentally injured and/or killed by MMPA Category II (occasional interactions) northeast bottom trawl fishery are provided in Table 11 (Waring et al. 2014; Waring et al. 2015; Waring et al. 2016; 82 FR 3655 (January 12, 2017)). Of the marine mammal species listed, short-beaked common dolphins and Atlantic white-sided dolphins are the most frequently observed bycatch in the northeast bottom trawl gear, followed by gray seals, long-finned pilot whales, and Risso's dolphins (Lyssikatos 2015).

In 2006, the Atlantic Trawl Gear Take Reduction Team (ATGTRT) convened to address the incidental mortality and serious injury of long-finned pilot whales (*Globicephala melas*), short-finned pilot whales (*Globicephala macrorhynchus*), common dolphins (*Delphinus delphis*), and white sided dolphins (*Lagenorhynchus acutus*) with bottom and mid-water trawl fisheries operating in both the Northeast and Mid-Atlantic regions. Because none of the marine mammal stocks of concern to the ATGTRT are classified as a "strategic stock," nor do they currently interact with a Category I fishery, it was determined at the time that development of a take reduction plan was not necessary.

[4] The measures identified in the ALWTRP are also beneficial to the survival of the minke whale, which are also known to be incidentally taken in commercial fishing gear.

In lieu of a take reduction plan, the ATGTRT agreed to develop strategies (ATGTRS) to provide the basis for decreasing mortalities and serious injuries of marine mammals to insignificant levels approaching zero mortality and serious injury rates. The ATGTRS identifies informational and research tasks, as well as education and outreach needs the ATGTRT believes are necessary. The ATGTRS also identifies several potential voluntary measures that can be adopted by certain trawl fishing sectors to potentially reduce the incidental capture of marine mammals.

Pot/Trap Gear

Over the past several years, observer coverage has been limited for fisheries prosecuted with trap/pot gear. In the absence of extensive observer data for these fisheries, stranding data provides the next best source of information on species interactions with trap/pot gear. Based on a review of stranding data for small cetacean and pinniped species provided in *Section 7.1*, there are no reports of trap/pot interactions or incidences of serious injury or mortality caused by pot/trap gear with small cetaceans and pinnipeds (see http://www.nmfs.noaa.gov for more information). As a result, trap pot gear is not expected to pose an interaction risk to these species. However, it is important to note, stranding data underestimates the extent of human-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in human interactions are discovered, reported, or show signs of entanglement. Additionally, if gear is present, it is often difficult to definitively attribute the animal's death to the gear interaction, or if pieces of gear are absent, attribute the death or serious injury to a specific fishery or fishing gear type. As a result, these conclusions should be taken with these considerations in mind, and with an understanding that interactions may occur more frequently than what we are able to detect at this time.

7.4.2 Atlantic Sturgeon

Bottom Trawl Gear

Atlantic sturgeon are known to interact with bottom trawl gear and in fact, since 1989, have been observed in bottom otter trawl gear where the primary species being targeted was Northern shrimp (NOAA Fisheries NEFSC FSB 2015, 2016). To understand the interaction risk between bottom otter trawls and Atlantic sturgeon, there are three documents that use data collected by the Northeast Fisheries Observer Program (NEFOP) to describe bycatch of Atlantic sturgeon in bottom otter trawl and sink gillnet gears: Stein et al. (2004b); ASMFC (2007); and Miller and Shepard (2011); none of these provide estimates of Atlantic sturgeon bycatch by DPS. Information provided in all three documents indicate that sturgeon bycatch occurs in bottom otter trawl gear, with the most recent document estimating, based on fishery observer data and Vessel Trip Report data from 2006-2010, that annual bycatch of Atlantic sturgeon is 1,342 animals (Miller and Shepard 2011; NOAA Fisheries 2013). Specifically, Miller and Shepard (2011) observed Atlantic sturgeon interactions in trawl gear with small (< 5.5 inches) and large (≥ 5.5 inches) mesh sizes. Although Atlantic sturgeon were observed to interact with trawl gear with various mesh sizes, based on observer data, Miller and Shepard (2011) concluded that of the possible fishing gear types, in general, trawl gear posed less of a mortality risk to Atlantic sturgeon than gillnet gear (i.e., estimated mortality rates in gillnet gear were 20.0%, while those in otter trawl gear were 5.0%); similar conclusions were reached in Stein et al. (2004b) and ASMFC (2007). However, although Atlantic sturgeon deaths have rarely been reported in bottom otter trawl gear (ASMFC 2007), it is important to recognize that effects of an interaction may occur long after the interaction and therefore, until additional studies are conducted, it remains uncertain what the overall impacts to Atlantic sturgeon survival are from trawl interactions (Beardsall et al. 2013). As a result, trawls should not be completely discounted as a form of gear that poses a mortality risk to Atlantic sturgeon. Further, even if an animal is released alive, pursuant to the ESA, any Atlantic sturgeon interaction with fishing gear is considered take.

Pot/Trap Gear:
To date, there have been no observed/documented interactions with Atlantic sturgeon and trap/pot gear (NOAA Fisheries NEFSC FSB 2015, 2016). Based on this information, trap/pot gear is not expected to pose an interaction risk to any Atlantic sturgeon.

7.4.3 Atlantic Salmon

Bottom Trawl Gear
According to the Biological Opinion issued by NOAA Fisheries Greater Atlantic Regional Fisheries Office on December 16, 2013, NOAA Fisheries Northeast Fisheries Science Center's (NEFSC) Northeast Fisheries Observer and At-Sea Monitoring Programs documented a total of 15 individual salmon incidentally caught on 60,000 observed commercial fishing trips from 1989 through August 2013 (NOAA Fisheries 2013; Kocik et al. 2014). Specifically, Atlantic salmon were an observed bycatch in gillnet and bottom otter trawl gear, with 10 of the incidentally caught salmon listed as "discarded" and five reported as mortalities (Kocik (NEFSC), personal communication (February 11, 2013)[5]. Since 2013, no additional Atlantic salmon have been observed in gillnet or bottom trawl (NOAA Fisheries NEFSC FSB 2015 and 2016). Therefore, the very low number of observed Atlantic salmon interactions in trawl gear over the past 26 years, suggests that interactions with Atlantic salmon are rare events (NOAA Fisheries 2013; Kocik et al. 2014).

Pot/Trap Gear
To date, there have been no observed/documented interactions with Atlantic salmon and trap/pot gear (NOAA Fisheries NEFSC FSB 2015, 2016). Therefore, trap/pot gear is not expected to pose an interaction risk to Atlantic salmon.

[5] The genetic identity of the 15 captured salmon is unknown; however, the NOAA Fisheries 2013 Biological Opinion considers all 15 fish to be part of the GOM Distinct Population Segment, although some may have originated from the Connecticut River restocking program (i.e., those caught south of Cape Cod, Massachusetts).

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9.0 TABLES AND FIGURES

TABLES

Table 1. Management of the Gulf of Maine Northern Shrimp Resource, 1973 – 2017.

NORTHERN SHRIMP SECTION ACTION TAKEN	
1973	Provisions for gear evaluation Establishment of studies
1974	Adoption of interim minimum mesh size regulation requiring use of trawls with stretched mesh sizes of not less than 38 mm (1.5 inches) in the body and 44.5 mm (1.75 in) in the cod end.
1975	Establishment of regulations requiring use of trawls with stretched mesh sizes of not less than 44.5 mm (1.75 inches) in the body and cod end (effective October, 1975) Closure of the fishery from July – September, 1975.
1976	Open season from January 1 – May 15, 1976, followed by indefinite closure. Continuation of mesh regulations.
1977	Open season from January 1 – May 15, 1977, followed by indefinite closure. Restrictions of 1977 harvest to 1,600 mt (3.5 million lbs) Continuation of mesh regulations.
1978	Continuation of closure through 1978.
1979	Open season from February 1 – March 31, 1979, followed by indefinite closure. Continuation of mesh regulations.
1980	Open season from February 15 – May 31, 1980, followed by indefinite closure. Continuation of mesh regulations.
1981	Open season from January 1 – May 15, 1981, followed by indefinite closure. Continuations of mesh regulations.
1982	Open season from January 1 – April 15, 1982. Continuation of mesh regulations.
1983	Open season December 15, 1982 – April 30, 1983 with possible 15 day extension with 70 count size limit. Continuation of mesh regulations.

NORTHERN SHRIMP SECTION ACTION TAKEN	
1984	Open season December 15, 1983 – April 30, 1984 with a possible extension of 15 days or until count exceeds 70/pound for any one trip. Continuation of mesh regulations.
1985	Open season December 1, 1984 – May 15, 1985. During May, landed count shall not exceed 70/pound or season closed immediately. Continuation of mesh regulations.
1986	Open season December 1, 1985 – May 31, 1986. Continuation of mesh regulations. Two week emergency opening June 8 – June 21 with 70 count maximum.
1987	Open season December 1, 1986 – May 31, 1987. Continuation of mesh regulations. Eliminate mesh size tolerance (1/4 Inch) in cod end by 1988 season.
1988	Full season. December 1, 1987 – May 31, 1988. 1-3/4 inch mesh required, 1/8 inch tolerance in body and wings, 2 inch mesh in cod end in April and May, 1988.
1989	Full season. December 1, 1988 – May 31, 1989. 1/8 inch tolerance in net, no tolerance in cod end. Approved separator trawl used in April and May, 1989.
1990	Full season. December 1, 1989 – May 31, 1990. 1-3/4 inch mesh net with no tolerance. Approved separator trawl must be used December, April and May.
1991	Full season. December 1, 1990 – May 31, 1991. 1-3/4 inch mesh net, separator panel must be 11 inch mesh, quarter to quarter.
1992	Season December 16, 1991 – May 15, 1992. 1-3/4 inch mesh net. No Sunday fishing. Separator trawl December 16, 1991 through March 31, 1992. Nordmore grate April 1, 1992 – May 15, 1992.
1993	Season December 14, 1992 – April 30, 1993. 1-3/4 inch mesh net. No Sunday fishing. Nordmore grate and 11 inch panel required. Exemption to Nordmore grate January – March if bycatch proven to be low.

