STOCK STATUS REPORT

FOR

GULF OF MAINE NORTHERN SHRIMP – 2014

Prepared
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by the
Atlantic States Marine Fisheries Commission's
Northern Shrimp Technical Committee

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

Landings in the Gulf of Maine northern shrimp fishery since the mid-1980s have fluctuated between 335-9,500 mt, reflecting variations in year class strength as well as regulatory measures, participation, and market conditions in the fishery. Preliminary landings in 2013 declined to 335 mt, which was 54% of the TAC set by ASMFC for 2013 (625 mt). Removals in 2014 were limited to research tows (0.3 mt) due to implementation of a fishery moratorium for the 2014 season.

A benchmark assessment review in 2014 revealed problems with model performance in recent years for Gulf of Maine northern shrimp. The problems were thought to be due primarily to recent extreme fluctuations in abundance. No models were accepted for use in shrimp management. The current assessment therefore uses an index-based approach to evaluate the condition of the stock.

The Northern Shrimp Technical Committee (NSTC) evaluated a suite of indicators including fishery performance, survey indices of abundance and biomass, and environmental conditions. Abundance and biomass indices for 2012-2014 were the lowest on record of the thirty-one year time series. Recruitment indices for the 2010-2012 year classes were also well below average, and included the two smallest year classes on record. As a result, the index of current fishable biomass is the lowest on record. The recruitment index increased slightly in the 2014 survey, but is the ninth lowest in the time series. These recruits (2013 year class) are not expected to reach exploitable size until 2017. Despite the marginal increase in recruitment, the population continues to meet the criteria defining a collapsed stock.

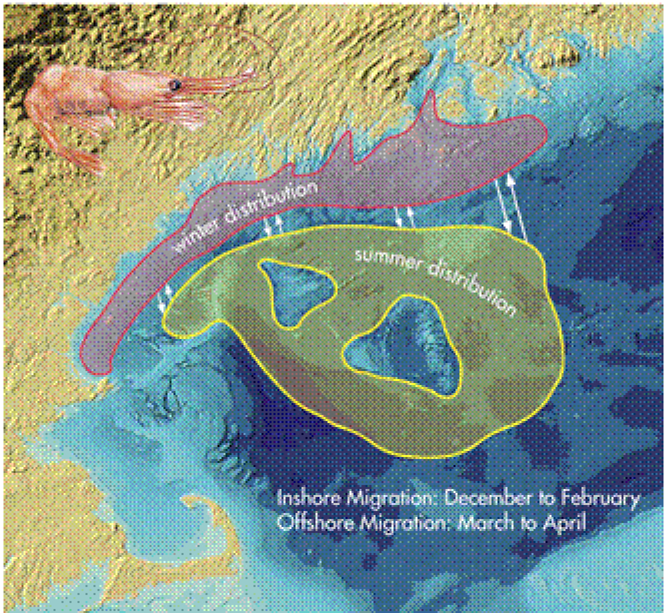
Recruitment of northern shrimp is related to both spawning biomass and ocean temperatures, with higher spawning biomass and colder temperatures producing stronger recruitment. Ocean temperatures in western Gulf of Maine shrimp habitat have increased in recent years and reached unprecedented highs in the past several years. 2014 temperatures were cooler; however, temperatures are predicted to continue rising as a result of climate change. This suggests an increasingly inhospitable environment for northern shrimp and the need for strong conservation efforts to help sustain the stock.

Given the depleted condition of the resource and poor prospects for the near future, the NSTC recommends that the Northern Shrimp Section extend the moratorium on fishing through 2015.

INTRODUCTION

Biological Characteristics

Northern shrimp (*Pandalus borealis* Krøyer) are hermaphroditic, maturing first as males at about 2½ years of age and then transforming to females at about 3½ years of age in the Gulf of Maine. Spawning takes place 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. Juveniles remain in coastal waters for a year or more before migrating to deeper offshore waters, where they mature as males. The exact extent and location of these migrations is variable and somewhat unpredictable. 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. The females are the individuals targeted in the Gulf of Maine fishery.



Distribution of adult female northern shrimp (NAMA, 2006)

Fishery Management

The Gulf of Maine fishery for northern shrimp is managed through an interstate agreement between the states of Maine, New Hampshire and Massachusetts (the Northern Shrimp Section). The management framework evolved during 1972-1979 under the auspices of the State/Federal Fisheries Management Program. In 1980, this program was restructured as the Interstate Fisheries Management Program (ISFMP) of the Atlantic States Marine Fisheries Commission (ASMFC). The Fishery Management Plan (FMP) for Northern Shrimp was first approved under the ISFMP in October 1986 (McInnes, 1986, FMR No. 9). Amendment 1, which was implemented in 2004, established biological reference points for the first time in the shrimp fishery and expanded the tools available to manage the fishery. Management of northern shrimp under Amendment 1 resulted in a rebuilt stock and increased fishing opportunities. However, 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 recommended total allowable catch (TAC).

In response to these issues, Amendment 2, approved in October 2011, provides management options to slow catch rates throughout the season, including trip limits, trap limits, and days out of the fishery. Amendment 2 completely replaces the FMP. It modifies the fishing mortality reference points to include a threshold level; includes a more timely and comprehensive reporting system, and allows for the initiation of a limited entry program to be pursued through the adaptive management addendum process. The fishing mortality target is defined as the average fishing mortality rate during 1985 to 1994 when biomass and landings were “stable”. 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.

Fishing mortality reference points were re-estimated by the NSTC in 2013 as F_{target} =0.38 and $F_{threshold}$= 0.48. F_{limit} is taken to be = 0.60, and is not re-estimated within the assessment framework. The F reference points were estimated under the assumption of natural mortality (M) = 0.25, as specified in Amendment 2. Higher values of M are considered more realistic (e.g. M=0.5); however using a higher M does not generally alter conclusions about stock status because the increased M scales the entire assessment.

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 tons (mt) and limit of B_{Limit} = 6,000 mt are based on historical abundance estimates and response to fishing pressure, and remain unchanged from Amendment 1. The limit was set at 2,000 mt 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.

Addendum I to Amendment 2, approved in November 2012, clarifies the annual specification process, and allocates the TAC with 87% for the trawl fishery and 13% for the trap fishery based on historical landings by each gear type.

Draft Amendment 3 is currently in development and considers limited entry and state-by-state allocations of the northern shrimp fishery. The Section initiated Draft Amendment 3 to address the variation in effort in the fishery over the past decade.

2014 Benchmark Assessment Review

A set of three stock assessment models for northern shrimp were presented to the Northeast Fisheries Science Center's Stock Assessment Workshop (SAW) for review as part of a benchmark assessment (NEFSC 2014). Several important conclusions came from the peer review panel. These are summarized below (the reviewers' reports can be accessed at http://www.nefsc.noaa.gov/saw/saw58/index.html.):

- Despite the high quality data available for northern shrimp, the models have difficulty fitting the data because of extreme fluctuations in recent years, including the exceptionally high 2006 shrimp survey index, and the sudden decline of all indices in 2012 followed by sustained extreme lows.
- A new statistical framework was developed for the catch-survey analysis (CSA, Collie and Sissenwine 1983; Cadrin et al. 1999). CSA has been used to guide management decisions in the shrimp fishery since 1997. The review panel considered the new statistical framework an important advance, but felt the results were overly sensitive to weightings chosen for different components of the model (e.g. catch data, survey data), and on this basis rejected the new CSA for management use. They were not able to

comment on the applicability of the previously-accepted version of CSA because there was insufficient time to review the previous version (and this was not their remit).

- The review panel concluded that a new length-based model developed for northern shrimp has promise but needs further development and testing before application to management.
- The review panel agreed that the use of a surplus production model (ASPIC) as a confirmatory analysis should be discontinued. ASPIC is unable to adequately handle the large fluctuations in recruitment which are a general feature of northern shrimp population dynamics.

In light of the review panel's comments on the new version of CSA, the NSTC conducted exploratory work to evaluate whether the previous CSA version has similar issues (these issues could not have been detected under the previous statistical framework). The results of the exploratory analysis suggest that the previous CSA also has difficulty with the major swings in data in recent years, although the conclusions with respect to overfishing status were robust and did not differ with different weighting scenarios.

Given the results of the benchmark assessment review and exploratory CSA analysis, the NSTC is not presenting modeling results in this stock assessment. However, the NSTC notes that the trends of the CSA updated through 2014 are consistent with observed trends in the stock indicators.

Management in the 2014 Season
A moratorium was imposed on the northern shrimp fishery for the 2014 season. The Section considered several factors in setting the specifications for the 2014 fishery. Northern shrimp abundance in the western Gulf of Maine had declined steadily since 2006. Estimated biomass at the end of 2013 (500 mt) was the lowest in recent history, estimated at 5.2% of the average biomass during the reference period (1985-1994), and well below the biomass threshold of 9,000 mt and biomass limit of 6,000 mt. Additionally, there had been recruitment failure for the consecutive prior three years (2010-2012 year classes).

Commercial Fishery Trends

The NSTC reviewed state and federal harvester reports (vessel trip reports (VTRs)) for the 2012 and 2013 fishing seasons and updated landings and effort data in Tables 1-8 and associated figures. No fishery was allowed in 2014 for the first time since 1978. Several samples were collected during winter 2014 near Pemaquid Point, Maine under a research permit.

Landings
Annual landings of Gulf of Maine northern shrimp (Table 1, Table 2, Table 3 and Figure 1) declined from an average of 11,400 metric tons (mt) during 1969-1972 to about 400 mt in 1977, culminating in a closure of the fishery in 1978 (Table 1). The fishery reopened in 1979 and landings increased steadily to over 5,000 mt by 1987. Landings ranged from 2,300 to 6,400 mt during 1988-1995, and then rose dramatically to 9,500 mt in 1996, the highest since 1973. Landings declined to an average of 2,000 mt for 1999 to 2001, and dropped further in the 25-day

2002 season to 450 mt, the lowest northern shrimp landings since the fishery was closed in 1978. Landings then increased steadily, averaging 2,100 mt during the 2003 to 2006 seasons, then jumping to 4,900 mt in 2007 and 5,000 mt in 2008. In 2009, 2,500 mt were landed during a season that was thought to be market-limited. The proposed 180-day season for 2010 was cut short to 156 days with 6,140 mt landed, due to the industry exceeding the total allowable catch (TAC) for that year, and concerns about small shrimp.

As in 2010, the 2011 season was closed early due to landings in excess of the TAC. A total of 6,397 mt of shrimp were landed, exceeding the TAC of 4,000 mt by approximately 2,400 mt (Table 1 and Figure 1). The average price per pound was $0.75 and the estimated landed value of the catch was $10.6 million (Table 2). In 2012, the season was further restricted by having trawlers begin on January 2 with 3 landings days per week and trappers begin on February 1 with a 1,000 pound limit per vessel per day. The TAC was set at 2,100 mt and would close when the projected landings reached 95%. The season was closed on February 17 and trawlers had a 21-day season and trappers had a 17-day season. Landings for 2012 were 2,485 mt and the average price per pound was $0.95 with an estimated landing value of $5.2 million. In 2013, the TAC was set at 625 mt with 5.44 mt set aside for research tows and closure when 85% of the TAC was reached in each fishery (trap and trawl). The trawl fishery was allocated a 539.02 mt TAC and the trap fishery was allocated an 80.54 mt TAC. Trawlers fished for 54 days and trappers fished 62 days culminating in 334.5 mt landed (preliminary), which is 285 mt under the TAC. The average price per pound was $1.81 and is the highest observed since 1989 (inflation-adjusted values, Table 2), with a preliminary estimated value of $1,332,150.

Most northern shrimp fishing in the Gulf of Maine is conducted by otter trawls, although traps are also employed off the central Maine coast. According to federal and state of Maine VTRs, trappers averaged 12% of Maine's landings during 2001 to 2007, 18% during 2008 to 2011, and 9% in 2012 (Table 4). Otter trawling effort has accounted for between 78% and 96% (preliminary data) of Maine's landings during 2000 to 2013. Harvester reports indicate that trappers accounted for about 7% of Maine's landings in 2013, the lowest since 2004 (4%).

Size, Sex, and Maturity Stage Composition of Landings

In years with fishing activity, size and sex-stage composition data have been collected from port samples from each of the three states. One kilogram samples were collected from randomly selected catches. Data were expanded from the sample to the catch, and then from all sampled catches to landings for each gear type, state, and month. Size composition data (Figure 2) collected from catches from 1985 through 2013 indicate that trends in landings have been determined primarily by recruitment of strong (dominant) year classes.

Landings more than tripled with recruitment to the fishery 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 mostly comprised assumed 4 year-old females from the moderate to strong 2003 year class, and possibly 6 year-olds from the 2001 year class. Landings in 2008 were mostly composed of the assumed 4 year-old females from the strong 2004 year class, and the 2003 year class (assumed 5 year–old females, which first appeared as a moderate year class in the 2004 survey).

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. The 2011 fishery consisted mainly of 4-year-old females from the assumed 2007 year class. Numbers of 5-year-old shrimp were limited likely due to the weak 2006 year class. Transitionals and female stage Is from the 2008 year class, and some males and juveniles from the assumed 2009 year class were observed, especially in the Massachusetts and New Hampshire catches and Maine's December and January trawl catches. Trawl catches in the 2012 fishery were likely 4-year-olds from the moderate 2008 year class, but they were small for their age. Low percentages of males and juveniles were caught in 2012 likely due to the later start date of January 2. In the 2013 fishery, catches were limited but likely comprised 4- and 5-year-olds from the moderate 2009 and 2008 year classes that were small for their assumed age. Limited numbers of males and transitionals were observed in catches.

Spatial and temporal differences in the timing of the egg-hatch can be estimated by noting the proportion of mature females (Female II) that have hatched their brood during the season and across geographic locations. The Maine Department of Marine Resources (DMR) contracted with a commercial shrimp trawler operating under a special DMR research license to collect northern shrimp samples during January–March 2014. These samples were used to obtain information on shrimp size and stage composition and progress of the egg hatch. The Boothbay area was chosen for the research tows as best representing the spatial "center" of a typical winter Maine shrimp fishery, which normally extends roughly from the Maine-New Hampshire border in the west to the Winter Harbor area in the east (Figure 5). Five trips were conducted, starting on January 30, 2014. There were two fishing days in February and two in March, with trips approximately two weeks apart. Each day (trip), the fisherman conducted three tows of about 15 minutes each, at about 42 fa (76m) depth. From each catch, a random 2 kg (approximate) sample was collected, bagged, and returned to the DMR laboratory in Boothbay Harbor. The rest of the catch was immediately discarded overboard.

The average count per pound in the 2014 winter samples was about 41. Most of the female shrimp were still carrying eggs on January 30, with only about 5–6% of females being post-hatch (female stage II). On the second sampling trip, February 9, post-hatch females were still only about 6%, but on February 23 they were up to about 32 %, on March 8 they were about 70%, and by March 25 they were 100% post-hatch (Figure 2). The mid-point of the hatch period was estimated to have been Feb. 27. Compared to the longer time series of hatch timing estimates (Figure 3), it appears that hatch metrics in 2014 were similar to pre-2000 fisheries, when the hatch started later and the duration of the hatch period was shorter. Egg hatch is known to begin earlier in the western GOM and end later in the east, so the timing of the egg hatch demonstrated in this project may not be representative of the entire range of the population.

For more information about the 2014 research trawling off Pemaquid Point, visit http://www.maine.gov/dmr/rm/shrimp/.

Discards

Discard rates of northern shrimp in the northern shrimp fishery are thought to be near zero because no size limits are in effect and most fishing effort occurs in areas where only the larger females are present. Data from a study which sampled the northern shrimp trap fishery indicated overall discard/kept ratios (kg) for northern shrimp of 0.2% in 2010 and 0.1% in 2011 (Moffett et al. 2012). Sea sampling data from Gulf of Maine shrimp trawlers in the 1990s indicated no discarding of northern shrimp (Richards and Hendrickson 2006). On an anecdotal level, port samplers in Maine reported seeing manual shakers (used to separate the small shrimp) on a few trawl vessels during April 2010, but made no similar observations in 2011 through 2013. Discarding of northern shrimp in other Gulf of Maine fisheries is rare (on average less than 0.001% during 2000-2013; Northeast Fishery Observer Program data, NMFS). For these reasons and because detailed data for estimating potential discards are lacking, shrimp discards from the shrimp and other fisheries are assumed zero in this assessment.

Black Gill Syndrome

Shrimp collected during routine port-sampling in Maine in 2003 exhibited a high incidence (greater than 70%) of Black Gill Syndrome, also called Black Gill Disease or Black Spot Syndrome. Affected shrimp displayed melanized, or blackened gills, with inflammation, necrosis, and significant loss of gill filaments. Black Gill Syndrome was also documented in the Gulf of Maine in 1966 (Apollonio and Dunton, 1969; Rinaldo and Yevich, 1974). Its etiology is unknown, although fungal and ciliated protist parasites have been implicated. In samples collected in Maine during the 2004-2013 fisheries, the incidence of Black Gill Syndrome was much lower, and detected cases were much less severe, than in 2003.

Effort and Distribution of Effort

Since the 1970s, effort in the fishery (measured by numbers of trips in which shrimp gear is used) has increased and then decreased on several occasions. In the 1980s there was a gradual increase in the total number of trips (Table 5) to a peak of 12,497 during the 1987 season. Increases in season length, shrimp abundance, and record ex-vessel prices, coupled with reduced abundance of groundfish, all contributed to this increase. Effort subsequently fell to 5,990 trips in the 1994 season. Effort nearly doubled between 1994 and 1996 and then declined again from the 1996 level of 11,791 to 1,304 trips in 2002, a year with only a 25-day open season. The number of trips increased during 2003-2005 as the seasons were lengthened, to 3,866 trips in 2005. Trips in 2006 dropped to 2,478, likely due to poor market conditions, increased in 2007 to 4,163, and increased in 2008 to 5,587, the most trips since 1999.

In 2009, the length of the season was increased to 180 days while the effort decreased to 3,002 trips, likely caused by limited demand from the processors and poor market conditions. In what turned out to be a 156-day season in 2010, effort increased dramatically to 5,979 trips. The market conditions were improved from prior years due to Canada's limited supply and an increase in local markets. In 2011, the truncated 90-day season yielded a higher effort than 2010 with 7,095 trips. The high level of effort was again due in part to a limited supply in Canada and demand from local markets. In 2012, the number of trips decreased to 3,666 due to the shortened season. The effort further decreased in 2013 to 1,530 trips, likely due to a low quota and poor fishing conditions (Table 5) (preliminary data).

The number of vessels participating in the fishery in recent years (prior to the 2014 moratorium) has varied from a high of 347 in 1996 to a low of 144 in 2006. In 2013, there were 207 vessels; 180 from Maine, 13 from Massachusetts, and 13 from New Hampshire, plus one that landed in both Maine and New Hampshire, according to harvester logbook data (preliminary). Of the 181 vessels from Maine, 72 were trapping (Table 7).

Prior to 1994, effort (numbers of trips by state and month) was estimated from landings data collected from dealers, and landings per trip information (LPUE) from dockside interviews of vessel captains: $Effort = \frac{Landings}{LPUE}$

Beginning in the spring of 1994, a vessel trip reporting system (VTR) supplemented the collection of effort information from interviews. From 1995 to 2000, landings per trip (LPUE) from these logbooks were expanded to total landings from the dealer weighouts to estimate the total trips: $Total.Trips = VTR.Trips \frac{Total.Landings}{VTR.Landings}$

Since 2000, VTR landings have exceeded dealer weigh-out landings, and the above expansion is not necessary. However, VTRs for 2013 are still being received and processed. Therefore, landings and effort estimates reported here for recent years should be considered preliminary. The 1996 assessment report (Schick et al. 1996) provides a comparison of 1995 shrimp catch and effort data from both the NEFSC interview and logbook systems and addresses the differences between the systems at that time. It showed a slightly larger estimate from the logbook system than from the interview system. Thus effort statistics reported through 1994 are not directly comparable to those collected after 1994. However, patterns in effort can be examined if the difference between the systems is taken into account. An additional complication of the logbook system is that one portion of the shrimp fishery may not be adequately represented by the logbook system during 1994-1999. Smaller vessels fishing exclusively in Maine coastal waters are not required to have federal groundfish permits and were not required to submit shrimp vessel trip reports until 2000. In the 1994-2000 assessments, effort from unpermitted vessels was characterized by catch per unit effort of permitted vessels.

Catch per Unit Effort

Catch per unit effort (CPUE) indices have been developed from NMFS interview data (1983-1994), logbook data (1995-2012), and Maine port interview data (1991-2013) and are measures of resource abundance and availability (Table 8 and Figure 4). They are typically measured in catch per hour (from Maine interview data) or catch per trip. A trip is a less precise measure of effort, because trips from interviews and logbooks include both trawl and trap trips, and single day trips and multiple day trips (in the spring), and the proportion of such trips can vary from season to season. Also, in some years, buyers imposed trip limits on their boats, and in 2012 and 2013, Maine DMR imposed day-length limits.

Pounds landed per trip (lbs/trip), from VTRs, averaged 1,410 pounds during 1995-2000. In 2001, the catch per trip dropped to 752 pounds, the lowest since 1994, and remained low, at 765 pounds, in 2002. During 2003 – 2005 it averaged 1,407 lbs/trip. The increasing trend continued in 2006 with 2,066 pounds per trip. In 2007, the highest pounds per trip of the time series was observed with 2,584 pounds. During 2008-2011, pounds per trip averaged 2,012, with a value of 2,264 in 2010, which is the second highest in the time series. There was a large decrease in 2012 to 1,497 lbs/trip. In 2013, the average pounds landed per trip was 482, with 609 lbs per trawl trip, both the lowest of their time series (preliminary, Table 9 and Figure 4).

More precise CPUE indices (pounds landed per hour trawling) have also been developed for both inshore (depth less than 55 fathoms) and offshore (depth more than 55 fathoms) areas using information collected by Maine's port sampling program, and agree well with the (less precise) catch per trip data from logbooks (Table 8 and Figure 8). Maine's inshore trawl CPUE for 2013 was 118 lbs/hr, offshore was 78 lbs/hr, and the season average was 110 lbs/hr, less than half the time series average of 250 lbs/hr (Table 8).

RESOURCE CONDITIONS

Trends in abundance of Gulf of Maine northern shrimp have been monitored since the late 1960's from data collected in Northeast Fisheries Science Center (NEFSC) spring and autumn bottom trawl surveys and in summer surveys by the State of Maine (discontinued in 1983). A Maine-New Hampshire inshore trawl survey has been conducted each spring and fall, beginning in the fall of 2000 (Sherman et al. 2005). A state-federal (ASMFC) survey was initiated by the NSTC in 1984 to specifically assess the shrimp resource in the western Gulf of Maine. This survey is conducted each summer aboard the *R/V Gloria Michelle* employing a stratified random sampling design and shrimp trawl gear designed for Gulf of Maine conditions. The NSTC has placed primary dependence on the ASMFC summer shrimp survey for fishery-independent data used in stock assessments, although the other survey data are also considered (see survey areas in Figure 6).

Abundance and biomass indices (stratified mean $\log_e$-transformed catch per tow in numbers and weight) for the ASMFC summer survey from 1984–2014 are given in Table 10, Figure 8 and Figure 13, and length-frequencies by year are provided in Figure 15. The series averaged 15.8 kg/tow from 1984 through 1990. Beginning in 1991, this index began to decline and averaged 10.2 kg/tow from 1991 through 1996. The survey mean weight per tow then declined further, averaging 6.5 kg/tow from 1997 through 2003, and reaching a low of 4.3 kg/tow in 2001. Between 2003 and 2006 the index increased markedly, reaching a new time series high in 2006 (66.0 kg/tow). Although 2006 was a high abundance year, as corroborated by the fall survey index, the 2006 summer survey index should be viewed with caution because it was based on 29 survey tows compared with about 40 tows in most years (Table 10). The summer survey index was 16.8 kg/tow in 2008, and has dropped steadily since then. The most recent values are well below the time series average of 12.5 kg/tow (Table 10). The 2013 and 2014 biomass indices were the lowest in the series, with a mean weight per tow of 1.0 and 1.7 kg/tow respectively. The total mean number of shrimp per tow demonstrated the same general trend as biomass over the time series (Table 10 and Figure 13).

The stratified mean catch per tow in numbers of assumed 1.5-year-old shrimp (Table 10, Figure 13, and graphically represented as the total number in the first (left-most) size mode in Figure 15) represents a recruitment index. Although these shrimp are not fully recruited to the survey gear, this index appears sufficient as a preliminary estimate of year class strength. This survey index indicated strong (more than 700 per tow) assumed 1987, 1992, 2001, and 2004 year classes. The assumed 1983, 2000, 2002, and 2006 age classes were weak (less than 100 per tow), well below the time series mean of 359 individuals per tow. From 2008 to 2010, the age 1.5 index varied around 500 individuals per tow, indicating moderate but above average assumed 2007, 2008, and 2009 year classes. The index dropped markedly to 44 individuals per tow in 2011, then 7 per tow in 2012, and a time series low of 1 per tow in 2013, signifying very weak 2010, 2011, and 2012 year classes respectively and an unprecedented three consecutive years of poor recruitment. The 1.5-year index for 2014 was 116 individuals per tow, higher than in recent years, but still the ninth lowest recruitment index in the 31-year time series.

Although the 2014 mean numbers per tow at size displayed in Figure 15 were too low to be clearly visible in the figure, further analyses showed that the mean carapace lengths of the assumed age 1.5 year class were (unusually) large, suggesting a high growth rate for the 2013 year class. There was also a high proportion of small (<22 mm carapace length (CL)) female I shrimp, possibly early-maturing primary females from the 2013 year class, and some larger female IIs, probably from the 2010 year class. The overall mean size of females was relatively small at 24.7 mm CL. This is the sixth smallest value in the time series, which suggests that female shrimp in a 2015 fishery would be small.

Individuals >22 mm CL in the summer would be fully recruited to a fishery the following winter (primarily age 3 and older) and thus survey catches of shrimp in this size category provide indices of harvestable numbers and biomass for the coming season (Table 10 and Figure 14). The harvestable biomass index exhibited peaks in 1985, 1990, and 1995, reflecting the strong assumed 1982, 1987, and 1992 year classes respectively. The index then trended down through 2003. The 2001 index of 1.5 kg/tow represented a time series low, and is indicative of poor assumed 1997 and 1998 year classes. From 2003 to 2006, the fully recruited index increased dramatically, reaching a time series high in 2006 (29.9 kg/tow). This increase may have been related to the continued dominance of the strong 2001 year class, some of which may have survived into the summer of 2006, and to an unexplained increase in the number of female stage 1 shrimp (Figure 15), probably the 2003 year class. The index has declined steadily since 2006 despite above average recruitment of the 2007, 2008, and 2009 year classes discussed above, and reached a new times series low in 2014 (0.2 kg/tow), consistent with the poor recruitment of the 2010, 2011, and 2012 year classes described above.

The NEFSC fall survey, conducted by the FRV *Albatross IV*, provided an index of shrimp abundance from 1968 to 2008 (Table 11 and Figure 10). The index was near time series highs (above 3.0 kg/tow) at the beginning of the time series in the late 1960's and early 1970's when the Gulf of Maine Northern shrimp stock was at or near virgin levels. In the late 1970's the index declined precipitously to a time-series low (0.2 kg/tow) as the fishery collapsed; this was followed by a substantial increase in the mid to late 1980's, reflecting recruitment and growth of the strong presumed 1982 and 1987 year classes. The index continued to vary with the influences of strong and weak year classes through the 1990s and 2000s, and the survey ended in 2008 with values well above the time series mean (>1.8 kg/tow) during its last four years, including the time series high of 6.6 kg/tow in 2006. This high value corresponded with the time series high seen in the ASMFC summer survey the same year (Table 10and Table 11). In 2009, the NEFSC fall survey changed vessels and protocols, thus indices since 2009 are not directly comparable to earlier years. However, the biomass index from the new NEFSC fall survey declined rapidly between 2009 and 2012 (Figure 10), parallel to trends in the summer shrimp survey and the ME-NH survey. NEFSC fall survey values for 2013 and 2014 are not yet available.

