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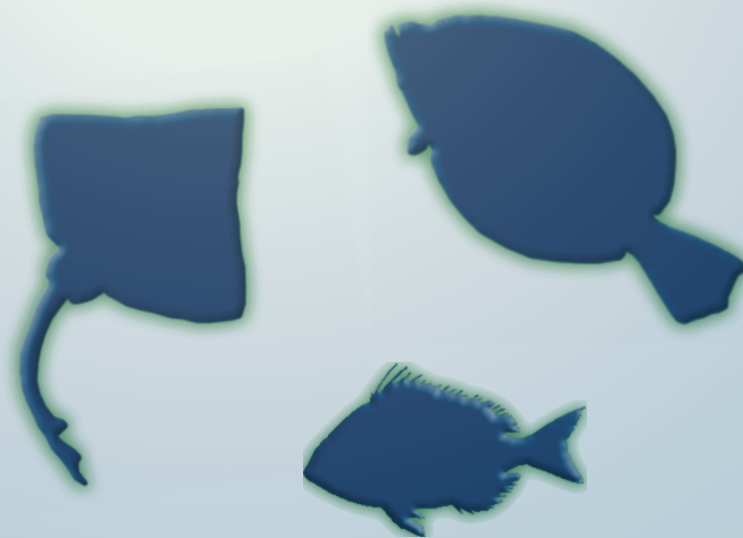
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A stylized map of the Northeast United States coastline, including parts of Maine, New Brunswick, Nova Scotia, and the Atlantic coast of the United States down to Florida. The map is rendered in a light blue color against a darker blue background.

# Northeast Area Monitoring and Assessment Program

## Final Report 2005-2009



Christopher F. Bonzek, James Gartland,  
J. David Lange Jr., Robert J. Latour





Northeast Area Monitoring and Assessment Program (NEAMAP)  
Near Shore Trawl Survey

Data collection and analysis in support of single and multispecies stock  
assessments in the Mid-Atlantic and Southern New England

Final Report

2005 – 2009

Submitted to:

Atlantic States Marine Fisheries Commission  
Washington, DC

By:

Christopher F. Bonzek  
James Gartland  
J. David Lange Jr.  
Robert J. Latour, Ph.D.

Department of Fisheries Science  
Virginia Institute of Marine Science  
College of William and Mary  
Gloucester Point, Virginia

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## Table of Contents

Project Summary.....	<i>i</i>
Introduction.....	1
Methods.....	3
Results.....	13
Literature Cited.....	48
Figures	
Survey Area.....	51
Sampling Sites.....	52
Gear Performance.....	58
Species Data Summaries (Figures and Tables)	
Alewife.....	63
American Lobster.....	69
American Shad.....	75
Atlantic Croaker.....	81
Atlantic Menhaden.....	89
Atlantic Spadefish.....	95
Atlantic Thread Herring.....	101
Bay Anchovy.....	107
Black Sea Bass.....	113
Blueback Herring.....	121
Bluefish.....	127
Bluntnose Stingray.....	135
Brown Shrimp.....	141
Bullnose Ray.....	147
Butterfish.....	153
Clearence Skate.....	159
Cownose Ray.....	167
Horseshoe Crab.....	173
Kingfish.....	179
Little Skate.....	185

<i>Loligo</i> Squid.....	193
Northern Searobin.....	199
Pinfish .....	205
Red Hake.....	211
Scup.....	217
Silver Hake.....	225
Silver Perch.....	233
Smooth Butterfly Ray .....	239
Smooth Dogfish .....	245
Spanish Mackerel.....	253
Spiny Dogfish.....	259
Spot.....	267
Spotted Hake.....	273
Striped Anchovy.....	279
Striped Bass.....	285
Striped Searobin.....	293
Summer Flounder.....	299
Weakfish.....	307
White Shrimp.....	315
Windowpane Flounder.....	321
Winter Flounder.....	327
Winter Skate.....	335
Appendix I.....	343

## **NEAMAP ASMFC Final Report Summary 2005 - 2009**

- I. Project Title:** Data collection and analysis in support of single and multispecies stock assessments in the Mid-Atlantic and Southern New England: Northeast Area Monitoring and Assessment Program, Near Shore Trawl Survey.
- II. Grantee State and Contact Name:** Virginia / Virginia Institute of Marine Science – Christopher F. Bonzek
- III. Project Period:** 1 August 2005 to 30 June 2009  
**Reporting Period:** 1 August 2005 to 30 June 2009
- IV. Project Description:** This is a new fishery-independent bottom trawl survey operating in the near coastal ocean waters of the Mid-Atlantic and Southern New England regions. The survey is an element of the Atlantic States Marine Fisheries Commission's (ASMFC) Northeast Area Monitoring and Assessment Program (NEAMAP) and is designed to sample fishes and invertebrates from waters bounded by the 6.1 m and 18.3 m depth contours between Montauk, New York and Cape Hatteras, North Carolina and the 18.3 m and 36.6 m depth contours in Rhode Island Sound and Block Island Sound using a bottom trawl. The primary objective of the survey is to estimate the abundance, biomass, length- and age-structure, diet composition, and other assessment-related parameters of the various fishes of management interest inhabiting the sampling area. There are also multiple associated objectives which are outlined in the attached full report.
- V. Project Summary/Accomplishments:** Following the successful completion of the pilot phase in 2006, the NEAMAP Near Shore Trawl Survey conducted four full-scale cruises between the fall of 2007 and spring of 2009: namely, the Fall 2007, Spring 2008, Fall 2008, and Spring 2009 surveys. In general, the fall cruises began around the fourth Monday in September and concluded near the third weekend of October (Fall 2007 - 25 September to 20 October 2007; Fall 2008 - 22 September to 17 October 2008). The spring surveys spanned from about the third Monday in April to the third weekend in May (Spring 2008 - 23 April to 15 May 2008; Spring 2009 - 21 April to 17 May 2009). The target number of 150 stations was sampled for each of the survey cruises. Ten additional sites were selected and sampled during the Spring 2009 survey to support efforts designed to evaluate the current stratification scheme of the NEAMAP sampling area.

Over 2,416,000 individual specimens (fishes and invertebrates) weighing approximately 169,000 kg and representing 173 species, including boreal, temperate, and tropical fishes, were collected during the four full-scale surveys conducted to date. As expected, catches were larger and more diverse on the fall cruises relative to the spring surveys. In all, individual length measurements were recorded for 265,783 animals. Lab processing is proceeding on the 16,949 stomach samples and 22,461 ageing structures (otoliths, vertebrae, spines, opercles) collected in the field. At the time that this report was generated, 14,460



of these stomachs had been examined and quantified. While only 6,008 ageing structures have been fully processed to date, otoliths from an additional 1,539 scup, 556 bluefish, and 255 black sea bass collected in 2008 have been prepared and sectioned. Readers were in the midst of assigning ages to these samples at the time of this report. Most of the remaining 14,103 structures are elasmobranch vertebrae, which require extensive preparation relative to most other ageing hard parts. Efforts to process these samples are well underway, however, and these data will likely be available in the near future.

A full report of the accomplishments of the NEAMAP Trawl Survey is attached to this standard project summary. Because multiple changes to the NEAMAP survey design were implemented following the pilot cruise, the pilot data are not comparable with those collected during the full-scale surveys. A description of the pilot work and resulting data has therefore been included as a separate appendix to avoid confusion.

- VI. Challenges/Changes:** Beyond completion of laboratory sample processing, no significant challenges remain for this contract segment.
- VII. Participants:** Primary program personnel remain unchanged.
- VIII. Quality Assurance:** Previous progress reports and the documents prepared for the NEAMAP Peer Review provide detailed discussions of the quality assurance procedures used in selecting fishing gear, conducting fishing operations, and processing the catch. These descriptions are interwoven into the attached report as well. All data (including those collected both in the field and in the laboratory) are subjected to several data quality checks; some were adopted from other monitoring surveys while several were created specifically for NEAMAP.
- IX. Funding Status:** Expenditures generally have been in line with expectations. The 2006 pilot cruises were funded by the ASMFC through the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA). Field and laboratory operations associated with the Fall 2007 and Spring 2008 surveys were also supported with monies provided by the ASMFC through ACFCMA and by the Northeast Fisheries Science Center's (NEFSC) Northeast Cooperative Research Program (NCRP). Since the fall of 2008, the NEAMAP Near Shore Trawl Survey has been funded primarily through the Mid-Atlantic Fishery Management Council's Research Set-Aside (RSA) Program.
- X. Future Activities:** The future of this program is dependent upon continued funding. We anticipate sufficient RSA funds to complete the Fall 2009 survey cruise and are presently awaiting a promised allocation of funds from the state of New York. NEAMAP personnel at VIMS have submitted a multi-year (2010-2012) proposal to the Mid-Atlantic Fishery Management Council's RSA Program, and award decisions are currently pending.
- XI. Presentations/Public Outreach/Survey Exchanges:** Since 2006, presentations of NEAMAP survey results have been made as follows:
  - November 2006: NEAMAP Operations Committee
  - November 2006: NEAMAP Board

- December 2006: Mid-Atlantic / New England Fishery Management Council, Trawl Survey Advisory Panel
- January 2007: NEAMAP Operations Committee
- January 2007: ASMFC Interstate Fisheries Management Program (ISFMP) Policy Board
- February 2007: New England Fishery Management Council
- February 2007: Mid-Atlantic Fishery Management Council
- January 2008: Mid-Atlantic Fishery Management Council
- February 2008: Cape May, New Jersey Party and Charter Boat Association
- February 2008: Mid-Atlantic / New England Fishery Management Council, Trawl Survey Advisory Panel
- February 2008: Bass Pro Shops Fishing Classic (Hampton, Virginia), Booth exhibit
- March 2008: NEAMAP Operations Committee
- March 2008: NEAMAP Board
- April 2008: New England Fishery Management Council
- July 2008: NEAMAP Board
- October 2008: ASMFC Management and Science Committee
- October 2008: ASMFC ISFMP Policy Board
- December 2008: NEAMAP Peer Review Panel
- February 2009: Bass Pro Shops Fishing Classic (Hampton, Virginia), Booth exhibit
- May 2009: Rhode Island Ocean Special Area Management Plan Team

Also since 2007, approximately 200 individuals representing the recreational, commercial, and management communities and local and national political leaders have observed survey operations both in port and at sea during layovers in New Bedford, Massachusetts, Point Judith, Rhode Island, Montauk, New York, Cape May, New Jersey and Hampton, Virginia. Brief news descriptions of the survey have appeared on local television in Providence, Rhode Island, and Long Island, New York. The NEAMAP Trawl Survey has also appeared in a number of periodicals, including the June 2008 issue of *The Fisherman* (published in New Jersey for the recreational community), the September 2008 and December 2008 issues of *National Fisherman*, and the March 2007 and November 2008 issues of *Commercial Fisheries News*. Finally, this survey has been featured in several newspapers including the *Cape May County Herald*, *Asbury Park Press*, *New Bedford Times*, and *The Southampton Press*.

In an attempt to promote survey coordination and idea-sharing between organizations, NEAMAP staff have participated in two trawl survey personnel exchanges. Specifically, the NEAMAP program manager worked with the NEFSC during Leg III of their Spring Bottom Trawl Survey in April 2009, while three NEAMAP survey technicians participated in the Alaska Fisheries Science Center's Bottom Trawl Surveys in the summer of 2009. In an effort to continue these exchanges, NEFSC staff will likely be accompanying NEAMAP during its Fall 2009 survey cruise.



## Introduction

Concerns regarding the status of fishery-independent data collection from continental shelf waters between Cape Hatteras, North Carolina and the U.S. / Canadian border led the Atlantic States Marine Fisheries Commission's (ASMFC) Management and Science Committee (MSC) to draft a resolution in 1997 calling for the formation of the Northeast Area Monitoring and Assessment Program (NEAMAP) (ASMFC 2002). NEAMAP is a cooperative state-federal partnership modeled after the Southeast Area Monitoring and Assessment Program (SEAMAP), which has been coordinating and conducting fishery-independent data collection south of Cape Hatteras since the mid-1980s (Rester 2001). The four main goals of the NEAMAP directly address the deficiencies noted by the MSC for the northeast region and include:

- developing fishery-independent surveys for areas where current sampling is either inadequate or absent
- coordinating data collection among fishery-independent surveys (both existing and newly formed)
- providing for efficient management and dissemination of data
- establishing outreach programs (ASMFC 2002).

The NEAMAP Memorandum of Understanding was signed by all partner agencies by July 2004.

One of the first major efforts of the NEAMAP was to develop a fishery-independent trawl survey for the near shore coastal zone of the Mid-Atlantic Bight (MAB). While the National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center's (NEFSC) Bottom Trawl Survey had been operating from Cape Hatteras to the U.S. / Canadian border in waters less than 457 m since 1963, sampling intensity inshore of the 27.4 m contour was relatively low ( $\sim 1$  site per  $90 \text{ nm}^2$ ) due to the large sizes of the NEFSC's sampling area and research vessels (NEFSC 1988, R. Brown, NMFS, pers. comm). Further, of the six coastal states in the MAB, only New Jersey had been conducting a fishery-independent trawl survey regularly in its ocean waters (Byrne 2004). The NEAMAP Near Shore Trawl Survey was therefore designed to address this gap in fishery-independent survey coverage, which is consistent with the program goals outlined above. Specifically, this survey was intended to sample the waters bounded by Montauk, New York, Cape Hatteras, North Carolina, and the 6.1 m and 27.4 m depth contours using a moderately high sampling intensity ( $\sim 1$  station per  $30 \text{ nm}^2$ ) and with the following objectives:

- estimate the abundance, biomass, length-frequency distribution, age-structure, sex ratio, maturity schedules, diet composition, and other assessment-related parameters of the various fishes of management interest inhabiting the sampling area
- estimate the abundance, biomass, and length-frequency distribution of all other fishes collected by the survey as well as invertebrates of management interest
- collect hydrographic and atmospheric data coincident with the monitoring of living marine resources

- identify and monitor essential fish habitat in the regions sampled by the survey
- serve as a platform for the collection of additional samples and data for collaborating investigators, as project resources allow.

In early 2005, the ASMFC received \$250,000 through the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) and made these funds available for pilot cruises designed to assess the viability of the NEAMAP Near Shore Trawl Survey. The Virginia Institute of Marine Science (VIMS) provided the sole response to the Commission's request for proposals and was awarded the contract for this work in August 2005. VIMS conducted two brief pre-pilot cruises and a fall pilot survey in 2006.

Upon favorable review of the pilot cruises and resulting data, the ASMFC bundled funds acquired from the ACFCMA and NEFSC Northeast Cooperative Research Program (NCRP) to generate the resources needed for the initiation of full-scale sampling operations. The ASMFC awarded this contract to VIMS in the late spring of 2007, and the first full NEAMAP survey was scheduled for fall of 2007.

Two significant changes to the NEAMAP sampling area were implemented prior to this first full cruise:

- The offshore extent of the survey area contracted. In 2007, the NEFSC took delivery of the *FSV Henry B. Bigelow*, began preliminary sampling operations, and determined that the vessel could safely operate in waters as shallow as 18.3 m. NEFSC personnel then made the determination that future surveys would likely extend inshore to that contour (R. Brown, NMFS, pers. comm.). The 27.4 m contour was originally defined as the offshore boundary for the NEAMAP Survey based on the belief that this would coincide with the inshore extent of NEFSC sampling with the *Bigelow*. In light of this new information, however, the NEAMAP Operations Committee decided to realign NEAMAP's offshore boundary between Montauk and Cape Hatteras with the new inshore boundary of the NEFSC survey (18.3 m); NEAMAP was directed to discontinue sampling between the 18.3 m and 27.4 m contours in the MAB.
- The northeastern reach of the survey area expanded. The NEFSC contributed significant funds toward NEAMAP full implementation through the NCRP under the condition that Block Island Sound (BIS) and Rhode Island Sound (RIS – together referred to as 'the Sounds' in this report), regions that were under-sampled at the time, be added to the NEAMAP survey area. Although these waters are deeper (18.3 m to 36.6m) than those sampled in the MAB by NEAMAP, the offshore extent of sampling in the Sounds (with respect to distance from shore) is consistent with that along the rest of the coast. The NEAMAP Survey has sampled BIS and RIS during each of its cruises since the fall of 2007 and intends to continue to do so.

Following the successful execution of the Fall 2007 cruise and dissemination of the results, VIMS acquired funding that was sufficient to support full sampling in 2008 (i.e., two cruises, one in the spring and one in the fall, each covering the entire survey range). A combination of ASMFC ACFCMA funds and carry-over NEFSC NCRP monies were

used for the spring survey, while proceeds derived from the auction of Research Set-Aside (RSA) quota awarded by the Mid-Atlantic Fishery Management Council supported the fall sampling. A 2009 RSA quota allocation was used to generate the resources needed to conduct the Spring and Fall 2009 survey cruises.

Because ACFCMA funds provided by the ASMFC were instrumental in the development of the NEAMAP Near Shore Trawl Survey and initiation of full-scale sampling, this final report summarizes the results of each of the four full-scale cruises conducted to date: namely, the Fall 2007, Spring 2008, Fall 2008, and Spring 2009 surveys. Unfortunately, data generated from the Fall 2006 pilot cruise are not comparable with those collected during the full-scale surveys due to multiple post-pilot changes to the NEAMAP survey design. The summary of the pilot work has therefore been separated from the main body of the report to avoid confusion (Appendix I).

## **Methods**

The following protocols and procedures were developed by the ASMFC NEAMAP Operations Committee, Trawl Technical Committee, and survey personnel at VIMS and approved through an external peer review of the NEAMAP Trawl Survey. This review was conducted in December 2008 in Virginia Beach, Virginia, and all associated documents are currently available (Bonzek *et al.* 2008, ASMFC 2009). While the review found no major deficiencies with the survey, some recommendations were offered to improve data collection both in the field and in the laboratory. Efforts to implement these suggestions are ongoing, and are discussed in the following sections where they occur.

### *Stratification of the Survey Area / Station Selection*

Sampling sites were selected for each cruise of the NEAMAP Near Shore Trawl Survey using a stratified random design. During the planning stages of the NEAMAP Survey, the Operations Committee and personnel at VIMS developed a stratification scheme for the survey area. Because the NEFSC sampled these same waters for decades prior to the arrival of the *Bigelow*, and since the NEAMAP Survey is effectively viewed as an inshore compliment to the NEFSC Bottom Trawl Surveys, consistency with the historical strata boundaries used by the NEFSC for the inshore waters of the MAB and Southern New England (SNE) was the primary consideration. Alternate stratification options for the near shore coastal zone (i.e., NEAMAP sampling area) were also open for consideration, however, given NEFSC plans to reevaluate the stratification of their survey area in the near future.

The examination of NEFSC inshore strata revealed that the major divisions among survey regions (latitudinal divisions from New Jersey to the south, longitudinal divisions off of Long Island and in BIS and RIS) generally correspond well with major estuarine outflows (Figure 1). These boundary definitions were therefore adopted for use by the NEAMAP Survey; minor modifications were made to align regional boundaries more closely with state borders. Evaluation of the NEFSC depth strata definitions, however, indicated that in some areas (primarily in the more southern regions) near shore stratum



boundaries did not correspond well to actual depth contours. NEAMAP depth strata were therefore redrawn using depth sounding data from the National Ocean Service and strata ranges of 6.1 m - 12.2 m and 12.2 m - 18.3 m from Montauk to Cape Hatteras, and 18.3 m - 27.4 m and 27.4 m - 36.6 m in BIS and RIS. Following the delineation of strata, each region / depth stratum combination was subdivided into a grid pattern, with each cell of the grid measuring 1.5 x 1.5 minutes (2.25 nm<sup>2</sup>) and representing a potential sampling site. The number of cells (sites) to be sampled in each stratum during each survey cruise was then determined by proportional allocation, based on the surface area of each stratum (Table 1). A minimum of 2 sites was assigned to smallest of the strata (i.e., those receiving less than 2 based on proportional allocation).

Table 1. Number of available sampling sites (Num. cells) in each region / depth stratum along with the number selected for sampling per stratum per cruise (Stations sampled). Totals for each region, along with surface area (nm<sup>2</sup>) and sampling intensity (nm<sup>2</sup> per Station) are also given.

Region	State*	Stations Sampled								Totals			nm <sup>2</sup> per Station
		6.1m-12.2m		12.2m – 18.3m		18.3m – 27.4m		27.4m –36.6m		Stations sampled	Num. cells	nm <sup>2</sup> **	
		Stations sampled	Num. cells	Stations sampled	Num. cells	Stations sampled	Num. cells	Stations sampled	Num. cells				
RIS	RI					6	85	10	161	16	246	553.2	34.6
BIS	RI					3	42	7	88	10	130	291.9	29.2
1	NY	0	0	2	19					2	19	42.3	21.2
2	NY	2	8	3	19					5	27	57.9	11.6
3	NY	2	16	3	28					5	44	95.4	19.1
4	NY	2	16	3	29					5	45	100.7	20.1
5	NY	2	27	3	45					5	72	160.6	32.1
6	NJ	2	20	3	42					5	62	132.1	26.4
7	NJ	4	49	6	97					10	146	318.9	31.9
8	NJ	2	32	7	90					9	122	269.2	29.9
9	DE	4	53	8	113	5	68			17	166	523.9	30.8
10	MD	2	33	8	114					10	147	324.3	32.4
11	VA	5	62	8	122					13	184	408.2	31.4
12	VA	5	60	4	67					9	127	280.2	31.1
13	VA	6	94	10	142					16	236	523.7	32.7
14	NC	2	24	5	61					7	85	180.8	25.8
15	NC	2	25	4	55					6	80	165.7	27.6
Total		42	519	77	1043	14	195	17	249	150	1938	4429.0	29.5
	<div>* Note that region boundaries are not perfectly aligned with all state boundaries:<ul style="list-style-type: none"><li>• Some stations in RI Sound may occur in MA</li><li>• Some stations in BI Sound may occur in NY</li><li>• Region 5 spans the NY-NJ Harbor area</li><li>• Some stations in Region 9 may occur in NJ</li></ul></div> <div>** Calculation does not account for decreases in distance per minute of longitude as latitude increases.</div>												

During the peer review of the NEAMAP Trawl Survey, review panelists raised concerns as to whether the survey area might be over-stratified. In particular, there are a number of strata along the coasts of New York and North Carolina that are relatively small and

therefore were only assigned two sampling sites per cruise (Table 1). In an effort to test whether this over-stratification is having a deleterious effect on the variance estimates of the resulting survey data, the principal detriment of over-stratification, an additional sampling site was added to each of these small strata for the Spring 2009 survey. An extra site will be sampled in each during the Fall 2009 cruise as well. Following analyses of the survey data with and without the information collected from these additional sampling stations, decisions will be made as to whether a re-stratification of the NEAMAP survey area is warranted.

Prior to a cruise, 150 sites were selected for sampling following the random stratified design outlined above. The NEAMAP Operations Committee chose the 150 station per cruise target because this number yields a sampling intensity of approximately 1 site per 30 nm<sup>2</sup>, a moderately high intensity when compared with other fishery-independent trawl surveys. A SAS program was used to randomly select the cells to be sampled from each region / depth stratum during the cruise (SAS, 2002). Again, the number of cells selected in a particular stratum was proportional to the surface area of that stratum. Once these 150 'primary' sampling sites (i.e., those to be sampled during the upcoming cruise) were generated, the program was run a second time to produce 150 'alternate' sites. In instances where sampling a primary site was not possible due to fixed gear, bad bottom, vessel traffic, etc., an alternate site was selected in its stead. If an alternate was sampled in the place of an untowable primary, the alternate was required to occupy the same region / depth stratum as the aberrant primary. Usually, the alternate chosen was the closest towable alternate to that primary. The locations of the primary and alternate sites selected for the Fall 2007 survey are provided as an example of a typical station layout for a survey cruise (Figures 2a.-f.). Station locations for the other three full-scale survey cruises were similar, but varied somewhat due to the random selection of sampling sites.

As noted above, sampling 150 sites per cruise results in a sampling intensity of approximately 1 station per 30 nm<sup>2</sup>, the target intensity for this survey. Besides supporting efforts to address potential over-stratification of the NEAMAP sampling area, the addition of 10 stations to both the Spring and Fall 2009 cruises will enable an evaluation of the sampling intensity chosen for this survey. Specifically, simulations will be run following the completion of 2009 field operations to evaluate the effect of changes in sampling effort on estimates of precision (i.e., whether variance estimates would improve with increased sampling or suffer as a result of a reduction in effort).

#### *Survey Gear – Description and Performance Monitoring*

The NEAMAP Near Shore Trawl Survey used a 400 x 12 cm, three-bridle four-seam bottom trawl, paired with a set of Thyboron, Type IV 66" trawl doors, for all sampling operations. Detailed specifications are provided in the NEAMAP peer review documents (Bonzek *et al.* 2008). This gear package was originally designed in 2004 by the joint Mid-Atlantic / New England Fishery Management Council Trawl Survey Advisory Panel for use by the NEFSC Bottom Trawl Survey when sampling from the *Bigelow*. The Operations Committee chose this new NEFSC net / door combination for NEAMAP in an attempt to facilitate comparability of the data resulting from these two surveys. Theoretically, the only remaining source of survey-related variability between the two

would have been the relative fishing power of the vessels. In reality, the NEFSC and NEAMAP gear designs have diverged in several aspects, including: NEFSC uses a rock-hopper sweep while NEAMAP uses a cookie sweep, NEFSC has added an extra top and bottom belly to the body of their net and changed the associated tapers, headline floats vary between the two surveys, and the trawl doors used by each of these groups differ. As a result, it is likely that calibration tows between the NEFSC and NEAMAP Surveys would be needed if any future comparisons or integration of the data collected by each are to occur.

The gear package used by NEAMAP was designed to maintain door spreads ranging from 32.0 m to 34.0 m, net wing spreads between 13.0 m and 14.0 m, and headline heights in the range of 5.0 m to 5.5 m when towed between 2.9 kts and 3.3 kts. Door spread, wing spread, and headline height were monitored on each tow of each survey cruise using a digital Netmind® Trawl Monitoring System. Door spread sensors were mounted in the trawl doors according to specifications provided by Netmind, while wing spread sensors were positioned on the middle ‘jib’ of the net (consistent with NEFSC protocols). The headline sensor was attached at the midpoint of the headline. A catch sensor was mounted in the cod-end of the net and set to signal when approximately 2,200 kg of catch had been collected.

Each of these gear geometry parameters was displayed on a computer in the wheelhouse of the research vessel during survey tows; parameters were updated every 10 – 20 seconds, depending on the sensor. Having a near real-time picture of the configuration of the survey gear allowed the captain and chief scientist to monitor the performance of the trawl and make adjustments as needed to ensure that the net and doors were consistently maintaining the proper configuration. Consistency in fishing operations is an essential element in surveys designed to monitor living marine resources (Koeller 1991).

Beginning with the Spring 2009 survey cruise, gear performance was used to assess tow validity. Specifically, tows in which the average headrope height or wing spread fell outside of the 4.7 m – 5.8 m or the 12.3 m – 14.7 m ranges, respectively, were considered invalid and resulted in a re-tow. Door spread was excluded from the criteria since door spread and wing spread are normally correlated (Gómez and Jiménez 1994). This protocol change was based on the recommendations of the NEAMAP peer review panel, and was implemented to promote consistency in sample collection. The NEAMAP Trawl Survey intends to continue to use this protocol on all future cruises.

### *Priority Species*

During the design phase of the NEAMAP Survey, the Operations Committee developed a set of species priority lists to identify and rank those of management interest and, in turn, guide the collection of biological data (Table 2). Priority ‘A’ species were to be taken for full processing (described in detail in the *Sampling Protocols* section below) whenever they were collected. Several species were added to the Priority ‘A’ list following the 2006 pilot work, a result of the expansion of the survey area (added species of management interest in SNE) and requests by the Mid-Atlantic Fishery Management Council. Priority ‘B’ species were to be sampled for full processing if time permitted

following the processing of 'A' list species. Priority 'C' species were only to be taken for full processing if the sampling of 'A' and 'B' would not be affected. In practice, because survey personnel work quickly and efficiently, time constraints were not an issue and it was not necessary to eliminate any of the Priority 'B' or 'C' species from full processing. As a result, all species on these three lists were effectively treated as though they were 'A' species. At a minimum, aggregate weights and individual length measurements were recorded for all other fishes (here called Priority 'D'). A fifth category ('E') includes those which require special handling, such as sharks (other than dogfish), stingrays, and sturgeon; these were individually measured and weighed. Sex was also recorded for the sharks and stingrays, and the sturgeon and sharks were tagged prior to release. Select invertebrates of management interest are included in the Priority 'E' list as well; individual length, weight, and sex were recorded, at a minimum, from these.

Table 2. Species priority lists (categories A-C only).

A LIST	
Atlantic Cod	<i>Gadus morhua</i>
Black Sea Bass	<i>Centropristis striata</i>
Bluefish	<i>Pomatomus saltatrix</i>
Butterfish	<i>Peprilus triacanthus</i>
Haddock	<i>Melanogrammus aeglefinus</i>
Pollock	<i>Pollachius virens</i>
Scup	<i>Stenotomus chrysops</i>
Silver Hake	<i>Merluccius bilinearis</i>
Striped Bass	<i>Morone saxatilis</i>
Summer Flounder	<i>Paralichthys dentatus</i>
Weakfish	<i>Cynoscion regalis</i>
Winter Flounder	<i>Pseudopleuronectes americanus</i>
B LIST	
American Shad	<i>Alosa sapidissima</i>
Atlantic Menhaden	<i>Brevoortia tyrannus</i>
Atlantic Croaker	<i>Micropogonias undulatus</i>
Monkfish	<i>Lophius americanus</i>
All Skate Species	
Smooth Dogfish	<i>Mustelus canis</i>
Spanish Mackerel	<i>Scomberomorus maculatus</i>
Spiny Dogfish	<i>Squalus acanthias</i>
Spot	<i>Leiostomus xanthurus</i>
Yellowtail Flounder	<i>Limanda ferruginea</i>

C LIST	
Alewife	<i>Alosa pseudoharengus</i>
Atlantic Herring	<i>Clupea harengus</i>
Atlantic Mackerel	<i>Scomber scombrus</i>
Black Drum	<i>Pogonias cromis</i>
Blueback Herring	<i>Alosa aestivalis</i>
Red Drum	<i>Sciaenops ocellatus</i>
Speckled Trout	<i>Cynoscion nebulosus</i>
Tautog	<i>Tautoga onitis</i>

### *Sampling Protocols*

All fishing operations for the NEAMAP Near Shore Trawl Survey were conducted during daylight hours. Standard tows were 20 minutes in duration with a target tow speed of 3.1 kts. Among the four completed full-scale NEAMAP surveys, only 11 of the 610 tows needed to be truncated: five between 15 and 17 minutes because of known hangs in the tow path, and six between 15 and 16 minutes due to the triggering of the catch sensor.

The vessel used by the NEAMAP Survey was determined by annual contract. To date, the *F/V Darana R* has served as the sampling platform for all field operations (both pilot and full-scale cruises). This vessel is a 27.4 m (waterline length) commercial stern-dragger, owned and operated by Captain James A. Ruhle, Sr. of Wanchese, North Carolina. The *Darana R* will be used for the Fall 2009 survey cruise.

Upon arrival at a sampling site, the Captain and Chief Scientist jointly determined the desired starting point and path for the tow. Flexibility was allowed with regard to these parameters so that a complete tow (i.e., 20 minutes at 3.1 kts) could be executed while remaining within the boundaries of the defined cell.

For each tow, one scientist was present in the wheelhouse during deployment and retrieval of the trawl. All gear handling, as well as repair and maintenance, was the responsibility of the vessel crew. The Captain and Chief Scientist were charged with determining the amount of wire to be set by the winches; for a given tow, the lengths deployed from each winch were equal and a function of water depth (Table 3). For the set-out, the Captain would signal when the winch brakes were locked, and this marked the beginning time of the tow. The scientist would immediately activate the Netmind Trawl Monitoring System and a tow track program that collected near-continuous data on vessel position and speed; log files created by each of these programs were saved to appropriately-named station folders. A digital clock was used to measure tow time. Several additional variables were recorded on paper data sheets. These included:

- Station identification parameters (date, station number, region, depth stratum, water depth).

- Tow parameters (beginning and ending GPS position for the tow, beginning and ending tow times, compass course, speed over ground, engine RPMs, amount of trawl warp deployed).
- Gear identification parameters (net type code and net number, door type code and door numbers).
- Atmospheric and weather data (air temperature, wind speed and direction, barometric pressure, general weather condition, sea state).

Table 3. Relationship between warp length and water depth used by the NEAMAP Near Shore Trawl Survey.

Water Depth (m)	Warp Length (fm)
<6.1	65
6.1 - 12.2	70
12.2 - 36.6	75
>36.6	100

At the conclusion of each tow, the scientist signaled the Captain when the clock reached 20 minutes, haul-back commenced, and the Netmind and tow track softwares were stopped. The vessel crew dumped the catch into one of two sorting areas (depending upon the size of the catch) for processing. Hydrographic data were collected at this time and included water temperature, salinity, pH, dissolved oxygen concentration, and dissolved oxygen percent saturation. Measurements were taken approximately 1 m below the surface and 0.5 m to 1 m above the bottom.

Each catch was sorted by species and modal size group (i.e., small, medium, and large size) within species. Aggregate biomass (0.01 kg) and individual length measurements (mm) were recorded for each species-size group combination of the Priority ‘D’ fishes. Priority ‘E’ species were processed as described in the *Priority Species* section above. For Priority ‘A’, ‘B’, and ‘C’ fishes, a subsample of five individuals from each size group was selected for full processing (described in next paragraph). For some very common Priority ‘B’ species, including spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), skates, and dogfishes, only three individuals per size group were sampled for full processing.

Data collected from each of the specimens taken for full processing included individual length (mm fork length where appropriate, mm total length for species lacking a forked caudal fin, mm pre-caudal length dogfishes, mm disk width for skates), individual whole and eviscerated weights (0.001 kg), and macroscopic sex and maturity stage (immature, mature-resting, mature-ripe, mature-spent) determination. Stomachs were removed (except for spot and butterfish [*Peprilus triacanthus*]; previous sampling indicated that little useful data could be obtained from the stomach contents of these species) and those containing prey items were preserved for post-cruise examination at the VIMS laboratories. Otoliths or other appropriate ageing structures were removed from each subsampled specimen for later age determination. All specimens of the Priority ‘A’, ‘B’, and ‘C’ species not selected for the full processing were weighed (aggregate weight –



0.01 kg), and individual length measurements were recorded as described for Priority 'D' species above.

Following the recommendation of the peer review panel, the NEAMAP Survey began recording individual length, weight, and sex from an additional 15 specimens per size-class per species per tow from the following fishes: black sea bass (*Centropristis striata*), summer flounder (*Paralichthys dentatus*), striped bass (*Morone saxatilis*), winter flounder (*Pseudopleuronectes americanus*), skates, and dogfishes. These species were chosen because either they are known to exhibit sex-specific growth patterns or sex determination through the examination of external characters is possible. This additional sampling began with the Spring 2009 survey cruise, and analyses are underway to determine the effect of these efforts on the precision estimates for the sex-related parameters of these species. The results of these investigations will be included in future reports.

In the event of a large catch, appropriate subsampling methods were implemented (Bonzek *et al.* 2008). The NEAMAP peer review panel did raise some concern with the way in which subsamples were selected, both from large catches and for full processing. Specifically, it was felt that subsample selection could be made to more closely approximate random sampling with some minor protocol adjustments. Several options were explored during the Spring 2009 survey cruise, including improved mixing, the formation of multiple subsamples from which to choose, the use of a table of random numbers, etc., and an evaluation of these methods is ongoing. Any changes made to the NEAMAP subsampling protocols will be outlined in future documents.

#### *Laboratory Methods*

Stomach samples were (and are being) analyzed according to standard procedures (Hyslop 1980). Specifically, each stomach was individually weighed (0.001 g), the contents were emptied, and all prey items were identified to the lowest possible taxonomic level. Each item was then enumerated, weighed (0.001 g), and individual length measurements (0.1mm) were taken when possible. Experienced laboratory personnel were able to process, on average, approximately 30 to 40 stomachs per day.

Ageing structures, including otoliths, vertebrae, spines, and opercles, were (and are in the process of being) prepared according to methodology established by the NEFSC, Old Dominion University, and VIMS. Preparations occurred in batches; all hard parts collected from a given species in a given year were processed together. The sectioned otolith method was the most common technique used to prepare ageing structures. Typically, the right otolith was selected and mounted on a piece of 100 weight paper with a layer of Crystal Bond®. A thin transverse section was then cut through the nucleus of the otolith using two Buehler® diamond wafering blades and a low speed Isomet® saw. The resulting section was mounted on a glass slide and covered with Crystal Bond. If necessary, the sample was wet-sanded to an appropriate thickness before being covered. Some species have smaller, more fragile otoliths (e.g., black sea bass), and these were often mounted whole. Once prepared, otoliths (both sectioned and whole) were viewed

using transmitted light under a dissecting microscope. Transmitted light would also be used to read whole opercles, while whole spines would be aged using reflected light.

All hard parts were read independently by each of three readers one time. Again, all samples for a given species collected in a given year were read together (i.e., did not separate spring and fall collections). For each sample, a reader would record an age based on the number of annuli present. Final ages were assigned to each specimen as the mode of the three independent readings, one by each of three readers, and were adjusted as necessary to account for the timing of the collection of the sample. Annuli are formed on hard parts in the spring for most fishes, so those collected in April / May would be advanced one year if it appeared that the annulus for that year had yet to form, and held if the ‘mark’ had formed recently. Ages of the specimens collected in the fall always corresponded to the number of annuli present on their structures.

### *Analytical Methods*

Abundance Indices: Catch data from fishery-independent trawl surveys tend not to be normally distributed. Preliminary analyses of NEAMAP data showed that, at least for some species, these data followed a log-normal distribution. As a result, VIMS proposed and the NEAMAP peer review panel approved the stratified geometric mean of catch per standard area swept as an appropriate form for the abundance indices generated by this survey (Bonzek *et al.* 2008, ASMFC 2009). These indices are presented in this report for each species by survey cruise.

For a given species, its abundance index for a particular survey cruise is given by:

$$\hat{N} = \exp \left( \sum_{s=1}^{n_s} \hat{A}_s \hat{N}_s \right) \quad (1),$$

where  $n_s$  is the total number of strata in which the species was captured,  $\hat{A}_s$  is an estimate of the proportion of the total survey area in stratum  $s$ , and  $\hat{N}_s$  is an estimate of the  $\log_e$  transformed mean catch (number or biomass) of the species per standard area swept in stratum  $s$  during that cruise. The latter term is calculated using:

$$\hat{N}_s = \frac{\sum_{t=1}^{n_{t,s}} \log_e \left( \frac{c_{t,s}}{\hat{a}_{t,s}/25000} \right)}{n_{t,s}} \quad (2),$$

where  $\hat{a}_{t,s}$  is an estimate of the area swept by the trawl (generated from wing spread and tow track data) during tow  $t$  in stratum  $s$ , 25,000 m<sup>2</sup> is the approximate area swept on a typical tow (making the quantity  $[\hat{a}_{t,s}/25000]$  approximately 1),  $n_{t,s}$  is the number of tows  $t$  in stratum  $s$  that produced the species of interest, and  $c_{t,s}$  is the catch of the species from tow  $t$  in stratum  $s$ .

Further analyses to determine the distribution of catch data on a species-by-species basis will be completed as more data are accumulated. While abundance indices in this report are presented overall by survey cruise, it is possible to generate these indices for particular sub-areas, by sex, etc. We are also currently evaluating several methods for the computation of age-specific indices, and the results of these investigations will be included in future reports.

Length-Frequency: Length-frequency histograms were constructed for each species by survey cruise using 1 cm length bins. These were identified using bin midpoints (e.g., a 25 cm bin represented individuals ranging from 24.5 cm to 25.4 cm in length). Although these histograms are presented by survey cruise, the generation of length-frequency distributions by year, sex, sub-area, overall, and a number of other variables, is possible.

For this and several other stock parameters, data from specimens taken as a subsample (either for full processing or in the event of a large catch) were expanded to the entire sample (i.e., catch-level) for parameter estimation. Because of the potential for differential rates of subsampling among size groups of a given species, failure to account for such factors would bias resulting parameter estimates. In the NEAMAP database, each specimen was assigned a calculated expansion factor, which indicated the number of fish that the individual represented in the total sample for the station in which the animal was collected.

Sex Ratios: Sex ratios were generated by length group for each of the Priority 'A', 'B', and 'C' species presented in this report, as well as for the Priority 'E' invertebrates. Either 2.5 cm or 5 cm length bins were used, depending on the size range of the species. These ratios were calculated by expanding the data from specimens taken for full processing (or individual measurement in the case of the invertebrates) to the catch-level and summing the result by sex for each length group, across all sites sampled.

These sex ratios were constructed using data collected during each of the four full-scale surveys, under the assumption that the same population(s) was(were) being sampled across cruises for a given species. While sex ratios in this report are presented by length, it would be possible to produce these ratios overall, by sub-area, by year, by cruise, etc.

Age-Structure: Age-frequency histograms were generated by cruise for each of the Priority 'A', 'B', and 'C' species for which age data are currently available (i.e., processing, reading, and age assignment has been completed). These distributions were constructed by scaling the age data from specimens taken for full processing to the catch-level, using the expansion factors described above. Again, while the age data are presented by survey cruise, the generation of these age-structures by year, sex, sub-area, overall, and a number of other variables (or a combination of these variables), is possible.

Diet Composition: It is well known that fishes distribute in temporally and spatially varying aggregations. The biological and ecological characteristics of a particular fish species collected by fishery-independent or -dependent activities inevitably reflect this underlying spatio-temporal structure. Intuitively, it follows then that the diets (and other

biological parameters) of individuals captured by a single gear deployment (e.g., NEAMAP tow) will be more similar to one another than to the diets of individuals captured at a different time or location (Bogstad *et al.* 1995).

Under this assumption, the diet index percent by weight for a given species can be represented as a cluster sampling estimator since, as implied above, trawl collections essentially yield a cluster (or clusters if multiple size groups are sampled) of the species at each sampling site. The equation is given by (Bogstad *et al.* 1995, Buckel *et al.* 1999):

$$\%W_k = \frac{\sum_{i=1}^n M_i q_{ik}}{\sum_{i=1}^n M_i} * 100 \quad (3),$$

where

$$q_{ik} = \frac{w_{ik}}{w_i}, \quad (4),$$

and where  $n$  is the total number of clusters collected of the fish species of interest,  $M_i$  is the number of that species collected in cluster  $i$ ,  $w_i$  is the total weight of all prey items encountered in the stomachs of the fish collected and processed from cluster  $i$ , and  $w_{ik}$  is the total weight of prey type  $k$  in these stomachs.

This estimator was used to calculate the diet compositions of the NEAMAP Priority ‘A’, ‘B’, and ‘C’ species (for those where diet data are currently available); the resulting diet descriptions are included in this report. Again, while these diets reflect a combination of data collected from the four full-scale survey cruises, presentations of diet by sub-area, year, cruise, size, age, etc., are possible. Furthermore, the percent weight index was included in this document since it is normally the index of greatest interest in ecosystem modeling efforts, but the estimation of diet using percent number, percent frequency of occurrence, and percent index of relative importance is also possible using NEAMAP data.

## Results

### *General Cruise Information / Station Sampling*

The NEAMAP Near Shore Trawl Survey conducted four full-scale cruises between the fall of 2007 and spring of 2009: namely, the Fall 2007, Spring 2008, Fall 2008, and Spring 2009 surveys. In general, the fall cruises began around the fourth Monday in September and concluded near the third weekend in October (Fall 2007 - 25 September to 20 October 2007; Fall 2008 - 22 September to 17 October 2008). The spring surveys spanned from approximately the third Monday in April to the third weekend in May (Spring 2008 - 23 April to 15 May 2008; Spring 2009 - 21 April to 17 May 2009). The target number of sites was sampled for each of these full-scale cruises, 150 for the first three and 160 for the Spring 2009 survey.

The number of primary and alternate sites sampled during each survey is given both by region and overall (Table 4). At the cruise level, the rate at which alternate sites were substituted for primaries remained fairly consistent at around 13%. Among regions within a cruise, however, the frequency of alternate sampling was more variable. In particular, the sampling of alternate sites in the place of primaries occurred most often in BIS and RIS across all surveys. These Sounds are notorious for their bad bottom and large fixed-gear (i.e., lobster pots) areas and, as a result, finding a 'towable lane' within a primary cell was often not possible. Lack of familiarity with these waters was also an issue; the captain of the survey vessel had not fished in these Sounds prior to his involvement with NEAMAP. While the NEAMAP protocol calls for sampling of the closest suitable alternate in the event of an untowable primary, this was often not possible in the Sounds for the same reasons outlined above. It is anticipated that the rates of substitution of alternates for primaries in BIS and RIS will begin to decline in future cruises, as the survey continues to accumulate information on known towable and untowable locations in these waters through both survey experience and cooperation with local industry representatives.

Outside of the Sounds, the rate of alternate sampling tended to be relatively high in Region 1, the eastern end of Long Island, due to rocky bottom and wrecks. The sampling of alternates off of Virginia and North Carolina (Regions 11-15) varied among cruises. Issues related to water depth (specifically, the lack of), were the most common cause of alternate substitution in these southern regions. Few alternates were sampled in all other areas.