NORTHERN SHRIMP SECTION ACTION TAKEN	
1994	Season December 1, 1993 – April 15, 1994. 1-3/4 inch mesh net. 15 fathom bare wire bottom legs. Nordmore grate all season, no exemptions. (122 days)
1995	Season December 1, 1994 – April 30, 1995. 1-3/4 inch mesh net. 15 Fathom bare wire bottom legs. Nordmore grate all season, no exemptions. No fishing on Sunday (or Friday as substitute). (128 days)
1996	Full season with one day/week off. Also, trappers to start January 1, 1996. (Review of effort at mid-season?) (152 days)
1997	Season December 1, 1996 – May 27, 1997 with two 5-day and four 4-day blocks off. (156 days)
1998	Season December 8 – 24, 1997; January 1, 1998 – March 15, 1998; April 1, 1998 – May 22, 1998 with weekends off. (105 days)
1999	Season December 15 – 23, January 4 - 26, February 1 – 23, March 1 – 16, April 1 – 28, May 2 – 25 with weekends off. (90 days)
2000	Season January 17, 2000 – March 15, 2000. (59 days)
2001	Season January 9– March 17, 2001, April 16 – 30, 2001. (83 days)
2002	Season February 15 – March 11, 2002. (25 days)
2003	Season January 19 – March 12, 2003 with Saturdays and Sundays off. (38 days)
2004	Season January 19 – March 12, 2004 with Saturdays and Sundays off. (40 days)
2005	Season December 19 – 23, 2004; December 26 – 30, 2004 with Friday and Saturdays off; and January 3 – March 25, 2005, with Saturdays and Sundays off. (70 days)
2006	Season December 12, 2005– April 30, 2006. (140 days)

NORTHERN SHRIMP SECTION ACTION TAKEN	
2007	Season December 1, 2006– April 30, 2007. (151 days)
2008	Season December 1, 2007– April 30, 2008. (152 days)
2009	Season December 12, 2008– May 29, 2009. (180 days)
2010	Season December 1, 2009– May 5, 2010* (156 days) *Emergency action taken to close the fishery 24 days early
2011	Season December 1, 2010– February 28, 2011* (90 days) *Emergency action taken to close the fishery 46 days early. TAC set at 4,000 mt.
2012	Trawlers begin January 2 with three landings day per week and trappers begin on February 1 with a 1,000 pounds limit per vessel per day. TAC set at 2,211 mt. *Emergency action taken to close the fishery on February 17
2013	TAC set at 625 mt and allocated 87% to the trawl fishery and 13% to the trap fishery (with 5.44 mt set aside for RSA) and would close when 85% of the TAC in each fishery closed.
2014	Moratorium due to stock collapse; Maine DMR contracted one shrimp trawler to collect samples during the winter
2015	Moratorium; 25 mt RSA for cooperative winter sampling program Four trawlers with a 1,800 lbs/trip limit (sale of catch permitted); five trappers with 10 trap and 100 lbs/week limit (sale of catch not permitted)
2016	Moratorium; 22 mt RSA for cooperative winter sampling program Four trawlers with a 1,800 lbs/trip limit and two trappers with a 40 traps and 600 lbs/week limit. Sale of catch permitted for both trappers and trawlers.
2017	Moratorium; 53 mt RSA for winter sampling 10 trawlers fishing one trip/week for 8 consecutive weeks and a 1,200 lbs/trip limit; five trappers fishing for 8 consecutive weeks with a 500 lbs/week limit and 40 trap limit per vessel

Table 2: U.S. commercial landings (mt) of northern shrimp in the Gulf of Maine, by year (1958–1984, left) or by season (1985–2016, right). Landings by season include the previous December. No shrimp were sold or purchased from cooperative winter sampling in 2014. Landings in 2015 and 2016 are from the RSA Program.

Year	Maine	Mass.	New Hamp.	Total
1958	2.2	0.0	0.0	2.2
1959	5.5	2.3	0.0	7.8
1960	40.4	0.5	0.0	40.9
1961	30.5	0.3	0.0	30.8
1962	159.5	16.2	0.0	175.7
1963	244.3	10.4	0.0	254.7
1964	419.4	3.1	0.0	422.5
1965	941.3	8.0	0.0	949.3
1966	1,737.8	10.5	18.1	1,766.4
1967	3,141.2	10.0	20.0	3,171.2
1968	6,515.2	51.9	43.1	6,610.2
1969	10,993.1	1,773.1	58.1	12,824.3
1970	7,712.8	2,902.3	54.4	10,669.5
1971	8,354.8	2,724.0	50.8	11,129.6
1972	7,515.6	3,504.6	74.8	11,095.0
1973	5,476.6	3,868.2	59.9	9,404.7
1974	4,430.7	3,477.3	36.7	7,944.7
1975	3,177.2	2,080.0	29.4	5,286.6
1976	617.3	397.8	7.3	1,022.4
1977	142.1	236.9	2.2	381.2
1978	0.0	3.3	0.0	3.3
1979	32.8	405.9	0.0	438.7
1980	69.6	256.9	6.3	332.8
1981	530.0	539.4	4.5	1,073.9
1982	883.0	658.5	32.8	1,574.3
1983	1,029.2	508.2	36.5	1,573.9
1984	2,564.7	565.4	96.8	3,226.9

* Landings by Season include the previous December.

*Season	Maine	Mass.	New Hamp.	Total
1985	2,946.4	968.8	216.7	4,131.9
1986	3,268.2	1,136.3	230.5	4,635.0
1987	3,680.2	1,427.9	157.9	5,266.0
1988	2,258.4	619.6	157.6	3,035.6
1989	2,384.0	699.9	231.5	3,315.4
1990	3,236.3	974.9	451.3	4,662.5
1991	2,488.6	814.6	282.1	3,585.3
1992	3,070.6	289.3	100.1	3,460.0
1993	1,492.5	292.8	357.6	2,142.9
1994	2,239.7	247.5	428.0	2,915.2
1995	5,013.7	670.1	772.8	6,456.6
1996	8,107.1	660.6	771.7	9,539.4
1997	6,086.9	366.4	666.2	7,119.5
1998	3,481.3	240.3	445.2	4,166.8
1999	1,573.2	75.7	217.0	1,865.9
2000	2,516.2	124.1	214.7	2,855.0
2001	1,075.2	49.4	206.4	1,331.0
2002	391.6	8.1	53.0	452.7
2003	1,203.7	27.7	113.0	1,344.4
2004	1,926.9	21.3	183.2	2,131.4
2005	2,270.2	49.6	290.3	2,610.1
2006	2,201.6	30.0	91.1	2,322.7
2007	4,469.3	27.5	382.9	4,879.7
2008	4,515.8	29.9	416.8	4,962.4
2009	2,315.7	MA & NH:	185.6	2,501.3
2010	5,721.4	35.1	506.8	6,263.3
2011	5,569.7	196.4	631.5	6,397.5
2012	2,219.9	77.8	187.8	2,485.4
2013	289.7	18.9	36.9	345.5
2014	0.0	0.0	0.0	0.0
2015	6.1	0.6	0.0	6.7
2016	11.5	0.0	1.8	13.3

Table 3: Stratified geometric mean number (abundance) and weight (biomass, kg) per tow and derived indices of northern shrimp from summer shrimp surveys (strata 1, 3, 5, 6, 7 and 8). Recruit index is abundance of presumed age 1.5 shrimp. Other derived indices are described in text. YC=year class, EPI=egg production index.

Year	N Tows	Total Abundance	Total Biomass	Recruit Index	Spawner Biomass	EPI millions	YC Survival index	>22 mm* Number	>22 mm Weight (kg)
1984	37	1,152	10.5	18	3.6	0.72		316	3.4
1985	44	1,825	17.7	332	5.7	1.19	496	1,169	11.5
1986	40	1,695	19.6	358	7.2	1.48	287	860	10.0
1987	41	1,533	15.4	342	6.2	1.25	559	854	9.5
1988	41	1,269	12.8	828	2.5	0.52	222	298	3.4
1989	43	1,884	17.0	276	5.0	1.01	274	564	6.1
1990	43	1,623	18.1	142	6.0	1.25	476	1,127	12.0
1991	43	1,256	11.7	482	6.5	1.34	226	657	8.0
1992	45	955	9.4	282	4.3	0.85	565	397	4.8
1993	46	1,157	9.1	757	2.2	0.44	431	250	2.8
1994	43	984	8.7	368	2.3	0.46	664	243	2.7
1995	35	1,449	13.3	292	6.2	1.27	506	628	7.0
1996	32	776	8.8	232	3.1	0.63	294	358	4.0
1997	40	762	7.7	374	2.3	0.48	212	245	2.8
1998	35	583	6.3	134	1.8	0.35	239	170	1.9
1999	42	398	5.8	114	1.5	0.31	1,294	174	1.9
2000	35	808	6.4	450	2.9	0.58	57	283	3.2
2001	36	451	4.3	18	1.7	0.31	1,992	146	1.5
2002	38	1,445	9.2	1,164	2.8	0.54	35	261	2.9
2003	37	564	5.5	11	2.0	0.34	527	173	1.7
2004	35	887	10.3	286	3.1	0.63	5,155	519	5.3
2005	46	3,661	23.4	1,752	9.2	1.89	589	871	10.3
2006	29	9,998	66.0	374	28.4	5.58	15	2,773	29.9
2007	43	887	11.5	28	3.4	0.67	91	412	4.1
2008	38	1,737	16.8	506	5.9	1.22	828	995	10.8
2009	49	1,627	15.4	555	6.4	1.29	391	702	8.5
2010	49	1,373	13.9	475	3.9	0.79	34	413	4.8
2011	47	830	8.6	44	3.0	0.57	8	316	3.2
2012	49	138	2.5	7	0.7	0.15	2	81	0.9
2013	40	27	1.0	1	0.2	0.05	773	24	0.3
2014	46	139	1.7	116	0.3	0.04	17	16	0.2
2015	32	55	1.3	1	0.4	0.08	5,291	41	0.4
2016	41	332	3.8	226	1.1	0.23		103	1.2
Mean	41	1341	11.9	344	4.3	0.86	727	498	5.5
Median	41	984	9.4	286	3.1	0.63	391	316	3.4
1984-93	42	1,435	14.1	382	4.9	1.01	393	649	7.1
Median	43	1,401	14.1	337	5.4	1.10	431	611	7.0

*Would be fully recruited to a winter fishery.

Table 4: Price per pound and value of U.S. commercial landings of northern shrimp in the Gulf of Maine, with inflation adjusted prices and value for 1985–2016. No shrimp were sold or purchased from cooperative winter sampling in 2014. 2015 and 2016 prices and value are from the RSA program.