The Maine-New Hampshire inshore trawl survey takes place annually, during spring and fall, in five regions and three depth strata (1 = 5–20 fa, 2 = 21–35 fa, 3 = 36–55 fa). A deeper stratum (4 = > 55 fa out to about 12 miles) was added in 2003 (Figure 6 and Figure 7). The survey consistently catches shrimp in regions 1–4 (NH to Mt. Desert Is.) and depths 3–4 (> 35 fa), and more are caught in the spring than the fall. The $\log_e$-transformed stratified mean weights per tow for *P. borealis* for the spring and fall surveys using regions 1–4 and depths 3–4 only are presented in Table 9 and Figure 10 and Figure 11. The Maine-New Hampshire index rose steadily from 4.2 kg/tow during spring 2003 to a time series high of 17.9 kg/tow in spring 2011. Since then, the index dropped abruptly, to a time series low of 1.7 kg/tow in 2013, and 2.1 kg/tow in 2014, the second lowest value in the time series. From 2007–2011, the ME-NH inshore trawl survey data did not match the declining trend in the summer survey data. Trends in the spring ME/NH survey may be affected by inter-annual variation in the timing of the offshore migration of post-hatch females. However, the low 2013 and 2014 biomass indices in the ME-NH survey are consistent with the 2013 and 2014 ASMFC summer survey results.

ENVIRONMENTAL CONDITIONS

Ocean temperatures have an important influence on northern shrimp in the Gulf of Maine (Apollonio et al. 1986; Richards et al. 1996; Richards et al. 2012). During the warm period of the 1950s, northern shrimp catches declined to zero despite continued fishing effort (Dow 1964), suggesting a population collapse. Spring ocean temperatures during the larval period are particularly important for recruitment, with cooler temperatures favoring higher recruitment (Richards et al. 2012). Spawner abundance also influences recruitment strength, with more recruits resulting from higher spawner abundance (Richards et al. 2012).

Sea surface temperature (SST) has been measured daily since 1906 at Boothbay Harbor, Maine, near the center of the inshore nursery areas for northern shrimp. Annual average SST at Boothbay increased from an average of 7.9 °C during 1906-1948 to an average of 10.4 °C during 2000-2013 (Figure 17). SST has exceeded the 1953 high point three times in the past decade, and 2012 was the warmest year in the 109 years of record. Similar trends have been seen during Feb-March, Figure 17), a critical time for determining recruitment strength. Feb-Mar SST was very high in 2012, but declined in 2013 and again in 2014. Spring temperature anomalies (temperature changes measured relative to a standard time period) in offshore shrimp habitat areas were the highest on record during 2012 (surface temperature) and 2011-2012 (bottom temperature) (NEFSC trawl survey data, 1968-2012; Figure 17). Temperature anomalies remained high in 2013, but were cooler in 2014. The spring bottom temperature anomaly in 2014 was near the long term average.

Timing of the larval hatch is influenced by temperature during late spring through early winter (Richards 2012). The start of the hatch period has become earlier as temperatures have increased, with the hatch in recent years beginning more than a month earlier than it did previous to 2000 (10% line in Figure 16). The midpoint of the hatch period has not changed as much as the start of the hatch (50% line in Figure 16). With the cooler temperatures in 2014, the hatch began later and reached its midpoint later than in other recent years (Figure 17).

STOCK STATUS

Traffic Light Approach

The Traffic Light Approach, developed by Caddy (1999*a*, 1999*b*, 2004) and extended by McDonough and Rickabaugh (Appendix 1) was applied to the Northern shrimp stock to characterize indices of abundance, fishery performance, and environmental trends from 1984 to present. The Strict Traffic Light Approach (STLA) categorizes annual values of each indicator as one of three colors (red, yellow, or green) to illustrate the state of the population and fishery. Red indicates unfavorable conditions or status, yellow indicates intermediate values, and green indicates favorable conditions or status.

The NSTC applied the STLA to a suite of indices. The fishery independent indicators (Figure 18) include survey indices of total abundance and biomass, spawning stock biomass, recruitment, and early life survival estimated from the ASMFC summer shrimp survey, NEFSC fall survey and ME-NH inshore survey. The survival index represents the number of eggs that survived to become recruits at age 1.5 ($\log_e$ ratio R/$E_{lag\ 2}$, scaled by 1,000,000). Environmental conditions indices include an index of predation pressure on northern shrimp that was developed for the benchmark assessment (NEFSC 2014), and several sources of temperature data for the northern shrimp resource area. The fishery performance indices include CPUE, price per pound, and annual landings value. Price per pound and annual landings values have been standardized to 2014 dollars (www.bls.gov).

Fishery independent indices have been at their lowest levels in all surveys in recent years, and this continued in 2014 (Figure 18). The only exception was a slight improvement in the recruitment index in 2014; however, the 2014 recruitment index remains below the 30th percentile for the time series (9th lowest index in the 31-year record). The survival index for the 2013 year class (observed in 2014 summer survey) was relatively high (6th highest in 31 yrs) and may reflect the somewhat cooler spring temperatures observed in the inshore nursery areas that year. The predation pressure index declined in the most recent two years (2012, 2013), but has been generally high since the late 1990s. Temperatures were very warm during 2010-2013 (Figure 25), but were cooler in the spring of 2014. There are no fishery dependent indicators for 2014 due to the moratorium. Fishery performance was very poor in 2013 with the exception of price, which was the highest since 1989 (inflation-adjusted dollars) (Figure 18).

The NSTC examined a subset of key indicators in more detail using the Fuzzy Traffic Light Approach (FTLA). The FTLA assigns color values on a finer scale than the Strict Traffic Light Approach. Rather than just the strict color bin for each annual value, the FTLA depicts the proximity of the index to a reference level where the proportion of yellow to red indicates the value (moving in an adverse direction), and the proportion of yellow to green (indicates the value moving in a favorable direction. We selected nine indicators to evaluate using the FTLA, including: 1) total biomass from the ASMFC Summer Shrimp survey, 2) recruit abundance from the ASMFC Summer Shrimp survey, 3) spawning biomass from the ASMFC Summer Shrimp survey, 4) commercial fishery CPUE (metric tons landed per trip), 5) early life survival, 6) predation pressure index (PPI), 7) spring sea surface temperature at Boothbay Harbor, ME, 8) spring bottom temperature anomaly from NEFSC shrimp habitat survey stations, and 9) bottom temperature from the ASMFC Summer Shrimp survey.

Qualitative stock status reference levels were developed based on the time series of observations. A desirable 'target' level was defined based on conditions existing during the fishery's stable period (1985-1994), which was the time period used to define previous reference points (Amendment 2 to the FMP). A 'limit' was considered to delineate an extremely adverse state, and was based on the 20th percentile of the entire time series. We further evaluated 10th percentile level as well. These reference levels are not management triggers, as they are not defined in the northern shrimp FMP or its Amendments. The levels are being used here to illustrate the current condition of the stock relative to earlier time periods.

For the FTLA, two figures were produced for each of the nine indices (
Figure 19,
Figure 20,
Figure 21,
Figure 22,
Figure 23,
Figure 24,
Figure 25,
Figure 26, and
Figure 27). The line graph (top panel) shows trends over the time series and the relation of each annual value to the 'target' and 'limit.' Point colors show when the annual index fell into an undesirable (red), favorable (green), or intermediate (yellow) zone. The stacked bar graph (bottom panel) for each indicator also shows trends over time; however these plots additionally reflect the proximity of the annual value to the stable period mean and confidence interval relative to the stable period. The greater the proportion of green in each stacked bar, the further that year's index is relative to the stable period mean in a favorable direction. Conversely, the greater the proportion of red, the further that year's index is relative to the stable period mean in an unfavorable direction. A bar that is 100% yellow indicates a value that is the same as or very close to the stable period mean.

Of the three biomass/abundance indicators examined, all were below the 20th percentile of the time series for three of the last four years (Table 12,
Figure 19,
Figure 20, Figure 21), and three were also below the 10th percentile of the time series for at least two of the last four years. Total biomass was below the 10th percentile from 2012-2014, with the lowest biomass on record in 2013 and second lowest in 2014 (
Figure 19). Spawning biomass was below the 10th percentile from 2012-2014, with the lowest spawning biomass on record in 2013 and second lowest in 2014 (
Figure 20). Recruitment was below the 10th percentile from 2012-2013, with the lowest recruitment on record in 2013 and second lowest in 2012 (Table 12, Figure 21).

The early life survival (to age 1.5) index was below both the 20th and the 10th percentile for the 2011 and 2012 year classes (second lowest and lowest on record, respectively) (Table 12,

Figure 22). The 2010-2012 year classes would be the target of the fishery for the 2014/2015 fishing year. The survival index for the 2013 year class increased to the green zone.

Fishery performance, as characterized by catch rate (mt per trip) was below both the 20th and the 10th percentile in 2013, a record low for the time series (Table 12, Figure 23). No commercial catch occurred in 2014 due to a harvest moratorium.

The four environmental indicators show that trends have not been favorable for Northern shrimp in recent years. Predation pressure on Northern shrimp has generally increased since the late 1990s, with two values above both the 80th and the 90th percentile of the time series since 2010 (Figure 24). Sea surface and bottom temperatures were colder in 2014 than in recent years, however an overall rise in temperature since the stable period is evident (Figure 25), with spring and summer bottom temperatures in Gulf of Maine shrimp habitat at or above the 90th percentile from 2011-2013 (Table 12, Figure 26, Figure 27).

Taken together, FTLA indicators demonstrate that Gulf of Maine Northern shrimp stock status continues to be critically poor. Indicators in recent years have been particularly unfavorable when compared to those of the stable period. While the recruitment index increased slightly in 2014, reflecting higher survival of the 2013 year class, it was still well below (less than a third) of the stable period mean. The higher survival of the 2013 year class may reflect both reduced fishing effort on the spawning stock and cooler spring temperatures in 2013. This modest improvement in recruitment would not be expected to influence the fishable stock until 2017.

RECOMMENDATIONS

The NSTC bases its recommendations to the Section on its assessment of current stock status, the biology of the species, and the stated management goal of protecting and maintaining the stock at levels that will support a viable fishery on a sustainable resource (Amendment 2 to the FMP, ASMFC 2011).

Short-term commercial prospects for the 2015 fishing season are very poor given the record low index of exploitable biomass in 2014 and the relatively small size of females. Longer-term prospects are also poor due to the unprecedented low abundance of age 1.5 shrimp seen in the 2012 - 2013 summer surveys, which would be the main contributors to a 2016 fishery. The recruitment index increased marginally in 2014, but was still well below the stable period mean (1984-1993). These recruits (2013 year class) are not expected to reach exploitable size until 2017.

Long term trends in environmental conditions are not favorable for northern shrimp. This suggests a need to conserve spawners to help compensate for what may continue to be an unfavorable environment.

Given the depleted condition of the resource and poor prospects for the near future, the NSTC strongly recommends that the Section extend the moratorium on fishing through 2015.

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Table 1: U.S. Commercial landings (mt) of northern shrimp in the Gulf of Maine.

Year	Maine		Massachusetts		New Hampshire		Total	
	Annual	Season	Annual	Season	Annual	Season	Annual	Season
1958	2.2		0.0		0.0		2.2	
1959	5.5		2.3		0.0		7.8	
1960	40.4		0.5		0.0		40.9	
1961	30.5		0.3		0.0		30.8	
1962	159.5		16.2		0.0		175.7	
1963	244.3		10.4		0.0		254.7	
1964	419.4		3.1		0.0		422.5	
1965	941.3		8.0		0.0		949.3	
1966	1,737.8		10.5		18.1		1,766.4	
1967	3,141.2		10.0		20.0		3,171.2	
1968	6,515.2		51.9		43.1		6,610.2	
1969	10,993.1		1,773.1		58.1		12,824.3	
1970	7,712.8		2,902.3		54.4		10,669.5	
1971	8,354.8		2,724.0		50.8		11,129.6	
1972	7,515.6		3,504.6		74.8		11,095.0	
1973	5,476.6		3,868.2		59.9		9,404.7	
1974	4,430.7		3,477.3		36.7		7,944.7	
1975	3,177.2		2,080.0		29.4		5,286.6	
1976	617.3		397.8		7.3		1,022.4	
1977	142.1		236.9		2.2		381.2	
1978	0.0		3.3		0.0		3.3	
1979	32.8		405.9		0.0		438.7	
1980	69.6		256.9		6.3		332.8	
1981	530.0		539.4		4.5		1,073.9	
1982	883.0		658.5		32.8		1,574.3	
1983	1,029.2		508.2		36.5		1,573.9	
1984	2,564.7		565.4		96.8		3,226.9	
1985	2,957.0	2,946.4	1,030.5	968.8	207.4	216.7	4,194.9	4,131.9
1986	3,407.2	3,268.2	1,085.7	1,136.3	191.1	230.5	4,684.0	4,635.0
1987	3,534.2	3,680.2	1,338.7	1,427.9	152.5	157.9	5,025.4	5,266.0
1988	2,272.5	2,258.4	632.7	619.6	173.1	157.6	3,078.3	3,035.6
1989	2,544.8	2,384.0	751.6	699.9	314.3	231.5	3,610.7	3,315.4

Table 1 continued – U.S. commercial landings of northern shrimp (2013 data are preliminary)

Year	Maine		Massachusetts		New Hampshire		Total	
	Annual	Season	Annual	Season	Annual	Season	Annual	Season
1990	2,962.1	3,236.3	993.4	974.9	447.3	451.3	4,402.8	4,662.5
1991	2,431.5	2,488.6	737.7	814.6	208.3	282.1	3,377.5	3,585.3
1992	2,990.4	3,070.6	291.7	289.3	100.1	100.1	3,382.2	3,460.0
1993	1,563.1	1,492.5	300.3	292.8	441.2	357.6	2,304.6	2,142.9
1994	2,815.4	2,239.7	381.9	247.5	521.0	428.0	3,718.3	2,915.2
1995		5,013.7		670.1		772.8		6,456.6
1996		8,107.1		660.6		771.7		9,539.4
1997		6,086.9		366.4		666.2		7,119.5
1998		3,481.3		240.3		445.2		4,166.8
1999		1,573.2		75.7		217.0		1,865.9
2000		2,516.2		124.1		214.7		2,855.0
2001		1,075.2		49.4		206.4		1,331.0
2002		391.6		8.1		53.0		452.7
2003		1,203.7		27.7		113.0		1,344.4
2004		1,926.9		21.3		183.2		2,131.4
2005		2,270.2		49.6		290.3		2,610.1
2006		2,201.6		30.0		91.1		2,322.7
2007		4,469.3		27.5		382.9		4,879.7
2008		4,515.8		29.9		416.8		4,962.4
2009		2,315.7		MA & NH combined		185.6		2,501.2
2010		5,604.3		35.1		501.4		6,140.8
2011		5,569.7		196.4		631.5		6,397.5
2012		2,219.9		77.8		187.8		2,485.4
*2013		278.7		18.9		36.9		334.5
2014		0.0		0.0		0.0		0.0

Table 2: Price and value of U.S. Commercial landings (mt) of northern shrimp in the Gulf of Maine. (*2013 data are preliminary.)

Year	Price $/Lb	Value $	Price ($/Lb) 2014 dollars**	Value ($) 2014 dollars**
1958	0.32	1,532		
1959	0.29	5,002		
1960	0.23	20,714		
1961	0.20	13,754		
1962	0.15	57,382		
1963	0.12	66,840		
1964	0.12	112,528		
1965	0.12	245,469		
1966	0.14	549,466		
1967	0.12	871,924		
1968	0.11	1,611,425		
1969	0.12	3,478,910		
1970	0.20	4,697,418		
1971	0.19	4,653,202		
1972	0.19	4,586,484		
1973	0.27	5,657,347		
1974	0.32	5,577,465		
1975	0.26	3,062,721		
1976	0.34	764,094		
1977	0.55	458,198		
1978	0.24	1,758		
1979	0.33	320,361		
1980	0.65	478,883		
1981	0.64	1,516,521		
1982	0.60	2,079,109		
1983	0.67	2,312,073		
1984	0.49	3,474,351	1.12	7,956,264
1985	0.44	3,984,562	0.97	8,805,883
1986	0.63	6,451,206	1.37	13,999,118
1987	1.10	12,740,581	2.30	26,755,220
1988	1.10	7,391,777	2.22	14,857,472
1989	0.98	7,177,659	1.89	13,781,105

Season	Price $/Lb	Value $	Price ($/Lb) 2014 dollars**	Value ($) 2014 dollars**
1990	0.72	7,351,420	1.30	13,379,585
1991	0.91	7,208,838	1.60	12,615,467
1992	0.99	7,547,941	1.68	12,831,499
1993	1.07	5,038,053	1.76	8,312,787
1994	0.75	4,829,106	1.21	7,774,861
1995	0.90	12,828,030	1.41	20,011,726
1996	0.73	15,341,504	1.11	23,319,086
1997	0.79	12,355,871	1.17	18,286,689
1998	0.96	8,811,938	1.40	12,865,429
1999	0.91	3,762,043	1.31	5,379,722
2000	0.79	4,968,655	1.09	6,856,744
2001	0.86	2,534,095	1.16	3,395,687
2002	1.08	1,077,534	1.43	1,422,344
2003	0.87	2,590,916	1.13	3,342,282
2004	0.44	2,089,636	0.56	2,632,941
2005	0.57	3,261,648	0.69	3,979,210
2006	0.37	1,885,978	0.43	2,225,454
2007	0.38	4,087,120	0.44	4,700,188
2008	0.49	5,407,373	0.55	6,002,184
2009	0.40	2,051,987	0.45	2,460,216
2010	0.52	6,994,106	0.56	7,623,575
2011	0.75	10,625,533	0.80	11,263,065
2012	0.95	5,230,032	0.99	5,439,234
*2013	1.81	1,332,150	1.84	1,358,793
2014		0	0	0

*2013 are preliminary.

** Inflation adjustment from http://www.bls.gov, accessed Oct. 22, 2014

Table 3: Distribution of landings (metric tons) in the Gulf of Maine northern shrimp fishery by season, state and month.

	Dec	Jan	Feb	Mar	Apr	May	Other	Season Total
1985 Season, 166 days, Dec 1 - May 15								
Maine	335.7	851.8	1,095.5	525.1	116.8	21.5	0.0	2,946.4
Mass.	91.7	283.9	238.3	239.3	57.8	57.0	0.8	968.8
N.H.	67.0	86.2	50.4	11.6	1.3		0.2	216.7
Total	494.4	1,221.9	1,384.2	776.0	175.9	78.5	1.0	4,131.9
1986 Season, 196 days, Dec 1 - May 31, June 8-21								
Maine	346.9	747.8	1,405.3	415.4	104.2	149.2	99.4	3,268.2
Mass.	154.3	213.4	221.2	200.7	111.2	84.8	150.7	1,136.3
N.H.	57.7	75.9	70.8	14.2	1.3	0.0	10.6	230.5
Total	558.9	1,037.1	1,697.3	630.3	216.7	234.0	260.7	4,635.0
1987 Season, 182 days, Dec 1 - May 31								
Maine	485.9	906.2	1,192.7	672.9	287.6	127.9	7.0	3,680.2
Mass.	103.5	260.0	384.9	310.2	180.8	182.8	5.7	1,427.9
N.H.	18.4	53.6	62.8	15.7	7.3	0.0	0.1	157.9
Total	607.8	1,219.8	1,640.4	998.8	475.7	310.7	12.8	5,266.0
1988 Season, 183 days, Dec 1 - May 31								
Maine	339.7	793.9	788.1	243.6	24.6	67.3	1.2	2,258.4
Mass.	14.4	225.8	255.0	104.9	8.6	10.9	0.0	619.6
N.H.	13.0	72.6	53.7	14.9	0.3	0.0	3.1	157.6
Total	367.1	1,092.3	1,096.8	363.4	33.5	78.2	4.3	3,035.6
1989 Season, 182 days, Dec 1 - May 31								
Maine	353.6	770.5	700.6	246.4	218.7	94.2		2,384.0
Mass.	26.2	197.5	154.9	104.8	160.9	55.6		699.9
N.H.	28.5	106.9	77.0	15.4	3.7	0.0		231.5
Total	408.3	1,074.9	932.5	366.6	383.3	149.8	0.0	3,315.4
1990 Season, 182 days, Dec 1 - May 31								
Maine	512.4	778.4	509.8	638.7	514.1	282.8	0.1	3,236.3
Mass.	75.6	344.5	184.8	100.2	159.0	110.0	0.8	974.9
N.H.	111.3	191.7	116.2	30.7	1.4			451.3
Total	699.3	1,314.6	810.8	769.6	674.5	392.8	0.9	4,662.5
1991 Season, 182 days, Dec 1 - May 31								
Maine	238.3	509.2	884.1	455.0	251.8	148.2	2.0	2,488.6
Mass.	90.6	174.7	176.0	131.2	93.3	133.8	15.0	814.6
N.H.	107.3	104.4	33.8	27.8	7.8	1.0		282.1
Total	436.2	788.3	1,093.9	614.0	352.9	283.0	17.0	3,585.3
1992 Season, 153 days, Dec 15 - May 15								
Maine	181.2	881.0	1,295.0	462.6	163.6	87.2		3,070.6
Mass.	17.1	148.3	73.3	47.6	2.9		0.1	289.3
N.H.	33.4	47.0	11.9	6.8	1.0			100.1
Total	231.7	1,076.3	1,380.2	517.0	167.5	87.2	0.1	3,460.0

	Dec	Jan	Feb	Mar	Apr	May	Other	Season Total
1993 Season, 138 days, Dec 14 - April 30								
Maine	101.0	369.1	597.1	297.5	127.8			1,492.5
Mass.	19.6	82.0	81.9	62.3	42.0	5.0		292.8
N.H.	33.5	85.4	101.8	77.0	59.9			357.6
Total	154.1	536.5	780.8	436.8	229.7	5.0	0.0	2,142.9
1994 Season, 122 days, Dec 15 - Apr 15								
Maine	171.5	647.8	972.1	399.6	48.7			2,239.7
Mass.	27.1	68.0	100.8	38.8	12.8			247.5
N.H.	117.2	124.3	128.7	49.6	8.2			428.0
Total	315.8	840.1	1,201.6	488.0	69.7	0.0	0.0	2,915.2
1995 Season, 128 days, Dec 1 - Apr 30, 1 day per week off								
Maine	747.3	1,392.9	1,336.0	912.1	625.4			5,013.7
Mass.	160.6	154.0	104.1	111.0	139.5		0.9	670.1
N.H.	210.2	186.8	118.3	158.5	99.0			772.8
Total	1,118.1	1,733.7	1,558.4	1,181.6	863.9	0.0	0.9	6,456.6
1996 Season, 152 days, Dec 1 - May 31, 1 day per week off								
Maine	1,122.0	1,693.1	3,236.9	795.6	361.5	897.6	0.4	8,107.1
Mass.	167.9	106.7	190.7	67.2	66.5	60.3	1.3	660.6
N.H.	189.8	169.5	234.0	81.9	78.8	17.1	0.6	771.7
Total	1,479.7	1,969.3	3,661.6	944.7	506.8	975.0	2.3	9,539.4
1997 Season, 156 days, Dec 1 - May 27, two 5-day and four 4-day blocks off								
Maine	1,178.0	1,095.8	1,749.3	758.4	766.8	538.2	0.4	6,086.9
Mass.	90.2	110.4	111.4	49.0	1.2	0.5	3.7	366.4
N.H.	185.6	104.1	140.1	108.4	85.8	42.2	0.0	666.2
Total	1,453.8	1,310.3	2,000.8	915.8	853.8	580.9	4.1	7,119.5
1998 Season, 105 days, Dec 8 - May 22, weekends off except Mar 14-15, Dec 25-31 and Mar 16-31 off.								
Maine	511.1	926.8	1,211.1	401.0	228.7	202.6		3,481.3
Mass.	49.1	73.3	88.6	14.0	15.3			240.3
N.H.	89.4	106.9	143.5	54.3	49.0	2.1		445.2
Total	649.6	1,107.0	1,443.2	469.3	293.0	204.7	0.0	4,166.8
1999 Season, 90 days, Dec 15 - May 25, weekends, Dec 24 - Jan 3, Jan 27-31, Feb 24-28, Mar 16-31, and Apr 29 - May 2 off.								
Maine	79.9	192.7	599.3	247.9	205.3	248.1		1,573.2
Mass.	25.0	23.8	16.0	2.5	8.4			75.7
N.H.	46.5	63.2	52.2	10.0	36.5	8.6		217.0
Total	151.4	279.7	667.5	260.4	250.2	256.7	0.0	1,865.9
2000 Season, 51 days, Jan 17 - Mar 15, Sundays off								
Maine		759.9	1,534.4	221.9				2,516.2
Mass.		25.9	86.0	12.2				124.1
N.H.		40.6	133.7	40.4				214.7
Total	0.0	826.4	1,754.0	274.6	0.0	0.0	0.0	2,855.0

Table 3 continued – Landings by season, state, and month.

	Dec	Jan	Feb	Mar	Apr	May	Other	Season Total
2001 Season, 83 days, Jan 9 - Apr 30, Mar 18 - Apr 15 off, experimental offshore fishery in May								
Maine		1,683	1,551	177	43	6		3,460
Mass.		111	48	10		1		170
N.H.		303	200	conf	conf			503
Total	0	2,097	1,799	187	43	7	0	4,133
2002 Season, 25 days, Feb 15 - Mar 11								
Maine			799	299				1,098
Mass.			31	conf				31
N.H.			119	56				175
Total	0	0	949	355	0	0	0	1,304
2003 Season, 38 days, Jan 15 - Feb 27, Fridays off								
Maine		1114	1,582	1			2	2,699
Mass.		41	50					91
N.H.		81	151					232
Total	0	1,236	1,783	1	0	0	2	3,022
2004 Season, 40days, Jan 19 - Mar 12, Saturdays and Sundays off								
Maine	7	647	1,197	482	13	14	6	2,366
Mass.		conf	56	conf				56
N.H.		46	147	66				259
Total	7	693	1,400	548	13	14	6	2,681
2005 Season, 70 days, Dec 19 - 30, Fri-Sat off, Jan 3 - Mar 25, Sat-Sun off								
Maine	140	667	1,305	1,255	0	0	1	3,368
Mass.	15	18	49	23				105
N.H.	24	76	216	77				393
Total	179	761	1,570	1,355	0	0	1	3,866
2006 Season, 140 days, Dec 12 - Apr 30								
Maine	148	585	947	530	101			2,311
Mass.	conf	conf	58	conf	conf			58
N.H.	5	23	19	62	conf			109
Total	153	608	1,024	592	101	0	0	2,478
2007 Season, 151 days, Dec 1 - Apr 30								
Maine	437	1,102	1,514	669	136	1	3	3,862
Mass.	conf	45	conf	conf				45
N.H.	26	115	71	44	conf			256
Total	463	1,262	1,585	713	136	1	3	4,163
2008 Season, 152 days, Dec 1 - Apr 30								
Maine	418	1,291	2,076	1,286	102	0	9	5,182
Mass.	conf	conf	25	13				38
N.H.	63	141	125	38	conf			367
Total	481	1,432	2,226	1,337	102	0	9	5,587

	Dec	Jan	Feb	Mar	Apr	May	Other	Season Total
2009 Season, 180 days, Dec 1 - May 29								
Maine	134	785	1,122	739	47	5	1	2,833
Mass.& NH	conf	107	62	conf	conf			169
Total	134	892	1,184	739	47	5	1	3,002
2010 Season, 156 days, Dec 1 - May 5								
Maine	241	1,561	2,593	911	185	29	1	5,521
Mass.	conf	26	23	conf	conf			49
N.H.	54	127	151	21	56	conf		409
Total	295	1,714	2,767	932	241	29	1	5,979
2011 Season, 90 days, Dec 1 - Feb 28								
Maine	599	2,880	2,875	1				6,355
Mass.	28	92	73	0	0			193
N.H.	108	241	198					547
Total	735	3,213	3,146	1	0	0	0	7,095
2012 Season, Trawling Mon,Wed,Fri, Jan 2 - Feb 17 (21 days); Trapping Feb 1-17 (17 days)								
Maine	1	1,305	2,014	1				3,321
Mass.		74	43					117
N.H.		129	99					228
Total	1	1,508	2,156	1	0	0	0	3,666
***2013** Season, Trawl 2-7 days/wk, Jan 23-Apr 12 (54 days); Trap 6-7 days/wk, Feb 5-Apr 12 (62 days)								
Maine		200	872	259	22			1,353
Mass.		9	28	20				57
N.H.		20	73	27	conf			120
Total	0	229	973	306	22	0	0	1,530
2014 Season was closed.								

conf = Confidential data were combined with an adjacent month.