Table 4. Number of sites sampled in each region during each of the four full-scale NEAMAP cruises. The numbers of primary and alternate sites sampled in each region are given in parenthesis below the totals

<b>Region</b>	<b>Fall 2007 Total (Prim. / Alt.)</b>	<b>Spring 2008 Total (Prim. / Alt.)</b>	<b>Fall 2008 Total* (Prim. / Alt.)</b>	<b>Spring 2009 Total** (Prim. / Alt.)</b>
<b>RI Sound</b>	<b>17</b> (10 / 7)	<b>17</b> (7 / 10)	<b>16</b> (11 / 5)	<b>16</b> (10 / 6)
<b>BI Sound</b>	<b>9</b> (7 / 2)	<b>10</b> (6 / 4)	<b>10</b> (6 / 4)	<b>10</b> (7 / 3)
<b>1</b>	<b>2</b> (1 / 1)	<b>2</b> (1 / 1)	<b>2</b> (0 / 2)	<b>3</b> (0 / 3)
<b>2</b>	<b>5</b> (4 / 1)	<b>5</b> (4 / 1)	<b>5</b> (5 / 0)	<b>6</b> (6 / 0)
<b>3</b>	<b>5</b> (5 / 0)	<b>5</b> (5 / 0)	<b>5</b> (5 / 0)	<b>6</b> (6 / 0)
<b>4</b>	<b>5</b> (5 / 0)	<b>5</b> (5 / 0)	<b>5</b> (4 / 1)	<b>6</b> (5 / 1)
<b>5</b>	<b>5</b> (5 / 0)	<b>5</b> (4 / 1)	<b>5</b> (4 / 1)	<b>6</b> (3 / 3)
<b>6</b>	<b>5</b> (4 / 1)	<b>5</b> (4 / 1)	<b>5</b> (5 / 0)	<b>6</b> (6 / 0)
<b>7</b>	<b>10</b> (10 / 0)	<b>10</b> (10 / 0)	<b>10</b> (9 / 1)	<b>10</b> (10 / 0)
<b>8</b>	<b>9</b> (8 / 1)	<b>9</b> (9 / 0)	<b>9</b> (9 / 0)	<b>10</b> (10 / 0)
<b>9</b>	<b>12</b> (11 / 1)	<b>12</b> (12 / 0)	<b>17</b> (16 / 1)	<b>17</b> (17 / 0)
<b>10</b>	<b>10</b> (10 / 0)	<b>10</b> (10 / 0)	<b>10</b> (10 / 0)	<b>11</b> (11 / 0)
<b>11</b>	<b>14</b> (13 / 1)	<b>14</b> (13 / 1)	<b>13</b> (13 / 0)	<b>13</b> (13 / 0)
<b>12</b>	<b>11</b> (9 / 2)	<b>10</b> (9 / 1)	<b>9</b> (7 / 2)	<b>9</b> (9 / 0)
<b>13</b>	<b>18</b> (15 / 3)	<b>18</b> (18 / 0)	<b>16</b> (13 / 3)	<b>16</b> (16 / 0)
<b>14</b>	<b>7</b> (7 / 0)	<b>7</b> (7 / 0)	<b>7</b> (5 / 2)	<b>8</b> (8 / 0)
<b>15</b>	<b>6</b> (5 / 1)	<b>6</b> (6 / 0)	<b>6</b> (4 / 2)	<b>7</b> (7 / 0)
<b>Total</b>	<b>150</b> (129 / 21)	<b>150</b> (130 / 20)	<b>150</b> (126 / 24)	<b>160</b> (144 / 16)

\*stations reallocated relative to past surveys as sampling of deep water in Region 9 (Delaware Bay mouth) began

\*\* one additional sampling site was added to region/depth strata that had only received two on previous cruises



### *Gear Performance*

The NEAMAP Trawl Survey currently owns three nets (identical in design and construction) and a single set of trawl doors. One net was used for the entire Fall 2007 survey, since no significant gear damage occurred during this cruise. The same net was employed for the Fall 2008 survey, again with no major incidents. A second net was used for sampling during the Spring 2008 cruise. The bottom bellies were torn out of this net on the 143<sup>rd</sup> tow, and the first trawl was used to complete the sampling. Following repair, the second net was fished on the Spring 2009 survey. This net was again replaced by the first after being torn in half on the 107<sup>th</sup> tow of the trip. The second net is currently in the process of being rebuilt by the manufacturer, while the bottom bellies of the first trawl will be replaced, due to normal wear-and-tear, prior to the Fall 2009 cruise. Both of these nets will be subjected to the NEAMAP gear certification process before being returned to service (Bonzek *et al.* 2008). To date, the third net has yet to be fished.

As was observed during the pilot cruises, the NEAMAP survey gear performed consistently and, for the most part, within expected ranges during each of the full-scale surveys (Figures 3-6). The cruise averages of door spread (32.6 m), wing spread (13.1 m), and headline height (5.3 m) were within optimal ranges for the Fall 2007 cruise (Figure 3). Average towing speed was 3.2 kts. The net and doors were slightly under-spread for the first 12 tows of this survey. Upon observing this problem, the captain postulated that the lack of spread may have been due to the installation of the sensors and their associated brackets in the trawl doors (all prior NEAMAP gear testing had occurred without door sensors). Specifically, the sensors and brackets could have changed the hydrodynamics of the doors such that they became less efficient. The captain and vessel crew made adjustments to the towing points on the doors, backstrap chains, and scope, and wing and door spreads returned to within the expected ranges. In general, the station averages of door spread, wing spread, and headline height remained within optimal ranges for the remainder of the cruise.

Relative to Fall 2007, the mean door spread, wing spread, and headline height increased for the Spring 2008 survey (Figure 4). The door and wing spreads remained within the optimal ranges, both overall and on average at most stations, while headline height exceeded the optimal range by 0.1 m. Average speed over ground for this cruise was 2.9 kts, less than that for the previous survey. The cruise averages for each of the gear parameters fell within the optimal ranges during Fall 2008; the overwhelming majority of the station averages for each of these parameters were within these ranges as well (Figure 5). Mean towing speed was 3.0 kts. Similar gear performance results and vessel speeds were observed for the Spring 2009 survey (Figure 6). As noted above, this cruise was the first where gear parameters were used to determine tow validity. It was not necessary to disregard any tows due to poor net performance, however.

In summary, based on the 610 tows conducted by NEAMAP since the completion of the pilot cruises, this gear package has been shown to perform consistently within acceptable ranges for this trawl survey.

### *Catch Summary*

Over 2,416,000 individual specimens (fishes and invertebrates) weighing approximately 169,000 kg and representing 173 species, including boreal, temperate, and tropical fishes, were collected during the four full-scale surveys conducted to date (Table 5). As expected, catches were larger and more diverse on the fall surveys relative to the spring cruises. In all, individual length measurements were recorded for 265,783 animals. Lab processing is proceeding on the 16,949 stomach samples and 22,461 ageing structures (otoliths, vertebrae, spines, opercles) collected in the field. As of the date of this report, 14,460 of these stomachs have been examined and quantified. While only 6,008 ageing structures have been fully processed to date, otoliths from an additional 1,539 scup, 556 bluefish, and 255 black sea bass collected in 2008 have been prepared and sectioned. Readers were in the midst of assigning ages to these samples at the time of this report. Most of the remaining 14,103 structures are elasmobranch vertebrae, which require extensive preparation relative to most other ageing hard parts. Efforts to process these samples are well underway, however, and these data will likely be available in the near future.

Table 5. Total number of species collected, along with the number of specimens caught, the weight of these animals in kilograms, and the number sampled for individual length measurements, given by survey cruise and overall. The numbers sampled and processed (to date) for age and diet determination are also provided.

Cruise	Species	Specimens Collected	Total Weight (kg)	Specimens Measured	Sampled / Processed for Age	Sampled / Processed for Diet
Fall '07	126	1,101,152	49,868	73,473	5,150 / 3,245	3,905 / 3,643
Spring '08	85	298,923	32,058	54,700	6,132 / 1,373	4,810 / 3,779
Fall '08	128	731,429	43,020	60,334	4,609 / 1,390	3,383 / 3,159
Spring '09	93	285,304	44,034	77,276	6,570 / 0	4,851 / 3,879
<b>TOTAL</b>	<b>173*</b>	<b>2,416,808</b>	<b>168,980</b>	<b>265,783</b>	<b>22,461 / 6,008</b>	<b>16,949 / 14,460</b>

\* not additive since a given species was often collected on several cruises

### *Species Data Summaries*

The data summaries presented in this report include the information collected on each of the NEAMAP Trawl Survey full-scale cruises conducted to date and focus on species that are of management interest to the ASMFC. Some that are of interest to the New England and Mid-Atlantic Fishery Management Councils, or that are not managed but considered valuable from an ecological standpoint, are also included. It is important to note that these summaries represent only a subset of the biological and ecological analyses that are feasible using the data collected by the NEAMAP Survey. Several additional analyses are possible for each of the species included in this report, as well as for others that have been collected by this survey but are not presented. Some analyses (e.g., length-weight relationships, growth curves, maturity ogives) found in previous progress reports are excluded here in an effort to make the scope of this document somewhat manageable. Certainly, any NEAMAP information (data or analyses) requested by assessment scientists and managers would be made available in a timely manner.

Relative indices of abundance are given for each species included in this report and are presented by survey as stratified geometric mean of catch per standard area swept. The total number and biomass collected, number sampled for individual length measurements, and numbers taken and processed for age determination and diet composition (Priority ‘A’, ‘B’, and ‘C’ species only) are also given for each by cruise. Catch distribution plots and length-frequencies are provided for these species on a per-cruise basis. Sex ratios by size are presented for all Priority ‘A-C’ species as well as for some of the invertebrates, and were generated by combining data across all cruises. Age-frequency distributions (by cruise) and diet compositions (overall) are also included for these priority species where field collections and subsequent laboratory progress have resulted in sufficient sample sizes.

For most species, the following tables and figures are presented:

- A table presenting, for each cruise, the total number of specimens of that species collected, total biomass of these individuals, number sampled for individual length measurements, number taken for full processing (including age and stomach analysis), and the number of age and stomach samples processed to date. Relative abundance indices (number and biomass) presented as stratified geometric mean of catch per standard area swept are also given.
- GIS figures showing the biomass of that species collected at each sampling site for each cruise.
- Figures displaying stratified geometric mean catch per standard area swept (both number and biomass) for each cruise, along with 95% confidence intervals.
- Length-frequency histograms, by cruise, that include the number of specimens for which individual length measurements were recorded and the number sampled for full processing.
- Histogram of sex ratio by size group, annotated with the number of specimens examined in each size category (available only for Priority ‘A-C’ species and select invertebrates). These histograms were generated by combining data across all cruises.
- Age-frequency histograms for each cruise, indicating the number caught at each age along with the year-class associated with each age group (Priority ‘A-C’ only, when available).
- Bar plot of diet composition, generated using data from all survey cruises combined. The number of stomachs examined as well as the number of ‘clusters’ sampled (i.e., effective sample size) is provided. Diet is presented for Priority ‘A-C’ species only, when available.

Species have been arranged alphabetically in this data summary section, and a full listing of species, along with their associated table and figure numbers, is given below (those with an \* are ASMFC managed). Text associated with these tables and figures is provided following this list. Detailed descriptions of these data and analyses are included for the ASMFC managed species, while a listing of the contents of the tables and figures is given for all others.

## Species list

- Alewife\* – Page 63 - Table 6, Figures 7-10.
- American lobster\* – Page 69 - Table 7, Figures 11-14.
- American shad\* – Page 75 - Table 8, Figures 15-18.
- Atlantic croaker\* – Page 81 - Table 9, Figures 19-24.
- Atlantic menhaden\* – Page 89 - Table 10, Figures 25-28.
- Atlantic spadefish – Page 95 - Table 11, Figures 29-31.
- Atlantic thread herring – Page 101 - Table 12, Figures 32-34.
- Bay anchovy – Page 107 - Table 13, Figures 35-37.
- Black sea bass\* – Page 113 - Table 14, Figures 38-43.
- Blueback herring\* – Page 121 - Table 15, Figures 44-47.
- Bluefish\* – Page 127 - Table 16, Figures 48-53.
- Bluntnose stingray – Page 135 - Table 17, Figures 54-56.
- Brown shrimp – Page 141 - Table 18, Figures 57-59.
- Bullnose ray – Page 147 - Table 19, Figures 60-62.
- Butterfish – Page 153 - Table 20, Figures 63-66.
- Clearnose skate – Page 159 - Table 21, Figures 67-71.
- Cownose ray – Page 167 - Table 22, Figures 72-74.
- Horseshoe crab\* – Page 173 - Table 23, Figures 75-78.
- Kingfish – Page 179 - Table 24, Figures 79-81.
- Little skate – Page 185 - Table 25, Figures 82-86.
- *Loligo* squid – Page 193 - Table 26, Figures 87-89.
- Northern searobin – Page 199 - Table 27, Figures 90-92.
- Pinfish – Page 205 - Table 28, Figures 93-95.
- Red hake – Page 211 - Table 29, Figures 96-98.
- Scup\* – Page 217 - Table 30, Figures 99-104.
- Silver hake – Page 225 - Table 31, Figures 105-109.
- Silver perch – Page 233 - Table 32, Figures 110-112.
- Smooth butterfly ray – Page 239 - Table 33, Figures 113-115.
- Smooth dogfish – Page 245 - Table 34, Figures 116-120.
- Spanish mackerel\* – Page 253 - Table 35, Figures 121-123.
- Spiny dogfish\* – Page 259 - Table 36, Figures 124-128.
- Spot\* – Page 267 - Table 37, Figures 129-132.
- Spotted hake – Page 273 - Table 38, Figures 133-135.
- Striped anchovy – Page 279 - Table 39, Figures 136-138.
- Striped bass\* – Page 285 - Table 40, Figures 139-144.
- Striped searobin – Page 293 - Table 41, Figures 145-147.
- Summer flounder\* – Page 299 - Table 42, Figures 148-153.
- Weakfish\* – Page 307 - Table 43, Figures 154-159.
- White shrimp – Page 315 - Table 44, Figures 160-162.
- Windowpane flounder – Page 321 - Table 45, Figures 163-165.
- Winter flounder\* – Page 327 - Table 46, Figures 166-171.
- Winter skate – Page 335 - Table 47, Figures 172-176.

### **Alewife (*Alosa pseudoharengus*)**

As expected, catches of alewife by the NEAMAP Near Shore Trawl Survey were greater during the spring surveys than on the fall cruises (Table 6). Spring catches exceeded those in the fall generally by about two orders of magnitude. This is not surprising given that alewife migrate inshore to spawn in the spring and typically move to offshore waters in the fall, apparently prior to the time that the NEAMAP survey cruises begin in mid-September. During each of the spring surveys, alewife were collected from all areas of the coast with the exception of the most southern region off of North Carolina (Figure 7). Highest abundances were encountered in the northeast portion of the survey area (north and east of central New Jersey in Spring 2008; eastern end of Long Island and Sounds in Spring 2009). Fall catches of alewife occurred exclusively in BIS and RIS during both years.

The relative abundance of alewife, both in terms of number and biomass, declined between the Spring 2008 and Spring 2009 NEAMAP cruises (Figure 8). The data from the fall surveys showed a similar trend, but the low catch rates on these surveys preclude any useful analysis of alewife abundance in the survey area during autumn.

Alewife collected during the Fall 2007 survey ranged from 11 cm to 20 cm fork length (FL), while those sampled in Fall 2008 were between 17 cm and 19 cm FL (Figure 9). Fish caught during the first fall cruise comprised two modal size groups, perhaps corresponding to two age-classes of fish. Much broader size ranges of alewife were sampled on the spring surveys; fish between 8 cm and 30 cm FL were collected during the Spring 2008 cruise, while specimens ranging from 6 cm to 27 cm FL were caught in Spring 2009 (difficult to see lower end of range due to scale of y-axis). Most of the fish sampled from the first spring survey ranged from 12 cm to 15 cm FL, and it appeared that multiple modal size groups were present. Alewife collected on the Spring 2009 cruise were larger on average; 17 cm to 21 cm was the dominant size range for this cruise, and modal size groups were less distinct.

With respect to sex ratio, it appeared that males were more abundant at smaller size, while the larger fish were predominantly female (Figure 10). The age-structure of the alewife sampled by NEAMAP was not available for this report as staff are in the process of researching the appropriate methods of otolith preparation and age assignment for this species. While the stomach samples collected from this species have yet to be processed, they will be examined in the near future and the diet composition of alewife collected by the NEAMAP Trawl Survey will be available at that time.

### **American Lobster (*Homarus americanus*)**

Catches of American lobster were relatively consistent among the four full-scale NEAMAP survey cruises conducted to date (Table 7). The number of lobster collected ranged from 262 to 519 specimens per survey; total biomass was between 59 kg and 90 kg. The lowest overall catch, both in terms of number and biomass, occurred on the Fall 2007 cruise. The largest numerical abundance was observed

during Spring 2008. Interestingly, while fewer lobster were collected on the Spring 2009 survey, total biomass was about the same as sampled during the previous spring. This indicates that the lobster collected on the second spring survey were larger on average than those caught on the first.

For each fall cruise, small collections of lobster were observed along coast of New Jersey (Figure 11). The majority of the fall collections occurred in the Sounds in both years. Similar distribution patterns were noted for the spring surveys. RIS and BIS were again the centers of lobster abundance within the NEAMAP survey area, but catches were larger in these Sounds in the spring relative to the fall. Lobster also tended to be distributed further south in the spring; a single collection was observed off of Chesapeake Bay in 2008 and multiple were documented near the mouth of Delaware Bay in 2009.

Numerical abundance indices for American lobster showed an increase between Fall 2007 and Fall 2008, but a decrease from Spring 2008 to Spring 2009 (Figure 12). It should be noted, however, that in each case the magnitude of these relative changes was less than the confidence intervals associated with these indices. Similar trends were seen with respect to biomass, but the rate of decrease between the spring surveys was not as great as was observed in terms of number.

The size ranges of lobster collected during on each of the full-scale cruises were similar (3 cm to 11 cm, carapace length – CL) and indicated that both juvenile and adult specimens were collected (Figure 13). Most of the animals sampled on the fall surveys were 5 cm to 8 cm CL. As noted above, lobster caught during the Spring 2009 cruise were larger on average than those collected during Spring 2008. Most of the specimens collected during the Spring 2008 survey were between 5 cm and 6 cm CL, while the majority sampled in the following spring ranged from 6 cm to 8 cm CL.

The ratio of male to female American lobster collected by the NEAMAP Survey was approximately 1:1 across all sizes sampled; females comprised a slightly greater proportion of the total sample at larger sizes (Figure 14). American lobster were not sampled for age or diet. Survey personnel have recorded the presence of shell disease for lobster since the beginning of the Spring 2008 cruise, and preliminary analyses of disease prevalence data will be available in the near future. It is likely that NEAMAP will expand this aspect of their sampling protocol to include measures of disease severity as well, the result of a collaborative effort between survey personnel at VIMS and a faculty member at the University of Massachusetts, Amherst.

### **American Shad (*Alosa sapidissima*)**

As was observed with alewife, catches of American shad were greater in the spring than in the fall (Table 8). These shad undertake migrations that are similar to those of their congener (i.e., migrate inshore in the spring, return offshore shortly thereafter), which likely explains the difference in catch rates. This species was collected mainly from RIS in the fall of 2007, and were only sampled at a single site (again in RIS)

during autumn 2008 (Figure 15). Catches in the spring ranged from the Sounds to the more northern waters (i.e., Region 14) off of the coast of North Carolina. Collections in 2008 were greatest along the coasts of New Jersey and Long Island and in RIS, while the center of shad biomass in 2009 seemed to be located off of the Delmarva Peninsula.

Trends in abundance showed declines for the spring and fall surveys, both in terms of number and biomass (Figure 16). Again, small sample sizes in the fall result in index values that are of limited utility for American shad during this season. Length-frequency distributions of shad collected by the NEAMAP Survey were similar within seasons (Figure 17). Spring-caught fish ranged from 8 cm and 25 cm FL, while the majority of the specimens were between 12 cm and 16 cm FL. Most of the shad sampled by NEAMAP during these four survey cruises were juveniles.

For the majority of the length categories with appreciable sample sizes, the ratio of male to female American shad in survey collections was about 1:1 (Figure 18). The age-structure of the shad sampled by NEAMAP was not available for this report as staff are in the process of researching the appropriate methods of otolith preparation and age assignment for this species. Assistance is being provided by the VIMS *Alosa* Monitoring Group, the staff of which have extensive experience with the preparation and ageing of American shad otoliths. While the stomach samples collected from this species have yet to be processed, they will be examined in the near future and the diet composition of the shad collected by the NEAMAP Trawl Survey will be available at that time.

### **Atlantic Croaker (*Micropogonias undulatus*)**

Atlantic croaker were consistently one of the most abundant species sampled by the NEAMAP Trawl Survey (Table 9). Catches were greater on the fall cruises relative to the spring surveys; average collections in the fall included approximately 62,000 fish with a total weight of about 6,300 kg. Croaker migrate into the NEAMAP survey area in the spring as near shore water temperatures begin to rise, spend their summer in the coastal ocean waters and estuaries, spawn in the coastal zones in late summer and fall, and then move to overwintering grounds south of Cape Hatteras in the late fall. This migratory pattern likely accounts for the difference in the catch rates of this species between seasons. Specifically, the spring surveys likely occurred just as these fish were beginning to move into the sampling area, while the fall cruises took place before the croaker out-migration became well established.

The aforementioned migratory pattern is reflected in the distribution of Atlantic croaker catches observed during the four NEAMAP full-scale surveys (Figure 19). For the spring cruises, croaker collections were relatively light and were patchy outside of the most southern portion of the survey area (i.e., North Carolina waters). All samples from the Spring 2009 cruise were collected south of the Virginia / North Carolina border. Large, consistent catches were encountered from Southern New Jersey to Cape Hatteras during both of the fall cruises.

Atlantic croaker abundance indices showed a decline between the Fall 2007 and Fall 2008 surveys, both in terms of number and biomass (Figure 20). A slight increase in abundance was observed between the spring cruises, however. Based on the length-frequency distributions, both juvenile and adult croaker were collected on each of the full-scale surveys (Figure 21). While the smallest croaker sampled were 14 cm total length (TL) on the Fall 2007 cruise and 12 cm TL for the Fall 2008 survey, the largest were 43 cm TL for both of these cruises (scale of the y-axis makes the full range difficult to see). Most of the fish collected during the first fall survey ranged between 17 cm and 24 cm TL, and those on the second mainly fell into the 15 cm to 19 cm range. It is worth noting that large croaker were much less abundant on the Fall 2008 survey relative to the first fall cruise. Whether the lack of big fish on the latter survey is a sampling effect (i.e., large fish were elsewhere during that cruise) or due to a decline in the abundance of larger croaker is unknown. Specimens collected during the Spring 2008 survey were between 7 cm and 26 cm TL and comprised three distinct modal size groups, while the size range of those sampled in Spring 2009 was slightly narrower (8 cm to 24 cm TL). Modal groups were also much less distinct for the latter.

For the most part, the sex ratio of Atlantic croaker varied around 1:1 (male to female) across size groups (Figure 22). The largest fish were predominantly female, but sample size issues preclude the drawing of any meaningful inferences at this point. Otoliths collected from this species were processed and aged using the sectioned otolith technique. Specimens sampled during the Fall 2007 survey ranged from age-0 to age-8, but the majority of the individuals collected were less than age-2 (Figure 23). Fish caught in the autumn of 2008 ranged from age-0 to age-11; the five oldest fish sampled during this survey belonged to the 1997 year-class. Again, most of the croaker were less than age-2. The abundance of young-of-the-year (YOY) fish overwhelmed all other age-classes during this cruise, and it will be interesting to see whether these fish translate into a strong age-1 group for the Fall 2009 survey. Croaker collected during the Spring 2008 survey ranged from age-0 to age-5. Spring 2009 age data are not yet available for this species as all age samples collected from a species during a given year are processed as a group. These samples will therefore be prepared and read following the Fall 2009 cruise.

The diet of Atlantic croaker sampled by the NEAMAP Survey during the full-scale cruises was comprised mostly of crustaceans (31% - Figure 24). Within this category, amphipods were the dominant prey type. Unidentified material was prevalent in the stomachs of croaker, which is a common finding for most predators that feed on the benthos. Fishes accounted for 15.6% of the Atlantic croaker diet; bay anchovy (*Anchoa mitchilli*) were the main prey in this category.

### **Atlantic Menhaden (*Brevoortia tyrannus*)**

Catches of Atlantic menhaden by NEAMAP varied widely and showed no apparent seasonal trends (Table 10). As few as 32 (Spring 2008) and as many as 24,566 (Spring 2009) fish were collected in a single cruise, and total biomass sampled ranged



from 2 kg to 786 kg. The surface-oriented nature of this species and patchy distribution of menhaden schools likely accounts for these results. Catches of Atlantic menhaden were spotty during the fall surveys; the largest collections occurred on the eastern end of Long Island and off of the coast of Southern New Jersey for Fall 2007 (Figure 25). A similar distribution observed during Fall 2008, but some larger catches off of the coast of Virginia were also documented. Sampling during the Spring 2008 cruise was extremely patchy as menhaden were collected from a single site off of Southern New Jersey, two sites along the coast of Virginia, and a single location off of North Carolina. In contrast, large catches of menhaden were encountered during the Spring 2009 cruise. These were restricted to the waters below the mouth of Chesapeake Bay, however, while smaller catches off of New York, New Jersey, and Maryland were also documented.

The abundance indices for Atlantic menhaden were consistent in terms of number and biomass within seasons, but indices showed opposite trends for the spring and fall (Figure 26). Specifically, abundance indices decreased between the fall cruises, while an increase was documented between spring surveys. Again, based on the behavioral characteristics of this species described above, it is likely that a bottom-oriented survey trawl is not an ideal sampling gear for Atlantic menhaden. As such, these indices probably do not reflect actual trends in the abundance of the menhaden.

Atlantic menhaden collected during the Fall 2007 survey ranged from 5 cm to 32 cm FL, and two distinct modal groups were present (Figure 27). Two size groupings were observed on the second fall survey as well, but the fish were larger on average than those sampled during the previous autumn. The menhaden caught on this cruise ranged from 10 cm to 32 cm FL. The 32 specimens collected on the first spring survey were between 9 cm and 20 cm FL. Those sampled from the Spring 2009 cruise were 8 cm to 29 cm FL, while most were in the 11 cm to 15 cm range. Based on these length data, it appears that both juvenile and adult menhaden were sampled during each of the survey cruises.

While females were more prevalent in NEAMAP collections across most size categories, sample sizes were relatively small for each and additional data would be needed to validate these trends (Figure 28). The age-structure of the Atlantic menhaden sampled by NEAMAP was not available for this report as staff are in the process of researching the appropriate methods of otolith preparation and age assignment for this species. Also, while the stomach samples collected from this species have yet to be processed, they will be examined in the near future and the diet composition of Atlantic menhaden collected by the NEAMAP Trawl Survey will be available at that time.

### **Atlantic Spadefish (*Chaetodipterus faber*)**

Table 11. Sampling rates and abundance indices of Atlantic spadefish for four NEAMAP cruises.

Figure 29. Biomass (kg) of Atlantic spadefish collected at each sampling site for four NEAMAP cruises.

Figure 30. Preliminary indices of abundance, in terms of number and biomass, of Atlantic spadefish for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 31. Length-frequency distributions, by cruise, for Atlantic spadefish. This species was absent from spring survey collections.

### **Atlantic Thread Herring (*Opisthonema oglinum*)**

Table 12. Sampling rates and abundance indices of Atlantic thread herring for four NEAMAP cruises.

Figure 32. Biomass (kg) of Atlantic thread herring collected at each sampling site for four NEAMAP cruises.

Figure 33. Preliminary indices of abundance, in terms of number and biomass, of Atlantic thread herring for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 34. Length-frequency distributions, by cruise, for Atlantic thread herring. This species was absent from spring survey collections.

### **Bay Anchovy (*Anchoa mitchilli*)**

Table 13. Sampling rates and abundance indices of bay anchovy for four NEAMAP cruises.

Figure 35. Biomass (kg) of bay anchovy collected at each sampling site for four NEAMAP cruises.

Figure 36. Preliminary indices of abundance, in terms of number and biomass, of bay anchovy for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 37. Length-frequency distributions, by cruise, for bay anchovy.

### **Black Sea Bass (*Centropristis striata*)**

No consistent patterns were observed between the spring and fall survey cruises in terms of the number or biomass of black sea bass caught (Table 14). The greatest number of sea bass was collected during the Fall 2007 cruise, while the fewest were sampled during the Spring 2008 survey. The total biomass caught was similar

between these two cruises, however, indicating that the fish collected on the latter were larger on average. Trawl surveys are not considered to be the ideal platforms for sampling this species, given the structure-orientated nature of sea bass and the tendency for trawl surveys to avoid towing their gear over structure. It seems, however, as though enough fish were collected by NEAMAP to extract some useful information.

With respect to the distribution of the catches of black sea bass, collections during the fall surveys, while patchy, occurred throughout the survey area (Figure 38). The largest catches of sea bass during the Fall 2007 and Fall 2008 cruises were located off of the coast of Southern New Jersey and in the Sounds, respectively. Collections of this species in the spring were also spotty, and survey tows in the southern portion of the sampling area failed to produce black sea bass. Specifically, sea bass were absent from all collections off of North Carolina in the spring of 2008 and both Virginia and North Carolina during the Spring 2009 survey. The largest samples of black sea bass occurred in BIS and RIS for both of the spring survey cruises conducted to date.

Abundance indices for black sea bass showed declines, both in terms of number and biomass, from Fall 2007 to Fall 2008 as well as between the Spring 2008 and Spring 2009 surveys (Figure 39). The rate of decrease was greater between the two fall cruises. A broad size range of sea bass was collected during each of the surveys, and included both juvenile and adult specimens (Figure 40). The smallest fish sampled during each of the fall cruises were 6 cm TL, while the largest were 56 cm TL and 55 cm TL on the Fall 2007 and Fall 2008 surveys, respectively. The majority of the sea bass collected on the Fall 2007 cruise ranged between 15 cm and 22 cm TL, and it appeared that multiple modal size groups (likely corresponding to age-classes) were present. Most of the fish collected during Fall 2008 were between 13 cm and 22 cm TL, similar to the dominant size range in the previous fall survey, but the 23 cm to 33 cm TL modal group seen in Fall 2007 collections was nearly absent. A 60 cm sea bass, which is believed to be the maximum size for this species, was collected during the Spring 2008 cruise. Most of the specimens caught on this survey ranged between 20 cm and 34 cm TL. A number of the sea bass sampled during the Spring 2009 survey fell within this range as well, but the large number of fish collected between 6 cm and 13 cm TL meant that the average size was smaller for this cruise.

Black sea bass are protogynous hermaphrodites, meaning that they begin life as female and, around a certain size, switch to male. This life history characteristic is evident in the trends in sex ratio by size documented by the NEAMAP Survey (Figure 41). It is important to note that this species is incompletely metagonous, meaning that some fish are actually born as males and remain so throughout their lifetime, while some females never switch to male.

The NEAMAP Trawl Survey ages black sea bass using both whole and sectioned otoliths (i.e., both preparations are read for each fish). As noted in the *Catch Summary* section of this report, age data from sea bass collected in 2008 (both cruises) are not yet available. For the Fall 2007 cruise, the fish collected ranged from

age-0 to age-9 (Figure 42). Most of the sea bass sampled during this cruise were age-3 or younger; the relatively low abundance of age-0 fish collected is most likely related to the availability of these fish to the trawl (i.e., sea bass occupy shallow, estuarine areas for most of their first year of life).

Crustaceans comprised the majority of the diet of black sea bass sampled by the NEAMAP Survey (Figure 43). This is consistent with the findings of several past studies. Rock crabs (*Cancer irroratus*) and sand shrimp (*Crangon septemspinosa*) were the main crustaceans consumed. Fishes accounted for approximately 25% of the sea bass diet and were represented mainly by butterfish and bay anchovy.

### **Blueback Herring (*Alosa aestivalis*)**

As was observed for the two other *Alosa* species discussed above, catches of blueback herring were much greater during the spring surveys than they were in the fall, both in terms of number and biomass (Table 15). This is not unexpected given the similarities in the migratory patterns of these three species. Specimens were collected throughout the survey area (albeit in small quantities) during the Fall 2007 cruise, but samples of blueback were limited to BIS and RIS for the Fall 2008 survey (Figure 44). This species was caught throughout the NEAMAP sampling range during each of the spring cruises; largest catches were encountered off of Southern New Jersey and in the Sounds in 2008, while the coast of Long Island and the Sounds produced the largest samples in 2009.

As was observed for the other *Alosa* species, the abundance indices for these herring declined between Fall 2007 and Fall 2008 as well as between Spring 2008 and Spring 2009, both with respect to number and biomass (Figure 45). Blueback herring collected during the Fall 2007 cruise ranged between 8 cm and 27 cm FL and comprised three distinct modal size groups (Figure 46). Most of the fish were 10 cm to 11 cm FL. The size range collected was narrower for Fall 2008 (14 cm to 20 cm FL), and the majority of the fish were about 15 cm FL. Again, due to the small sample sizes collected during these cruises, it is unlikely that the length-frequencies observed during the fall surveys were representative of the blueback herring population. Fish collected on the spring cruises ranged from 7 cm to 25 cm FL (difficult to see full range due to scale of y-axis). Most of the blueback collected on these surveys were between 10 cm and 12 cm FL. A second modal size group between 16 cm and 19 cm FL was observed for both of these cruises, but was more distinct on the Spring 2009 survey.

The sex ratio of blueback herring sampled by the NEAMAP Trawl Survey was approximately 1:1 (male to female) across all length categories with appreciable sample sizes (Figure 47). The age-structure of the blueback herring sampled by NEAMAP was not available for this report as staff are in the process of researching the appropriate methods of otolith preparation and age assignment for this species. While the stomach samples collected from this species have yet to be processed, they

will be examined in the near future and the diet composition of blueback herring collected by the NEAMAP Trawl Survey will be available at that time.

### **Bluefish (*Pomatomus saltatrix*)**

Bluefish are a fast-swimming, coastal pelagic species, and as such survey trawls are not deemed the most effective tool for sampling this species. Nevertheless, appreciable amounts (number and biomass) of bluefish were caught on three of the four full-scale NEAMAP cruises conducted to date (Table 16). Few fish were sampled during the Spring 2008 survey. Overall, it appeared that NEAMAP fall collections of this species were consistently much greater than those in the spring.

This species was sampled throughout the NEAMAP survey range during each of the fall cruises (Figure 48). Catches were largest off of the coast of New Jersey, followed by the coast of Long Island, the Sounds, and the waters off of the northern portion of North Carolina (Region 14), for both of these surveys. Relatively large collections also occurred off of Maryland and the upper portion of the Eastern Shore of Virginia during the Fall 2008 cruise. Bluefish catches were restricted to the eastern end of Long Island and RIS and BIS in the spring of 2008. The largest collections of bluefish during the Spring 2009 cruise occurred off of Cape Hatteras and the coast of Long Island.

Bluefish indices of abundance (both number and biomass) increased between the Fall 2007 and 2008 cruises as well as between the Spring 2008 and 2009 surveys (Figure 49). The rate of increase was greater for the fall surveys with respect to number and for the spring cruises in terms of biomass. Bluefish collected during the Fall 2007 and Fall 2008 surveys ranged from 7 cm to 70 cm FL and 8 cm to 71 cm FL, respectively (Figure 50 – difficult to see full range due to scale of y-axis). The sizes of the majority of the specimens sampled during each of these surveys indicate that YOY and age-1 fish were the dominant age-classes sampled. This is probably due both to the structure of the population (i.e., more younger fish available) and the ability for larger, faster bluefish to avoid the trawl. Bluefish collected during the Spring 2008 cruise ranged between 14 cm and 59 cm FL, while those collected the following spring were 11 cm to 72 cm FL (again, scale of y-axis obscures full range). The sizes of the majority of the specimens sampled during the spring surveys correspond with age-1 fish.

Bluefish sex ratio by size did not exhibit any apparent trends, and ratios were approximately 1:1 (male to female) for most length groups (Figure 51). The NEAMAP Near Shore Trawl Survey ages bluefish using the sectioned otolith technique. As noted in the *Catch Summary* section of this report, age data from bluefish collected in 2008 (both cruises) are not yet available. For the Fall 2007 cruise, the fish collected ranged from age-0 to age-5 (Figure 52). The overwhelming majority of the specimens were age-0 fish, which were likely beginning to leave estuaries and coastal ocean surf zones (YOY summer nursery habitats) for deeper waters prior to their southern migration to overwintering grounds.

As expected, the diet of bluefish collected by NEAMAP was overwhelmingly dominated by fishes; bay anchovy accounted for more than half of the bluefish diet by weight (Figure 53). The morphology and behavior of this species are well suited for a piscivorous lifestyle. Besides fishes, squid were the only other prey type accounting for greater than 1% of the bluefish diet by weight.

### **Bluntnose Stingray (*Dasyatis say*)**

Table 17. Sampling rates and abundance indices of bluntnose stingray for four NEAMAP cruises.

Figure 54. Biomass (kg) of bluntnose stingray collected at each sampling site for four NEAMAP cruises.

Figure 55. Preliminary indices of abundance, in terms of number and biomass, of bluntnose stingray for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 56. Length-frequency distributions, by cruise, for bluntnose stingray.

### **Brown Shrimp (*Penaeus aztecus*)**

Table 18. Sampling rates and abundance indices of brown shrimp for four NEAMAP cruises.

Figure 57. Biomass (kg) of brown shrimp collected at each sampling site for four NEAMAP cruises.

Figure 58. Preliminary indices of abundance, in terms of number and biomass, of brown shrimp for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 59. Length-frequency distributions, by cruise, for brown shrimp.

### **Bullnose Ray (*Myliobatis freminvillei*)**

Table 19. Sampling rates and abundance indices of bullnose ray for four NEAMAP cruises.

Figure 60. Biomass (kg) of bullnose ray collected at each sampling site for four NEAMAP cruises.

Figure 61. Preliminary indices of abundance, in terms of number and biomass, of bullnose ray for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 62. Length-frequency distributions, by cruise, for bullnose ray. This species was not collected during the Spring 2008 survey.

### **Butterfish (*Peprilis triacantus*)**

Table 20. Sampling rates and abundance indices of butterfish for four NEAMAP cruises.

Figure 63. Biomass (kg) of butterfish collected at each sampling site for four NEAMAP cruises.

Figure 64. Preliminary indices of abundance, in terms of number and biomass, of butterfish for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 65. Length-frequency distributions, by cruise, for butterfish.

Figure 66. Sex ratio, by length group, for butterfish collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

### **Clearence Skate (*Raja eglanteria*)**

Table 21. Sampling rates and abundance indices of clearence skate for four NEAMAP cruises.

Figure 67. Biomass (kg) of clearence skate collected at each sampling site for four NEAMAP cruises.

Figure 68. Preliminary indices of abundance, in terms of number and biomass, of clearence skate for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 69. Length-frequency distributions, by cruise, for clearence skate.

Figure 70. Sex ratio, by length group, for clearence skate collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

Figure 71. Diet composition, expressed using the percent weight index, of clearence skate collected during four NEAMAP survey cruises. The number of fish sampled for

diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of clearnose skate sampled.

### **Cownose Ray (*Rhinoptera bonasus*)**

Table 22. Sampling rates and abundance indices of cownose ray for four NEAMAP cruises.

Figure 72. Biomass (kg) of cownose ray collected at each sampling site for four NEAMAP cruises.

Figure 73. Preliminary indices of abundance, in terms of number and biomass, of cownose ray for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 74. Length-frequency distributions, by cruise, for cownose ray. This species was absent from spring survey collections.

### **Horseshoe Crab (*Limulus polyphemus*)**

Catches of horseshoe crab by the NEAMAP Near Shore Trawl Survey were relatively consistent among the four full-scale cruises conducted to date (Table 23). Between about 800 and 2,400 specimens were collected per survey, weighing a total of between 1,200 kg and 2,700 kg. With respect to spatial distribution, the largest catches during each of these four cruises were encountered off of the mouth of Delaware Bay and in adjacent waters (Figure 75). This was not surprising, given that this bay has historically supported the largest spawning population of horseshoe crab in the world. Relatively large catches of this species were also documented in the New York Harbor area on each of the surveys. Horseshoe crab were absent from collections in the Sounds during both of the spring cruises and from the waters off of the coast of North Carolina each fall.

Indices of horseshoe crab abundance showed similar trends for both number and biomass (Figure 76). Both increased between the two fall surveys as well as from Spring 2008 to Spring 2009. The rate of increase was greater between spring cruises for both metrics. The sizes of horseshoe crab sampled during the Fall 2007 and Fall 2008 surveys ranged from 14 cm to 34 cm carapace width (CW) and 9 cm to 38 cm CW, respectively (Figure 77). In both cases, however, the overwhelming majority of the crab collected were between 20 cm and 29 cm CW. Two modal size groups were obvious within this range during the first fall survey, but were less apparent on the second. The length-frequency distributions observed on the spring cruises were similar to those documented for the fall (8 cm to 33 cm CW, Spring 2008; 9 cm to 35 cm CW, Spring 2009), but smaller specimens (i.e., less than 20 cm CW) were much more abundant in the spring collections.



Overall, it appeared that the majority of the smallest and largest horseshoe crab collected by NEAMAP were female (Figure 78). While it is known that the largest specimens are normally female, the ratios at the small sizes were somewhat surprising. Because sex-specific characters are not as well developed at small sizes (males can often look like females), misidentification cannot be ruled out. Horseshoe crab were not sampled for age or diet by the NEAMAP Trawl Survey.

### **Kingfish (*Menticirrhus* spp.)**

Table 24. Sampling rates and abundance indices of kingfish for four NEAMAP cruises.

Figure 79. Biomass (kg) of kingfish collected at each sampling site for four NEAMAP cruises.

Figure 80. Preliminary indices of abundance, in terms of number and biomass, of kingfish for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 81. Length-frequency distributions, by cruise, for kingfish.

### **Little Skate (*Leucoraja erinacea*)**

Table 25. Sampling rates and abundance indices of little skate for four NEAMAP cruises.

Figure 82. Biomass (kg) of little skate collected at each sampling site for four NEAMAP cruises.

Figure 83. Preliminary indices of abundance, in terms of number and biomass, of little skate for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 84. Length-frequency distributions, by cruise, for little skate.

Figure 85. Sex ratio, by length group, for little skate collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

Figure 86. Diet composition, expressed using the percent weight index, of little skate collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of little skate sampled.

***Loligo Squid (Loligo pealeii)***

Table 26. Sampling rates and abundance indices of *Loligo* squid for four NEAMAP cruises.

Figure 87. Biomass (kg) of *Loligo* squid collected at each sampling site for four NEAMAP cruises.

Figure 88. Preliminary indices of abundance, in terms of number and biomass, of *Loligo* squid for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 89. Length-frequency distributions, by cruise, for *Loligo* squid.

**Northern Searobin (*Prionotus carolinus*)**

Table 27. Sampling rates and abundance indices of northern searobin for four NEAMAP cruises.

Figure 90. Biomass (kg) of northern searobin collected at each sampling site for four NEAMAP cruises.

Figure 91. Preliminary indices of abundance, in terms of number and biomass, of northern searobin for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 92. Length-frequency distributions, by cruise, for northern searobin.

**Pinfish (*Lagodon rhomboides*)**

Table 28. Sampling rates and abundance indices of pinfish for four NEAMAP cruises.

Figure 93. Biomass (kg) of pinfish collected at each sampling site for four NEAMAP cruises.

Figure 94. Preliminary indices of abundance, in terms of number and biomass, of pinfish for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 95. Length-frequency distributions, by cruise, for pinfish. This species was not collected during the Spring 2008 survey.

### **Red Hake (*Urophycis chuss*)**

Table 29. Sampling rates and abundance indices of red hake for four NEAMAP cruises.

Figure 96. Biomass (kg) of red hake collected at each sampling site for four NEAMAP cruises.

Figure 97. Preliminary indices of abundance, in terms of number and biomass, of red hake for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 98. Length-frequency distributions, by cruise, for red hake.

### **Scup (*Stenotomus chrysops*)**

Scup have typically been one of the most abundant species collected by the NEAMAP Trawl Survey (Table 30). Over a quarter of a million specimens were collected during the Fall 2007 cruise, weighing nearly 4,000 kg. While catches on the subsequent three surveys were an order of magnitude smaller with respect to number and between one-third and two-thirds less in terms of weight, scup was still one of the dominant species collected on these cruises. It is likely, then, that the scup population within the NEAMAP sampling area was well sampled by the survey trawl.

Scup were collected from throughout the survey area during the Fall 2007 cruise, and were encountered consistently in all but the most southern portion of NEAMAP's range (i.e., waters off of North Carolina) in Fall 2008 (Figure 99). Large catches of scup were restricted to the Sounds during the second fall survey. BIS and RIS produced large catches during Fall 2007 as well, but sizeable collections were also encountered off of Northern New Jersey, Maryland, the mouth of the Chesapeake Bay, and the northern portion of North Carolina. Scup sampling was patchy south of Chesapeake Bay during the Spring 2008 cruise, and none were caught below the bay the following spring. The largest collections of scup were documented off of the coast of Long Island and in the Sounds for each of the spring surveys.

The abundance indices for scup showed declines between both the spring and fall surveys in terms of number and biomass (Figure 100). The rate of decline was greater between the fall cruises. The overwhelming majority of the scup collected during the fall survey were YOY specimens (see below). The decrease in abundance from Fall 2007 to 2008 may therefore be due to a difference in age-0 recruitment between years. The decline between spring surveys may have been the result of the availability of this species in the sampling area. Scup move inshore to spawn during the spring, and their migration is likely triggered by temperature. Water temperatures in early 2009 remained colder, longer than they had in 2008. If this delayed scup migration relative to 2008, it is possible that the absence of fish from the survey area (i.e., many were still offshore), rather than a decrease in population abundance, was responsible for the observed decline.

Scup sampled during the Fall 2007 survey ranged from 3 cm to 41 cm FL, while those collected the following autumn were between 3 cm and 36 cm FL (Figure 101 – difficult to see range due to scale of y-axis). As noted above, an overwhelming number of YOY fish between 5 cm and 7 cm FL were collected during the first fall survey, while these fish were much less abundant during the second autumn sampling. As a result, fish about 8 cm to 9 cm FL dominated the scup collections on the Fall 2008 cruise. Similar size ranges were collected during the spring surveys (3 cm to 37 cm FL, Spring 2008; 3 cm to 43 cm FL, Spring 2009). While larger scup were collected with regularity during the Spring 2008 cruise, fish ranging from 7 cm to 10 cm FL comprised the majority of the collections. Larger fish accounted for a greater percentage of the total catch during the Spring 2009 sampling.

No particular trends were evident in the sex ratio of scup presented by size (Figure 102). The largest specimens collected were female, but sample sizes of the bigger fish are relatively small, so it would be necessary to collect additional information prior to drawing any conclusions. Scup were aged by survey personnel using the sectioned otoliths technique. As mentioned in the *Catch Summary* section above, the 2008 samples have been prepared, and they are currently in the process of being read. It is anticipated that these data should be available prior to the Fall 2009 survey. Scup collected during the Fall 2007 cruise ranged from age-0 to age-4 (Figure 103). It will be interesting to compare these data with the age-frequency distribution generated for the Fall 2008 survey to see if a reduction in the number of YOY fish collected might be the cause of the decline in the abundance indices between the fall cruises.