Price $/Lb	Value $
0.32	1,532
0.29	5,002
0.23	20,714
0.20	13,754
0.15	57,382
0.12	66,840
0.12	112,528
0.12	245,469
0.14	549,466
0.12	871,924
0.11	1,611,425
0.12	3,478,910
0.20	4,697,418
0.19	4,653,202
0.19	4,586,484
0.27	5,657,347
0.32	5,577,465
0.26	3,062,721
0.34	764,094
0.55	458,198
0.24	1,758
0.33	320,361
0.65	478,883
0.64	1,516,521
0.60	2,079,109
0.67	2,312,073
0.49	3,474,351

Season	Price $/Lb	Value $	Price ($/Lb) 2016 dollars	Value ($) 2016 dollars
1985	0.44	3,984,562	0.98	8,927,095
1986	0.63	6,451,206	1.39	14,203,612
1987	1.10	12,740,581	2.33	27,050,235
1988	1.10	7,391,777	2.24	14,990,869
1989	0.98	7,177,659	1.91	13,960,583
1990	0.72	7,351,420	1.32	13,568,350
1991	0.91	7,208,838	1.61	12,725,816
1992	0.99	7,547,941	1.70	12,967,590
1993	1.07	5,038,053	1.78	8,409,229
1994	0.75	4,829,106	1.22	7,840,837
1995	0.90	12,828,030	1.42	20,212,800
1996	0.73	15,341,504	1.12	23,554,470
1997	0.79	12,355,871	1.18	18,521,057
1998	0.96	8,811,938	1.42	13,044,435
1999	0.91	3,762,043	1.32	5,429,959
2000	0.79	4,968,655	1.10	6,923,627
2001	0.86	2,534,095	1.17	3,433,191
2002	1.08	1,077,534	1.44	1,437,056
2003	0.87	2,590,916	1.14	3,378,855
2004	0.44	2,089,636	0.57	2,678,370
2005	0.57	3,261,648	0.70	4,028,047
2006	0.37	1,885,978	0.44	2,253,069
2007	0.38	4,087,120	0.44	4,733,474
2008	0.49	5,407,373	0.55	6,017,089
2009	0.40	2,216,411	0.45	2,481,435
2010	0.52	7,133,718	0.57	7,870,739
2011	0.75	10,625,533	0.81	11,424,359
2012	0.95	5,230,481	1.00	5,479,435
2013	1.81	1,375,788	1.87	1,424,395
2014		0		0
2015	3.49	51,269	3.54	52,049
2016	6.67	195,925	6.67	195,925

http://www.bls.gov/data/inflation_calculator.htm
accessed Sep. 23, 2016.

Table 5: Estimated numbers of vessels in the Gulf of Maine Northern Shrimp fishery by fishing season and state. 2015 and 2016 data are from the RSA.

Season	Maine			Massachusetts	New Hampshire	Total
	Trawl	Trap	Total			
1980			15-20	15-20		30-40
1981			~75	~20-25		~100
1982			>75	~20-25		>100
1983			~164	~25	~5-8	~197
1984			239	43	6	288
1985			~231	~40	~17	~300
1986						~300
1987			289	39	17	345
1988			~290	~70	~30	~390
1989			~230	~50	~30	~310
1990			~220			~250
1991			~200	~30	~20	~250
1992			~259	~50	16	~325
1993			192	52	29	273
1994			178	40	29	247
1995						
1996			275	43	29	347
1997			238	32	41	311
1998			195	33	32	260
1999			181	27	30	238
2000	207	68	265	17	27	304
2001	174	60	234	19	27	275
2002	117	52	168	7	23	198
2003	142	49	191	12	22	222
2004	114	56	170	7	15	192
2005	102	64	166	9	22	197
2006	68	62	129	4	11	144
2007	97	84	179	3	15	196
2008	121	94	215	4	15	234
2009	80	78	158	12 (MA and NH combined)		170
2010	124	112	235	6	15	256
2011	172	143	311	12	19	342
2012	164	132	295	15	17	327
2013	110	72	182	13	14	208
2014	0	0	0	0	0	0
2015	3	5	8	1	0	9
2016	3	2	5	0	1	6

Note that some boats reported both trapping and trawling, and some landed in more than one state.

Table 6. Species protected under the ESA and/or MMPA that may occur in the affected environment of the northern shrimp fishery. Marine mammal species (cetaceans and pinnipeds) italicized and in bold are considered MMPA strategic stocks[1].

Species	Status[2]	Potentially affected by this action?
Cetaceans		
North Atlantic right whale (Eubalaena glacialis)	Endangered	Yes
Humpback whale, West Indies DPS (Megaptera novaeangliae)[3]	Protected (MMPA)	Yes
Fin whale (Balaenoptera physalus)	Endangered	Yes
Sei whale (Balaenoptera borealis)	Endangered	Yes
Minke whale (Balaenoptera acutorostrata)	Protected (MMPA)	Yes
Long-finned pilot whale (Globicephala macrorhynchus)	Protected (MMPA)	Yes
Atlantic white-sided dolphin (Lagenorhynchus acutus)	Protected (MMPA)	Yes
Short Beaked Common dolphin (Delphinus delphis)	Protected (MMPA)	Yes
Harbor porpoise (Phocoena phocoena)	Protected (MMPA)	Yes
Sea Turtles		
Leatherback sea turtle (Dermochelys coriacea)	Endangered	No
Kemp's ridley sea turtle (Lepidochelys kempii)	Endangered	No
Green sea turtle, North Atlantic DPS (Chelonia mydas)[4]	Threatened	No
Loggerhead sea turtle (Caretta caretta), Northwest Atlantic Ocean DPS	Threatened	No
Hawksbill sea turtle (Eretmochelys imbricate)	Endangered	No
Fish		
Shortnose sturgeon (Acipenser brevirostrum)	Endangered	No
Atlantic salmon (Salmo salar)	Endangered	Yes
Atlantic sturgeon (Acipenser oxyrinchus)		
Gulf of Maine DPS	Threatened	Yes
New York Bight DPS, Chesapeake Bay DPS, Carolina DPS & South Atlantic DPS	Endangered	Yes
Cusk (Brosme brosme)	Candidate	Yes
Pinnipeds		
Harbor seal (Phoca vitulina)	Protected (MMPA)	Yes
Gray seal (Halichoerus grypus)	Protected (MMPA)	Yes
Harp seal (Phoca groenlandicus)	Protected (MMPA)	Yes
Hooded seal (Cystophora cristata)	Protected (MMPA)	Yes
North Atlantic Right Whale[5]	ESA (Protected)	No

Footnotes to Table 6:

[1] A strategic stock is defined under the MMPA as a marine mammal stock for which: (1) the level of direct human-caused mortality exceeds the potential biological removal level; (2) based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future; and/or (3) is listed as a threatened or endangered species under the ESA, or is designated as depleted under the MMPA (Section 3 of the MMPA of 1972).
[2] The status of the species is defined by whether the species is listed under the ESA as endangered (species are at risk of extinction) or threatened (species at risk of endangerment), or protected under the MMPA. Note, marine mammals listed under the ESA are also protected under the MMPA. Candidate species are those species in which ESA listing may be warranted.
[3] A final rule was issued on September 8, 2016, revising the ESA listing status of humpback whales (81 FR 62259). Fourteen DPSs were designated: one as threatened, four as endangered, and nine as not warranting listing. The DPS found in U.S. Atlantic waters, the West Indies DPS, is delisted under the ESA; however, this DPS is still protected under the MMPA.
[4] A final rule was issued on April 6, 2016, removing the current range-wide listing of green sea turtles and, in its place, listing eight green sea turtle DPSs as threatened and three DPSs as endangered (81 FR 20057). The green sea turtle DPS located in the Northwest Atlantic is the North Atlantic DPS of green sea turtles; this DPS is considered threatened under the ESA.
[5] Originally designated June 3, 1994 (59 FR 28805); Expanded on January 27, 2016 (81 FR 4837).

Table 7. Large whale occurrence in the area of operation for the northern shrimp fishery. Sources: NOAA Fisheries 1991, 2005, 2010, 2011, 2012; Hain et al. 1992; Payne et al. 1984; Good 2008; Pace and Merrick 2008; McLellan et al. 2004; Hamilton and Mayo 1990; Schevill et al. 1986; Watkins and Schevill 1982; Payne et al. 1990; Winn et al. 1986; Kenney et al. 1986, 1995; Khan et al. 2009, 2010, 2011, 2012; Brown et al. 2002; NOAA 2008; 50 CFR 224.105; CETAP 1982; Clapham et al. 1993; Swingle et al. 1993; Vu et al. 2012; Baumgartner et al. 2011; Cole et al. 2013; Risch et al. 2013; Waring et al. 2014; Waring et al. 2015; Waring et al. 2016; 81 FR 4837 (January 27, 2016); NOAA Fisheries 2015b.

Species	Prevalence and Approximate Months of Occurrence
North Atlantic Right Whale	• Distributed throughout all continental shelf waters from the Gulf of Maine to the South Atlantic Bight throughout the year. • New England waters (Gulf of Maine and Georges Bank regions) = Foraging Grounds (January through October). Seasonally important foraging grounds include: › Cape Cod Bay (January-April); › Great South Channel (April-June); › western Gulf of Maine (April-May, and July-October); › Jordan Basin (August-October); › Wilkinson Basin (April-July); and › northern edge of Georges Bank (May-July). • Mid-Atlantic waters: Migratory pathway to/from northern (high latitude) foraging and southern calving grounds. • SAB (Coastal waters from Cape Fear, North Carolina, to 28oN (northeastern Florida) = Calving and Nursing Grounds (mid- November-early April). • Increasing evidence of wintering areas (approximately November – January) in: › Cape Cod Bay; › Jeffreys and Cashes Ledges; › Jordan Basin; and › Massachusetts Bay (e.g., Stellwagen Bank).
Humpback	• Distributed throughout all continental shelf waters of the Mid-Atlantic (Southern New England included), Gulf of Maine, and Georges Bank throughout the year. • New England waters (Gulf of Maine and Georges Bank regions) = Foraging Grounds (March-November). • Mid-Atlantic waters: Migratory pathway to/from northern (high latitude) foraging and southern (West Indies) calving grounds. • Increasing evidence of whales remaining in mid- and high- latitudes throughout the winter. Specifically, increasing evidence of wintering areas (for juveniles) in Mid-Atlantic (e.g., waters in the vicinity of Chesapeake and Delaware Bays; peak presence approximately January through March) and Southeastern coastal waters.

Table 7 continued.