* Preliminary data

Table 4: Distribution of landings (metric tons) in the Maine northern shrimp fishery by season, gear type, and month.

	Dec	Jan	Feb	Mar	Apr	May	Other	Season Total	% of total
2000 Season, 51 days, Jan 17 - Mar 15, Sundays off									
Trawl		731.1	1,354.8	163.6				2,249.47	89%
Trap		28.9	179.6	58.3				266.7	11%
Total	0.0	759.9	1,534.4	221.9	0.0	0.0	0.0	2,516.2	
2001 Season, 83 days, Jan 9 - Apr 30, Mar 18 - Apr 16 off, experimental offshore fishery in May									
Trawl		533.0	360.1	30.9	29.8	0.3		954.0	89%
Trap		42.9	72.6	5.7				121.2	11%
Total	0.0	575.8	432.8	36.6	29.8	0.3	0.0	1,075.2	
2002 Season, 25 days, Feb 15 - Mar 11									
Trawl			263.6	77.2				340.8	87%
Trap			43.2	7.6				50.8	13%
Total	0.0	0.0	306.8	84.8	0.0	0.0	0.0	391.6	
2003 Season, 38 days, Jan 15 - Feb 27, Fridays off									
Trawl		467.2	518.8	0.4			0.6	987.0	82%
Trap		67.5	149.2					216.7	18%
Total	0.0	534.7	668.0	0.4	0.0	0.0	0.6	1,203.7	
2004 Season, 40 days, Jan 19 - Mar 12, Saturdays and Sundays off									
Trawl	1.8	514.0	905.5	430.0	4.7	2.7	0.04	1858.7	96%
Trap		12.2	39.5	16.5				68.1	4%
Total	1.8	526.2	945.1	446.4	4.7	2.7	0.04	1926.9	
2005 Season, 70 days, Dec 19 - 30, Fri-Sat off, Jan 3 - Mar 25, Sat-Sun off									
Trawl	75.0	369.4	770.6	663.6			0.01	1878.5	83%
Trap		conf	132.6	259.0				391.6	17%
Total	75.0	369.4	903.2	922.6	0.0	0.0	0.01	2270.2	
2006 Season, 140 days, Dec 12 - Apr 30									
Trawl	144.1	675.0	733.8	256.9	117.1			1927.0	88%
Trap	conf	16.7	163.1	93.9	0.9			274.6	12%
Total	144.1	691.7	896.9	350.8	118.0	0.0	0.0	2201.6	
2007 Season, 151 days, Dec 1 - Apr 30									
Trawl	758.2	1,443.3	1,275.6	362.1	143.6	0.4	0.0	3,983.2	89%
Trap	3.7	37.2	314.7	119.8	10.6			486.1	11%
Total	761.9	1,480.5	1,590.4	481.9	154.2	0.4	0.0	4,469.3	
2008 Season, 152 days, Dec 1 - Apr 30									
Trawl	408.5	989.6	1,680.8	603.4	42.6		0.1	3,724.9	82%
Trap	conf	64.1	339.6	380.4	6.7			790.8	18%
Total	408.5	1,053.7	2,020.4	983.8	49.3	0.0	0.1	4,515.8	
2009 Season, 180 days, Dec 1 - May 29									
Trawl	134.3	579.7	780.9	405.4	33.6	1.8	0.2	1,935.9	84%
Trap	0.4	16.2	207.3	154.7	1.3			379.8	16%
Total	134.6	595.9	988.2	560.1	34.9	1.8	0.2	2,315.7	
2010 Season, 156 days, Dec 1 - May 5									
Trawl	263.4	1,488.3	2,091.1	326.3	194.3	33.0	0.4	4,396.7	78%
Trap	conf	194.8	823.4	189.3	conf			1,207.6	22%
Total	263.4	1,683.1	2,914.5	515.6	194.3	33.0	0.4	5,604.3	
2011 Season, 90 days, Dec 1 - Feb 28									
Trawl	720.8	2,194.5	1,728.5	0.5				4,644.4	83%
Trap	1.9	377.7	545.8					925.3	17%
Total	722.7	2,572.2	2,274.3	0.5	0.0	0.0	0.0	5,569.7	
2012 Season, Trawling Mon,Wed,Fri, Jan 2 - Feb 17 (21 days); Trapping Feb 1-17 (17 days)									
Trawl	0.5	1,130.6	895.2	0.5				2,026.8	91%
Trap			193.1					193.1	9%
Total	0.5	1,130.6	1,088.2	0.5	0.0	0.0	0.0	2,219.9	
***2013** Season, Trawl 2-7 days/wk, Jan 23-Apr 12 (54 days); Trap 6-7 days/wk, Feb 5-Apr 12 (62 days)									
Trawl		63.0	155.6	37.4	2.4			258.3	93%
Trap			15.2	4.9	0.2			20.4	7%
Total	0.0	63.0	170.8	42.4	2.6	0.0	0.0	278.7	
2014 Season was closed.									

conf = Confidential data were combined with an adjacent month.

* Preliminary data

Table 5: Distribution of fishing effort (number of trips) in the Gulf of Maine northern shrimp fishery by season, state, and month.

	Dec	Jan	Feb	Mar	Apr	May	Other	Season Total
1985 Season, 166 days, Dec 1 - May 15								
Maine	552	1,438	1,979	1,198	260	35		5,462
Mass.	127	269	224	231	92	73		1,016
N.H.	118	135	78	26	22			379
Total	797	1,842	2,281	1,455	374	108	0	6,857
1986 Season, 183 days, Dec 1 - May 31								
Maine	590	1,309	2,798	831	224	133	68	5,953
Mass.	128	235	225	320	194	133	159	1,394
N.H.	156	163	165	51	3		17	555
Total	874	1,707	3,188	1,202	421	266	244	7,902
1987 Season, 182 days, Dec 1 - May 31								
Maine	993	2,373	3,073	2,241	617	340	16	9,653
Mass.	325	354	414	426	283	317	164	2,283
N.H.	67	164	175	95	28		32	561
Total	1,385	2,891	3,662	2,762	928	657	212	12,497
1988 Season, 183 days, Dec 1 - May 31								
Maine	972	2,183	2,720	1,231	193	122		7,421
Mass.	28	326	426	315	26	57		1,178
N.H.	72	231	236	99	3			641
Total	1,072	2,740	3,382	1,645	222	179	0	9,240
1989 Season, 182 days, Dec 1 - May 31								
Maine	958	2,479	2,332	936	249	84		7,038
Mass.	103	479	402	254	297	102		1,637
N.H.	120	369	312	69	16			886
Total	1,181	3,327	3,046	1,259	562	186	0	9,561
1990 Season, 182 days, Dec 1 - May 31								
Maine	1,036	1,710	1,529	1,986	897	238		7,396
Mass.	147	459	273	202	175	118		1,374
N.H.	178	363	284	157	6			988
Total	1,361	2,532	2,086	2,345	1,078	356	0	9,758
1991 Season, 182 days, Dec 1 - May 31								
Maine	568	1,286	2,070	1,050	438	139		5,551
Mass.	264	416	401	231	154	147		1,613
N.H.	279	285	135	82	22	1		804
Total	1,111	1,987	2,606	1,363	614	287	0	7,968
1992 Season, 153 days, Dec 15 - May 15								
Maine	411	1,966	2,700	1,222	318	141		6,758
Mass.	59	337	145	101	41			683
N.H.	96	153	76	29	3			357
Total	566	2,456	2,921	1,352	362	141	0	7,798

	Dec	Jan	Feb	Mar	Apr	May	Other	Season Total
1993 Season, 138 days, Dec 14 - April 30								
Maine	249	1,102	1,777	1,032	227			4,387
Mass.	60	200	250	185	72			767
N.H.	76	246	275	256	151			1,004
Total	385	1,548	2,302	1,473	450	0	0	6,158
1994 Season, 122 days, Dec 15 - Apr 15								
Maine	265	1,340	1,889	1,065	122			4,681
Mass.	58	152	147	83	15			455
N.H.	169	228	266	173	18			854
Total	492	1,720	2,302	1,321	155	0	0	5,990
1995 Season, 128 days, Dec 1 - Apr 30, 1 day per week off								
Maine	879	2,341	2,641	1,337	694			7,892
Mass.	145	385	275	157	109			1,071
N.H.	189	331	279	359	344			1,502
Total	1,213	3,057	3,195	1,853	1,147	0	0	10,465
1996 Season, 152 days, Dec 1 - May 31, 1 day per week off								
Maine	1,341	2,030	3,190	1,461	444	457		8,923
Mass.	299	248	325	269	106	126		1,373
N.H.	331	311	389	248	155	61		1,495
Total	1,971	2,589	3,904	1,978	705	644	0	11,791
1997 Season, 156 days, Dec 1 - May 31, two 5-day and four 4-day blocks off								
Maine	1,674	1,753	2,737	1,178	793	530		8,665
Mass.	184	226	245	114	7	1		777
N.H.	277	245	301	218	189	62		1,292
Total	2,135	2,224	3,283	1,510	989	593	0	10,734
1998 Season, 152 days, Dec 1 - May 31, 1 day per week off								
Maine	852	1,548	1,653	725	346	189		5,313
Mass.	94	200	148	70	3	1		515
N.H.	141	216	182	134	83	22		778
Total	1,087	1,964	1,983	929	432	212	0	6,606
1999 Season, 152 days, Dec 1 - May 31, 1 day per week off								
Maine	190	556	1,125	553	324	172		2,920
Mass.	39	57	71	9	40			216
N.H.	82	192	213	44	123	21		675
Total	311	805	1,409	606	487	193	0	3,811
2000 Season, 51 days, Jan 17 - Mar 15, Sundays off								
Maine		897	2,494	647				4,038
Mass.		33	117	32	1			183
N.H.		45	201	87				333
Total	0	975	2,812	766	1	0	0	4,554

Table 5 continued – Trips by season, state, and month.

	Dec	Jan	Feb	Mar	Apr	May	Other	Season Total
2001 Season, 83 days, Jan 9 - Apr 30, Mar 18 - Apr 15 off, experimental offshore fishery in May								
Maine		1,683	1,551	177	43	6		3,460
Mass.		111	48	10		1		170
N.H.		303	200	conf	conf			503
Total	0	2,097	1,799	187	43	7	0	4,133
2002 Season, 25 days, Feb 15 - Mar 11								
Maine			799	299				1,098
Mass.			31	conf				31
N.H.			119	56				175
Total	0	0	949	355	0	0	0	1,304
2003 Season, 38 days, Jan 15 - Feb 27, Fridays off								
Maine		1114	1,582	1			2	2,699
Mass.		41	50					91
N.H.		81	151					232
Total	0	1,236	1,783	1	0	0	2	3,022
2004 Season, 40days, Jan 19 - Mar 12, Saturdays and Sundays off								
Maine	7	647	1,197	482	13	14	6	2,366
Mass.		conf	56	conf				56
N.H.		46	147	66				259
Total	7	693	1,400	548	13	14	6	2,681
2005 Season, 70 days, Dec 19 - 30, Fri-Sat off, Jan 3 - Mar 25, Sat-Sun off								
Maine	140	667	1,305	1,255	0	0	1	3,368
Mass.	15	18	49	23				105
N.H.	24	76	216	77				393
Total	179	761	1,570	1,355	0	0	1	3,866
2006 Season, 140 days, Dec 12 - Apr 30								
Maine	148	585	947	530	101			2,311
Mass.	conf	conf	58	conf	conf			58
N.H.	5	23	19	62	conf			109
Total	153	608	1,024	592	101	0	0	2,478
2007 Season, 151 days, Dec 1 - Apr 30								
Maine	437	1,102	1,514	669	136	1	3	3,862
Mass.	conf	45	conf	conf				45
N.H.	26	115	71	44	conf			256
Total	463	1,262	1,585	713	136	1	3	4,163
2008 Season, 152 days, Dec 1 - Apr 30								
Maine	418	1,291	2,076	1,286	102	0	9	5,182
Mass.	conf	conf	25	13				38
N.H.	63	141	125	38	conf			367
Total	481	1,432	2,226	1,337	102	0	9	5,587
2009 Season, 180 days, Dec 1 - May 29								
Maine	134	785	1,122	739	47	5	1	2,833
Mass.& NH	conf	107	62	conf	conf			169
Total	134	892	1,184	739	47	5	1	3,002
2010 Season, 156 days, Dec 1 - May 5								
Maine	241	1,561	2,593	911	185	29	1	5,521
Mass.	conf	26	23	conf	conf			49
N.H.	54	127	151	21	56	conf		409
Total	295	1,714	2,767	932	241	29	1	5,979
2011 Season, 90 days, Dec 1 - Feb 28								
Maine	599	2,880	2,875	1				6,355
Mass.	28	92	73	0	0			193
N.H.	108	241	198					547
Total	735	3,213	3,146	1	0	0	0	7,095
2012 Season, Trawling Mon,Wed,Fri, Jan 2 - Feb 17 (21days); Trapping Feb 1-17 (17 days)								
Maine	1	1,305	2,014	1				3,321
Mass.		74	43					117
N.H.		129	99					228
Total	1	1,508	2,156	1	0	0	0	3,666
***2013** Season, Trawl 2-7 days/wk, Jan 23-Apr 12 (54 days); Trap 6-7 days/wk, Feb 5-Apr 12 (62 days)								
Maine		200	872	259	22			1,353
Mass.		9	28	20				57
N.H.		20	73	27	conf			120
Total	0	229	973	306	22	0	0	1,530
2014 Season was closed.								

conf = Confidential data were combined with an adjacent month.
* Preliminary data

Table 6: Distribution of fishing trips in the Maine northern shrimp fishery by season, gear type, and month.

	Dec	Jan	Feb	Mar	Apr	May	Other	Season Total	%
2000									
Trawl		818	2,073	462				3,353	97%
Trap		79	421	185				685	20%
Total	0	897	2,494	647	0	0	0	4,038	
2001									
Trawl		1,500	1,214	112	43	6		2,875	83%
Trap		183	337	65				585	17%
Total	0	1,683	1,551	177	43	6	0	3,460	
2002									
Trawl			595	236				831	76%
Trap			204	63				267	24%
Total	0	0	799	299	0	0	0	1,098	
2003									
Trawl		850	1,081	1			2	1,934	72%
Trap		264	501					765	28%
Total	0	1,114	1,582	1	0	0	2	2,699	
2004									
Trawl	7	566	965	382	13	14	6	1,953	83%
Trap		81	232	100				413	17%
Total	7	647	1,197	482	13	14	6	2,366	
2005									
Trawl	140	647	953	778			1	2,519	75%
Trap		conf	372	477				849	25%
Total	140	647	1,325	1,255	0	0	1	3,368	
2006									
Trawl	145	490	563	273	88			1,559	67%
Trap	conf	98	384	257	13			752	33%
Total	145	588	947	530	101	0	0	2,311	
2007									
Trawl	425	977	921	349	119	1	3	2,795	72%
Trap	12	125	593	320	17			1,067	28%
Total	437	1,102	1,514	669	136	1	3	3,862	
2008									
Trawl	414	1,062	1,393	661	51	0	9	3,590	69%
Trap	conf	233	683	625	51			1,592	31%
Total	414	1,295	2,076	1,286	102	0	9	5,182	
2009									
Trawl	130	705	673	381	32	5	1	1,927	68%
Trap	4	80	449	358	15			906	32%
Total	134	785	1,122	739	47	5	1	2,833	
2010									
Trawl	238	1,230	1,512	447	157	29	1	3,614	65%
Trap	conf	334	1,081	492	conf			1,907	35%
Total	238	1,564	2,593	939	157	29	1	5,521	
2011									
Trawl	577	2,068	1,692	1				4,338	68%
Trap	22	812	1,183					2,017	32%
Total	599	2,880	2,875	1	0	0	0	6,355	
2012									
Trawl	1	1,305	1,046	1				2,353	71%
Trap			968					968	29%
Total	1	1,305	2,014	1	0	0	0	3,321	
***2013**									
Trawl		200	590	157	14			961	71%
Trap			282	102	8			392	29%
Total	0	200	872	259	22	0	0	1,353	
2014 Season was closed.									

conf = Confidential data were included in an adjacent month.

* Preliminary data

Table 7: Estimated numbers of vessels in the Gulf of Maine northern shrimp fishery by fishing season and state.

Season	Maine			Massachusetts	New Hampshire	Total
	Trawl	Trap	Total			
1980			15-20	15-20		30-40
1981			~75	~20-25		~100
1982			>75	~20-25		>100
1983			~164	~25	~5-8	~197
1984			239	43	6	288
1985			~231	~40	~17	~300
1986						~300
1987			289	39	17	345
1988			~290	~70	~30	~390
1989			~230	~50	~30	~310
1990			~220			~250
1991			~200	~30	~20	~250
1992			~259	~50	16	~325
1993			192	52	29	273
1994			178	40	29	247
1995						
1996			275	43	29	347
1997			238	32	41	311
1998			195	33	32	260
1999			181	27	30	238
2000			249	15	23	287
2001	174	60	234	19	27	275
2002	117	52	168	7	23	198
2003	142	49	191	12	22	222
2004	114	56	170	7	15	192
2005	102	64	166	9	22	197
2006	68	62	129	4	11	144
2007	97	84	179	3	15	196
2008	121	94	215	4	15	234
2009	80	78	158		12 (MA and NH combined)	170
2010	124	112	236	6	14	256
2011	172	143	311	12	19	342
2012	164	132	295	15	17	327
*2013	109	72	181	13	14	207
2014	0	0	0	0	0	0

note that some boats reported both trapping and trawling

* preliminary

Table 8: Gulf of Maine northern shrimp trawl catch rates by season. Mean CPUE in lbs/hour towed is from Maine trawler port sampling. Mean catch in lbs/trip is from NMFS weighout and logbook data for all catches for all states. Trawl lbs/trip is trawler only catch.

Season	Maine pounds per hour towing			Pounds/trip	Trawl lbs/trip
	Inshore (<55F)	Offshore (>55F)	Combined		
1991	94	152	140	992	
1992	132	93	117	978	
1993	82	129	92	767	
1994	139	149	141	1,073	
1995	172	205	193	1,360	
1996	340	203	251	1,784	
1997	206	192	194	1,462	
1998	158	151	154	1,391	
1999	148	147	147	1,079	
2000	279	224	272	1,382	1,475
2001	100	135	109	710	752
2002	223	91	194	765	854
2003	174	215	182	981	1,102
2004	361	310	351	1,753	2,006
2005	235	212	228	1,488	1,621
2006	572	345	499	2,066	2,616
2007	531	477	507	2,584	3,129
2008	350	327	343	1,958	2,302
2009	400	315	370	1,837	2,231
2010	424	354	401	2,264	2,671
2011	334	435	347	1,988	2,376
2012	407	313	399	1,497	1,873
*2013	118	78	110	482	609
2014	--	--	--	--	--

* Pounds/trip are preliminary

Table 9: Stratified retransformed mean weights (kg) per tow of northern shrimp collected during the Maine - New Hampshire inshore trawl surveys by year, regions 1-4 (NH to Mt. Desert) and depths 3-4 (> 35 fa.) only, with number of tows (n) and 80% confidence intervals.

	Spring				Fall			
	kg/tow	n	80% CI		kg/tow	n	80% CI	
2003	**4.2**	40	3.4	5.1	**1.9**	33	1.4	2.6
2004	**3.9**	42	3.3	4.5	**1.5**	38	1.0	2.1
2005	**7.8**	40	6.6	9.2	**3.6**	25	2.5	5.1
2006	**11.0**	46	8.5	14.1	**2.1**	38	1.4	2.8
2007	**10.7**	43	7.9	14.3	**4.0**	45	3.1	5.1
2008	**15.4**	45	12.7	18.6	**3.6**	37	2.3	5.4
2009	**9.7**	45	7.7	12.1	**2.7**	41	2.3	3.3
2010	**16.0**	48	12.6	20.1	(samples lost)			
2011	**17.9**	51	14.9	21.4	**4.2**	32	3.2	5.4
2012	**7.5**	50	6.1	9.2	**1.9**	42	1.5	2.3
2013	**1.7**	46	1.1	2.5	**0.6**	45	0.4	0.8
2014	**2.1**	47	1.7	2.5				

Table 10: 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	37	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	555	702	8.5	1,627	15.4
2010	49	475	413	4.8	1,373	13.9
2011	47	44	316	3.2	830	8.6
2012	49	7	81	0.9	138	2.5
2013	40	1	24	0.3	27	1.0
2014	46	116	16	0.2	139	1.7
Mean	41	359	526	5.8	1,415	12.5
Median	41	292	358	4	1152	10
1984-93						
Mean	42	382	649	7.1	1,435	14.1
Median	43	337	611	7.0	1,401	14.1

*Based on strata 1, 3, 5, 6, 7 and 8.

**Would be fully recruited to the winter fishery.

Table 11: Fall NEFSC trawl survey indices for northern shrimp.

	kg/tow		kg/tow	
Year	***Albatross***	**Year**	***Albatross***	***Bigelow***
1968	3.20	**1991**	0.44	
1969	2.70	**1992**	0.41	
1970	3.70	**1993**	1.85	
1971	3.00	**1994**	2.24	
1972	3.30	**1995**	1.22	
1973	1.90	**1996**	0.90	
1974	0.80	**1997**	1.12	
1975	0.90	**1998**	1.99	
1976	0.60	**1999**	2.32	
1977	0.20	**2000**	1.28	
1978	0.40	**2001**	0.63	
1979	0.50	**2002**	1.70	
1980	0.50	**2003**	1.08	
1981	1.50	**2004**	1.58	
1982	0.30	**2005**	2.77	
1983	1.00	**2006**	6.64	
1984	1.90	**2007**	4.13	
1985	1.60	**2008**	3.05	
1986	2.50	**2009**		7.83
1987	1.70	**2010**		5.01
1988	1.20	**2011**		5.55
1989	1.81	**2012**		1.24
1990	2.04	**2013**		
		Average:	1.77	4.91

*2013 and 2014 values are not finalized**.**

Table 12: Recent (2011-2014) values of Gulf of Maine northern shrimp FTLA indicators at or below reference levels. Dark red with white text = at or below 10th percentile of time series; Red with black text = at or below 20th percentile of time series; Yellow = between 20th percentile and stable period (1985-1994) mean (SPM); Green = at or above SPM.

	Indicator values				Reference levels		
						percentile	
	2011	2012	2013	2014	SPM	20th	10th
Total Biomass	8.6	2.5	1.0	1.7	13.9	6.3	4.3
Spawner Biomass	3.0	0.7	0.2	0.3	4.8	2.0	1.5
Recruit Abundance	43.7	6.7	0.9	116.2	416.7	43.7	17.6
Year Class Survival	8	2	773		77	77	30
CPUE (mt/trip)	0.90	0.68	0.23		0.45	0.41	0.35

Table 13: Recent (2011-2014) values of Gulf of Maine environmental FTLA indicators at or above reference levels. Dark red with white text = at or above 90th percentile of time series; Red with black text = at or above 80th percentile of time series; Yellow = between 20th percentile and stable period (1985-1994) mean (SPM); Green = at or above SPM.

	Indicator values				Reference levels		
						percentile	
	2011	2012	2013	2014	SPM	80th	90th
Predator Predation Index	1267	1118	888		550	1141	1193
Boothbay Feb-Mar SST	2.9	5.5	3.9	2.3	2.4	3.5	4.1
Spring Bottom Temp NEFSC	2.3	2	1.3	0.5	0.4	1.3	1.3
Summer Survey Bottom Temp	7.7	7.9	7.1	6.2	5.7	7.6	7.1

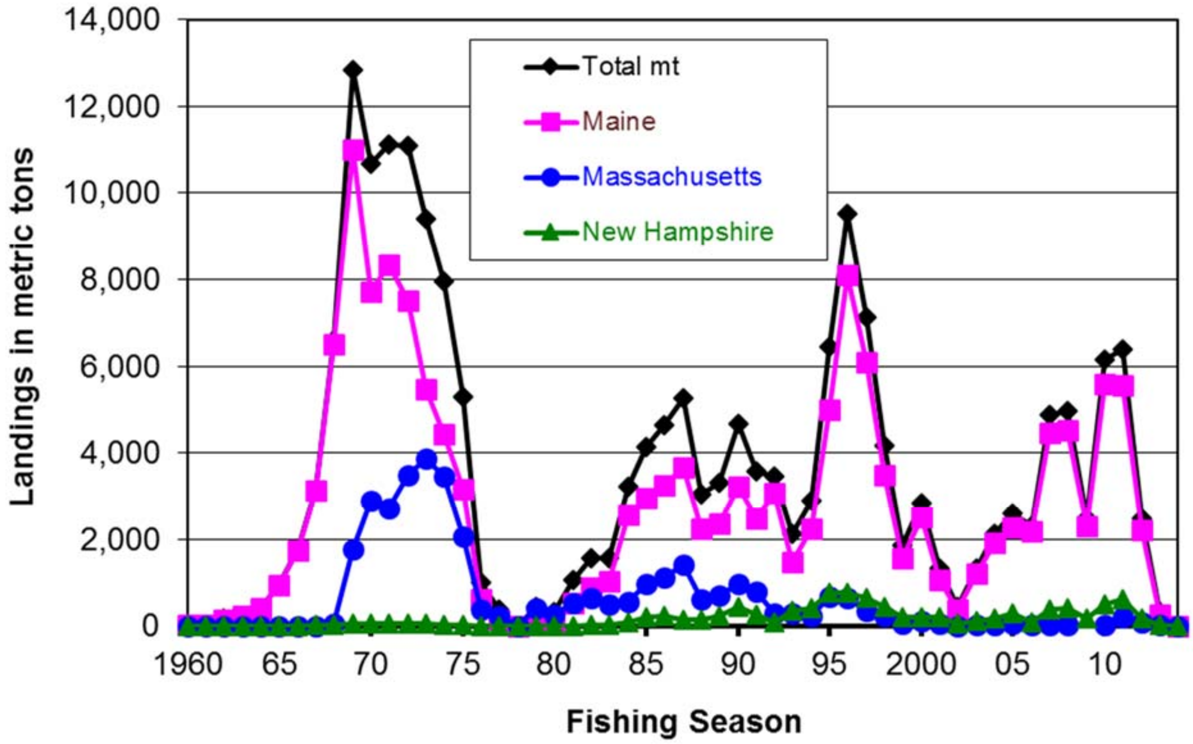


Figure 1: Gulf of Maine northern shrimp landings by season and state. MA landings are combined with NH landings in 2009 to preserve confidentiality. Data for 2013 are preliminary.