Crustaceans accounted for more than half of the scup diet composition by weight (Figure 104). Amphipods and small, shrimp-like animals were the dominant prey types within this category. Of the remaining prey categories, worms accounted for 19.3% of the diet, fishes comprised 8.8%, and molluscs were approximately 5%.

### **Silver Hake (*Merluccius bilinearis*)**

Table 31. Sampling rates and abundance indices of silver hake for four NEAMAP cruises.

Figure 105. Biomass (kg) of silver hake collected at each sampling site for four NEAMAP cruises.

Figure 106. Preliminary indices of abundance, in terms of number and biomass, of silver hake for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 107. Length-frequency distributions, by cruise, for silver hake.

Figure 108. Sex ratio, by length group, for silver hake collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and

green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

Figure 109. Diet composition, expressed using the percent weight index, of silver hake collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of hake sampled.

### **Silver Perch (*Bairdiella chrysoura*)**

Table 32. Sampling rates and abundance indices of silver perch for four NEAMAP cruises.

Figure 110. Biomass (kg) of silver perch collected at each sampling site for four NEAMAP cruises.

Figure 111. Preliminary indices of abundance, in terms of number and biomass, of silver perch for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 112. Length-frequency distributions, by cruise, for silver perch.

### **Smooth Butterfly Ray (*Gymnura micrura*)**

Table 33. Sampling rates and abundance indices of smooth butterfly ray for four NEAMAP cruises.

Figure 113. Biomass (kg) of smooth butterfly ray collected at each sampling site for four NEAMAP cruises.

Figure 114. Preliminary indices of abundance, in terms of number and biomass, of smooth butterfly ray for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 115. Length-frequency distributions, by cruise, for smooth butterfly ray. This species was absent from spring survey collections.

### **Smooth Dogfish (*Mustelus canis*)**

Table 34. Sampling rates and abundance indices of smooth dogfish for four NEAMAP cruises.

Figure 116. Biomass (kg) of smooth dogfish collected at each sampling site for four NEAMAP cruises.

Figure 117. Preliminary indices of abundance, in terms of number and biomass, of smooth dogfish for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 118. Length-frequency distributions, by cruise, for smooth dogfish.

Figure 119. Sex ratio, by length group, for smooth dogfish collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

Figure 120. Diet composition, expressed using the percent weight index, of smooth dogfish collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of dogfish sampled.

### **Spanish Mackerel (*Scomberomorus maculatus*)**

Spanish mackerel were not well sampled by the NEAMAP Trawl Survey, likely due to the surface-oriented, fast swimming nature of this fish. In addition, a cyclical abundance pattern has historically been observed for this species in the Chesapeake Bay-area (i.e., the estuary and adjacent coastal zones), and it is currently thought that abundance in this region is at a low point in the cycle. To date, Spanish mackerel have only been sampled during fall NEAMAP cruises (Table 35). The first fall survey yielded 161 specimens, while only 14 were collected on the second. The largest catches of Spanish mackerel during the Fall 2008 cruise were encountered off of the Southside of Virginia and the northern coast of North Carolina (Figure 121). All specimens were collected from a single site off of North Carolina (Region 15) in the autumn of 2008.

Indices of abundance (number and biomass) show a decline between the fall surveys, but it is likely that this trend reflects sampling variability rather than an actual decrease in the abundance of the Spanish mackerel population in the NEAMAP survey area (Figure 122). Fish collected during Fall 2007 ranged from 8 cm to 44 cm FL (Figure 123). Most were between 22 cm and 34 cm FL, and it appeared as though two modal size groups (perhaps reflecting age-classes) were present within this range. Mackerel sampled during Fall 2008 were 19 cm to 32 cm FL. Sex ratio by size information was not included for Spanish mackerel due to low sample size. Those taken for full processing have not yet been aged and the stomachs of these fish have yet to be examined, as species with larger sample sizes (and therefore likely more useful information) have taken priority.

### **Spiny Dogfish (*Squalus acanthias*)**

Catches of spiny dogfish by the NEAMAP Trawl Survey varied seasonally; spring collections exceeded fall catches (Table 36). Approximately 1,300 specimens, weighing between 3,300 kg and 3,600 kg, were sampled during each of the spring cruises. Catches on the second fall survey exceeded those on the first by an order of magnitude in terms of number and by two orders of magnitude with respect to weight. The seasonality of the NEAMAP collections of spiny dogfish is consistent with the known migratory patterns of this species. These fish congregate in Mid-Atlantic waters in winter and early spring, and then migrate north in the late spring and summer. By fall, the southern extent of this species' range only overlaps with the most northeastern reaches of the NEAMAP sampling area (i.e., RIS and BIS).

The catch distribution of spiny dogfish on the four NEAMAP full-scale cruises reflected this migratory pattern (Figure 124). The largest catches of this species during the fall surveys were restricted to the Sounds and the eastern end of Long Island. Some smaller samples were encountered off of the Delmarva Peninsula in 2008, and these catches were comprised of juvenile specimens. Spiny dogfish were collected throughout the entire NEAMAP survey area during the Fall 2008 cruise. The largest catches were found in RIS, off of the coast of New Jersey, and at the mouth of Chesapeake Bay. Spiny dogfish were distributed throughout the sampling area during both of the spring surveys. The mouth of the Chesapeake Bay, the coast of New Jersey, and the Sounds produced the largest catches of this species during each of these cruises.

The abundance indices for spiny dogfish, both in terms of number and biomass, showed a slight increase between surveys for each of the seasons (Figure 125). The rate of increase was larger in terms of number for the spring surveys and biomass for the fall cruises. Based on the length-frequency distributions, it appeared that juvenile and adult dogfish were collected on each of the full-scale surveys, with the exception of the Fall 2007 cruise (Figure 126). Fish sampled on the first fall survey ranged from 63 cm to 88 cm pre-caudal length (PCL). Those collected during the Fall 2008 cruise were from 21 cm to 78 cm PCL, but two very distinct modal size groups were present (21 cm to 36 cm PCL and 52 cm to 78 cm PCL). These modal size groups represented the juvenile and adult fish. Dogfish collected on the Spring 2008 survey ranged from 18 cm to 87 cm PCL, and two distinct modal groups were again observed. Specimens in the juvenile size category were smaller than those sampled during the previous fall, and likely represent fish that were born over that previous winter and early spring. Juvenile fish, while present, were much less abundant on the Spring 2009 cruise. For both spring surveys, the size range of most of the adults collected was between 55 cm and 80 cm PCL.

Spiny dogfish are known to school by sex, with males most often found in offshore waters and females typically inhabiting shallower waters. NEAMAP sex ratio by size data were consistent with this pattern; nearly all of the spiny dogfish collected across all sizes were female (Figure 127). The NEAMAP Trawl Survey intends to age spiny dogfish by reading whole dorsal spines (specifically, the spine that precedes the

second dorsal fin). Age data for the dogfish sampled by this survey were not available for this report, however, as staff were in the process of researching the appropriate methods of annuli interpretation for this species.

Approximately half of the spiny dogfish diet by weight was fishes (Figure 128). The largest 'prey type' within this category was a combination of 37 species of fishes, each of which individually contributed a small amount to the dogfish diet. Atlantic menhaden, striped bass, and butterfish comprised between 2% and 10% of the diet by weight. Of the remaining prey categories, molluscs (primarily *Loligo* squid) accounted for the greatest percentage of the diet of spiny dogfish.

### **Spot (*Leiostomus xanthurus*)**

Collections of spot by the NEAMAP Survey were consistently greater during the fall cruises than on the spring surveys (Table 37). Between 44,000 and 57,000 spot, weighing about 3,900 kg, were sampled during each of the autumn cruises, while approximately 30,000 specimens weighing around 1,000 kg were collected each spring. Like several other of the sciaenid species collected by NEAMAP (e.g., Atlantic croaker, weakfish, etc.), spot overwinter mainly south of Cape Hatteras, migrate north into the NEAMAP survey area in the spring, and inhabit the estuaries and coastal zones of the Mid-Atlantic before migrating back to the south in the fall. The inter-seasonal fluctuations in abundance observed by NEAMAP were consistent with this migratory pattern.

Spot distribution was relatively consistent within seasons (Figure 129). This species was sampled throughout most of the NEAMAP survey range during the fall surveys. The largest catches of spot on these cruises were found from Delaware to North Carolina. Spot were collected as far north as Long Island during the autumn of 2007, and were collected from several sites in RIS and BIS on the Fall 2008 cruise. For the spring surveys, the overwhelming majority of the spot samples were collected south of Chesapeake Bay. The largest catches occurred in the Virginia / North Carolina border area each year. A few collections were made off of the coast of Maryland and the Eastern Shore of Virginia in 2008, but none were caught north of the bay in 2009. This disparity may have been due to water temperatures, which were colder during the second spring survey and may have delayed spot migration into the Mid-Atlantic.

Spot indices of abundance exhibited similar trends both in terms of number and biomass (Figure 130). Spot abundance increased between the Fall 2007 and Fall 2008 cruises, but remained relatively stable between the spring surveys. The length-frequency distributions for spot were similar for the two fall surveys conducted to date (Figure 131). Fish ranged between 10 cm and 25 cm FL during Fall 2007 cruise and from 8 cm to 25 cm FL on the second fall survey. It appears that fish collected on the latter cruise may have been slightly smaller, on average. For the spring surveys, spot were between 11 cm and 19 cm FL and 8 cm and 19 cm FL, respectively. The 13 cm FL size category dominated the collections in Spring 2008,



while most of the fish sampled during Spring 2009 were between 11 cm and 14 cm FL.

The sex ratio of spot by size group failed to exhibit any discernable trends when focusing only on those categories with appreciable sample sizes (Figure 132). Survey staff will age spot using the sectioned otolith method. None of these age samples have been processed to date, however, as efforts have focused on generating age data for those species of greater interest to assessment scientists and managers. The NEAMAP Survey does not sample stomachs from spot, as preliminary work showed that little useful information could be obtained from these samples. Specifically, the vast majority of the prey items encountered in the stomachs of this species were unidentifiable.

### **Spotted Hake (*Urophycis regia*)**

Table 38. Sampling rates and abundance indices of spotted hake for four NEAMAP cruises.

Figure 133. Biomass (kg) of spotted hake collected at each sampling site for four NEAMAP cruises.

Figure 134. Preliminary indices of abundance, in terms of number and biomass, of spotted hake for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 135. Length-frequency distributions, by cruise, for spotted hake.

### **Striped Anchovy (*Anchoa hepsetus*)**

Table 39. Sampling rates and abundance indices of striped anchovy for four NEAMAP cruises.

Figure 136. Biomass (kg) of striped anchovy collected at each sampling site for four NEAMAP cruises.

Figure 137. Preliminary indices of abundance, in terms of number and biomass, of striped anchovy for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 138. Length-frequency distributions, by cruise, for striped anchovy.

### **Striped Bass (*Morone saxatilis*)**

For the most part, few striped bass were collected on each of the NEAMAP surveys (Table 40). While over 1,500 specimens weighing in excess of 4,600 kg were

sampled during the Fall 2008 cruise, most of the fish collected were taken in just two tows off of the coast of Northern New Jersey. For each of the rest of the surveys, fewer than 200 fish weighing less than 400 kg total were collected. It is unlikely that these low catches of striped bass were caused by low population abundance or the inability of the survey gear to collect this species; other surveys have shown a relatively healthy population of stripers along the Atlantic coast, and the net used by NEAMAP samples large fishes with regularity. Rather, it is more likely that these low catches are due to timing of the surveys. It is well known that striped bass move into estuaries to spawn beginning in early spring, and that larger fish then migrate to waters north of Cape Cod for the summer months while the smaller individuals remain in the estuaries. As water temperatures begin to drop in the fall, the large fish migrate back south. Unless NEAMAP sampling happens to coincide with the time of the spring or fall migrations, few fish will be available in the survey area for collection. Based on the timing of the NEAMAP cruises and the known migrations of the striped bass, it is reasonable to assume that the spring surveys occurred while most of the stripers were still spawning in the estuaries, while the fall cruises took place before much of the population had started migrating south around Cape Cod.

All striped bass collected to date by NEAMAP were sampled from waters north and east of Delaware Bay (Figure 139). Catches during the Fall 2007 cruise were patchy and limited to waters off of Long Island and BIS and RIS. Stripers were sampled from these same areas during the Fall 2008 survey, but the largest catches were encountered off of the coasts of Northern and Southern New Jersey. For the spring cruises, most of the fish were caught off of Long Island and Northern New Jersey each year. Smaller collections occurred in the Sounds and near the mouth of Delaware Bay during these surveys. Both of the abundance indices (number and weight) showed increases in striped bass abundance for each set of cruises, and the rate of increase was greater between fall surveys (again, likely due to those two large catches – Figure 140). It is important to note, however, that it is unlikely that these indices reflect actual trends in the striped bass population, due to the issues discussed above.

The striped bass sampled by the NEAMAP survey were relatively large, which is not unexpected given that only the bigger individuals are thought to undertake the coastal migrations (Figure 141). Fish caught on the Fall 2007 cruise ranged from 59 cm to 91 cm FL, while those sampled during the second fall survey exhibited a broader range (56 cm to 111 cm FL). Most of the fish collected on the latter cruise ranged from 61 cm to 78 cm FL, and the bulk of those were taken from a single tow off of Sandy Hook, NJ. Stripers sampled during the Spring 2008 survey ranged between 49 cm and 104 cm FL, while those taken the following spring were from 26 cm to 100 cm FL. Specimens collected on the Spring 2009 survey comprised multiple distinct modal size groups.

While the sample sizes for each length category were relatively small, it appeared that the majority of striped bass collected by the NEAMAP Survey were female, across all size groups (Figure 142). This was expected since it is predominantly the female

segment of the population that undertakes the coastal migrations. Striped bass were aged using the sectioned otolith technique. Fish collected during the Fall 2007 cruise ranged from age-4 to age-13 (Figure 143). The second fall cruise yielded fish between age-4 and age-15. The overwhelming majority were age-5, and were taken from the aforementioned large tow off of Sandy Hook. These fish were a product of the strong 2003 year-class of stripers. Fish collected during the Spring 2008 survey were age-4 to age-21. The strong 2003 year-class was again evident in the collections of age-5 fish. The oldest fish caught was a member of the relatively large 1987 year-class.

The diet of striped bass collected by the NEAMAP Survey was comprised overwhelmingly of fishes (Figure 144). Bay anchovy accounted for over half of the striped diet by weight, while bluefish, scup, and butterfish made up most of the remainder. Besides fishes, *Loligo* squid was the main prey.

### **Striped Searobin (*Prionotus evolans*)**

Table 41. Sampling rates and abundance indices of striped searobin for four NEAMAP cruises.

Figure 145. Biomass (kg) of striped searobin collected at each sampling site for four NEAMAP cruises.

Figure 146. Preliminary indices of abundance, in terms of number and biomass, of striped searobin for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 147. Length-frequency distributions, by cruise, for striped searobin.

### **Summer Flounder (*Paralichthys dentatus*)**

Catches of summer flounder by the NEAMAP Near Shore Trawl Survey were relatively consistent among survey cruises (768 – 974 specimens weighing 418 kg to 625 kg; Table 42). Summer flounder were collected from throughout the NEAMAP survey range on each of the cruises (Figure 148). A restriction of summer flounder to the southern portion of the survey area during spring, as was observed with other fishes such as Atlantic croaker and spot, was not seen for summer flounder as this species undertakes inshore-offshore, rather than north-south, migrations each spring and fall. For each of the four survey cruises, summer flounder catches were greatest off of the coast of Long Island and in BIS and RIS. Relatively large catches of summer flounder were encountered off of the coast of Maryland during the Fall 2007 survey, but this was not observed on the other three cruises. In general, catches became patchier with decreasing latitude.

The numerical and biomass abundance indices for summer flounder exhibited declines between both the spring and fall cruises (Figure 149). The rate of decline

was greater for the fall surveys, however. Summer flounder collected during the Fall 2007 cruise ranged from 16 cm to 76 cm TL, while those sampled in the following autumn were 17 cm to 69 cm (Figure 150). At least three distinct modal size groups were evident for each; average size on the second fall survey appeared to be slightly larger than that on the first. The size ranges collected during the spring surveys were similar to those seen during the fall cruises (19 cm to 67 cm TL, Spring 2008; 18 cm to 68 cm TL, Spring 2009), and modal size groups (likely corresponding to age-classes) were again evident. Because the gear used by NEAMAP collects appreciable numbers of summer flounder over a broad size range, it is likely that this survey will prove to be a valuable source of information for this species into the future.

As noted in previous project reports, a distinct trend was evident in the sex ratio of summer flounder collected by NEAMAP when examined by flounder size (Figure 151). Specifically, the proportion of females in the sample increased with increasing length. Females began to outnumber males at about 35 cm TL, and nearly all fish greater than 55 cm TL were female. Summer flounder otoliths collected by the NEAMAP Trawl Survey were processed and read using the sectioned otolith technique. Fish sampled during the Fall 2007 cruise ranged from age-0 to age-13; most were age-3 or younger (Figure 152). No YOY summer flounder were collected on the Spring 2008 survey, which was not unexpected given that age-0 summer flounder inhabit estuaries early in their first year of life. Flounder collected on this cruise ranged from age-1 to age-12, and the relative abundance among ages observed during the previous fall survey was evident during this cruise as well. YOY summer flounder were collected during the Fall 2008 cruise, since these fish were again available in the survey area after migrating out of their spring / summer estuarine habitats. Specimens as old as age-10 were collected during this survey.

Summer flounder are known piscivores, and the diet of flounder collected by NEAMAP confirmed this classification (Figure 153). Specifically, fishes accounted for 58% of the summer flounder diet by weight; a wide array of species comprised this category. Crustaceans (mostly small, shrimp-like animals) and molluscs (mainly *Loligo* squid) composed the remainder of the diet. A similar feeding ecology was recently documented for summer flounder in Chesapeake Bay. *Loligo* squid were absent from flounder stomachs collected in the bay, however, likely due to the relative absence of this prey from this estuary.

### **Weakfish (*Cynoscion regalis*)**

In general, fall catches of weakfish exceeded those of the spring surveys (Table 43). Between 44,000 and 61,000 individuals, weighing a total of approximately 4,000 kg, were collected on each of the fall cruises. Spring sampling of weakfish was more variable; the number of weakfish collected ranged between 8,700 and 40,000 specimens and total weights were approximately 400 kg and 2,200 kg, respectively. Like the Atlantic croaker and spot, weakfish undertake seasonal north-to-south migrations, moving into the NEAMAP survey area in the spring and out during the

late fall. This migratory pattern likely accounts for the difference in the catch rates between the spring and fall surveys.

With respect to spatial distribution, weakfish were collected from throughout the NEAMAP sampling area during the fall cruises (Figure 154). For both Fall 2007 and 2008, catches were consistently greatest between Southern New Jersey and the northern portion of North Carolina. Relatively large samples were encountered off of Long Island and in the Sounds during the first fall survey and along the coast of Long Island during the second. The largest weakfish catches for each of the spring cruises occurred off of the coast of North Carolina. Smaller, patchier collections were observed between Central New Jersey and the Virginia / North Carolina border area during the spring surveys.

The abundance indices (number and biomass) showed declines between both the spring and fall cruises (Figure 155). The rate of decrease appeared to be greater for the spring cruises, however. Weakfish collected during the fall surveys ranged from 7 cm to 57 cm TL (2007) and 6 cm to 58 cm TL (2008) (Figure 156 – full range difficult to see due to the scale of the y-axis). Most of the specimens sampled during Fall 2007 were 12 cm to 24 cm TL, while the majority on the Fall 2008 cruise were 16 cm to 24 cm TL. The size range of weakfish collected during the Spring 2008 cruise was similar to those observed on the fall surveys (8 cm to 45 cm TL), while that of the Spring 2009 survey was much narrower (10 cm to 28 cm TL). It is interesting to note that large weakfish were absent from these NEAMAP collections, a trend that has proven to be consistent among several fishery-independent surveys in recent years.

No particular trends in the sex ratio of weakfish were evident when partitioned by length group; the male to female ratio varied around 1:1 for the limited size range sampled by the NEAMAP Survey (Figure 157). Weakfish collected by NEAMAP were aged using the sectioned otolith technique. Older weakfish were absent from all cruises for which age data are currently available. All fish collected on each of the first three full-scale surveys were age-3 or younger, with the exception of a single age-4 specimen sampled during the Fall 2008 cruise (Figure 158). Age-0 fish were absent from the Spring 2008 survey because weakfish are mid-summer spawners. YOY fish were relatively abundant during both fall cruises, however.

Approximately 58% of the diet of weakfish collected by NEAMAP was composed of fishes (Figure 159). Bay and striped anchovy were the main fish prey, while the remainder of this category was comprised of a variety of species, each contributing a small amount to the overall diet. Crustaceans accounted for about 30% of the weakfish diet by weight and a single prey type within this group, mysid shrimp, was responsible for nearly 25% of the diet. Appreciable amounts of mysid shrimp in the diets of weakfish have also been documented in several previous investigations into the feeding ecology of this predator in the Mid-Atlantic.

### **White Shrimp (*Penaeus setiferus*)**

Table 44. Sampling rates and abundance indices of white shrimp for four NEAMAP cruises.

Figure 160. Biomass (kg) of white shrimp collected at each sampling site for four NEAMAP cruises.

Figure 161. Preliminary indices of abundance, in terms of number and biomass, of white shrimp for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 162. Length-frequency distributions, by cruise, for white shrimp. This species was absent from collections during the Spring 2009 survey.

### **Windowpane Flounder (*Scopthalmus aquosus*)**

Table 45. Sampling rates and abundance indices of windowpane flounder for four NEAMAP cruises.

Figure 163. Biomass (kg) of windowpane flounder collected at each sampling site for four NEAMAP cruises.

Figure 164. Preliminary indices of abundance, in terms of number and biomass, of windowpane flounder for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 165. Length-frequency distributions, by cruise, for windowpane flounder.

### **Winter Flounder (*Pseudopleuronectes americanus*)**

As noted for several of the other ASMFC managed species discussed above, catches of winter flounder by the NEAMAP Trawl Survey were highly seasonal; these flounder were more abundant in spring surveys than during the fall cruises (Table 46). Approximately 1,900 fish, weighing between 550 kg and 630 kg, were sampled each spring. Fall collections yielded 390 and 670 specimens, and total weights were 98 kg and 142 kg, respectively. The migratory patterns of the winter flounder likely account for this seasonal disparity. These flatfish move into shallow-water areas in late fall, spawn in these regions during the winter and spring, and then migrate to offshore waters in the late spring / early summer. As a result, these fish are more available in the sampling area during the spring than in the fall.

Relative to most other species sampled by the NEAMAP Survey, the winter flounder is a cold-water fish. As such, all of the fall collections of this species were encountered in the northern portion of the survey range (Figure 166). Catches were greatest in the Sounds for both 2007 and 2008. No winter flounder were sampled

outside of BIS and RIS during 2007, while only a few small collections occurred along the coasts of Long Island and New Jersey (north of Barnegat Light) in 2008. During the spring cruises, winter flounder were caught regularly north of the Delaware / Maryland border area. Large samples were documented in the Sounds during both of these cruises, and sizeable catches were encountered off of Long Island and the New York Harbor area during the Spring 2009 survey as well.

All but one of the abundance indices showed increases for winter flounder within seasons (Figure 167). Numerical abundance between the Spring 2008 and Spring 2009 surveys was relatively constant. A broad size range of winter flounder was sampled during each of the full-scale surveys (Figure 168). Fish caught on the fall cruises were between 16 cm and 43 cm TL. Modal size-groups, likely representing age-classes (see below), were evident in each length distribution. The upper and lower bounds of the size ranges collected during the spring cruises were greater than those observed for the fall surveys. The smallest flounder sampled on the spring cruises were 8 cm and 10 cm TL for the 2008 and 2009 surveys, respectively. The largest were 49 cm TL for both, and several distinct modal size groups were evident in these distributions. Much like as was observed for summer flounder, appreciable numbers of winter flounder were collected over a broad size range, indicating that this survey is an effective sampling tool for this species and will likely prove to be a valuable source of information for winter flounder into the future.

The sex ratios of summer and winter flounder were similar in that the proportion of female fish in the population sampled by the NEAMAP Survey increased with increasing size (Figure 169). Winter flounder otoliths were prepared and aged using the sectioned otolith technique. Flounder between age-1 and age-7 were sampled during the Fall 2007 cruise; most of these fish were age-3 or younger (Figure 170). The Fall 2008 collections yielded winter flounder between age-1 and age-11 and, as observed during the previous fall cruise, the majority of the specimens belonged to the younger age-classes. The age-frequency distribution of the fish collected on the Spring 2008 survey showed a similar pattern to those observed for the fall cruises. The oldest fish sampled during this survey was age-13, meaning that it was part of the 1995 year-class.

Soft-bodied organisms and small crustaceans were the main prey of the winter flounder collected by NEAMAP (Figure 171). Specifically, worms comprised about 36% of the diet by weight, while molluscs accounted for an additional 28%. Amphipods and other miscellaneous prey types and were responsible for most of the remainder of the winter flounder diet.

### **Winter Skate (*Leucoraja ocellata*)**

Table 47. Sampling rates and abundance indices of winter skate for four NEAMAP cruises.

Figure 172. Biomass (kg) of winter skate collected at each sampling site for four NEAMAP cruises.

Figure 173. Preliminary indices of abundance, in terms of number and biomass, of winter skate for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 174. Length-frequency distributions, by cruise, for winter skate.

Figure 175. Sex ratio, by length group, for winter skate collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

Figure 176. Diet composition, expressed using the percent weight index, of winter skate collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of skate sampled.

#### *Presentations / Public Outreach / Survey Exchanges:*

Since 2006, presentations of NEAMAP survey results have been made as follows:

- November 2006: NEAMAP Operations Committee
- November 2006: NEAMAP Board
- December 2006: Mid-Atlantic / New England Fishery Management Council, Trawl Survey Advisory Panel
- January 2007: NEAMAP Operations Committee
- January 2007: ASMFC Interstate Fisheries Management Program (ISFMP) Policy Board
- February 2007: New England Fishery Management Council
- February 2007: Mid-Atlantic Fishery Management Council
- January 2008: Mid-Atlantic Fishery Management Council
- February 2008: Cape May, New Jersey Party and Charter Boat Association
- February 2008: Mid-Atlantic / New England Fishery Management Council, Trawl Survey Advisory Panel
- February 2008: Bass Pro Shops Fishing Classic (Hampton, Virginia), Booth exhibit
- March 2008: NEAMAP Operations Committee
- March 2008: NEAMAP Board
- April 2008: New England Fishery Management Council
- July 2008: NEAMAP Board
- October 2008: ASMFC Management and Science Committee
- October 2008: ASMFC ISFMP Policy Board
- December 2008: NEAMAP Peer Review Panel



- February 2009: Bass Pro Shops Fishing Classic (Hampton, Virginia), Booth exhibit
- May 2009: Rhode Island Ocean Special Area Management Plan Team

Also since 2007, approximately 200 individuals representing the recreational, commercial, and management communities and local and national political leaders have observed survey operations both in port and at sea during layovers in New Bedford, Massachusetts, Point Judith, Rhode Island, Montauk, New York, Cape May, New Jersey and Hampton, Virginia. Brief news descriptions of the survey have appeared on local television in Providence, Rhode Island, and Long Island, New York. The NEAMAP Trawl Survey has also appeared in a number of periodicals, including the June 2008 issue of *The Fisherman* (published in New Jersey for the recreational community), the September 2008 and December 2008 issues of *National Fisherman*, and the March 2007 and November 2008 issues of *Commercial Fisheries News*. Finally, this survey has been featured in several newspapers including the *Cape May County Herald*, *Asbury Park Press*, *New Bedford Times*, and *The Southampton Press*.

In an attempt to promote survey coordination and idea-sharing between organizations, NEAMAP staff have participated in two trawl survey personnel exchanges. Specifically, the NEAMAP program manager worked with the NEFSC during Leg III of their Spring Bottom Trawl Survey in April 2009, while three NEAMAP survey technicians participated in the Alaska Fisheries Science Center's Bottom Trawl Surveys in the summer of 2009. In an effort to continue these exchanges, NEFSC staff will likely be accompanying NEAMAP during its Fall 2009 survey cruise.

### *Appendix I*

Northeast Area Monitoring and Assessment Program (NEAMAP), Mid Atlantic Nearshore Trawl Program: Pilot Survey Completion Report

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Figure 1. NEAMAP sampling area including region boundaries and depth strata.

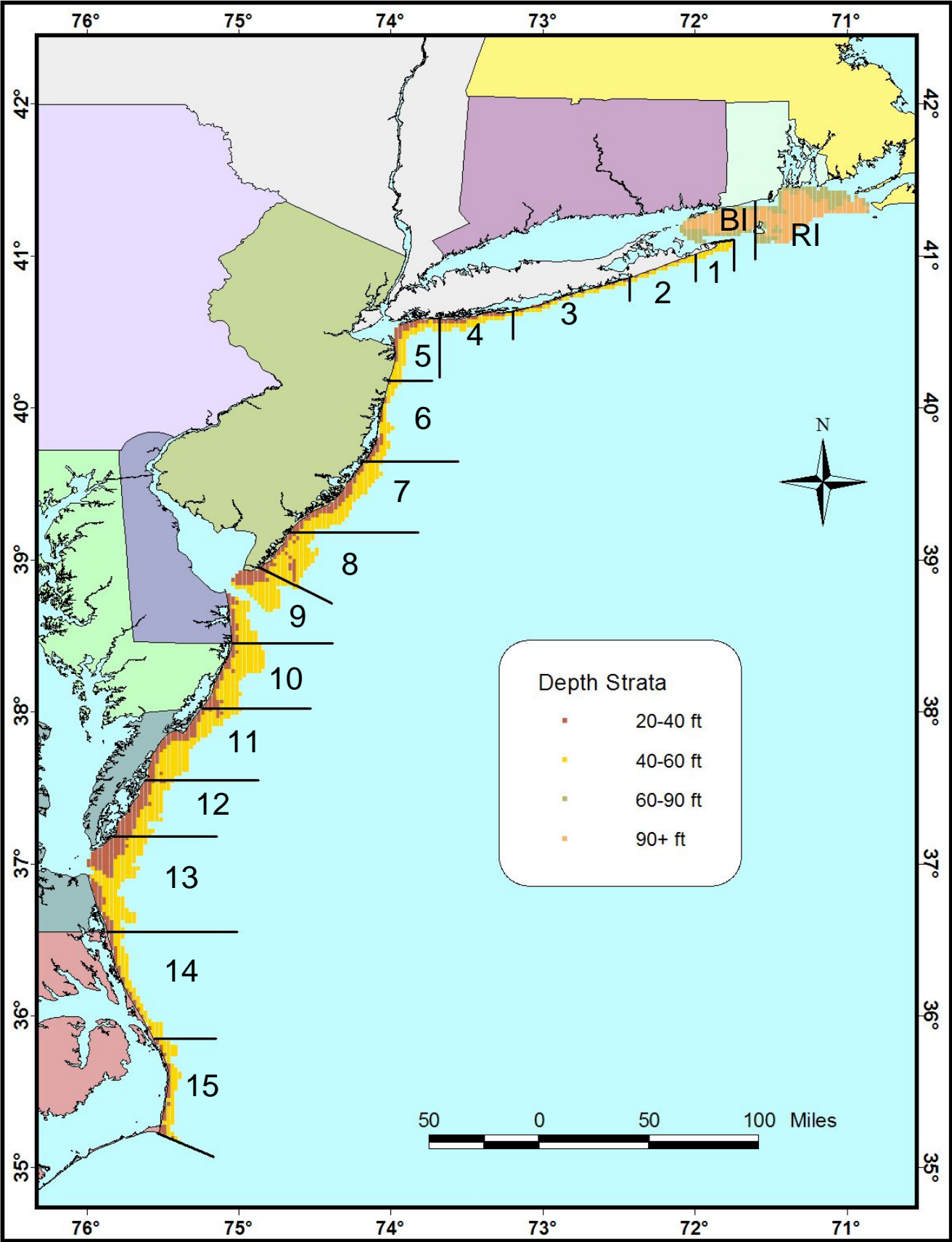


Figure 2a. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites in Rhode Island Sound and Block Island Sound for the Fall 2007 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

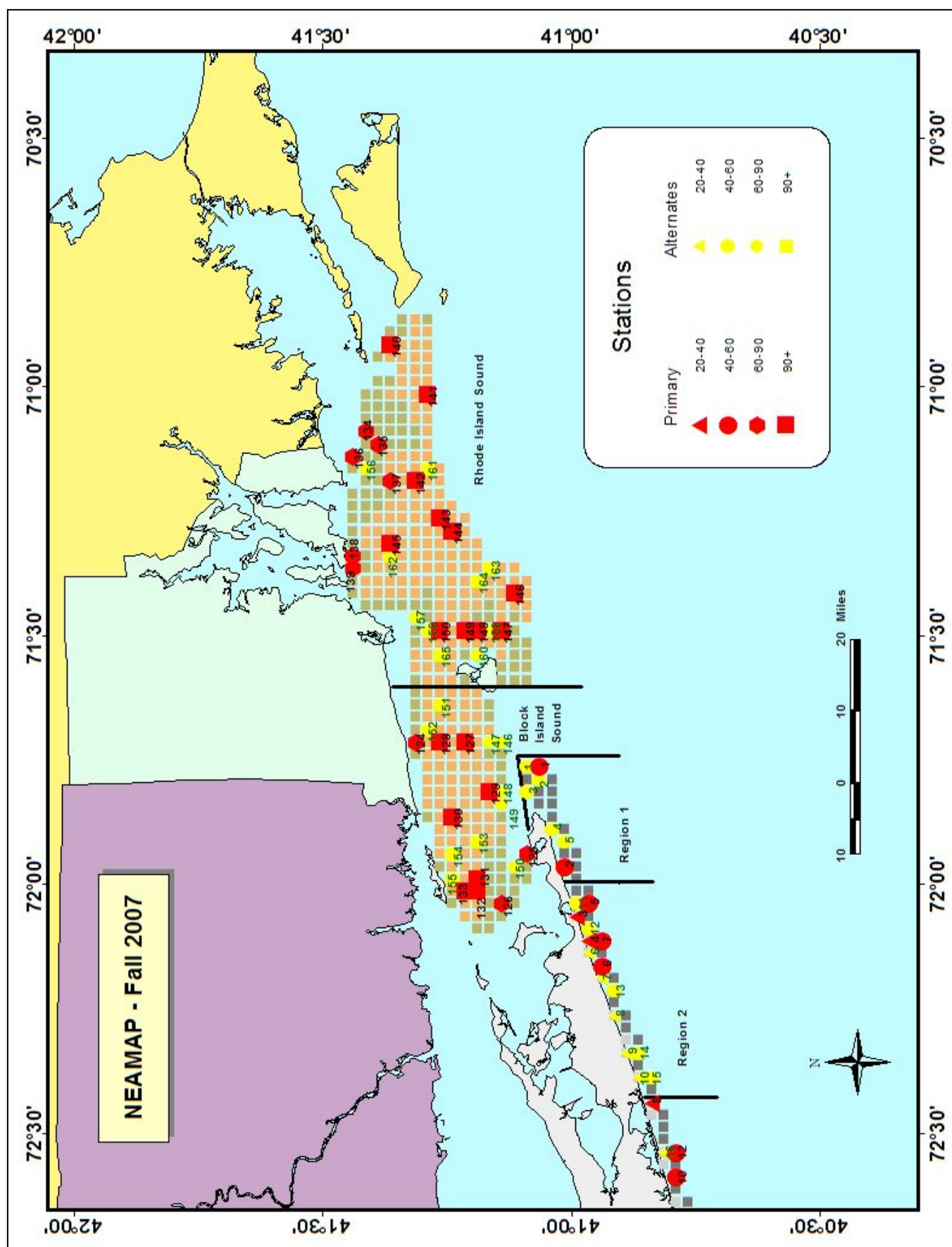


Figure 2b. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites along the coast of Long Island for the Fall 2007 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

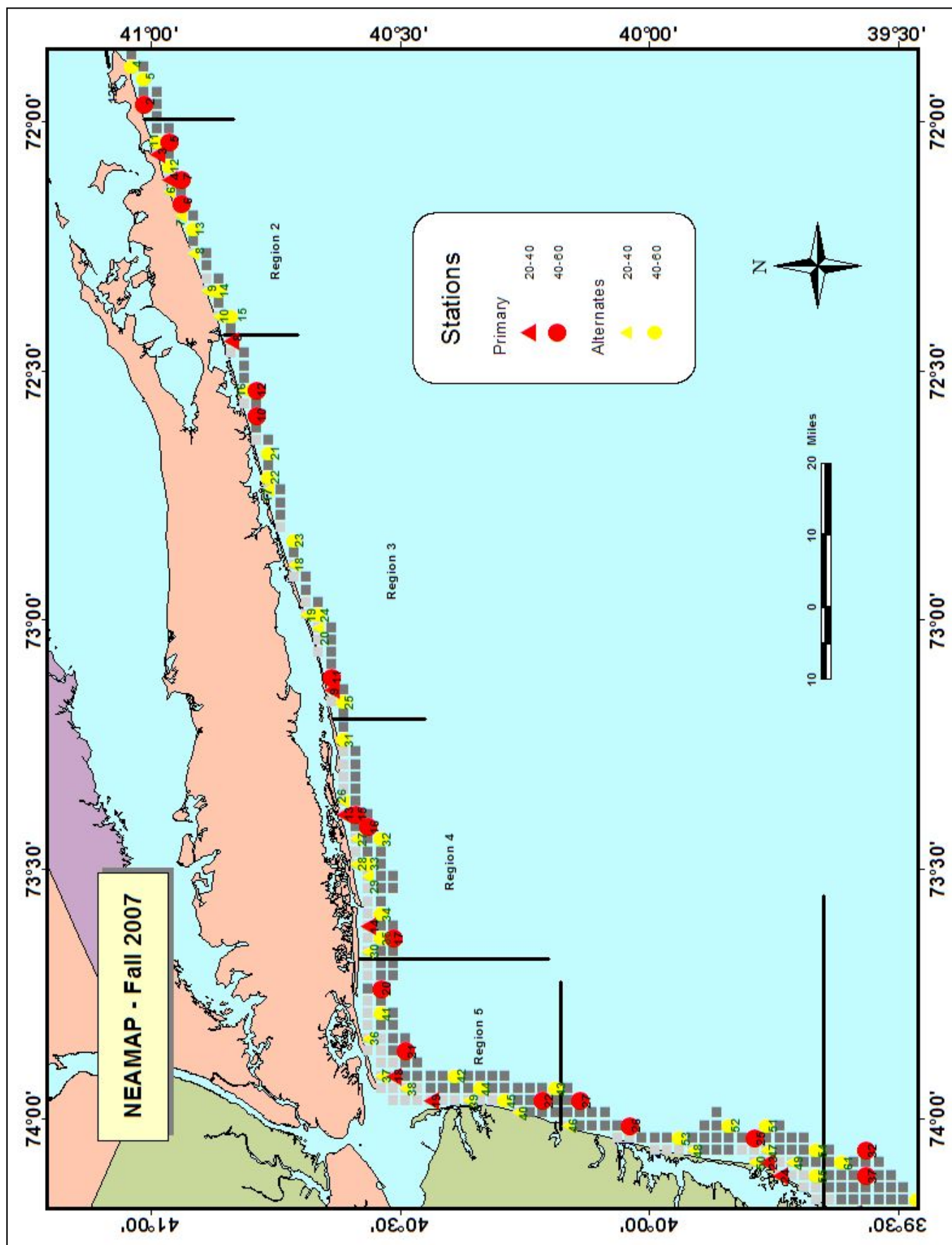




Figure 2c. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites along the coast of New Jersey for the Fall 2007 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

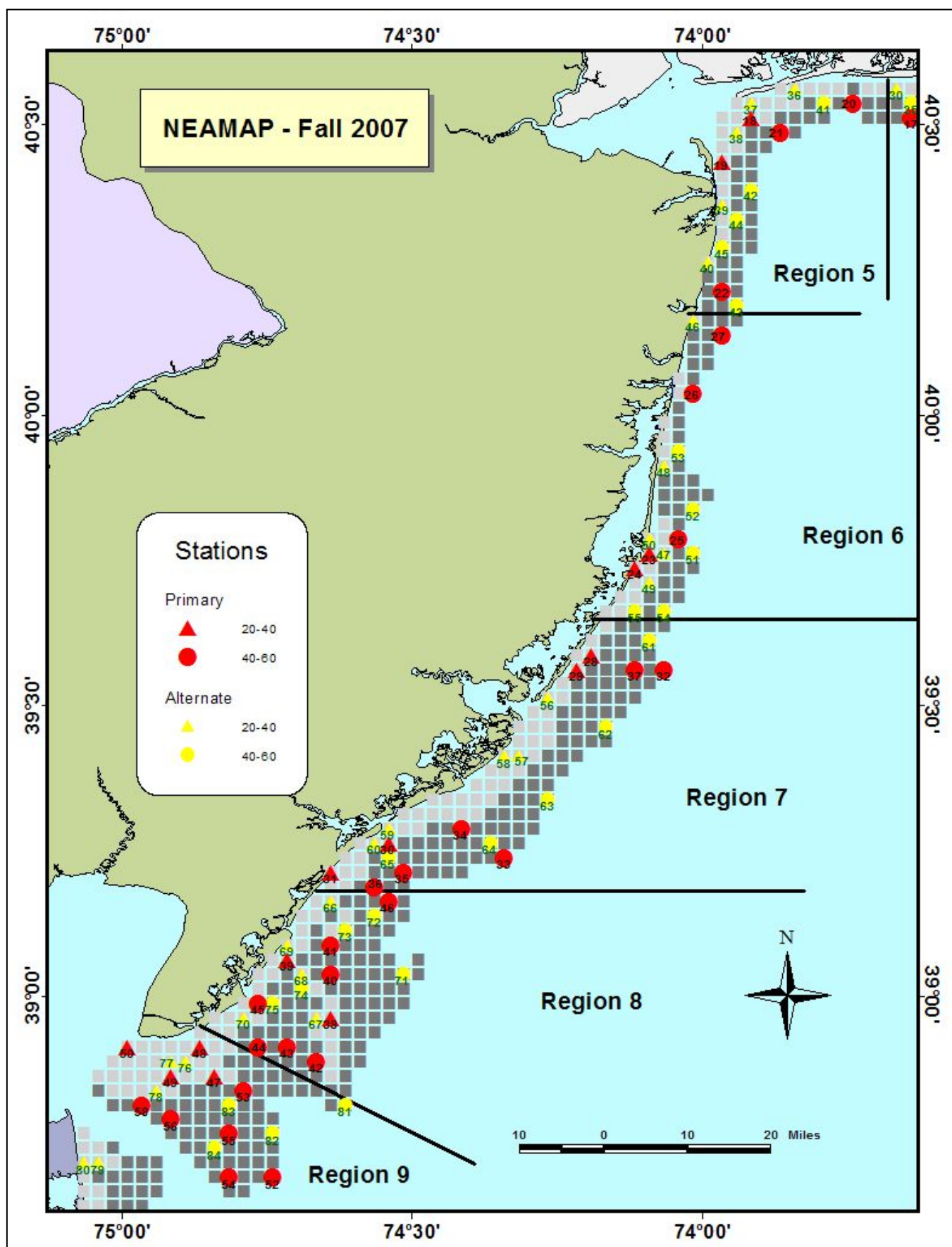


Figure 2d. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites along the coasts of Delaware and Maryland for the Fall 2007 cruise. Sampling of the deep channel waters in Region 9 began with the Fall 2008 survey cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

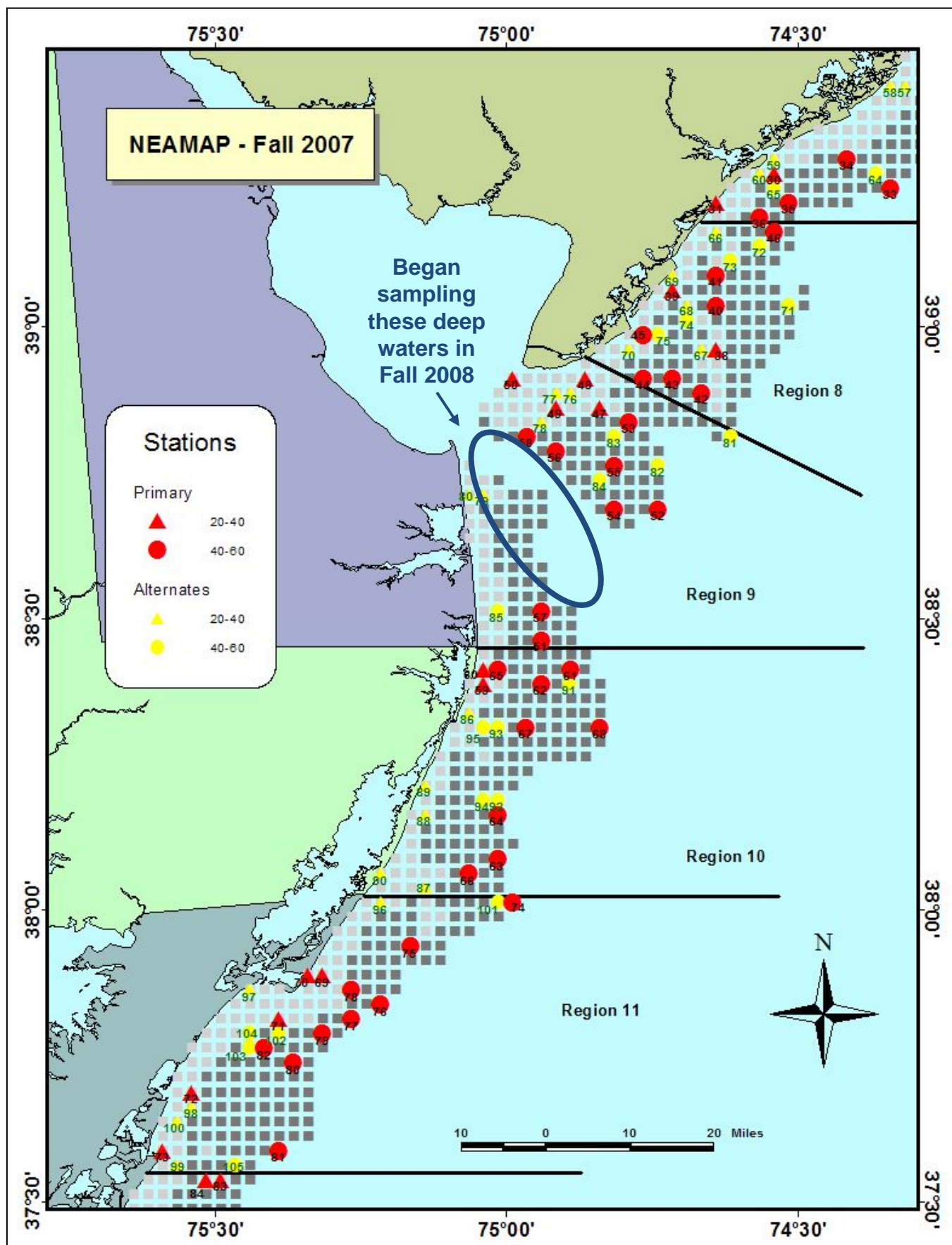




Figure 2e. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites along the coast of Virginia for the Fall 2007 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