Species	Prevalence and Approximate Months of Occurrence
Fin	• Distributed throughout all continental shelf waters of the Mid-Atlantic (Southern New England included), Gulf of Maine, and Georges Bank throughout the year. • Mid-Atlantic waters: > Migratory pathway to/from northern (high latitude) foraging and southern (low latitude) calving grounds; and > Possible offshore calving area (October-January). • New England (Gulf of Maine and Georges Bank)/ Southern New England waters = Foraging Grounds (greatest densities March-August; lower densities September-November).Important foraging grounds include: > Massachusetts Bay (esp. Stellwagen Bank); > Great South Channel; > Waters off Cape Cod (~40-50 meter contour); > Gulf of Maine; > Perimeter (primarily eastern) of Georges Bank; and > Mid-shelf area off the east end of Long Island. • Evidence of wintering areas in mid-shelf areas east of New Jersey Stellwagen Bank; and eastern perimeter of Georges Bank.
Sei	• Uncommon in shallow, inshore waters of the Mid-Atlantic (SNE included), Georges Bank, and Gulf of Maine; however, occasional incursions during peak prey availability and abundance. • Primarily found in deep waters along the shelf edge, shelf break, and ocean basins between banks. • Spring through summer, found in greatest densities in offshore waters of the Gulf of Maine and Georges Bank; sightings concentrated along the northern, eastern (into Northeast Channel) and southwestern (in the area of Hydrographer Canyon) edge of Georges Bank.
Minke	• Widely distributed throughout continental shelf waters (<100m deep) of the Mid-Atlantic (Southern New England included), Gulf of Maine, and Georges Bank. • Most common in the EEZ from spring through fall, with greatest abundance found in New England waters

Table 8. Small cetacean occurrence in the area of operation of the northern shrimp fishery. Information presented in table is representative of small cetacean occurrence in the Northwest Atlantic continental shelf waters out to the 2,000 meter isobath. Sources: Waring et al. 1992, 2007, 2014, 2015, 2016; Payne and Heinemann 1993; Payne et al. 1984; Jefferson et al. 2009.

Species	Prevalence and Approximate Months of Occurrence
Atlantic White-Sided Dolphin	• Distributed throughout the continental shelf waters (primarily to 100 meter isobath) of the Mid-Atlantic (north of 35°N), Southern New England, Georges Bank, and Gulf of Maine; however, most common in continental shelf waters from Hudson Canyon (~ 39°N) to Georges Bank, and into the Gulf of Maine. • January-May: low densities found from Georges Bank to Jeffreys Ledge. • June-September: large densities found from Georges Bank through the Gulf of Maine. • October-December: intermediate densities found from southern Georges Bank to southern Gulf of Maine. • South of Georges Bank (Southern New England and Mid-Atlantic), low densities found year round, with waters off Virginia and NC representing southern extent of species range during winter months.
Short-Beaked Common Dolphin	• Regularly found throughout the continental shelf-edge-slope waters (primarily between the 100-2,000 meter isobaths) of the Mid-Atlantic, Southern New England, and Georges Bank (esp. in Oceanographer, Hydrographer, Block, and Hudson Canyons). • Less common south of Cape Hatteras, NC, although schools have been reported as far south as the Georgia /South Carolina border. • January-May: occur from waters off Cape Hatteras, NC, to Georges Bank (35° to 42°N). • Mid-summer-fall: occur primarily on Georges Bank with small numbers present in the Gulf of Maine; Peak abundance found on Georges Bank in the autumn.

Table 8 Continued.

Species	Prevalence and Approximate Months of Occurrence
Harbor Porpoise	• Distributed throughout the continental shelf waters of the Mid-Atlantic (north of 35oN), Southern New England, Georges Bank, and Gulf of Maine. • July-September: concentrated in the northern Gulf of Maine (waters < 150 meters); low numbers can be found on Georges Bank. • October-December: widely dispersed in waters from NJ to Maine; seen from the coastline to deep waters (>1,800 meters). • January-March: intermediate densities in waters off NJ to NC; low densities found in waters off NY to Gulf of Maine. • April-June: widely dispersed from NJ to ME; seen from the coastline to deep waters (>1,800 meters).
Long-finned pilot whale	• Long-Finned Pilot Whales • Except for area of overlap (see below), primarily occur north of 42˚N. • Winter to early spring (November through April): primarily distributed along the continental shelf edge-slope of the Mid-Atlantic, Southern New England, and Georges Bank. • Late spring through fall (May through October): movements and distribution shift onto/within Georges Bank, the Great South Channel, and Gulf of Maine.

Table 9. Pinniped occurrence in the area of operation of the northern shrimp fishery. Sources: Waring et al. 2007 (for hooded seals); Waring et al. 2014; Waring et al. 2015; Waring et al. 2016

Species	Prevalence
Harbor Seal	• Primarily distributed in waters from NJ to ME; however, increasing evidence indicates that their range is extending into waters as far south as Cape Hatteras, NC (35oN). • Year Round: waters of ME • September-May: waters from New England to NJ.
Gray Seal	• Distributed in waters from NJ to ME. • Year Round: waters from ME to MA. • September-May: waters from Rhode Island to NJ.
Harp Seal	• Winter-Spring (approximately January-May): waters from ME to NJ.
Hooded Seal	• Winter-Spring (approximately January-May): waters of New England.

Table 10. Summary of confirmed human-caused injury or mortality to fin, minke, humpback, sei, and North Atlantic right whales from 2010-2014 due to entanglement in fishing gear. Information presented here is based on confirmed human-caused injury and mortality events along the Gulf of Mexico Coast, US East Coast, and Atlantic Canadian Provinces; it is not specific to US waters only. NOAA Fisheries defines a serious injury as an injury that is more likely than not to result in mortality (visit the NOAA Fisheries website for more information). Source: Henry et al. 2016

Species	Total Confirmed Entanglement: Serious Injury[2]	Total Confirmed Entanglement: Non-Serious Injury	Total Confirmed Entanglement: Mortality	Entanglement Events: Total Average Annual Injury and Mortality Rate (US waters/Canadian waters/unassigned waters)
North Atlantic Right Whale	16	31	8	4.65 (0.4/0/4.25)
Humpback Whale	30	53	8	6.85 (1.55/0/5.3)
Fin Whale	6	1	4	1.8 (0.2/0.8/0.8)
Sei Whale	0	0	0	0
Minke Whale	20	11	16	6.4 (1.7/2.45/2.25)

Table 11. Small cetacean and pinniped species observed seriously injured and/or killed by Category II Northeast bottom trawl fisheries in the affected environment of the northern shrimp fishery. Sources: Waring et al. 2014; Waring et al. 2015; Waring et al. 2016; LOF 82 FR 3655 (January 12, 2107).

Category II Northeast bottom trawl fisheries in the affected environment of the northern shrimp fishery
Harp seal
Harbor seal
Gray seal
Pilot whales (spp)
Short-beaked common dolphin
White-sided dolphin
Harbor porpoise
Bottlenose dolphin (offshore)
Risso’s dolphin

FIGURES

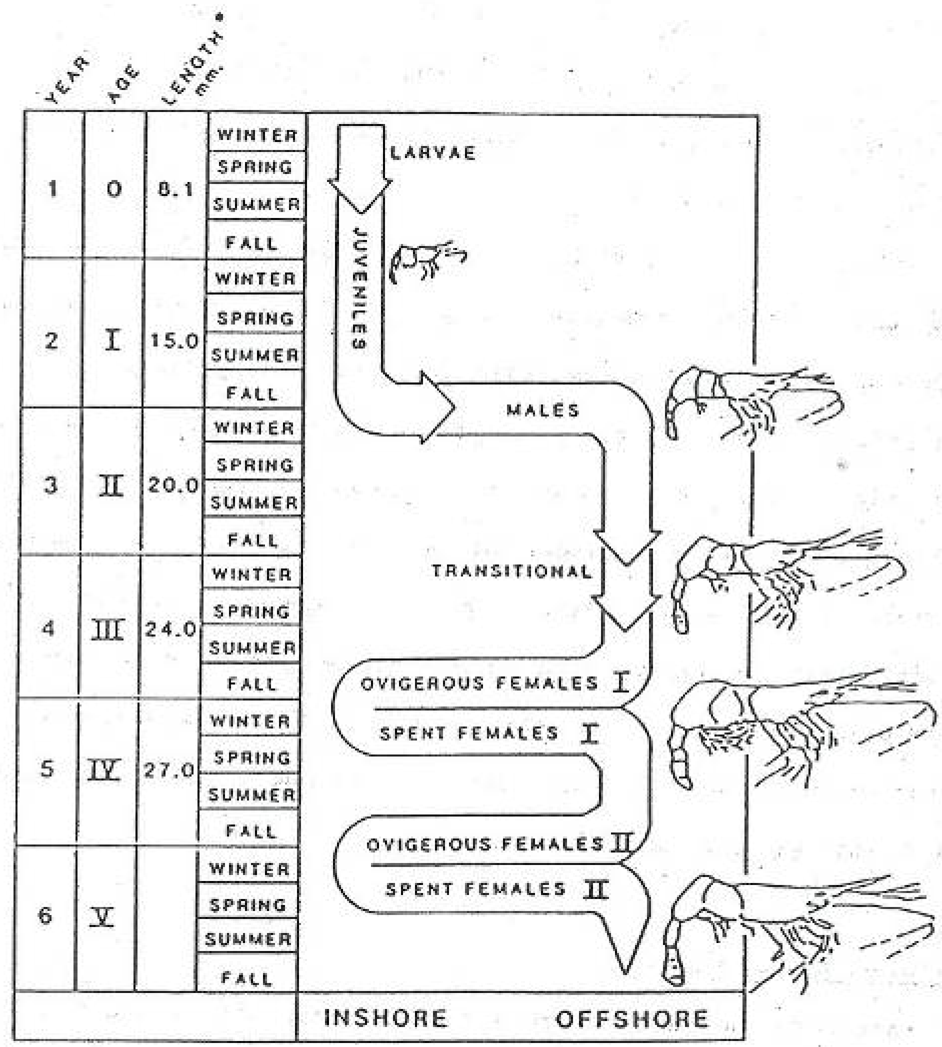

Figure 1. Schematic diagram of the life cycle of *Pandalus borealis* in the Gulf of Maine (modified from Shumway et. al. 1985)