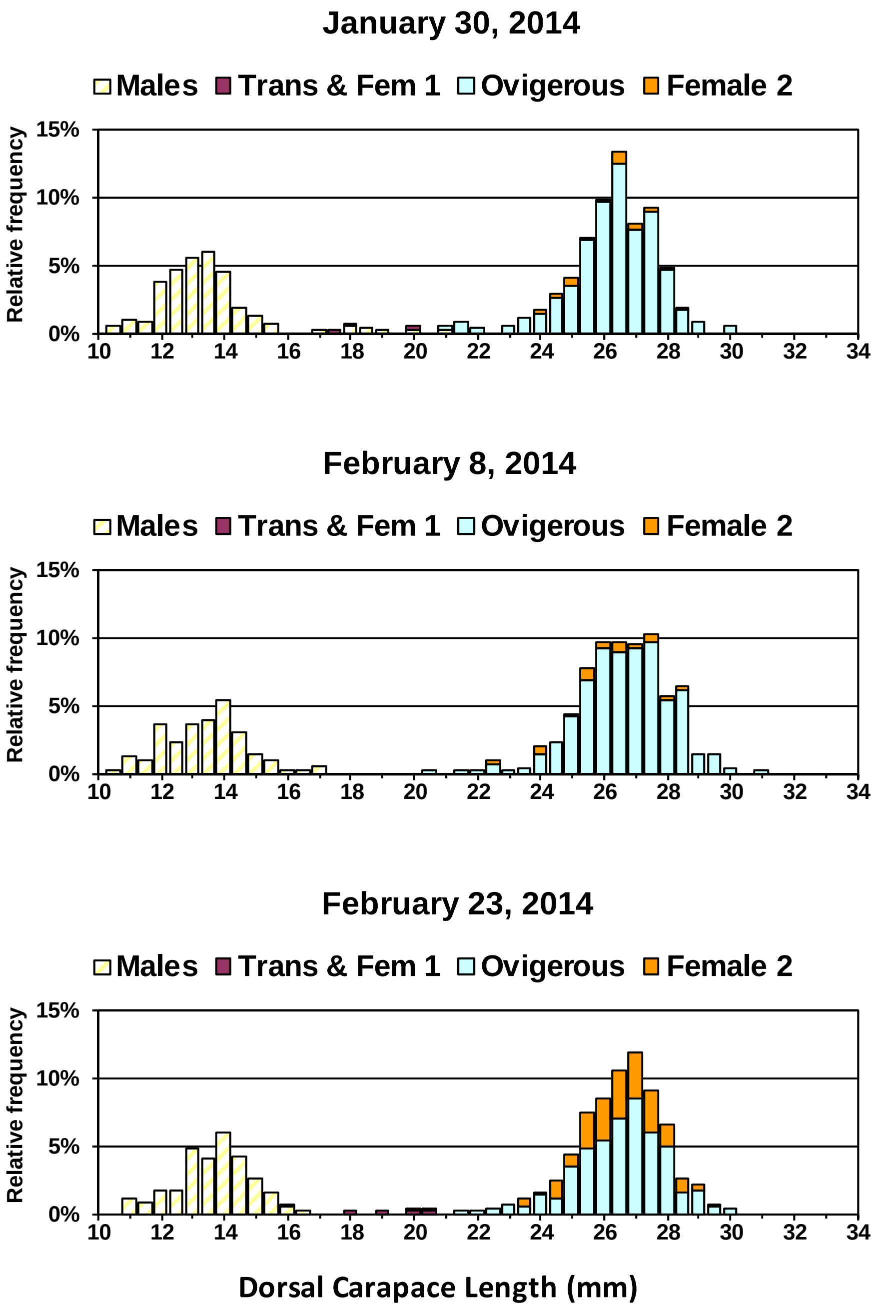


Figure 2: Gulf of Maine northern shrimp size-sex-stage frequency distributions from 2014 samples.

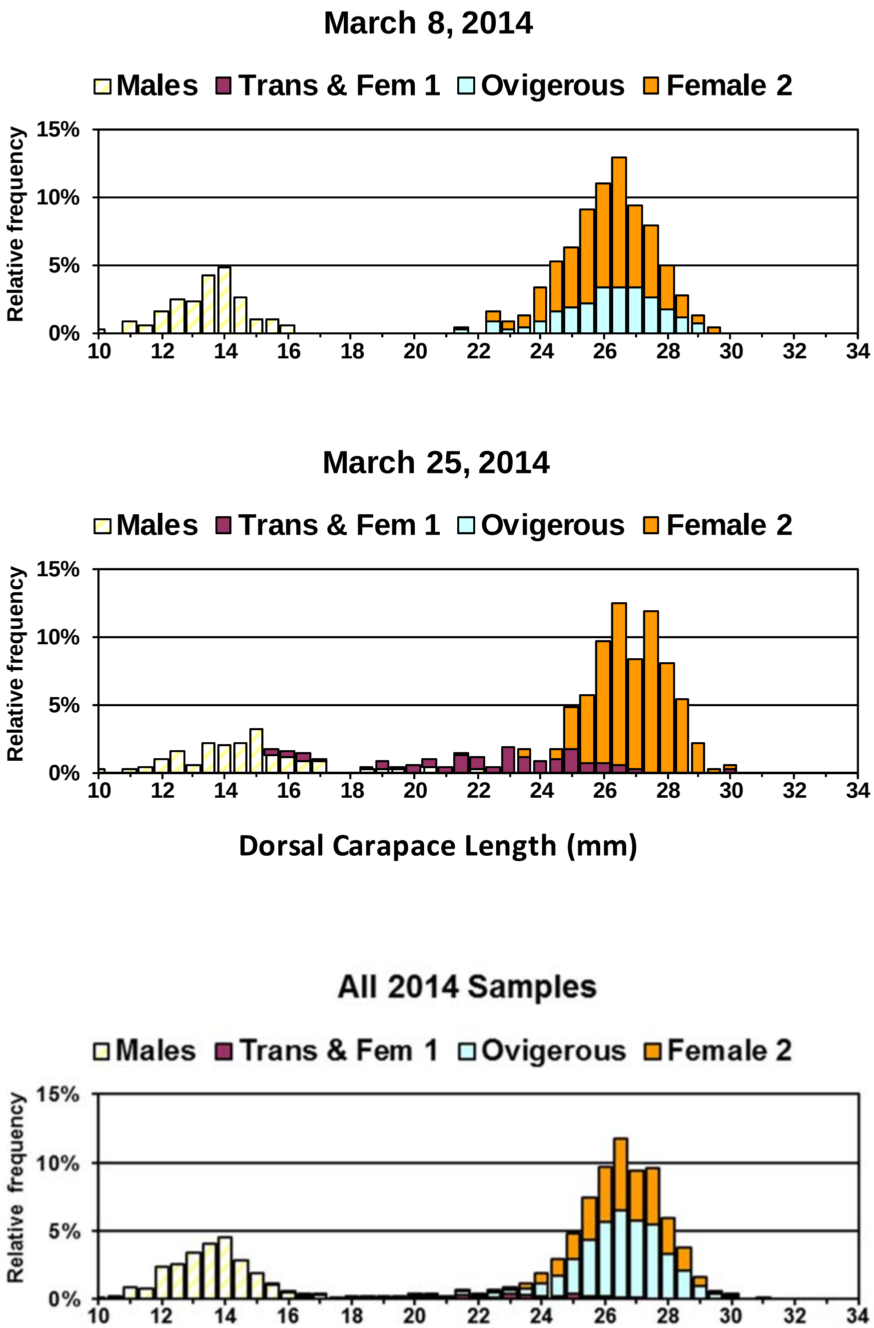


Figure 2 continued. Gulf of Maine northern shrimp size-sex-stage frequency distributions from 2014 samples.

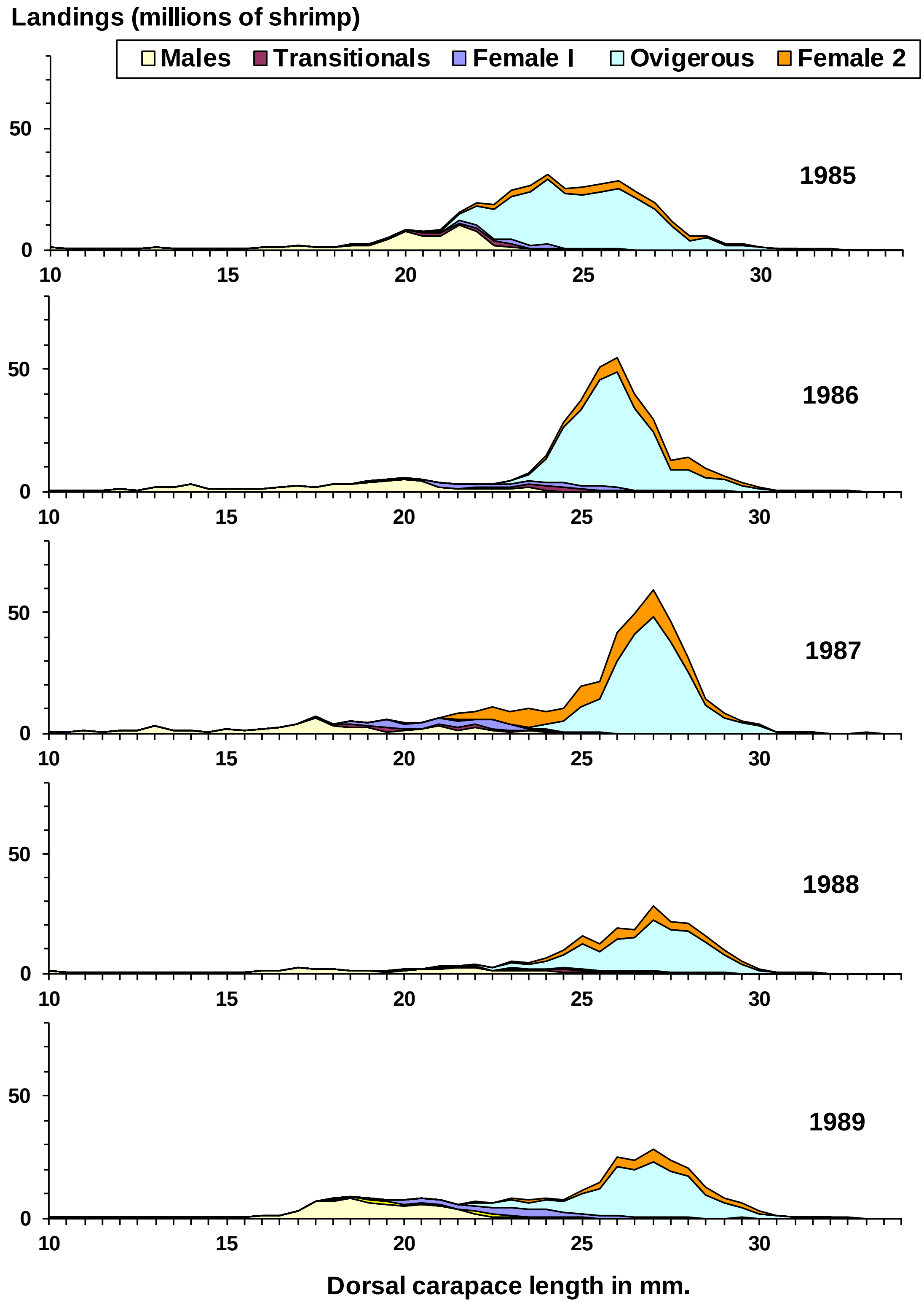


Figure 3: Gulf of Maine northern shrimp landings in estimated numbers of shrimp, by length, development stage, and fishing season.

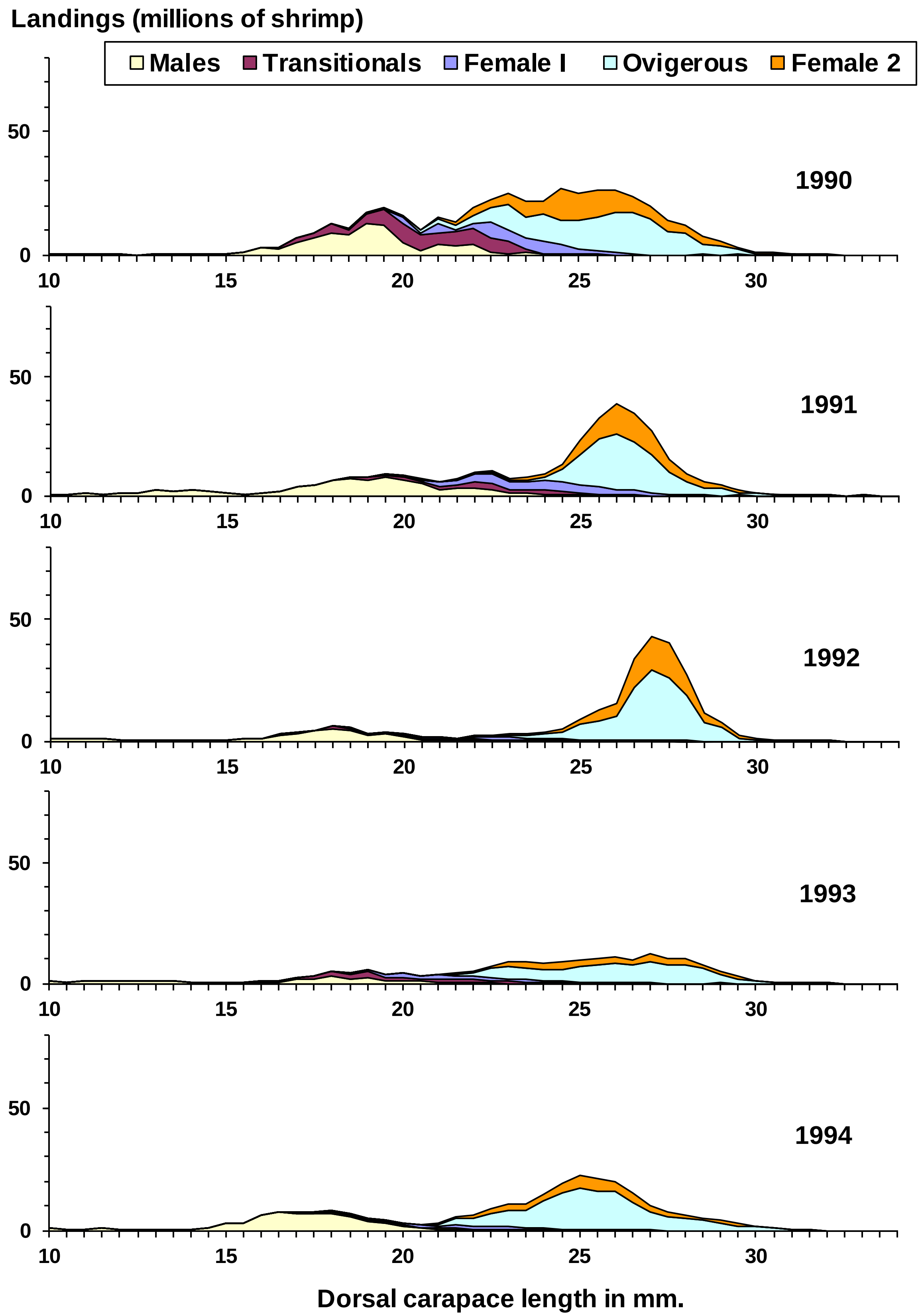


Figure 3 continued – Landings in estimated numbers of shrimp.

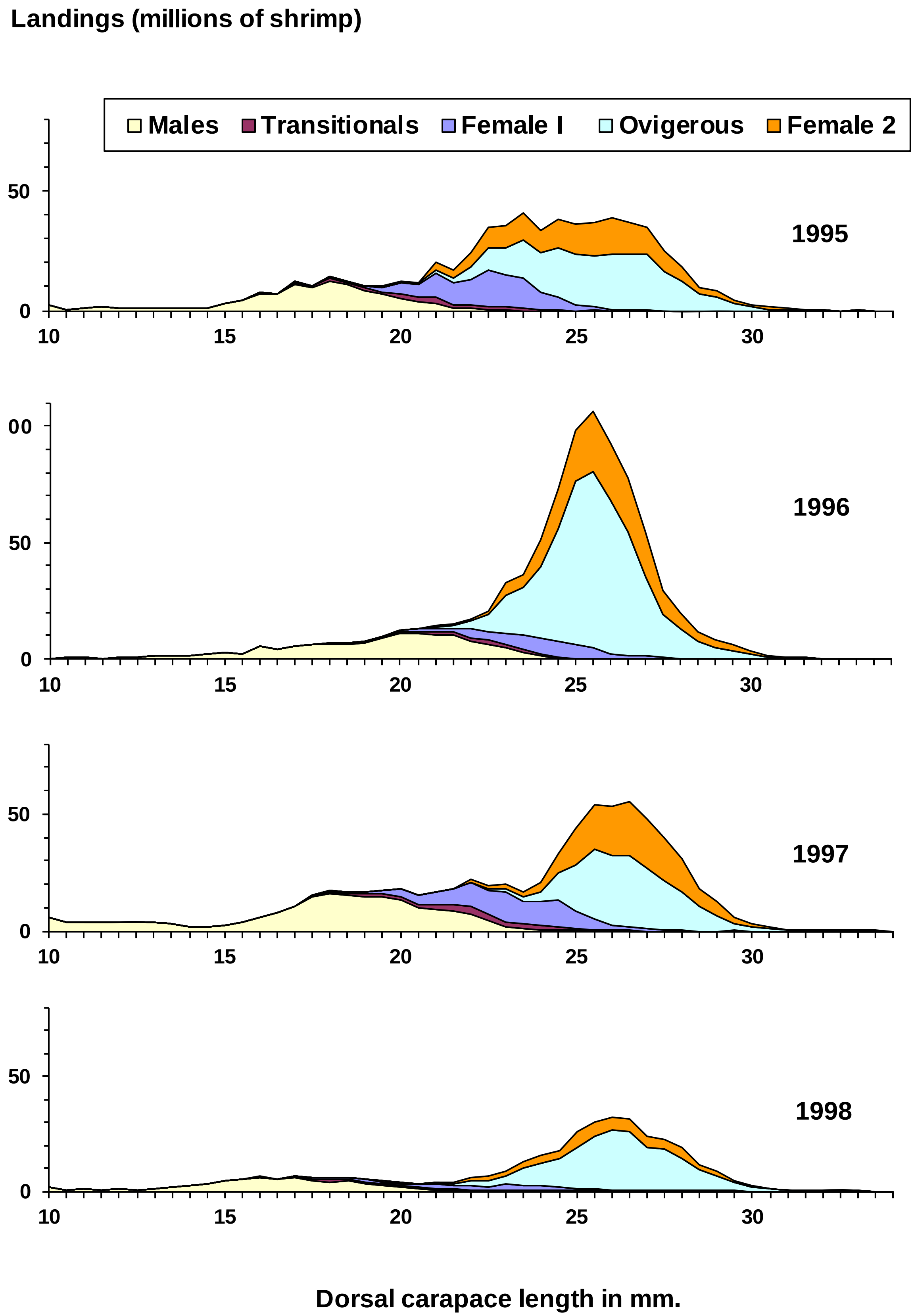


Figure 3 continued –Landings in estimated numbers of shrimp.

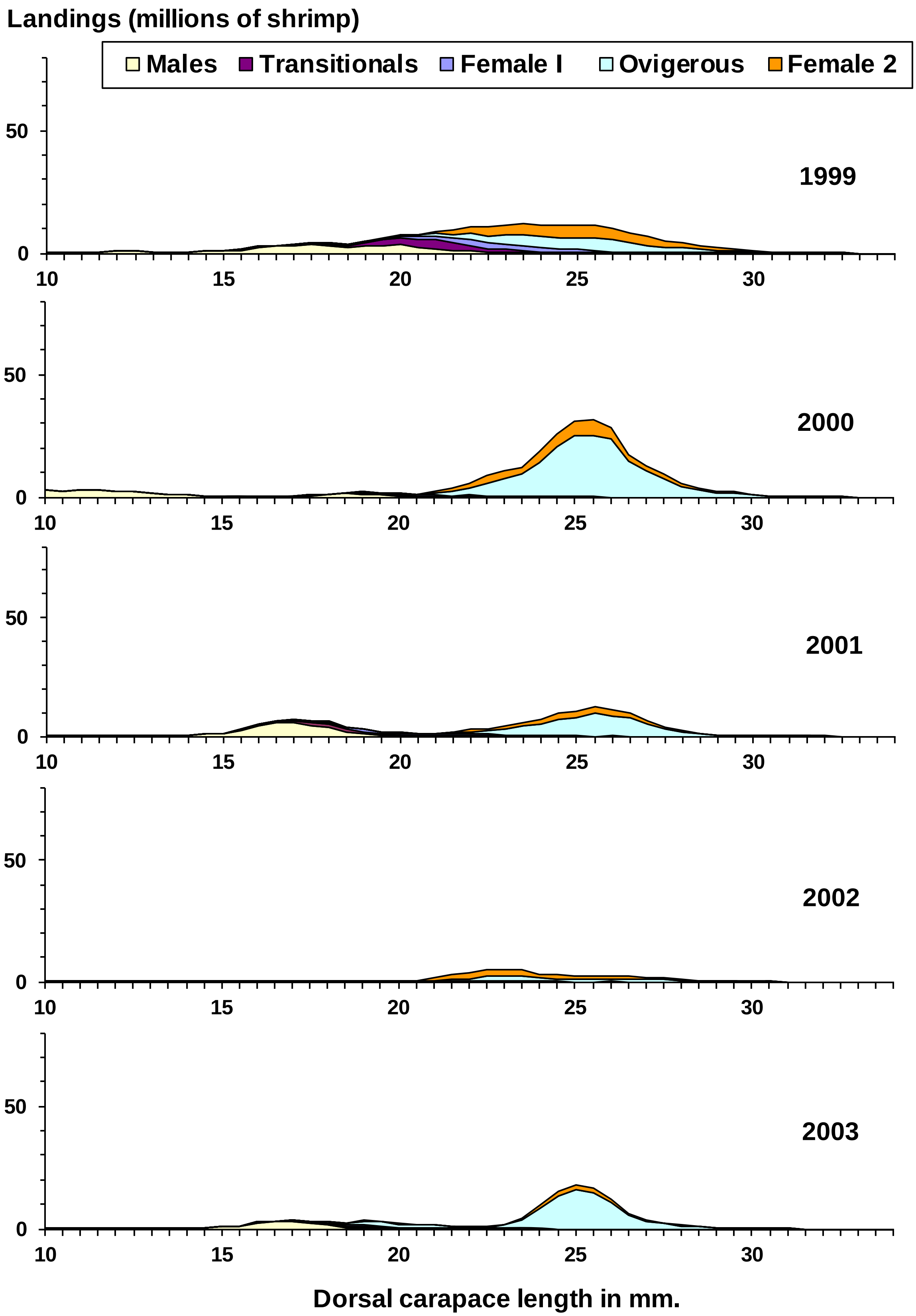


Figure 3 continued – Landings in estimated numbers of shrimp.

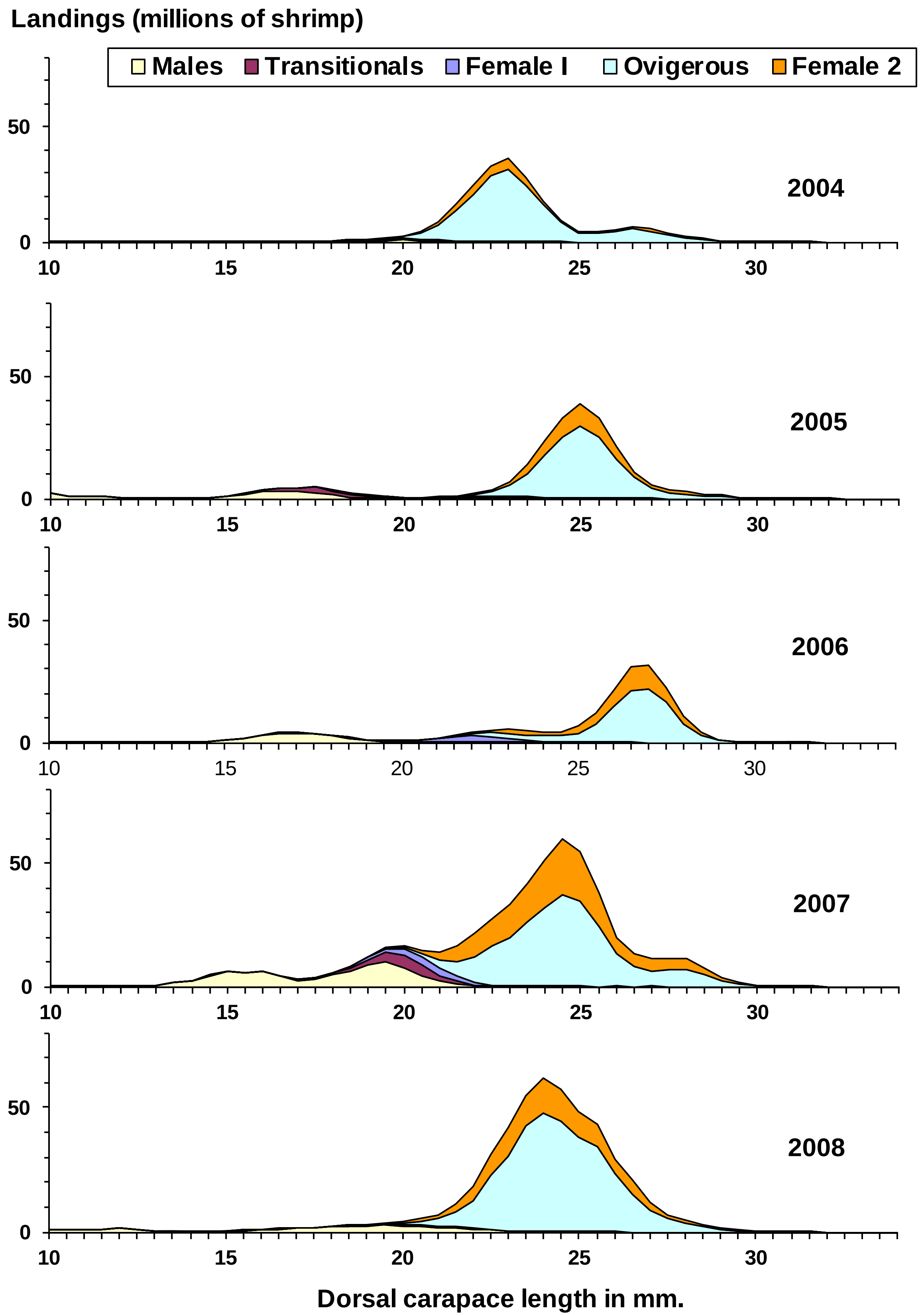


Figure 3 continued – Landings in estimated numbers of shrimp.

