Atlantic States Marine Fisheries Commission

Amendment 2 to the Interstate Fishery Management Plan for Northern Shrimp

ASMFC Vision Statement:
Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

October, 2011

Amendment 2 to the Interstate Fishery Management Plan for Northern Shrimp

Prepared by

Atlantic States Marine Fisheries Commission
Northern Shrimp Plan Development Team

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This Management Plan was prepared under the guidance of the Atlantic States Marine Fisheries Commission's Northern Shrimp Section, chaired by Douglas Grout of New Hampshire. Technical and advisory assistance was provided by the Northern Shrimp Technical Committee and the Northern Shrimp Advisory Panel.

This is a report of the Atlantic States Marine Fisheries Commission pursuant to U.S. Department of Commerce, National Oceanic and Atmospheric Administration Award Nos. NA10NMF4740061.

EXECUTIVE SUMMARY

1.0 INTRODUCTION

The Atlantic States Marine Fisheries Commission (ASMFC) 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 Northern Shrimp FMP was approved in 1986, based on a plan developed in 1979. The October 1979 plan responded to deteriorating conditions in the fishery and a desire for cooperative management. The participating states – Maine, New Hampshire, and Massachusetts – designated the ASMFC as the joint regulatory agency in managing the northern shrimp fishery through its Northern Shrimp Section, which is the management body that establishes the annual fishing regulations. Responsibility for compatible management action in the Exclusive Economic Zone (EEZ) from 3-200 miles from shore lies with the Secretary of Commerce through ACFCMA in the absence of a federal fishery management plan.

Statement of the Problem (1.1.1)

Northern shrimp is currently managed under Amendment 1 to the FMP. Since the adoption of Amendment 1 in 2004, knowledge of the northern shrimp biology, population dynamics, and fishery has improved. While the management of northern shrimp has resulted in a rebuilt stock and increased fishing opportunity, Amendment 1 only provides two options for managing the fishery – season length and gear limitations. Early season closures occurred in the 2010 and 2011 fishing seasons because landing rates were far greater than anticipated. Furthermore, untimely reporting resulted in short notice of the season closures and an overharvest of the target total allowable catch (TAC) by 28% in 2010 and 48% in 2011. Given that these issues jeopardize the future of the fishery and shrimp resource, managers and stakeholders want to develop a management program that maximizes shrimp markets and benefits of the fishery, while maintaining a healthy shrimp stock. Therefore, draft Amendment 2 is designed to provide flexible management options including a clarification of fishing mortality reference points, a timely and comprehensive reporting system, trip limits, trap limits, and days out of the fishery.

Upon completion of Amendment 2, the Section will initiate consideration of a limited entry program through the adaptive management addendum process detailed in *Section 4.6.1*. The Public Information Document (PID) for this Amendment initially notified the public of the Section's intent to consider development of a limited entry program. Based on public comment received on the PID and the Section's concern regarding continuing effort increases in this fishery, the Section established a control date of June 7, 2011. 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. As noted in the PID, the Section may use historic landings and/or participation criteria for current and past participants as the limited entry system is established.

2.0 GOAL, OBJECTIVES, AND BIOLOGICAL REFERENCE POINTS

The goal of Amendment 2 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.

OBJECTIVES (2.3)

The following objectives are selected to support the goal of Amendment 2:

- 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

BIOLOGICAL REFERENCE POINTS (2.5)

The fishing mortality target is $F_{1985\text{-}94} = 0.29$, 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 is the maximum annual F during the same stable period (1985-94), which is $F_{1987} = 0.37$, as estimated by the NSTC in 2010. 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. The fishing mortality target, threshold and limit may be updated as the best scientific information becomes available through updated stock assessments. Overfishing is occurring if the threshold is exceeded.

3.0 MONITORING PROGRAM

Catch and Landings Information (3.1.1)

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

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.

4.0 MANAGEMENT PROGRAM IMPLEMENTATION

COMMERCIAL FISHERIES MANAGEMENT MEASURES (4.1)

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 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 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.

Fall Meeting Specification Options

a) Fishing Season (*Section 4.1.1)*
b) Trip Limits (*Section 4.1.2)*
c) Trap Limits (*Section 4.1.3*)
d) Days out of the Fishery (*Section 4.1.4)*

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 make adjustments to the fishing season, trip limits, and days out of the fishery at anytime during the rest of 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 fall fishing season specification meeting.

Amendment 2 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.

Fishing Season (4.1.1)
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. The Section may set different seasons for the harvesting and processing sectors of the fishery to accommodate for the lag time of processing shrimp that are harvested late in the season. The Section may close the fishery at any time at a public meeting or conference call.

Trip Limits (4.1.2)
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.

Trap Limits (4.1.3)
The Section may annually set trap limits during the fall specification 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 more than the specified amount of traps during a designated trap limit fishing year.

All traps fished, or aboard a vessel, must be tagged. A permanent trap tag shall be used so that it is not transferable once attached to a trap. Each trap tag shall be color-coded coastwide by fishing year. Information printed on the tags shall be: 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.

Days Out of the Fishery (4.1.4)
Days out of the fishery will be implemented to slow catch rates in order to prolong the harvest of the target TAC, or make shrimp available when demand is greatest. 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.

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.

Limited Entry – Control Date (4.1.5)
Upon completion of Amendment 2, the Section will initiate consideration of a limited entry program through the adaptive management addendum process detailed in *Section 4.6.1*. The Public Information Document (PID) for this Amendment initially notified the public of the Section's intent to consider development of a limited entry program. Based on public comment received on the PID and the Section's concern regarding continuing effort increases in this fishery, the Section established a control date of June 7, 2011. 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. As noted in the PID, the Section may use historic landings and/or participation criteria for current and past participants as the limited entry system is established.

ALTERNATIVE STATE MANAGEMENT REGIMES (4.5)
Once approved by the Northern Shrimp Section, a state may not change its regulatory program without approval by the Section. However, a state may implement more restrictive measures without Section approval. A state can request a change only if that state can show to the Section's satisfaction that the action will not contribute to overfishing of the resource. Changes to state plans must be submitted in writing to, and approved by, the Section prior to implementation.

ADAPTIVE MANAGEMENT (4.6)
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 4.6.2. The process under which adaptive management can occur is provided in Section 4.6.1.

Measures Subject to Change (4.6.2.2)
The following measures are subject to change under adaptive management upon approval by the Northern Shrimp Section:

(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 2 that are not subject to annual specification
(13) Vessel monitoring programs

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. Although ASMFC does not have authority to directly compel the states to implement these measures, it will continually monitor the effectiveness of state implementation and determine whether states are in compliance with the provisions of this fishery management plan (FMP). The Section sets forth specific elements that the Commission will consider in determining state compliance with this FMP, 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 2009).

Compliance Schedule (5.1.2)

States must implement the provisions of this amendment no later than January 22, 2012. States may begin implementation prior to this date when approved by the full Commission.

Annually each state must submit reports on compliance must be submitted to the Commission, no later than September 30 each year.

6.0 MANAGEMENT AND RESEARCH NEEDS

Amendment 2 contains a list of research needs that should be addressed in order to improve the current state of knowledge of shrimp biology, stock assessment, population dynamics, habitat, and social and economic issues. The list is not inclusive. The research needs will be periodically reviewed and updated through the Commission's FMP review process.

7.0 PROTECTED SPECIES

Amendment 2 provides an overview of the protected species known to occur throughout the range of northern shrimp and potential interactions with the fishery.

ACKNOWLEDGEMENTS

Amendment 2 to the Interstate Fishery Management Plan for Northern Shrimp was developed under the supervision of the Atlantic States Marine Fisheries Commission's Northern Shrimp Section, chaired by Douglas Grout of New Hampshire. Members of the Northern Shrimp Plan Development Team (PDT) that contributed to the development of this amendment include: Margaret Hunter, Maine Department of Marine Resources; Cheri Patterson, New Hampshire Fish and Game; Robert Glenn, Massachusetts Division of Marine Fisheries; Peter Burns, National Marine Fisheries Service; Michael Waine, Atlantic States Marine Fisheries Commission; and Vincent Balzano. Additional contributions by: Robert Beal, Atlantic States Marine Fisheries Commission; Toni Kerns, Atlantic States Marine Fisheries Commission; Dr. Madeline Hall-Arbor, Massachusetts Institute of Technology. Considerable support was also provided by the Northern Shrimp Technical Committee, chaired by Margaret Hunter, Maine Department of Marine Resources.

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1.0 INTRODUCTION

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1.1.2 Benefits of Implementation

The amendment is designed to continue the prevention of a northern shrimp population collapse due to overfishing, minimize the risk of recruitment failure, and maintain a healthy and productive northern shrimp resource and fishery. It provides mechanisms for effective and timely monitoring of the northern shrimp population, maintaining an efficient management regime and

structure that is flexible and encourages public involvement in the management process. The most recent stock assessment recommends the continuation of efforts to maintain fishing mortality at or below the FMP target/threshold value. When fishing mortality is consistently at or below the target and the stock biomass is consistently above the threshold as defined by Amendment 1, long-term economic gains have been realized in the harvesting and processing sectors. Amendment 2 should continue to improve the Northern Shrimp Section's ability to effectively assess the status of the resource, predict its responses to both changes in the ocean climate and to various management actions, and match fishing effort and fishing mortality with sustainable yield through various methods. The methods that may be considered are:

- Stabilizing the fishery by considering limited entry into the fishery and establishing a control date.
- Require weekly reporting of catch and landings to allow managers the ability to accurately monitor harvest and help the industry make better business plans.
- Consider trip limits, trap limits and days-out to control landings rates, extend the season, and provide for better business planning for the industry.
- Updating F to assure the best available science is used for management decisions.

Sustaining a viable shrimp fishery benefits the region by helping maintain diversity in the industry and providing opportunities to harvest, process, and further develop support industries. Specific benefits associated with the amendment will vary depending upon the management tools selected by the Section.

1.1.3 Ecological Benefits

Northern shrimp is an identified link in marine food chains, preying on both planktonic and benthic invertebrates and in turn being 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 a balanced 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 the NOAA Fisheries Service (NMFS) 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 methods may improve the population of northern shrimp such as minimizing exceeding the harvest target through timely reporting or minimizing the harvest of smaller shrimp through trip and/or Days-Out limitations.

1.2 DESCRIPTION OF THE RESOURCE

1.2.1 Northern Shrimp Life History

The biology of northern shrimp in the Gulf of Maine has been studied extensively (Apollonio and Dunton 1969; Apollonio et al. 1986; Haynes and Wigley 1969; and others), and the biology of *P.borealis* has been reviewed by Shumway et al. (1985) and Bergström (2000). The species is hermaphroditic, maturing (in the Gulf of Maine) first as male at roughly 2½ years of age and then transforming to female at roughly 3½ years of age (Figure 1). 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. The males pass through a series of transitional stages before maturing as females. Some females may survive to repeat the spawning process in succeeding years, and may live to be five or perhaps six years old.

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).

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). 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.

1.2.2 Stock Assessment Summary

The 2010 stock assessment, conducted in the fall of 2010 by the Northern Shrimp Technical Committee, (NSTC) was based on commercial fishery data and fishery independent resource surveys through August 2010. 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 (i.e. the Collie-Sissenwine, or Catch-Survey Analysis (CSA), ASPIC surplus production, yield per recruit and eggs per recruit models) were introduced in 1997 and continue to be used to provide guidance for management of the stock. The annual stock assessments were peer-reviewed in 1997, 2002, and 2007 (NEFSC 1997, 2003, and 2007a-c).

Trends in abundance have been monitored since the late 1960's using data from Northeast Fisheries Science Center (NEFSC) autumn bottom trawl surveys (Figure 3), and summer surveys conducted by the State of Maine (discontinued in 1983). A state-federal shrimp survey was initiated by the NSTC in 1984. This survey is conducted each summer aboard the *R/V Gloria Michelle* and employs a stratified random sampling design and gear specifically designed for Gulf of Maine conditions. The strata sampled and catch per tow data for the 2010 summer survey cruise are plotted in Figure 4. The summer 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. The Maine annual spring inshore trawl survey has also been collecting data in depths greater than 55 fathoms (100 m) since 2003 which have been used in the assessment since 2008.
Abundance and biomass indices (stratified mean catch per tow in both numbers and weight) for the state-federal survey from 1984-2010 are given in Table 1, which includes indices for all

size/age groups, including those for age 1.5 animals and for shrimp >22 mm mid-dorsal carapace length.

The catch per tow in numbers of 1.5-year old shrimp (Table 1) represents a recruitment index, which, although the shrimp are not fully recruited to the survey gear, appears sufficient as a preliminary estimate of year-class strength. Individuals >22 mm will be fully recruited to the upcoming winter fishery (primarily age 3½ females and older) and thus survey catches of shrimp in this size category provide indices of harvestable numbers and biomass for the coming season. Both of these indices have reflected recruitment of the strong 1982, 1987, 1992, 2001 and 2004 year-classes.

Fishing mortality and exploitable biomass estimates for the Gulf of Maine northern shrimp fishery are generated by two separate models; the Collie-Sissenwine Analysis, also called Catch-Survey Analysis (CSA), and a surplus production model (ASPIC). The CSA tracks the removals of shrimp using summer survey indices of recruits and fully recruited shrimp scaled to total catch in numbers. The surplus production analysis models the biomass dynamics of the stock with a longer time series of total landings and four survey indices of stock biomass. The CSA estimates are used as the primary estimates for managing the fishery, while the surplus production estimates are used to corroborate results from the CSA and provide information about the period before the summer survey began (1968-1983).

Estimates of fishing mortality and biomass as described in the 2010 assessment, are in Table 2 and Figure 5.

1.2.3 Present condition of the stock

Landings in the Gulf of Maine northern shrimp fishery (Table 3 and Figure 6; Figure 7) declined after the mid 1990's, from a high of 9,166 mt in 1996 to a low of 424 mt in 2002, the result of low abundances of shrimp and reductions in fishing effort. Since then, landings have increased to 4,912 mt in the 152-day 2008 season (preliminary), and then declined to 2,163 mt in the 180-day 2009 season, probably due to market limitations. Preliminary landings data from harvester reports for the 2010 season total 5,617 mt. The 2010 season was characterized by very high catch rates and improved market conditions. 2010 landings were comprised mostly of assumed 5-year-old female shrimp from the moderate 2005 year class. (2009 and 2010 data are preliminary).

The number of fishing vessels (Table 4) and trawl trips dropped from about 347 and 11,791 respectively in 1996 to 198 and 1,010 in 2002, increased to 238 and 5,480 respectively in 2008, declined to 172 and 2,893 in 2009 (preliminary) and rose to 230 and 5,263 during 2010 (preliminary). Of the 230 vessels that have reported shrimp landings in 2010, 98 were trapping, and trappers accounted for about 19% of the 2010 landings (ASMFC 2010). (2009 and 2010 data are preliminary).

Fishing mortality rates (F), as calculated by CSA, declined from 1.16 in 1997 to 0.10 in 2002, then rose to 0.26 in the 2008 fishery, dropped to 0.09 in 2009, and rose again to 0.31 in 2010. Terminal year estimates are the most poorly approximated however. F was above the 1985-1994 average of 0.29 every year from 1995 through 2001, and has averaged 0.19 during 2002-2010 (Table 2 and Figure 5).

Exploitable biomass as estimated from CSA (Table 2 and Figure 5) declined from 12,800 mt at the beginning of the 1996 season to a time series low of 3,800 before 2001. Since then the biomass estimate has risen to 10,300 mt before 2005, as a result of the appearance of the strong 2001 year class, and to 23,000 mt for the 2007 season, driven by a strong 2004 year class and high summer survey indices for 2005 and 2006. The CSA biomass estimate has since declined to 14,400 for the 2011 season. The technical committee notes that there is a high degree of uncertainty around terminal year estimates, however. Exceptionally high survey indices from the 2006 summer survey, which had fewer tows than usual, continue to add a source of uncertainty.

Size composition data from both the fishery and summer surveys indicate that good landings have followed the recruitment of strong (dominant) year classes. Poor landings from 1998 to 2004, as well as low biomass estimates, can be attributed in part to the below-average recruitment of the assumed 1994, 1995, 1997, 1998, 2000, and 2002 year classes. In 2011, the female population will be comprised of the weak assumed 2006 year class (5-year-old females), and the moderate 2007 year class. The 2010 summer survey index for shrimp >22mm carapace (4.8 kg/tow) was at a median value, but below the time series average. However, the assumed 2008 and 2009 year classes appear to be of above-average abundance (Table 1).

1.2.3.1 Peer Review Panel Results from the 45h SAW

The northern shrimp stock assessment was peer-reviewed at the 45th Northeast Regional Stock Assessment Workshop (45th SAW) in June 2007, and included data through the 2006 summer survey. The following section was taken from the Summary Report (NEFSC 2007c):

"The SARC concluded that [the] stock assessment workshop (SAW) had completed its terms of reference successfully. Data were compiled correctly, benchmarks set reasonably, and stock status estimated in accordance with good scientific practice. The main reservations of the SARC were that biological benchmarks (reference points) were derived without reference to stock-recruitment relationships. While basing benchmarks on recruitment patterns may not always be possible, it should always be attempted. However, the SARC concluded that proposed reference points are acceptable in the short term, but should be re-evaluated at the next assessment and through additional research. Based on the above, the SARC concurs with the SAW's findings that the stock of northern shrimp is being fished at a rate below its F threshold, and thus, over fishing is not taking place; also, that the stock's biomass is above its biomass threshold, and thus, the stock is not in an over fished state."

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 90-180 meters.

The fishery has been seasonal in nature, peaking in late winter when egg-bearing females move into inshore waters and terminating in spring under regulatory closure. Table 5 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 264 tons in 1945, but then declined into the 1950s and during 1954-1957 no commercial landings of shrimp were recorded.