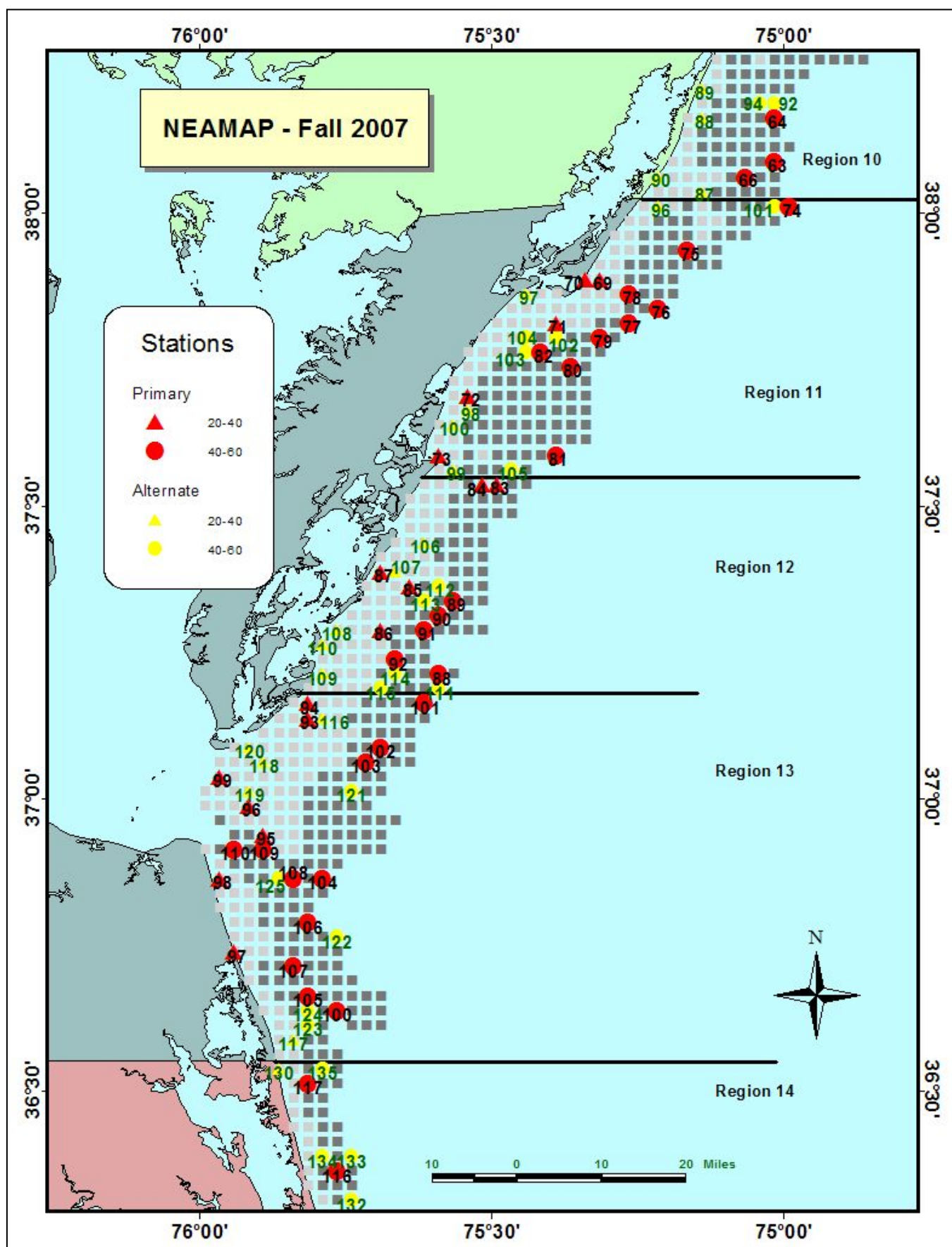


Figure 2f. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites along the coast of North Carolina for the Fall 2007 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

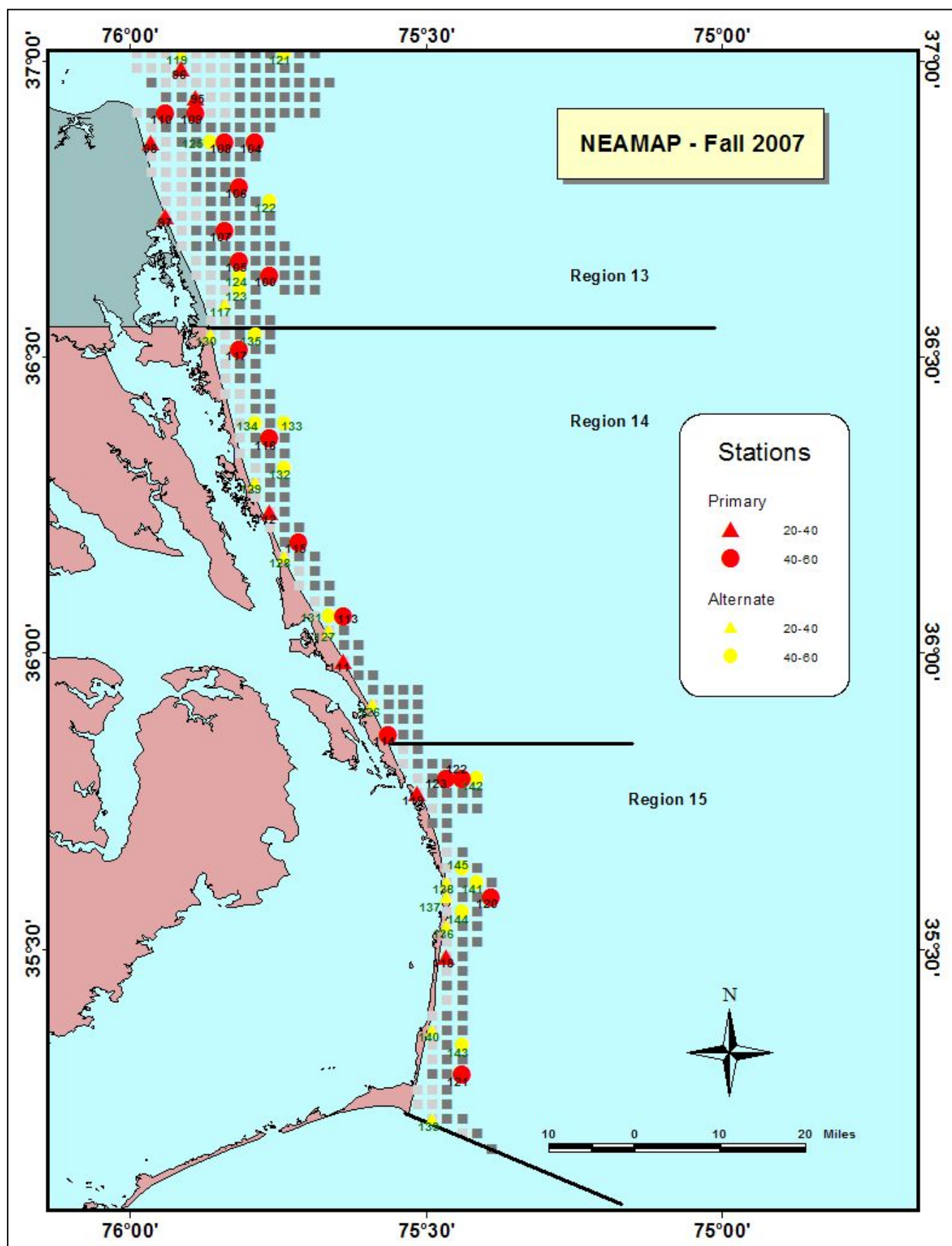


Figure 3. Performance of the NEAMAP Trawl Survey sampling gear during the Fall 2007 cruise. Tows are numbered sequentially along the x-axis; the first tow made during the Fall 2007 survey is given as 1, while the last tow of the cruise is 150. Points on the graph are tow averages for each of the respective parameters. Average door spreads (m) for each tow are given in green, average vessel speeds over ground (kts) in purple, average wing spreads (m) in blue, and average headline heights (m) in red. Cruise averages are given with each parameter. Optimal ranges for each parameter are represented by the horizontal dotted lines. Optimal door spreads are 32.0 m - 34.0 m, vessel speeds over ground are 2.9 kts - 3.3 kts, wing spreads are 13.0 m - 14.0 m, and headline heights are 5.0 m - 5.5 m.

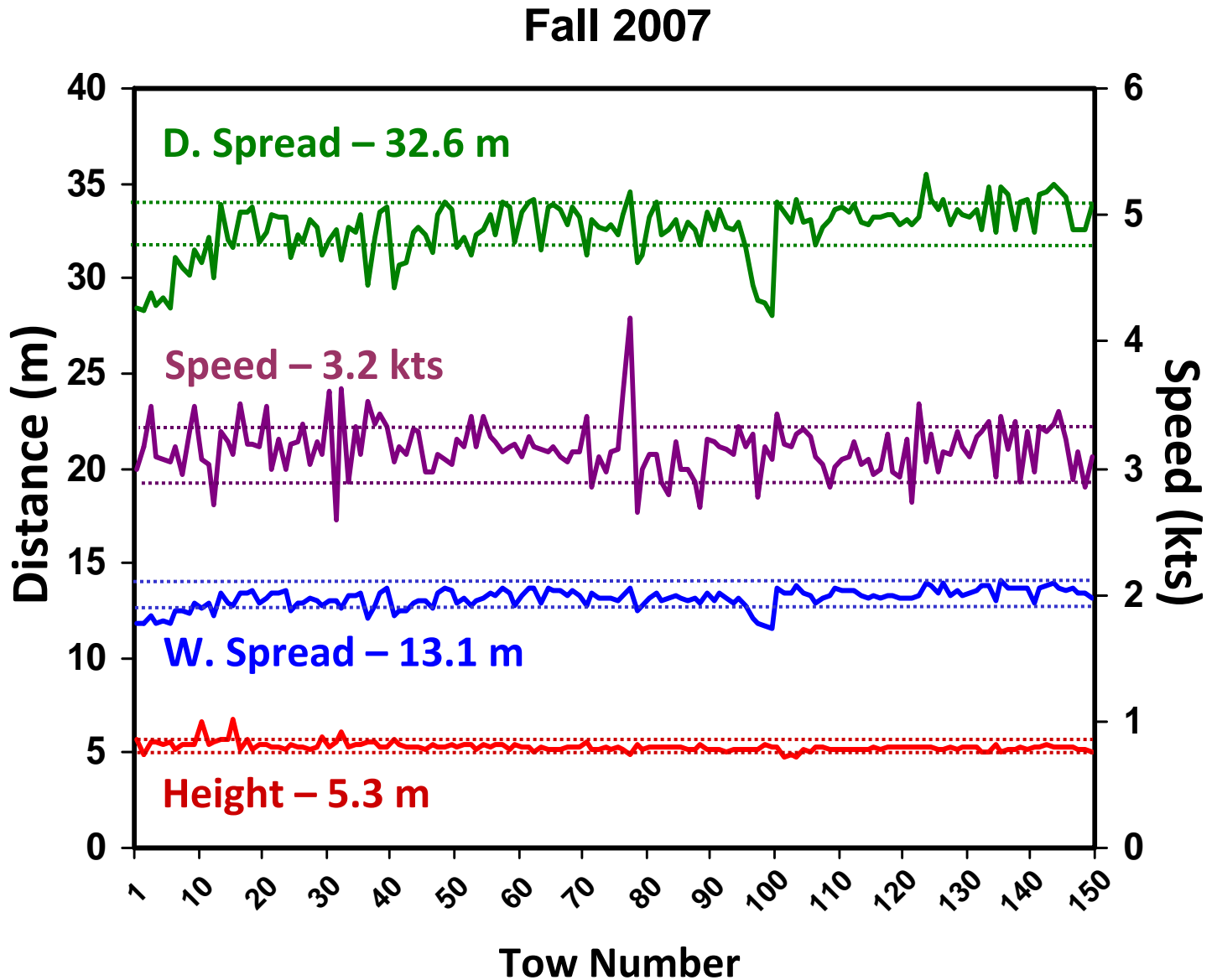


Figure 4. Performance of the NEAMAP Trawl Survey sampling gear during the Spring 2008 cruise. Tows are numbered sequentially along the x-axis; the first tow made during the Spring 2008 survey is given as 1, while the last tow of the cruise is 150. Points on the graph are tow averages for each of the respective parameters. Average door spreads (m) for each tow are given in green, average vessel speeds over ground (kts) in purple, average wing spreads (m) in blue, and average headline heights (m) in red. Cruise averages are given with each parameter. Optimal ranges for each parameter are represented by the horizontal dotted lines. Optimal door spreads are 32.0 m - 34.0 m, vessel speeds over ground are 2.9 kts - 3.3 kts, wing spreads are 13.0 m - 14.0 m, and headline heights are 5.0 m - 5.5 m.

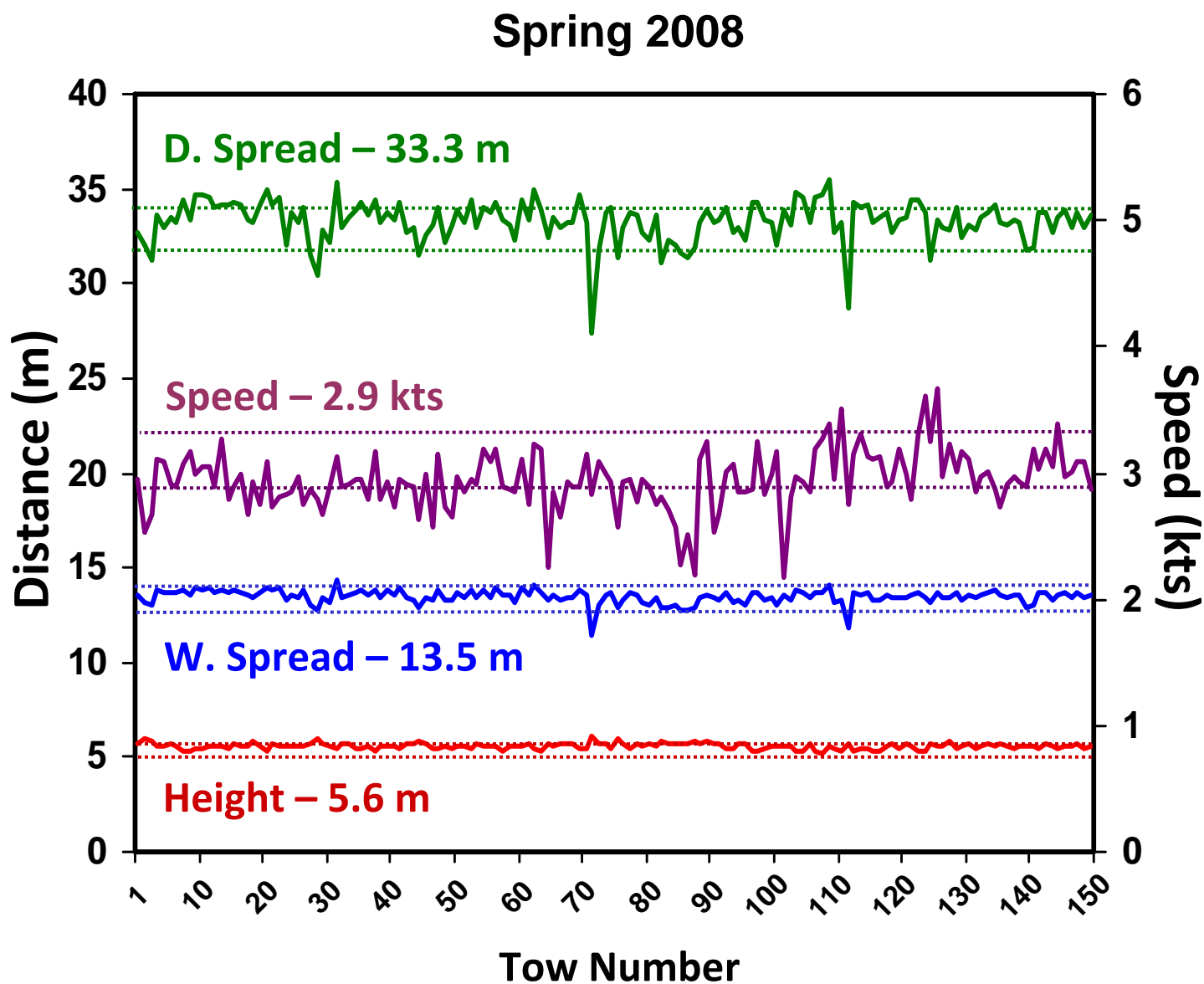


Figure 5. Performance of the NEAMAP Trawl Survey sampling gear during the Fall 2008 cruise. Tows are numbered sequentially along the x-axis; the first tow made during the Fall 2008 survey is given as 1, while the last tow of the cruise is 150. Points on the graph are tow averages for each of the respective parameters. Average door spreads (m) for each tow are given in green, average vessel speeds over ground (kts) in purple, average wing spreads (m) in blue, and average headline heights (m) in red. Cruise averages are given with each parameter. Optimal ranges for each parameter are represented by the horizontal dotted lines. Optimal door spreads are 32.0 m - 34.0 m, vessel speeds over ground are 2.9 kts - 3.3 kts, wing spreads are 13.0 m - 14.0 m, and headline heights are 5.0 m - 5.5 m.

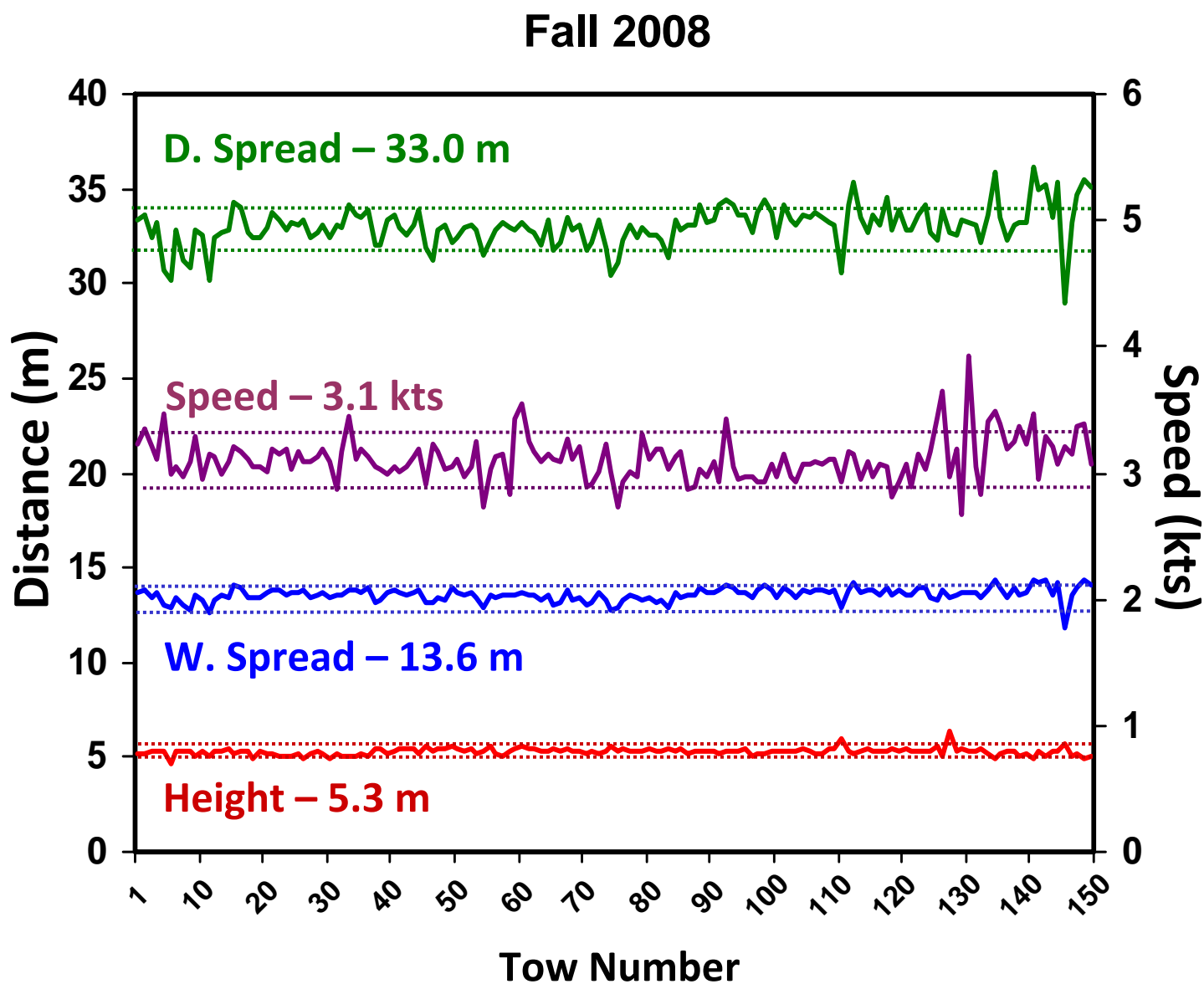
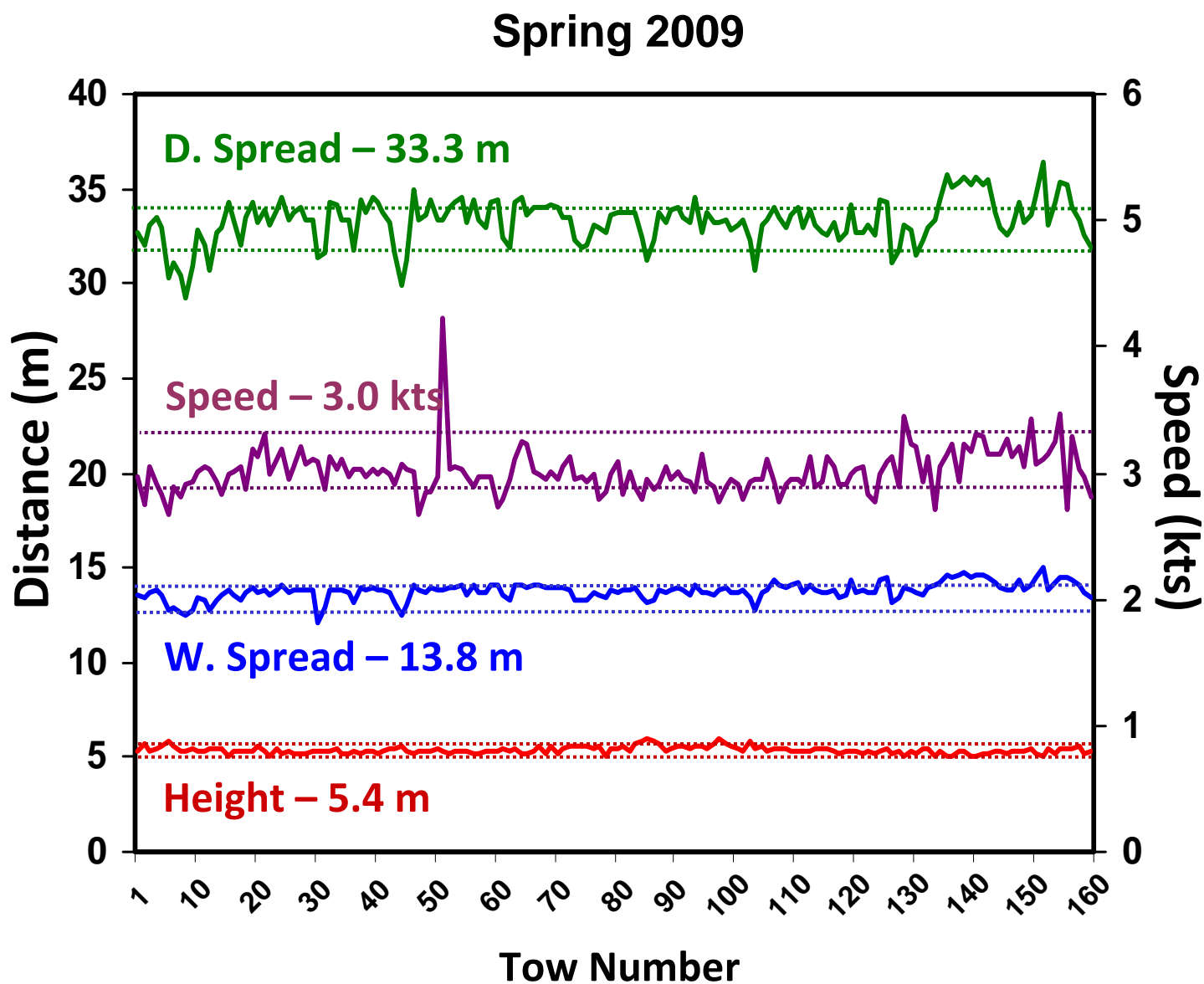


Figure 6. Performance of the NEAMAP Trawl Survey sampling gear during the Spring 2009 cruise. Tows are numbered sequentially along the x-axis; the first tow made during the Spring 2009 survey is given as 1, while the last tow of the cruise is 160. Points on the graph are tow averages for each of the respective parameters. Average door spreads (m) for each tow are given in green, average vessel speeds over ground (kts) in purple, average wing spreads (m) in blue, and average headline heights (m) in red. Cruise averages are given with each parameter. Optimal ranges for each parameter are represented by the horizontal dotted lines. Optimal door spreads are 32.0 m - 34.0 m, vessel speeds over ground are 2.9 kts - 3.3 kts, wing spreads are 13.0 m - 14.0 m, and headline heights are 5.0 m - 5.5 m.







# Alewife (Priority C)



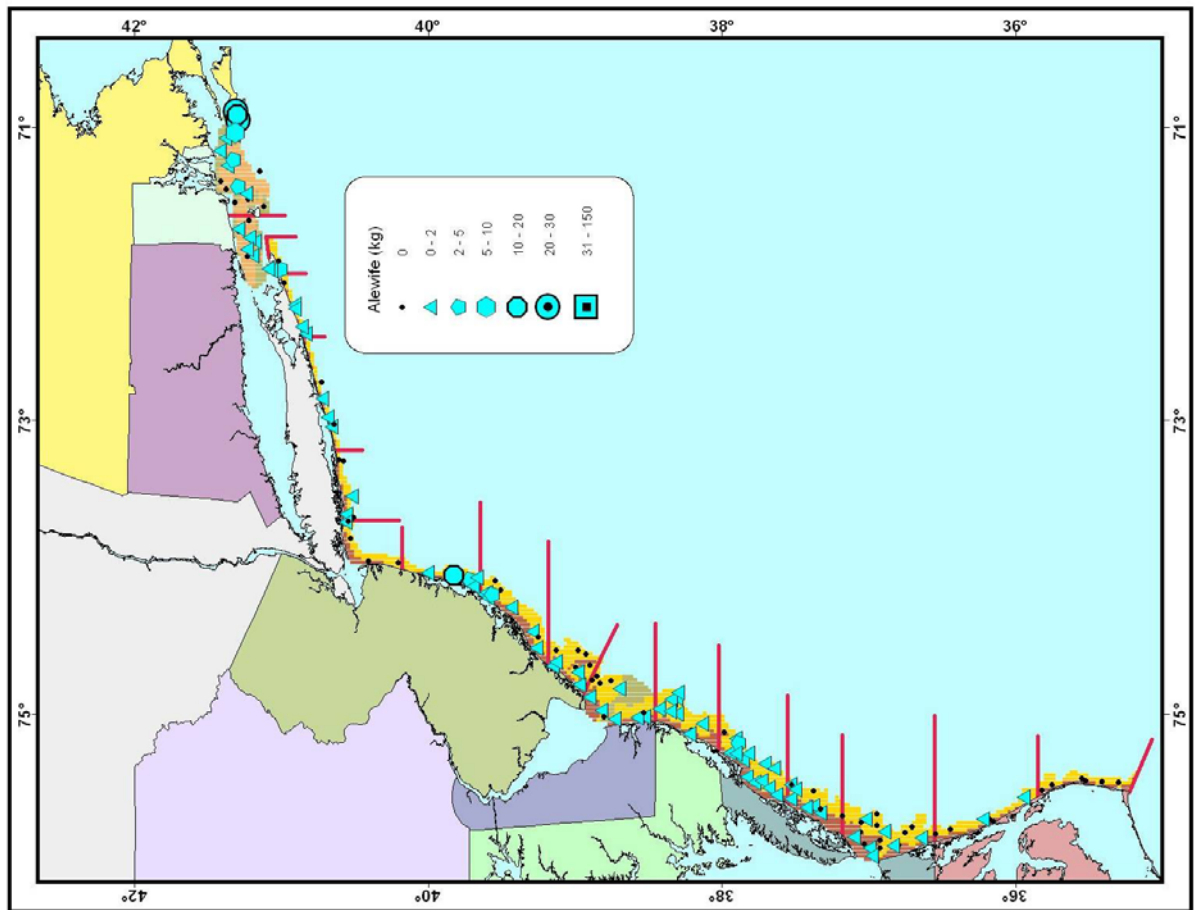
Table 6. Sampling rates and abundance indices of alewife for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	56	3.1	56	24	0	24	0	0.09	0.38
2008	Spring	2,419	141.8	1,572	350	0	344	5	2.27	0.27
	Fall	5	0.3	5	5	0	5	0	0.02	0.02
2009	Spring	2,955	233.0	1,225	235	0	235	0	1.23	0.00

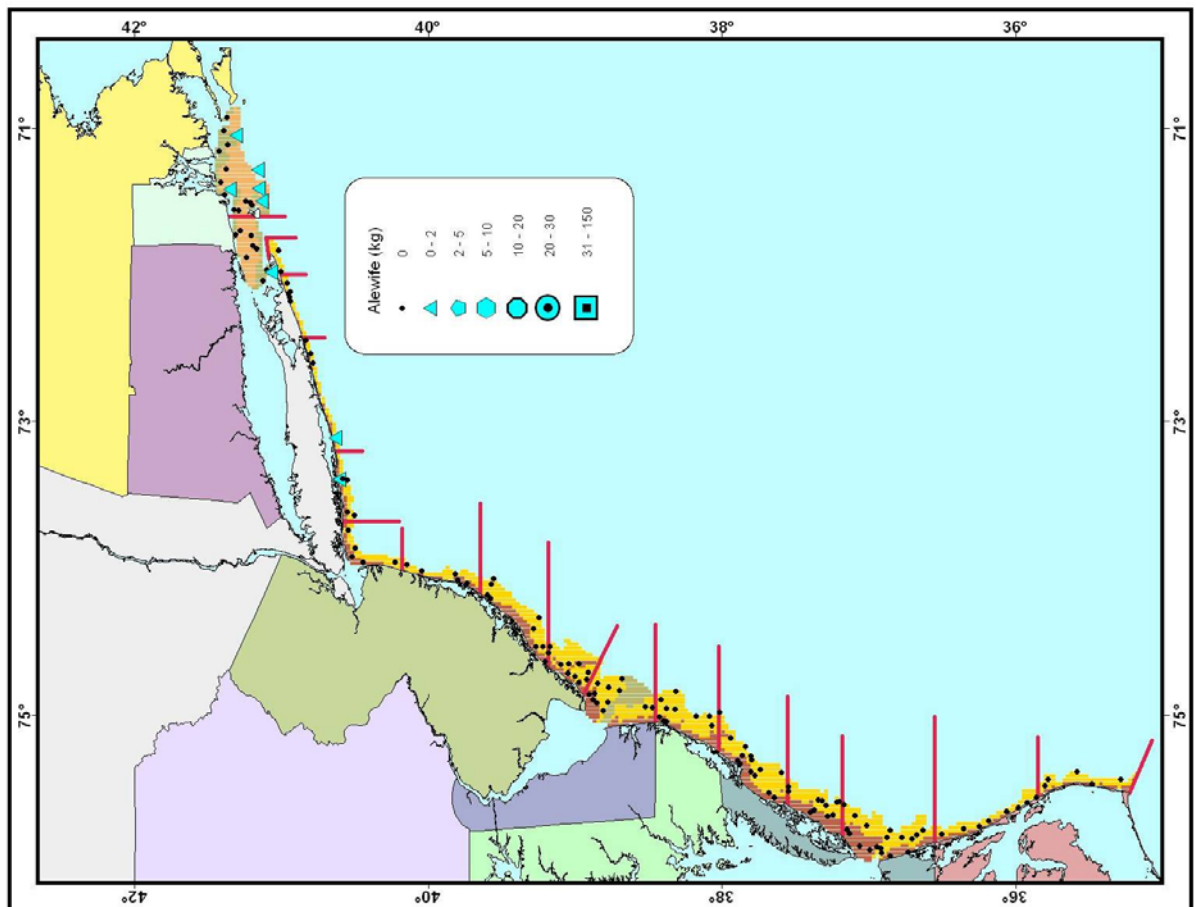


Figure 7. Biomass (kg) of alewife collected at each sampling site for four NEAMAP cruises.

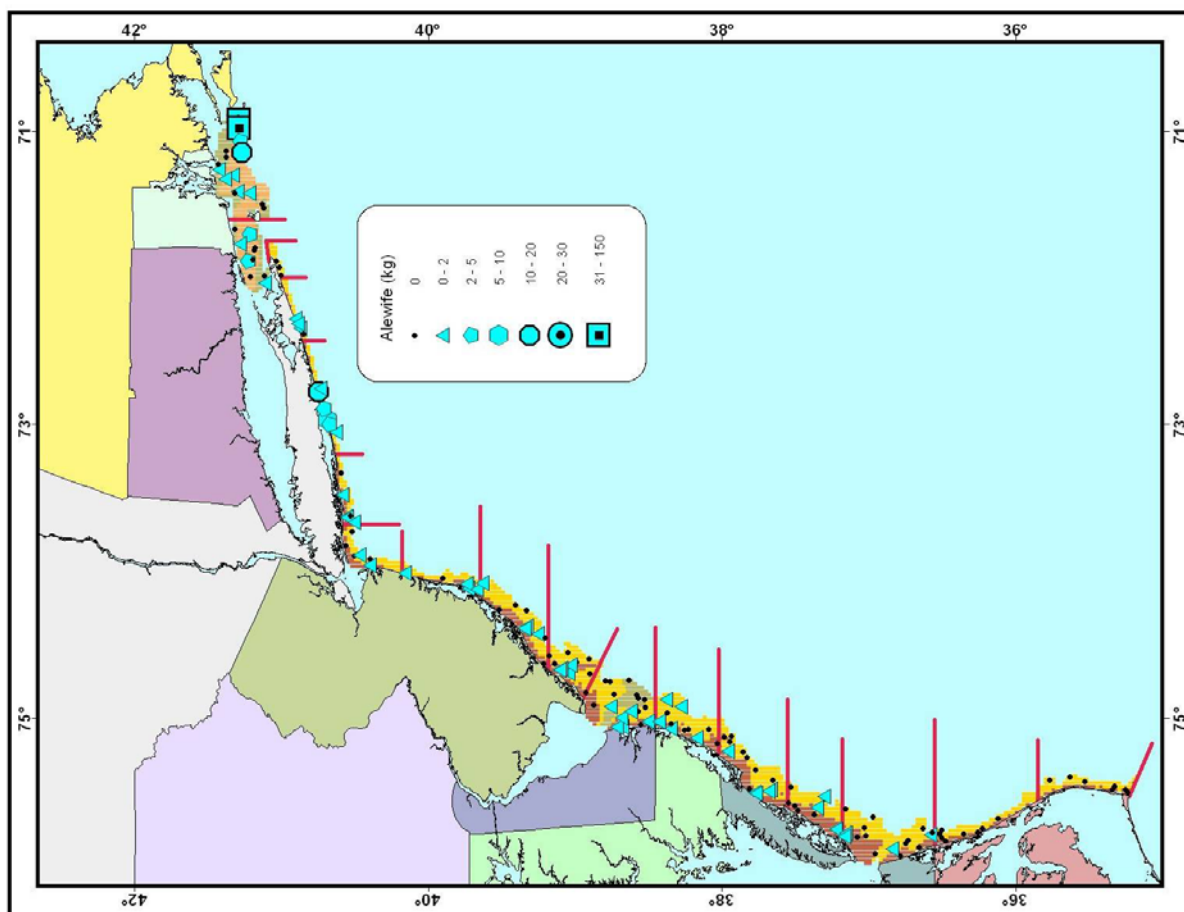
Spring 2008



Fall 2007



Spring 2009



Fall 2008

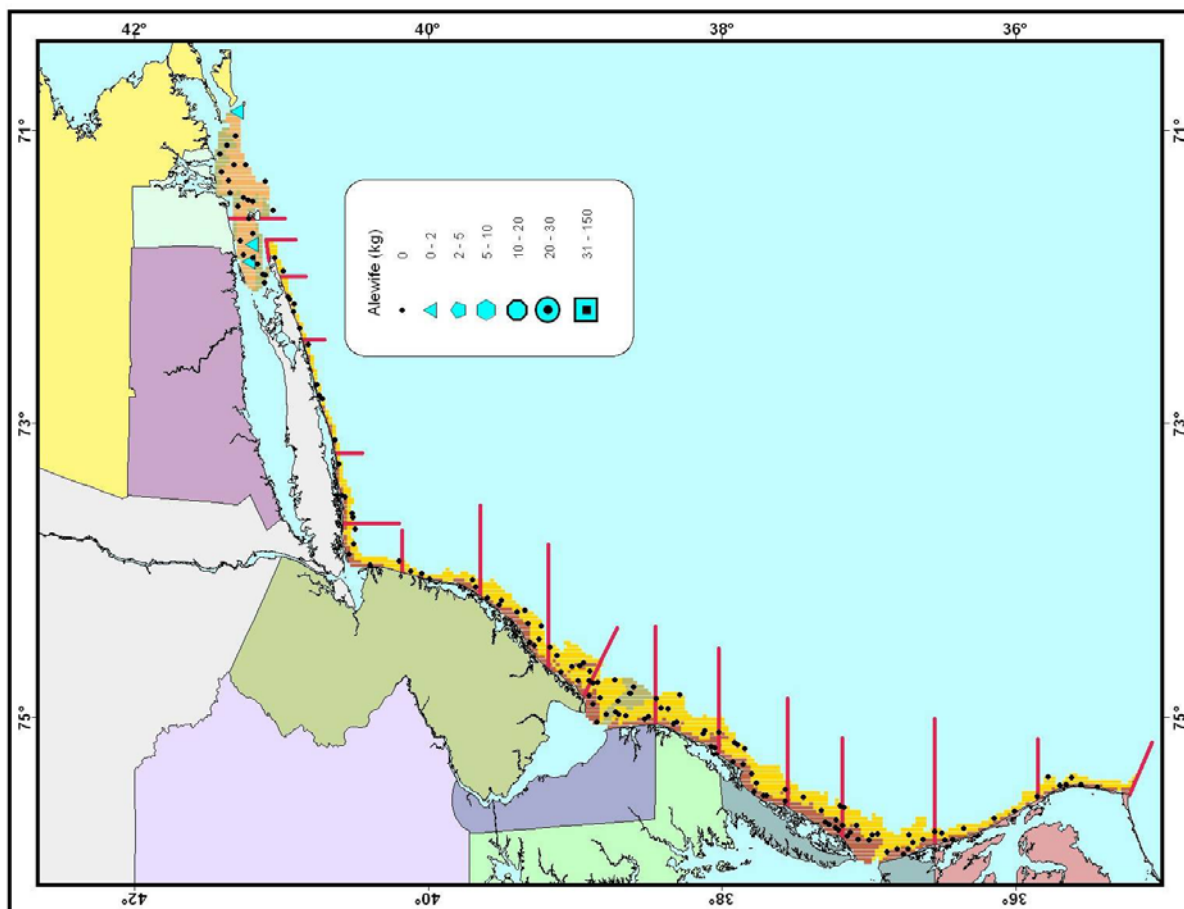


Figure 8. Preliminary indices of abundance, in terms of number and biomass, of alewife for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

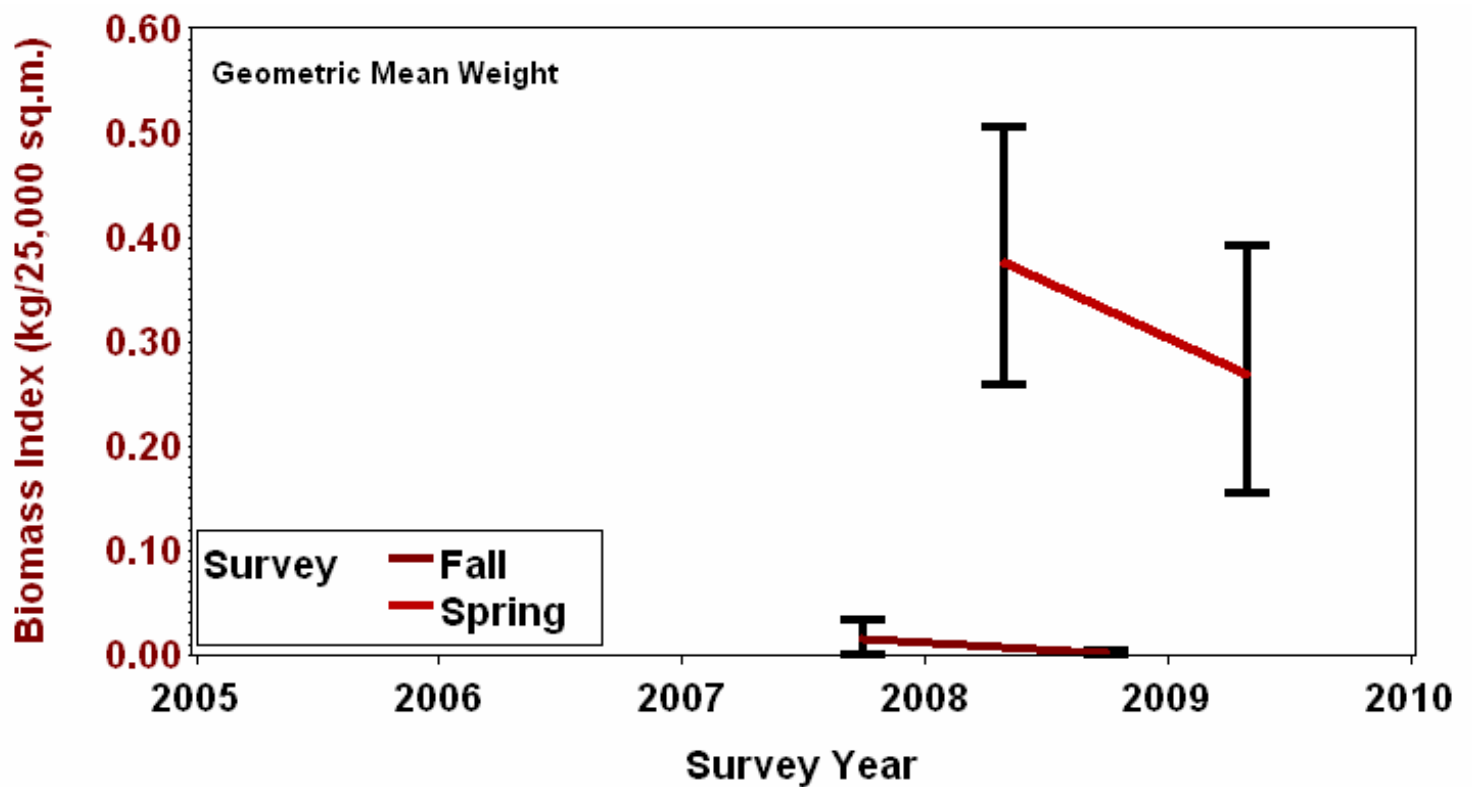
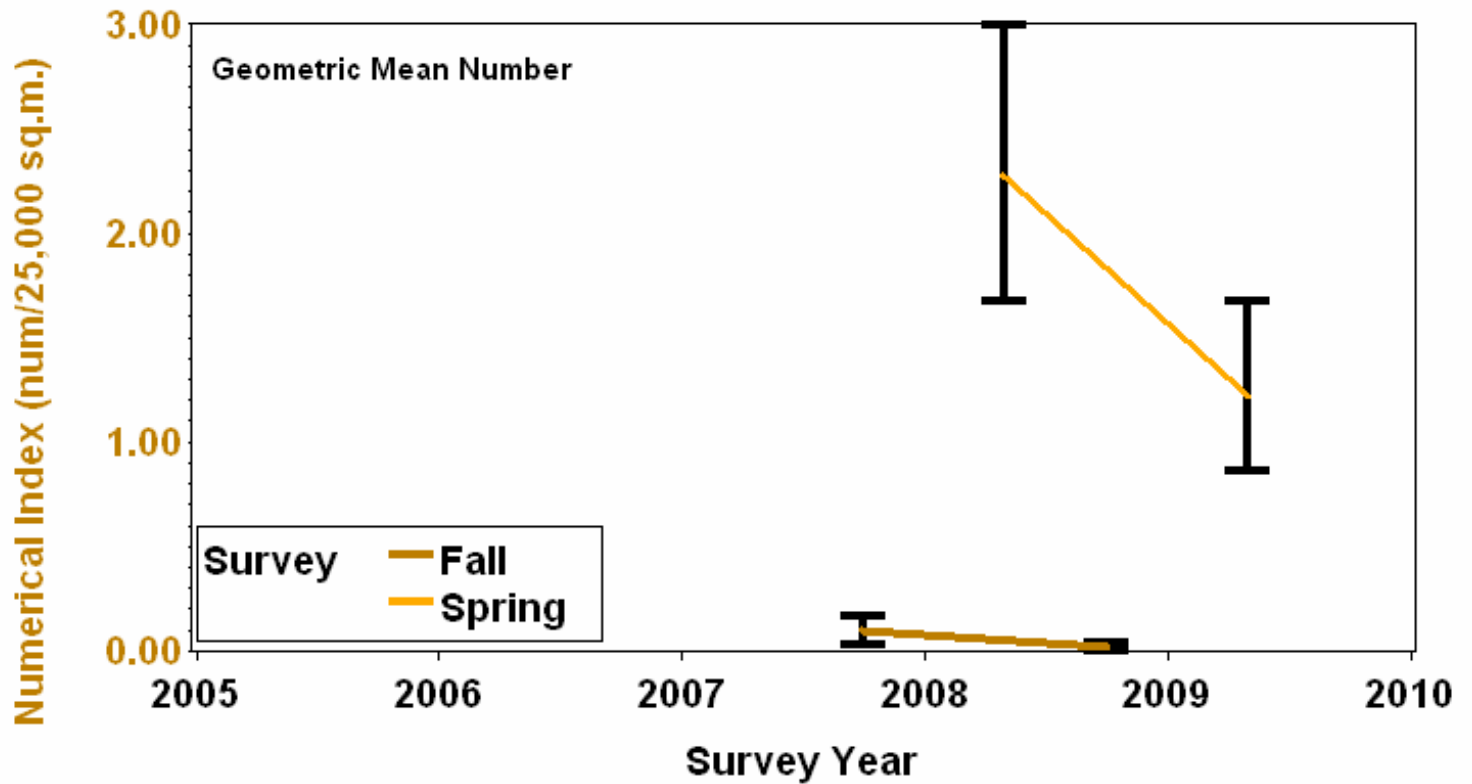


Figure 9. Length-frequency distributions, by cruise, for alewife. Numbers taken for full processing, by length, are represented by the orange bars.