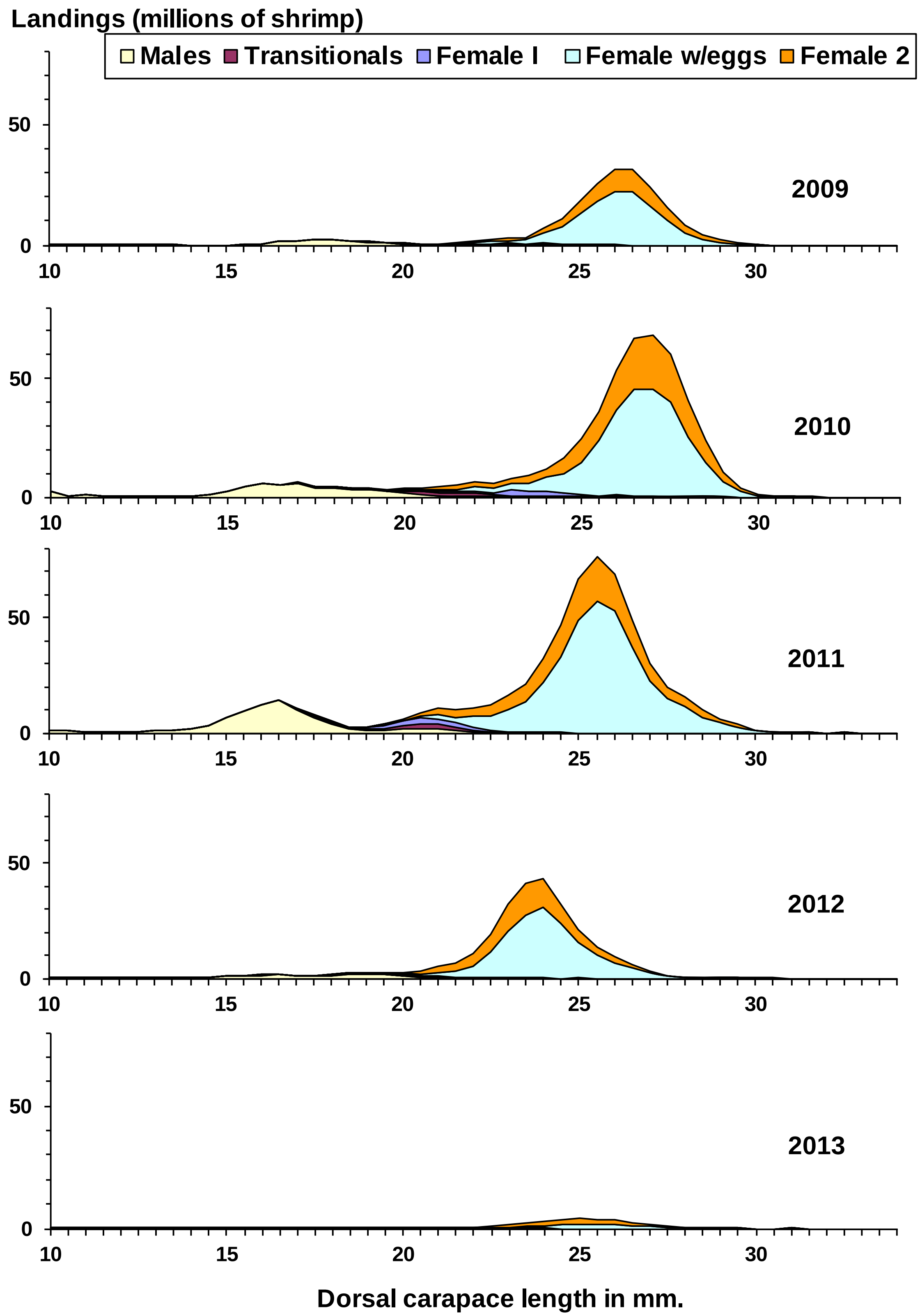
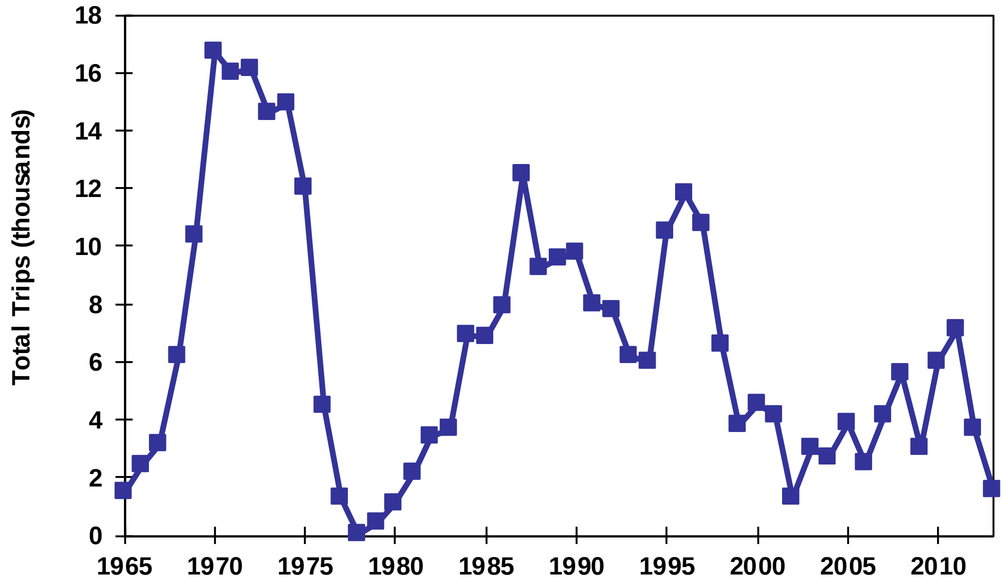


Figure 3 continued – Landings in estimated numbers of shrimp. Data for 2013 are preliminary. There was no fishery in 2014.



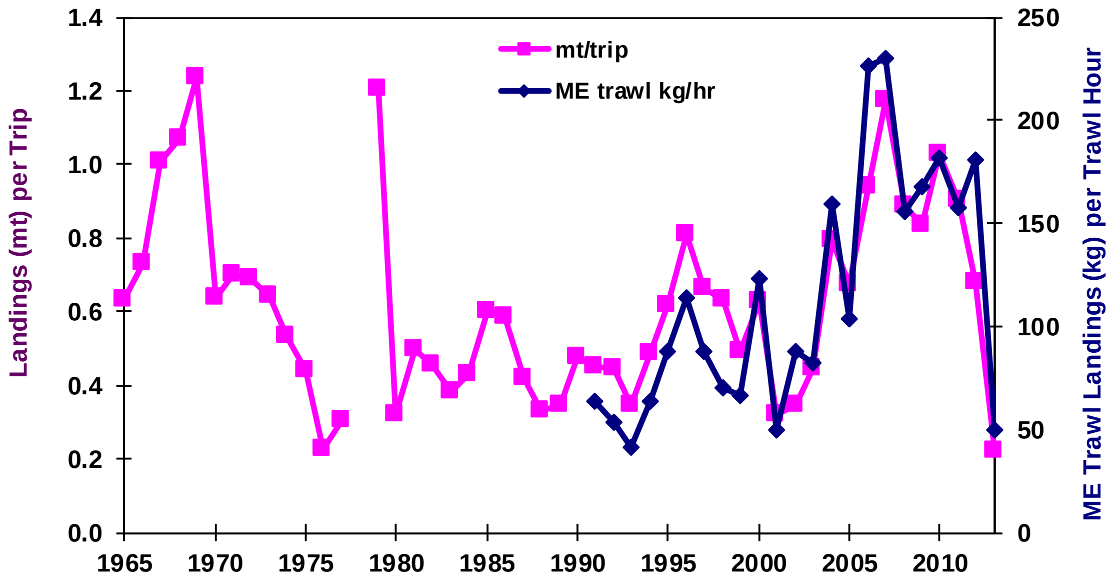


Figure 4: Nominal fishing effort (trips) (above) and catch per unit effort (below), in the Gulf of Maine northern shrimp fishery by season. 2013 trip data are preliminary. There was no fishery in 2014.

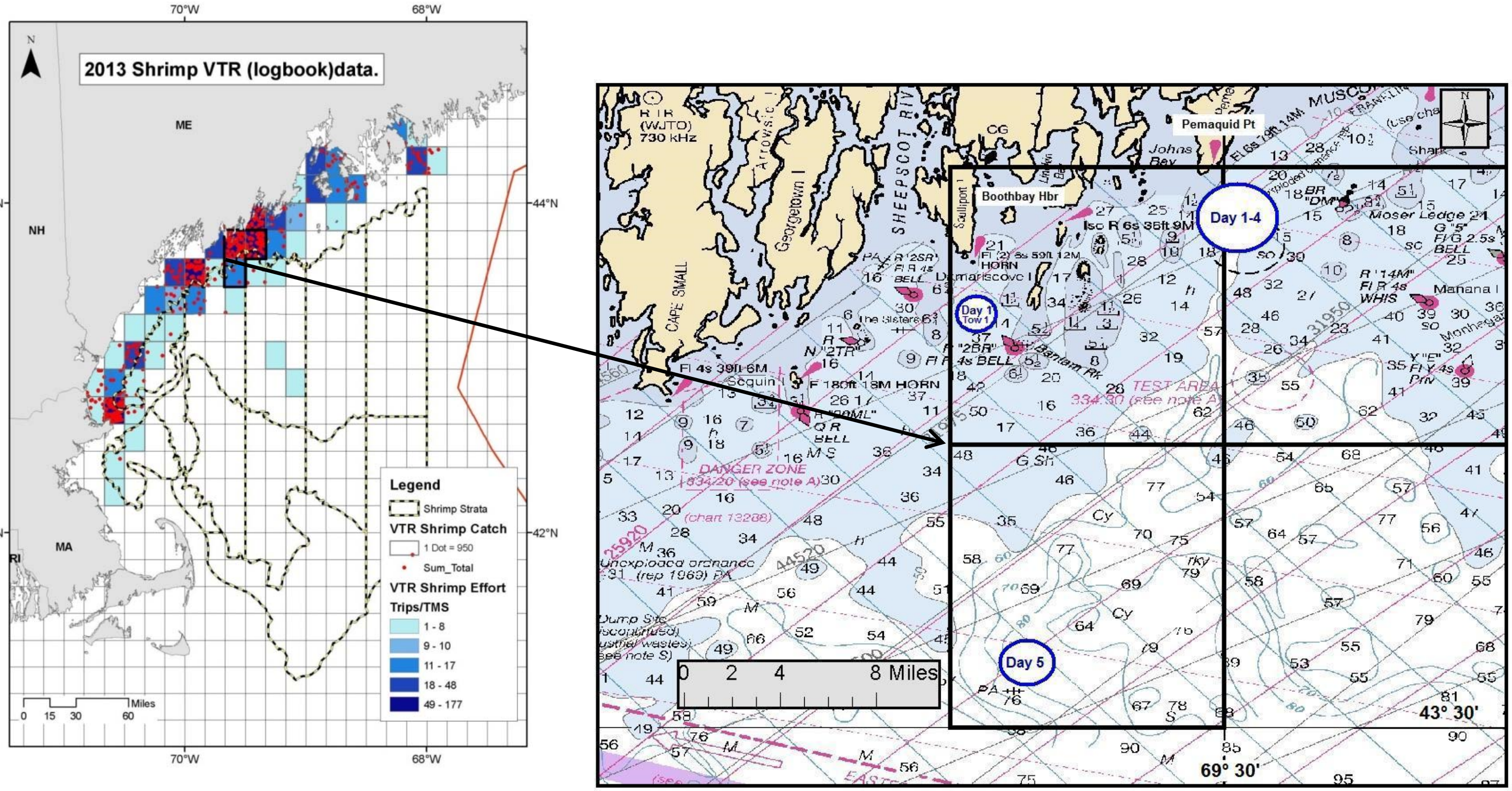


Figure 5: Locations of tows for the 2014 northern shrimp sample collection (right) relative to 2013 fishing effort from VTR data (left).

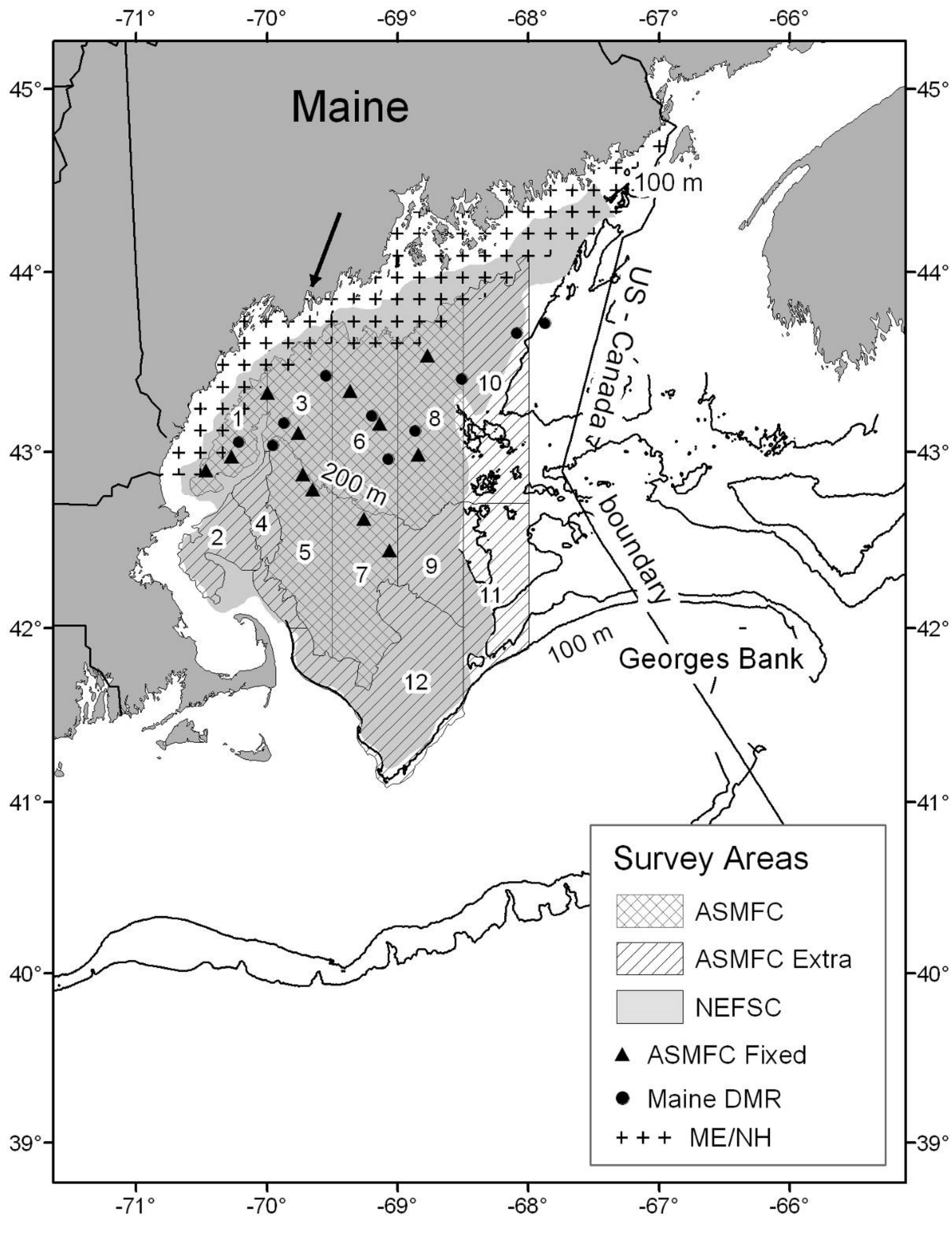


Figure 6. Gulf of Maine survey areas and station locations.

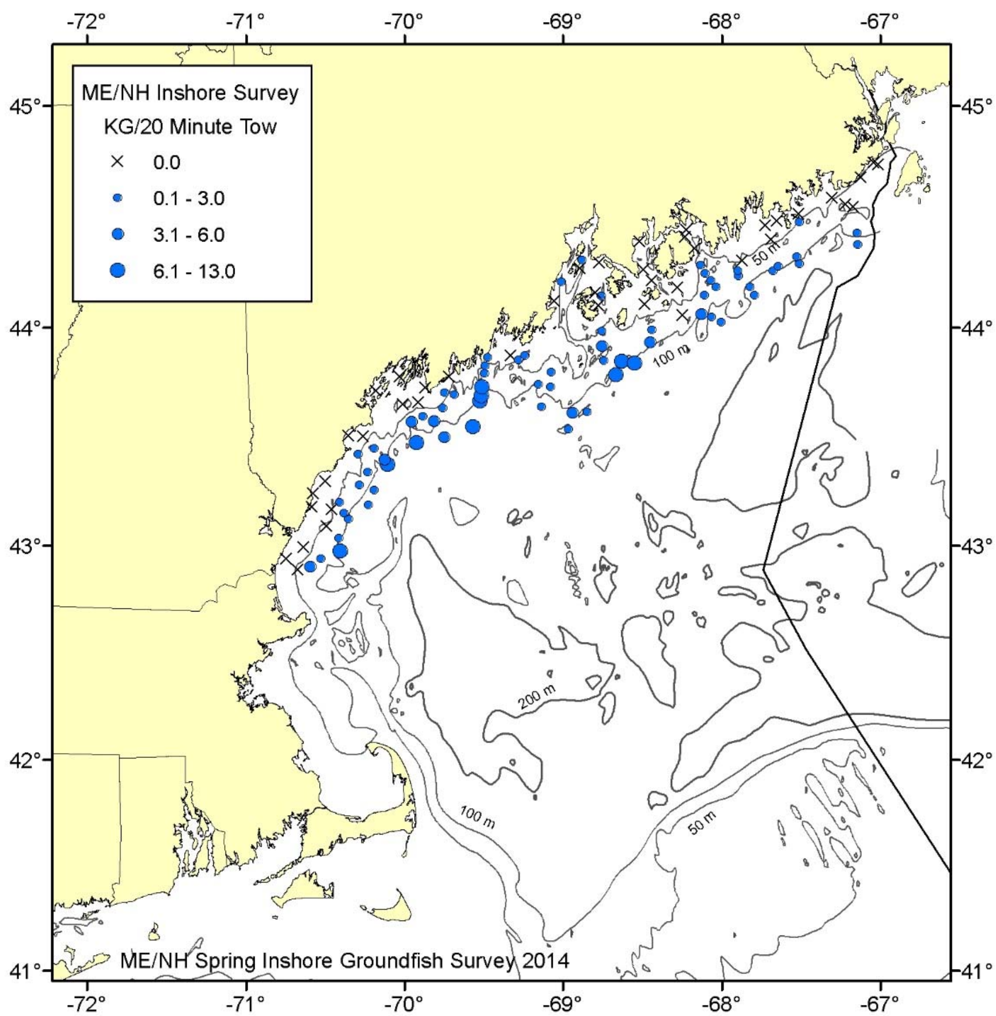


Figure 7: Distribution of northern shrimp catches (kg/tow) in the spring 2014 Maine-New Hampshire inshore trawl survey.

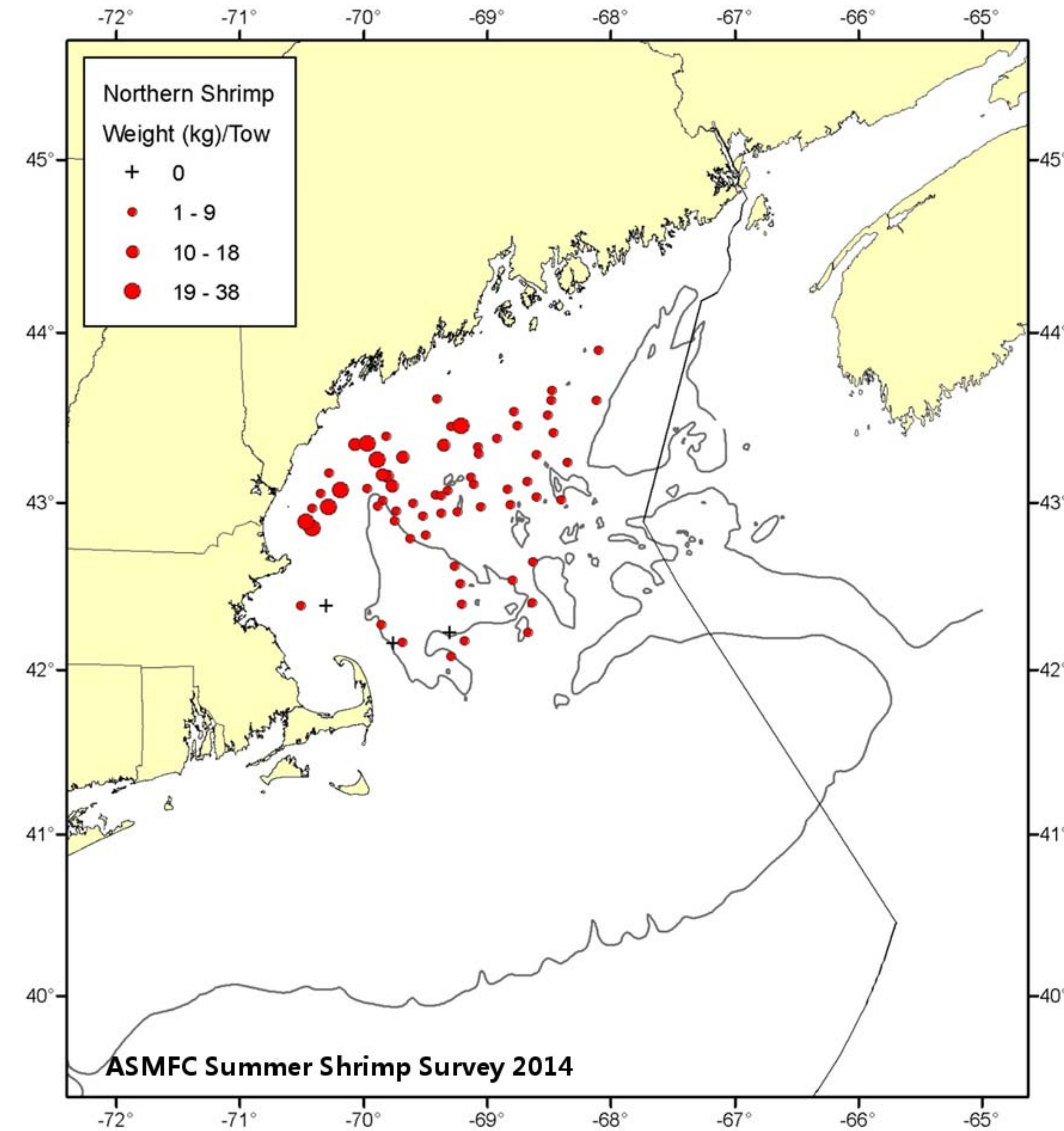


Figure 8: Distribution of northern shrimp catches (kg/tow) in the 2014 ASMFC summer shrimp survey, random station locations, all sampled strata.

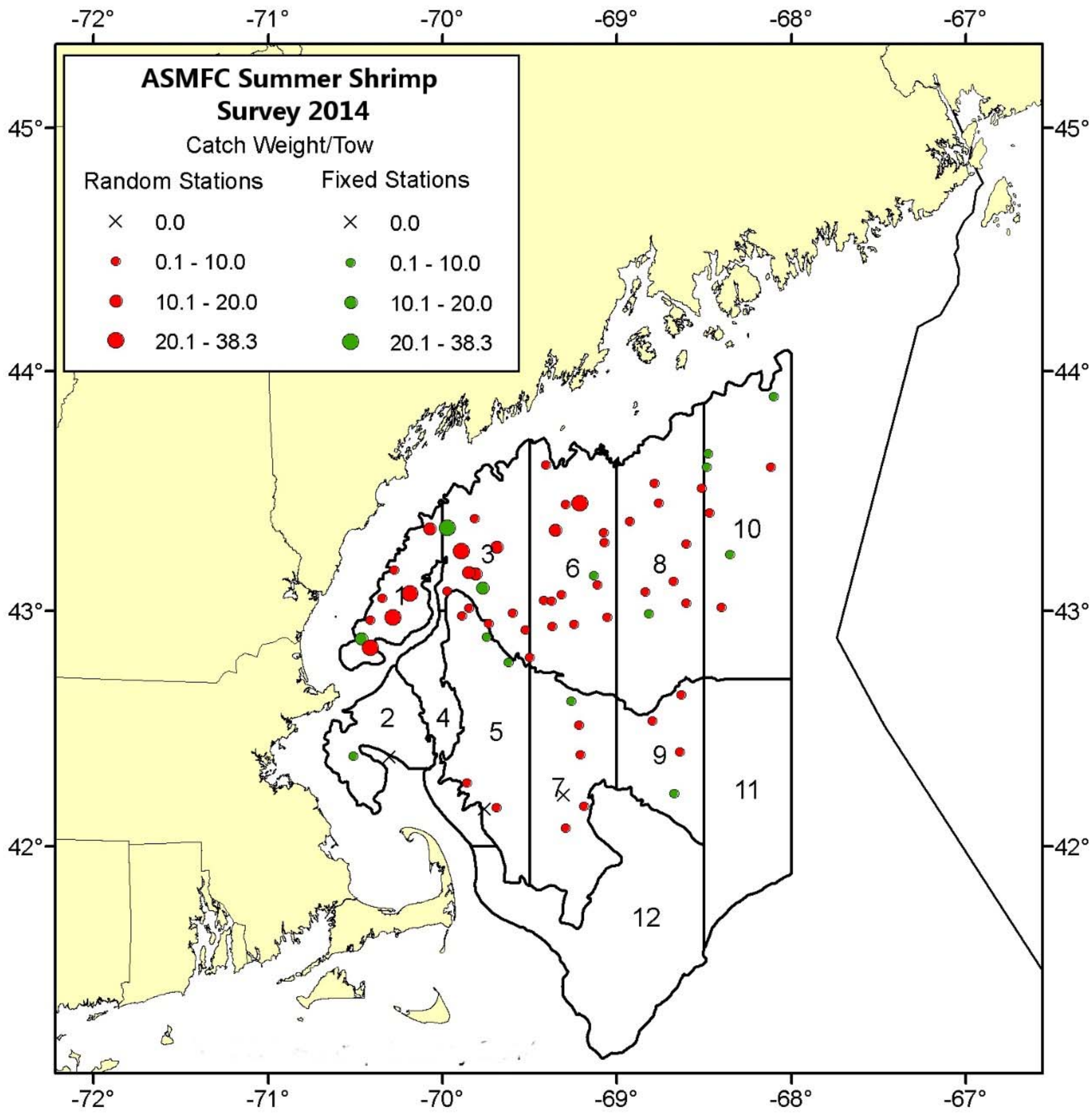


Figure 9: 2014 State/federal summer northern shrimp survey aboard the R/V Gloria Michelle, fixed and random survey sites and shrimp catches in kg/tow.

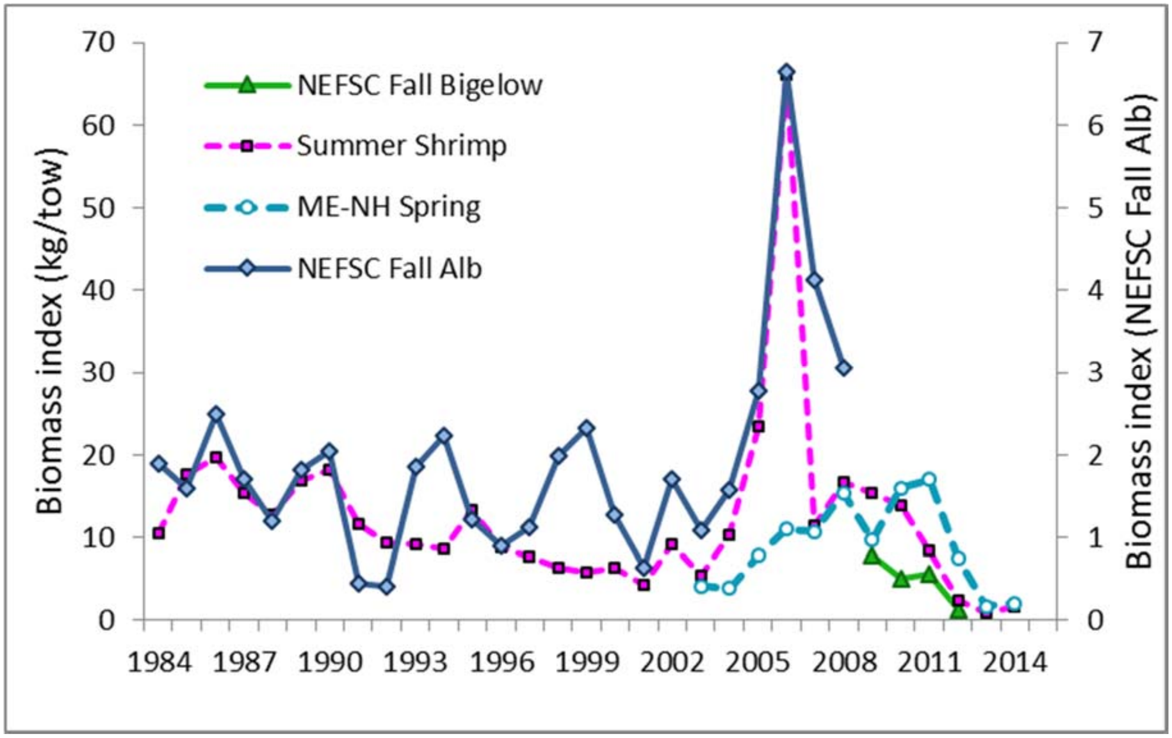


Figure 10: Biomass indices (kg/tow) from various northern shrimp surveys in the Gulf of Maine.