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 3) 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 minor. Landings by Massachusetts vessels were insignificant until 1969, but in the early 1970s the fishery developed rapidly, with landings increasing from 14% of the Gulf of Maine total in 1969 to over 40% in 1974-1975. 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 fluctuated considerably in response to recruitment from several strong year classes. Annual landings peaked at 5,000 tons and 4,400 tons in 1987 and 1990, respectively, dropping to 2,300 tons in 1993. Landings then increased to 9,500 tons in 1996 before declining to 3,700 tons in 1998. 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. Landings increased steadily, averaging 2,000 mt during the 2003 to 2006 seasons, then jumped to 4,100 mt in 2007 and 4,900 mt in the 2008 season. In 2009, 2,400 mt were landed during a season that was market-limited. The proposed 180-day season for 2010 was cut short to 156 days due to the industry exceeding the committee's 2009 recommended landings cap for that year, and concerns about small shrimp. The preliminary landings for 2010 are 5,600 mt which is more than double the landings observed in 2009. Maine landed 90% (5,081 mt) of the 2010 season total, while New Hampshire and Massachusetts combined landed 10% (535 mt) of the season total. The relative proportion of landings by month (preliminary data) remain generally similar to past years (ASMFC 2010). Mid-coast Maine, from Portland to Port Clyde, predominates in shrimping compared to the other regions in Maine.

Size composition collected from catches since the early 1980s, indicate that trends in landings have been determined primarily by recruitment of strong (dominant) year classes (ASMFC 2010). Landings more than tripled with recruitment of a strong assumed 1982 year class in 1985 - 1987 and then declined sharply in 1988. A strong 1987 year class was a major contributor to

the 1990-1992 fisheries. A strong 1992 year class, supplemented by a moderate 1993 year class, partially supported large annual landings in 1995 - 1998. Low landings in 1999 - 2003 were due in part to poor 1994, 1995, 1997, 1998, and 2000 year classes with only moderate 1996 and 1999 year classes. A very strong 2001 year class supported higher landings in 2004 - 2006. In the 2007 fishery, landings were mostly comprised of assumed 4-year-old females from the moderate to strong 2003 year class, and possibly 6-year-olds from the 2001 year class. 2008 landings were mostly composed of the assumed 4 year-old females from the strong 2004 year class, and the 2003 year class. In the 2009 fishery, catches were comprised mainly of assumed 5-year old females from the strong 2004 year class. Catches in the 2010 fishery consisted of assumed 5-year old females from the 2005 year class and possibly some 4 year old females from the weak 2006 year class. A few transitionals and female I's were observed from the assumed 2007 year class, and some juveniles from the assumed 2008 year class. A few shrimp in the <10 to 12 mm range may be our first look at the one-year-old shrimp (2009 year class; Figure 7).

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. Currently, the shrimp fleet is comprised of lobster vessels in the 9-14 m range that re-rig for shrimping, small to mid-sized stern trawlers in the 12-17 m range, and larger trawlers primarily in the 17-24 m range. The 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 yet is 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. As the trap fishery is dependent on the availability of shrimp in a specific area, there is a shorter season for traps than for draggers. However, 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 a few areas such as South Bristol and Boothbay Harbor (lower mid-coast Maine). According to federal and state of Maine Vessel Trip Reports (VTRs), trappers averaged 15% of Maine's landings during 2001 to 2009 (preliminary data), and 21% (preliminary data) in 2010 (ASMFC 2010).

The majority of the shrimp boats work out of smaller ports, though not necessarily the same small ports every year. In at least one case the shrimp fishery has been the salvation of the local marketing organization. Yankee Co-op in Seabrook (NH) weathered a crisis precipitated by the curtailment of groundfish landings due to regulatory action when their members successfully turned to the shrimp fishery.

Fishermen commonly point out that fishing has always been cyclical. Flexibility is critical, especially for small boats that are constrained by weather and safety considerations. A typical annual round for fishermen in the smaller ports is to lobster in the spring, summer and fall and

then to go shrimping in winter (December-May). Where this flexibility is curtailed by license limitations, many fishermen feel that the resilience of both the fleet and their communities is compromised. It is precisely the 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 fishermen even a limited shrimp harvest is sufficient to make the difference between financial stability and failure.

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 bring home 10 or 20 pounds of shrimp for home consumption or distribution to friends on a regular basis.

1.3.4 Non-Consumptive Factors

No non-consumptive factors in the northern shrimp fishery have been identified at this time.

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 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)

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 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, stock levels were extremely low, ultimately leading to the closure of the fishery in April 1977. Fishermen 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 shrimpers today also fish for other species during the year. Much the same behavior would be expected from a restricted or closed shrimp season, with most vessels extending their participation in other fisheries. However, the ability to switch between fisheries

has decreased since the implementation of limited entry and effort restrictions in the northeast multispecies (groundfish) fishery. Moreover, limited access in the groundfish fishery continues to add fishing participants to northeast fisheries including northern shrimp.

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 interaction between mobile gear and fixed gear does exist during two time periods. If the shrimp fishery begins in December or January, coastal lobstermen are quick to pay heed and make sure that their gear has been removed at the end of their season before the mobile gear vessels begin working on shrimp. In January through March, some shrimp fishermen use fixed gear to harvest shrimp. They also must be careful to avoid bottom where draggers might fish. Most trap fishermen fish in and around hard bottom coves and holes where mobile gear can't reach.

1.4 HABITAT CONSIDERATIONS

1.4.1 Habitat Important to the Stocks

1.4.1.1 Description of the Habitat

Pandalus borealis, commonly known as northern or pink shrimp, has a discontinuous distribution throughout the North Atlantic, North Pacific, and Arctic Oceans. In the Gulf of Maine, northern shrimp populations comprise a single stock (Clark and Anthony 1981), which is concentrated in the southwestern region of the Gulf (Haynes and Wigley 1969; Clark et al 1999, see Figure 3). Water temperature, depth, and substrate 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; Table 6).

Temperature

Adult northern shrimp have been reported to live in waters from -1.6^0C (Gorbunow 1934; Ingraham 1981) up to around 12^0C (Bjork 1913; Allen 1959), while larvae can tolerate temperatures up to at least 14^0 C (Poulson 1946); however, the most common temperature range for this species is 0-5^0 C (Shumway et al 1985). The Gulf of Maine marks the southern-most extent of this species' range, and seasonal water temperatures in many areas regularly exceed the upper physiological limit for northern shrimp. This environmental limitation restricts the amount of available habitat occupied by this species to the western region of the Gulf (west of 68^0 W) where bottom topography and oceanographic conditions create submarine basins protected from seasonal warming by thermal stratification. The deep basins act as cold water refuges for adult shrimp populations. In northeastern regions of the Gulf, large shrimp populations do not persist because bottom waters are not protected from seasonal warming due to continual mixing from intense tidal currents nearer the Bay of Fundy.

Depth

In the Gulf of Maine, northern shrimp are most frequently found from about 10 m to over 300 m (Haynes and Wigley 1969), with juveniles and immature males occupying shallower, inshore waters and mature males and females occupying cooler, deeper offshore waters for most of the year (Apollonio and Dunton 1969; Haynes and Wigley 1969, Apollonio et al 1986). During the summer months, adult shrimp inhabit water from 93-183 m (Clark et al. 1999); ovigerous female shrimp are found in shallower near-shore waters during the late winter and spring (Clark et al. 1999) when their eggs are hatching.

Substrate

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), where they prey on benthic invertebrates; however, the shrimp is not limited to this habitat and has been observed on rocky substrate (Berkeley 1930; Balsiger 1981). Shrimp distribution in relation to substrate type determined by spring, summer (Figure 4), and autumn (Figure 3) fisheries independent trawl surveys, clearly show northern shrimp primarily occupy areas with fine sediments (sand, silt, and clay). Shrimp are often associated with biotic or abiotic structures such as cerianthid anemone tubes (Langton and Uzmann 1989) and occasional boulders (Dan Schick, Maine Department of Marine Resources, pers.comm.) in these fine sediment habitats.

Other Environmental and Life History Features Governing Northern Shrimp Distribution

Northern shrimp occupy a variety of habitats during their complex life history. Like all members of the family Pandalidae, northern shrimp are protandric hermaphrodites, developing first into functional males, and later undergoing a transformation into females. Distribution and migratory patterns of this species change with age, (and in the case of females, with season), causing habitat preference to shift with different life history stages.

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 of this species 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).

As a stenohaline species, northern shrimp 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 to 35.7 (Shumway et al. 1985)

Spawning Habitat

In the Gulf of Maine, northern shrimp spawn in offshore waters beginning in late summer months (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 summertime population centers in deep mud basins in the southwestern Gulf (Haynes and Wigley 1969; Apollonio et al 1986). Ovigerous females remain in cold, stratified bottom waters offshore

through the fall until near-shore waters have cooled, at which time they begin an inshore migration to release their eggs (Haynes and Wigley 1969; Apollonio et al. 1986). 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 near-shore (Dan Schick, pers.comm.).

Eggs & Larval Habitat

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. 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 near-shore waters after about 30 to 60 days (Rinaldo 1981). It is important to note that time of egg release and larval development rate are temperature related, with colder water temperatures resulting in slower developmental progress (Allen 1959). Thus, the timing of egg release and length of pelagic larval stages may vary slightly from year to year as a result of water temperature fluctuations in the Gulf of Maine (Koeller et al 2009).

Juvenile Habitat

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 the age of 2 (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.

Adult Habitat & Distribution in the Gulf of Maine

Adult shrimp distributions appear to be governed by seasonal changes in water temperature. During the summer months, adult shrimp are confined to cold waters (4-6^{0}C) found only in the deeper basins (92-183 m) in the southwestern Gulf of Maine. Female shrimp are found in abundance in near-shore waters only during the late winter and spring when coastal waters are coldest (Clark et al. 1999). Within their preferred temperature range, northern shrimp occur mainly on mud bottom habitats (Clark et al. 1999) where the organic matter content of the sediment is high (Haynes and Wigley 1969). Bigelow and Schroeder (1939) and Wigley (1960) found a direct correlation between shrimp abundance and sediment organic matter content. Apollonio et al. (1986) argued that temperature is the most important factor driving the distributional patterns of shrimp in the Gulf. They suggest that correlations between shrimp abundance and fine sediments with high organic matter content may be purely coincidental because deep, quiescent environments in the Gulf of Maine are characterized by both cold,

unmixed water and accumulation of fine sediments.

Mud bottom habitats which support large populations of shrimp include: Jeffrey's basin (Apollonio and Dunton 1969), Cashes basin, Scantum basin (Dan Schick, Maine Department of Marine Resources, pers.comm.) and the region southeast of Mount Desert Island, Maine (Haynes and Wigley 1969). There are small populations in deep, cold water pockets in Penobscot Bay (Dan Schick, pers.comm.) and in the Sheepscot River (Les Watling, University of Maine, pers. comm.).

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. A wintertime fishery for northern shrimp extends as far south as the outer arm of Cape Cod, reaches as far north as Jonesport, Maine (Dan Schick, pers.comm.)

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 region of the 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. Changes 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, some deep, muddy bottom habitats are impacted by the use of mobile fishing gear to harvest groundfish (e.g.-trawls). Groundfish gear generally has a longer sweep and is towed much faster over the bottom. The small mesh in the shrimp gear creates more drag than a groundfish net and can't be towed as fast for the same size net. Also, groundfish gear generally has a larger diameter roller/rockhopper frame.

The effects of this type of fishing gear on habitat quality for shrimp are not known at this time. The use of mobile fishing gear has been shown to reduce structural complexity of bottom habitats (Auster et al. 1996). Such an effect could potentially reduce the survival of adult shrimp, which seem to utilize biotic and abiotic structures on mud bottoms, possibly to avoid predation.

Simpson and Watling (2006) suggested that seasonal trawling with shrimp gear on mud bottoms 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, etc. At this time, the inshore habitats occupied by larval and juvenile shrimp have not been mapped, and therefore 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 (like the North Atlantic oscillation, or climate change) on the amount of suitable habitat available to adult shrimp.

Likewise, the effects of mobile fishing gear on bottom habitats have been a subject of study for over a decade; however, the long-term impacts of trawling on shrimp habitat in deep, muddy basins is not known at this time.

1.4.1.4 Temperature Considerations

While the manner by which temperature affects recruitment and abundance trends has not been precisely determined, record high sea surface temperatures during the early 1950s correlate with complete failure of the fishery from 1954-1957; and 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. The collapse of the fishery during the 1970s was more problematic as it occurred during a period of warming temperatures, and high and increasing levels of fishing mortality rate; overfishing has been strongly implicated for the collapse. During the next two decades, significant recruitment events have coincided with normal to below normal spring sea surface temperature anomalies.

Given that this resource is at the southernmost extent of its Atlantic range, one would expect that temperature conditions would have a significant influence on long-term trends in abundance. Apollonio *et al.* (1986) concluded that this resource, because of its geographic location and its inherent susceptibility to environmental influences, would be inherently unstable. Dow (1977) found an inverse correlation between abundance and sea surface temperature (i.e. abundance is higher with lower sea surface temperatures) and has since been corroborated (Richards *et al.* 1996 and others). Koeller et al (2009) suggested that the winter inshore migration of egg-bearing females may be a behavioral adaptation to relatively warm (compared with other locations in their range) bottom water temperatures that delays egg development and brings hatching time closer to the time of spring bloom. This effect would be enhanced when temperatures of the well-mixed nearshore waters were colder, leading to the observed negative correlation between abundance and temperature. 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).

1.4.1.5 Ecosystem Considerations

Recently, the ASMFC, NOAA Fisheries Service, and several Fishery Management Councils have begun 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, coastal development). EBFM strives to integrate ecological, social, and economic goals while recognizing humans as key components of the ecosystem. EBFM also engages a broad and diverse group of stakeholders in a collaborative process 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 (e.g. 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 for northern shrimp. However, the Commission's Multispecies Technical Committee, Northern Shrimp Technical Committee (NSTC) and the NEFMC 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

This amendment continues to provide guidelines for managers to regulate the species in a biologically sustainable manner. Amendment 2 proposes timelier reporting to adequately monitor landings throughout the fishing season to prevent overharvest of the soft target TAC. If harvest is maintained at or below the soft target, biological collapse of the species will likely be prevented. However, unfavorable environmental conditions may severely impact northern shrimp regardless of stock biomass and fishing mortality levels.

If stock biomass is below the threshold established in this amendment or fishing mortality is above the threshold, 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.

When biomass is low or fishing mortality is high, managers have many options for taking action. Amendment 2 provides an extensive list of management tools from which they may choose. Depending on the tool or combination of tools chosen, the action may have varying impacts on the northern shrimp stock. For example, trip limits and days out may help control the catch rate of northern shrimp enabling more escapement opportunity for mature females; however, the potential for discard mortality associated with trip limits may preclude the biological benefits of this management option.

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).

For a variety of reasons, cold-water shrimp is primarily a secondary fishery for lobstermen and groundfishermen. It is regarded as an important winter fishery that allows fishermen to supplement their income when lobstering is slow and/or weather and quota constraints limit groundfishing. Trapping has 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 fishermen 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.

Fluctuations in abundance, size, cost and seasonal availability pose significant marketing challenges to the industry. In fact, in 2009, 83% of trapper respondents and 97% of trawler fishermen respondents noted that their efforts in shrimp 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).

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

Since shrimping is usually out of the smaller ports in the region, regulations that limit access and effort may have noticeable short-term negative impacts on the associated communities. 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, fishermen 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. The harvest target was exceeded in 2010 and 2011 fishing years.

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 fisherman 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 to participate in the fishery for a longer term.

The small ports where shrimp constitutes 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.

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. Shrimp is an essential component of the year's fishing returns for individual vessels from Rye, Hampton and Portsmouth and for New Hampshire's fishing cooperative. Furthermore, boats from Newburyport (Massachusetts) and York (Maine) are shrimp-landing members of the Yankee Fisherman's Coops, so the shrimp networks clearly extend beyond the borders of states and sub-regions in New England.

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, 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 ($0.50/lb) and 2011 ($0.75) (Table 3 and ME DMR unpublished data).

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 shrimpers passes through the hands of small businesses. Some of these are small-processors who peel and sell the raw product. Direct retail sale via roadside vending is common in Maine. 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 has been allowed as bycatch.

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 NMFS-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 release of finfish is seen across the length spectrum for flatfish, with a high percentage of even small flatfish escaping the net. The grate was instituted into the northern shrimp fishery for April and May, 1992 and 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 $\geq$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 MEDMR 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 (He and Balzano 2007).

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 noted, 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 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 45th Northeast Regional Stock Assessment Workshop report. Annual assessment updates are prepared. The results are found in the most recent report of the Northern Shrimp Technical Committee.

1.6.3 Social Assessment Documents

Moffett and Wilson (2010) conducted a recent survey of Gulf of Maine northern shrimp fishers.

The 1986 ASMFC FMP for northern shrimp includes data on: a history of the fishery; a statistical portrait of the fleet with respect to vessel sizes, horsepower, home ports, ports of landing, and seasonal distribution of fishing effort; a quantitative description of the processing sector and markets; a description of the economic value of the fishery as compared with other fisheries in the region.

While these data have historical value and serve as a useful context for present and future management actions, they are 15 years old and must be updated and expanded before it will be possible to conduct a thorough and accurate analysis of the socioeconomic consequences of currently proposed management actions.

1.6.4 Economic Assessment Document

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.

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" (November 2002) 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.

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. Management had its origins in 1972, when 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 northern shrimp 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 northern shrimp 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 codend);
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). As well, there 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).

The mid-1980s witnessed a resurgence of the resource, accompanied by relatively low instantaneous fishing mortality (F) and exploitation rates. Improved recruitment, particularly from the strong 1982 year class, made it possible for the Technical Committee to advise, and the Section to implement, a gradual extension of the open season for 1982-1985 culminating in the maximum duration allowable for the 1986 and 1987 seasons. Fishing mortality and exploitation rates averaged about 0.2 during the mid-1980s, well below levels thought to be sustainable. With good recruitment and continued moderate levels of exploitation, resource conditions remained healthy into the mid-1990s. During these years 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 since 1995 than were seen during the 1980s and early 1990s, and sharp declines in stock biomass and recruiting year-class size. The 36th Northeast Regional Stock Assessment Workshop (SAW) in December 2002 (NEFSC 2002) recognized these recent high levels of fishing mortality and low levels of biomass recommending biological reference points based on a stable period (1985 to 1994).