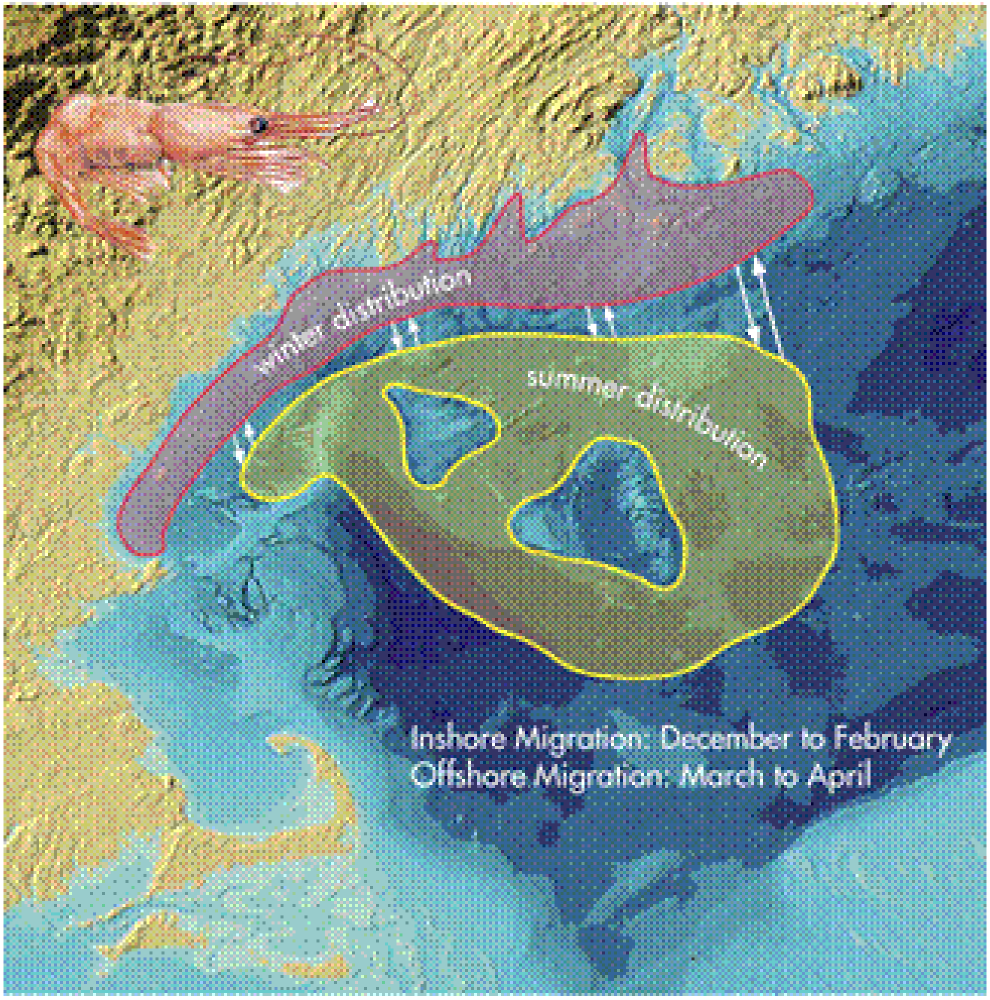

Figure 2. Distribution and migration of adult female shrimp in the Gulf of Maine (Anon. 2006 courtesy of NAMA)

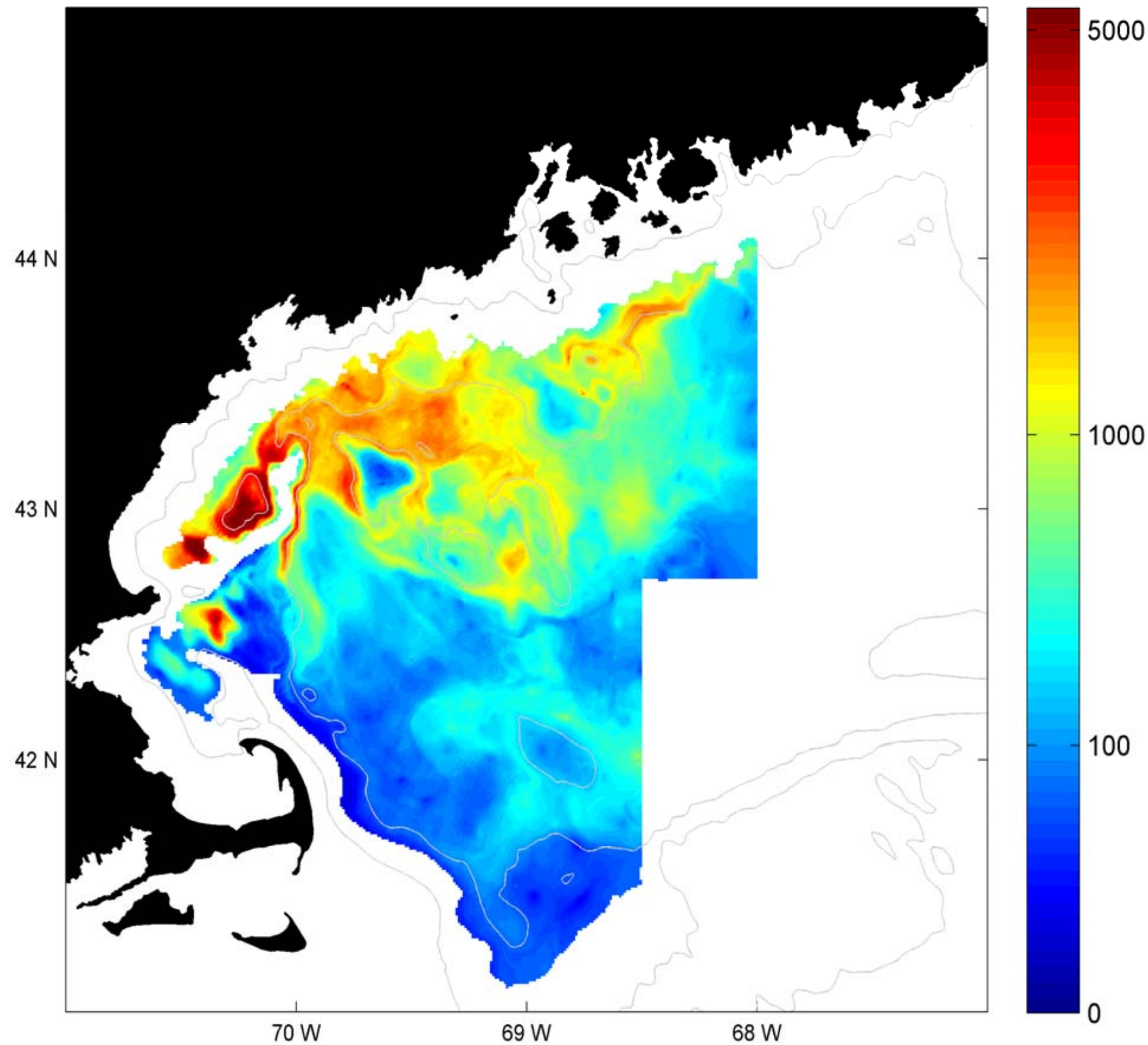

Figure 3. Heat map of average shrimp abundance from the ASMFC summer trawl survey, 1984-2016. Courtesy of Dave Richardson, NEFSC.

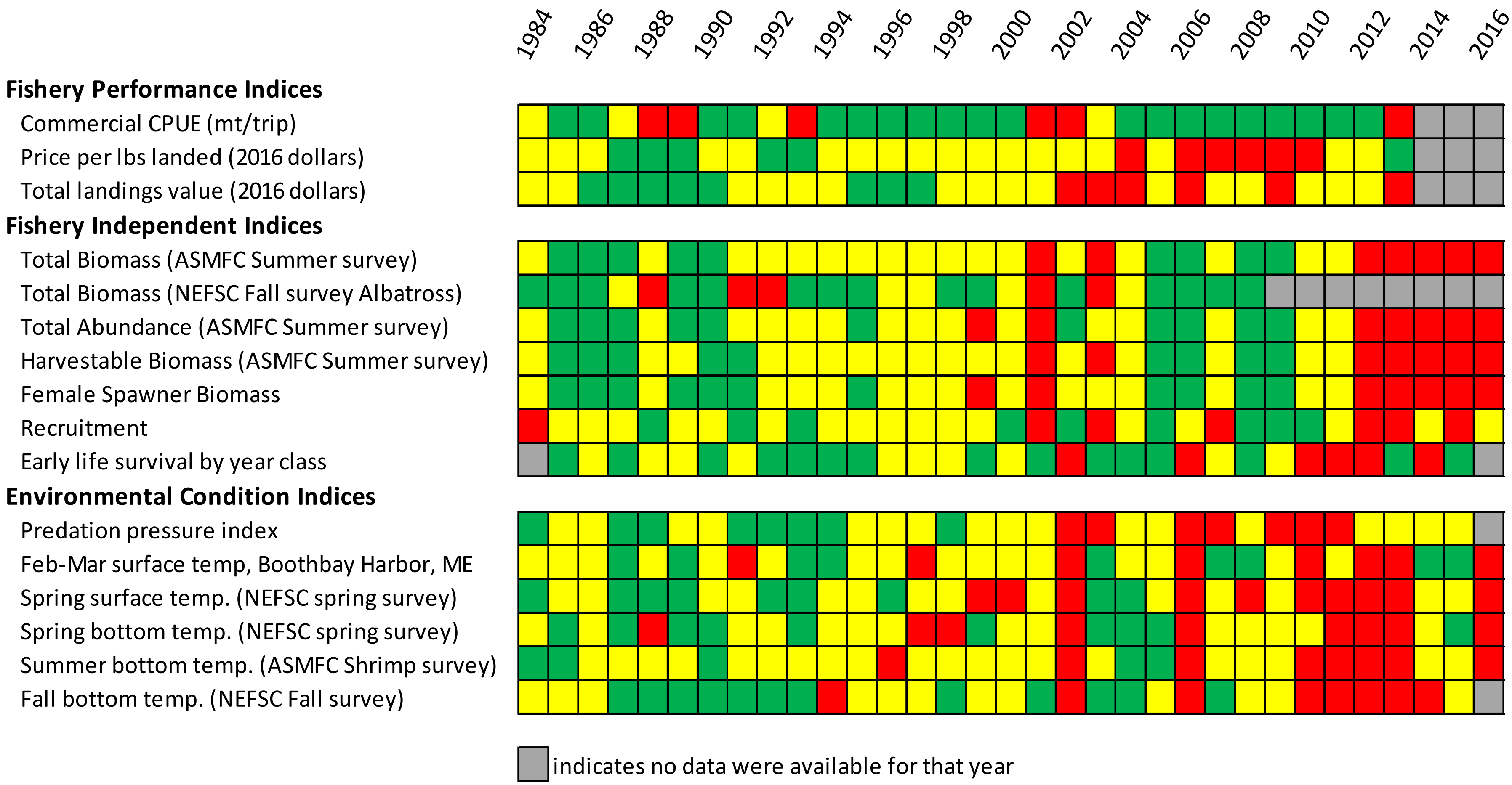

Figure 4: Strict Traffic Light Approach (STLA) results. Red indicates unfavorable conditions or status, yellow indicates intermediate values, and green indicates favorable conditions or status. Source: 2016 Stock Status Update for GOM Northern Shrimp