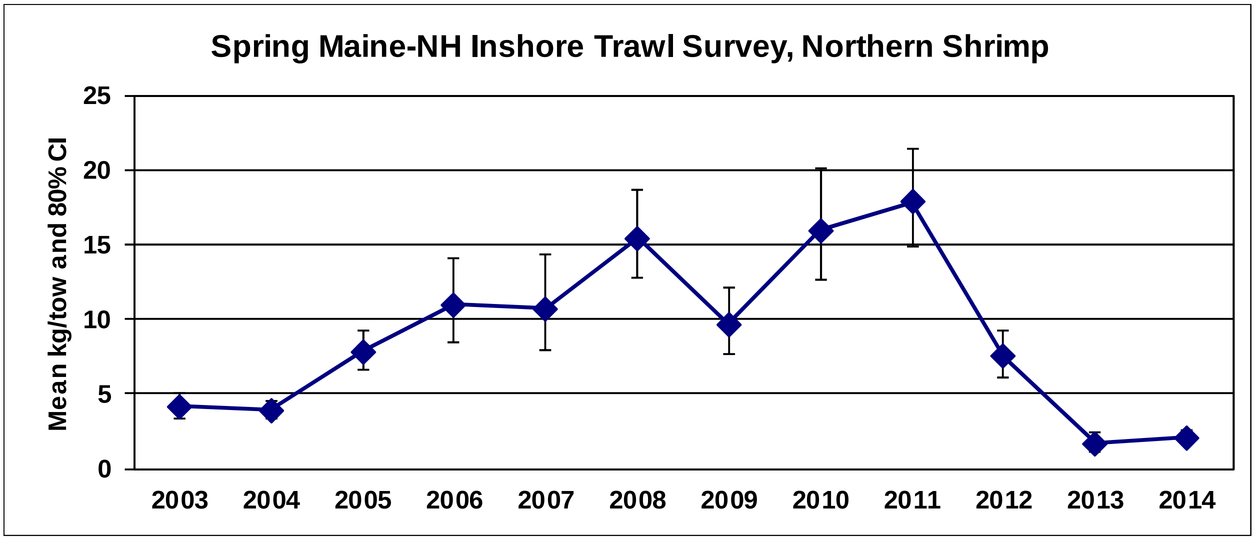


Figure 11: Spring Maine-New Hampshire inshore trawl survey northern shrimp biomass indices, with 80% confidence intervals. 2014 data are preliminary.

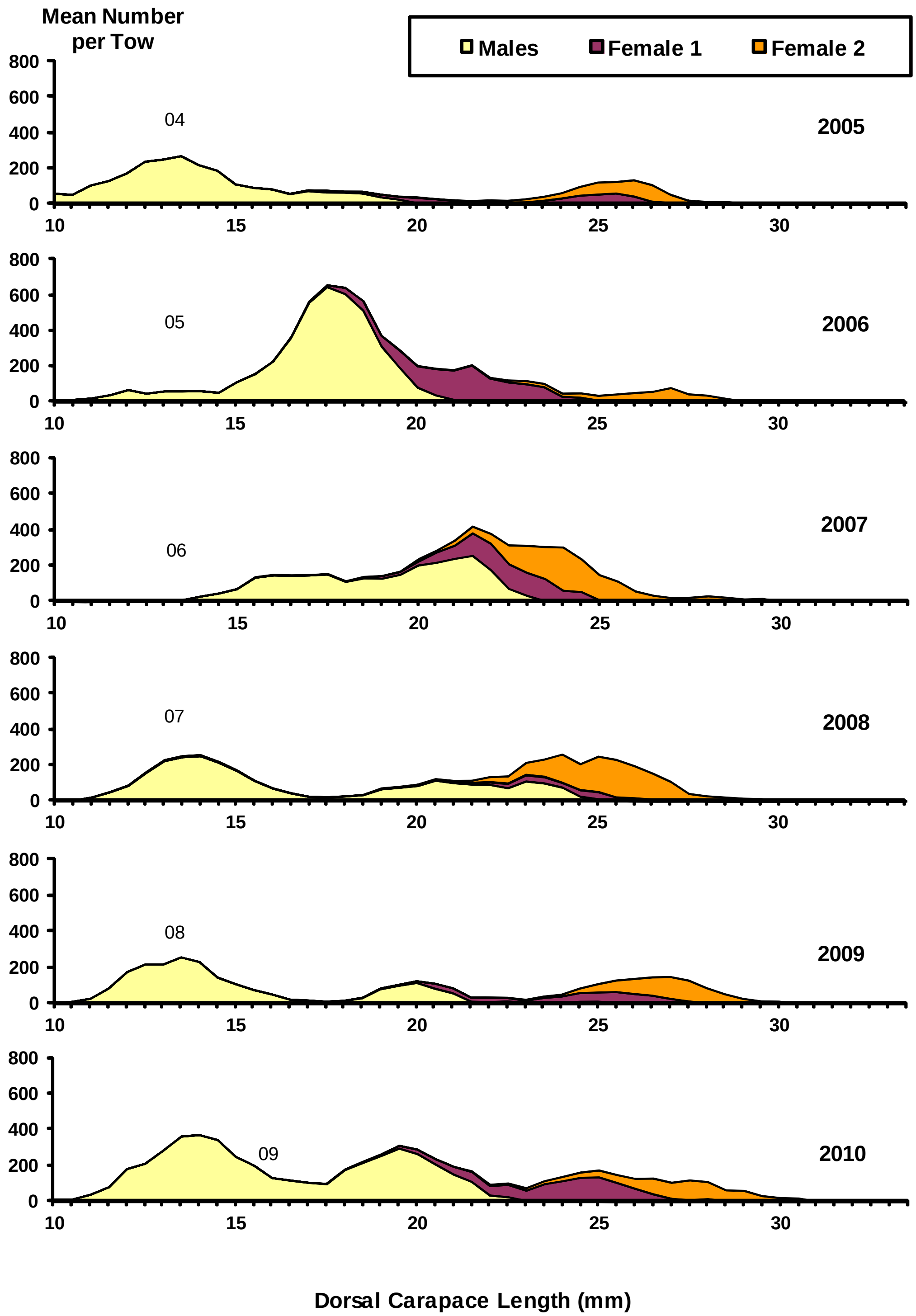


Figure 12: Maine-New Hampshire spring inshore survey; northern shrimp untransformed mean catch per tow by year, length, and development stage. Two-digit years are the year class at assumed age 1.

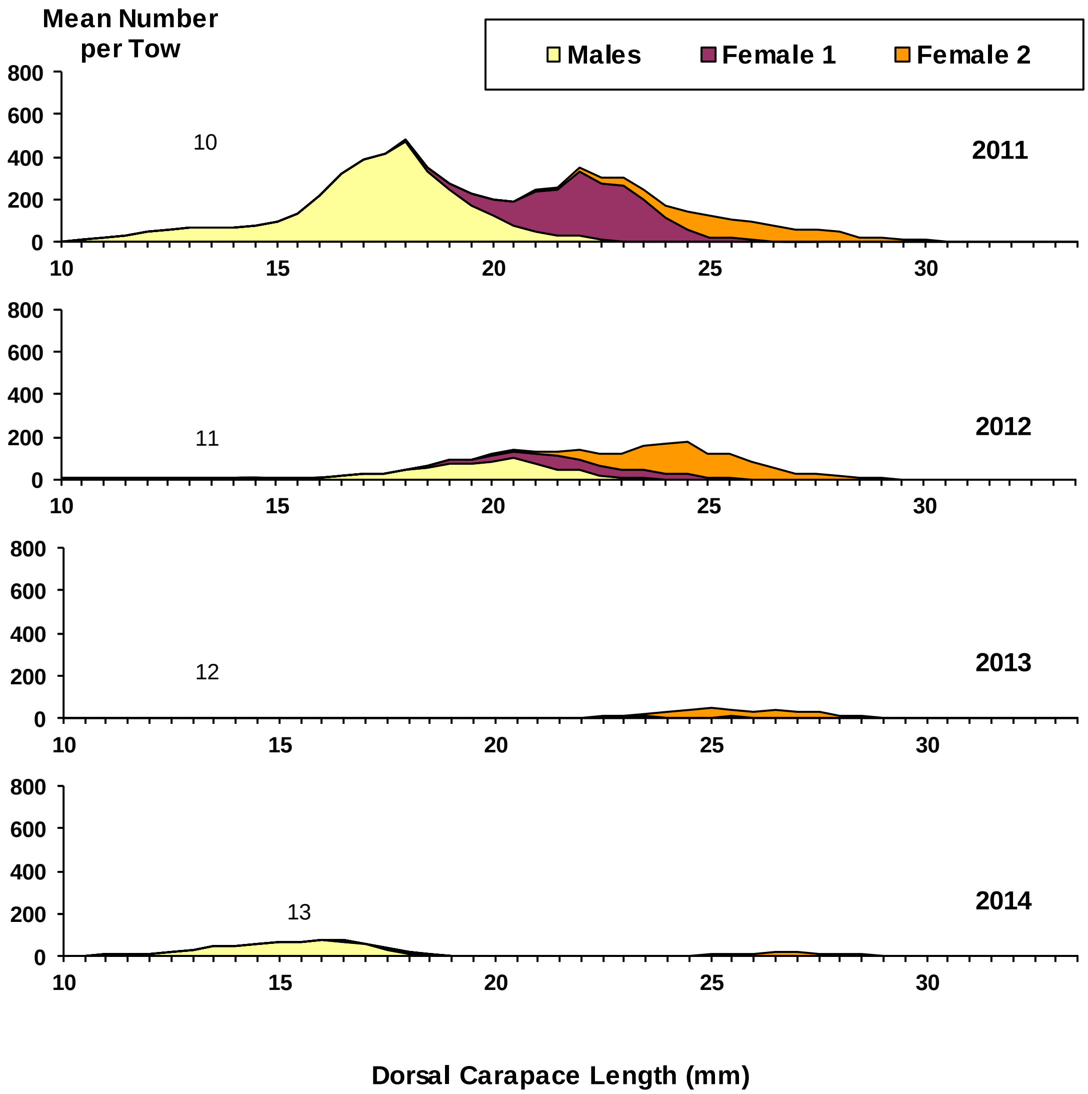
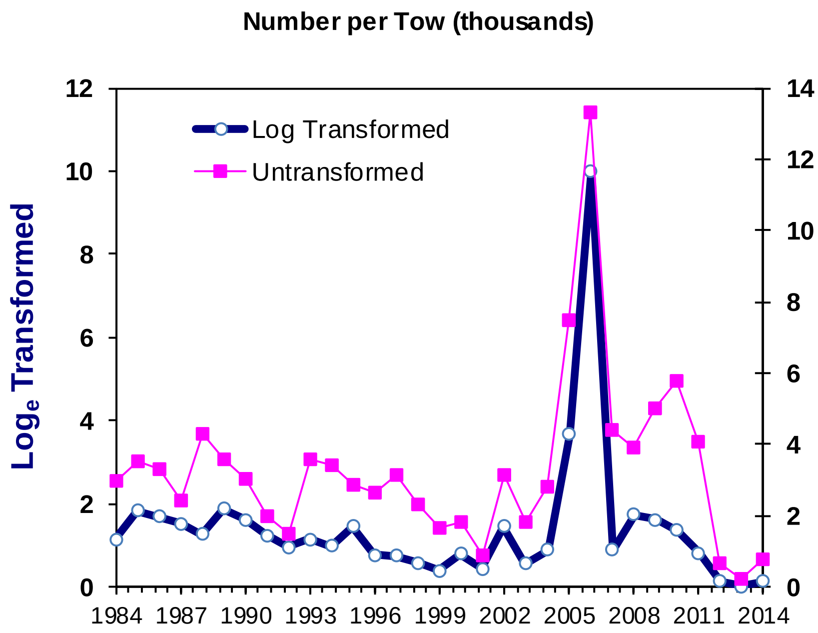


Figure 12 continued - ME/NH spring inshore survey. 2014 data is preliminary.



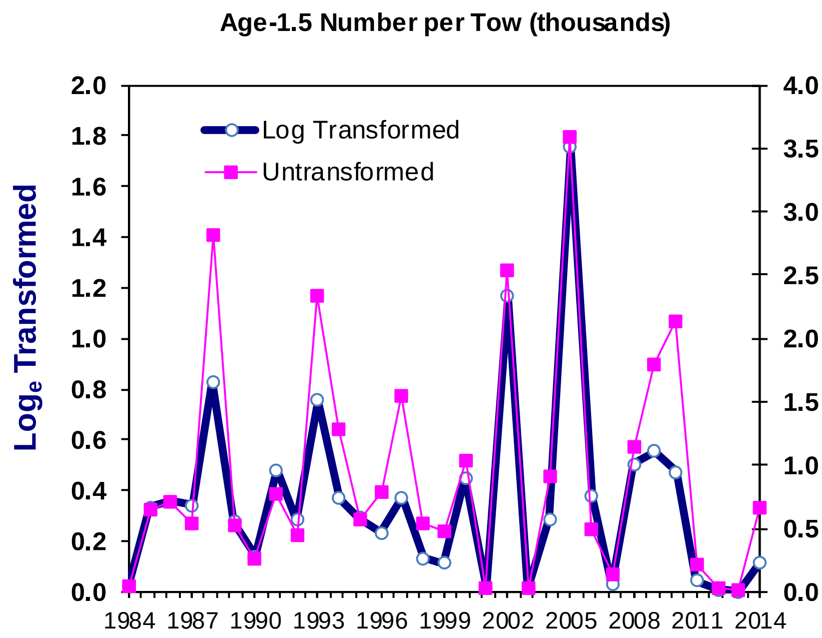
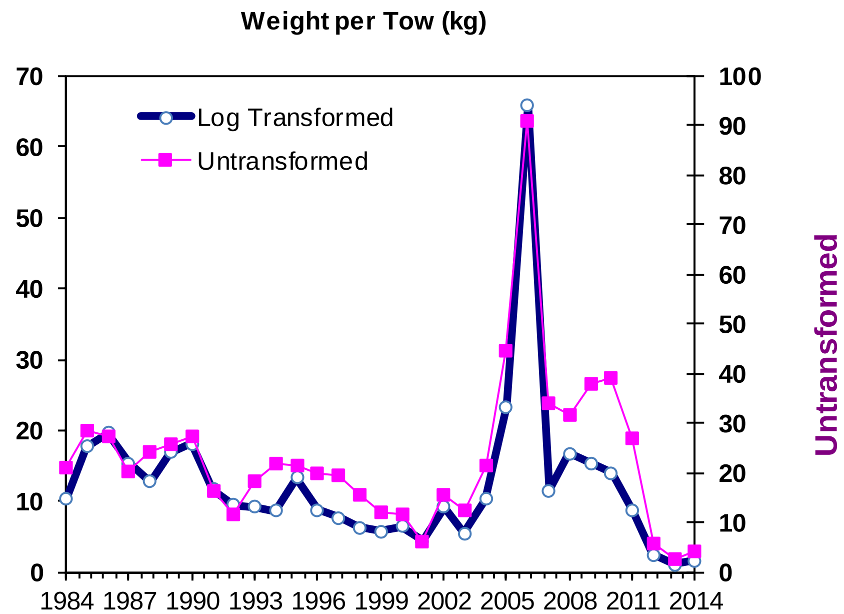


Figure 13: Gulf of Maine northern shrimp summer survey indices of abundance by year.



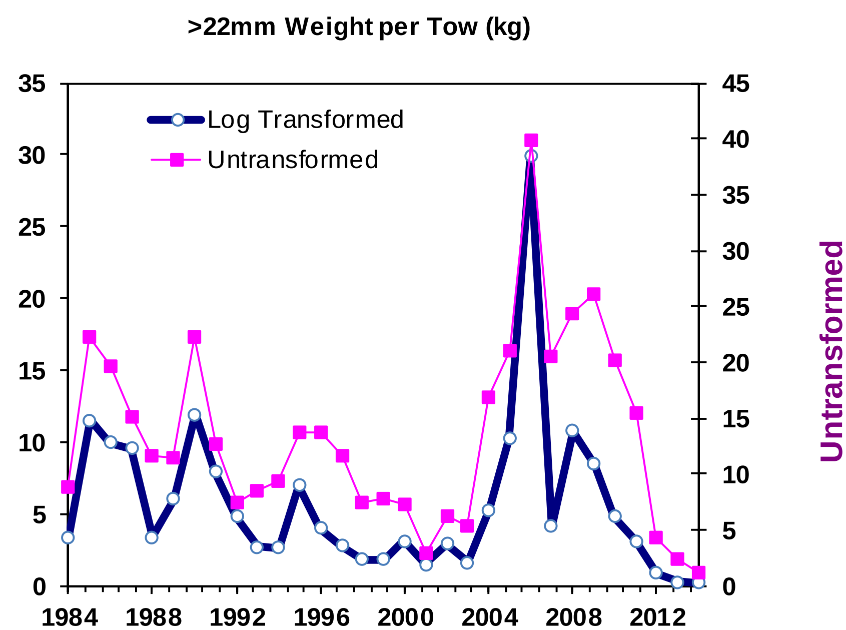


Figure 14: Gulf of Maine northern shrimp survey indices of biomass by survey year.

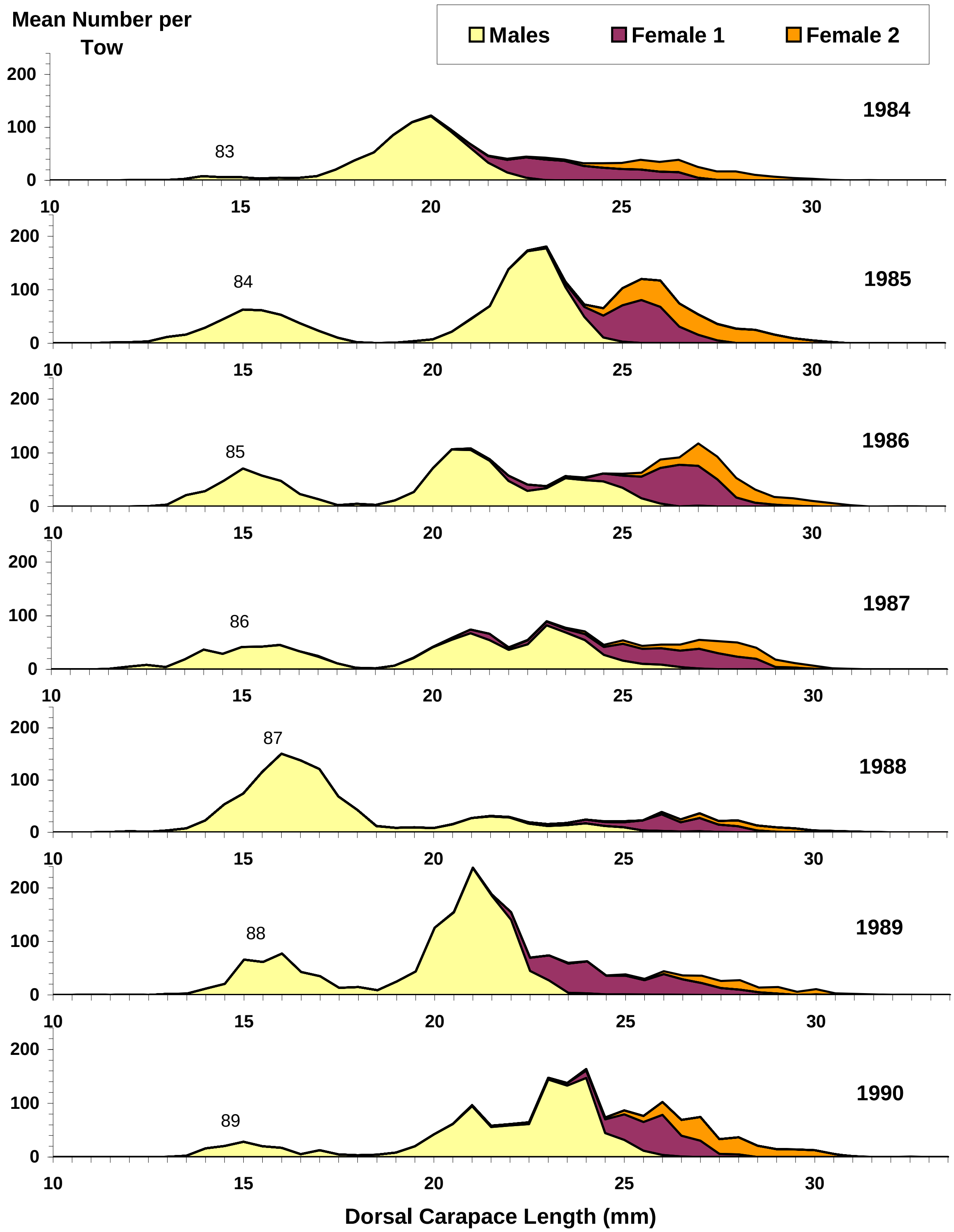


Figure 15: Gulf of Maine northern shrimp summer survey mean catch per tow by year, length, and development stage. Two-digit years are year class at assumed age 1.5.

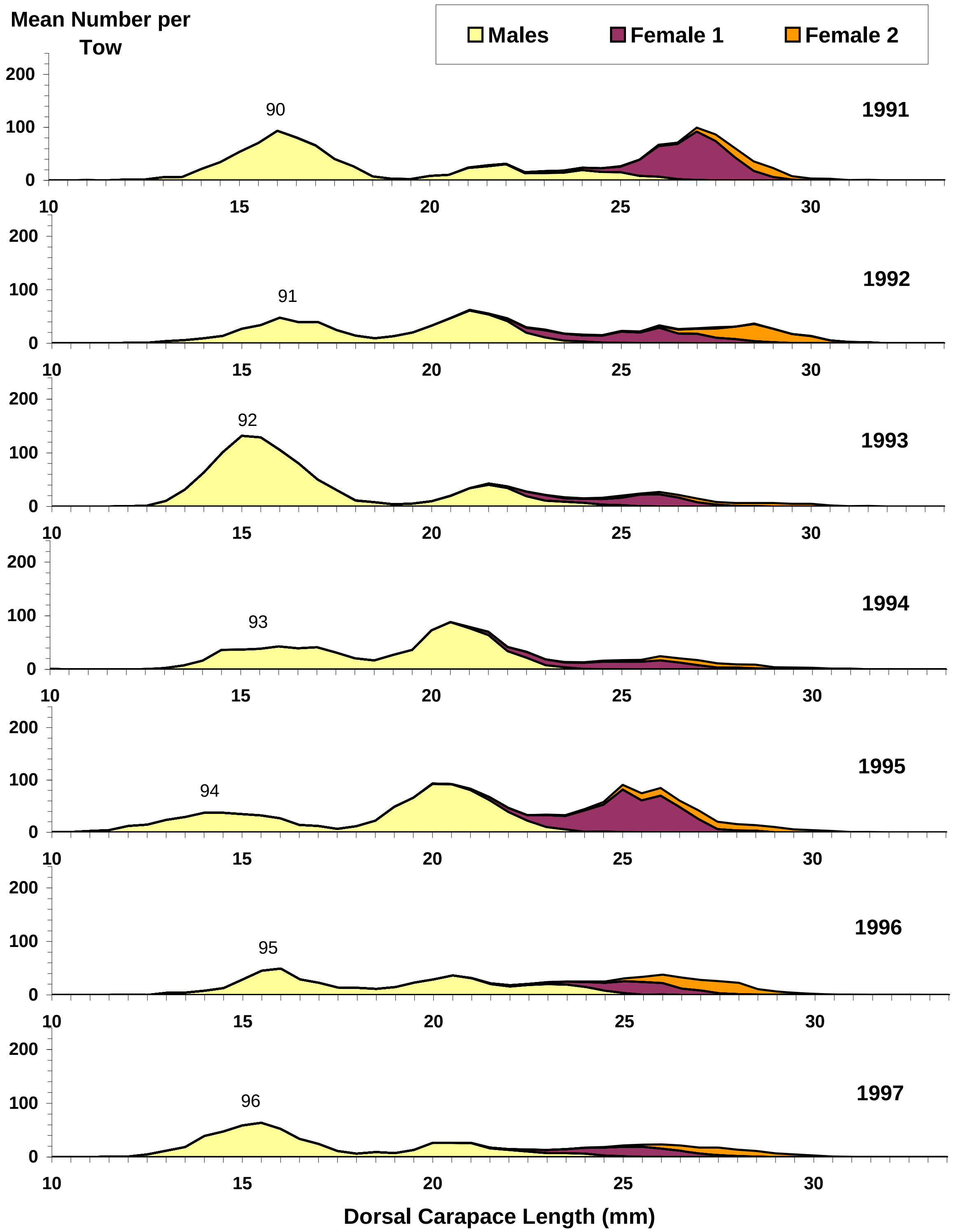


Figure 15 continued – summer survey.

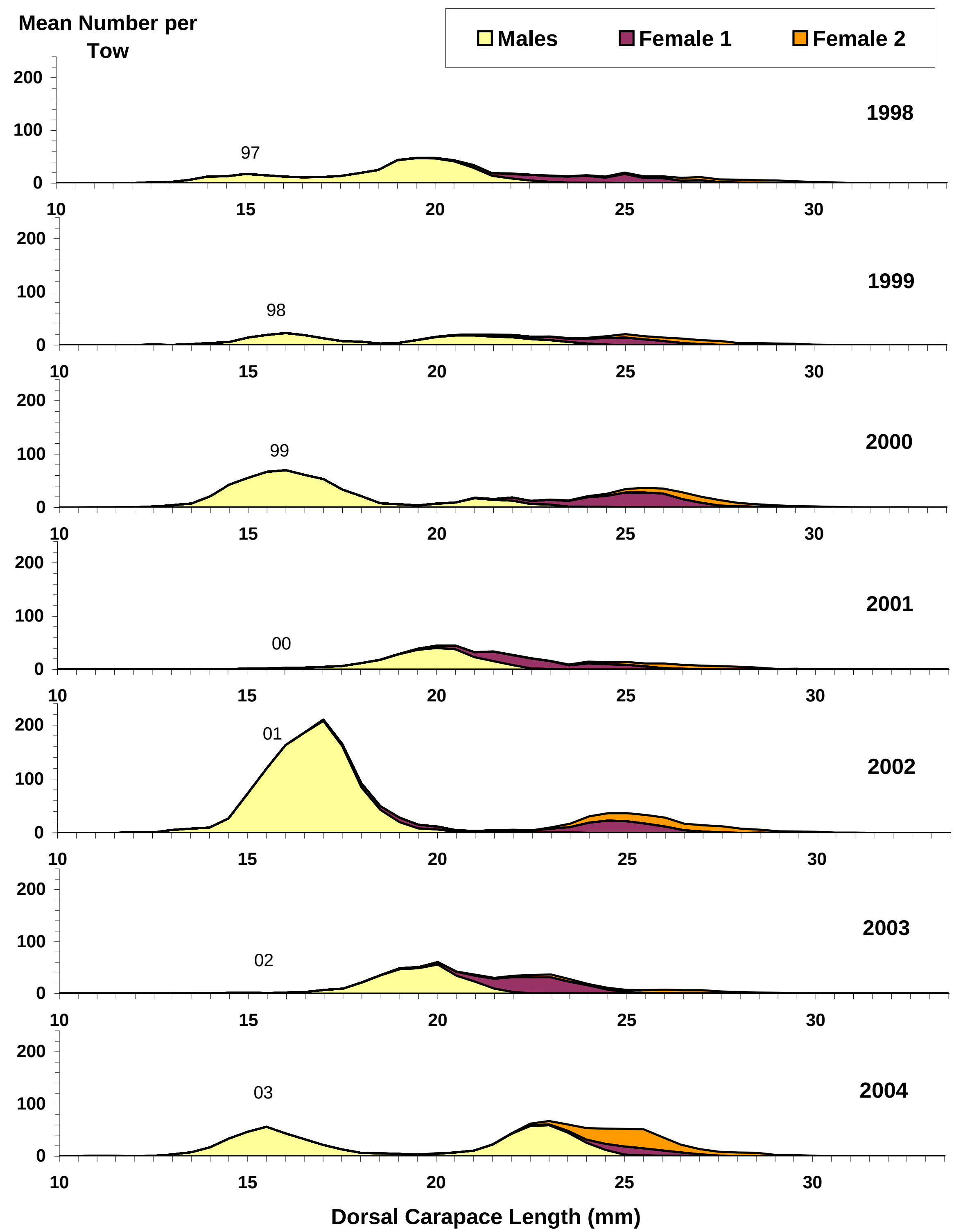


Figure 15 continued – summer survey.