Given the consistently poor condition of the northern shrimp stock, the Section adopted Amendment 1 in 2004 to implement biological reference points to rebuild the shrimp resource. Provisions in Amendment 1 helped decrease fishing mortality rates and increase biomass through the use of a soft harvest target and closed season. Under Amendment 1 biomass began to increase as fishing mortality rates were consistently lower than the target from 2005 through 2009. A strong 2004, and moderate 2005 year class helped recover the northern shrimp stock to a healthy status.

Despite the recovery of the northern shrimp 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 closures and an overharvest of the target by 28% in 2010 and 48% in 2011 (preliminary data). In response to these issues, Amendment 2 is being developed to protect the northern shrimp resource, and stabilize its fishery.

2.1.2 Purpose and Need for Action

The decision to amend the FMP has been driven by three main issues: 1) the state of knowledge and tools available to manage the fishery have improved since 2004; 2) all ASMFC FMPs should be updated under the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) and the Interstate Fishery Management Program (ISFMP) Charter; 3) the desire by stakeholders and managers to stabilize the fishery to maximize its overall benefits.

Since the adoption of Amendment 1 to the Northern Shrimp FMP in 2004, the state of knowledge of the northern shrimp biology, population dynamics, and fishery has improved. While the management of northern shrimp has resulted in a rebuilt stock and increased fishing opportunity, there are a number of concerns that have been raised by managers and stakeholders.

The Northern Shrimp Section has closed the fishery prior to the end of the season due to landings rates that are greater than anticipated. The 2010 fishery closed 24 days early and the 2011 fishery closed 46 days early. Trip limits and days out of the fishery have been successfully implemented in other fisheries as a way to restrict total landings to extend the fishing season, prevent the market from being flooded with too much product, and control landings rates to better predict length of season. Controlling the catch rate and fishing effort may help maintain a more predictable fishery, and maximize potential markets.

Amendment 1 established a new fishing mortality target, $F_{1985-94}$= 0.22, based on the average fishing mortality rate from 1985 - 1994 when the biomass and landings were "stable". Amendment 1 also established a fishing mortality limit of F = 0.6, which is based on the fishing mortality rate from the mid-1970s and late 1990s when the stock collapsed. The F target and F limit were based on estimates that were generated in the December 2002 stock assessment for northern shrimp that was reviewed by the 36th Northeast Regional Stock Assessment Review Committee (SARC). Following this peer reviewed assessment; the shrimp assessment has been updated annually to provide the most up to date information on stock status. The 2010 assessment update estimates the average fishing mortality rate for the "stable" period at F = 0.29, rather than the F = 0.22. Therefore, as new assessment information becomes available the estimate of a fishing mortality reference points should be updated.

The current catch reporting requirements for the northern shrimp fishery do not provide timely or complete data for use by managers and scientists. The current reporting program requires catch reporting on a weekly, monthly, and yearly basis depending on gear and permit type. These significant delays in reporting have resulted in relatively short notice of the fishery closing in the last two seasons, as well as significant overages. Timely reporting would allow managers and stakeholders to monitor the landings relative to the harvest target and provide advance notice that a closure may be necessary.

The northern shrimp fishery is currently open access and has experienced significant fluctuations in participation over the last 30 years (Table 4). Interest and participation in the fishery generally increases as the season length or market price increases. Limited entry has been used in a number of fisheries along the Atlantic coast to control effort and maintain access to fishermen that have a history and a vested interest in the fishery. The early closures of the 2010 and 2011 fishery have increased the interest in exploring options to limit new entrants into the fishery. Although this amendment does not establish a limited entry program, it establishes a control date as a first step towards a limited entry program.

2.2 GOAL

Amendment 2 to the Interstate Fishery Management Plan for Northern Shrimp replaces Amendment 1 to the 1986 FMP for Northern Shrimp.

The Northern Shrimp Section agrees that, despite natural fluctuations in stock abundance, the northern shrimp fishery is manageable. In addition, the Section will provide for a continuing management program based on recommendations of the Technical Committee and the Advisory Panel to ensure a viable northern shrimp fishery in the Gulf of Maine over time.

The goal of Amendment 2 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 Amendment 2:

- 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

2.4 SPECIFICATION OF MANAGEMENT UNIT

The management unit for Amendment 2 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 BIOLOGICAL REFERENCE POINTS

Amendment 2 includes biological reference points as benchmarks for developing future management measures. 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 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.

There are two broad strategies for defining overfishing and stock status in practice today: 1) fishing mortality rate (F) strategies, and 2) stock biomass (B) strategies. Fishing mortality based reference points are designed to prevent fishing mortality rates from getting too high, which could result in a subsequent decline in the population because individual shrimp are being removed at too fast a rate. Fishing mortality rates above the threshold or target can be defined as a state of overfishing. Stock biomass based reference points are designed to prevent B from getting too low and compromising the ability of the stock to replenish itself. A B below the threshold can be considered to be depleted or overfished. To accurately categorize the status of a stock one should look at both fishing mortality and biomass, simultaneously.

The Section chose a stock biomass threshold and limit based on historical patterns. Amendment 2 does not employ a biomass target because the Section did not want to set unlikely goals for a species whose biomass can easily be affected by environmental conditions. The stock biomass threshold of $B_{Threshold}$ = 9,000 metric ton and limit of B_{Limit} = 6,000 metric ton are based on historical abundance estimates and response to fishing pressure, and remain unchanged from Amendment 1. The limit was set at 2,000 metric ton higher than the lowest observed biomass. The Section stresses that the threshold is not a substitute for a target. It will manage the fishery to maintain stock biomass above the threshold. Furthermore, the Section's management decisions will be affected by the year class composition of the stock.

The fishing mortality target is $F_{1985\text{-}94}$ = 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 is the maximum annual F during the same stable period (1985-94), which is F_{1987} = 0.37, as estimated by the NSTC in 2010. 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. The fishing mortality target, threshold and limit may be updated as the best scientific information becomes available through updated stock assessments. Overfishing is occurring if the threshold is exceeded.

2.6 STOCK REBUILDING PROGRAM

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. Should fishing mortality go above the threshold, 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 1.4.1.4 for the role northern shrimp play in ecosystem dynamics.

2.8 IMPLEMENTATION SCHEDULE

States are required to implement the provisions of Amendment 2 no later than January 22, 2012.

3.0 MONITORING PROGRAM SPECIFICATIONS/ELEMENTS

3.1 SUMMARY OF MONITORING PROGRAMS

In order to achieve the goals and objectives of Amendment 2, the collection and maintenance of quality data is necessary.

3.1.1 Catch and Landings Information

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

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.

3.1.2 Biological Information

The ACCSP will require the collection of baseline biological data on commercial, for-hire, and recreational fisheries. Biological data for commercial fisheries will be collected through port sampling programs and at-sea observers. Biological data for recreational fisheries will be collected in conjunction with the access-intercept survey. Biological data for for-hire fisheries will be collected through existing surveys and at-sea observer programs. A minimum set of standard data elements will be collected in all biological sampling programs. Refer to the ACCSP Program Design document for details. Priorities and target sampling levels will be determined by the ACCSP Biological Review Panel, in coordination with the Discard/Release Prioritization Committee.

3.1.3 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 fishermen 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 the research and analyses identified as needed in this amendment would help place the necessary decision-making on a more objective foundation.

3.1.4 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 almost the entire catch through the NMFS dealer weighout program. These data show that the average price per pound ranged from $0.57 in 2005 to $0.40 in 2009, with a low of $0.37 in 2006 (ASMFC 2010). Average price per pound increased from 2009 to $0.52 in 2010. Generally, higher landings flood the market resulting in a lower price per pound, but if shrimp count per pound is low (from the landings of larger shrimp) market price may increase.

Many vessels in the shrimp fleet fill out the NMFS Vessel Trip Reports for each trip. These logbooks do give an indication of fishing effort and crew size. There is no direct source of cost

data for this fleet except where a particular vessel has supplied these data to another NMFS 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 NMFS and state agencies. Up until about 1998, the NMFS funded shrimp sampling trips through the observer program at the Manomet Center for Conservation Science. State agencies also conduct routine sea sampling programs particularly since the wintertime is slow for fieldwork and shrimp boats are an excellent source of day trips. 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.

The ACCSP Socioeconomic data collection programs 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 the ACCSP program have slowed down the implementation of socioeconomic data collection programs.

3.1.5 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 fishery-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: http://www.accsp.org/programdocument.htm#prog). 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 are generated by two separate models; the Collie-Sissenwine, or Catch-Survey Analysis (CSA), and a surplus production model (ASPIC). The CSA tracks the removals of shrimp using summer survey indices of recruits and fully recruited shrimp scaled to total catch in numbers. The surplus production analysis models 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 are used as the primary point estimates for managing the fishery, while the surplus production estimates of fishing mortality are used to corroborate results from the CSA and provide historical perspective.

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 report will be prepared for the Section in a timely fashion (currently mid-October, depending on when data from the summer survey becomes available) in order to make annual adjustments to the management program as necessary.

Criteria

The stock assessment report will comprise landings, effort, survey indices, abundance, biomass, recruitment, fishing mortality, yield-per-recruit and spawning potential. Several primary surveys are examined, including the state-federal summer shrimp survey and the NMFS fall ground fish survey. Trends in abundance, biomass, recruitment and fishing mortality are derived from the CSA model. Fishing mortality estimates and stock size are corroborated using the surplus production analysis. Yield-per-recruit and egg-per-recruit models are used to estimate yield-per-recruit and maximum spawning potential.

Process

The Northern Shrimp Technical Committee prepares a stock assessment report each fall, using the best available scientific information and fishery statistics. 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 commercial, recreational, and for-hire fisheries. 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 logbook reported data, and port sampling. Recreational fisheries will be monitored through add-ons to existing intercept surveys and additional questions added to the telephone survey. For-hire fisheries will be monitored through an at-sea observer program and several qualitative programs (refer to the ACCSP Program Design for details).

3.4 HABITAT PROGRAM

No habitat monitoring program is currently in place for the Gulf of Maine. NEFMC is working on a document.

4.0 MANAGEMENT PROGRAM IMPLEMENTATION

4.1 COMMERCIAL FISHERIES MANAGEMENT MEASURES

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 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 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.

Fall Meeting Specification Options

e) Fishing Season (*Section 4.1.1)*
f) Trip Limits (*Section 4.1.2)*
g) Trap Limits (*Section 4.1.3*)
h) Days out of the Fishery (*Section 4.1.4)*

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 make adjustments to the fishing season, trip limits, and days out of the fishery at anytime during the rest of 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 fall fishing season specification meeting.

Amendment 2 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.

4.1.1 Fishing Season

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. The Section may set different seasons for the harvesting and processing sectors of the fishery to accommodate for the lag time of processing shrimp that are harvested late in the season. The Section may close the fishery at any time at a public meeting or conference call.

4.1.2 Trip Limits

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.

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 1.1) 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 1.2 shows the number of trips by state, gear, and vessel size and trip poundage categories for fishing years 2007-2011.

Appendix 1.3 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 1.4 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.

4.1.3 Trap Limits

The Section may annually set trap limits during the fall specification 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 more than the specified amount of traps during a designated trap limit fishing year.

All traps fished, or aboard a vessel, must be tagged. A permanent trap tag shall be used so that it is not transferable once attached to a trap. Each trap tag shall be color-coded coastwide by fishing year. Information printed on the tags shall be: 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.

4.1.4 Days Out of the Fishery

Days out of the fishery will be implemented to slow catch rates in order to prolong the harvest of the target TAC, or make shrimp available when demand is greatest. 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.

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.

4.1.5 Limited Entry – Control Date

Upon completion of Amendment 2, the Section will initiate consideration of a limited entry program through the adaptive management addendum process detailed in *Section 4.6.1*. The Public Information Document (PID) for this Amendment initially notified the public of the Section's intent to consider development of a limited entry program. Based on public comment received on the PID and the Section's concern regarding continuing effort increases in this fishery, the Section established a control date of June 7, 2011. 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. As noted in the PID, the Section may use historic landings and/or participation criteria for current and past participants as the limited entry system is established.

4.1.6 Minimum Mesh Size

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.

Tolerance. Due to the differences of net manufacturer mesh measurements and the mesh measurements used for enforcement of this regulation and other inherent variables 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.

4.1.7 Fishing Gear

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.

4.1.8 Cod End Strengthener

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.

4.1.9 Finfish Excluder Devices

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 shall not be allowed to possess regulated groundfish species.

4.1.10 Double Nordmore Grate

A double Nordmore grate may be used while fishing for northern shrimp. A double Nordmore grate is a second grate placed 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.

4.1.11 Mechanical "Shaking" Devices

Mechanical "shakers" have been used to rid from nets smaller shrimp. 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.

4.2 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

Until the habitat requirements for larval, juvenile, and adult shrimp are understood and maps of essential habitat for these life history stages are developed it is not feasible to make recommendations or develop requirements to conserve the inshore habitats utilized by these life history stages. The New England Fishery Management Council is developing an Omnibus Habitat Amendment that will likely contain additional information on the status of northern shrimp habitat in the Gulf of Maine. This Section can be updated in a subsequent amendment or addendum based on available information.

4.3.2 Habitat Restoration, Improvement, and Enhancement

Until the habitat requirements for larval, juvenile, and adult shrimp are understood and maps of essential habitat for these life history stages are developed it is not feasible to make recommendations or develop requirements to conserve the inshore habitats utilized by these life history stages. The New England Fishery Management Council is developing an Omnibus Habitat Amendment that will likely contain additional information on the status of northern shrimp habitat in the Gulf of Maine. This Section can be updated in a subsequent amendment or addendum based on available information.

4.5 ALTERNATIVE STATE MANAGEMENT REGIMES

Once approved by the Northern Shrimp Section, a state may not change its regulatory program without prior approval by the Section. However, a state may implement more restrictive measures without Section approval. A state can request a change only if that state can show to the Section's satisfaction that the action will not contribute to overfishing of the resource. Changes to state plans must be submitted in writing to, and approved by, the Section prior to implementation.

4.5.1 General Procedures

A state may submit a proposal for a change to its regulatory program or any mandatory compliance measure under this amendment. 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, the Stock Assessment Committee and the Advisory Panel.

The Plan Review Team is responsible for gathering the comments of the Technical Committee, the Stock Assessment 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 target fishing mortality rate, and the goals and objectives of this amendment.

4.5.2 Management Program Equivalency

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

4.6 ADAPTIVE MANAGEMENT

4.6.1 General Procedures

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 4.6.2.2. The process under which adaptive management can occur is provided below.

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, the Stock Assessment 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, the Stock Assessment 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.

4.6.2 Measures Subject to Change

4.6.2.1 Limited Entry – Control Date

Upon completion of Amendment 2, the Section initiate consideration of a limited entry program through the adaptive management addendum process detailed in *Section 4.6.1*. The Public Information Document (PID) for this Amendment initially notified the public of the Section's intent to consider development of a limited entry program. Based on public comment received on the PID and the Section's concern regarding continuing effort increases in this fishery, the Section established a control date of June 7, 2011. 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. As noted in the PID, the Section may use historic landings and/or participation criteria for current and past participants as the limited entry system is established.

4.6.2.2 Measures Subject to Change through Adaptive Management

The following measures are subject to change under adaptive management upon approval by the Northern Shrimp Section:

(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 2 that are not subject to annual specification
(13) Vessel monitoring programs

4.7 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 2. Procedures for implementation are addressed in the ASMFC ISFMP Charter, Section 6(c)(10) (ASMFC 2009).

4.8 MANAGEMENT INSTITUTIONS

4.8.1 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 must also 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.

4.8.2 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. It is responsible for the development of fishery management plans, amendments and addenda with respect to the northern shrimp fishery, and for soliciting public participation during their development. The Section establishes and oversees the activities of the Plan Review Team and the Technical Committee; and requests the establishment of the Commission's Northern Shrimp Advisory Panel. In addition, the Section makes changes to the management program under adaptive management and approves state programs implementing the amendment 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.

4.8.3 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 ASMFC 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 Amendment 2. 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 2, using the best scientific information available and the most current stock assessment information.

4.8.4 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.

4.8.5 Northern Shrimp Advisory Panel

The Northern Shrimp Advisory Panel is established according to the Commission's Advisory Committee Charter. Members of the Advisory Panel are citizens who represent a cross-section of commercial fishing interests. The Advisory Panel provides advice concerning the Commission's northern shrimp management program directly to the Section.

4.9 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.

4.10 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.

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. Although ASMFC does not have authority to directly compel states implementation of these measures, it 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 that the Commission will consider in determining state 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 2009).

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 7 of the ISFMP Charter if:

- It fails to meet any schedule required by Section 5.1.2, or any addendum prepared under adaptive management (Section 4.6); 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 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 in Section 4.1; except that a state may propose an alternative management program under Section 4.5. If the alternative program is approved by the Section, it shall be implemented as an alternative regulatory requirement for compliance.

5.1.1.1 Regulatory Requirements

States may begin to implement Amendment 2 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.

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 2.

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. However, elements of state plans may be added to address any needs identified through implementation of Amendment 2.

5.1.2 Compliance Schedule

States must implement the provisions of this amendment no later than January 22, 2012. States may begin implementation prior to this date when approved by the full Commission.

Reports on compliance must be submitted to the Commission by each jurisdiction annually, no later than September 30 each year.

5.1.3 Compliance/Technical Report Content

Each state must submit to the Commission and Technical Committee an annual report concerning its northern shrimp fisheries and management program for the previous year. The report shall cover:

- the previous calendar year's fishery and management program including activity and results of monitoring, regulations that were in effect, and harvest, including estimates of non-harvest losses; and
    - the planned management program for the current calendar year summarizing regulations that will be in effect and monitoring programs that will be performed, highlighting any changes from the previous year.

5.2 PROCEDURES FOR DETERMINING COMPLIANCE

Detailed procedures regarding compliance determinations are contained in the ISFMP Charter, Section Seven (ASMFC 2009).

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 2 will be reviewed at least annually. The Section, Policy Board or the ASMFC may request the Plan Review Team 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 addressed in a report. The report will include the required measures of Amendment 2 that the state has not implemented or enforced, a statement of how failure to implement or enforce required measures jeopardizes northern shrimp conservation, and the actions a state must take in order to comply with Amendment 2 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 the Amendment 2, 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.