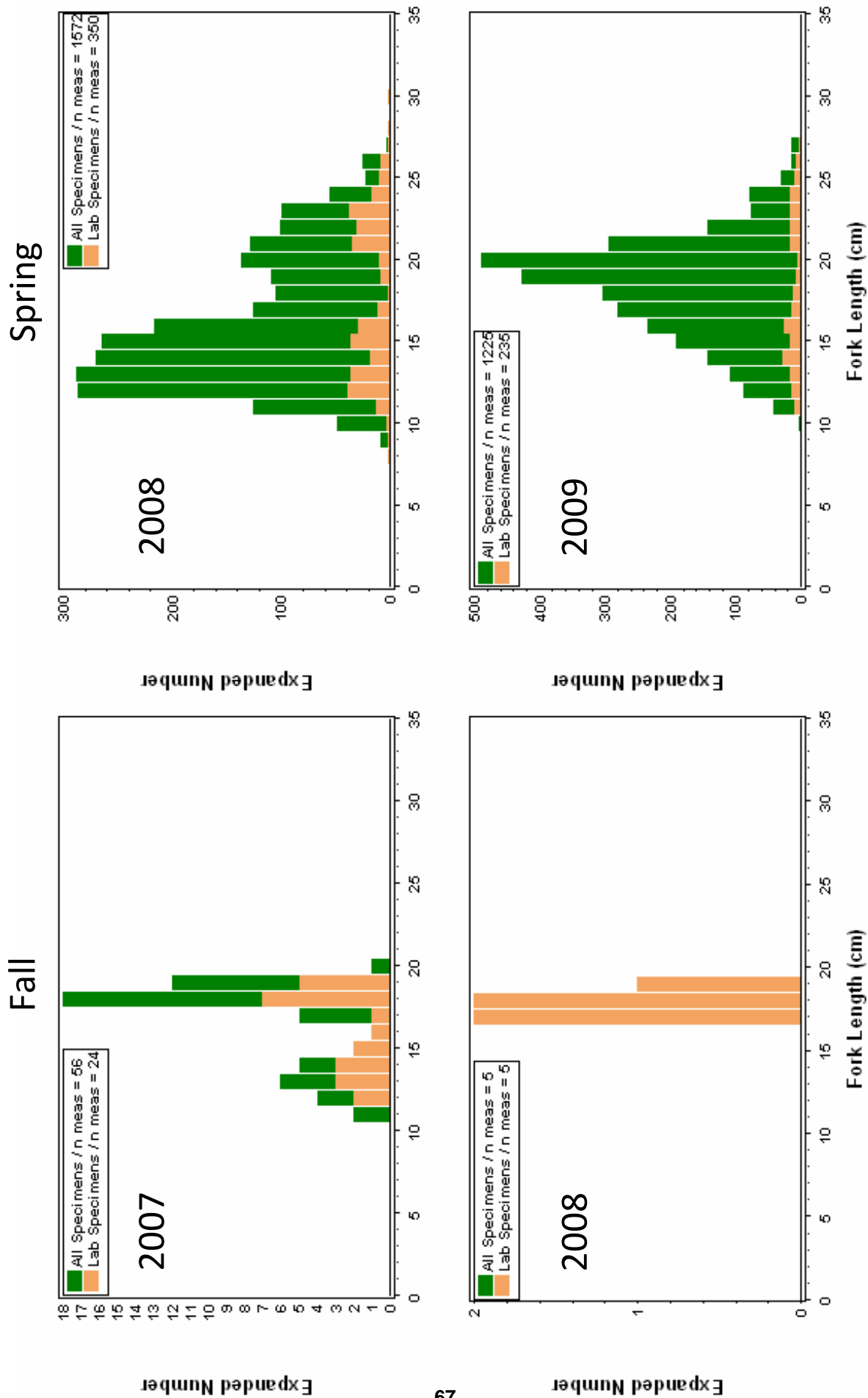
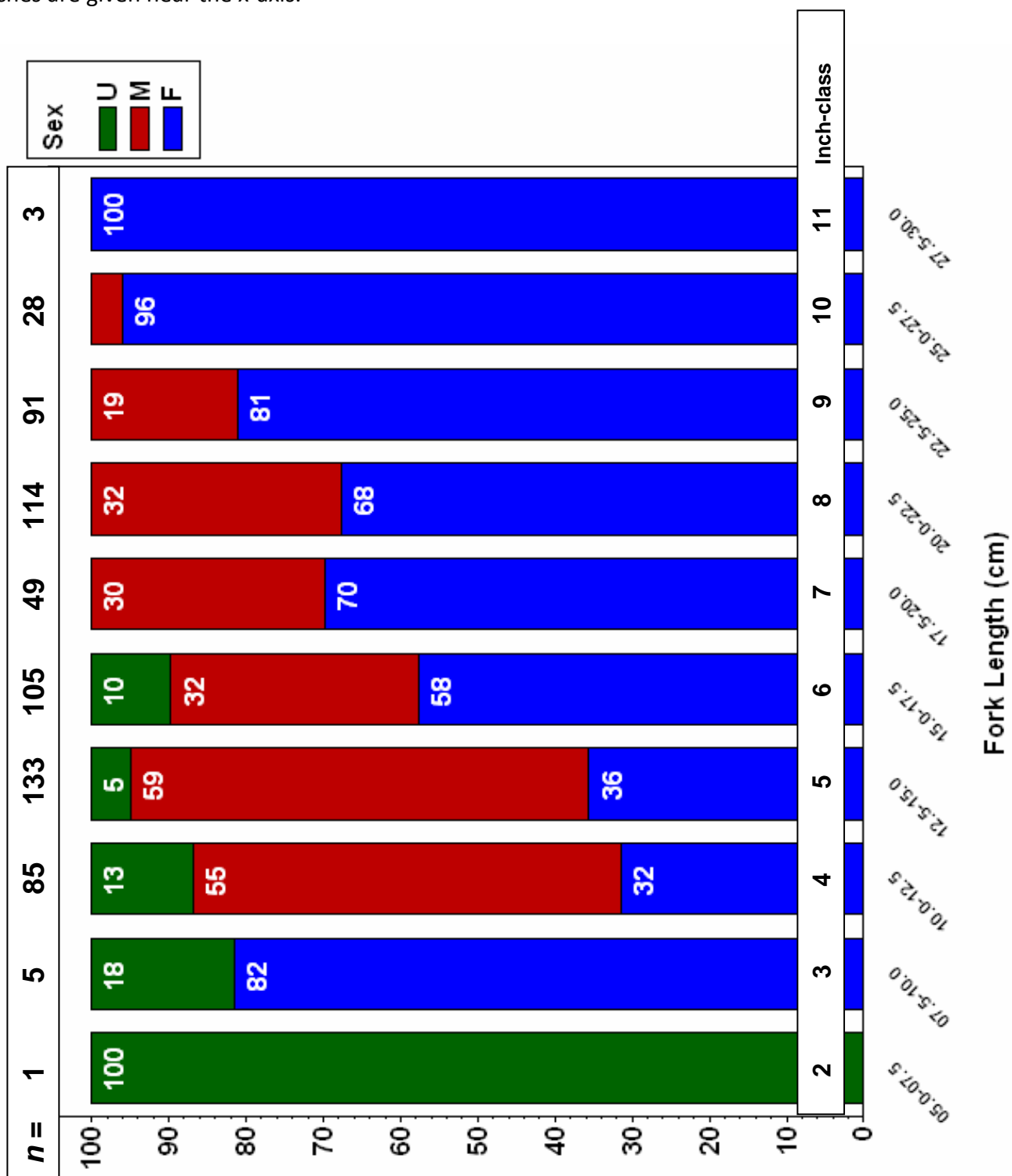


Figure 10. Sex ratio, by length group, for alewife collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



# American Lobster (Priority E)

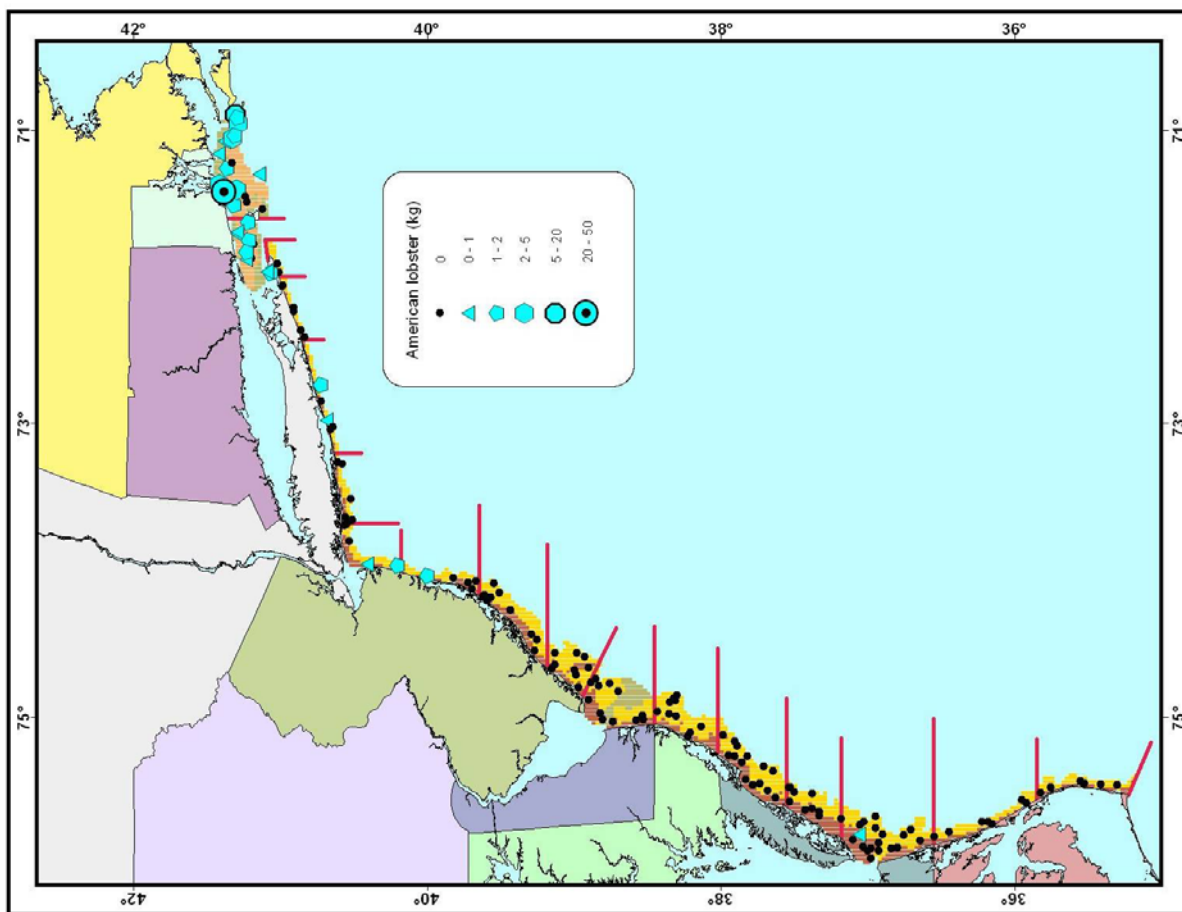


Table 7. Sampling rates and abundance indices of American lobster for four NEAMAP cruises.

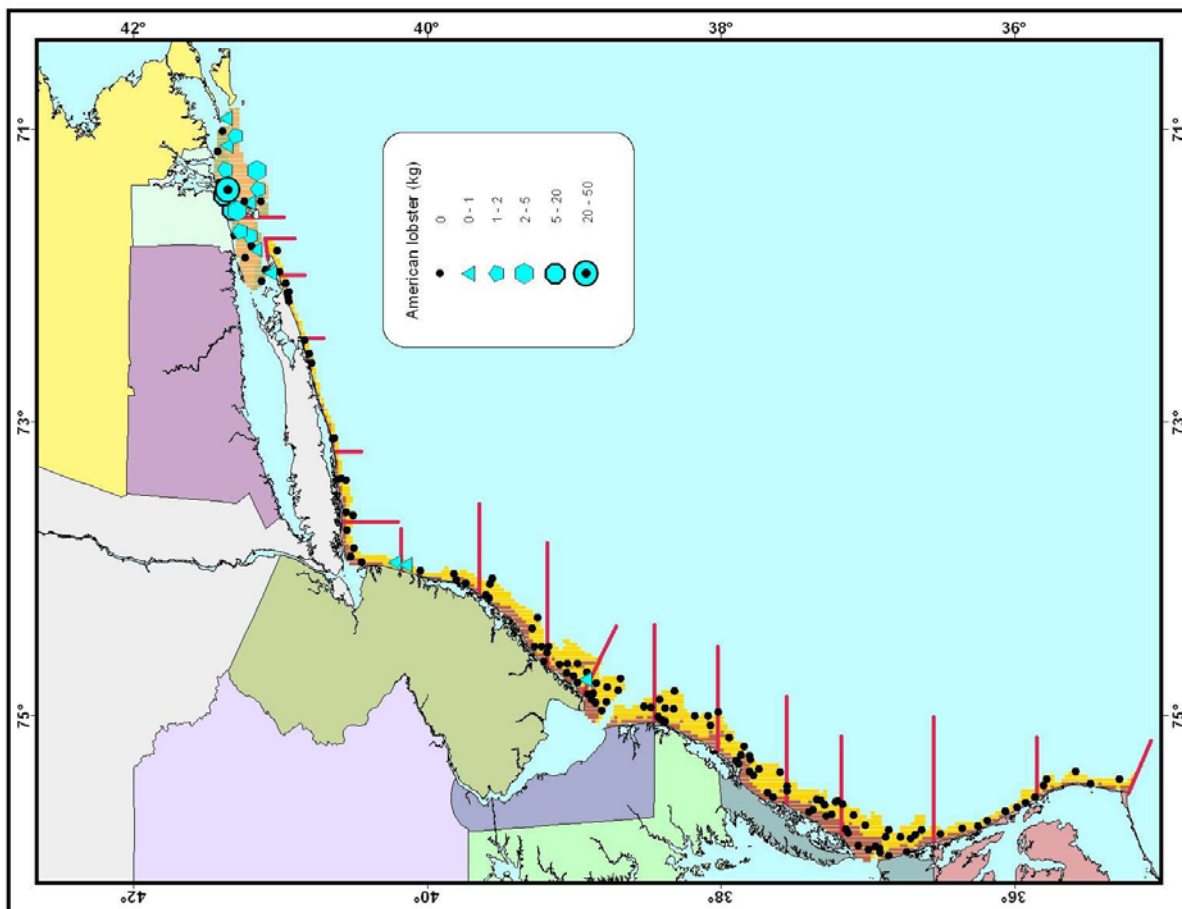
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	262	59.0	262	0		0		0.30	0.14
2008	Spring	519	89.8	286	0		0		0.47	0.21
	Fall	352	80.6	178	0		0		0.36	0.16
2009	Spring	290	89.9	248	0		0		0.37	0.20

Figure 11. Biomass (kg) of American lobster collected at each sampling site for four NEAMAP cruises.

Spring 2008

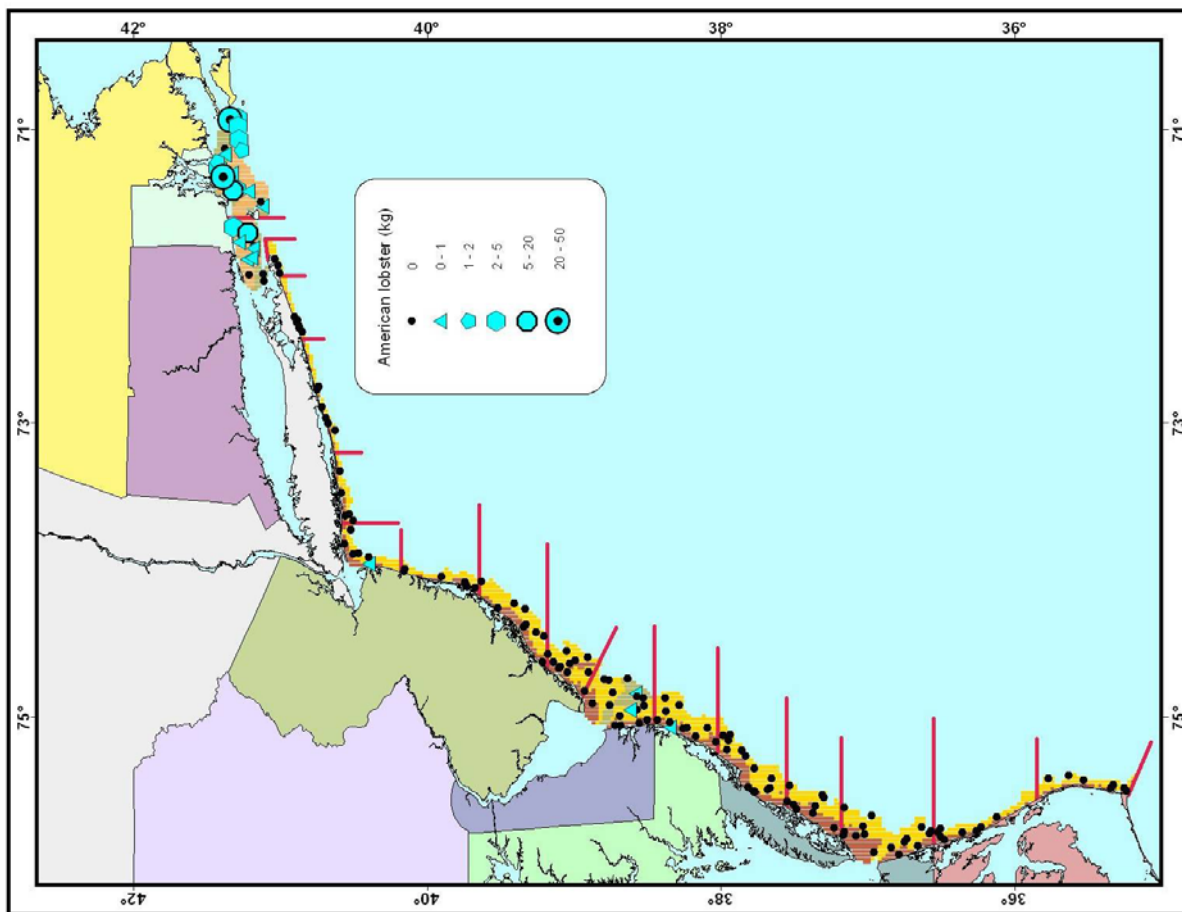


Fall 2007





Spring 2009



Fall 2008

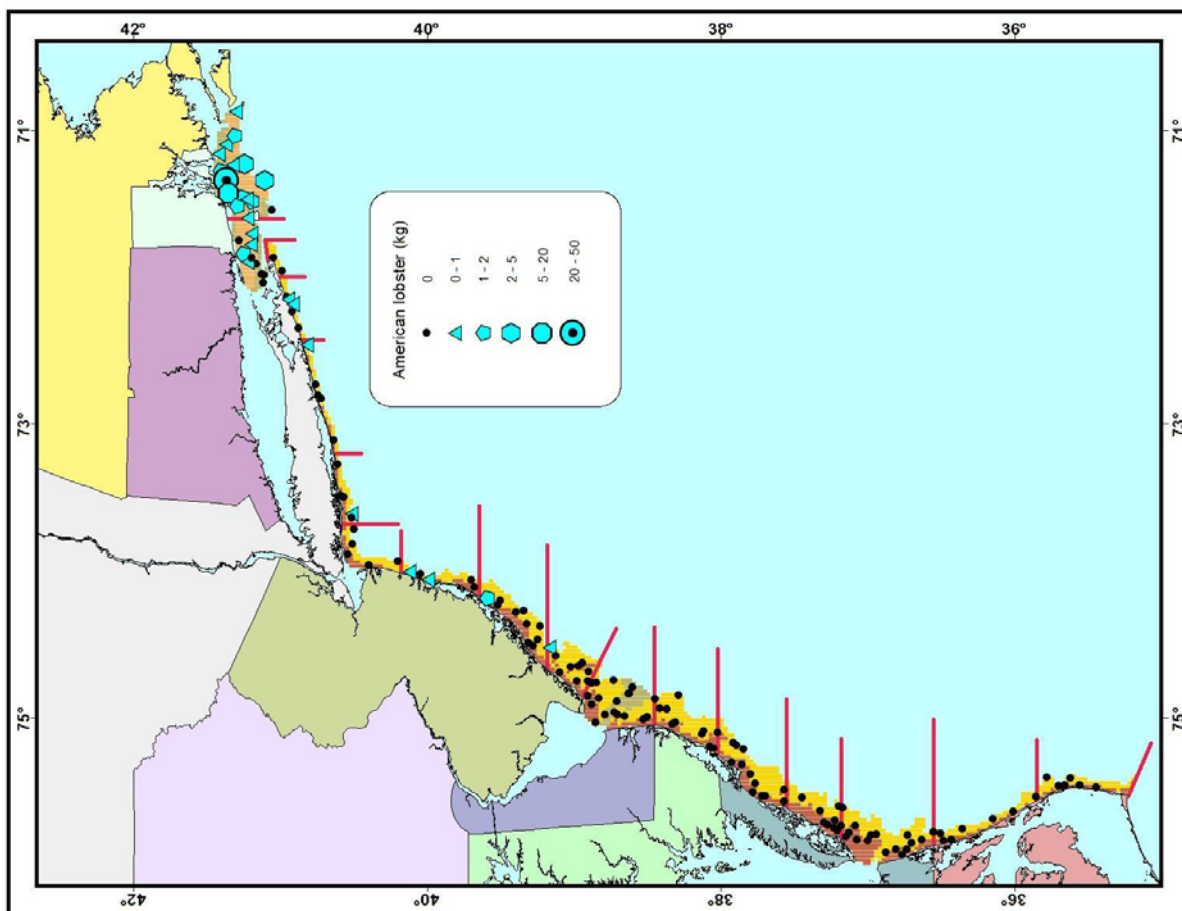




Figure 12. Preliminary indices of abundance, in terms of number and biomass, of American lobster for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

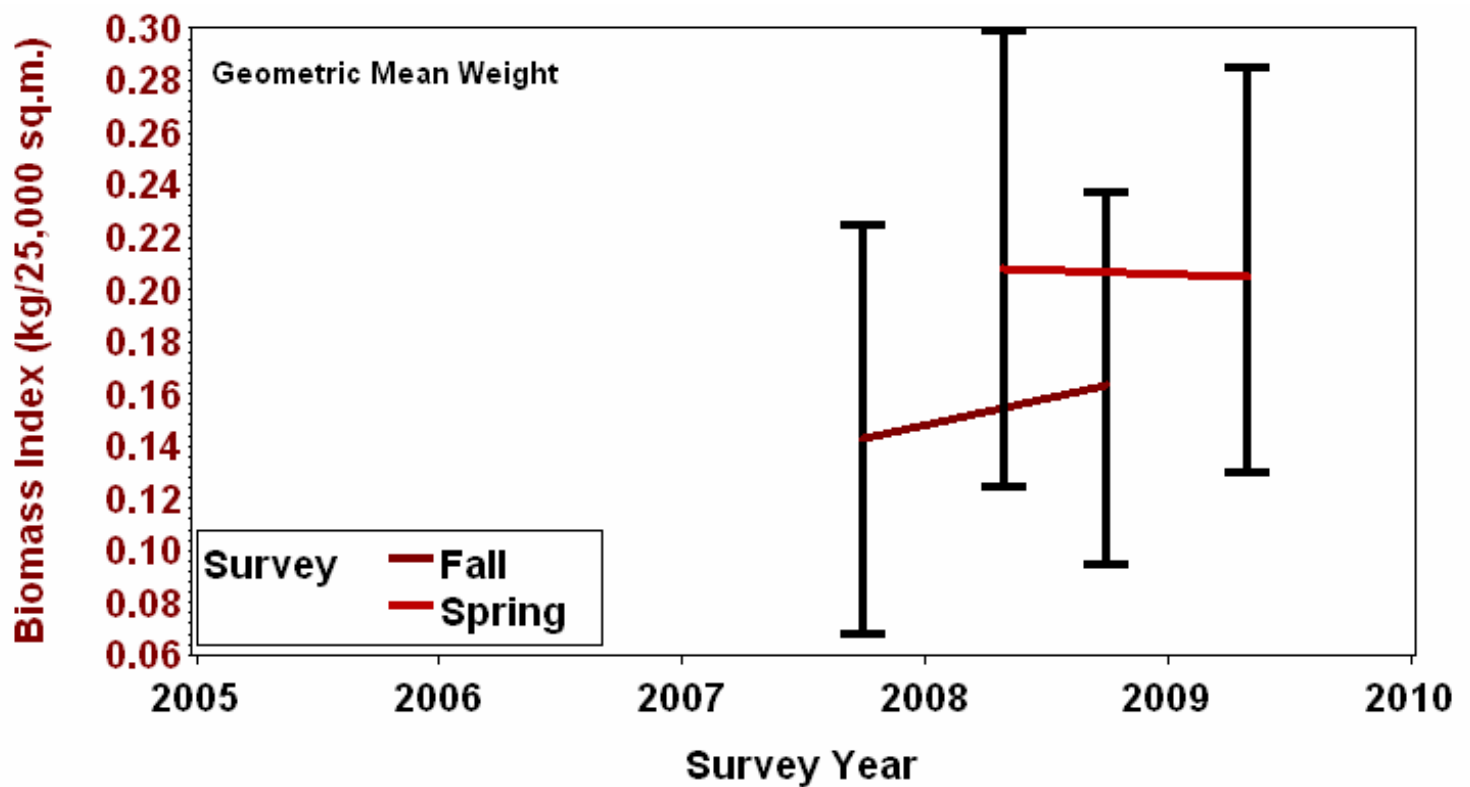
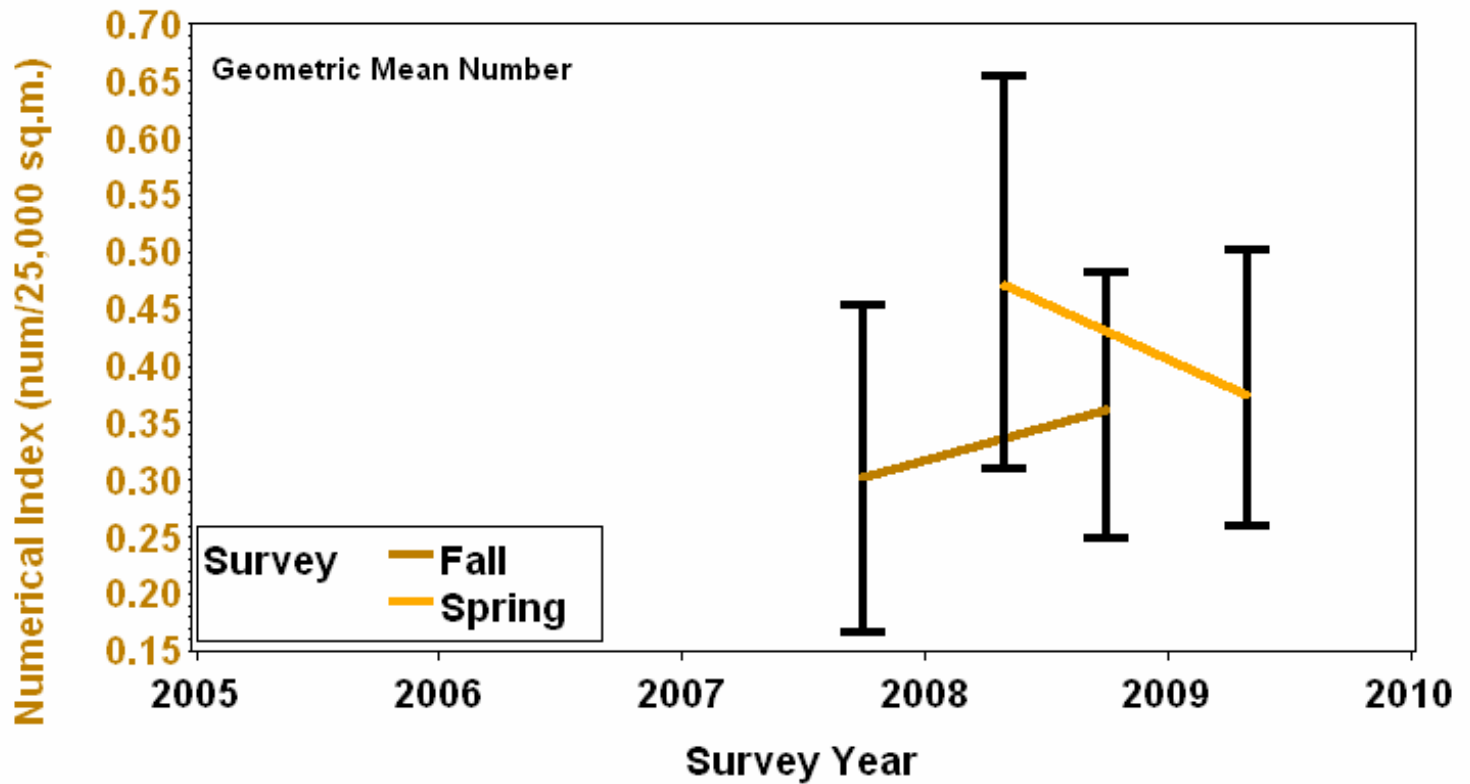


Figure 13. Length-frequency distributions, by cruise, for American lobster.

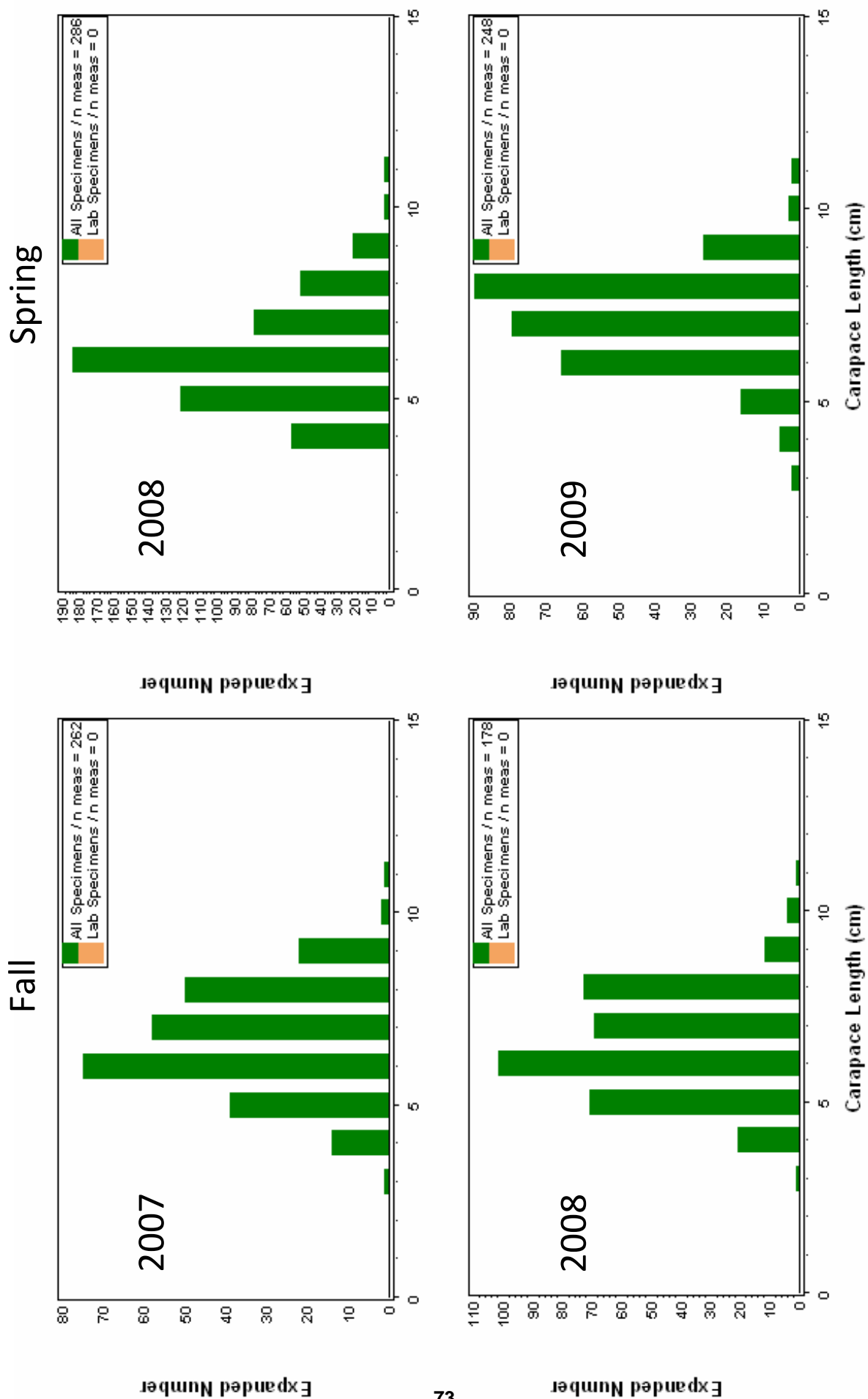
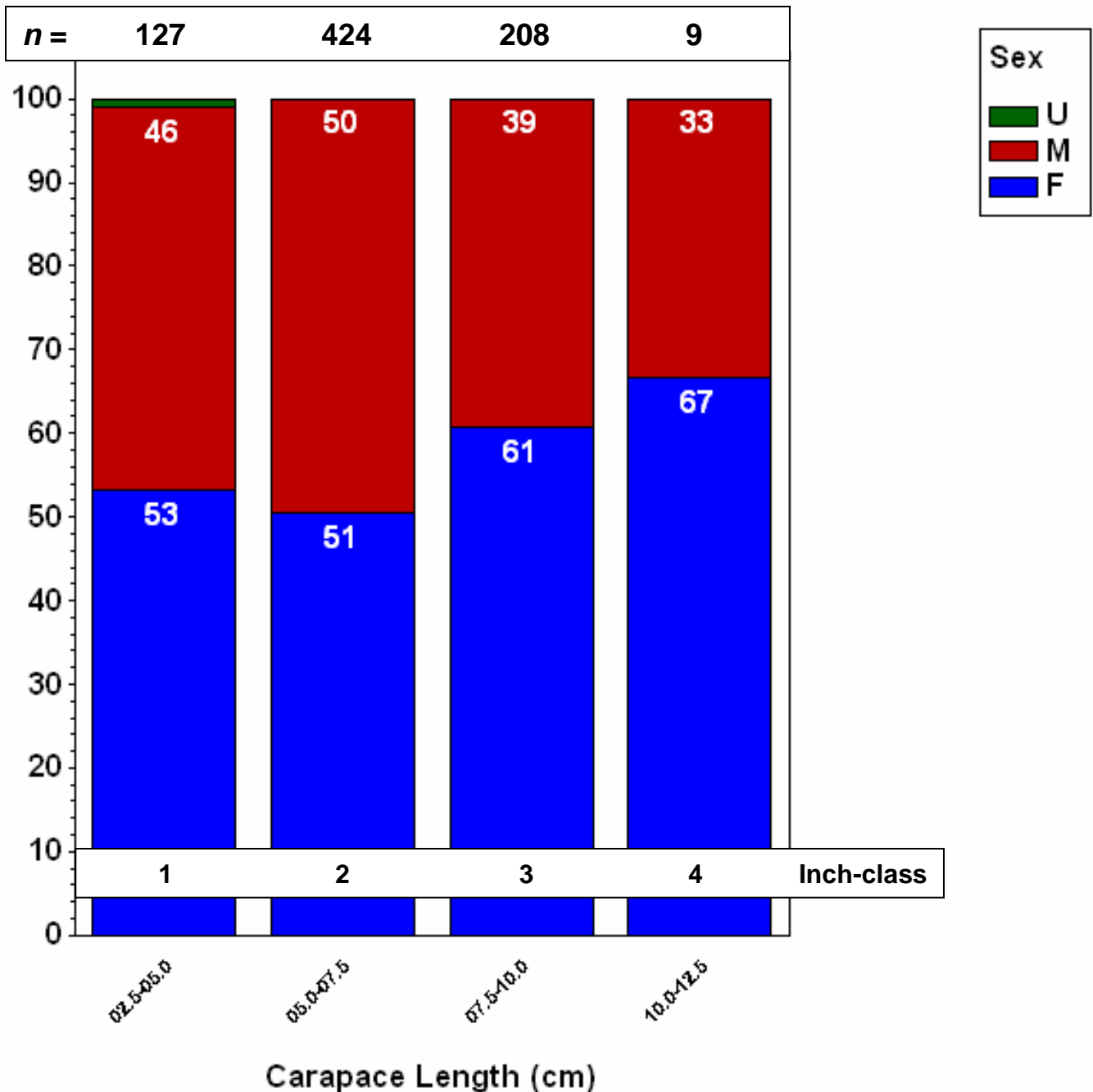


Figure 14. Sex ratio, by length group, for American lobster collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



# American Shad (Priority B)

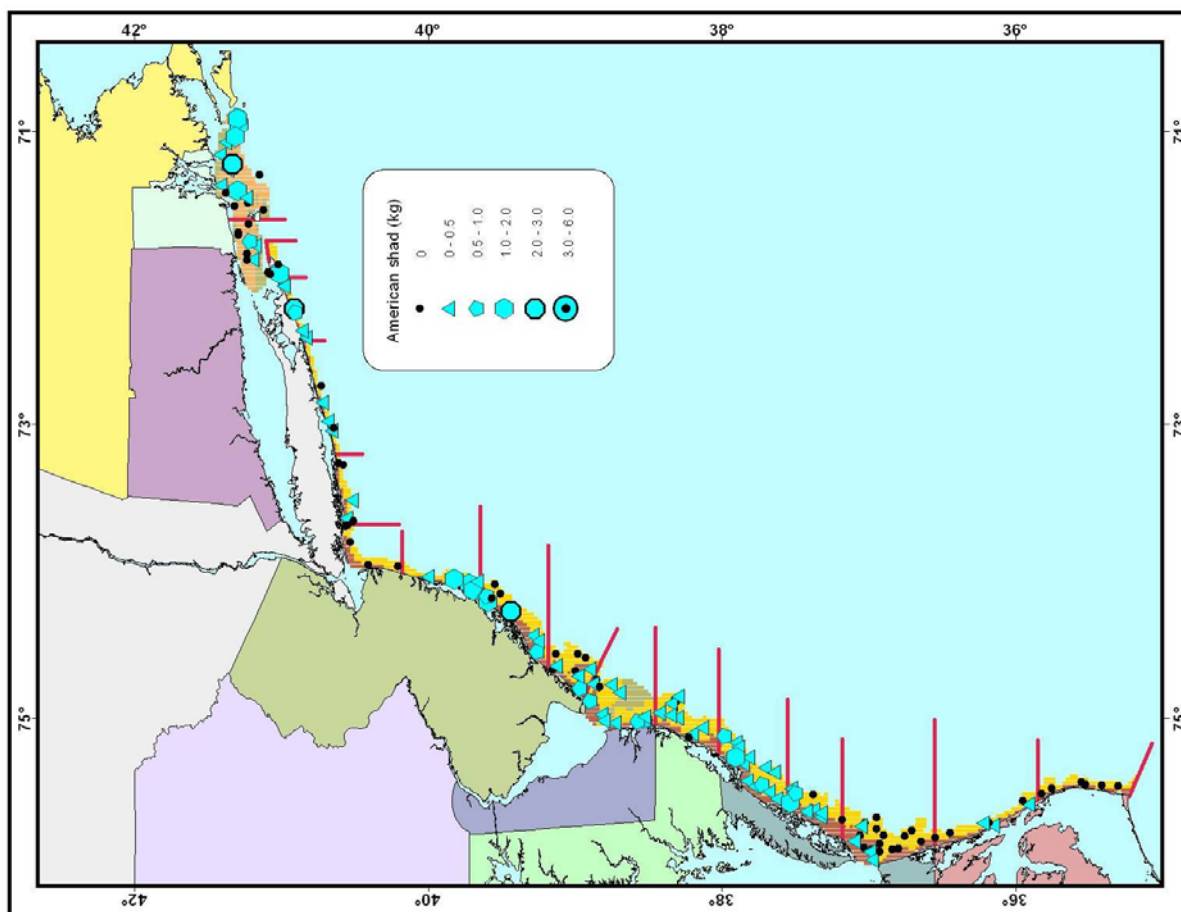


Table 8. Sampling rates and abundance indices of American shad for four NEAMAP cruises.

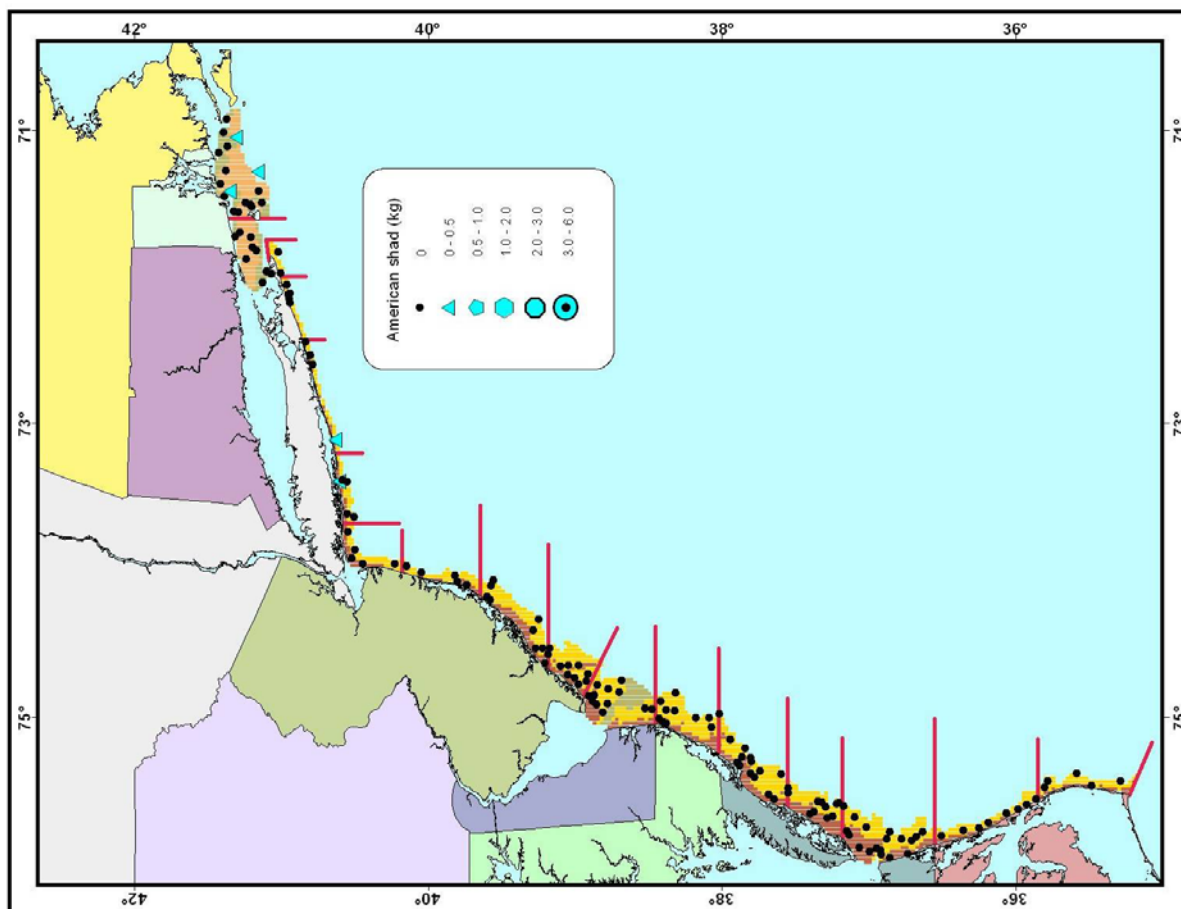
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	9	0.8	9	9	0	9	0	0.03	0.01
2008	Spring	1,205	40.8	1,205	327	0	321	0	2.35	0.20
	Fall	9	0.5	9	5	0	5	0	0.02	0.00
2009	Spring	1,141	33.2	859	260	0	260	1	1.47	0.14

Figure 15. Biomass (kg) of American shad collected at each sampling site for four NEAMAP cruises.