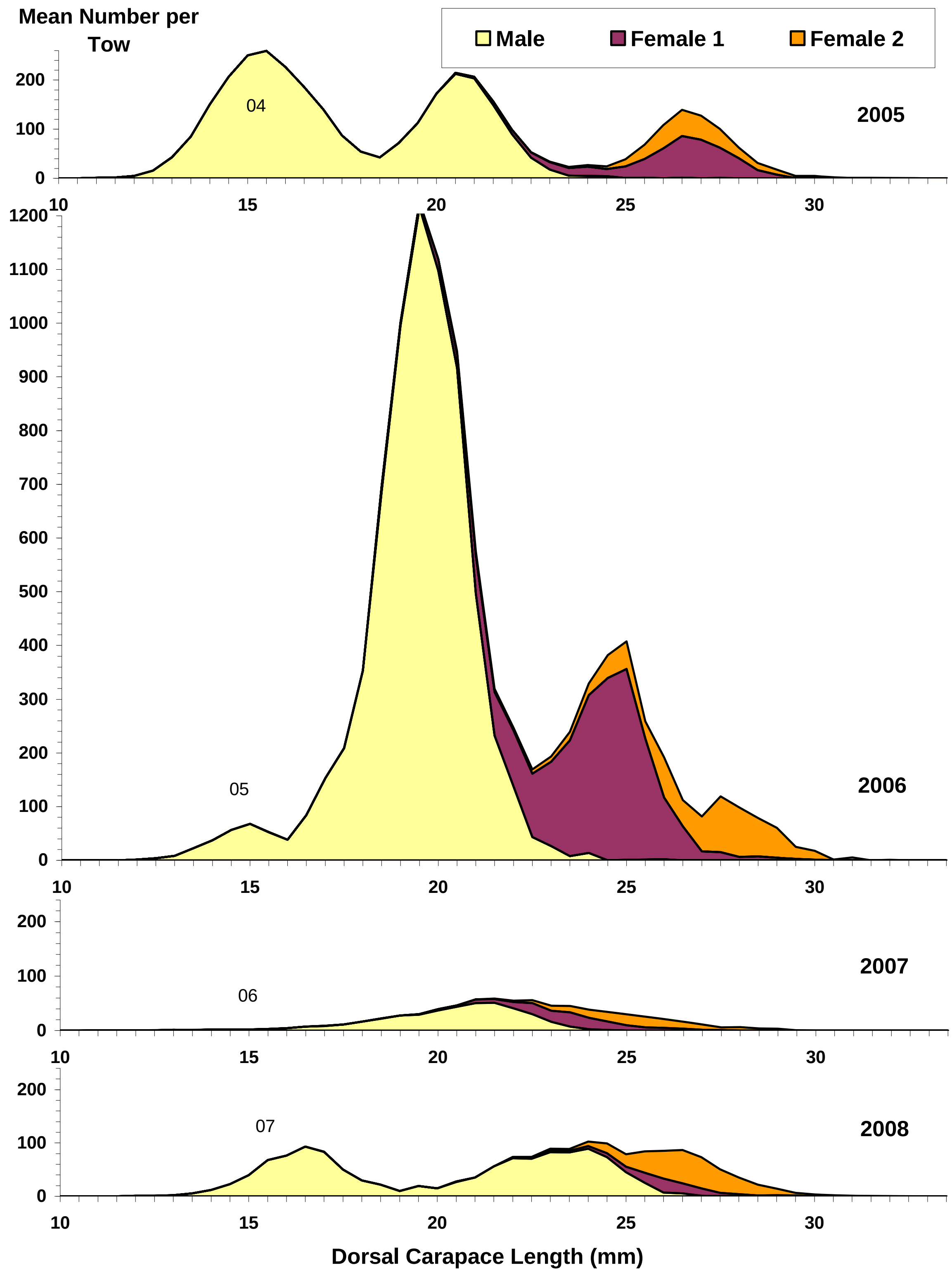


Figure 15 continued – summer survey.

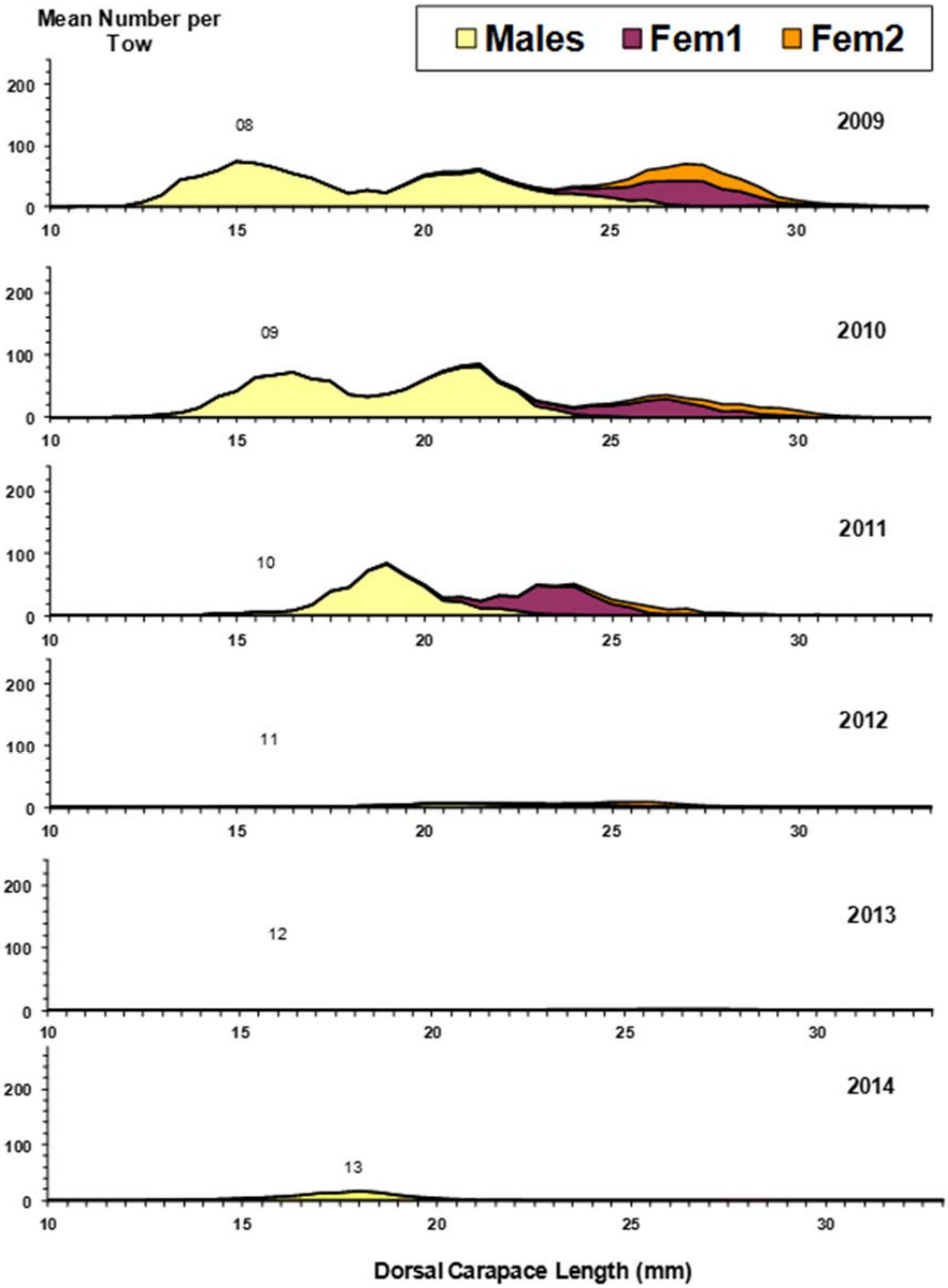


Figure 15 continued – summer survey.

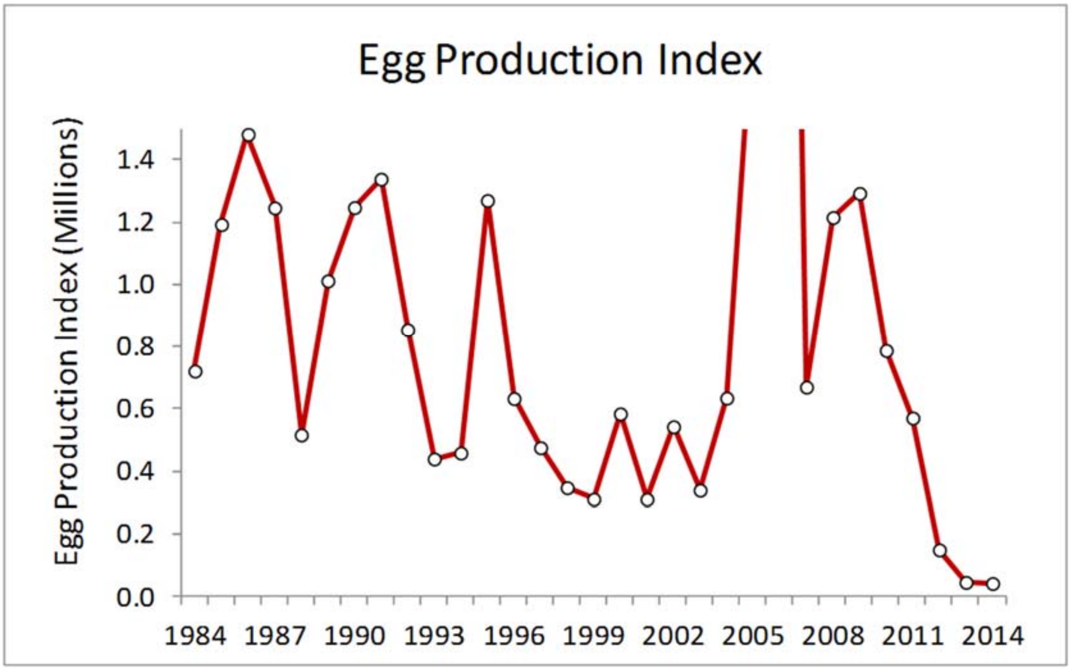


Figure 16: Egg production index for Gulf of Maine northern shrimpbased on stratified mean number of females at length from the summer shrimp survey and estimated fecundity at length (Haynes and Wigley 1969). Index for 2006 (off scale) was 5.6 million.

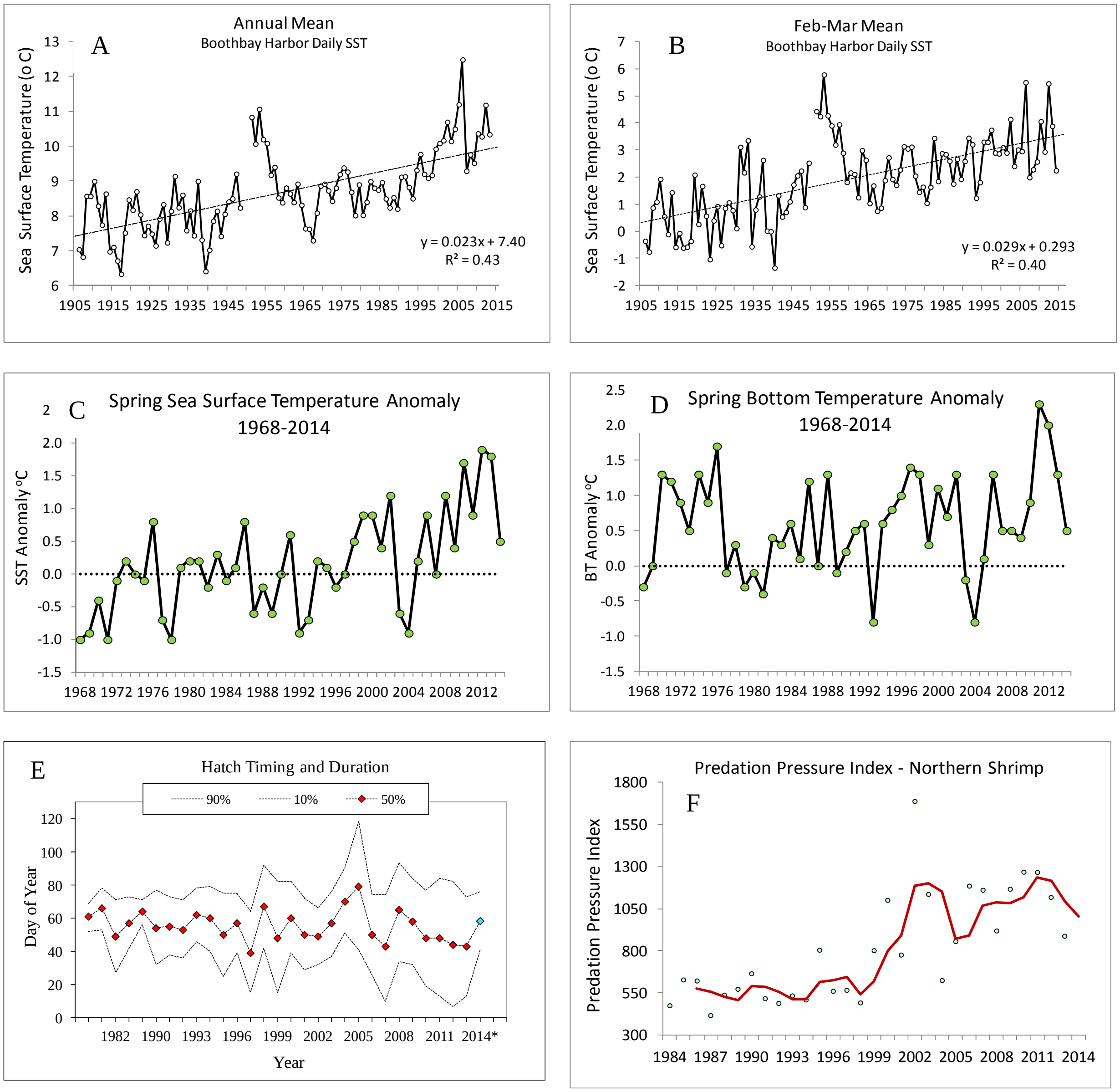


Figure 17: Annual temperature, predation pressure, and hatch timing and duration for northern shrimp in the Gulf of Maine. (A) Average annual sea surface temperature (SST) and (B) average SST during February-March at Boothbay Harbor, Maine, 1906-2014. (C) Spring sea surface temperature anomaly in shrimp offshore habitat areas from NEFSC trawl surveys, 1968-2014. (D) Spring bottom temperature anomaly in shrimp offshore habitat areas from NEFSC trawl surveys, 1968-2014. (E) Estimated hatch timing (10%=start, 50%=midpoint, 90%=completion) for northern shrimp in the Gulf of Maine, 1980-1983 and 1989-2014 (no data 1984-1988). (F) Predation pressure index for northern shrimp in the Gulf of Maine, 1984-2013.

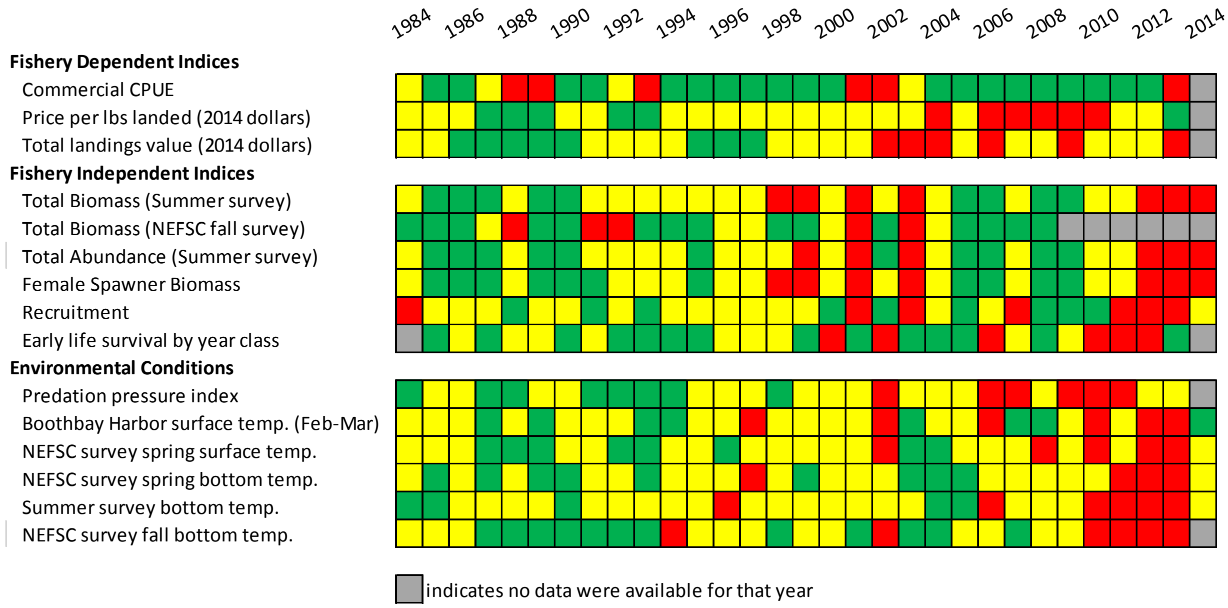
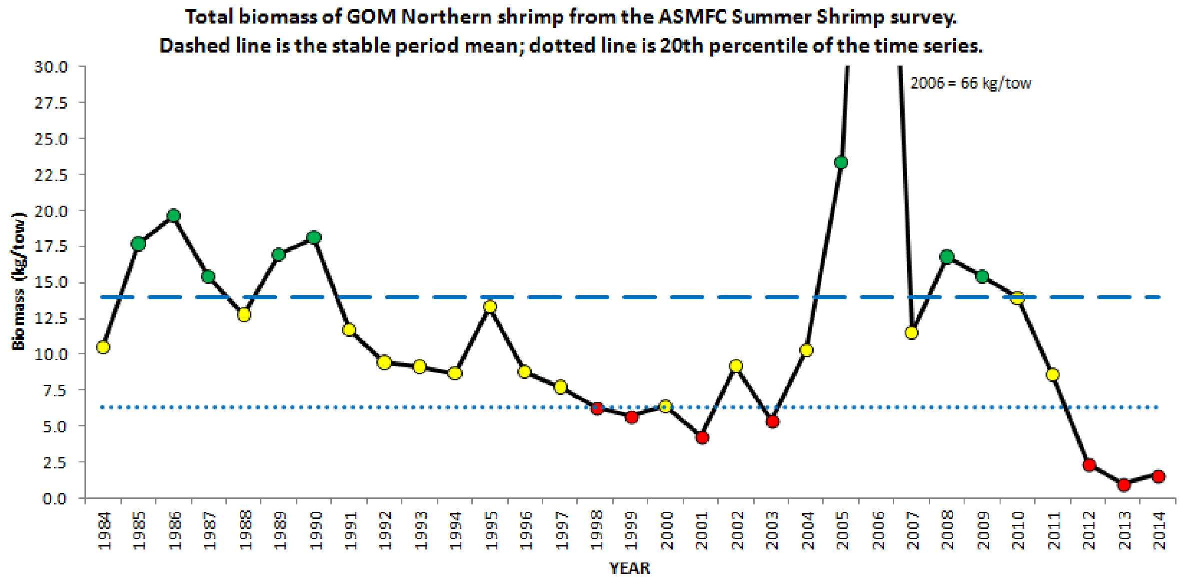


Figure 18: Strict Traffic Light Approach (STLA) results. Red indicates unfavorable conditions or status, yellow indicates intermediate values, and green indicates favorable conditions or status.



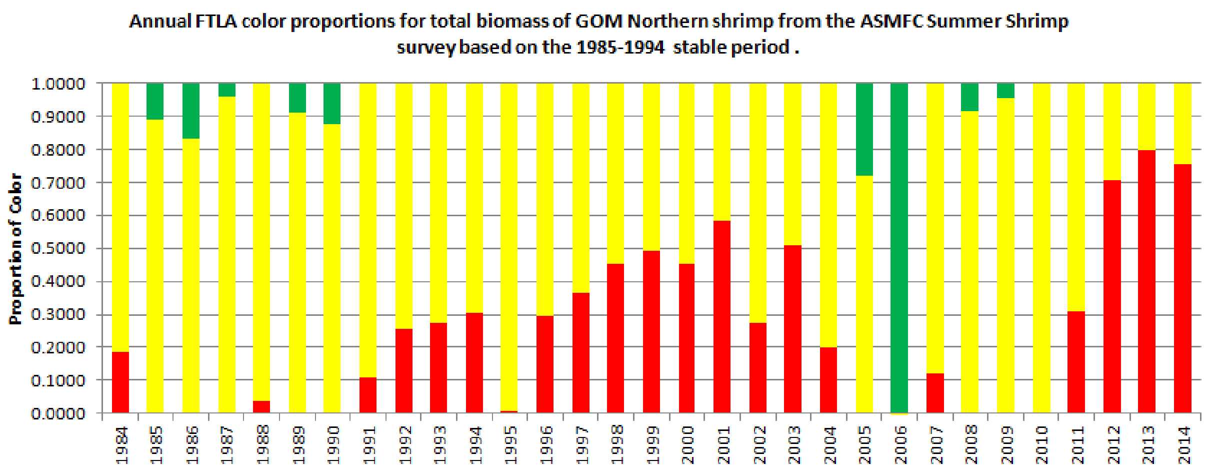


Figure 19: Total biomass of Gulf of Maine northern shrimp from the ASMFC Summer Shrimp survey 1984-2014.Top: annual index relative to the stable period mean (SPM) (dashed line) and to the 20th percentile of the time series from 1984-2014 (dotted line). Green dots are values ≥ SPM; red dots are values ≤ the 20th percentile of the time series; yellow dots are values between the SPM and the 20th percentile. Bottom: annual color proportions indicate proximity to the SPM (red = unfavorable; green = favorable).

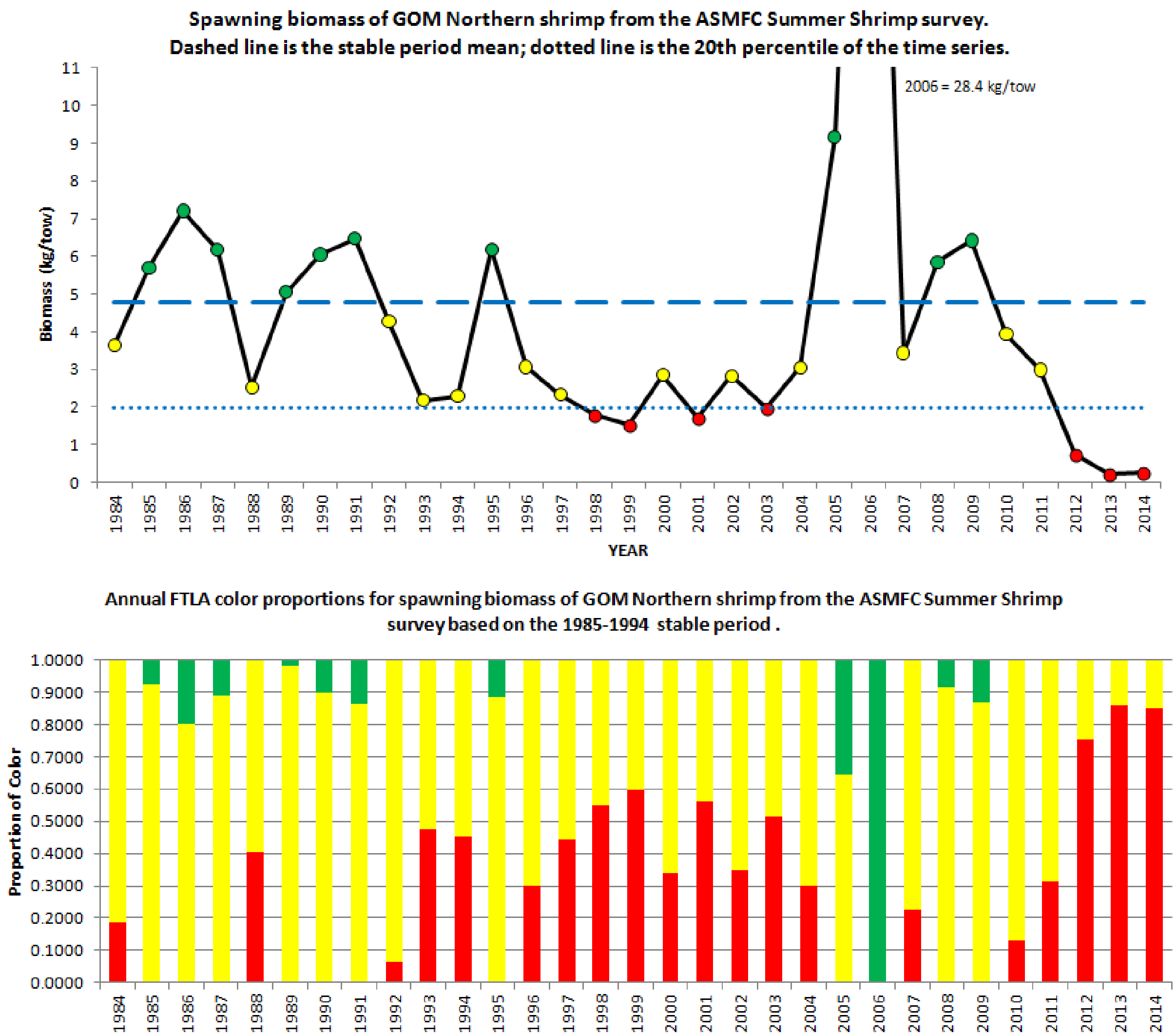
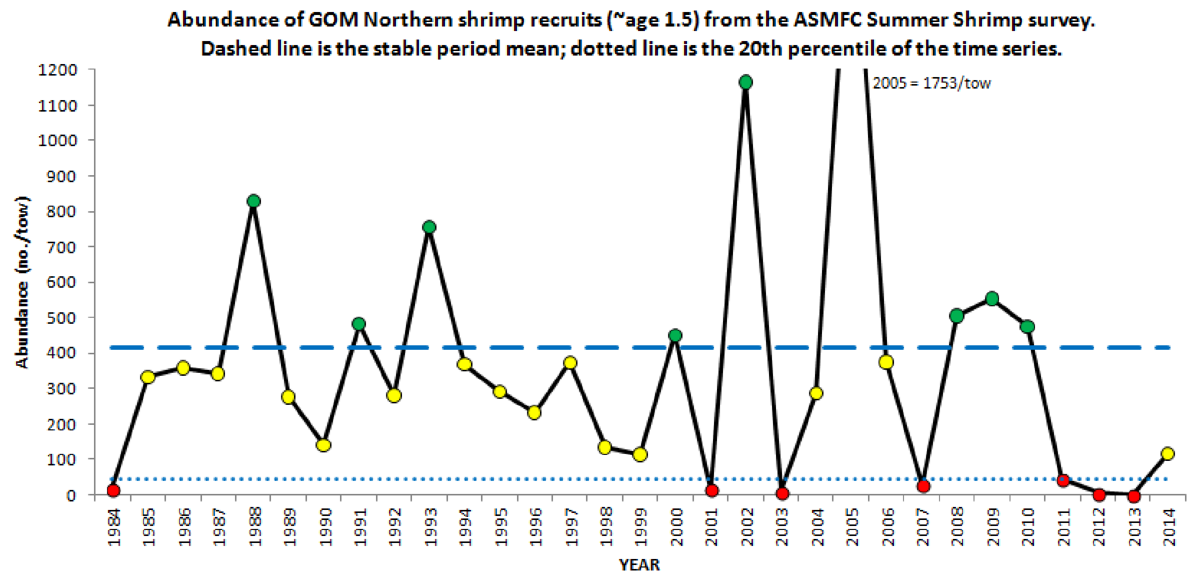


Figure 20: Spawning biomass of Gulf of Maine northern shrimp from the ASMFC Summer Shrimp survey 1984-2014. Top: annual index relative to the stable period mean (SPM) (dashed line) and to the 20th percentile of the time series from 1984-2014 (dotted line). Green dots are values ≥ SPM; red dots are values ≤ the 20th percentile of the time series; yellow dots are values between the SPM and the 20th percentile. Bottom: annual color proportions indicate proximity to the SPM (red = unfavorable; green = favorable) = unfavorable; green = favorable).