5.3 ANALYSIS OF THE ENFORCEABILITY OF PROPOSED MEASURES

Amendment 2 does not prescribe a specific management measures. The northern shrimp management program will be developed through the annual public hearing and addendum process. Enforceability of management measures will be analyzed as specific measures are being contemplated.

6.0 MANAGEMENT AND RESEARCH NEEDS

6.1 STOCK ASSESSMENT AND POPULATION DYNAMICS

Research recommendations from the 45th Northeast Regional Stock Assessment Workshop (45th SAW), June 2007 (NEFSC 2007c):

- "Data collection
    - Data collection on discard rates in the northern shrimp fishery would be useful, not just with respect to shrimp, but to quantify discards of finfish. It is also recommended to sample shrimp discards in the small mesh herring and whiting fisheries.
    - Increased sampling of commercial catches, ensuring good allocation of samples among ports and months, could provide better estimates of size composition.
    - Research on annual variation of size at age could increase precision of the assessment."
- "Modeling
    - "The possibility of using a more detailed assessment model, such as the CASA model used for Atlantic sea scallop, should be studied. Use of a model with a more detailed treatment of northern shrimp population dynamics could increase accuracy and precision of assessment results.
    - "The relevance of environmental effects should be investigated in several contexts

        - Survey index - Exploration of any spatial, depth, or temperature influences on survey catchability could contribute to better standardization of the survey abundance index.
        - Stock and recruitment - It appears that temperature-correlated effects contribute to variation in the stock-recruitment relationship. Such effects should be examined further through continuing the type of research presented by A. Richards.
        - Surplus production - Environmental effects could likewise be examined through development of a surplus-production model that includes effects of environmental variation on per-capita production or carrying capacity.
    - "The CSA model as used here 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 better estimating this parameter could reduce uncertainty in the assessment.
    - "Further research to refine annual estimates of consumption by predators could be useful in several ways. Consumption estimates could lead to annual estimates of M that would be more realistic than assuming constant M, for use in models that include M explicitly. Alternatively, consumption estimates could be used in production models as annual removals similar to fishery removals.
    - "It seems likely that M will be assumed constant over time until annual consumption estimates can be refined and methods developed to provide them on an annual basis. In that case, the best value of M appears to be substantially higher than 0.25/yr. Unless new evidence appears to the contrary, a suitable higher value should be identified and used in future assessments. Such a change in the value used for M will require reference points to be recomputed.
    - "Target and threshold reference points for northern shrimp are set equal to one another at F = 0.22/yr. Using a buffer of zero between target and threshold reduces the relevance of reference points to management. Specifically, the distinction between desirable exploitation rates and those that indicate overfishing is blurred. The SARC recommends dialogue with managers and industry on this matter, as well as research to illustrate whether separating threshold from target would allow more stable or robust management techniques. When a common agreement exists about the function of each reference point, assessment scientists can calculate values to best serve each function."

6.2 RESEARCH AND DATA NEEDS

6.2.1 Biological

- Continue to collect fisheries-dependent data: landings, numbers, size, sex, and harvest area, effort, and gear.
- Continue to collect fisheries-independent data from surveys as described in section 1.2.2.
- Continue to monitor bycatch and develop fishing gear that reduces bycatch, the catch of small shrimp, and other habitat impacts.

- Evaluate effects of environmental factors on growth, survival and abundance of northern shrimp.
- Evaluate distribution and migration of larval, juvenile, and adult shrimp.

6.2.2 Social and Economic

- The data needs identified by the 1986 FMP remain important today. While the FMP did respond to the basic requisite, a much fuller examination of the industry is needed to properly analyze the potential impacts of the plan and the current amendment. Additional research needs include:
- Broad-based and detailed socioeconomic description and analysis of the structure, operations, markets, revenues and expenditures of the northern shrimp fishery itself and in relation to other commercial fisheries in northern New England.
- Ground-truthing for all of the data gathered via Federal and State databases. Contradictions and inaccuracies abound, so face-to-face interviews with a randomized sample of participants in all sectors of the fishery are needed.
- Develop a bioeconomic model to study the interactions between four variables: movements of shrimp, catchability of shrimp, days fished, and market price.
- Develop and economic-management model to determine (1) the most profitable times to fish, (2) how harvest timing effects markets, and (3) how the market effects the timing of harvesting.
- Determine the relative power relationships between the harvesting and processing sector and the larger markets for shrimp and shrimp products. 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.

6.2.3 Habitat

- Study specific habitat requirements for all life history stages.
- Develop habitat maps for all life history stages.
- Identify migration routes of immature males offshore, and ovigerous females inshore.
- Study the effects of large-scale climatic events (like the North Atlantic Oscillation) on the cold water refuges for shrimp in the Gulf of Maine.
- Determine the short and long-term effects of mobile fishing gear on shrimp habitat.
- Evaluate effects of habitat loss/degradation on northern shrimp.

7.0 PROTECTED SPECIES

In the fall of 1995, Commission member states, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) began discussing ways to improve implementation of the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA) in state waters. Historically, these policies have been only minimally implemented

and enforced in state waters (0-3 miles). In November 1995, the Commission, through its Interstate Fisheries Management Program (ISFMP) Policy Board, approved amendment of its ISFMP Charter (Section 6(b)(2)) so that protected species/fishery interactions are addressed in the Commission's fisheries management planning process. Specifically, the Commission's fishery management plans will describe impacts of state fisheries on certain marine mammals and endangered species (collectively termed "protected species"), and recommend ways to minimize these impacts. The following section outlines: (1) the federal legislation which guides protection of marine mammals and sea turtles, (2) the protected species with potential fishery interactions; (3) the specific type(s) of fishery interaction; (4) population status of the affected protected species; and (5) potential impacts to Atlantic coastal state and interstate fisheries.

7.1 MARINE MAMMAL PROTECTION ACT (MMPA) REQUIREMENTS

Since its passage in 1972, one of the underlying goals of the MMPA has been to reduce the incidental serious injury and mortality of marine mammals permitted in the course of commercial fishing operations to insignificant levels approaching a zero mortality and serious injury rate. The 1994 Amendments to the MMPA established section 118 to govern the taking of marine mammals incidental to commercial fishing operations. Under section 118, the National Marine Fisheries Service (NMFS) is required to develop and implement a take reduction plan to assist in the recovery or prevent the depletion of each strategic stock that interacts with a Category I or II fishery. Category I and II fisheries are those that have frequent or occasional incidental mortality and serious injury of marine mammals, respectively. In addition to complying with any applicable take reduction plans, vessels operating in Category I or II fisheries are required to annually register with NMFS and obtain an authorization certificate and carry observers if requested. All commercial fishermen, regardless of Category, are required to report all incidental mortality or serious injury of marine mammals that occurs incidental to commercial fishing to NMFS.

A strategic stock is defined as a stock: (1) for which the level of direct human caused mortality exceeds the potential biological removal (PBR) level; (2) which is declining and is likely to be listed under the Endangered Species Act (ESA) in the foreseeable future; or (3) which is listed as a threatened or endangered species under the ESA or as a depleted species under the MMPA.

Section 101(a)(5)(E) of the MMPA requires the authorization of the incidental taking of individuals from marine mammal stocks listed as threatened or endangered under the ESA in the course of commercial fishing operations if it is determined that: (1) incidental mortality and serious injury will have a negligible impact on the affected species or stock; (2) a recovery plan has been developed or is being developed for such species or stock under the ESA; and (3) where required under section 118 of the MMPA, a monitoring program has been established, vessels engaged in such fisheries are registered in accordance with section 118 of the MMPA, and a take reduction plan has been developed or is being developed for such species or stock. Currently, there are no permits that authorize takes of threatened or endangered species by any commercial fishery in the Atlantic.

7.2 ENDANGERED SPECIES ACT (ESA) REQUIREMENTS

The taking of endangered sea turtles and marine mammals is prohibited under Section 9 of the ESA. In addition, NMFS may issue Section 4(d) protective regulations necessary and advisable to provide for the conservation of threatened species. There are several mechanisms established

in the ESA to avoid the takings prohibition in Section 9. First, a 4(d) regulation may include less stringent requirements intended to reduce incidental take and thus allow for the exemption from the taking prohibition. Section 10(a)(1)(B) of the ESA authorizes NMFS to permit, under prescribed terms and conditions, any taking otherwise prohibited by Section 9 of the ESA, if the taking is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Finally, Section 7(a) requires NMFS to consult with each federal agency to ensure that any action that is authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any listed species. Section 7(b) authorizes incidental take of listed species after full consultation and identification of reasonable and prudent alternatives or measure to monitor and minimize such take.

7.3 PROTECTED SPECIES WITH POTENTIAL FISHERY INTERACTIONS

There are numerous protected species that inhabit the environment within the Northern Shrimp FMP management unit, and that, therefore, potentially occur in the operations area of the fishery. These species are afforded protection under the Endangered Species Act of 1973 (ESA; i.e., for those designated as threatened or endangered) and/or the Marine Mammal Protection Act of 1972 (MMPA), and are under NMFS' jurisdiction. As listed in Table 7, 16 marine mammal, sea turtle, and fish species are classified as endangered or threatened under the ESA; the remaining species in Table 7are protected by the MMPA and could likely interact with the northern shrimp fishery.

Species Present in the Area

Table 7 lists the species, protected either by the ESA, the MMPA, or both, that may be found in the environment that would be utilized by the fishery. Table 7 also includes two candidate fish species and one proposed fish species (species being considered for listing as an endangered or threatened species), as identified under the ESA. Candidate species are those petitioned species that are actively being considered for listing as endangered or threatened under the ESA, as well as those species for which NMFS has initiated an ESA status review that it has announced in the Federal Register. Atlantic sturgeon, Atlantic bluefin tuna, and cusk are known to occur within the action area of the northern shrimp fishery and could interact with types of gear used in the northern shrimp fishery.

Several Distinct Population Segments (DPSs) of loggerhead sea turtle are also proposed for uplisting to endangered status from threatened at this time.

Atlantic sturgeon has been proposed for listing under the ESA at this time, as well. A status review for Atlantic sturgeon was completed in 2007. NMFS has concluded that the U.S. Atlantic sturgeon spawning populations comprise five DPSs (ASSRT, 2007). The Gulf of Maine DPS of Atlantic sturgeon is proposed to be listed as threatened, and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs of Atlantic sturgeon are proposed as endangered. On October 6, 2010 (75 FR 61872 and 75 FR 61904), NMFS proposed listing five populations of Atlantic sturgeon along the U.S. East Coast as either threatened or endangered species. A final listing rule is expected by October 6, 2011.

Atlantic sturgeon from any of the five DPSs could occur in areas where the northern shrimp fishery operates, and the species has been captured in gear targeting multispecies, monkfish,

spiny dogfish and other fisheries (Stein et al. 2004a, ASMFC 2007). The proposed action to modify the northern shrimp fishery is expected to be completed after the anticipated date of a final listing determination for Atlantic sturgeon. However, the conference provisions of the ESA apply to actions proposed to be taken by federal agencies once a species is proposed for listing (50 CFR 402.10). Therefore, this EA includes information on the anticipated effects of the action on Atlantic sturgeon.

Candidate species receive no substantive or procedural protection under the ESA; however, NMFS recommends that project proponents consider implementing conservation actions to limit the potential for adverse effects on candidate species from any proposed project. NMFS has initiated review of recent stock assessments, bycatch information, and other information for these candidate and proposed species. The results of those efforts are needed to accurately characterize recent interactions between fisheries and the candidate/proposed species in the context of stock sizes. Final determinations on the proposed listings are expected by October 6, 2011. Any conservation measures deemed appropriate for these species will follow the information reviews. Please note that once a species is proposed for listing the conference provisions of the ESA apply (see 50 CFR 402.10).

7.4 POTENTIAL PROTECTED SPECIES INTERACTIONS WITH EXISTING FISHERIES

It is expected that the sea turtle, cetacean, and pinniped species discussed below have the potential to be affected by the operation of the northern shrimp fishery. Background information on the range-wide status of sea turtle and marine mammal species that occur in the area and are known or suspected of interacting with fishing gear (demersal gear including trawls, and pot/trap type gears) can be found in a number of published documents. These include sea turtle status reviews and biological reports (NMFS and USFWS 1995; Marine Turtle Expert Working Group (TEWG) 1998, 2000; NMFS and USFWS 2007a, 2007b; Leatherback TEWG 2007), recovery plans for ESA-listed cetaceans and sea turtles (NMFS 1991, 2005; NMFS and USFWS 1991a, 1991b; NMFS and USFWS 1992), the marine mammal stock assessment reports (e.g., Waring et al. 2006; 2007; 2009), and other publications (e.g., Clapham et al. 1999, Perry et al. 1999, Best et al. 2001, Perrin et al. 2002).

Additional ESA background information on the range-wide status of these species and a description of critical habitat can be found in a number of published documents including recent sea turtle (NMFS and USFWS 1995, TEWG 2000, NMFS SEFSC 2001, NMFS and USFWS 2007a), loggerhead recovery team report (NMFS and USFWS 2008), status reviews and stock assessments, Recovery Plans for the humpback whale (NMFS 1991), right whale (NMFS 1991a, NMFS 2005), right whale EIS (August 2007), fin and sei whale (NMFS 1998b), and the marine mammal stock assessment report (Waring et al. 2008) and other publications (*e.g.*, Perry *et al.* 1999; Clapham *et al.* 1999; IWC 2001 *a*). A recovery plan for fin and sei whales is also available and may be found at the following website (NOAA Fisheries unpublished).
http://www.NOAAFisheries.noaa.gov/prot_res/PR3/recovery.html

7.4.1 Sea Turtles

Loggerhead, leatherback, Kemp's ridley, and green sea turtles occur seasonally in southern New England and Mid-Atlantic continental shelf waters north of Cape Hatteras, North Carolina. In

general, turtles move up the coast from southern wintering areas as water temperatures warm in the spring (James et al. 2005a, Morreale and Standora 2005, Braun-McNeill and Epperly 2004, Morreale and Standora 1998, Musick and Limpus 1997, Shoop and Kenney 1992, Keinath et al. 1987). The trend is reversed in the fall as water temperatures cool. By December, turtles have passed Cape Hatteras, returning to more southern waters for the winter (James et al. 2005a, Morreale and Standora 2005, Braun-McNeill and Epperly 2004, Morreale and Standora 1998, Musick and Limpus 1997, Shoop and Kenney 1992, Keinath et al. 1987). Hard-shelled species are typically observed as far north as Cape Cod whereas the more cold-tolerant leatherbacks are observed in more northern Gulf of Maine waters in the summer and fall (Shoop and Kenney 1992, STSSN database http://www.sefsc.noaa.gov/seaturtleSTSSN.jsp).

The loggerhead sea turtle is listed as threatened throughout its worldwide range. On July 12, 2007, NMFS and USFWS (Services) received a petition from Center for Biological Diversity and Turtle Island Restoration Network to list the ‘‘North Pacific populations of loggerhead sea turtle’’ as an endangered species under the ESA. In addition, on November 15, 2007, the Services received a petition from Center for Biological Diversity and Oceana to list the ‘‘Western North Atlantic populations of loggerhead sea turtle’’ as an endangered species under the ESA. NMFS published notices in the *Federal Register*, concluding that the petitions presented substantial scientific information indicating that the petitioned actions may be warranted (72 FR 64585, November 16, 2007; 73 FR 11849; March 5, 2008). In 2008, a Biological Review Team (BRT) was established to assess the global population structure to determine whether DPSs exist and, if so, the status of each DPS. The BRT identified nine loggerhead DPSs, distributed globally (Conant et al. 2009). On March 16, 2010, the Services announced 12-month findings on the petitions to list the North Pacific populations and the Northwest Atlantic populations of the loggerhead sea turtle as DPSs with endangered status and published a proposed rule to designate nine loggerhead DPSs worldwide, seven as endangered (North Pacific Ocean DPS, South Pacific Ocean DPS, Northwest Atlantic Ocean DPS, Northeast Atlantic Ocean DPS, Mediterranean Sea DPS, North Indian Ocean DPS, and Southeast Indo-Pacific Ocean DPS) and two as threatened (Southwest Indian Ocean DPS and South Atlantic Ocean DPS). On March 22, 2011, the timeline for the final determination was extended for six months until September 16, 2011 (76 FR 15932).

In general, sea turtles are a long-lived species and reach sexual maturity relatively late (NMFS SEFSC 2001; NMFS and USFWS 2007a, 2007b, 2007c, 2007d). Sea turtles are injured and killed by numerous human activities (NRC 1990; NMFS and USFWS 2007a, 2007b, 2007c, 2007d). Nest count data are a valuable source of information for each turtle species since the number of nests laid reflects the reproductive output of the nesting group each year. A decline in the annual nest counts has been measured or suggested for four of five western Atlantic loggerhead nesting groups through 2004 (NMFS and USFWS 2007a), however, data collected since 2004 suggests nest counts have stabilized or increased (TEWG 2009). Nest counts for Kemp’s ridley sea turtles as well as leatherback and green sea turtles in the Atlantic demonstrate increased nesting by these species (NMFS and USFWS 2007b, 2007c, 2007d).

7.4.2 Large Cetaceans

The most recent Marine Mammal Stock Assessment Report (SAR) (Waring et al. 2009) reviewed the current population trend for each of these cetacean species within U.S. EEZ waters, as well as providing information on the estimated annual human-caused mortality and serious

injury, and a description of the commercial fisheries that interact with each stock in the U.S. Atlantic. Information from the SAR is summarized below.

The western North Atlantic baleen whale species (North Atlantic right, humpback, fin, sei, and minke) follow a general annual pattern of migration from high latitude summer foraging grounds, including the Gulf of Maine and Georges Bank, to low latitude winter calving grounds (Perry et al. 1999, Kenney 2002). However, this is an oversimplification of species movements, and the complete winter distribution of most species is unclear (Perry et al. 1999, Waring et al. 2009). Studies of some of the large baleen whales (right, humpback, and fin) have demonstrated the presence of each species in higher latitude waters even in the winter (Swingle et al. 1993, Wiley et al. 1995, Perry et al. 1999, Brown et al. 2002, Patrician et al. 2009). Blue whales are most often sighted on the east coast of Canada, particularly in the Gulf of St. Lawrence, and occurs only infrequently within the U.S. EEZ (Waring et al. 2002).