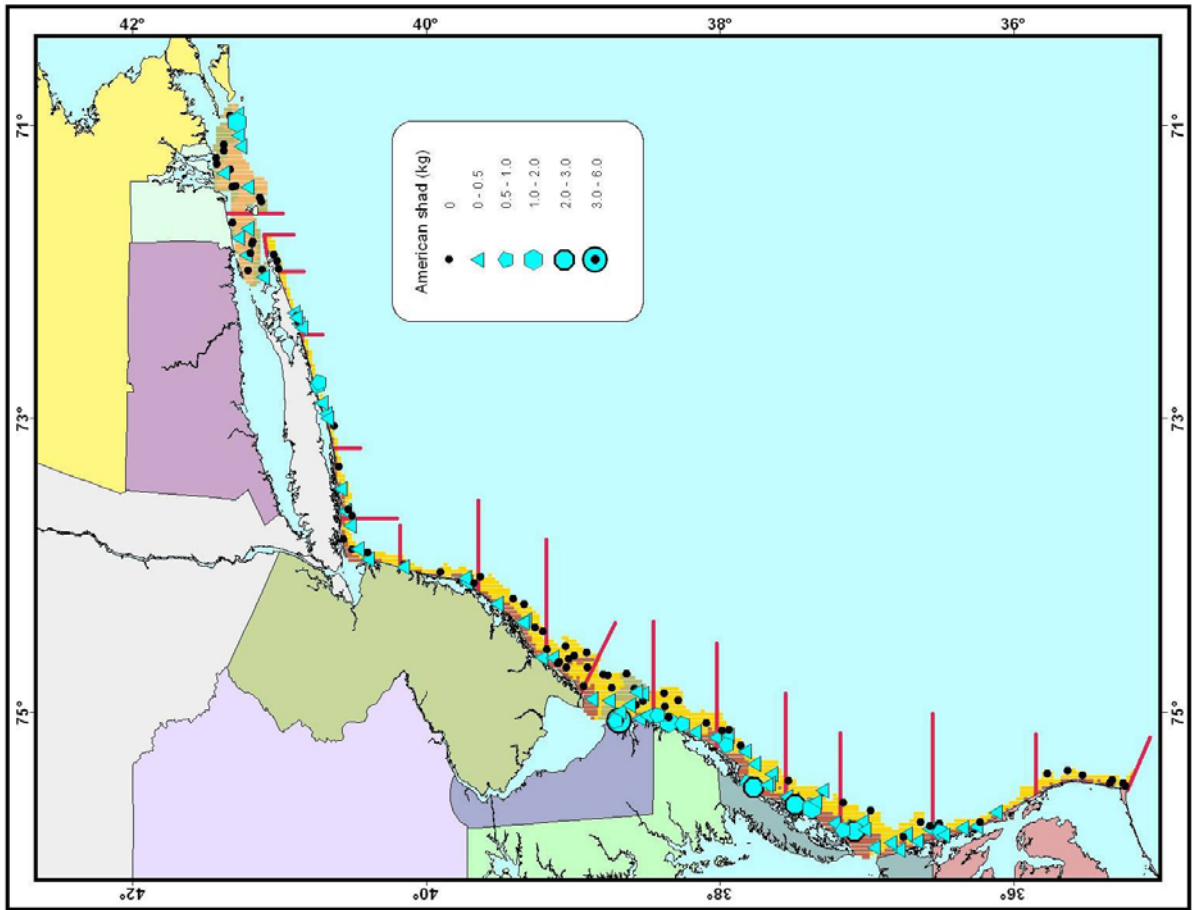
Spring 2008



Fall 2007



Spring 2009



Fall 2008

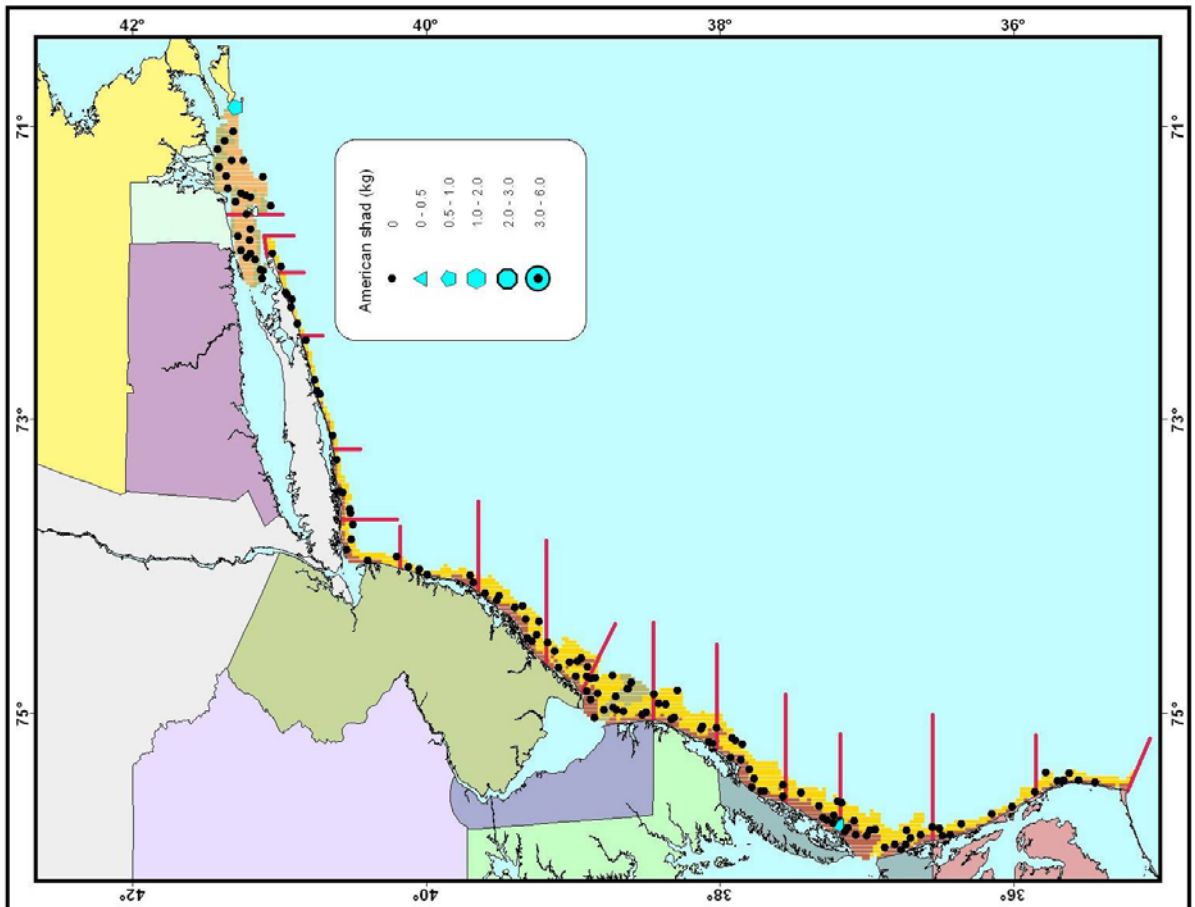


Figure 16. Preliminary indices of abundance, in terms of number and biomass, of American shad for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

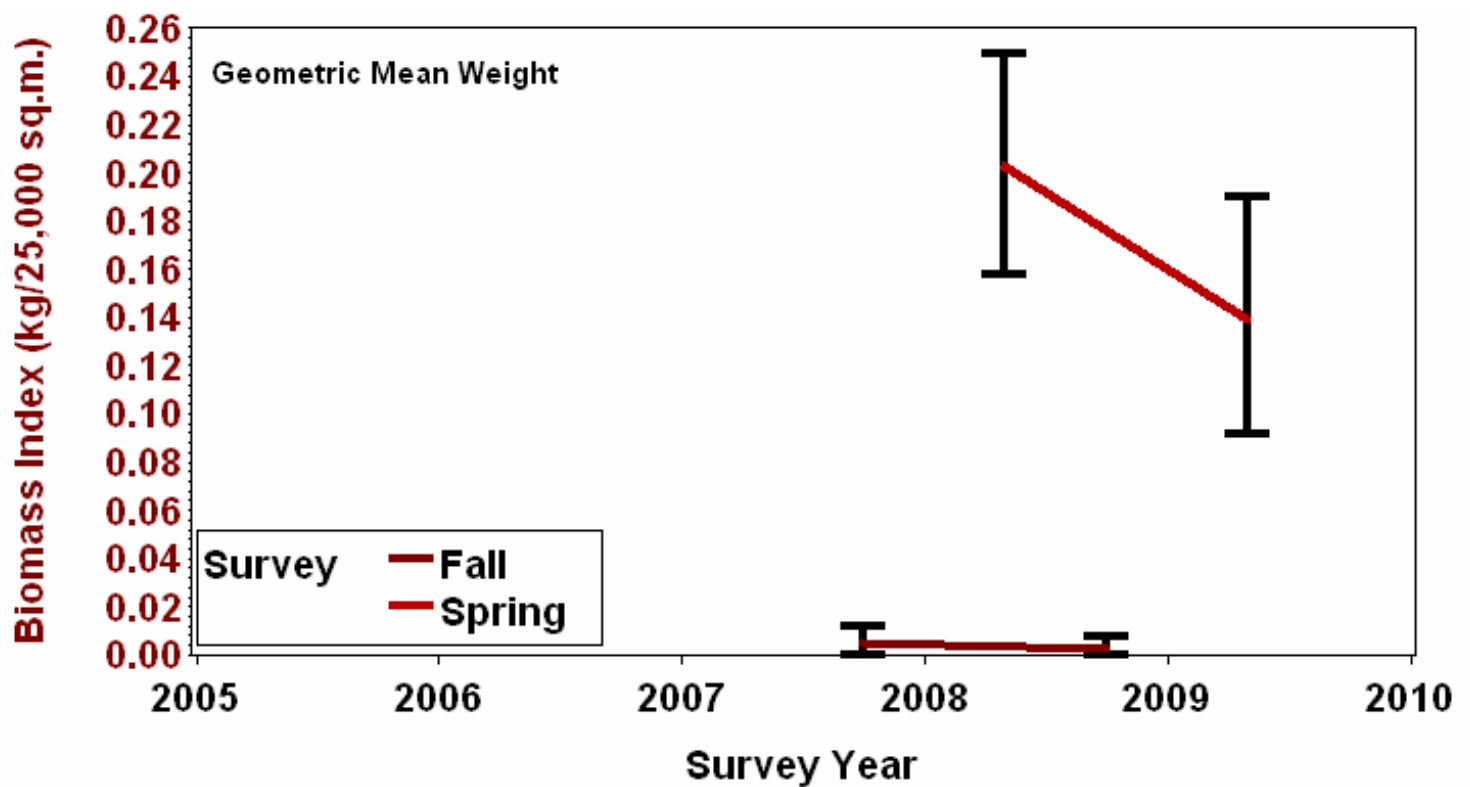
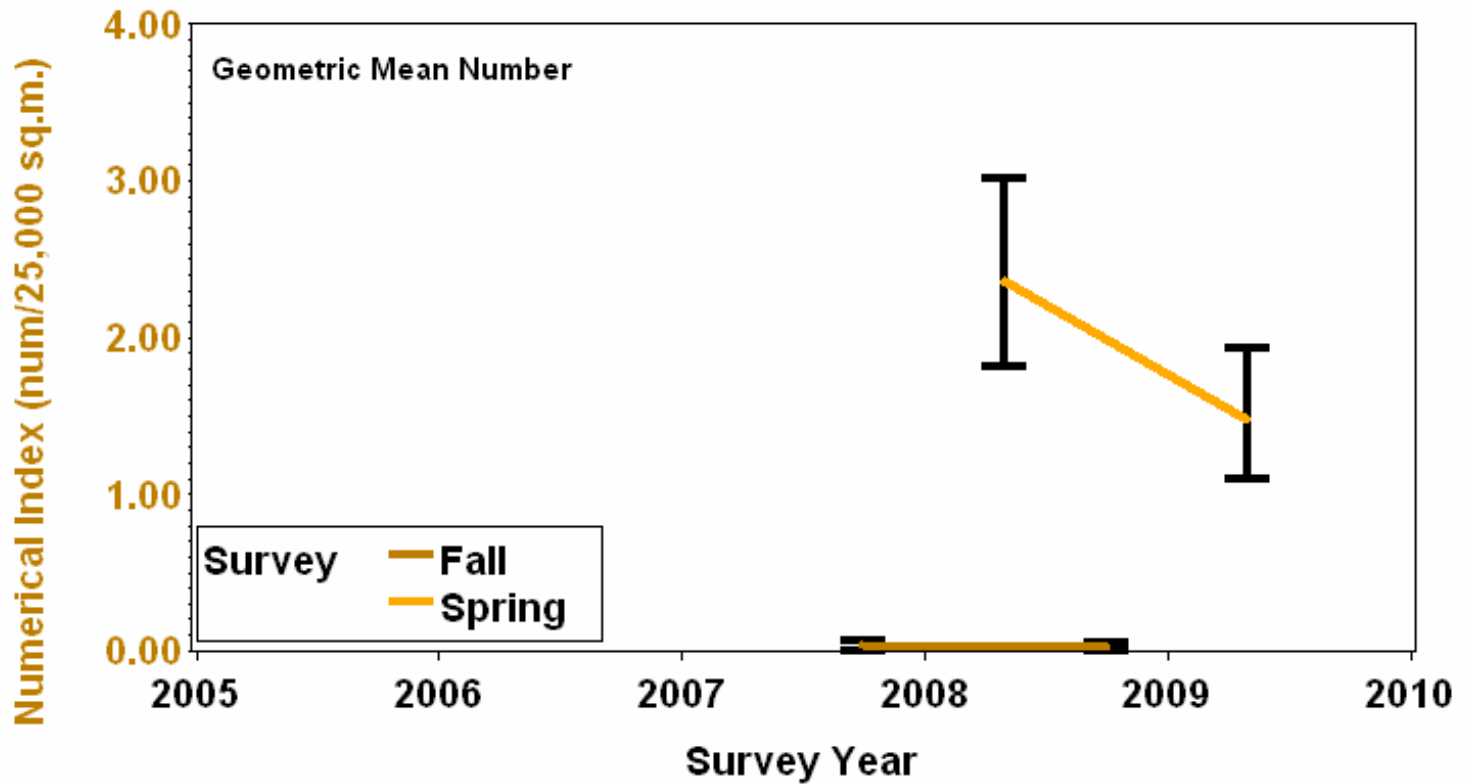


Figure 17. Length-frequency distributions, by cruise, for American shad. Numbers taken for full processing, by length, are represented by the orange bars.

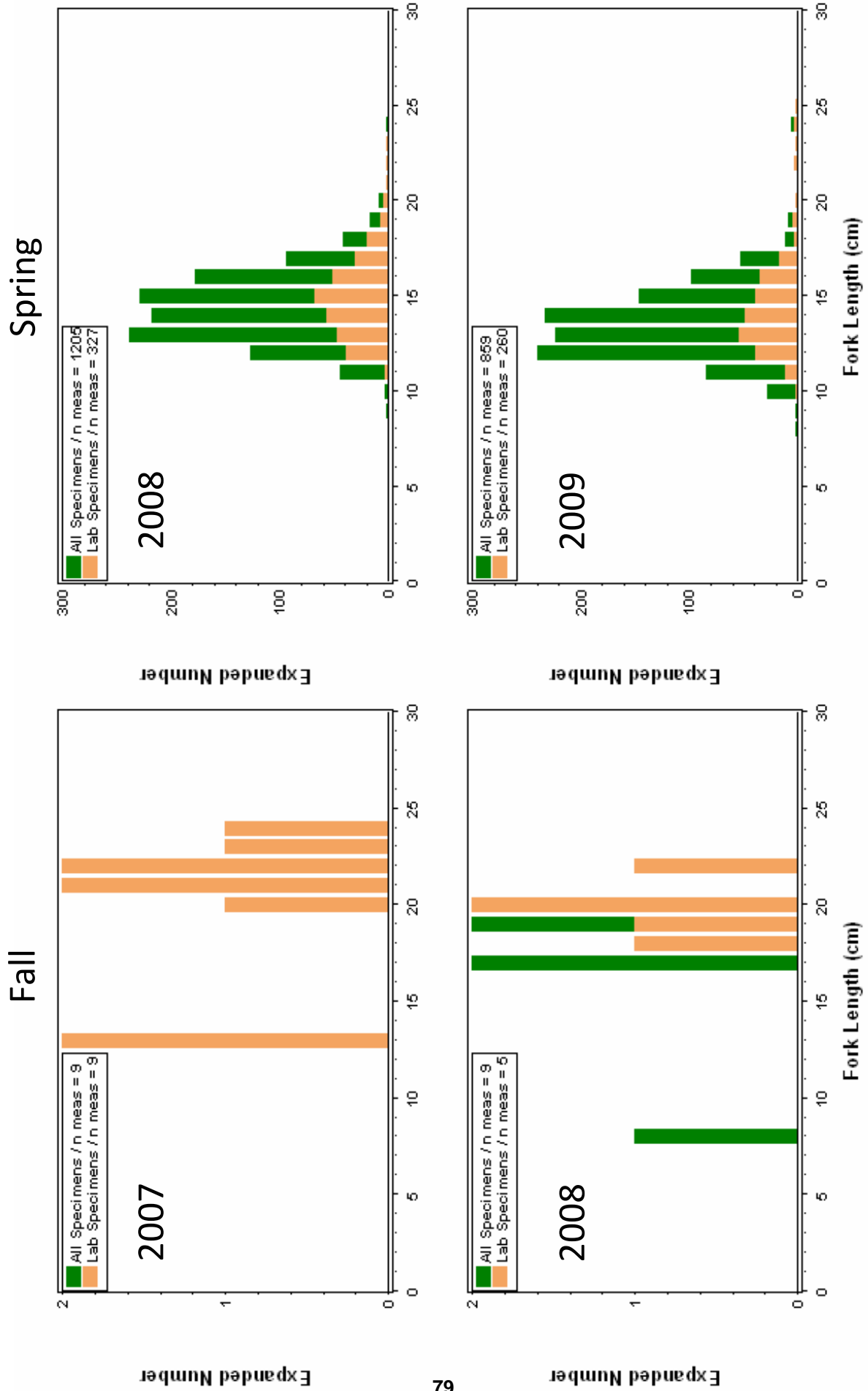
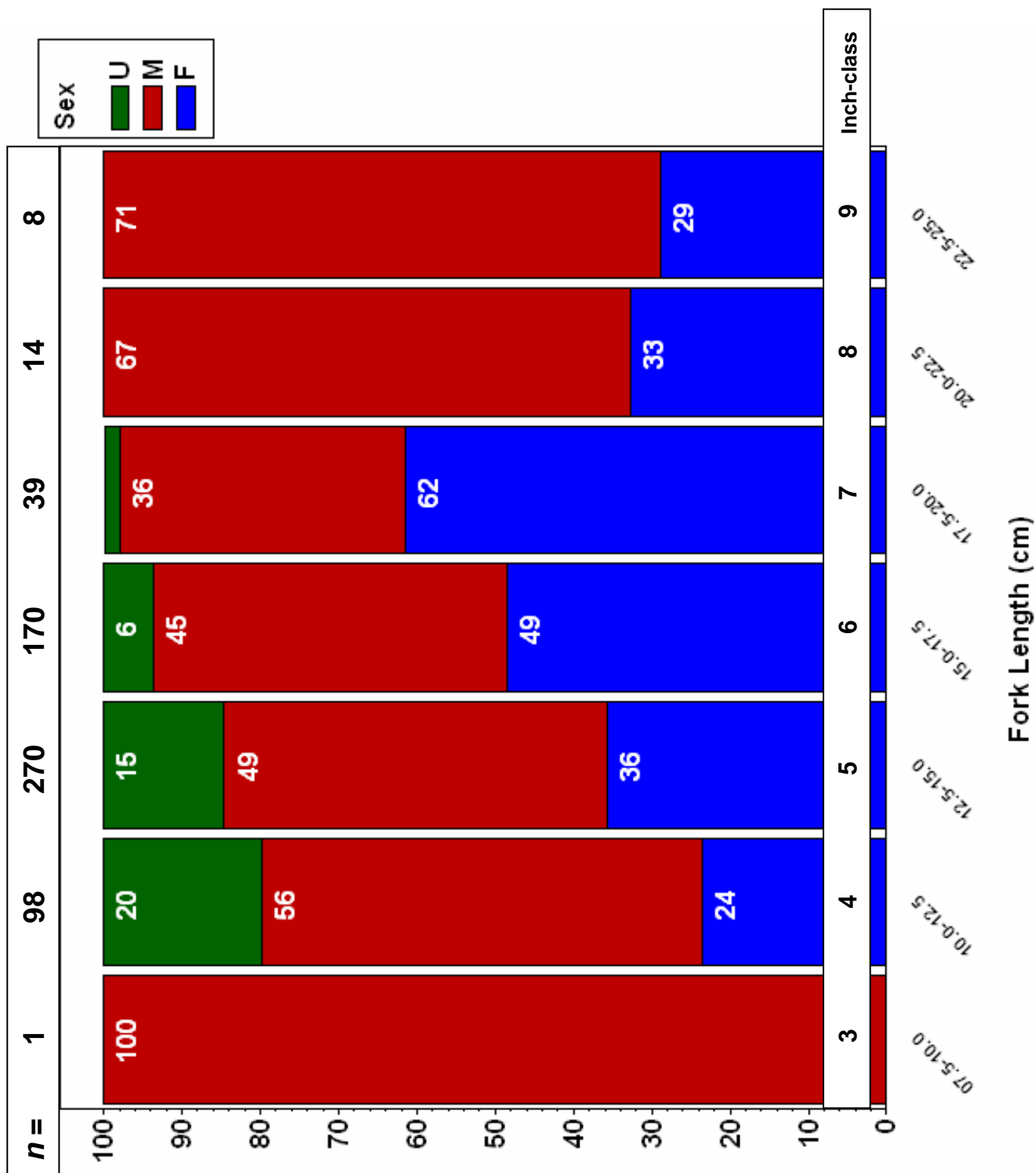




Figure 18. Sex ratio, by length group, for American shad collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



# Atlantic Croaker (Priority B)

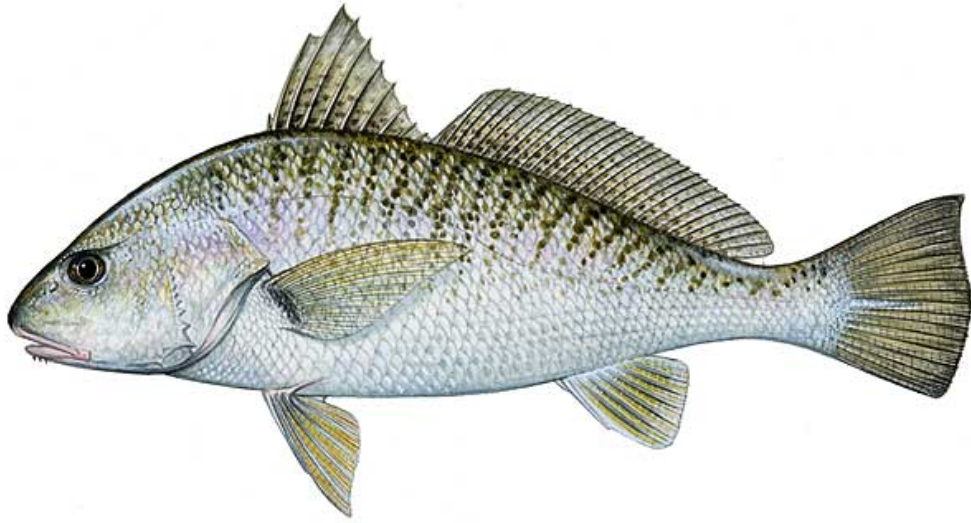
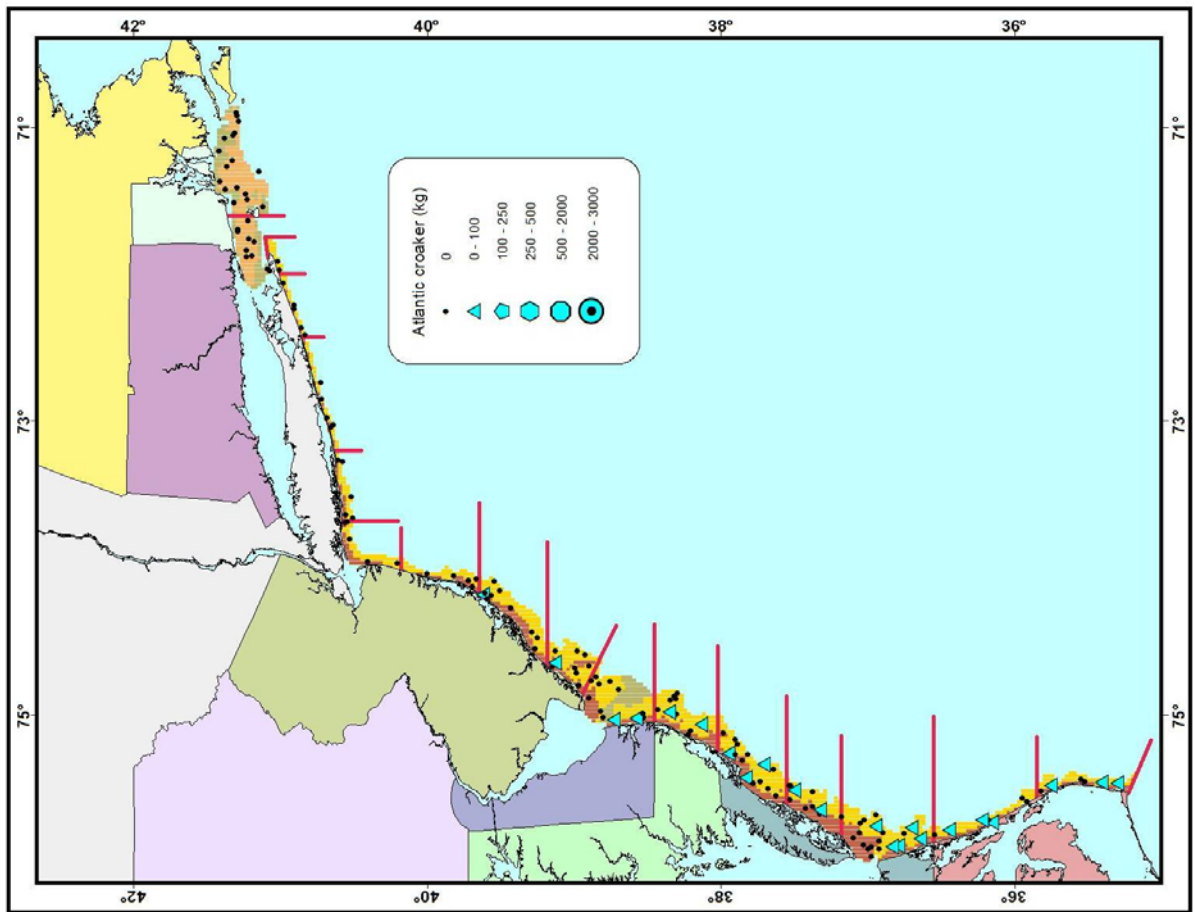


Table 9. Sampling rates and abundance indices of Atlantic croaker for four NEAMAP cruises.

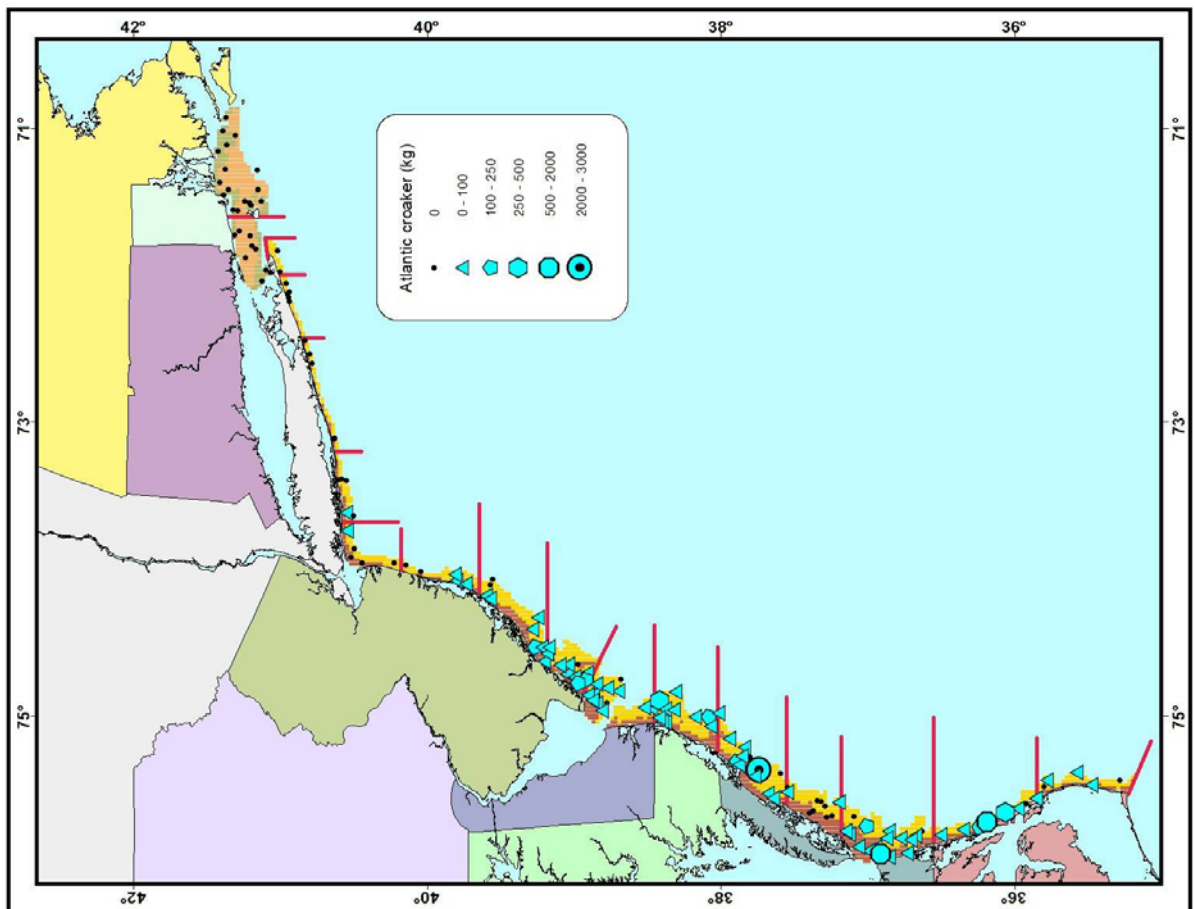
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	58,763	7,616.5	2,843	211	211	193	187	7.10	3.09
2008	Spring	467	25.0	212	41	41	38	36	0.28	0.07
	Fall	66,823	5,123.2	3,591	307	307	281	273	4.95	1.71
2009	Spring	17,040	1,004.3	1,225	80	0	66	59	0.56	0.23

Figure 19. Biomass (kg) of Atlantic croaker collected at each sampling site for four NEAMAP cruises.

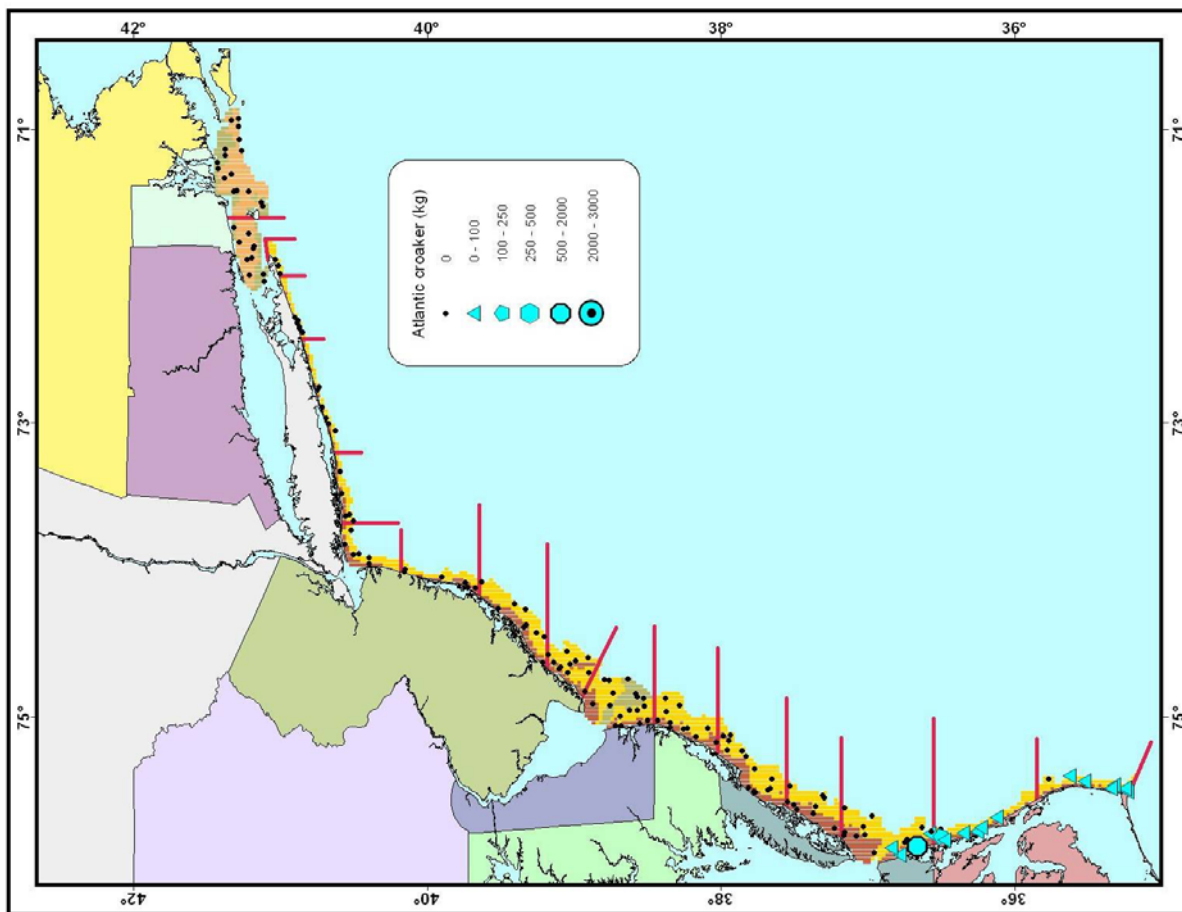
Spring 2008



Fall 2007



Spring 2009



Fall 2008

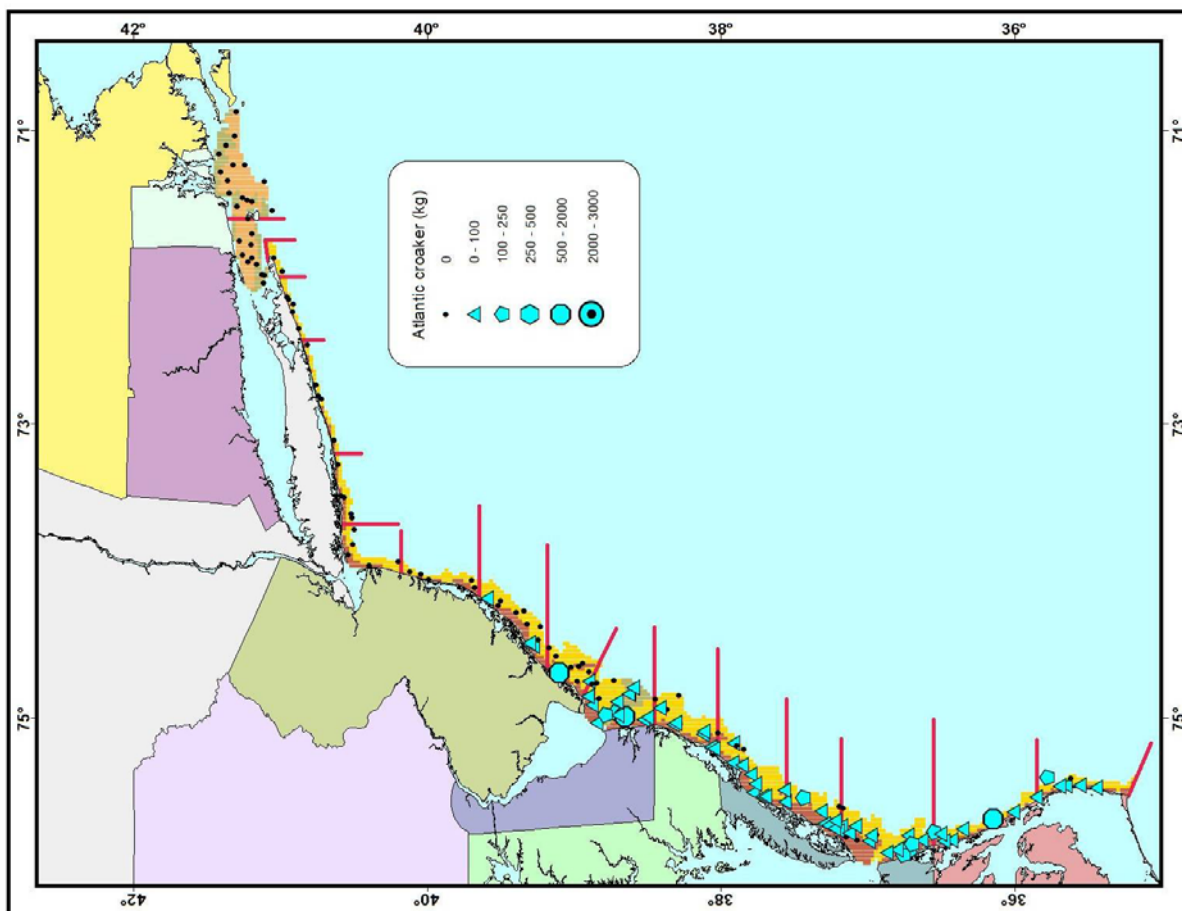


Figure 20. Preliminary indices of abundance, in terms of number and biomass, of Atlantic croaker for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

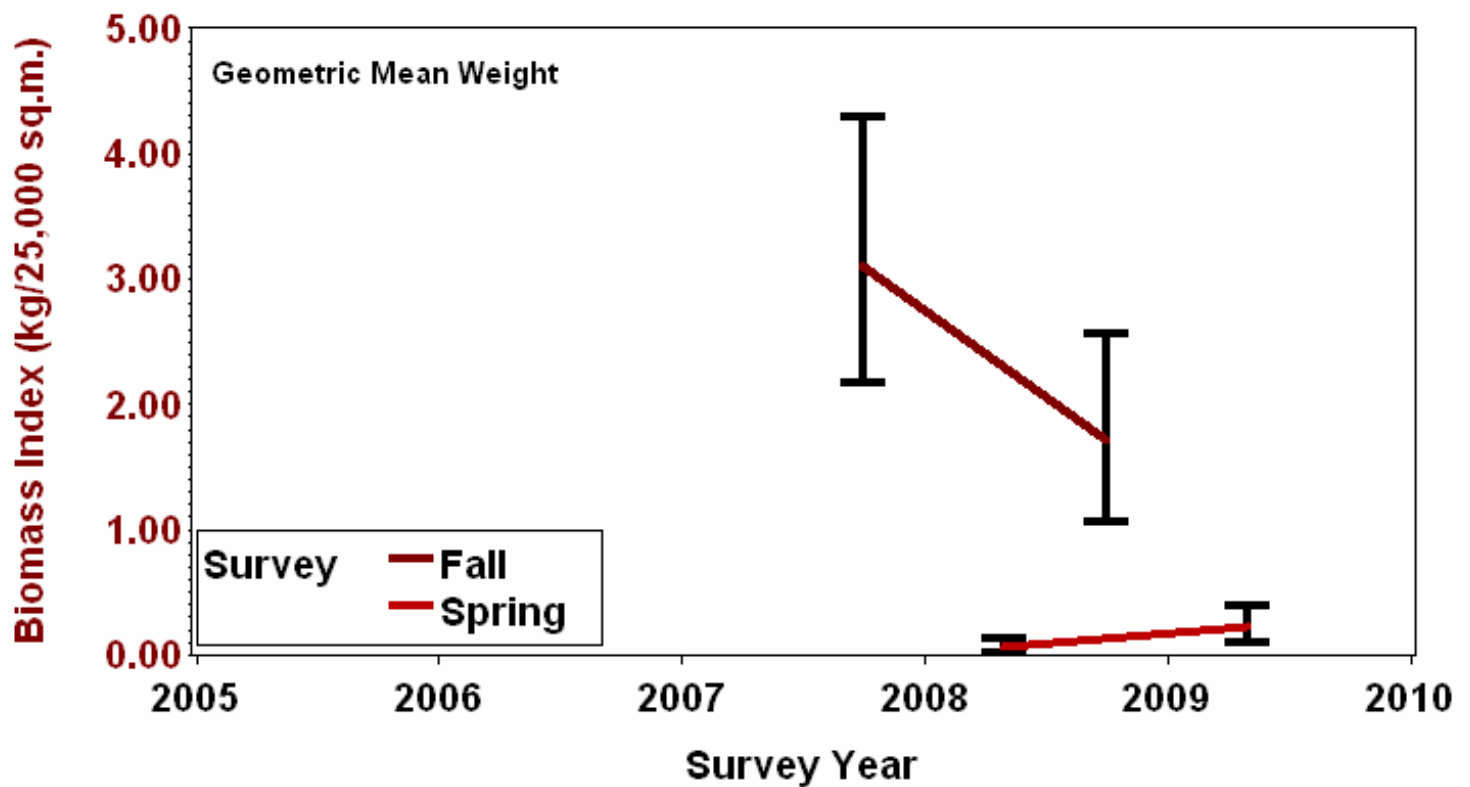
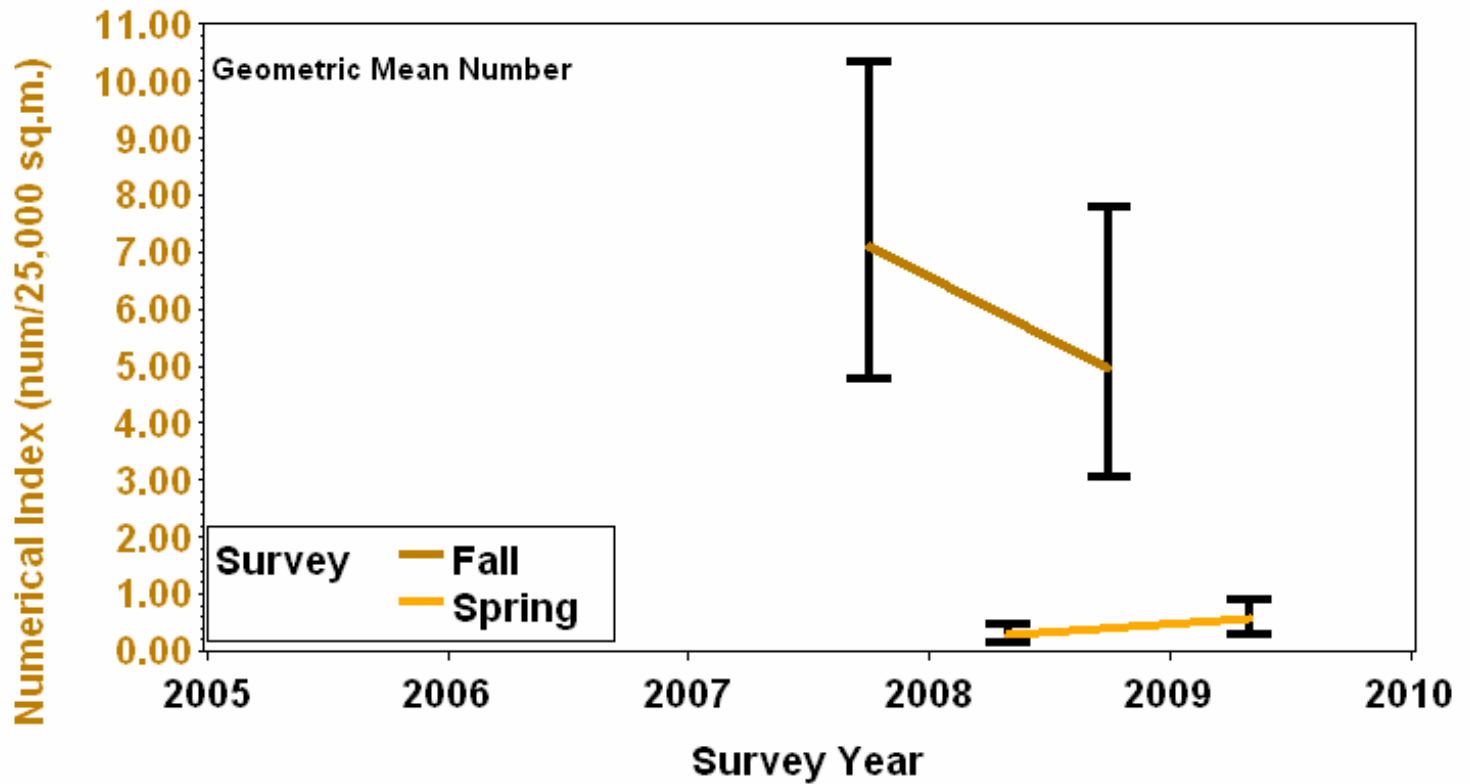


Figure 21. Length-frequency distributions, by cruise, for Atlantic croaker. Numbers taken for full processing, by length, are represented by the orange bars.