	Indicator values				Reference levels	
	2013	2014	2015	2016	SPM	20th percentile
Total Biomass	1.0	1.7	1.3	3.8	14.1	5.6
Spawner Biomass	0.2	0.3	0.4	1.1	4.9	1.7
Harvestable Biomass	0.3	0.2	0.4	1.2	7.1	1.7
Recruit Abundance	0.9	116	0.8	226	382	34
Early Life (YC) Survival	773	17	5291		393	57
CPUE (mt/trip)	0.23				0.45	0.40

KEY
- ≥ SPM
- > 20th percentile but < SPM
- ≤ 20th percentile

Figure 5: Recent (2013–2016) Gulf of Maine northern shrimp FTLA indicator values relative to reference levels. RED = at or below 20th percentile of time series; YELLOW = between 20th percentile and stable period (1985–1994) mean (SPM); GREEN = at or above SPM. Source: 2016 Stock Status Update for GOM Northern Shrimp.

	Indicator values				Reference levels	
	2013	2014	2015	2016	SPM	80th percentile
Predator Predation Index	888	1005	890		546	1133
Boothbay Feb-Mar SST	3.9	2.3	1.4	4.1	2.4	3.6
Spring Bottom Temp NEFSC	1.3	0.5	0.1	1.4	0.4	1.3
Summer Survey Bottom Temp	7.1	6.2	5.8	7.2	5.4	7.0

KEY
- ≤ SPM
- < 80th percentile but > SPM
- ≥ 80th percentile

Figure 6: Recent (2013–2016) Gulf of Maine northern shrimp FTLA environmental indicator values relative to reference levels. RED = at or above 80th percentile of time series; YELLOW = between 80th percentile and stable period (1985–1994) mean (SPM); GREEN = at or below SPM. Source: 2016 Stock Status Update for GOM Northern Shrimp.

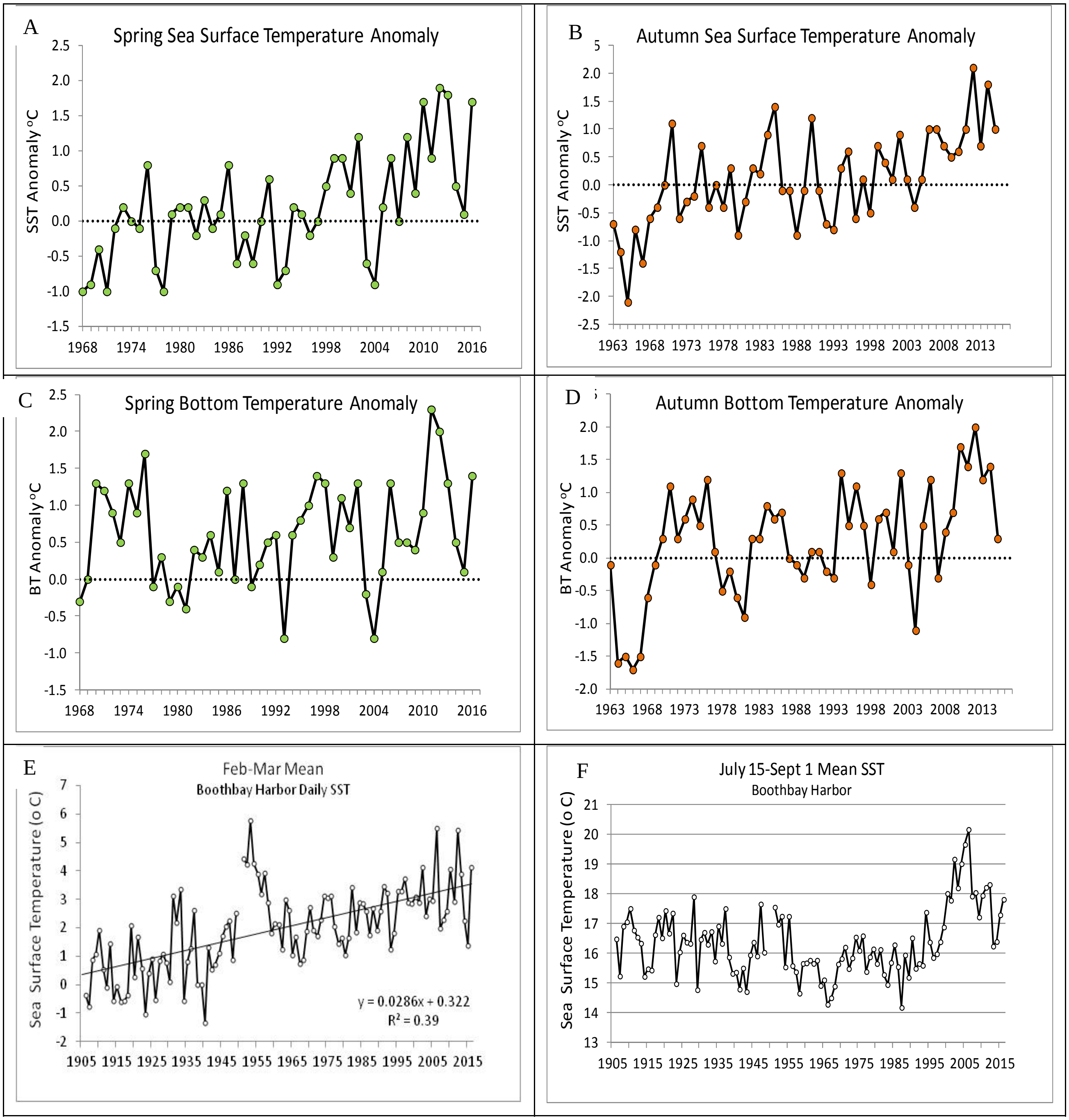

Figure 7: Ocean temperature anomalies in the Gulf of Maine. (A) spring and (B) autumn sea surface temperature anomalies in shrimp offshore habitat areas from NEFSC trawl surveys, 1968–2016 (through 2015 for autumn temperatures). (C) spring and (D) autumn bottom temperature anomalies in shrimp offshore habitat areas from NEFSC trawl survey, 1968–2016 (through 2015 for autumn temperature). (E – F) average sea surface temperature during (E) February–March and (F) July 15–September 1 at Boothbay Harbor, Maine, 1906–2016. Source: 2016 Stock Status Update for GOM Northern Shrimp.

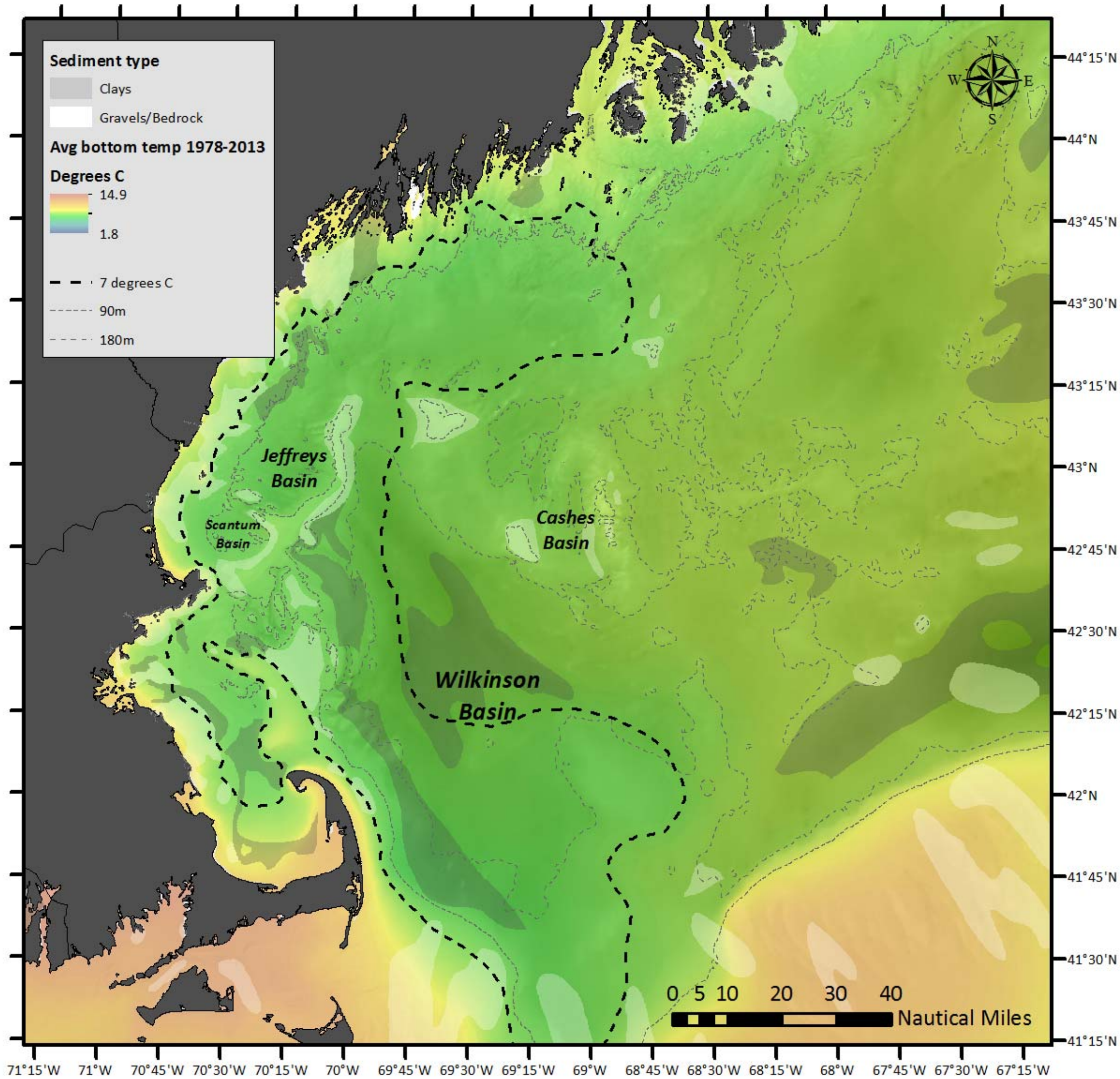

Figure 8. Habitat map for the Gulf of Maine. Colored shading indicates average annual bottom temperature based on the Finite Volume Coastal Ocean Model for the period 1978 to 2013, with the heavy dotted contour line enclosing areas where temperatures were on average below 7 degrees. Grey shaded patches indicate areas of clay or mixed clay sediments, while white patches show areas of gravel or bedrock. Other areas are sand or mixed sand/silt/clay. The light dotted lies show the 90 m and 180 m contours. Shrimp are commonly found between these depths during the spring, summer, and fall months.