In comparison to the baleen whales, sperm whale distribution occurs more on the continental shelf edge, over the continental slope, and into mid-ocean regions (Waring et al. 2006). However, sperm whales distribution in U.S. EEZ waters also occurs in a distinct seasonal cycle (Waring et al. 2006). Typically, sperm whale distribution is concentrated east-northeast of Cape Hatteras in winter and shifts northward in spring when whales are found throughout the Mid-Atlantic Bight (Waring et al. 2006). Distribution extends further northward to areas north of Georges Bank and the Northeast Channel region in summer and then south of New England in fall, back to the Mid-Atlantic Bight (Waring et al. 1999).

For North Atlantic right whales, the available information suggests that the population is increasing at a rate of 1.8 percent per year during 1990-2003, and the total number of North Atlantic right whales is estimated to be at least 323 animals in 2003 (Waring et al. 2009). The minimum rate of annual human-caused mortality and serious injury to right whales averaged 3.8 per year during 2002 to 2006 (Waring et al. 2009). Of these, 1.4 per year resulted from fishery interactions. Recent mortalities included six female right whales, including three that were pregnant at the time of death (Waring et al. 2009).

The North Atlantic population of humpback whales is estimated to be 11,570, although the estimate is considered to be negatively biased (Waring et al. 2009). The best estimate for the Gulf of Maine stock of humpback whales is 847 whales (Waring et al. 2009). The population trend was considered positive for the Gulf of Maine population, but there are insufficient data to estimate the trend for the larger North Atlantic population. Based on data available for selected areas and time periods, the minimum population estimates for other western north Atlantic whale stocks are 2,269 fin whales, 207 sei whales, 4,804 sperm whales, and 3,312 minke whales (Waring et al. 2009). No recent estimates are available for blue whale abundance. Insufficient data exist to determine trends for any other large whale species.

The ALWTRP was recently revised with publication of a new final rule (72 FR 57104, October 5, 2007) that is intended to continue to address entanglement of large whales (right, humpback, fin, and minke) in commercial fishing gear and to reduce the risk of death and serious injury from entanglements that do occur.

NMFS expects to propose changes to right whale critical habitat in the latter half of 2011. On October 5, 2010, NOAA's Fisheries Service (NMFS) published a notice of a 90-day petition

finding and notice of 12-month determination in the Federal Register. NMFS was already conducting an ongoing analysis and evaluation of new information not available at the time of the original 1994 critical habitat designation prior to the receipt of this petition. Three critical habitat areas currently exist, established in 1994, two of which occur in the northeast region: feeding grounds in Cape Cod Bay and the Great South Channel

7.4.3 Small Cetaceans

Numerous small cetacean species (dolphins; pygmy and dwarf sperm whales; pilot and beaked, whales; and the harbor porpoise) occur within [the area from Cape Hatteras through the Gulf of Maine]. Seasonal abundance and distribution of each species in [Mid-Atlantic, Georges Bank, and/or Gulf of Maine] waters varies with respect to life history characteristics. Some species primarily occupy continental shelf waters (e.g., white sided dolphins, harbor porpoise), while others are found primarily in continental shelf edge and slope waters (e.g., Risso's dolphin, pilot whales), and still others occupy all three habitats (e.g., common dolphin, spotted dolphins, striped dolphins). Information on the western North Atlantic stocks of each species is summarized in Waring et al. (2009).

With respect to harbor porpoise, the most recent Stock Assessment Reports show that the number of harbor porpoise takes (817 animals/year from 2003-2007) exceed this stocks Potential Biological Removal (PBR) level calculated for this species (703 animals) and is therefore a strategic stock. Observer information collected from January 2005 to June 2006 has indicated an increase in porpoise bycatch throughout the geographic area covered by the Harbor Porpoise Take Reduction Plan (HPTRP) in both the Gulf of Maine and Mid-Atlantic regions and in monkfish gear specifically (NMFS, Discussion Paper on Planned Amendments to the Harbor Porpoise TRP 2007). The Harbor Porpoise Take Reduction Team developed options to reduce takes, and NMFS published a proposed rule on July 21, 2009 (74 *Federal Register* 36058) with four alternatives including no action. The comment period on this rule ended on August 20, 2009 and the final rule was published on February 19, 2010 (75 *Federal Register* 7383).

The following changes were implemented in the 2010 amendments to the HPTRP:

New England

- Expand the size of the Massachusetts Bay Management Area, as well as pinger use to include November;
- Establish the Stellwagen Bank Management Area and require pingers from November 1 through May 31;
- Establish the Southern New England Management Area where pingers are required from December 1 through May 31; and
- Establish the Cape Cod South Expansion Consequence Closure Area and Coastal Gulf of Maine Consequence Closure Area. These areas would be closed to gillnetting for two to three months if harbor porpoise bycatch levels are too high.

Mid-Atlantic

- Establish the Mudhole South Management Area, with a seasonal closure and gear modifications for large and small mesh gear;

- Modify the northern boundary of the waters off New Jersey Management Area to intersect with the southern shoreline of Long Island, NY at 72° 30' W longitude; and
- Modify tie-down spacing requirement for large mesh gillnets in all Mid-Atlantic management areas (waters off New Jersey, Mudhole North and South, and Southern Mid-Atlantic Management Areas).

The Atlantic Trawl Gear Take Reduction Team (ATGTRT) was organized in 2006 to implement a plan to address the incidental mortality and serious injury of long-finned pilot whales, short-finned pilot whales, common dolphins, and Atlantic white-sided dolphins in several trawl gear fisheries. In lieu of a TRP, the ATGTRT agreed to develop an Atlantic Trawl Gear Take Reduction Strategy (ATGTRS). The ATGTRS identifies informational and research tasks as well as education and outreach needs the ATGTRT believes are necessary to provide the basis for achieving the ultimate MMPA goal of achieving ZMRG. 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. These voluntary measures are as follows:

- Reducing the numbers of turns made by the fishing vessel and tow times while fishing at night; and
- Increasing radio communications between vessels about the presence and/or incidental capture of a marine mammal to alert other fishermen of the potential for additional interactions in the area.

7.4.4 Pinnipeds

Of the four species of seals expected to occur in the area, harbor seals have the most extensive distribution with sightings occurring as far south as 30° N (Katona et al. 1993, Waring et al. 2009). Gray seals are the second most common seal species in U.S. EEZ waters, occurring primarily in New England (Katona et al. 1993; Waring et al. 2009). Pupping for both species occurs in both U.S. and Canadian waters of the western north Atlantic with the majority of harbor seal pupping likely occurring in U.S. waters and the majority of gray seal pupping in Canadian waters, although there are at least three gray seal pupping colonies in U.S. waters as well. Harp and hooded seals are less commonly observed in U.S. EEZ waters. Both species form aggregations for pupping and breeding off eastern Canada in the late winter/early spring, and then travel to more northern latitudes for molting and summer feeding (Waring et al. 2006). Both species have a seasonal presence in U.S. waters from Maine to New Jersey, based on sightings, stranding, and fishery bycatch (Waring et al. 2009).

7.4.5 Atlantic Salmon DPSs

The Gulf of Maine (GOM) Distinct Population Segment (DPS) of anadromous Atlantic salmon was initially listed by the USFWS and NMFS (collectively, the Services) as an endangered species on November 17, 2000 (65 FR 69459). A subsequent listing as an endangered species by the Services on June 19, 2009 (74 FR 29344) included an expanded range for the GOM DPS of Atlantic salmon.

Presently, the GOM DPS includes all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River. Included are all associated conservation hatchery populations used to supplement these natural populations; currently, such conservation hatchery populations are maintained at

Green Lake National Fish Hatchery (GLNFH) and Craig Brook National Fish Hatchery (CBNFH). Coincident with the June 19, 2009 endangered listing, NMFS designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009). The critical habitat designation for the GOM DPS includes 45 specific areas occupied by Atlantic salmon at the time of listing that include approximately 19,571 km of perennial river, stream, and estuary habitat and 799 square km of lake habitat within the range of the GOM DPS and in which are found those physical and biological features essential to the conservation of the species. The entire occupied range of the GOM DPS in which critical habitat is designated is within the State of Maine.

7.4.6 Atlantic Sturgeon DPSs

Atlantic sturgeon is an anadromous species that spawns in relatively low salinity, river environments, but spends most of its life in the marine and estuarine environments from Labrador, Canada to the Saint Johns River, Florida (Holland and Yelverton 1973, Dovel and Berggen 1983, Waldman et al. 1996, Kynard and Horgan 2002, Dadswell 2006, ASSRT 2007). Tracking and tagging studies have shown that subadult and adult Atlantic sturgeon that originate from different rivers mix within the marine environment, utilizing ocean and estuarine waters for life functions such as foraging and overwintering (Stein et al. 2004a, Dadswell 2006, ASSRT 2007, Laney et al. 2007, Dunton et al. 2010). Fishery-dependent data as well as fishery-independent data demonstrate that Atlantic sturgeon use relatively shallow inshore areas of the continental shelf; primarily waters less than 50 m (Stein et al. 2004b, ASMFC TC 2007, Dunton et al. 2010). The data also suggest regional differences in Atlantic sturgeon depth distribution with sturgeon observed in waters primarily less than 20 m in the Mid-Atlantic Bight and in deeper waters in the Gulf of Maine (Stein et al. 2004b, ASMFC TC 2007, Dunton et al. 2010). Information on population sizes for each Atlantic sturgeon DPS is very limited. Based on the best available information, NMFS has concluded that bycatch, vessel strikes, water quality and water availability, dams, lack of regulatory mechanisms for protecting the fish, and dredging are the most significant threats to Atlantic sturgeon.

Comprehensive information on current abundance of Atlantic sturgeon is lacking for all of the spawning rivers (ASSRT, 2007). Based on data through 1998, an estimate of 870 spawning adults per year was developed for the Hudson River (Kahnle et al., 2007), and an estimate of 343 spawning adults per year is available for the Altamaha River, GA, based on data collected in 2004-2005 (Schueller and Peterson, 2006). Data collected from the Hudson River and Altamaha River studies cannot be used to estimate the total number of adults in either subpopulation, since mature Atlantic sturgeon may not spawn every year, and it is unclear to what extent mature fish in a non-spawning condition occur on the spawning grounds. Nevertheless, since the Hudson and Altamaha Rivers are presumed to have the healthiest Atlantic sturgeon subpopulations within the United States, other U.S. subpopulations are predicted to have fewer spawning adults than either the Hudson or the Altamaha (ASSRT, 2007). It is also important to note that the estimates above represent only a fraction of the total population size as spawning adults comprise only a portion of the total population (e.g., this estimate does not include subadults and early life stages)

7.4.7 Species Not Likely to be Affected

The action being considered in the EA is not likely to adversely affect shortnose sturgeon, the Gulf of Maine distinct population segment (DPS) of Atlantic salmon, hawksbill sea turtles, blue whales, or sperm whales, all of which are listed as endangered species under the ESA. Shortnose sturgeon and salmon belonging to the Gulf of Maine DPS of Atlantic salmon occur within the general geographical areas fished by the multispecies fishery, but they are unlikely to occur in the area where the fishery operates given their numbers and distribution. Therefore, none of these species are likely to be affected by the groundfish fishery. The following discussion provides the rationale for these determinations. Although there are additional species that may occur in the operations area that are not known to interact with the specific gear types that would be used by the groundfish fleet, impacts to these species are still considered due to their range and similarity of behaviors to species that have been adversely affected.

Shortnose sturgeon are benthic fish that mainly occupy the deep channel sections of large rivers. Shortnose sturgeon can be found in rivers along the western Atlantic coast from St. Johns River, Florida (although the species is possibly extirpated from this system), to the Saint John River in New Brunswick, Canada. The species is anadromous in the southern portion of its range (i.e., south of Chesapeake Bay), while some northern populations are amphidromous (NMFS 1998). Since the northern shrimp fishery would not operate in or near the rivers where concentrations of shortnose sturgeon are most likely found, it is highly unlikely that the fishery would affect shortnose sturgeon.

The wild populations of Atlantic salmon found in rivers and streams from the lower Kennebec River north to the U.S. - Canada border are listed as endangered under the ESA. These populations include those in the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, and Sheepscot Rivers and Cove Brook. Juvenile salmon in New England rivers typically migrate to sea in May after a 2- to 3-year period of development in freshwater streams, and remain at sea for two winters before returning to their U.S. natal rivers to spawn. Results from a 2001 post-smolt trawl survey in Penobscot Bay and the nearshore waters of the Gulf of Maine indicate that Atlantic salmon post-smolts are prevalent in the upper water column throughout this area in mid- to late May. Therefore, commercial fisheries deploying small-mesh active gear (pelagic trawls and purse seines within 10 m of the surface) in nearshore waters of the Gulf of Maine may have the potential to incidentally take smolts. However, it is highly unlikely that the approval of this EA would affect the Gulf of Maine DPS of Atlantic salmon given that operation of the northern shrimp fishery would not occur in or near the rivers where concentrations of Atlantic salmon are likely to be found and northern shrimp fishing gear used by the fleet operates in the ocean at or near the bottom rather than near the water surface.

The hawksbill turtle is uncommon in the waters of the continental U.S. Hawksbills prefer coral reefs, such as those found in the Caribbean and Central America. Hawksbills feed primarily on a wide variety of sponges but also consume bryozoans, coelenterates, and mollusks. The Culebra Archipelago of Puerto Rico contains especially important foraging habitat for hawksbills. Nesting areas in the western North Atlantic include Puerto Rico and the Virgin Islands. There are accounts of hawksbills in south Florida and individuals have been sighted along the east coast as far north as Massachusetts; however, east coast sightings north of Florida are rare (NMFS 2009a). Since operation of the northern shrimp fishery would not occur in waters that are

typically used by hawksbill sea turtles, it is highly unlikely that its operations would affect this turtle species.
Blue whales do not regularly occur in waters of the U.S. EEZ (Waring et al. 2009). In the North Atlantic, blue whales are most frequently sighted in the St. Lawrence from April to January (Sears 2002). No blue whales were observed during the Cetacean and Turtle Assessment Program (CeTAP) surveys of the mid- and north Atlantic areas of the outer continental shelf (CeTAP 1982). Calving for the species occurs in low latitude waters outside of the area where the groundfish fishery operates. Blue whales feed on euphausiids (krill) that are too small to be captured in fishing gear. Given that the species is unlikely to occur in areas where the northern shrimp fishery operates, and given that the operation of the fishery would not affect the availability of blue whale prey or areas where calving and nursing of young occurs, the Proposed Action would not be likely to adversely affect blue whales.

Unlike blue whales, sperm whales do regularly occur in waters of the EEZ. However, the distribution of the sperm whales in the EEZ occurs on the continental shelf edge, over the continental slope, and into mid-ocean regions (Waring et al. 2006). In contrast, the northern shrimp fishery does not operate in continental shelf waters. The average depth of sperm whale sightings observed during the CeTAP surveys was 1792 m (CeTAP 1982). Female sperm whales and young males almost always inhabit open ocean, deep water habitat with bottom depths greater than 1000 m and at latitudes less than 40° N (Whitehead 2002). Sperm whales feed on large squid and fish that inhabit the deeper ocean regions (Perrin et al. 2002). Given that sperm whales are unlikely to occur in areas (based on water depth) where the northern shrimp fishery would operate, and given that the operation of the fishery would not affect the availability of sperm whale prey or areas where calving and nursing of young occurs, the Proposed Action would not be likely to adversely affect sperm whales.

Although large whales and marine turtles may be potentially affected through interactions with fishing gear, it is likely that the continued authorization of the norterhn shrimp fishery should not have any adverse effects on the availability of prey for these species. Right whales and sei whales feed on copepods (Horwood 2002, Kenney 2002). The northern shrimp fishery would not affect the availability of copepods for foraging right and sei whales because copepods are very small organisms that would pass through multispecies fishing gear rather than being captured in it. Humpback whales and fin whales also feed on krill as well as small schooling fish (e.g., sand lance, herring, mackerel) (Aguilar 2002, Clapham 2002). Northern shrimp fishing gear operates on or very near the bottom. Fish species caught in norterhn shrimp gear are species that live in benthic habitat (on or very near the bottom) such as flounders versus schooling fish such as herring and mackerel that occur within the water column. Therefore, the continued authorization of the northern shrimp fishery should likely not affect the availability of prey for foraging humpback or fin whales.

7.4.8 Seabirds

Like marine mammals, seabirds are vulnerable to entanglement in commercial fishing gear. The interaction has not been quantified in the northern shrimp fishery, but impacts are not considered to be significant. Human activities such as coastal development, habitat degradation and destruction, and the presence of organochlorine contaminants are considered to be the major threats to some seabird populations. Endangered and threatened bird species, which include the

roseate tern and piping plover, are unlikely to be impacted by the gear types employed in the northern shrimp fishery.

7.5 POPULATION STATUS REVIEW OF RELEVANT PROTECTED SPECIES

7.5.1 Marine Mammals

The status of marine mammal populations inhabiting the Gulf of Maine has been discussed in great detail in the U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Reports (Waring, *et al.* 2000). The reports present information on stock definition, geographic range, population size, productivity rates, potential biological removal (PBR) level, fishery specific mortality estimates, and a comparison of the PBR level to estimated human-caused mortality for each stock.

7.6 IDENTIFICATION OF CURRENT DATA GAPS AND RESEARCH NEEDS

A lack of sea sampling data in regard to protected species interactions in the Gulf of Maine northern shrimp fishery has been identified. Additional observer coverage in this fishery is needed to understand whether interaction occurs between the Gulf of Maine northern shrimp fishery and protected species.

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9.0 TABLES

Table 1. Stratified* retransformed mean numbers and weights per tow of northern shrimp collected during R/V Gloria Michelle state/federal summer surveys.