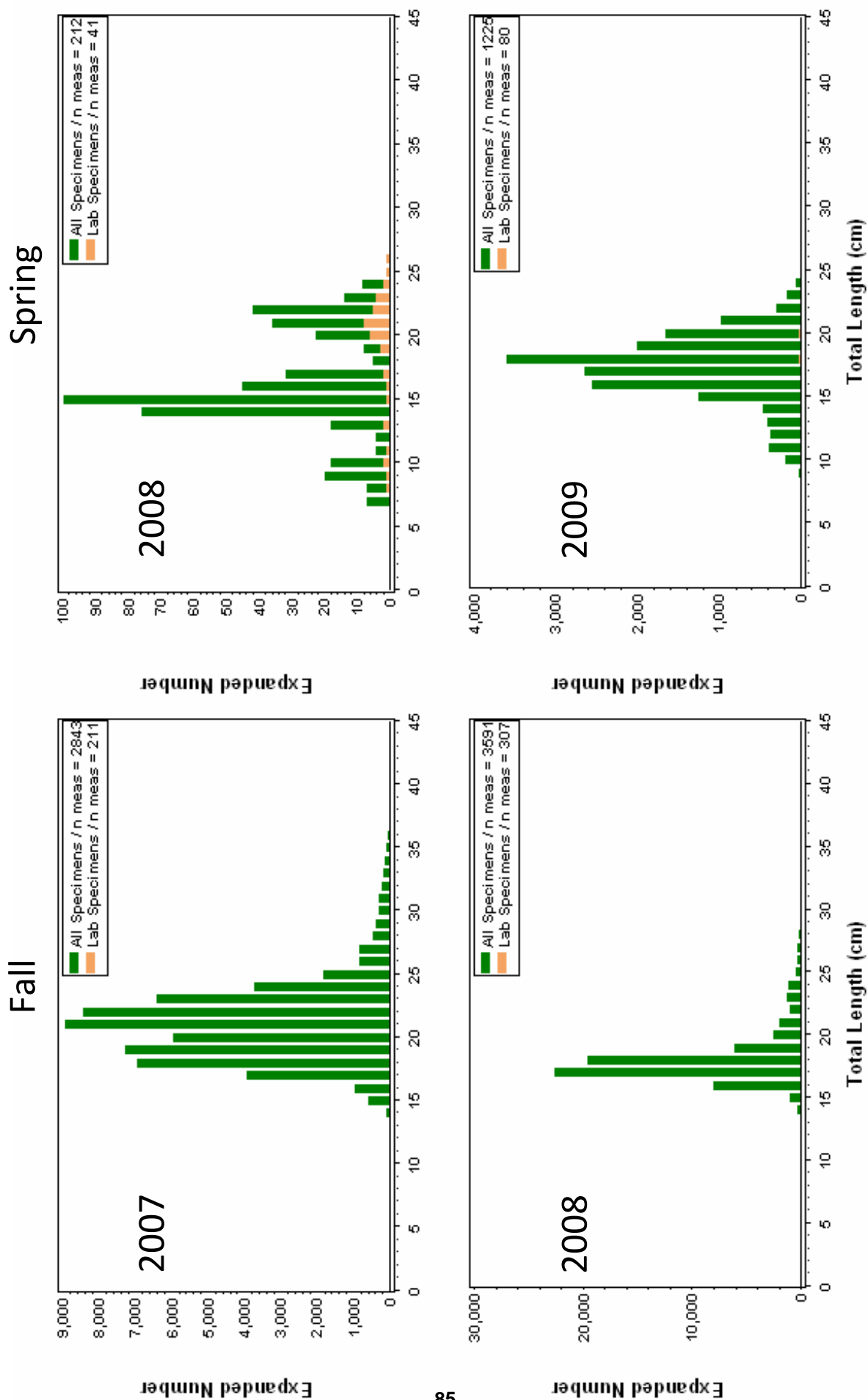


Figure 22. Sex ratio, by length group, for Atlantic croaker collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

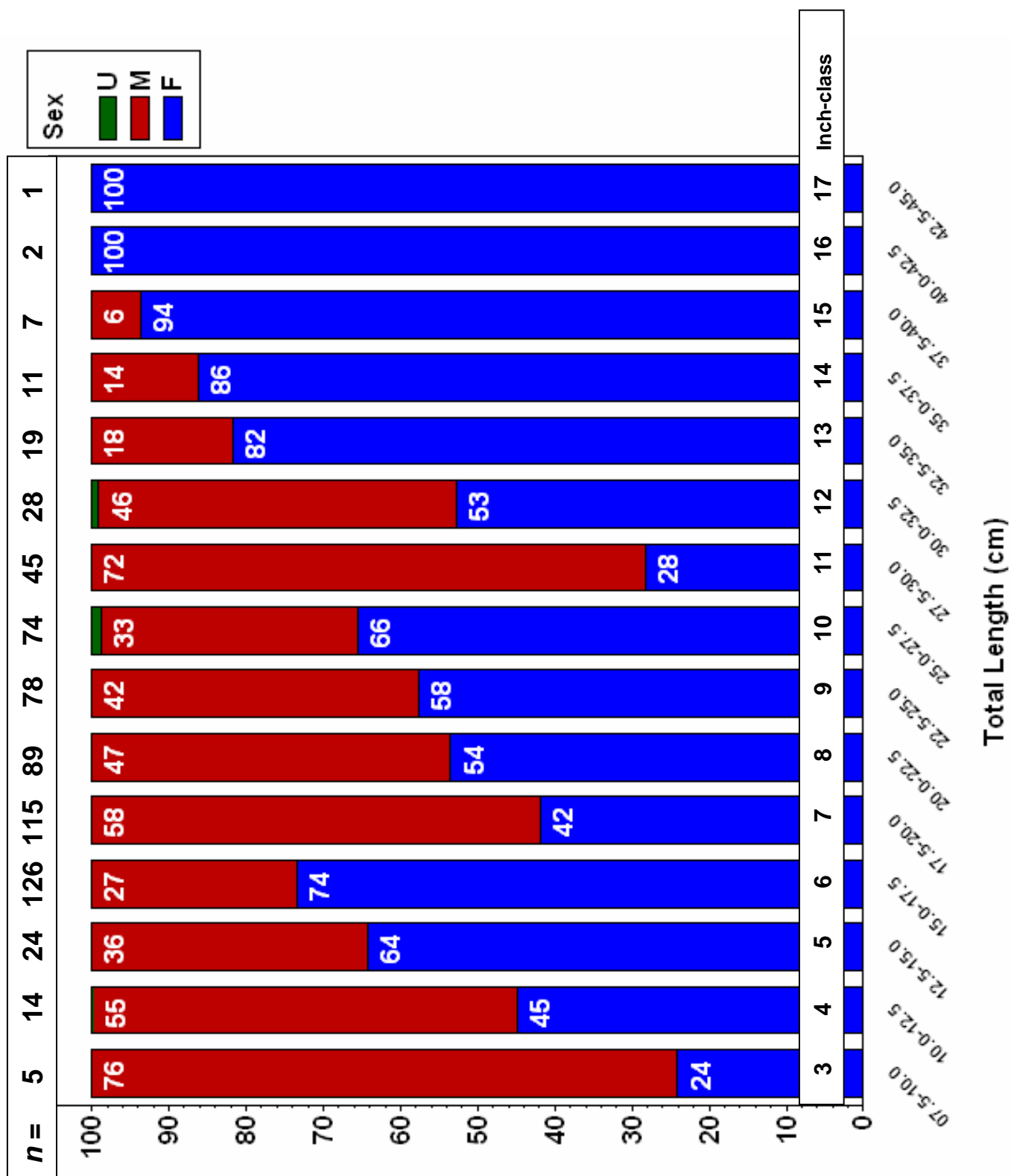


Figure 23. Age-frequency distribution, by cruise, for Atlantic croaker. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.

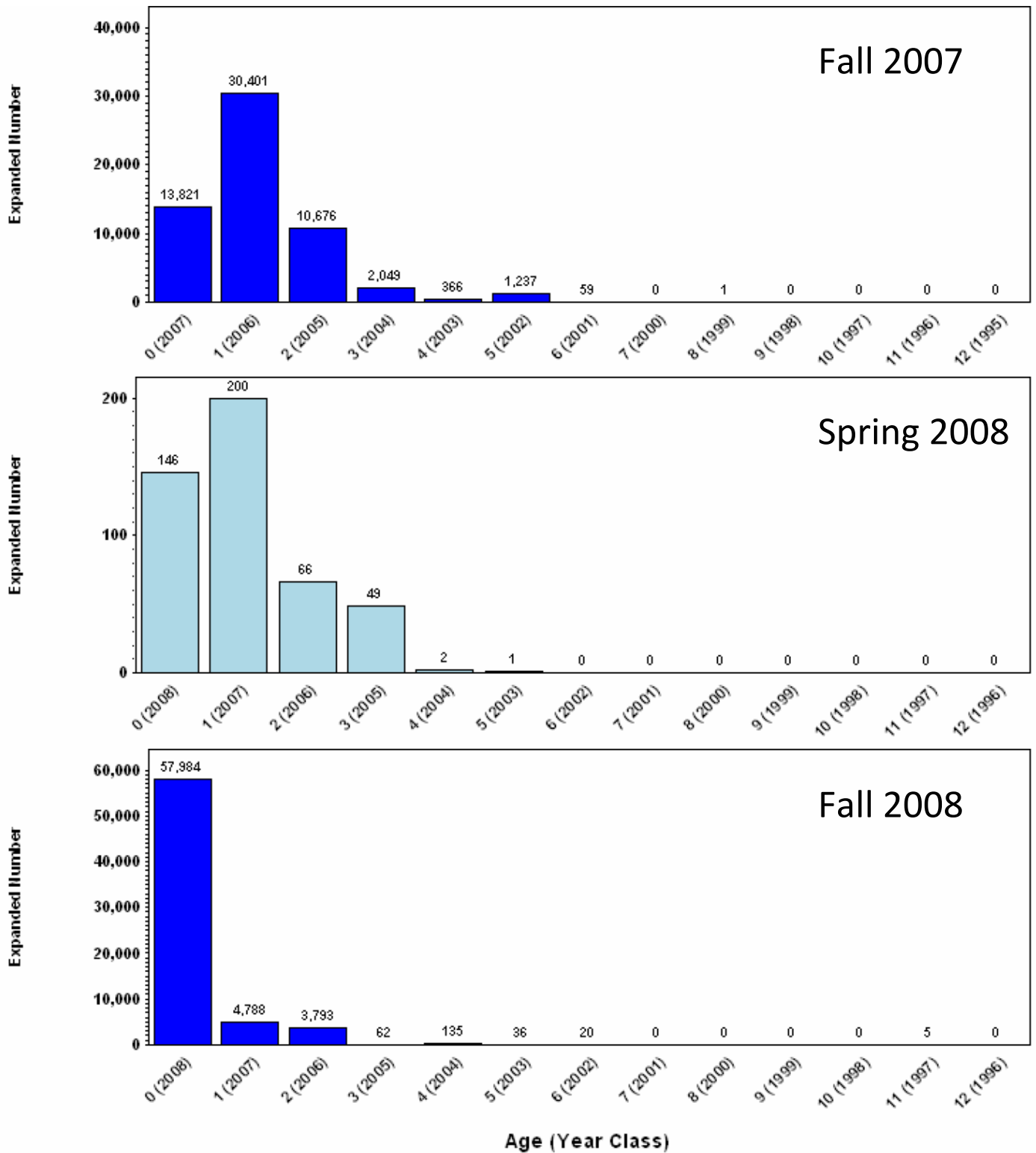
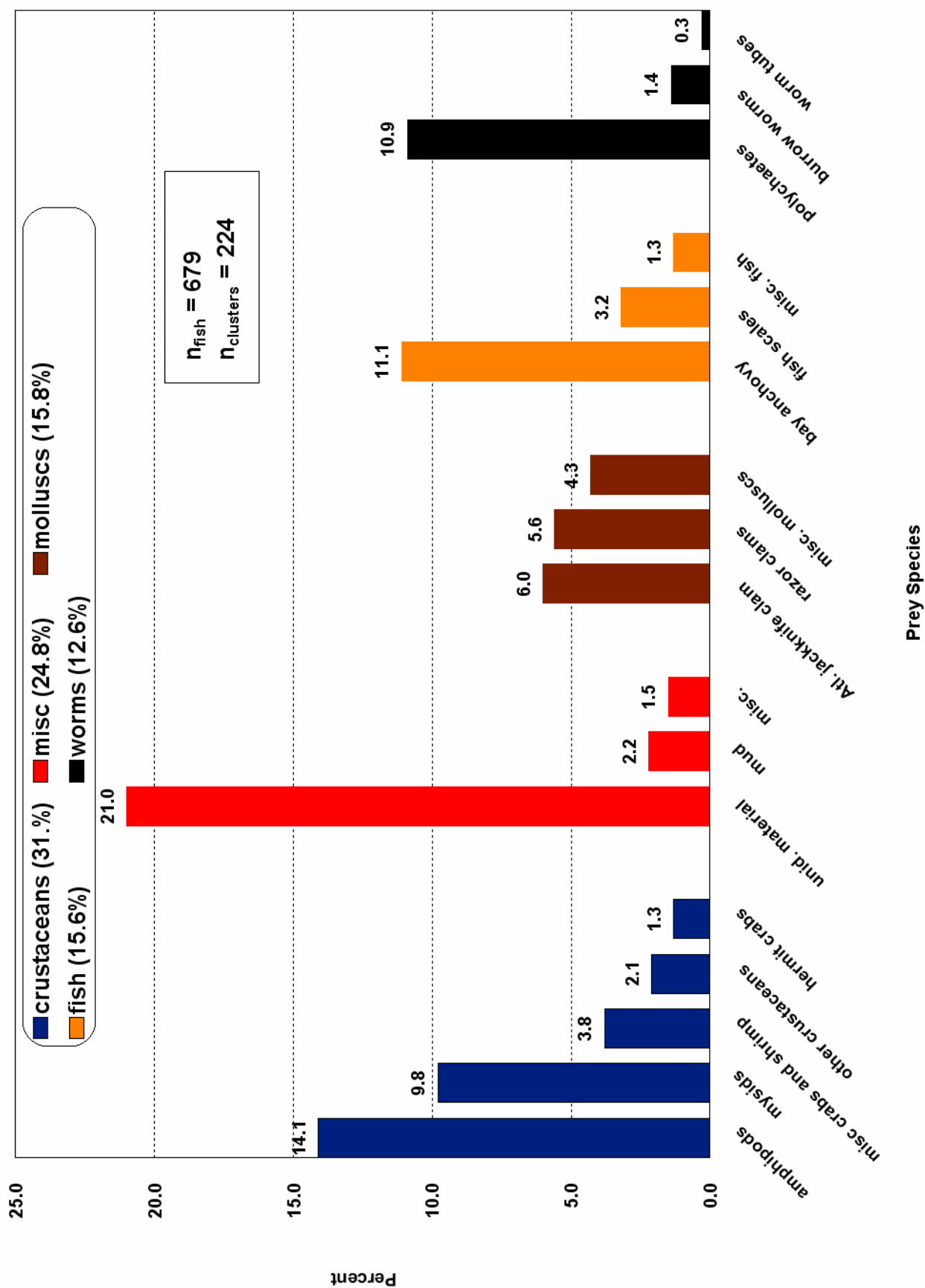




Figure 24. Diet composition, expressed using the percent weight index, of Atlantic croaker collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of croaker sampled.



# Atlantic Menhaden (Priority B)

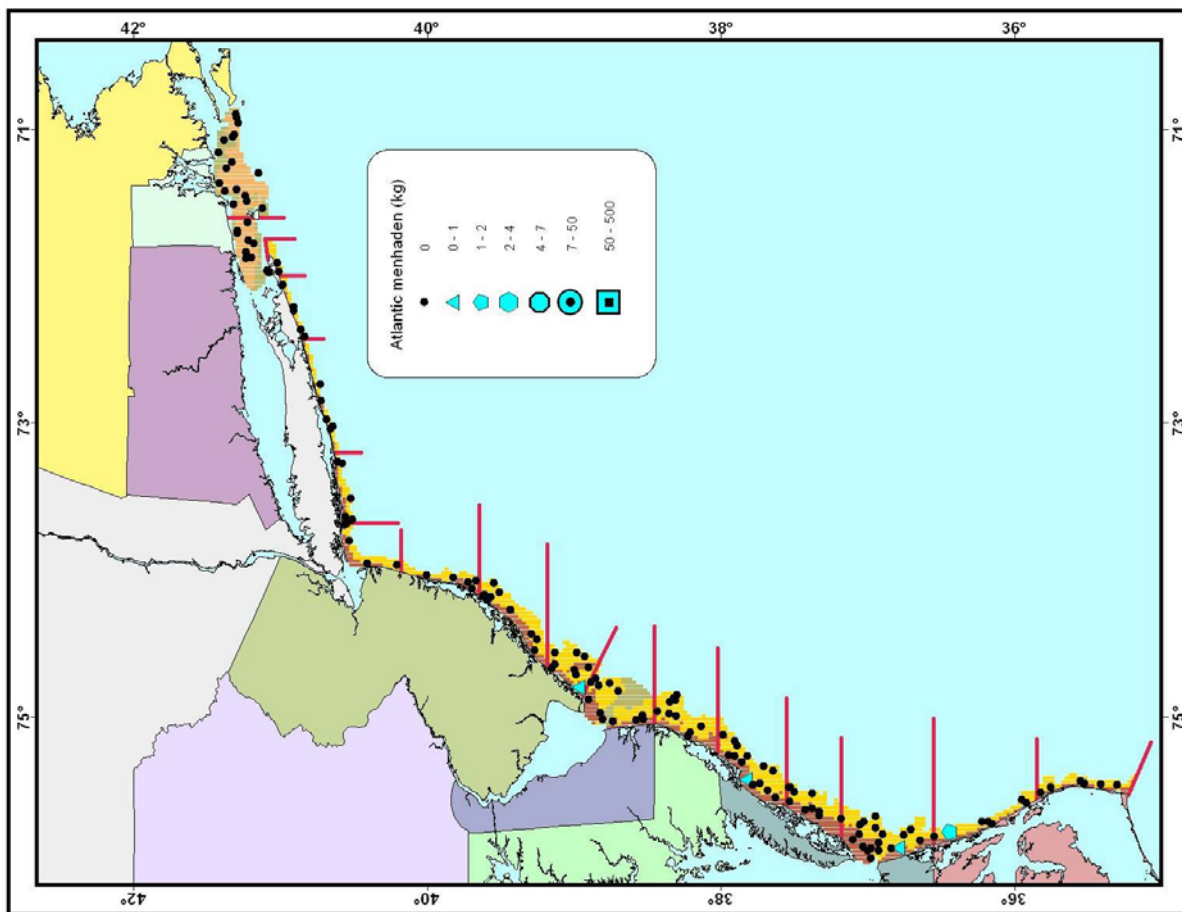


Table 10. Sampling rates and abundance indices of Atlantic menhaden for four NEAMAP cruises.

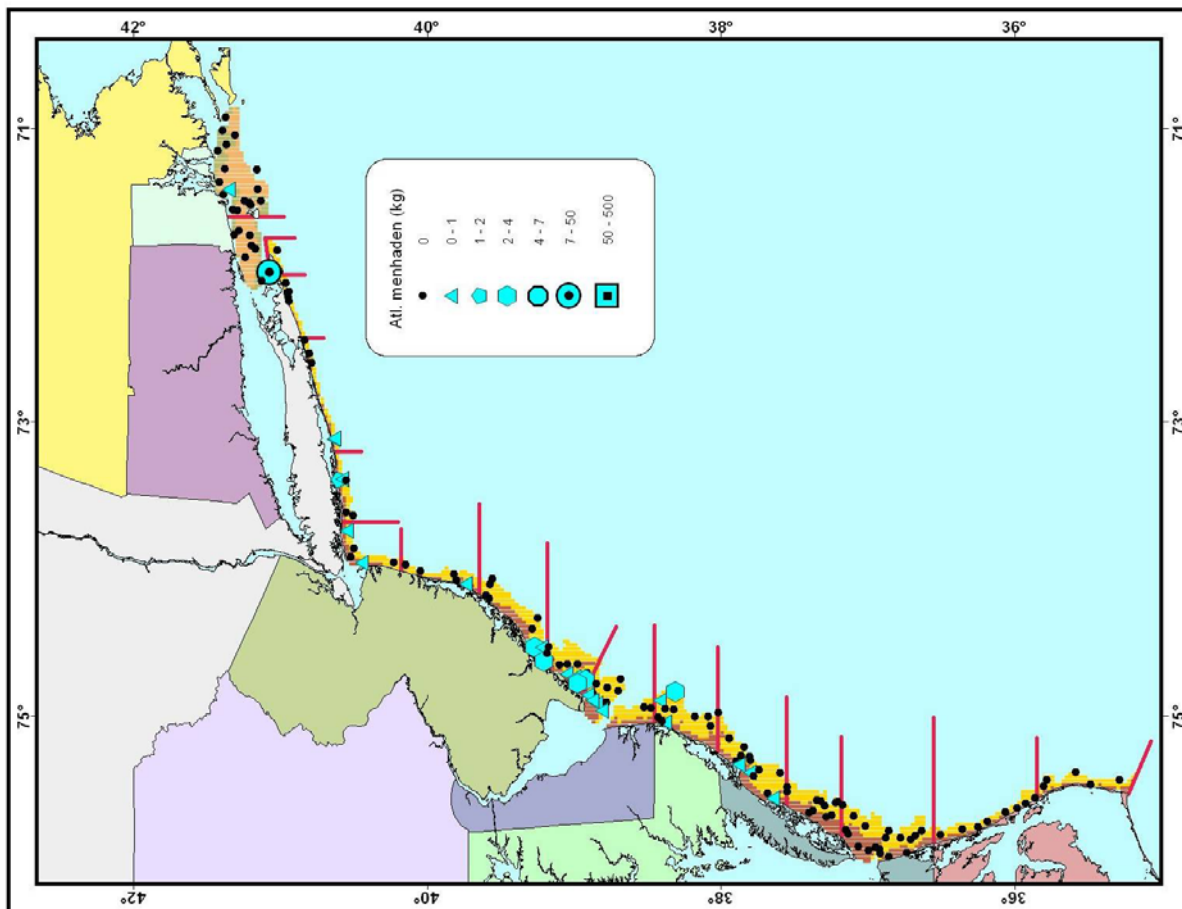
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	740	30.2	288	78	0	78	1	0.30	0.10
2008	Spring	32	2.0	32	10	0	10	0	0.05	0.01
	Fall	208	25.0	208	68	0	68	0	0.21	0.08
2009	Spring	24566	786.0	2146	78	0	78	0	0.66	0.25

Figure 25. Biomass (kg) of Atlantic menhaden collected at each sampling site for four NEAMAP cruises.

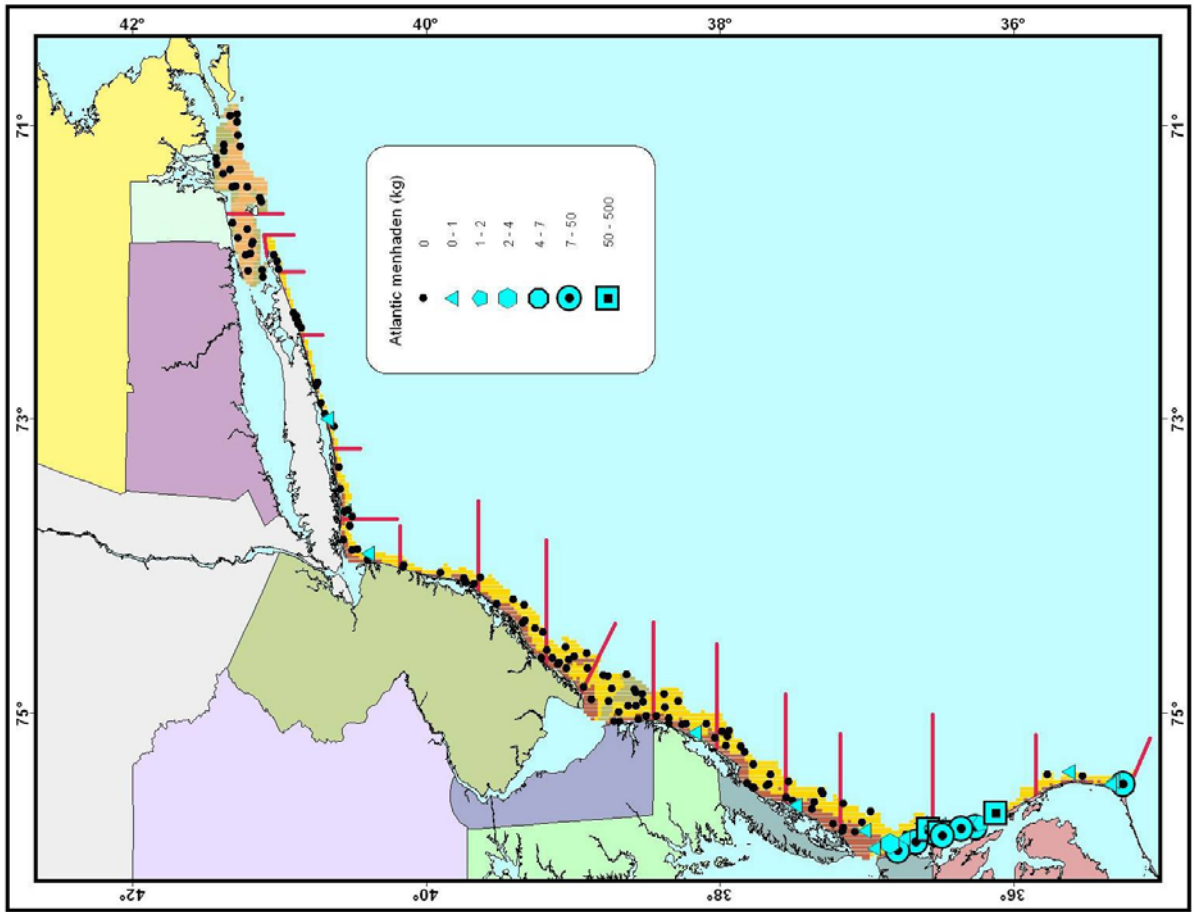
Spring 2008



Fall 2007



Spring 2009



Fall 2008

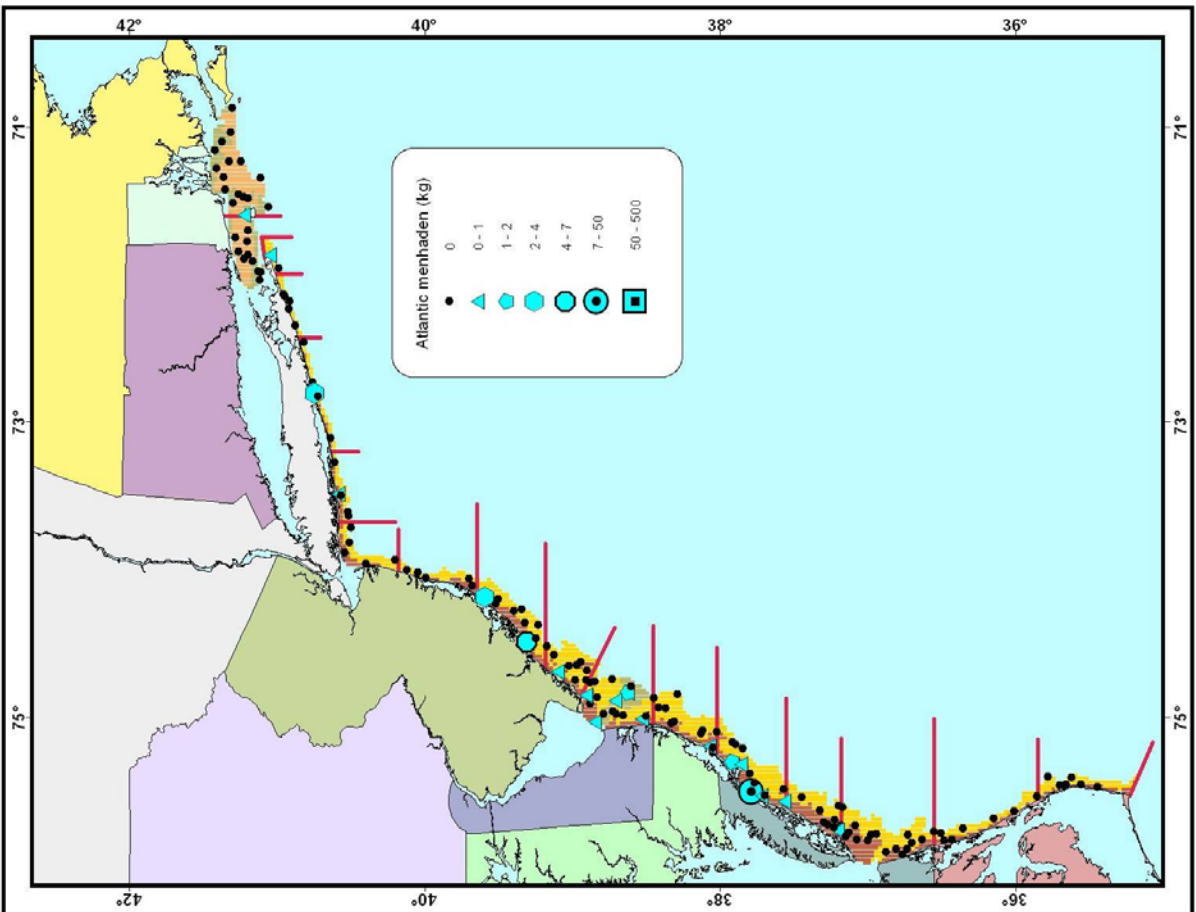


Figure 26. Preliminary indices of abundance, in terms of number and biomass, of Atlantic menhaden for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

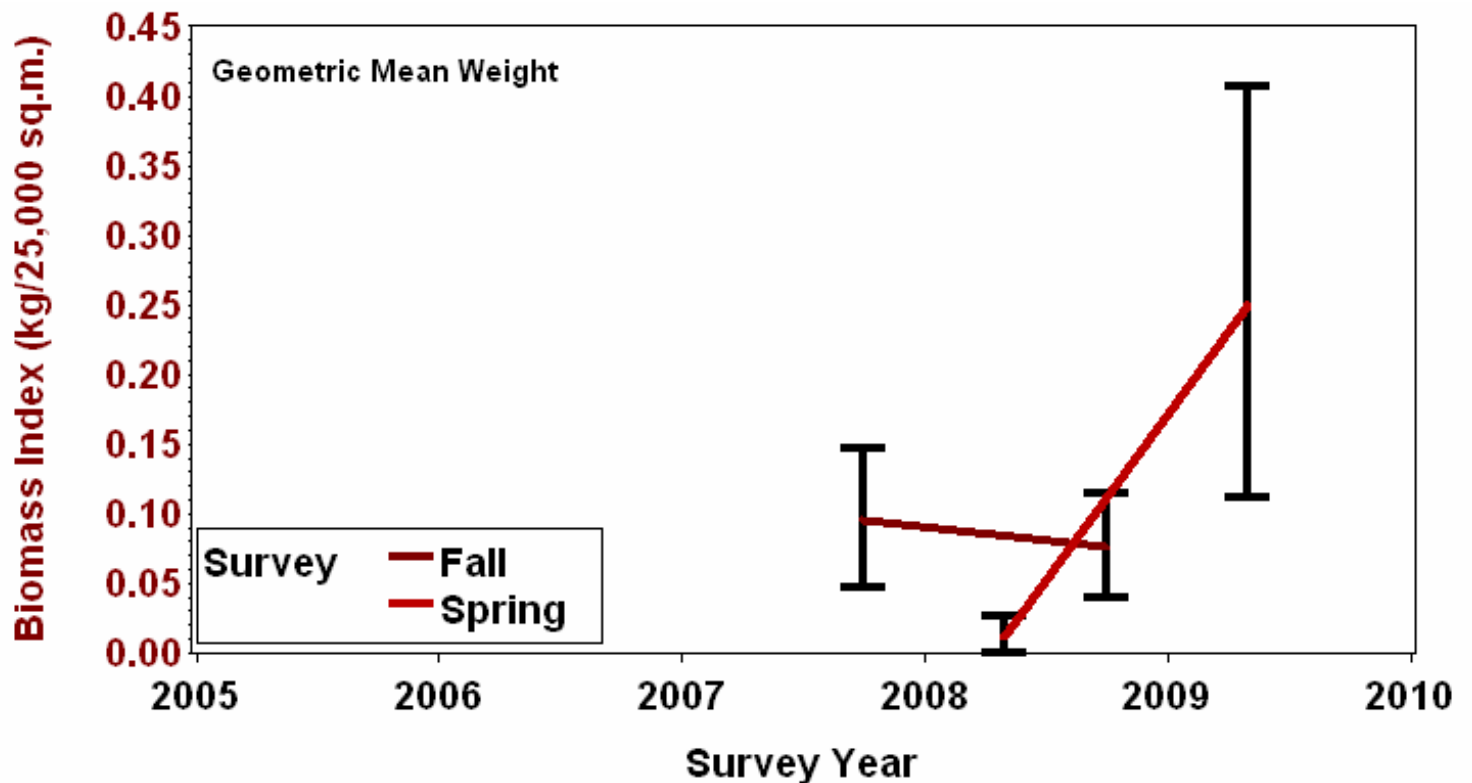
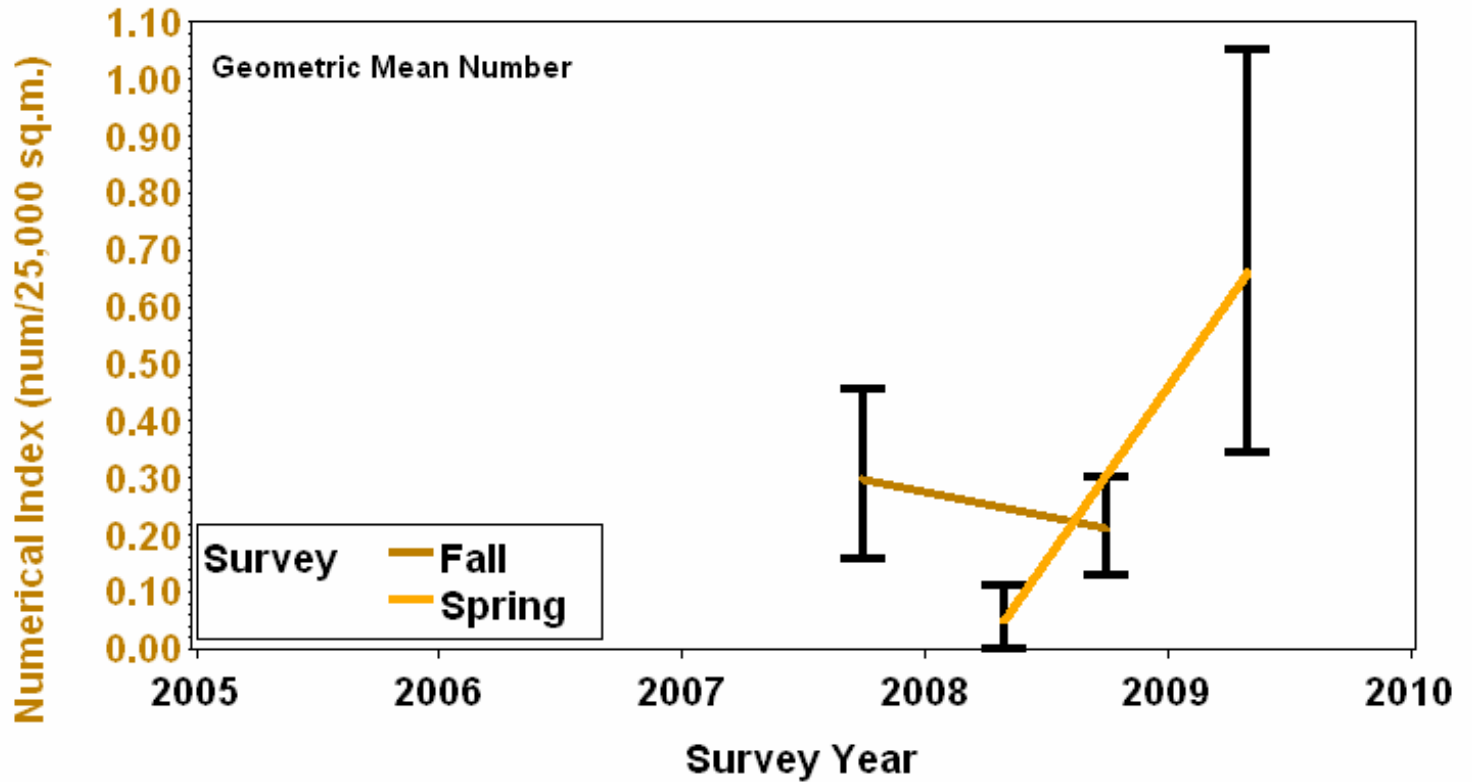


Figure 27. Length-frequency distributions, by cruise, for Atlantic menhaden. Numbers taken for full processing, by length, are represented by the orange bars.

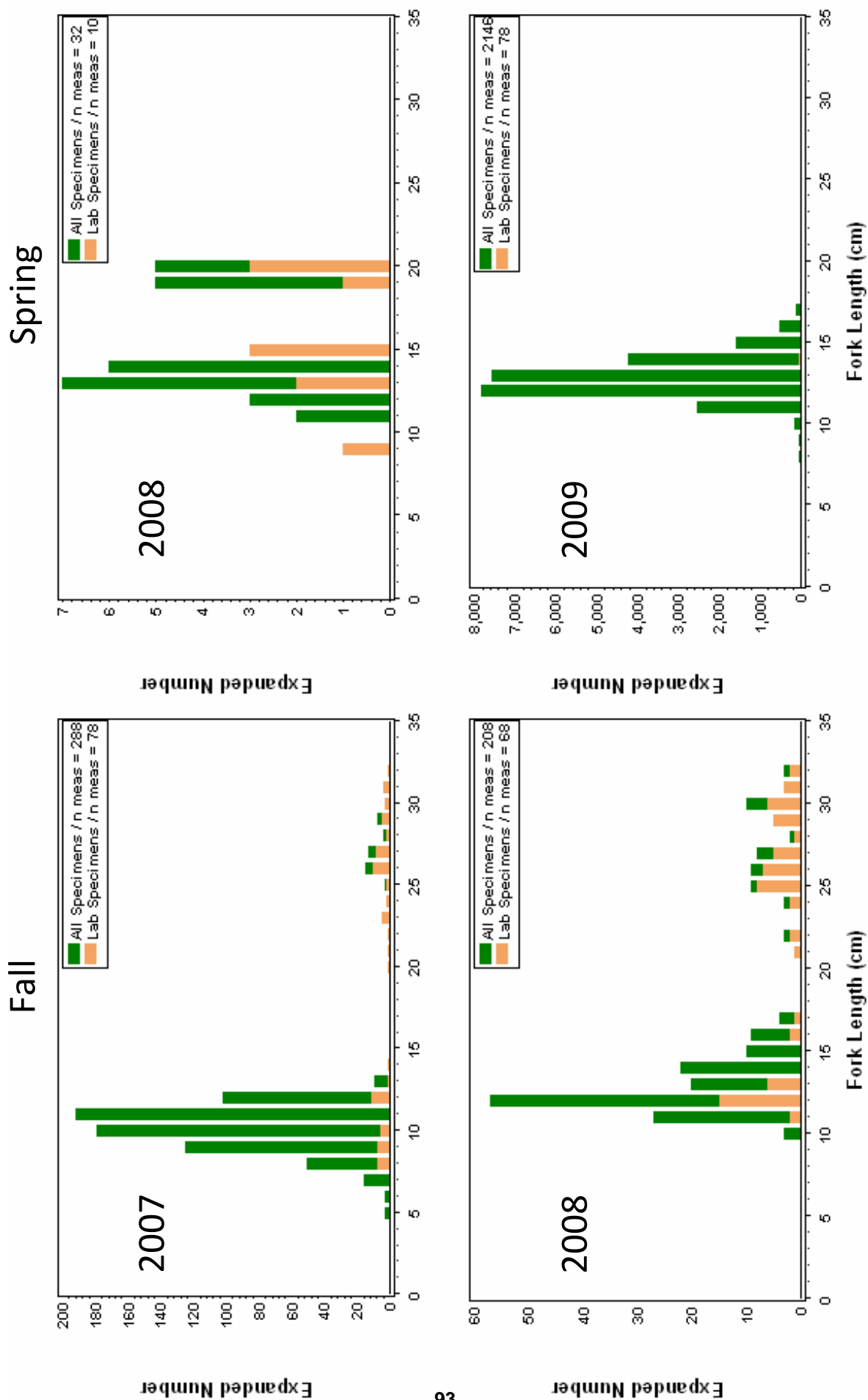
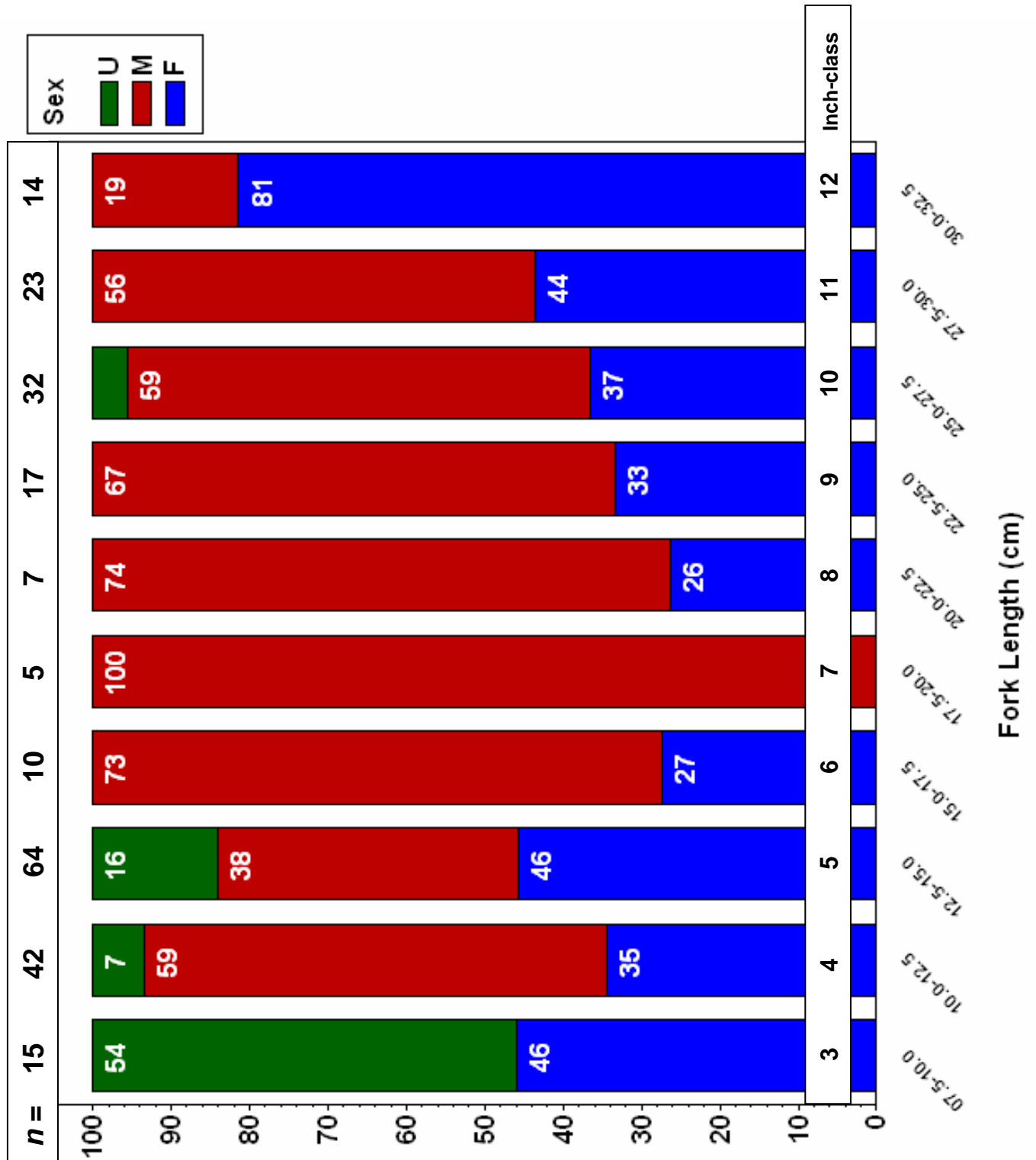


Figure 28. Sex ratio, by length group, for Atlantic menhaden collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



# Atlantic Spadefish (Priority D)

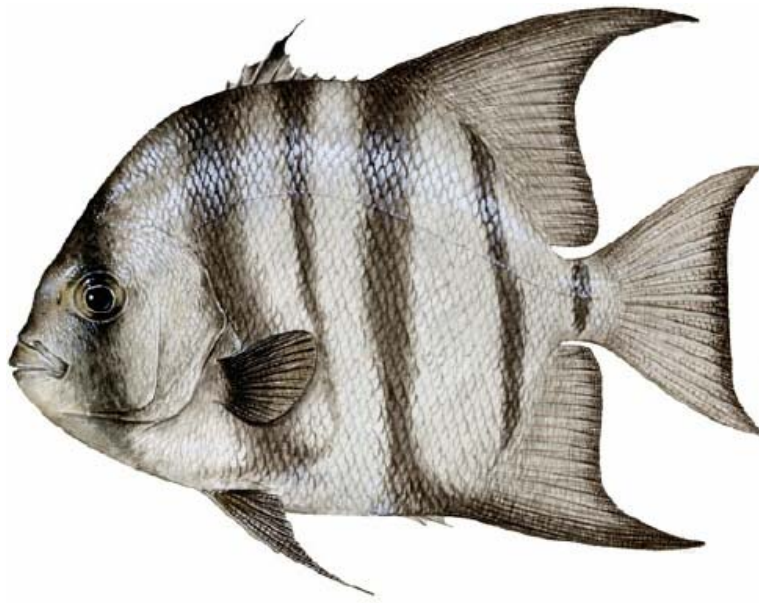


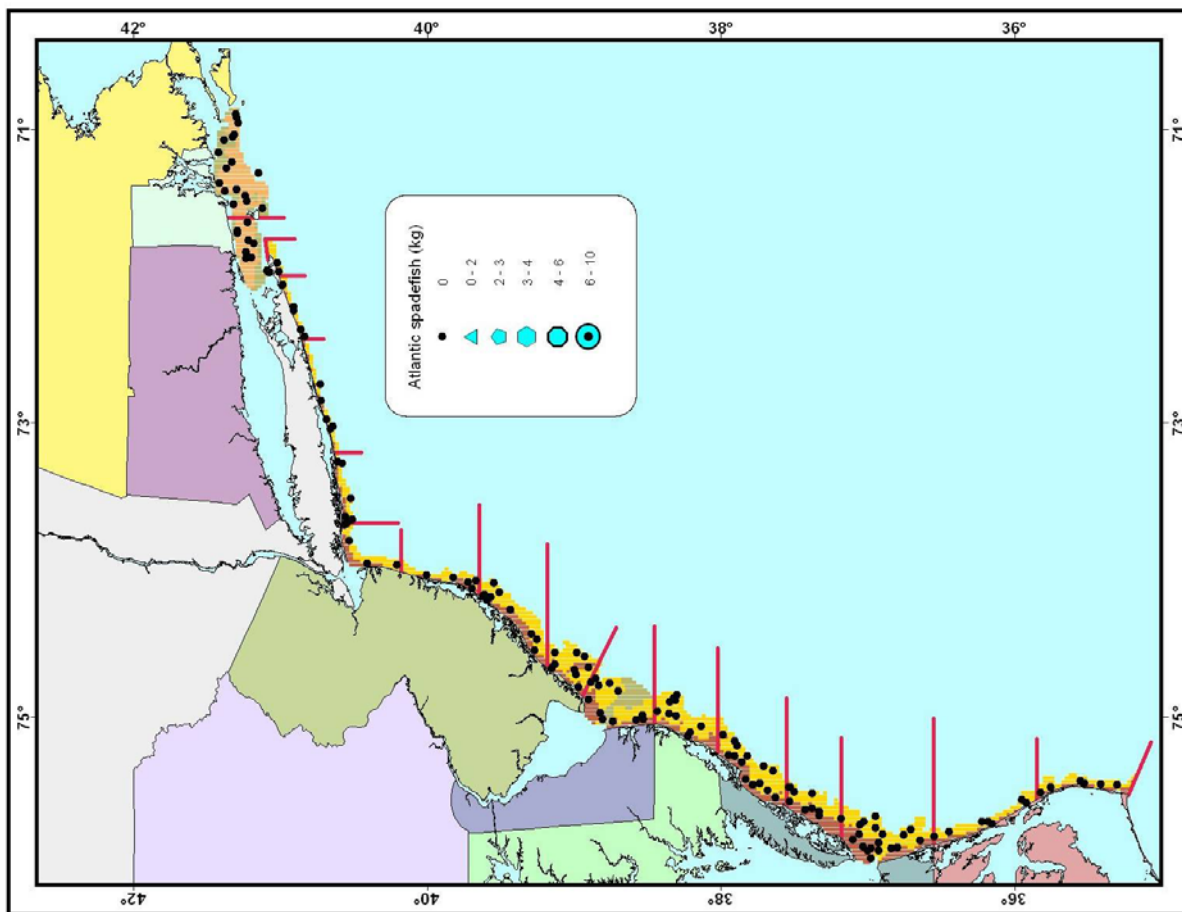
Table 11. Sampling rates and abundance indices of Atlantic spadefish for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	673	31.0	478	0		0		0.33	0.09
2008	Spring	0	0.0						0.00	0.00
	Fall	231	8.0	197	0		0		0.31	0.04
2009	Spring	0	0.0						0.00	0.00

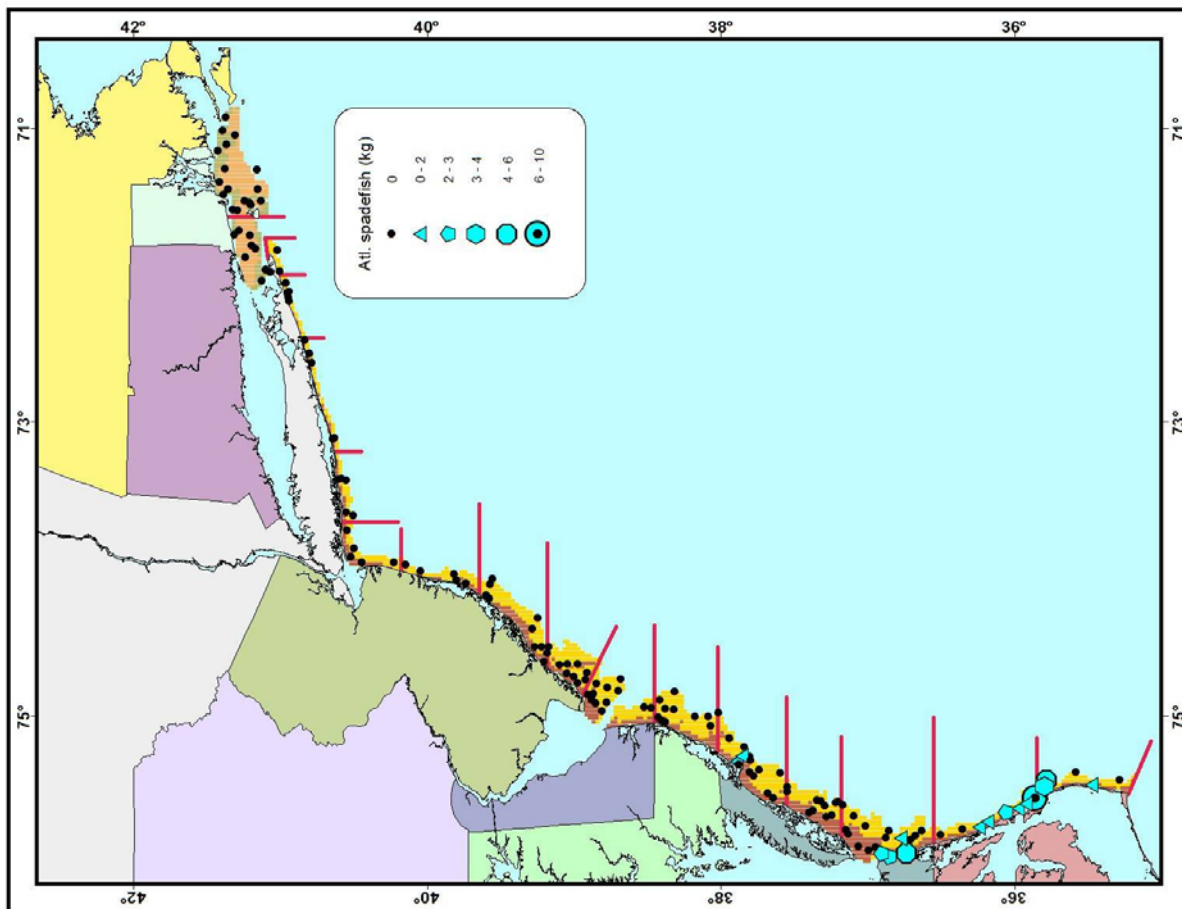


Figure 29. Biomass (kg) of Atlantic spadefish collected at each sampling site for four NEAMAP cruises.