10.0 APPENDIX 1

APPENDIX 1.1 Preliminary Trip Limit Analysis

The PDT analyzed trip limit options by vessel catch history and gear type. The PDT developed two methodologies to evaluate trip limits. First, the PDT computed the average trip weight for each individual vessel across all trips taken from 2008 through 2011 fishing years. The PDT also applied a range of trip limits to the 2010 fishery to determine the percentage of trips that would have been impacted.

When the PDT computed average trip weight, vessels that landed zero pounds during the four year time series were excluded from the analysis (n=169). The remaining active vessels (n=249) were placed in a matrix by average pounds landed and vessel size class to determine the percentage of vessels impacted by specific trip limits (see Appendix 1.2) The analysis for the pot fishery was not conclusive as the average pounds landed by 54% of the fleet was less than 100 pounds. Appendix 1.1 provides a breakdown of the vessels by vessel class and poundage category.

Table A.1.1. Percent of trawl vessels impacted by various trip limits based on the average pounds landed by a specific vessel for fishing years 2008 - 2011. Total number of vessels was 249.

Trip Limits (LBS)	% vessels impacted
1000	81.6%
1500	64.3%
2000	40.6%
2500	26.9%
3000	16.9%

The PDT also analyzed trip level data excluding specific vessel catch history. Appendix 1.3 shows the number of trips by state, gear, and vessel size and trip poundage categories for fishing years 2007-2011.

Appendix 1.4 details the average trip weight (pounds) by state, gear, and vessel size class fishing years 2001-2011. The table below is a subset of these results from 2008 to 2011.

Table A.1.2. Average trip weight (pounds) by state, gear, and vessel size class from 2008 to 2011. This analysis excludes vessel catch history and is the average of trip data. Cells marked by an asterisk (*) are confidential data.

State and Gear	Vessel Size Class	2008	2009	2010	2011
Maine Trawl	< 20 FT.			125	*
	21 TO 30 FT.		*	764	*
	31 TO 40 FT.	1,641	1,582	2,130	1,824
	41 TO 50 FT.	2,555	2,453	3,032	2,391
	51 TO 60 FT	3,118	2,997	3,754	3,201
	61 TO 70 FT.	*		*	4,278
	> 70 FT.	5,715	*	6,508	5,039
	ALL VESSELS COMBINED	2,307	2,216	2,744	2,437
Maine Pots	< 20 FT.	*	*	*	245
	21 TO 30 FT.	814	934	1,301	819
	31 TO 40 FT.	1,132	922	1,495	1,108
	41 TO 50 FT.	1,151	993	839	532
	ALL VESSELS COMBINED	1,110	922	1,451	1,043
State and Gear	**Vessel Size Class**	**2008**	**2009**	**2010**	**2011**
New Hampshire Trawl	31 TO 40 FT.	*	*		
	41 TO 50 FT.	2,470	2,497	2,352	2,422
	51 TO 60 FT	2,639	*	3,675	2,853
	61 TO 70 FT.				
	> 70 FT.				
	ALL VESSELS COMBINED	2,488	2,518	2,734	2,539
Massachusetts Trawl	31 TO 40 FT.	*		*	2,148
	41 TO 50 FT.	*	*	1,449	1,992
	51 TO 60 FT				*
	61 TO 70 FT.				
	> 70 FT.				*
	ALL VESSELS COMBINED	1,695	1,660	1,560	2,252

Appendix 1.5 details the impacts of 1,000, 2,000, 3,000, and 4,000 trip limits applied to data from the 2010 fishery. The analysis includes impacts on trawl, trap, and the overall fishery. In 2010, landings would have been reduced overall by 62% if a 1,000 trip limit was in effect. Trawl landings would have been reduced by 66% and trap landings by 47%. Trawlers greater than 60 feet would have been reduced by 83%. Total landings would have been reduced by 12% if a 4,000 pound trip limit was in place for the 2010 fishery.

APPENDIX 1.2. Analysis by vessel catch history, size class, and gear (trawl and pot) across 2008 to 2011 fishing years.

Number of vessels by vessel class and poundage category for the ME, NH, and MA TRAWL fishery based on the 2008 to 2011 average catch per trip

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.	Total Vessels
< = 30 FT. 31		3	3	1							7
TO 40 FT.		6	21	32	28	12	7	2	3		111
41 TO 50 FT.	1	5	6	9	27	17	11	7	8		91
51 TO 60 FT	1			1	2	5	6	3	7		25
61 TO 70 FT.					1		1	1	3	1	7
> 70 FT.					1			2	3	2	8
ALL VESSELS COMBINED	2	14	30	43	59	34	25	15	24	3	249
% of Fleet	0.80%	5.62%	12.05%	17.27%	23.69%	13.65%	10.04%	6.02%	9.64%	1.20%	
% Impacted by Trip Limit Equal to Poundage Category MAX	99.20%	93.57%	81.53%	64.26%	40.56%	26.91%	16.87%	10.84%	1.20%		

Number of vessels by vessel class and poundage category for the ME, NH, and MA POT fishery based on the 2008 to 2011 average catch per trip

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< = 30 FT.	1	4								
31 TO 40	6	7								
FT.	127	33	5	1		1	1			
41 TO 50 FT.										
51 TO 60 FT										
61 TO 70 FT.										
> 70 FT.	134	44	5	1	0	1	1	0	0	0
ALL VESSELS COMBINED	53.82%	17.67%	2.01%	0.40%	0.00%	0.40%	0.40%	0.00%	0.00%	
% of Fleet % Impacted by Trip Limit Equal to	27.96%	4.30%	1.61%	1.08%	1.08%	0.54%	0.00%	0.00%	0.00%	0.00%

APPENDIX 1.3. The number of trips by state, gear, and vessel size and trip poundage categories for fishing years 2007-2011.

Number of trips by vessel class and poundage category - N. Shrimp - 2007 MAINE- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
<30 FT.										
31 TO 40 FT.	3	64	153	140	137	127	130	80	155	65
41 TO 50 FT.	3	33	48	74	112	131	146	108	239	224
51 TO 60 FT		4	19	31	55	45	62	50	142	129
> 60 FT.	1	2	4	3	3	0	8	9	19	16
ALL VESSELS COMBINED	**6**	**101**	**220**	**245**	**304**	**303**	**338**	**238**	**536**	**418**

Number of trips by vessel class and poundage category - N. Shrimp - 2008 MAINE- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 30 FT.										
31 TO 40 FT.	17	187	325	330	272	147	88	54	101	28
41 TO 50 FT.	5	59	110	186	242	182	178	118	184	97
51 TO 60 FT	1	12	39	54	76	68	72	52	125	65
> 60 FT.	0	1	4	8	8	4	5	3	14	39
ALL VESSELS COMBINED	**23**	**258**	**474**	**570**	**590**	**397**	**338**	**224**	**410**	**190**

Number of trips by vessel class and poundage category - N. Shrimp - 2009 MAINE- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 30 FT.		*	*	*						
31 TO 40 FT.	7	93	186	182	114	62	64	28	43	10
41 TO 50 FT.	1	37	116	94	86	90	61	50	88	59
51 TO 60 FT	1	16	33	41	61	50	47	29	94	44
> 60 FT.			*	*		*		*	*	*
ALL VESSELS COMBINED	**9**	**146**	**335**	**317**	**261**	**202**	**172**	**107**	**225**	**113**

* Confidential Data

Number of trips by vessel class and poundage category - N. Shrimp - 2010 MAINE- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 30 FT.	5	6	10	5	1					
31 TO 40 FT.	10	134	292	318	283	220	193	105	163	98
41 TO 50 FT.	4	39	101	130	146	134	120	90	200	161
51 TO 60 FT	3	15	29	42	54	53	58	49	138	130
> 60 FT.			1	3	1	8	5	2	28	35
ALL VESSELS COMBINED	**17**	**188**	**422**	**490**	**483**	**407**	**371**	**244**	**501**	**389**

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Number of trips by vessel class and poundage category - N. Shrimp - 2011 MAINE- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 30 FT.	*	*	*							
31 TO 40 FT.	10	137	243	341	343	218	152	76	113	20
41 TO 50 FT.	8	71	113	173	230	222	198	117	179	54
51 TO 60 FT		5	24	33	61	72	88	61	105	64
> 60 FT.		5	9	6	11	15	23	30	123	111
ALL VESSELS COMBINED	**18**	**218**	**389**	**553**	**645**	**527**	**461**	**284**	**520**	**249**

* Confidential Data

Number of trips by vessel class and poundage category - N. Shrimp - 2007 MAINE- POT Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs.	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 40 FT.	100	209	251	165	130	64	40	8	3	
41 TO 50 FT.	7	14	17	9	17	8	2			1
ALL VESSELS COMBINED	**107**	**223**	**268**	**174**	**147**	**72**	**42**	**8**	**3**	**1**

Number of trips by vessel class and poundage category - N. Shrimp - 2008 MAINE- POT Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs.	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 40 FT.	156	316	293	249	181	101	59	32	25	7
41 TO 50 FT.	8	28	32	38	28	11	5	1	1	
ALL VESSELS COMBINED	**164**	**344**	**325**	**287**	**209**	**112**	**64**	**33**	**26**	**7**

Number of trips by vessel class and poundage category - N. Shrimp - 2009 MAINE- POT Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs.	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 40 FT.	152	171	180	172	91	30	21	14	6	2
41 TO 50 FT.	14	7	16	11	16	4	1			
ALL VESSELS COMBINED	**166**	**178**	**196**	**183**	**107**	**34**	**22**	**14**	**6**	**2**