		Log_e retransformed				
Year	N Tows	Age-1.5 Number	>22 mm** Number	>22 mm** Weight (kg)	Total Number	Total Weight (kg)
1984		18	316	3.4	1,152	10.5
1985	44	332	1,169	11.5	1,825	17.7
1986	40	358	860	10.0	1,695	19.6
1987	41	342	854	9.5	1,533	15.4
1988	41	828	298	3.4	1,269	12.8
1989	43	276	564	6.1	1,884	17.0
1990	43	142	1,127	12.0	1,623	18.1
1991	43	482	657	8.0	1,256	11.7
1992	45	282	397	4.8	955	9.4
1993	46	757	250	2.8	1,157	9.1
1994	43	368	243	2.7	984	8.7
1995	35	292	628	7.0	1,449	13.3
1996	32	232	358	4.0	776	8.8
1997	40	374	245	2.8	762	7.7
1998	35	134	170	1.9	583	6.3
1999	42	114	174	1.9	398	5.8
2000	35	450	283	3.2	808	6.4
2001	36	18	146	1.5	451	4.3
2002	38	1,164	261	2.9	1,445	9.2
2003	37	11	173	1.7	564	5.5
2004	35	286	519	5.3	887	10.3
2005	46	1,752	871	10.3	3,661	23.4
2006	29	374	2,773	29.9	9,998	66.0
2007	43	28	412	4.1	887	11.5
2008	38	506	995	10.8	1,737	16.8
2009	49	582	702	8.5	1,627	15.4
2010	49	475	413	4.8	1,373	13.9
Mean	40	407	587	6.5	1,583	13.9
Median	41	342	412	4.8	1,256	11.5

*Based on strata 1, 3, 5, 6, 7 and 8.
**Will be fully recruited to the winter fishery.

Table 2. Summary of results from 2010 CSA analysis, Gulf of Maine northern shrimp.

Fishing Season	New Recruits (millions)	Fully-Recruited (millions)	F (NR+FR)	Biomass (1000 mt)	Exploitation Rate
1985	757	703	0.32	10.59	24%
1986	785	829	0.29	13.67	22%
1987	602	939	0.37	13.99	28%
1988	464	827	0.22	11.84	18%
1989	718	805	0.24	10.42	18%
1990	763	936	0.35	13.02	26%
1991	501	935	0.29	13.58	22%
1992	368	838	0.28	11.64	22%
1993	330	710	0.24	9.44	18%
1994	517	639	0.31	7.69	23%
1995	907	662	0.57	10.77	39%
1996	916	691	0.80	12.77	50%
1997	582	560	1.16	9.32	60%
1998	467	278	0.82	5.12	50%
1999	337	257	0.52	4.22	36%
2000	250	275	0.59	4.21	39%
2001	304	227	0.35	3.78	26%
2002	233	291	0.10	3.98	8%
2003	490	369	0.16	4.97	13%
2004	363	569	0.27	6.74	21%
2005	724	553	0.23	10.29	18%
2006	1,674	791	0.09	15.78	8%
2007	1,394	1,751	0.17	22.99	14%
2008	375	2,057	0.26	20.61	20%
2009	552	1,467	0.12	18.59	9%
2010	585	1,397	0.31	18.35	23%
2011	678	1,135		14.40	
Overall average	614	783	0.36	11.1	25%
1985-94 average	580	816	0.29	11.6	22%

Table 3. U.S. Commercial landings (mt) of northern shrimp in the Gulf of Maine.

Year	Maine		Massachusetts		New Hampshire		Total		Price	Value
	Annual	Season	Annual	Season	Annual	Season	Annual	Season	$/Lb	$
1958	2.2		0.0		0.0		2.2		0.32	1,532
1959	5.5		2.3		0.0		7.8		0.29	5,002
1960	40.4		0.5		0.0		40.9		0.23	20,714
1961	30.5		0.3		0.0		30.8		0.20	13,754
1962	159.5		16.2		0.0		175.7		0.15	57,382
1963	244.3		10.4		0.0		254.7		0.12	66,840
1964	419.4		3.1		0.0		422.5		0.12	112,528
1965	941.3		8.0		0.0		949.3		0.12	245,469
1966	1,737.8		10.5		18.1		1,766.4		0.14	549,466
1967	3,141.2		10.0		20.0		3,171.2		0.12	871,924
1968	6,515.2		51.9		43.1		6,610.2		0.11	1,611,425
1969	10,993.1		1,773.1		58.1		12,824.3		0.12	3,478,911
1970	7,712.8		2,902.3		54.4		10,669.5		0.20	4,697,419
1971	8,354.8		2,724.0		50.8		11,129.6		0.19	4,653,203
1972	7,515.6		3,504.6		74.8		11,095.0		0.19	4,586,484
1973	5,476.6		3,868.2		59.9		9,404.7		0.27	5,657,348
1974	4,430.7		3,477.3		36.7		7,944.7		0.32	5,577,465
1975	3,177.2		2,080.0		29.4		5,286.6		0.26	3,062,721
1976	617.3		397.8		7.3		1,022.4		0.34	764,094
1977	142.1		236.9		2.2		381.2		0.55	458,198
1978	0.0		3.3		0.0		3.3		0.24	1,758
1979	32.8		405.9		0.0		438.7		0.33	320,361
1980	69.6		256.9		6.3		332.8		0.65	478,883
1981	530.0		539.4		4.5		1,073.9		0.64	1,516,521
1982	883.0		658.5		32.8		1,574.3		0.60	2,079,110
1983	1,029.2		508.2		36.5		1,573.9		0.67	2,312,073
1984	2,564.7		565.4		96.8		3,226.9		0.49	3,474,352
1985	2,957.0	2,946.4	1,030.5	968.0	207.4	216.5	4,194.9	4,130.9	0.44	3,983,599
1986	3,407.2	3,268.2	1,085.7	1,136.3	191.1	230.5	4,684.0	4,635.0	0.63	6,451,207
1987	3,534.2	3,680.2	1,338.7	1,427.9	152.5	157.9	5,025.4	5,266.0	1.10	12,740,583
1988	2,272.5	2,258.4	632.7	619.6	173.1	157.6	3,078.3	3,035.6	1.10	7,391,778
1989	2,544.8	2,384.0	751.6	699.9	314.3	231.5	3,610.7	3,315.4	0.98	7,177,660
1990	2,962.1	3,236.3	993.4	974.9	447.3	451.3	4,402.8	4,662.5	0.72	7,351,421
1991	2,431.5	2,488.6	737.7	814.6	208.3	282.1	3,377.5	3,585.3	0.91	7,208,839
1992	2,990.4	3,070.6	291.7	289.3	100.1	100.1	3,382.2	3,460.0	0.99	7,547,942
1993	1,563.1	1,492.5	300.3	292.8	441.2	357.6	2,304.6	2,142.9	1.07	5,038,053
1994	2,815.4	2,239.7	381.9	247.5	521.0	428.0	3,718.3	2,915.2	0.75	4,829,107
1995		5,013.7		670.1		772.8		6,456.6	0.90	12,828,031
1996		8,107.1		660.6		771.7		9,539.4	0.73	15,341,506
1997		6,086.9		366.4		666.2		7,119.5	0.79	12,355,873
1998		3,481.3		240.3		445.2		4,166.8	0.96	8,811,939
1999		1,573.2		75.7		217.0		1,865.9	0.91	3,762,044
2000		2,085.3		110.3		212.3		2,407.9	0.79	4,190,546
2001		1,073.4		49.2		206.4		1,329.1	0.86	2,530,396
*2002		364.8		7.7		51.2		423.7	1.08	1,008,647
*2003		1,081.2		23.1		106.7		1,211.0	0.87	2,333,789
*2004		1,752.7		17.5		174.6		1,944.8	0.44	1,906,712
2005		2,218.6		48.1		289.8		2,556.5	0.57	3,194,664
2006		1,965.9		24.8		90.2		2,080.9	0.37	1,689,650
*2007		3,759.4		10.3		290.2		4,059.9	0.38	3,400,517
*2008		4,470.4		25.4		413.8		4,909.6	0.49	5,349,876
2009		2,187.4		MA and NH combined -->		178.5		2,365.9	0.40	2,096,476
2010		5,081.1		34.6		501.7		5,617.4		

*Includes removals by experimental studies

2009 and 2010 are preliminary.

Table 4. Estimated numbers of vessels in the Gulf of Maine northern shrimp fishery by fishing season and state from 1980 to 2010.

Season	Maine	Massachusetts	New Hampshire	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	249	15	23	287
2001	235	25	28	288
2002	167	8	23	198
2003	213	12	23	248
2004	169	7	15	191
2005	167	9	22	198
2006	126	5	11	142
2007	177	3	15	195
2008	219	4	15	238
*2009	160	1	11	172
*2010	209	5	16	230

* preliminary

Table 5. Management of the Gulf of Maine Northern Shrimp Resource, 1973 – 2011.

NSS	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 codend.
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.

NSS ACTION TAKEN	
1984	Open seson 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 codend 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.

NSS 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)
2007	Season December 1, 2006– April 30, 2007. (151 days)
2008	Season December 1, 2007– April 30, 2008. (152 days)

NSS ACTION TAKEN	
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

Table 6. Important factors affecting shrimp distribution in the Gulf of Maine.

LIFE HISTORY STAGE	TIME OF YEAR	LOCATION	TEMPERATURE	DEPTH	SALINITY	SUBSTRATE	ESTUARINE USE
Spawning Adults	Late summer through fall (Haynes and Wigley 1969)	Deep cold water refuges in southwestern Gulf of Maine (Apollonio et al. 1986)	< 7 0 C (Clark et al. 1999)	92-183 m (Clark et al. 1999)	Most common in waters from 32.3 to around 33 (Haynes and Wigley 1969)	Mud (Clark et al. 1999)	-
Eggs	Eggs retained on pleopods of female after extrusion in late summer/early fall until hatch in winter	Hatch in near-shore waters (Apollonio and Dunton 1969)	Same as for ovigerous females (see below).	Same as for ovigerous females (see below).	Same as for ovigerous females (see below).		Unknown
Larvae **(30 to 60 days; Rinaldo 1980)**	Larvae: in water column winter – late summer (Apollonio and Dunton 1969)	Near-shore waters out to ~ 10 miles (Apollonio and Dunton 1969)	Unknown, likely below 14 0 C (Poulson 1946)	Unknown	Often in water < 30 (Haynes and Wigley 1969)	Water column near-shore (Apollonio and Dunton 1969)	Unknown
Juvenile/ Immature Male **(Age 1 to 2 months until 27 to 28 months**	Late summer / early fall through the following summer (Apollonio and Dunton 1969) Juvenile stage up to 20 months ()	Near-shore waters, beginning migration to offshore waters (>10 miles) around age 20 months (Apollonio and Dunton 1969)	Unknown	Unknown	Unknown	Unknown, probably mud	Unknown
Mature Male **(Age 29-30 months)**	Summer/fall through the following (Apollonio and Dunton 1969)	Deep offshore basins in southwestern Gulf of Maine (Apollonio and Dunton 1969)	0-6 0C (Shumway et al. 1985	92 – 183 m (Clark et al. 1999)	Most common in waters from 32.3 to around 33 (Haynes and Wigley 1969)	Mud (Clark et al. 1999)	-
Transitional Stage	Fall – Spring (Apollonio and Dunton 1969)	Deep offshore basins in southwestern Gulf of Maine (Apollonio and Dunton 1969)	0-6 0C (Shumway et al. 1985	92 – 183 m (Clark et al. 1999)	Most common in waters from 32.3 to around 33 (Haynes and Wigley 1969)	Mud (Clark et al. 1999)	-
Mature Female **Age 41-42 months until death around ages 54-66 months)**	Spring – live one or two more years until death (Apollonio and Dunton 1969)	Deep offshore basins in southwestern Gulf of Maine (Apollonio and Dunton 1969)	0-6 0C (Shumway et al. 1985	92 – 183 m (Clark et al. 1999)	Most common in waters from 32.3 to around 33 (Haynes and Wigley 1969)	Mud (Clark et al. 1999)	
Ovigerous Females	Early fall – late winter (Apollonio and Dunton 1969)	Migration to near-shore waters (Haynes and Wigley 19690	0-6 0C (Shumway et al. 1985	Most < 60 m (Haynes and Wigley 1969)	Coastal	Mud (Clark et al. 1999); few and sandy and rocky bottoms	Unknown

Table 7. Species protected under the Endangered Species Act and Marine Mammal Protection Act that may occur in the operations area for the northern shrimp fishery

Species	Status
Cetaceans	
North Atlantic right whale (*Eubalaena glacialis*)	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered
Fin whale (*Balaenoptera physalus*)	Endangered
Sei whale (*Balaenoptera borealis*)	Endangered
Minke whale (*Balaenoptera acutorostrata*)	Protected
Pilot whale (*Globicephala spp*.)	Protected
Risso's dolphin (*Grampus griseus*)	Protected
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Protected
Common dolphin (*Delphinus delphis*)	Protected
Harbor porpoise (*Phocoena phocoena*)	Protected
Sea Turtles	
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered
Green sea turtle (*Chelonia mydas*)	Endangered[a]
Loggerhead sea turtle (*Caretta caretta*)	Threatened
Fish	
Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered
Atlantic salmon (*Salmo salar*)	Endangered
Cusk *(Brosme brosme)*	Candidate
Atlantic sturgeon *(Acipenser oxyrinchus)*	Proposed
Atlantic Bluefin Tuna (*Thunnus thynnus)*	Candidate
Pinnipeds	
Harbor seal (*Phoca vitulina*)	Protected
Gray seal (*Halichoerus grypus*)	Protected
Harp seal (*Phoca groenlandicus*)	Protected
Hooded seal (*Cystophora cristata*)	Protected

Notes:

- MMPA-listed species occurring on this list are only those species that have a history of interaction with similar gear types within the action area of the Northeast Multispecies Fishery, as defined in the 2010 List of Fisheries.
- Bottlenose dolphin (*Tursiops truncatus*), Western North Atlantic coastal stock is listed as depleted.

a Green turtles in U.S. waters are listed as threatened except for the Florida breeding population which is listed as endangered. Due to the inability to distinguish between these populations away from the nesting beach, green turtles are considered endangered wherever they occur in U.S. waters.

10.0 FIGURES

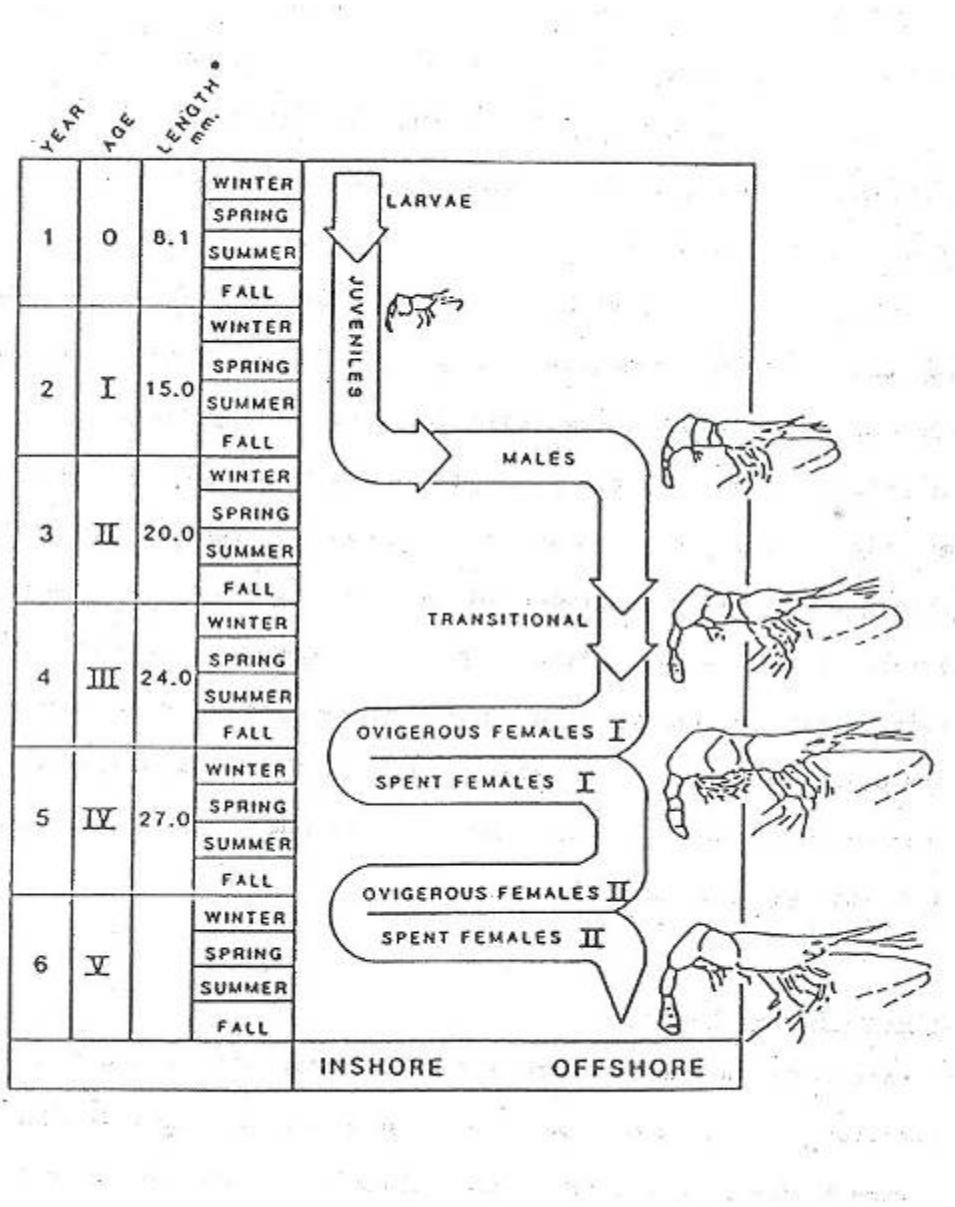

Figure 1. Schematic diagram of the life cycle of *Pandalus borealis* in the Gulf of Maine (modified from Shumway et. al. 1985)