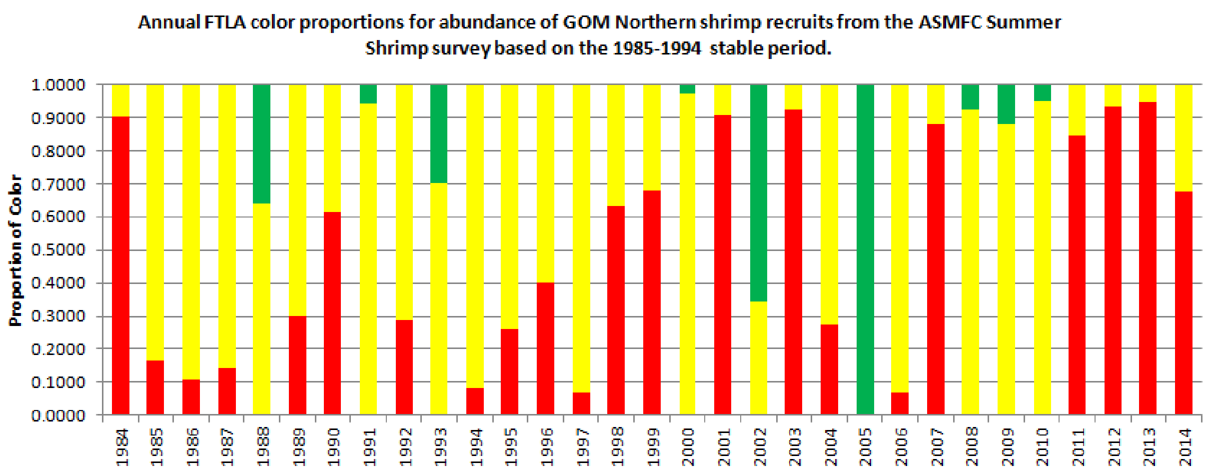
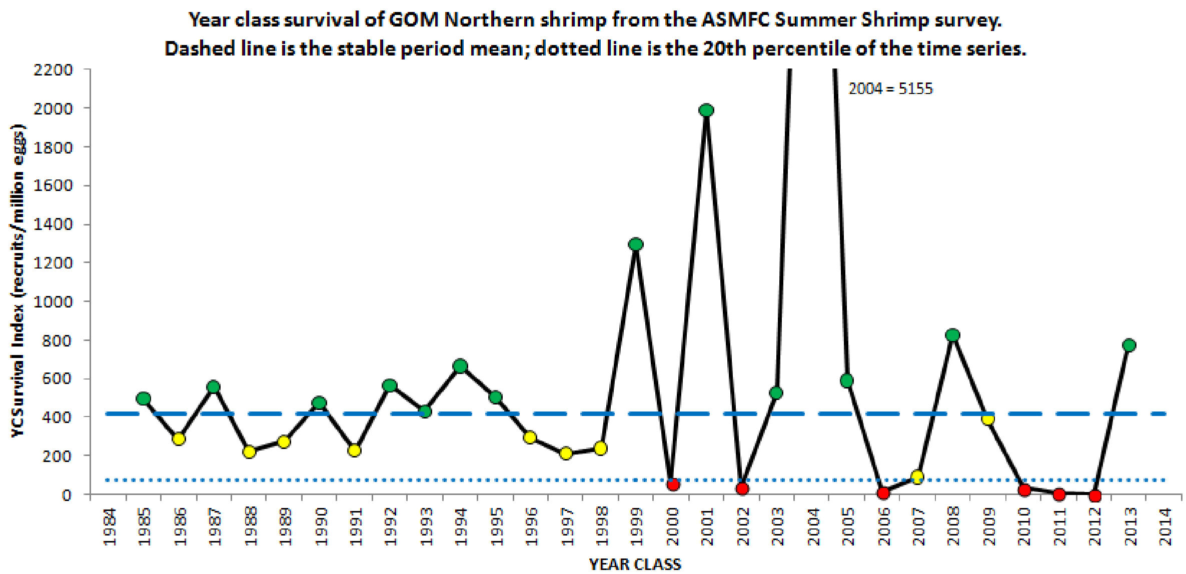


Figure 21: Recruit abundance of Gulf of Maine northern shrimp from the ASMFC Summer Shrimp survey 1984-2014. Top: annual index relative to the stable period mean (SPM) (dashed line) and to the 20th percentile of the time series from 1984-2014 (dotted line). Green dots are values ≥ SPM; red dots are values ≤ the 20th percentile of the time series; yellow dots are values between the SPM and the 20th percentile. Bottom: annual color proportions indicate proximity to the SPM (red = unfavorable; green = favorable).



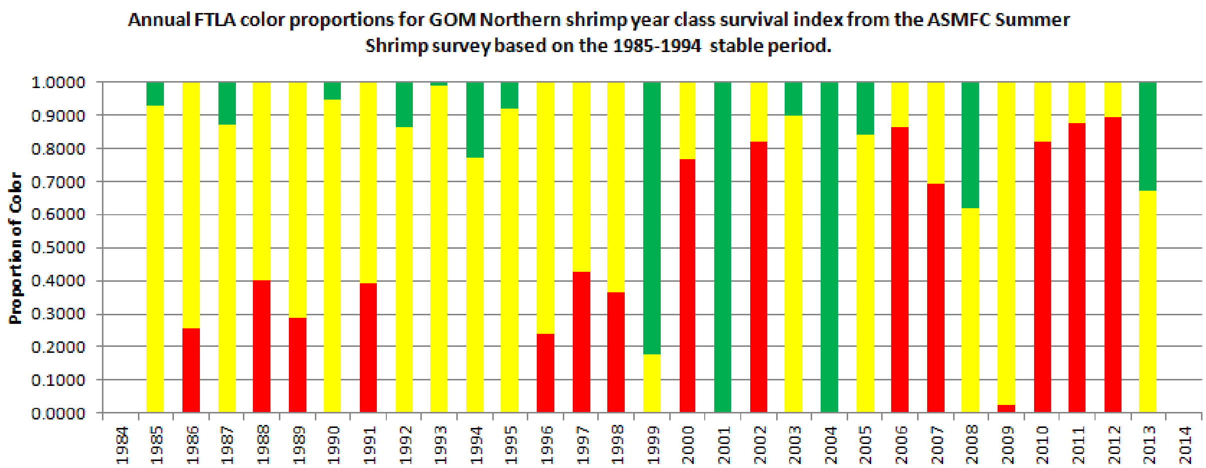
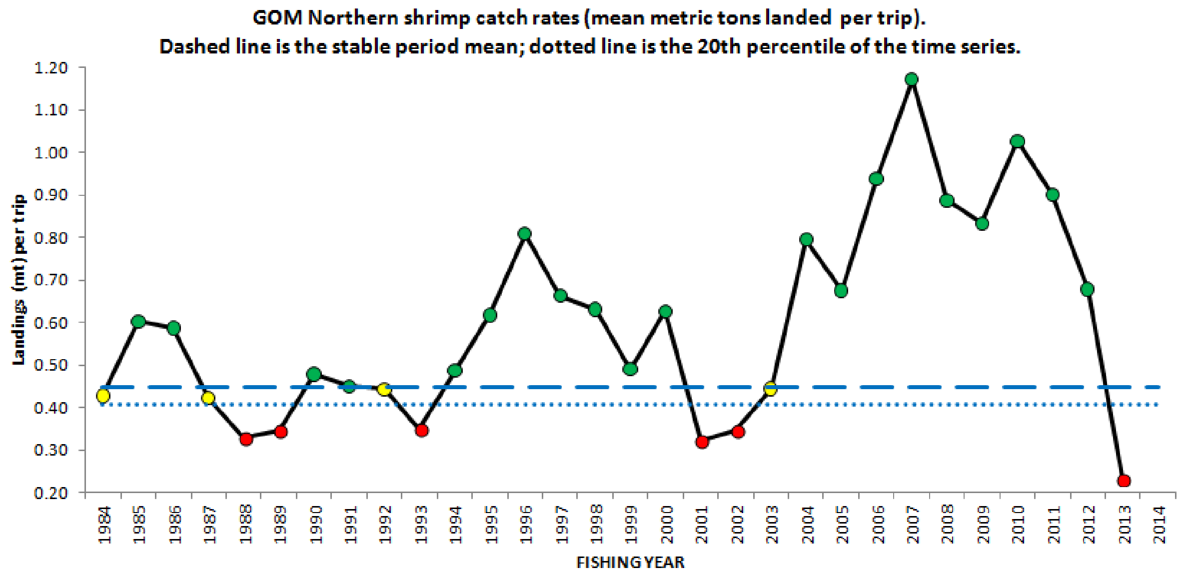


Figure 22: Early life survival (to age 1.5) of Gulf of Maine northern shrimp from the ASMFC Summer Shrimp survey 1984-2014. Top: annual index relative to the stable period mean (SPM) (dashed line) and to the 20th percentile of the time series from 1984-2014 (dotted line). Green dots are values ≥ SPM; red dots are values ≤ the 20th percentile of the time series; yellow dots are values between the SPM and the 20th percentile. Bottom: annual color proportions indicate proximity to the SPM (red = unfavorable; green = favorable).



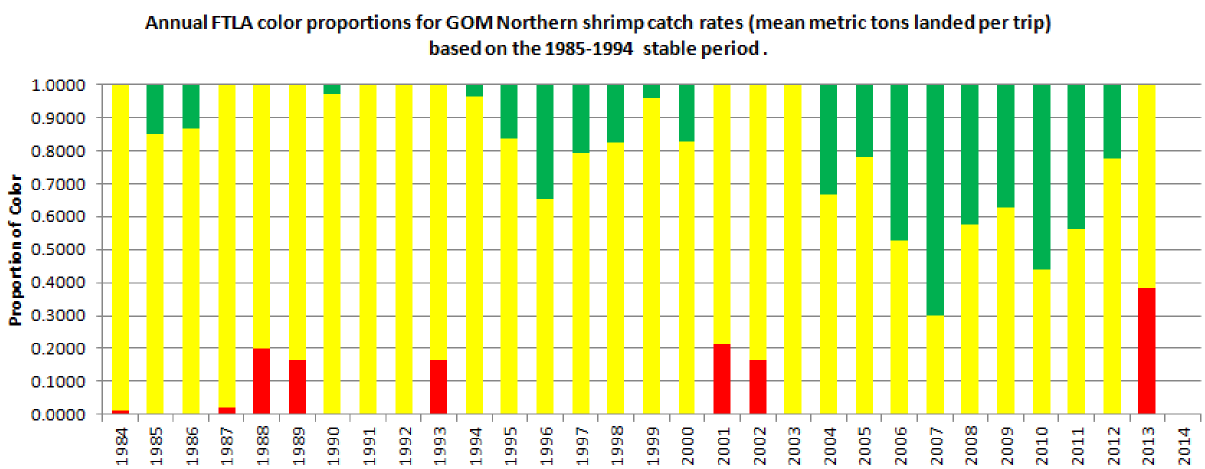


Figure 23: Gulf of Maine northern shrimp fishery catch rates (mt of landings per trip) from 1984-2013. Top: annual index relative to the stable period mean (SPM) (dashed line) and to the 20th percentile of the time series from 1984-2014 (dotted line). Green dots are values ≥ SPM; red dots are values ≤ the 20th percentile of the time series; yellow dots are values between the SPM and the 20th percentile. Bottom: annual color proportions indicate proximity to the SPM (red = unfavorable; green = favorable).

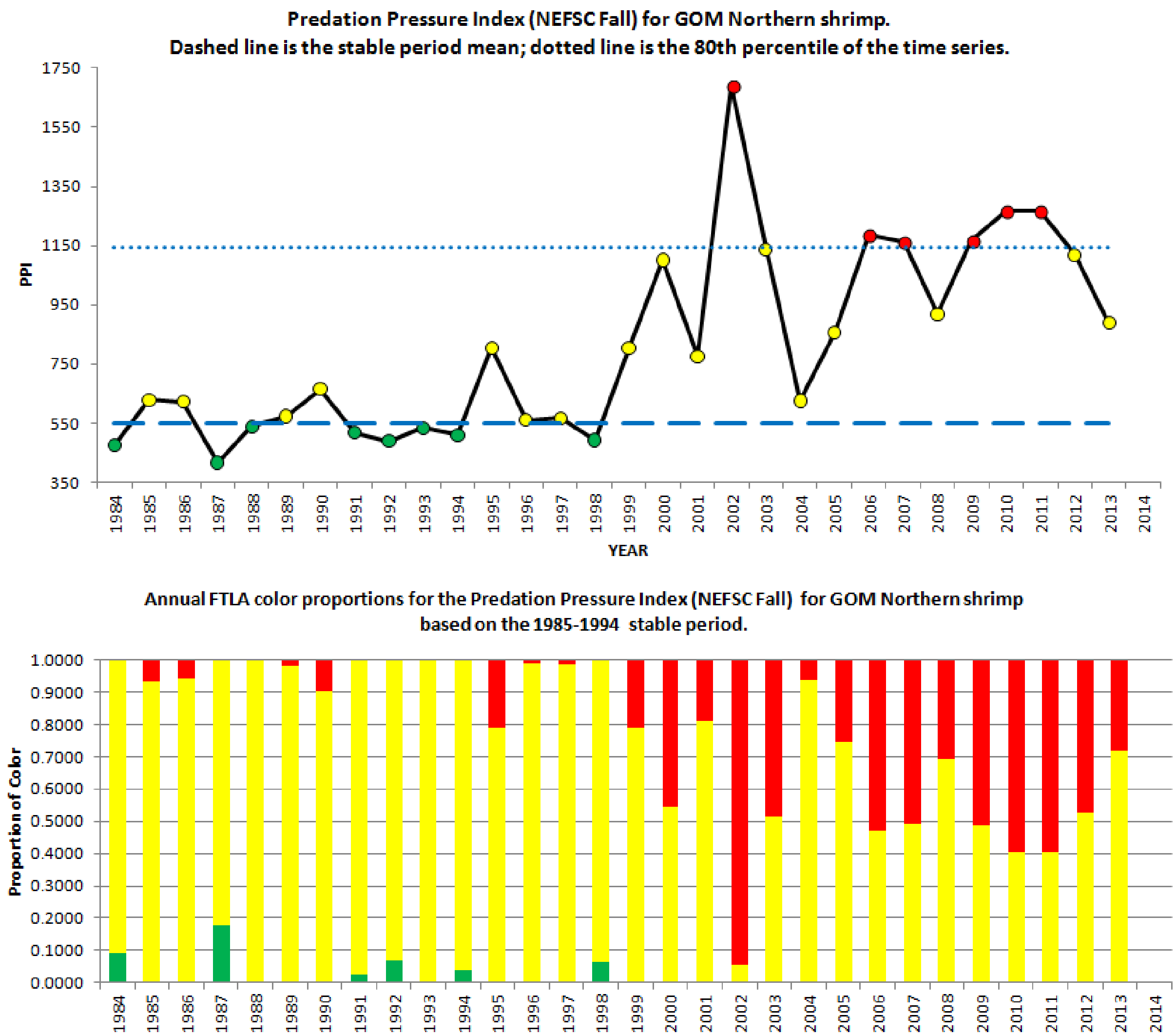
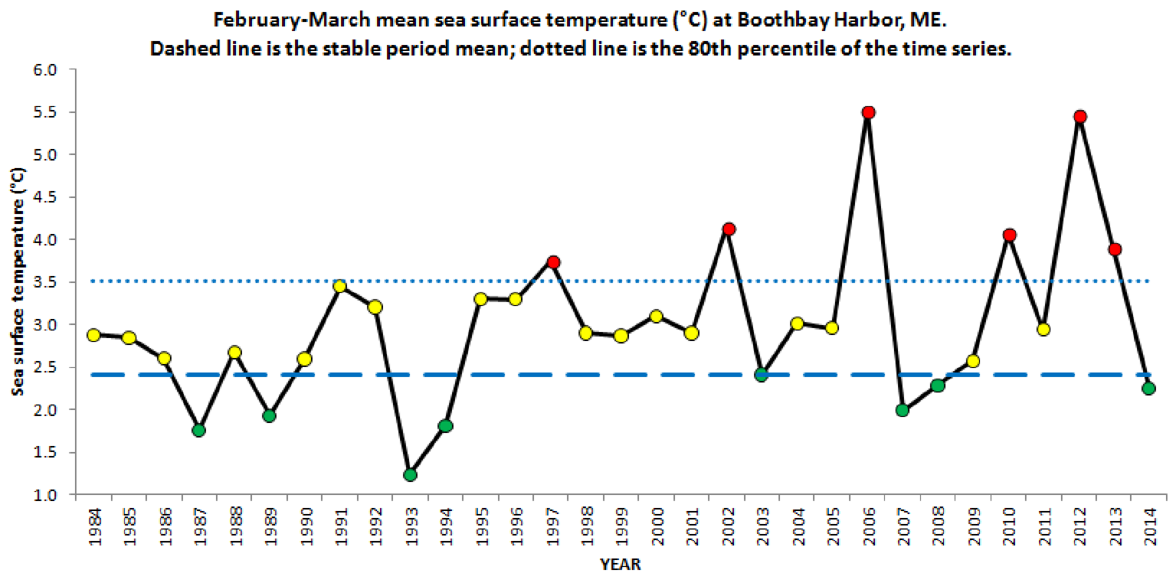


Figure 24: Predation Pressure Index (PPI) for Gulf of Maine northern shrimp from 1984-2013. Top: annual index relative to the stable period mean (SPM) (dashed line) and to the 80th percentile of the time series from 1984-2014 (dotted line). Green dots are values ≤ SPM; red dots are values ≥ the 80th percentile of the time series; yellow dots are values between the SPM and the 80th percentile. Bottom: annual color proportions indicate proximity to the SPM (red = unfavorable; green = favorable).



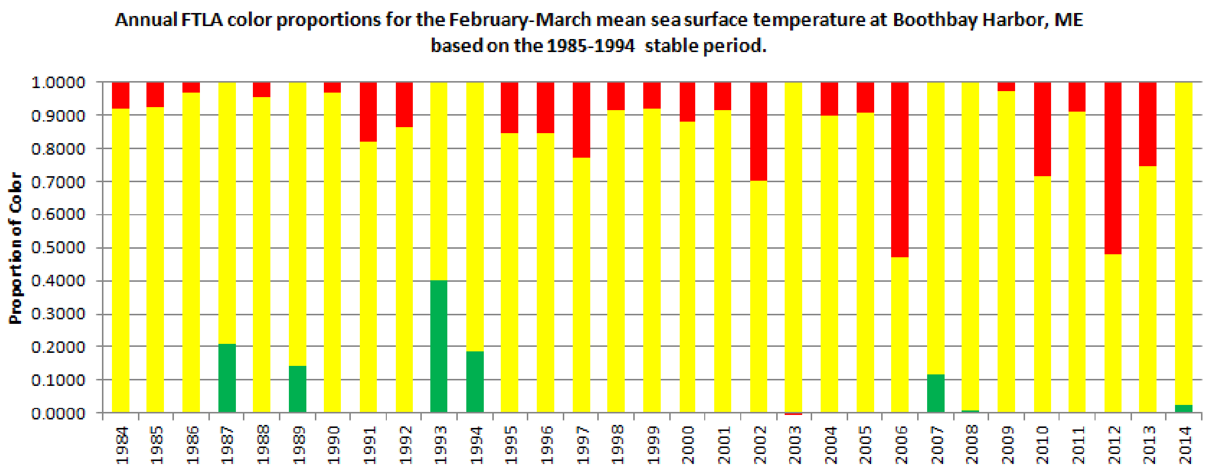


Figure 25: February-March mean sea surface temperature (°C) at Boothbay Harbor, ME from 1984-2014. Top: annual index relative to the stable period mean (SPM) (dashed line) and to the 80th percentile of the time series from 1984-2014 (dotted line). Green dots are values ≤ SPM; red dots are values ≥ the 80th percentile of the time series; yellow dots are values between the SPM and the 80th percentile. Bottom: annual color proportions indicate proximity to the SPM (red = unfavorable; green = favorable).

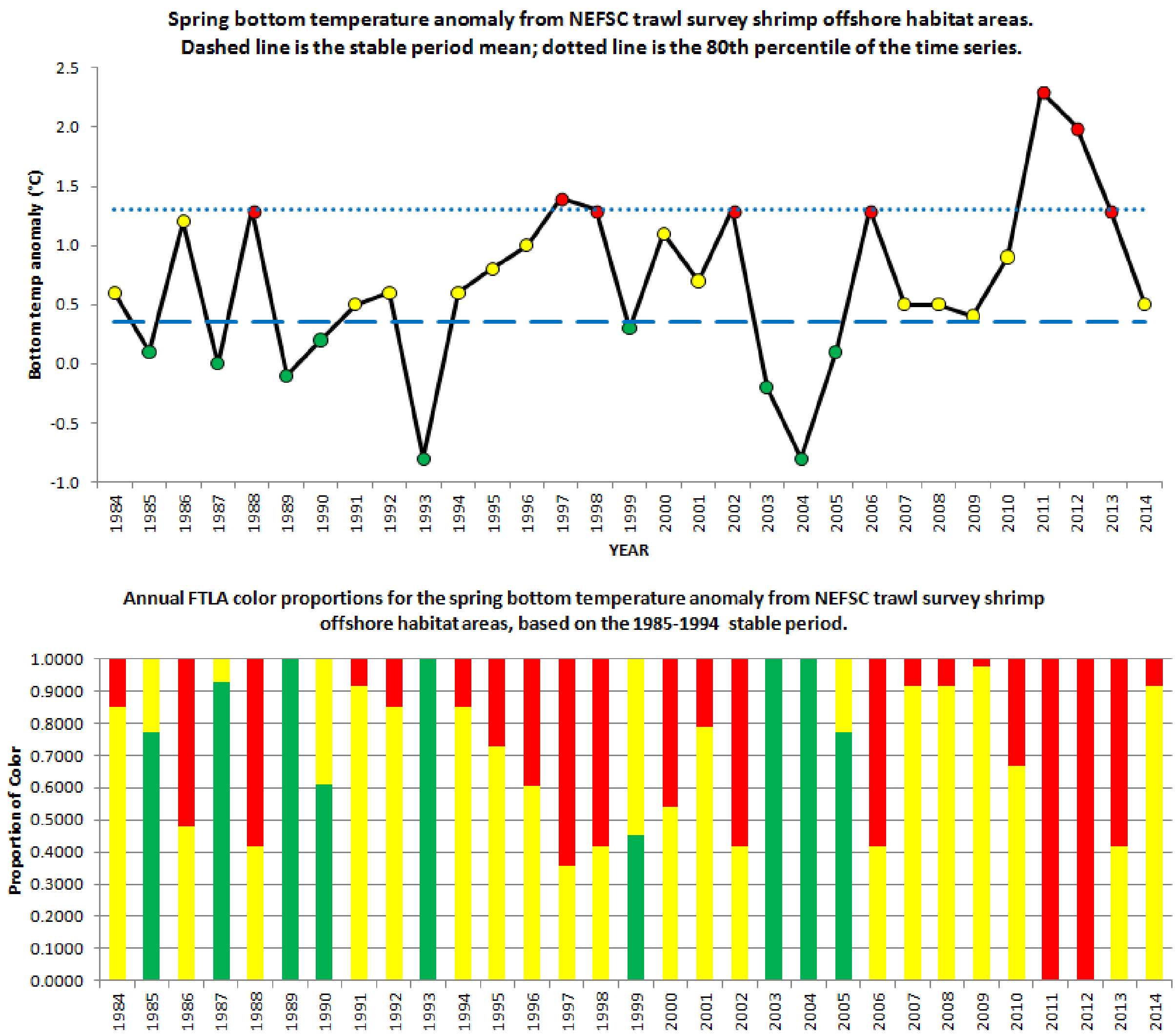


Figure 26: Spring bottom temperature anomaly from the NEFCS trawl survey in shrimp offshore habitat areas from 1984-2014. Top: annual index relative to the stable period mean (SPM) (dashed line) and to the 80th percentile of the time series from 1984-2014 (dotted line). Green dots are values ≤ SPM; red dots are values ≥ the 80th percentile of the time series; yellow dots are values between the SPM and the 80th percentile. Bottom: annual color proportions indicate proximity to the SPM (red = unfavorable; green = favorable).

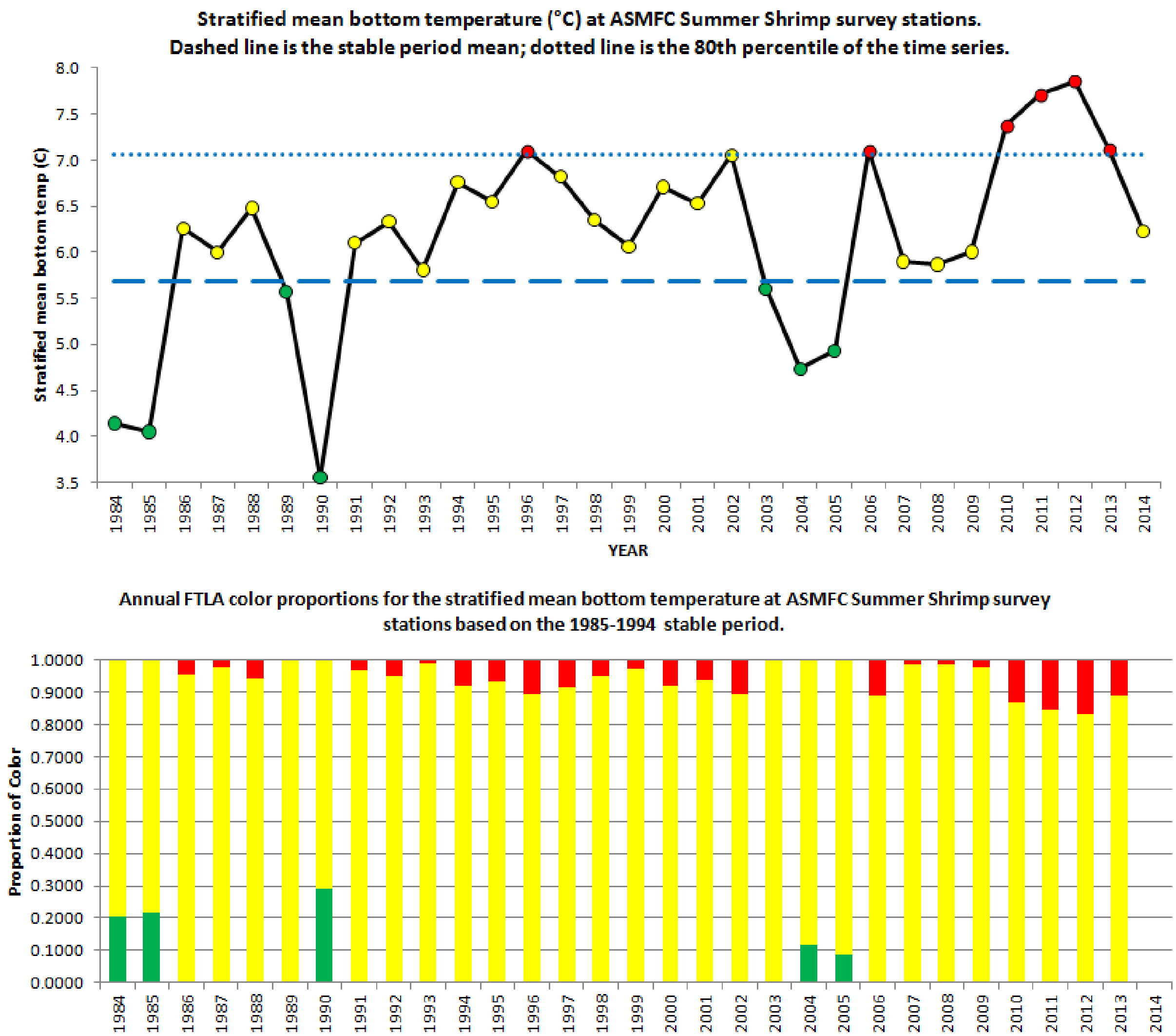


Figure 27: Stratified mean bottom temperature (°C) at ASMFC Summer Shrimp survey stations from 1984-2014. Top: annual index relative to the stable period mean (SPM) (dashed line) and to the 80th percentile of the time series from 1984-2014 (dotted line). Green dots are values ≤ SPM; red dots are values ≥ the 80th percentile of the time series; yellow dots are values between the SPM and the 80th percentile. Bottom: annual color proportions indicate proximity to the SPM (red = unfavorable; green = favorable).