Number of trips by vessel class and poundage category - N. Shrimp - 2010 MAINE- POT Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs.	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 40 FT.	141	301	317	282	278	198	121	68	88	24
41 TO 50 FT.	6	21	14	23	7	1				
ALL VESSELS COMBINED	**147**	**322**	**331**	**305**	**285**	**199**	**121**	**68**	**88**	**24**

Number of trips by vessel class and poundage category - N. Shrimp - 2011 MAINE- POT Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs.	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 40 FT.	123	348	358	348	181	94	55	25	21	2
41 TO 50 FT.	13	39	22	11	2	1				
ALL VESSELS COMBINED	**136**	**387**	**380**	**359**	**183**	**95**	**55**	**25**	**21**	**2**

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Number of trips by vessel class and poundage category - N. Shrimp - 2007 New Hampshire- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 20 FT.										
21 TO 30 FT.										
31 TO 40 FT.			*		*	*				
41 TO 50 FT.		6	27	25	27	20	18	14	36	27
51 TO 60 FT		*		*		*	*	*	*	*
61 TO 70 FT.										
> 70 FT.										
ALL VESSELS COMBINED	**0**	**6**	**27**	**25**	**27**	**20**	**18**	**14**	**36**	**27**

* Confidential Data

Number of trips by vessel class and poundage category - N. Shrimp - 2008 New Hampshire- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 20 FT.										
21 TO 30 FT.										
31 TO 40 FT.	1			*	*					
41 TO 50 FT.	3	15	17	41	55	51	41	21	32	16
51 TO 60 FT		3	7	6	11	8	11	9	10	4
61 TO 70 FT.										
> 70 FT.										
ALL VESSELS COMBINED	**4**	**18**	**24**	**47**	**66**	**59**	**52**	**30**	**42**	**20**

* Confidential Data

Number of trips by vessel class and poundage category - N. Shrimp - 2009 New Hampshire- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 20 FT.										
21 TO 30 FT.										
31 TO 40 FT.			*						*	
41 TO 50 FT.		3	13	29	12	10	9	5	17	10
51 TO 60 FT			*	*	*	*	*	*	*	*
61 TO 70 FT.										
> 70 FT.										
ALL VESSELS COMBINED	**0**	**3**	**13**	**29**	**12**	**10**	**9**	**5**	**17**	**10**

* Confidential Data

Number of trips by vessel class and poundage category - N. Shrimp - 2010 New Hampshire- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 20 FT.										
21 TO 30 FT.										
31 TO 40 FT.										
41 TO 50 FT.	2	16	37	52	53	42	31	15	40	20
51 TO 60 FT	1		3	4	14	19	15	8	37	24
61 TO 70 FT.										
> 70 FT.										
ALL VESSELS COMBINED	**3**	**16**	**40**	**56**	**67**	**61**	**46**	**23**	**77**	**44**

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Number of trips by vessel class and poundage category - N. Shrimp - 2011 New Hampshire- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 20 FT.										
21 TO 30 FT.										
31 TO 40 FT.										
41 TO 50 FT.	1	11	35	52	80	81	60	25	44	18
51 TO 60 FT		3	7	16	22	22	16	28	26	12
61 TO 70 FT.										
> 70 FT.										
ALL VESSELS COMBINED	**1**	**14**	**42**	**68**	**102**	**103**	**76**	**53**	**70**	**30**

Number of trips by vessel class and poundage category - N. Shrimp - 2010 Massachusetts- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs.	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 40FT			1	2	5		2	1		
41 TO 50 FT.	2	6	8	9	5	3	5	2	1	
>50 FT.										
ALL VESSELS COMBINED	**2**	**6**	**9**	**11**	**10**	**3**	**7**	**3**	**1**	**0**

Number of trips by vessel class and poundage category - N. Shrimp - 2011 Massachusetts- Trawl Fishery

Vessel Size	1 to 100 lbs.	101 to 500 lbs.	501 to 1000 lbs.	1001 to 1500 lbs.	1501 to 2000 lbs.	2001 to 2500 lbs.	2501 to 3000 lbs.	3001 to 3500 lbs.	3501 to 5000 lbs.	> 5000 lbs.
< 40FT		1	4	16	21	15	9	6	6	
41 TO 50 FT.		3	3	6	6	12	7	2	1	
>50 FT.	3		2	3	9	8	8	5	14	3
ALL VESSELS COMBINED	**3**	**4**	**9**	**25**	**36**	**35**	**24**	**13**	**21**	**3**

***All MA 2007, 2008, and 2009 trip level data are confidential**

APPENDIX 1.4. Average trip weight (pounds) by state, gear, and vessel size class from 2001 to 2011.

Average trip weight (lbs) of N. Shrimp Landed - MAINE- Trawl Fishery by Vessel Class

Vessel Size	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
< 20 FT.										125	*
21 TO 30 FT.			*				*		*	764	*
31 TO 40 FT.	565	619	877	1,291	1,175	2,059	2,402	1,641	1,582	2,130	1,824
41 TO 50 FT.	836	992	1,241	2,366	1,772	2,816	3,494	2,555	2,453	3,032	2,391
51 TO 60 FT	965	1,279	1,323	2,968	2,090	3,339	3,867	3,118	2,997	3,754	3,201
61 TO 70 FT.	1,325	*	1,606	*	2,982	*	2,949	*		*	4,278
> 70 FT.	863	*	1,348	*	*	*	*	5,715	*	6,508	5,039
ALL VESSELS COMBINED	739	908	1,127	2,131	1,659	2,741	3,158	2,307	2,216	2,744	2,437

* Confidential Data

Average trip weight (lbs) of N. Shrimp Landed - MAINE- POT Fishery by Vessel Class

Vessel Size	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
< 20 FT.	188	126	*	*	*	*	790	*	*	*	245
21 TO 30 FT.	241	254	499	407	512	745	664	814	934	1,301	819
31 TO 40 FT.	493	448	709	375	1,057	805	1,028	1,132	922	1,495	1,108
41 TO 50 FT.	461	*	816	*	1,041	1,234	1,190	1,151	993	839	532
51 TO 60 FT											
61 TO 70 FT.											
> 70 FT.											
ALL VESSELS COMBINED	456	420	712	364	1,019	809	1,007	1,110	922	1,451	1,043

* Confidential Data

Average trip weight (lbs) of N. Shrimp Landed - New Hampshire- Trawl Fishery by Vessel Class

Vessel Size	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
< 20 FT.											
21 TO 30 FT.											
31 TO 40 FT.	850	512	775	1,050	1,184	*	*	*	*		
41 TO 50 FT.	880	726	1,190	1,685	1,738	1,766	2,953	2,470	2,497	2,352	2,422
51 TO 60 FT	*	*	*		1,639	*	*	2,639	*	3,675	2,853
61 TO 70 FT.											
> 70 FT.											
ALL VESSELS COMBINED	905	669	1,069	1,545	1,631	1,825	2,980	2,488	2,518	2,734	2,539

* Confidential Data

Average trip weight (lbs) of N. Shrimp Landed - Massachusetts- Trawl Fishery by Vessel Class

Vessel Size	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
< 20 FT.											
21 TO 30 FT.											
31 TO 40 FT.	622	428	647	*	1,211	*	*	*		*	2,148
41 TO 50 FT.	677	*	688	774	984	1,161	*	*	*	1,449	1,992
51 TO 60 FT		*	*		*		*				*
61 TO 70 FT.			*	*							
> 70 FT.			*								*
ALL VESSELS COMBINED	645	544	681	803	1,044	1,147	1,196	1,695	1,660	1,560	2,252

* Confidential Data

APPENDIX 1.5 Analysis of trip limit scenarios applied to 2010 northern shrimp fishery data.

Trip Limit Scenarios Applied to 2010 Northern Shrimp Fishery Data*

		2010 Actual			Landings (lbs) with Trip Limit Scenarios if catches were cut off at (lbs)…..				Percent Reduction from Actual if catches were cut off at (lbs)…..			
Trawl gear	Vessel size	No. of Vessels	No. of Trips	Landings (lbs)	1,000	2,000	3,000	4,000	1000	2000	3000	4000
Maine	20-30 ft.	6	27	19,341	16,841	19,341	19,341	19,341	13%	0%	0%	0%
	31-40 ft.	62	1,814	3,867,333	1,653,533	2,737,801	3,311,786	3,581,857	57%	29%	14%	7%
	41-50 ft.	39	1,125	3,410,622	1,073,373	1,934,979	2,526,090	2,898,241	69%	43%	26%	15%
	51-60 ft.	14	569	2,143,507	550,932	1,034,333	1,414,007	1,686,959	74%	52%	34%	21%
	61-87 ft.	4	83	499,191	82,600	162,725	234,614	296,050	83%	67%	53%	41%
Maine Totals		125	3,618	9,939,994	3,377,279	5,889,179	7,505,838	8,482,448	66%	41%	24%	15%
Mass. Totals	31-50 ft.	5	47	81,110	39,674	66,710	79,010	81,110	51%	18%	3%	0%
New Hamp.	41-50 ft.	12	281	724,543	263,051	444,084	551,630	623,894	64%	39%	24%	14%
	51-60 ft.	3	125	459,416	123,415	238,487	324,949	385,520	73%	48%	29%	16%
New Hamp. Totals		15	406	1,183,959	386,466	682,571	876,579	1,009,414	67%	42%	26%	15%
Trawl Totals		145	4,071	11,205,063	3,803,419	6,638,460	8,461,427	9,572,972	66%	41%	24%	15%
Trap gear												
Maine	17-30 ft.	9	126	149,598	91,541	131,058	146,824	150,226	39%	12%	2%	0%
	31-40 ft.	94	1,693	2,531,195	1,307,188	2,046,269	2,347,589	2,456,869	48%	19%	7%	3%
	41-50 ft.	8	73	62,087	49,596	61,887	62,087	62,087	20%	0%	0%	0%
Maine Totals		111	1,892	2,744,763	1,448,325	2,239,214	2,556,500	2,669,182	47%	18%	7%	3%
Trap Totals		111	1,892	2,744,763	1,448,325	2,239,214	2,556,500	2,669,182	47%	18%	7%	3%
Grand Totals (Trawl + Trap)		256	5,963	13,949,826	5,251,744	8,877,674	11,017,927	12,242,154	62%	36%	21%	12%

* 2010 Shrimp season harvester trip report data are preliminary, as of 7/7/11.