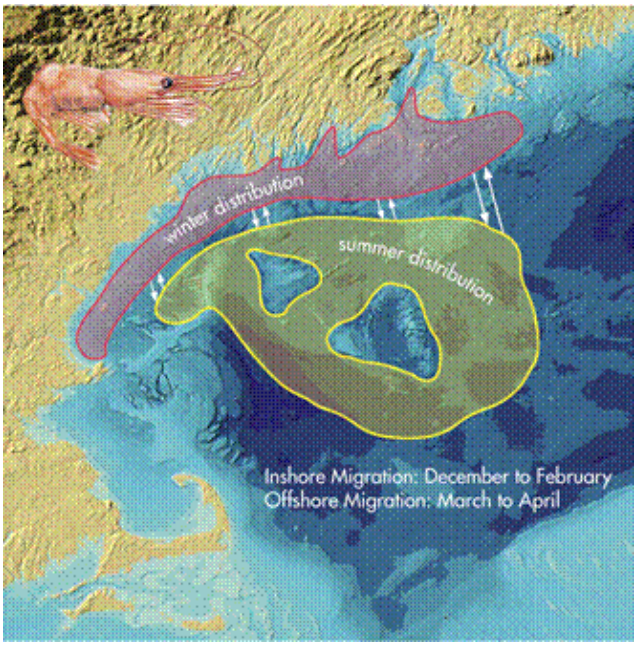

Figure 2. Distribution and migration of adult female shrimp in the Gulf of Maine (Anon. 2006 courtesy of NAMA)

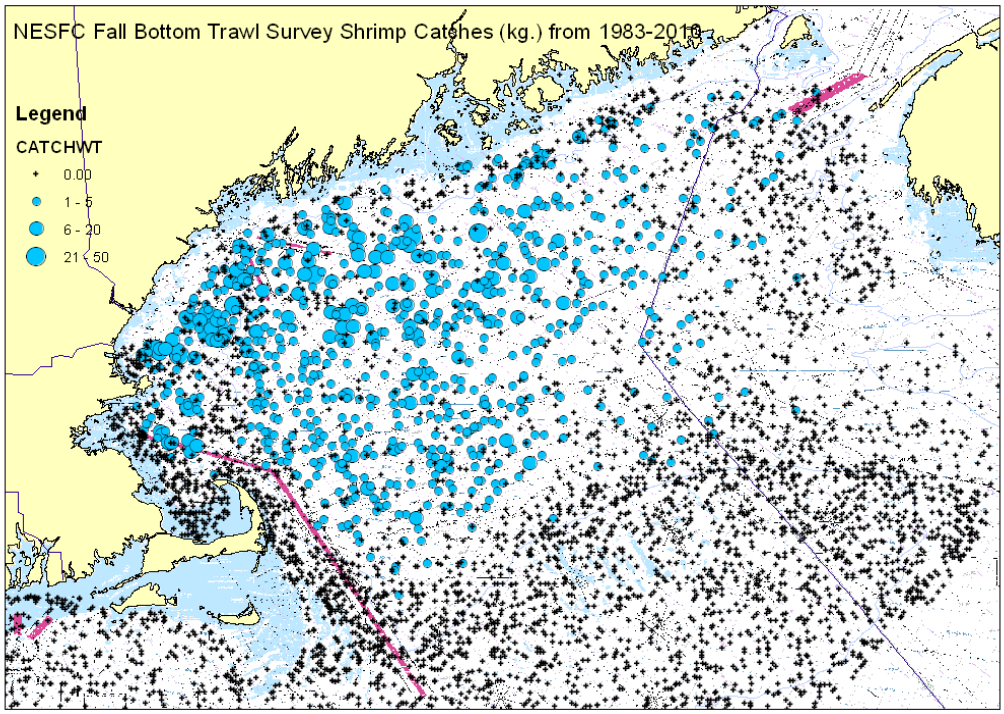

Figure 3. NEFSC fall trawl survey, shrimp catches (kg/tow) in the Gulf of Maine, 1983-2010.

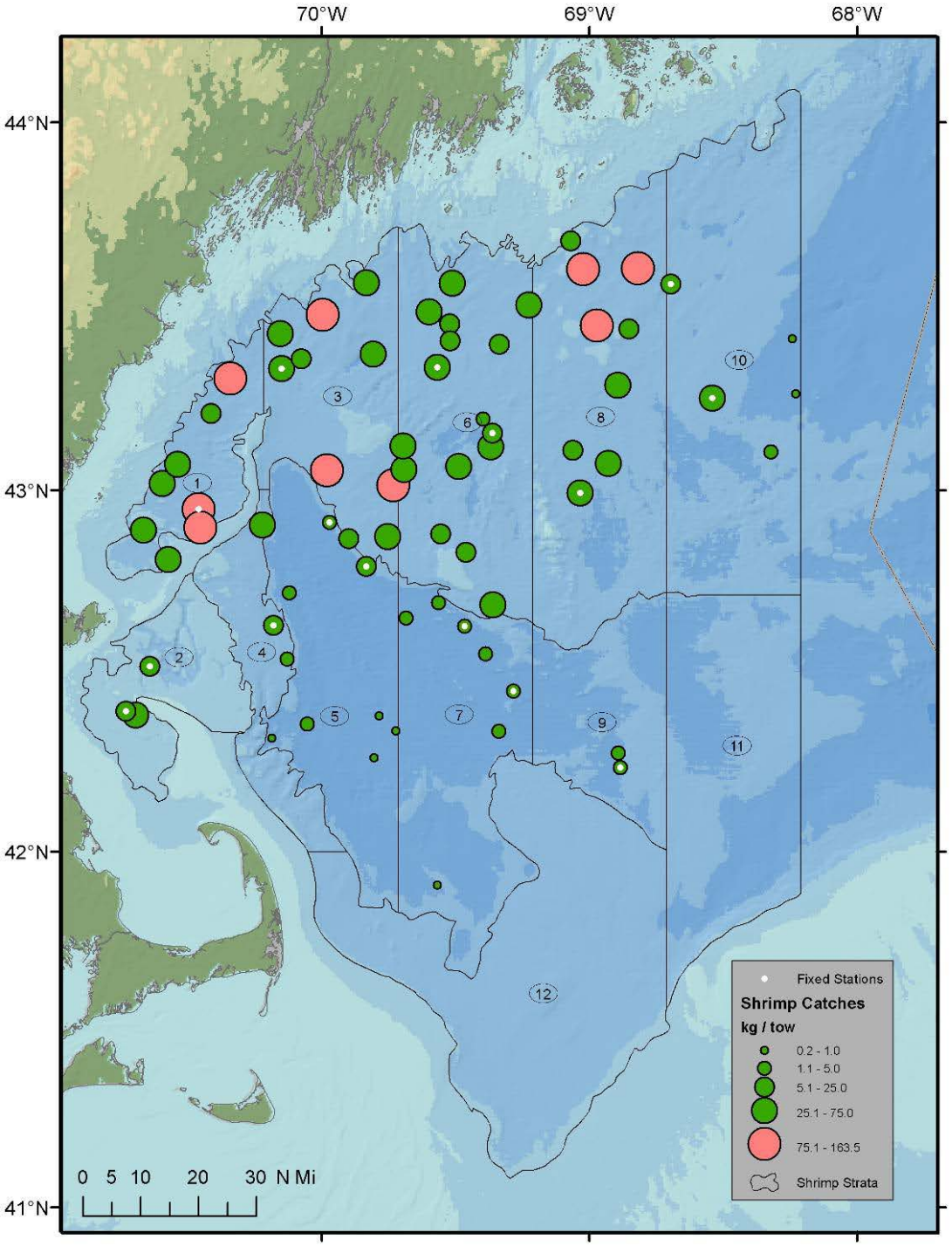

Figure 4. State/federal summer trawl survey, shrimp catches (kg/tow) in the Gulf of Maine, 2010, with statistical strata.

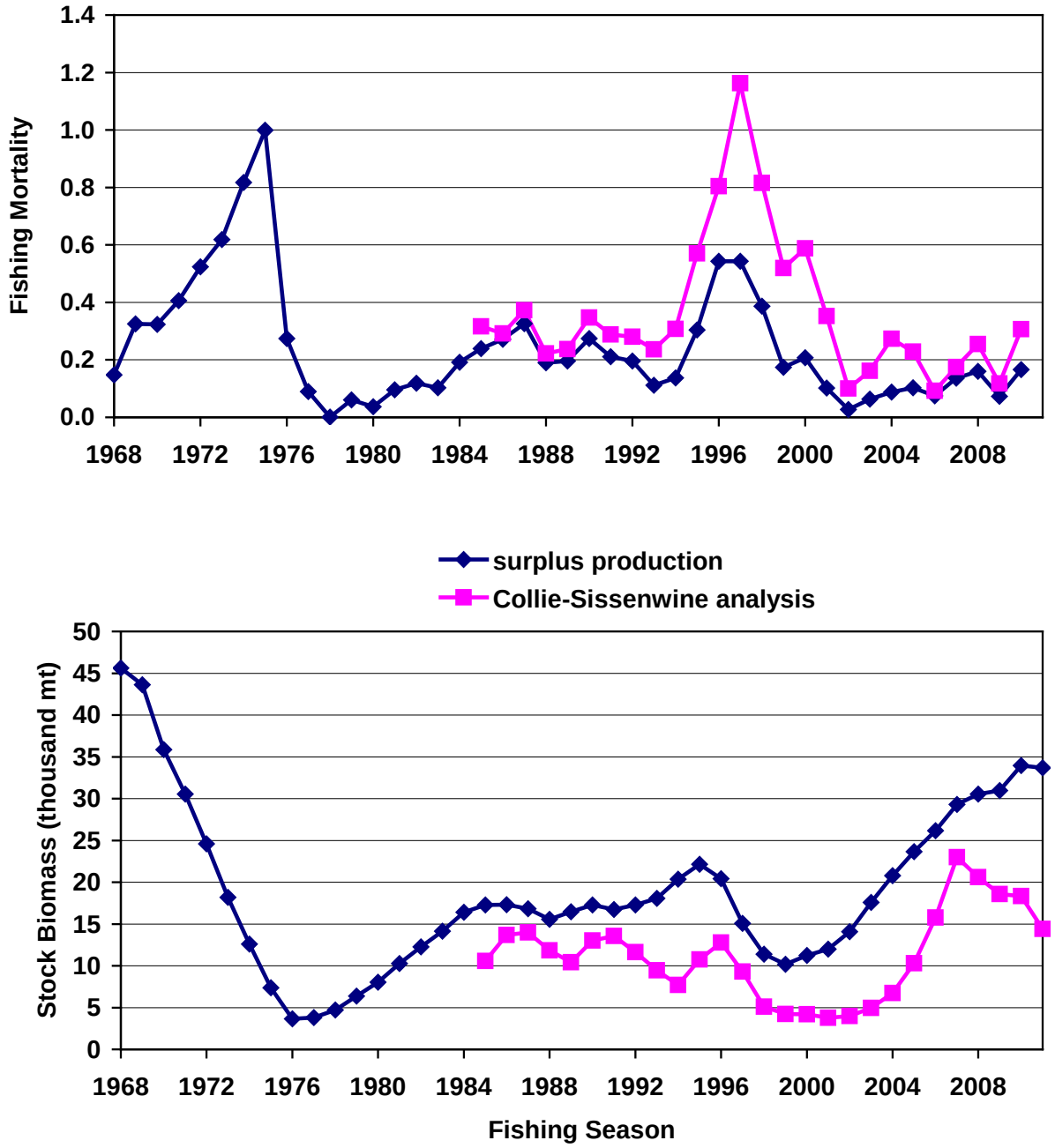

Figure 5. Estimates of fishing mortality (above) and stock biomass (below) for northern shrimp from Catch-Survey Analysis (CSA) and surplus production (ASPIC) modeling in 2010.

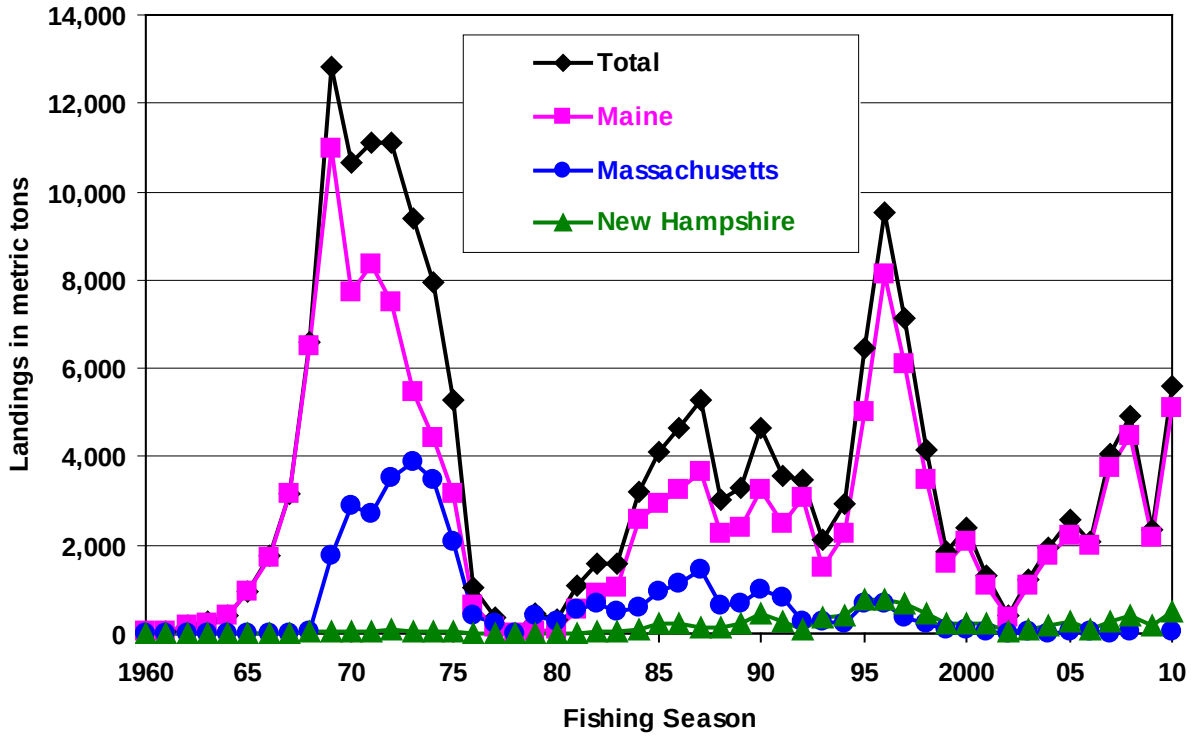

Figure 6. Gulf of Maine northern shrimp landings (mt) by season and state. MA landings are combined with NH landings in 2009 to preserve confidentiality. 2009 and 2010 are preliminary.

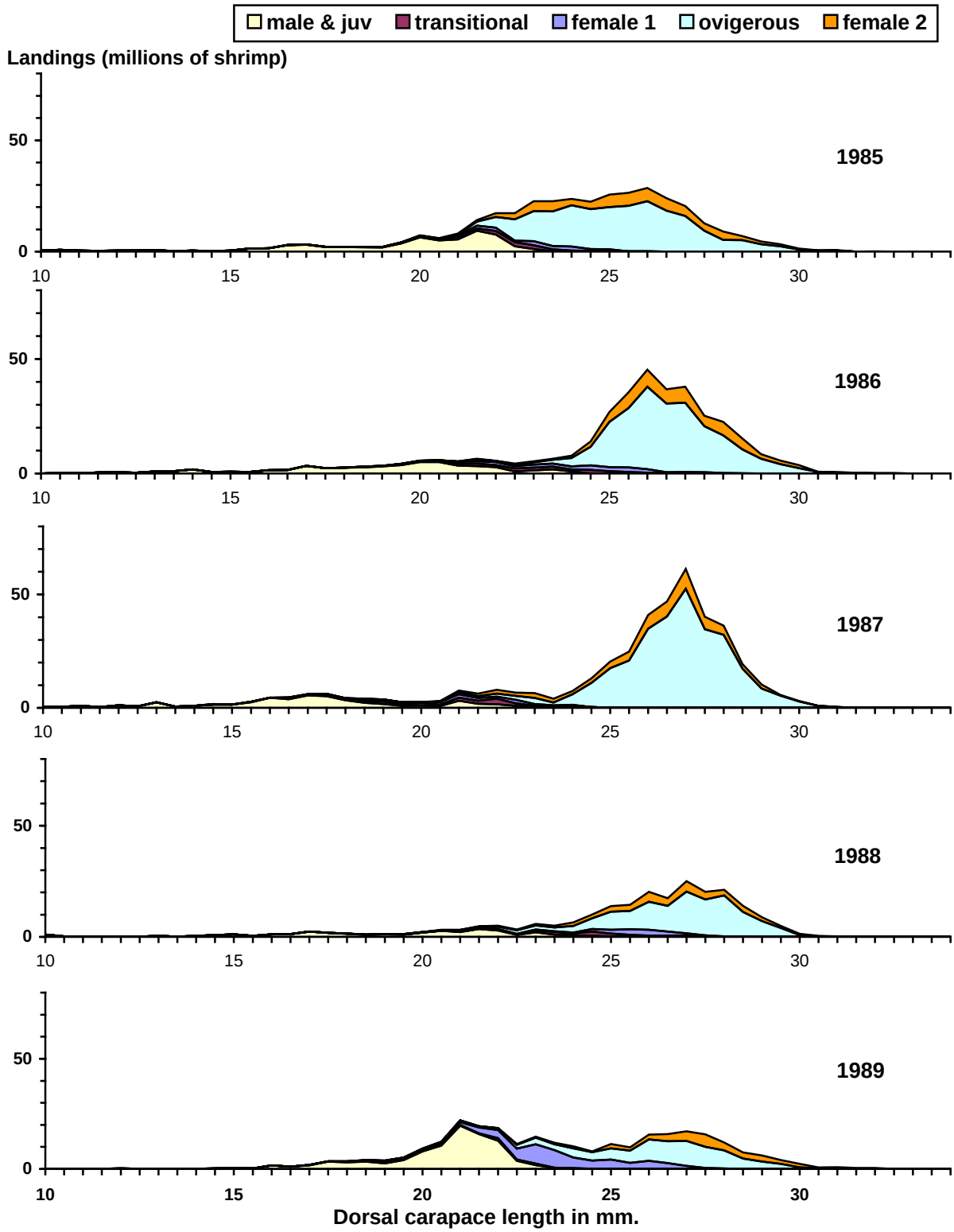

Figure 7. Gulf of Maine northern shrimp landings in estimated numbers of shrimp, by length, development stage, and fishing season. Landings are preliminary throughout.

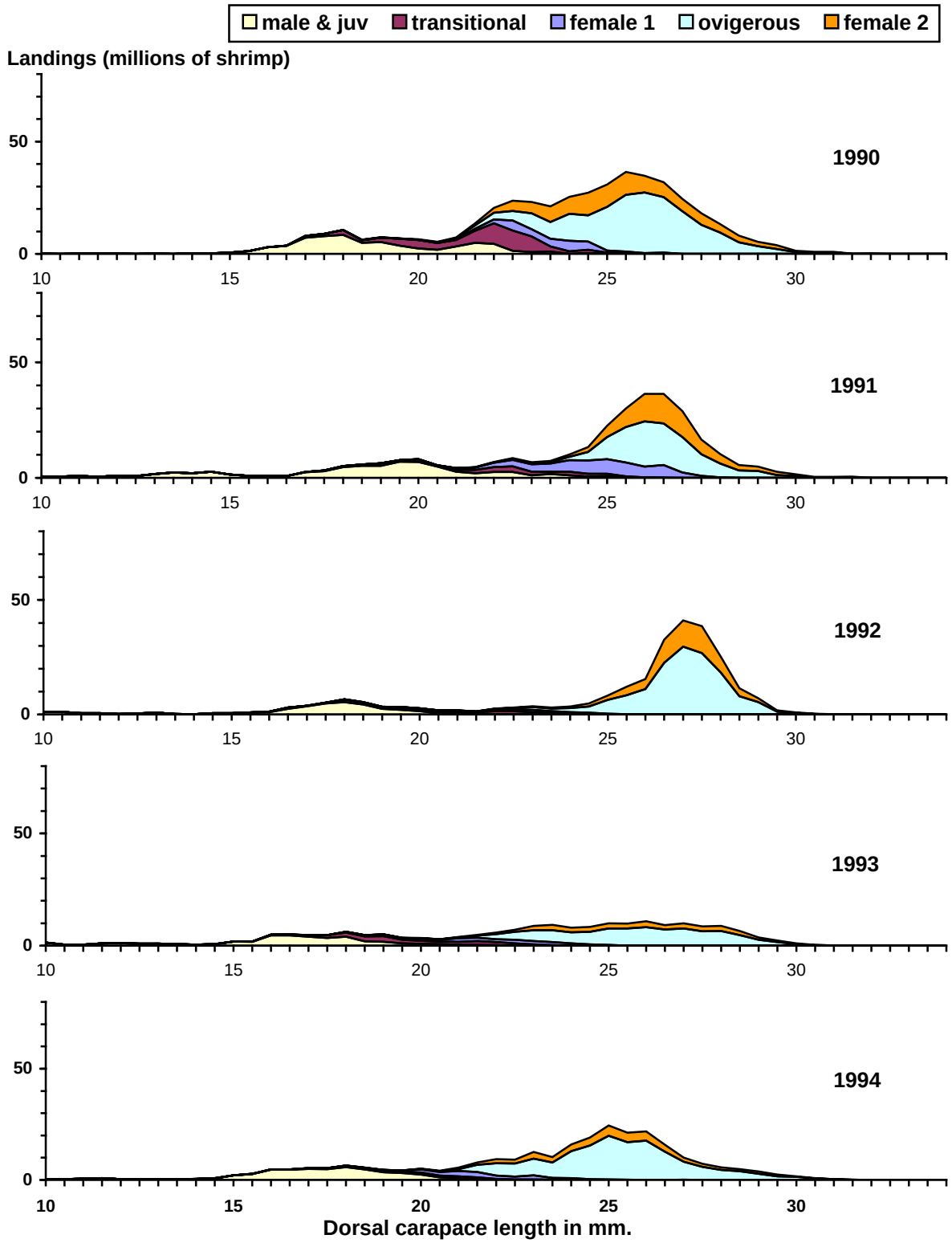

Figure 7 continued – Preliminary landings in estimated numbers of shrimp.

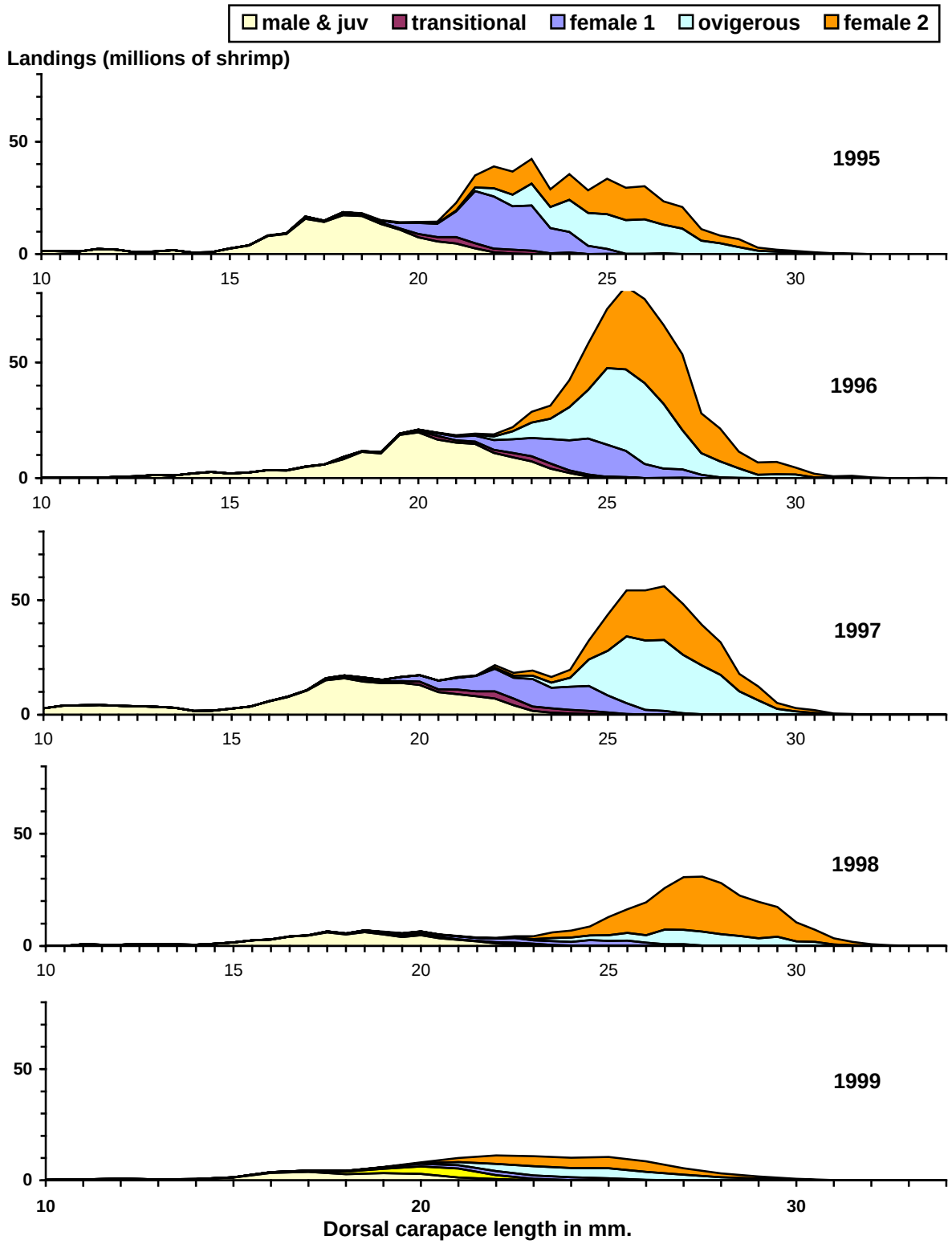

Figure 7 continued – Preliminary landings in estimated numbers of shrimp.

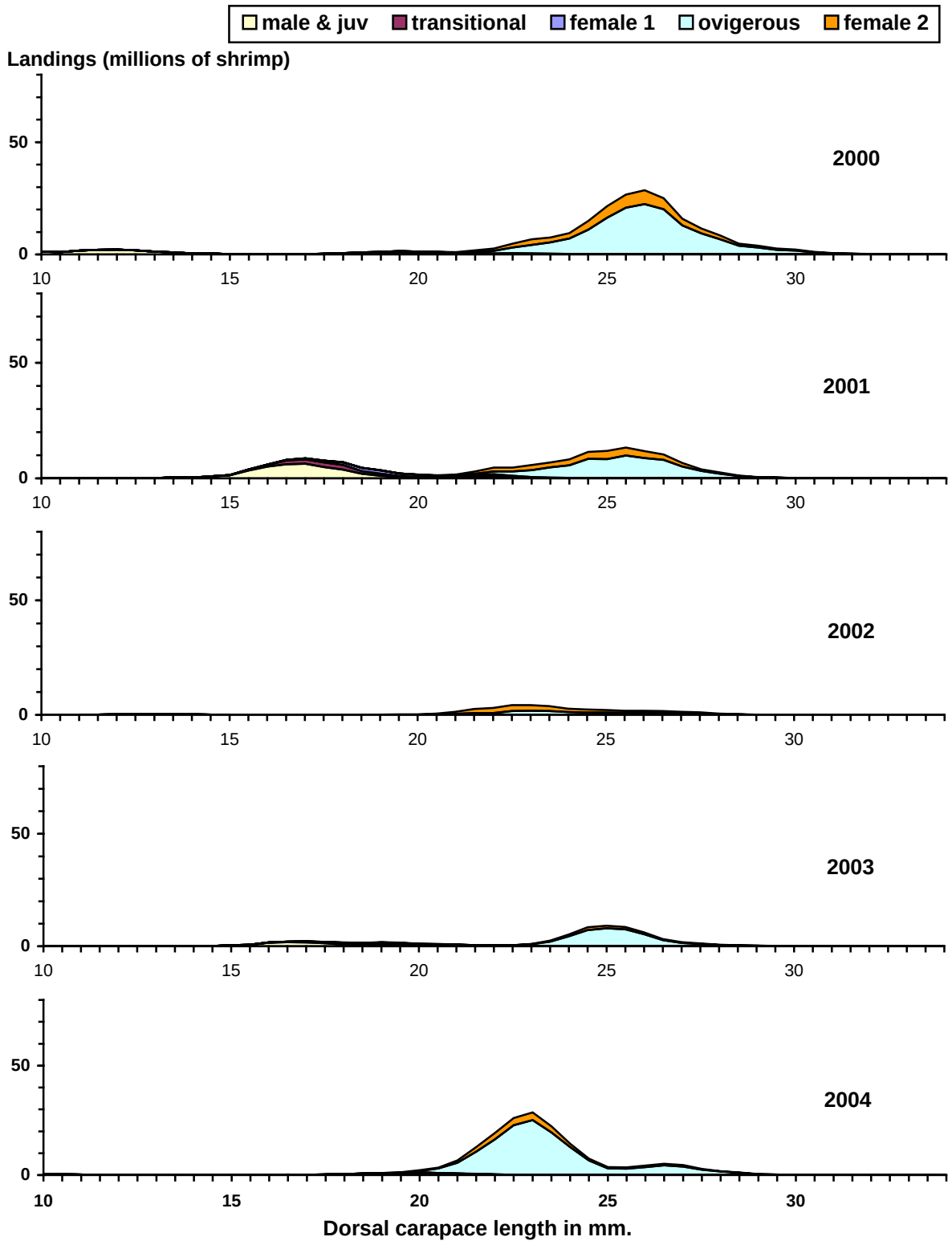

Figure 7 continued – Preliminary landings in estimated numbers of shrimp.

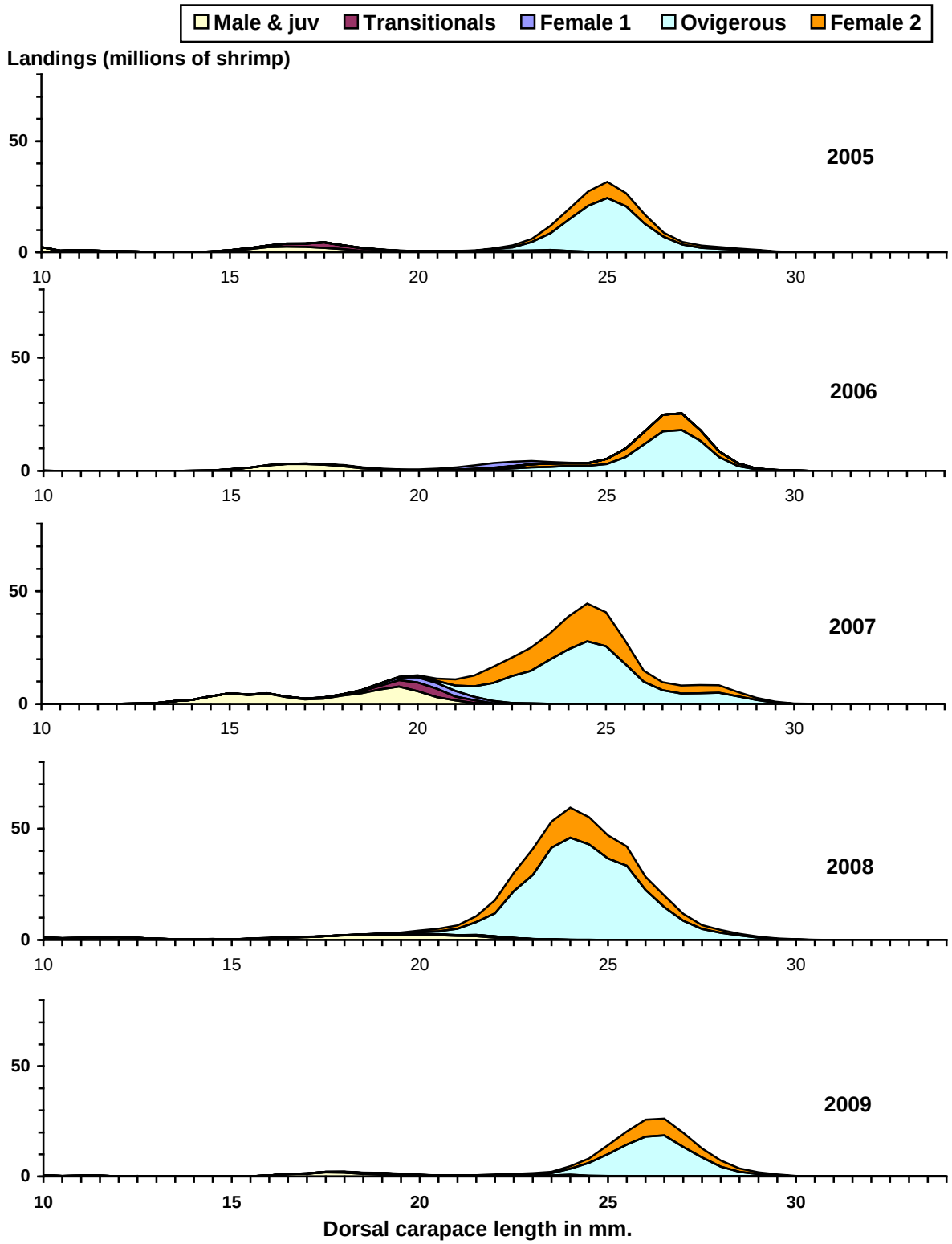

Figure 7 continued – Preliminary landings in estimated numbers of shrimp.

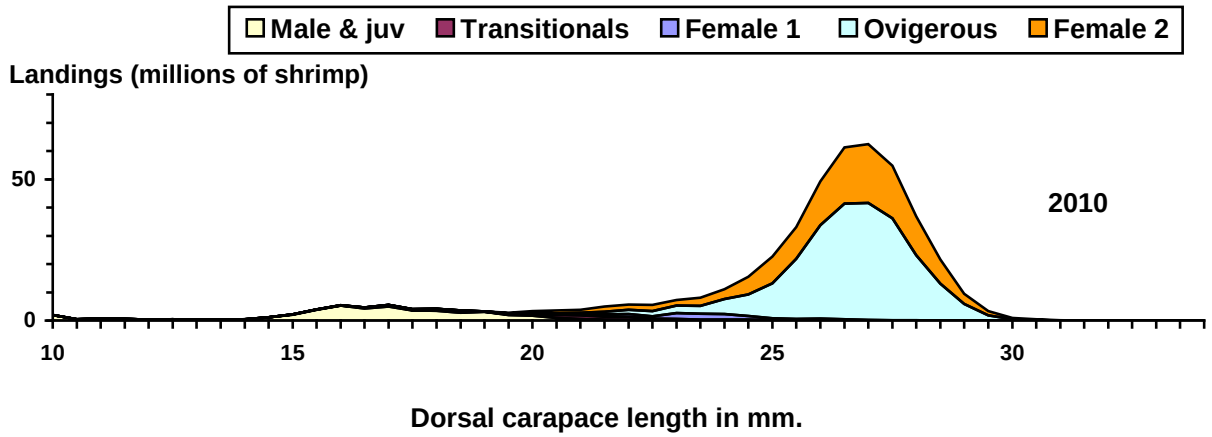

Figure 7 continued – Preliminary landings in estimated numbers of shrimp.

11.0 APPENDIX 1

Appendix 1.1. 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.		3	3	1							7
31 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.	Total Vessels
< = 30 FT.	1	4									5
31 TO 40 FT.	6	7									13
41 TO 50 FT.	127	33	5	1		1	1				168
51 TO 60 FT											0
61 TO 70 FT.											0
> 70 FT.											0
ALL VESSELS COMBINED	134	44	5	1	0	1	1	0	0	0	186
% of Fleet	53.82%	17.67%	2.01%	0.40%	0.00%	0.40%	0.40%	0.00%	0.00%	0.00%	
% Impacted by Trip Limit Equal to Poundage Category MAX	27.96%	4.30%	1.61%	1.08%	1.08%	0.54%	0.00%	0.00%	0.00%	0.00%	

Appendix 1.2. 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**

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**

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

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 1.3. 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 1.4 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				Percent Reduction from Actual			
Trawl gear		No. of	No. of	Landings	if catches were cut off at (lbs)…..				if catches were cut off at (lbs)…..			
	Vessel size	Vessels	Trips	(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.