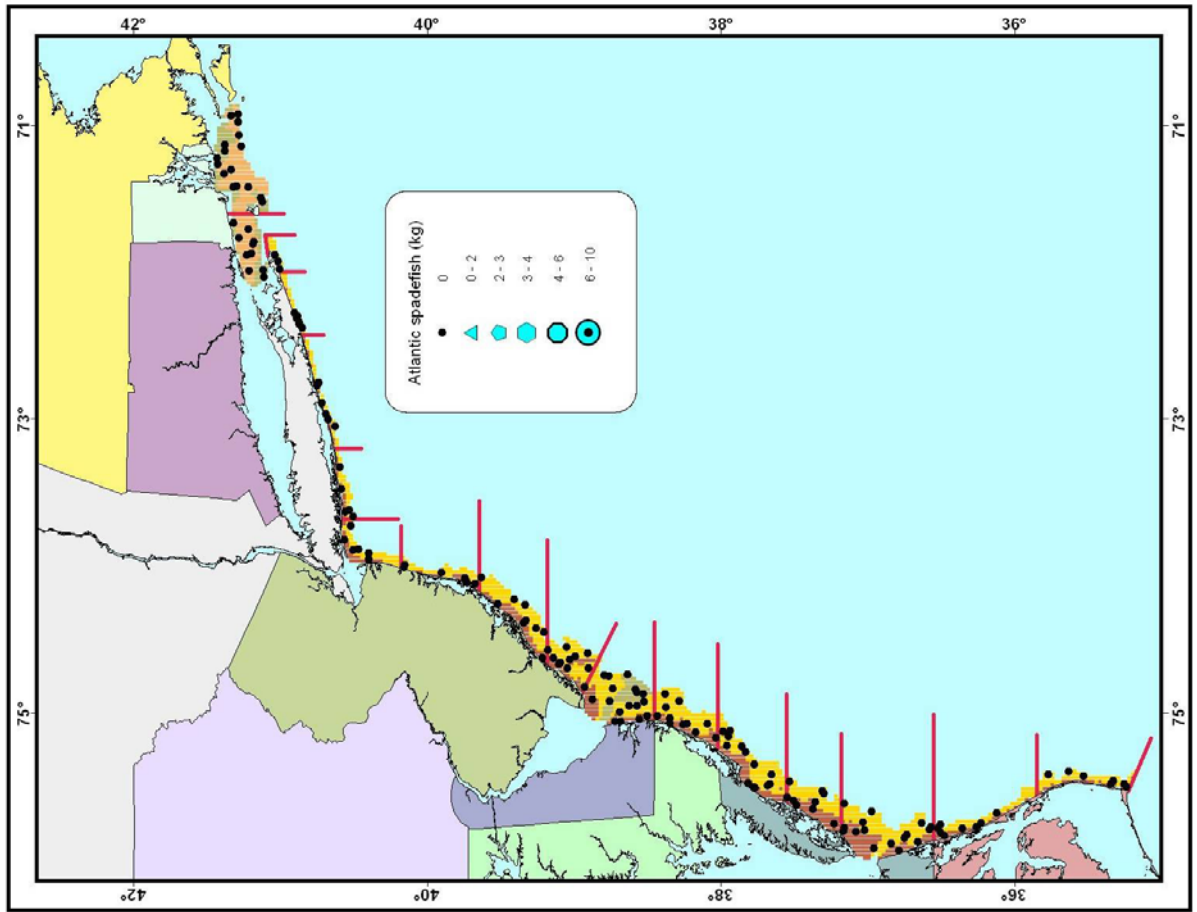
Spring 2008



Fall 2007



Spring 2009



Fall 2008

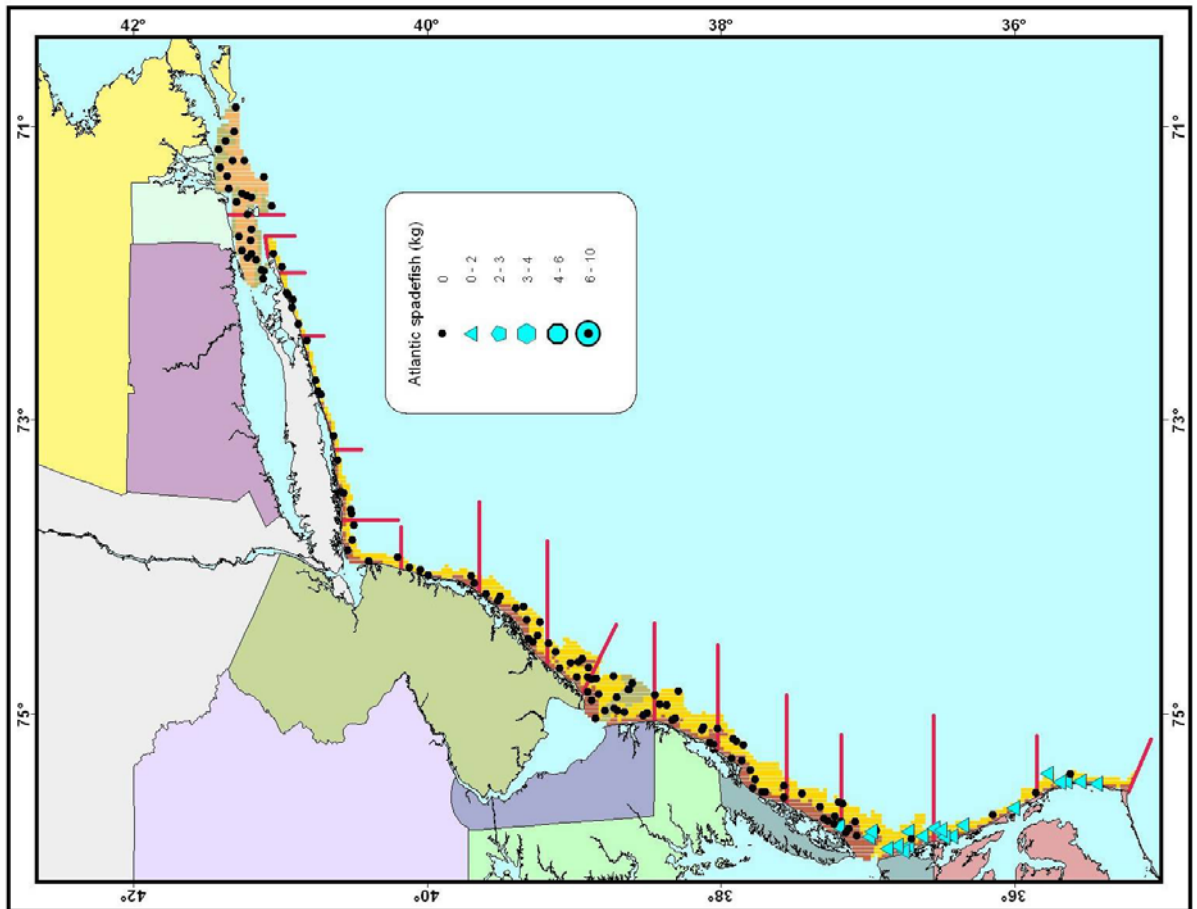


Figure 30. Preliminary indices of abundance, in terms of number and biomass, of Atlantic spadefish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

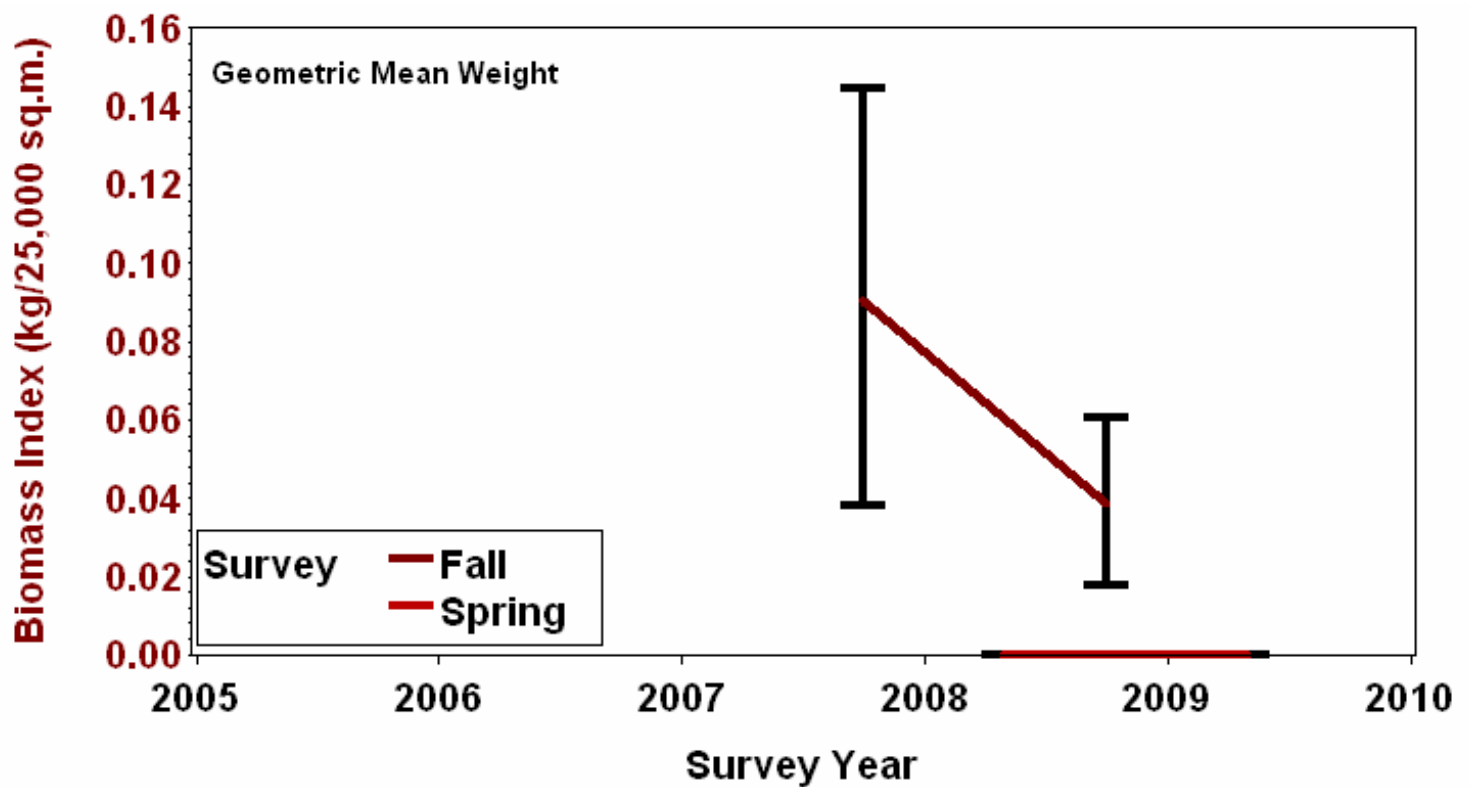
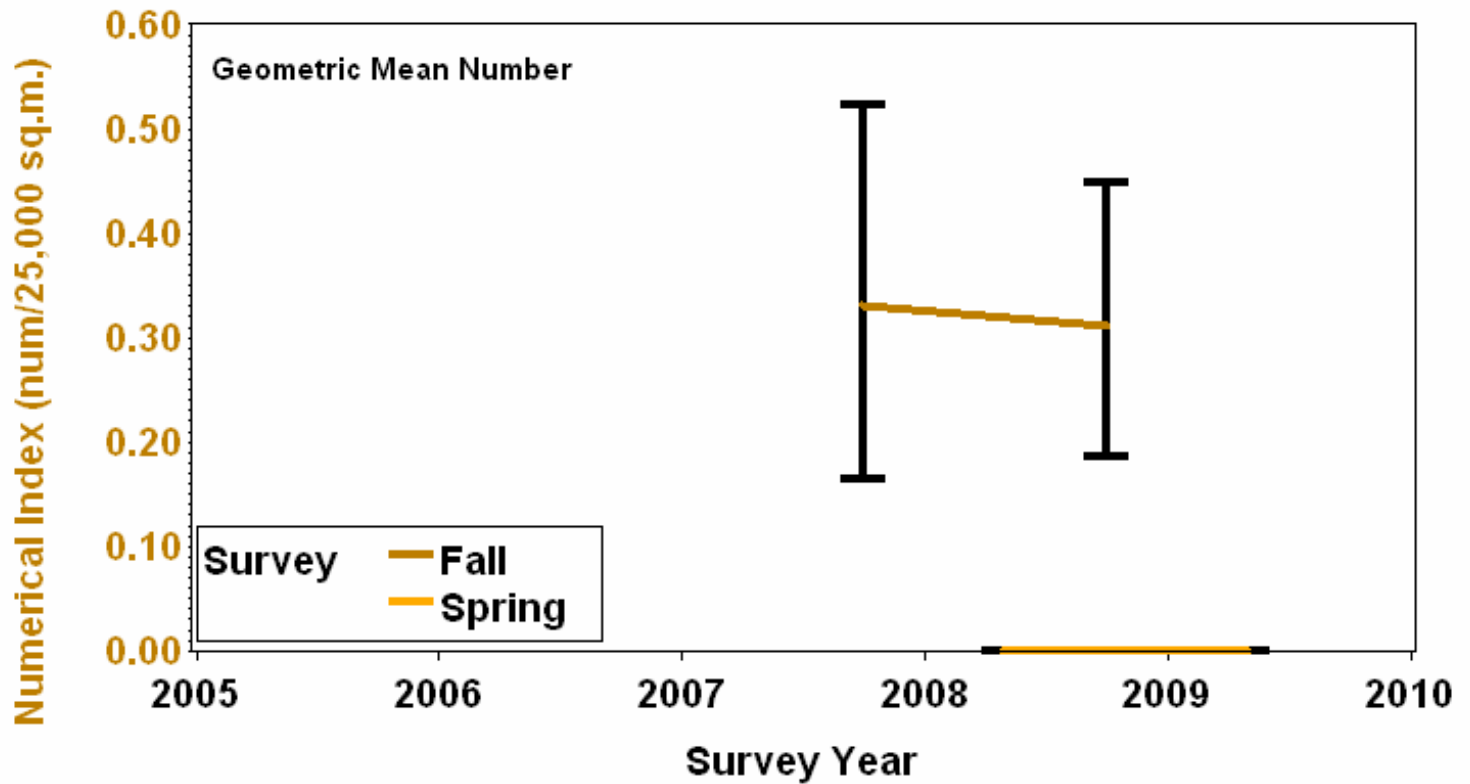
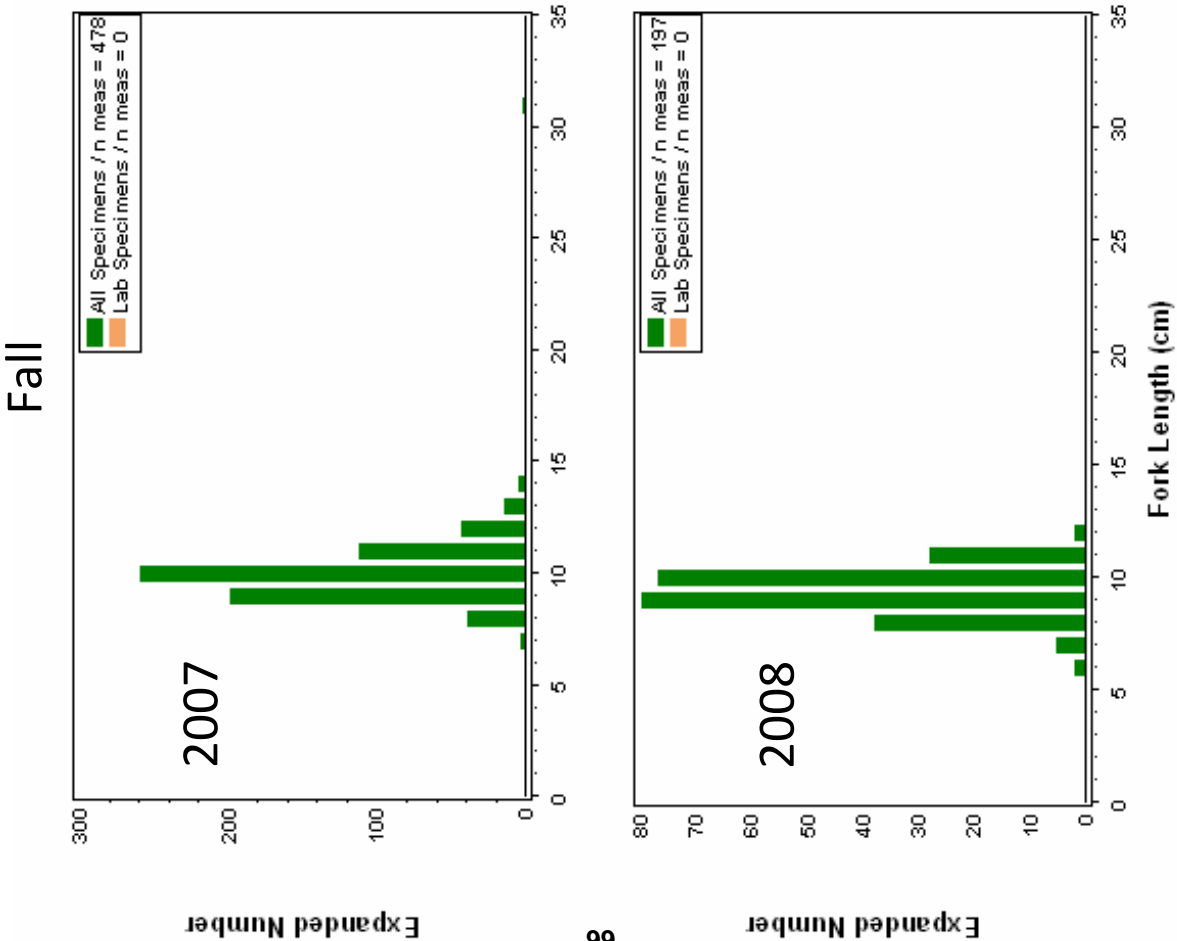


Figure 31. Length-frequency distributions, by cruise, for Atlantic spadefish. This species was absent from spring survey collections.





# Atlantic Thread Herring (Priority D)

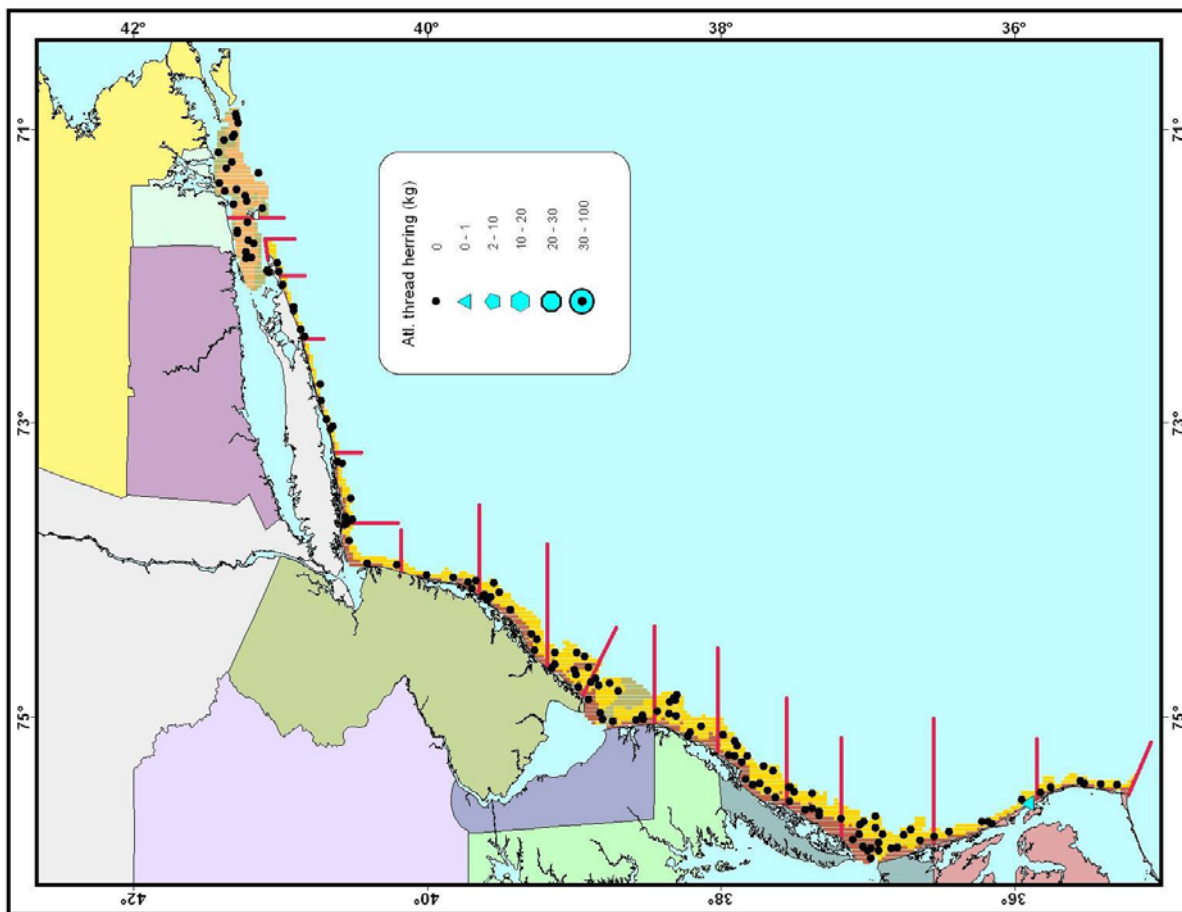


Table 12. Sampling rates and abundance indices of Atlantic thread herring for four NEAMAP cruises.

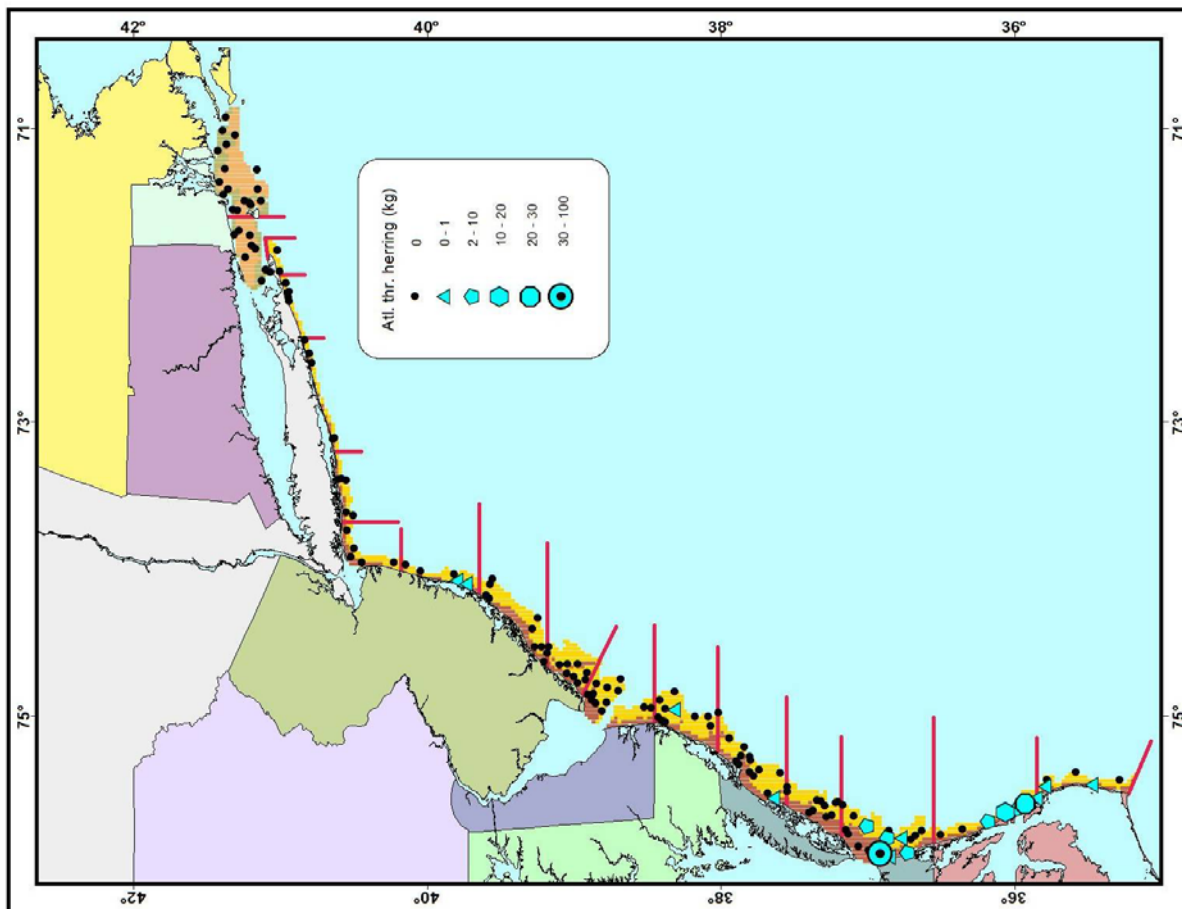
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	3345	167.7	554	0		0		8.74	0.27
2008	Spring	2	0.0	2	0		0		7.02	0.40
	Fall	801	12.0	292	0		0		5.04	0.50
2009	Spring	3	0.0	3	0		0		12.03	0.23

Figure 32. Biomass (kg) of Atlantic thread herring collected at each sampling site for four NEAMAP cruises.

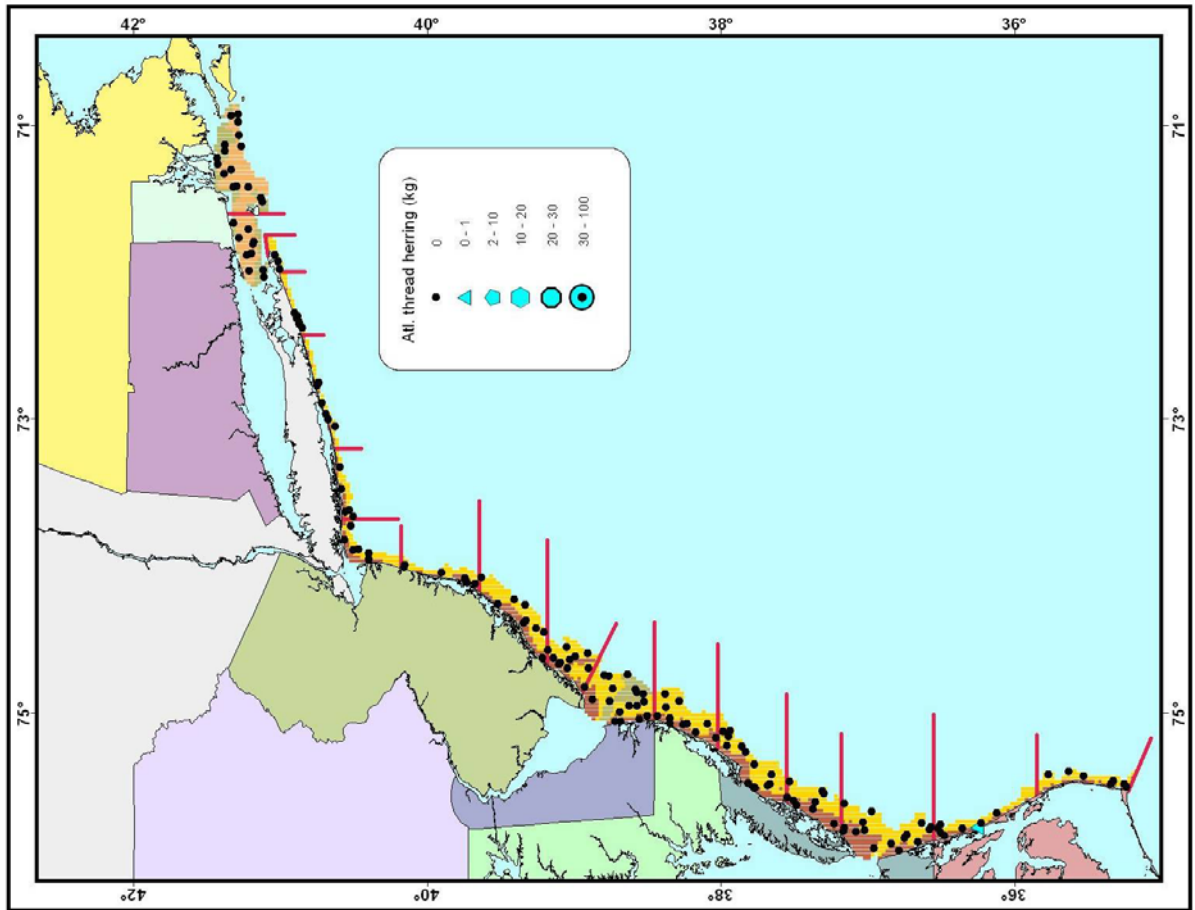
Spring 2008



Fall 2007



Spring 2009



Fall 2008

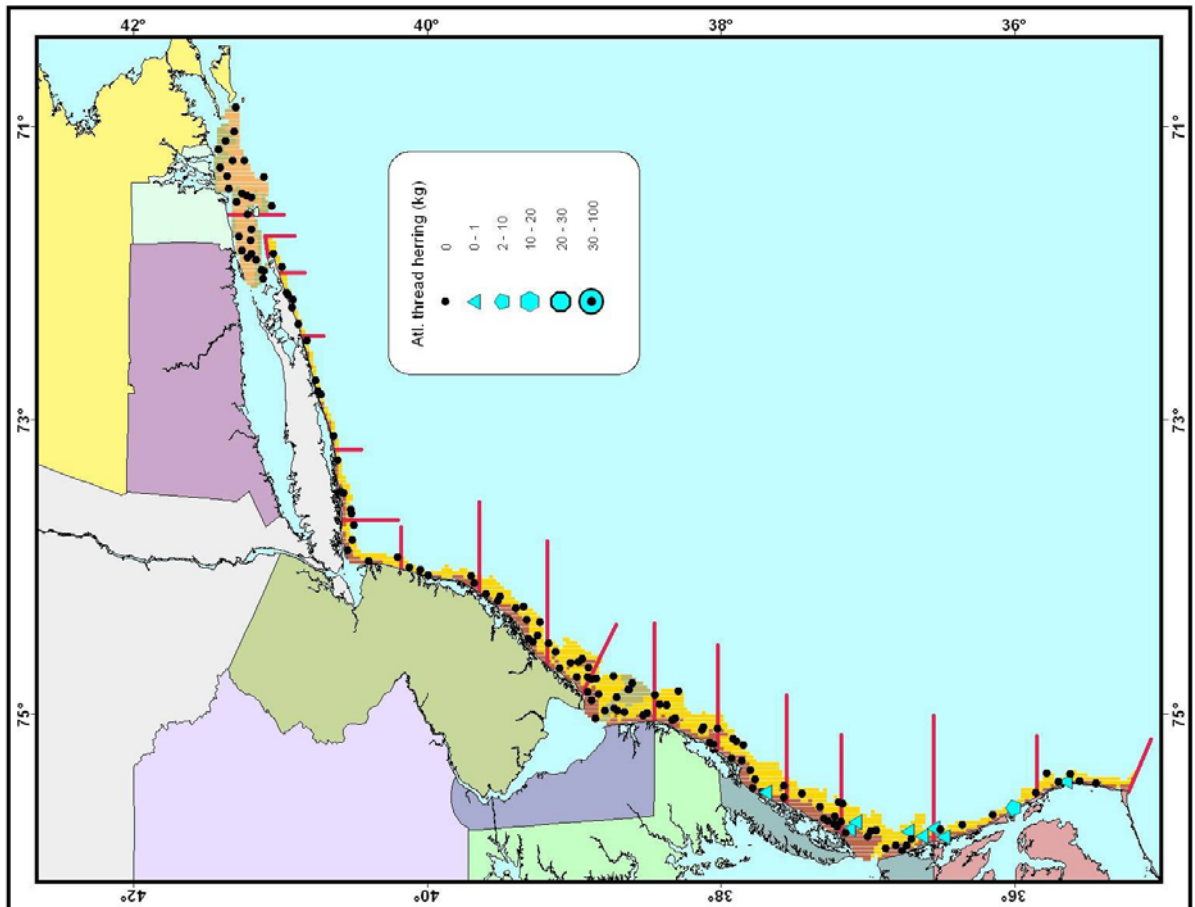




Figure 33. Preliminary indices of abundance, in terms of number and biomass, of Atlantic thread herring for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

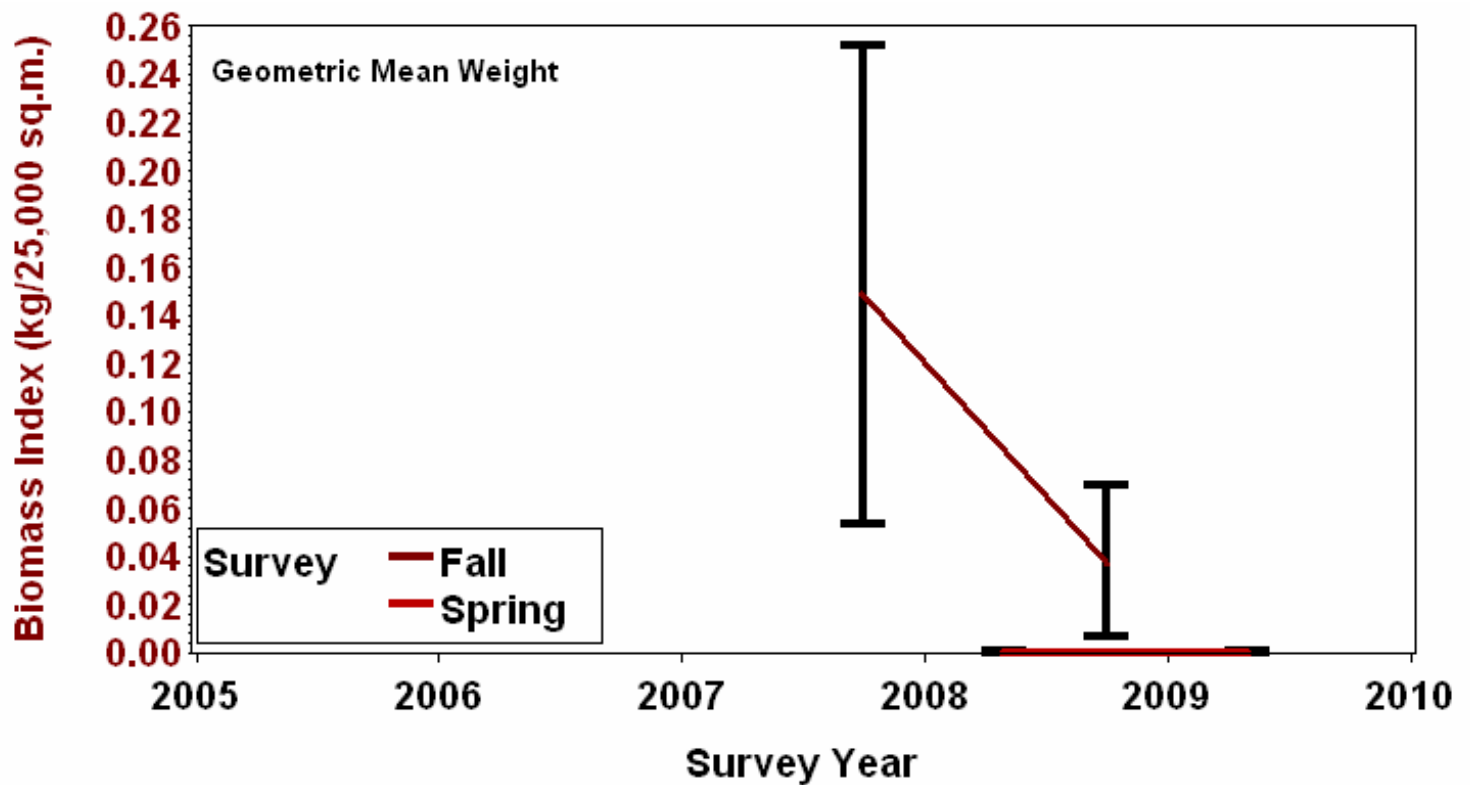
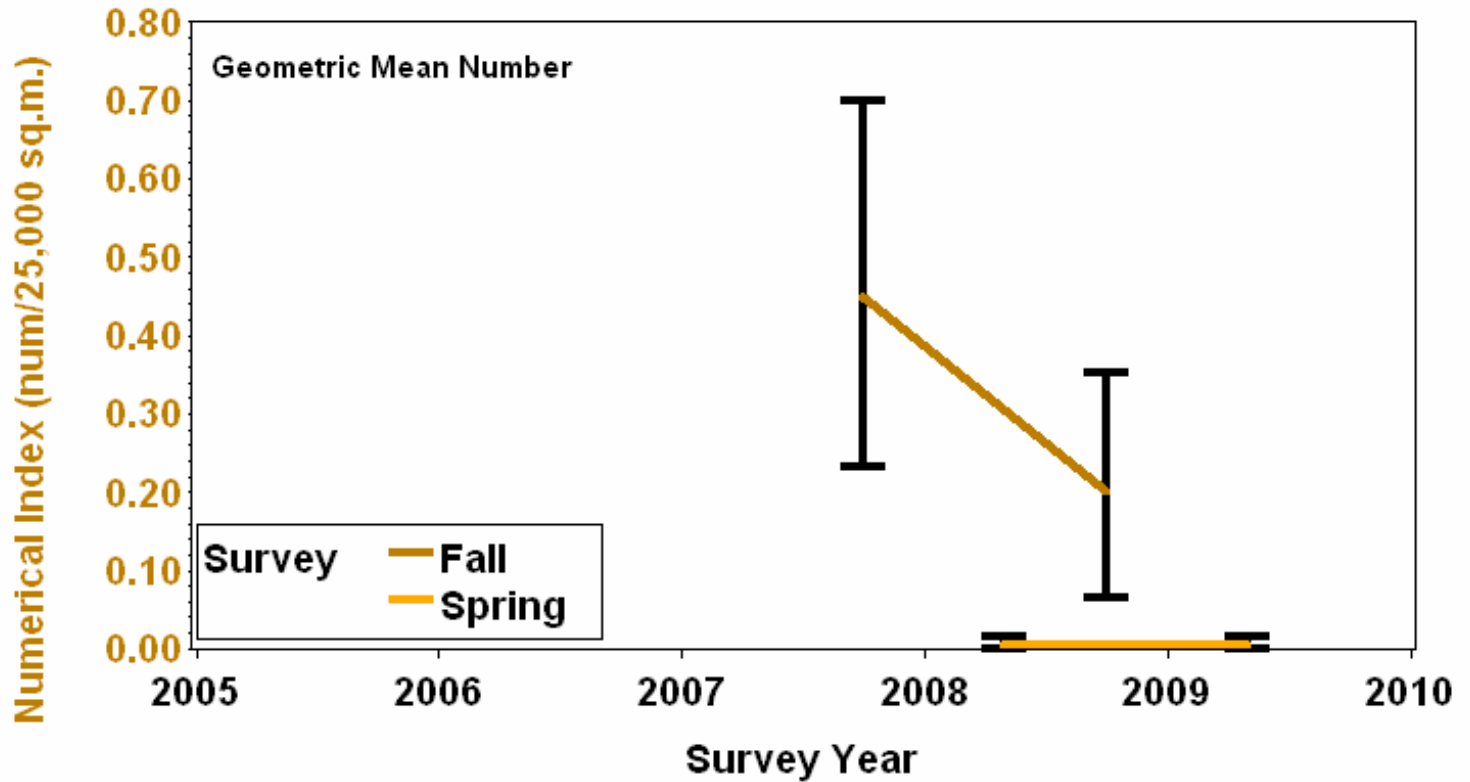
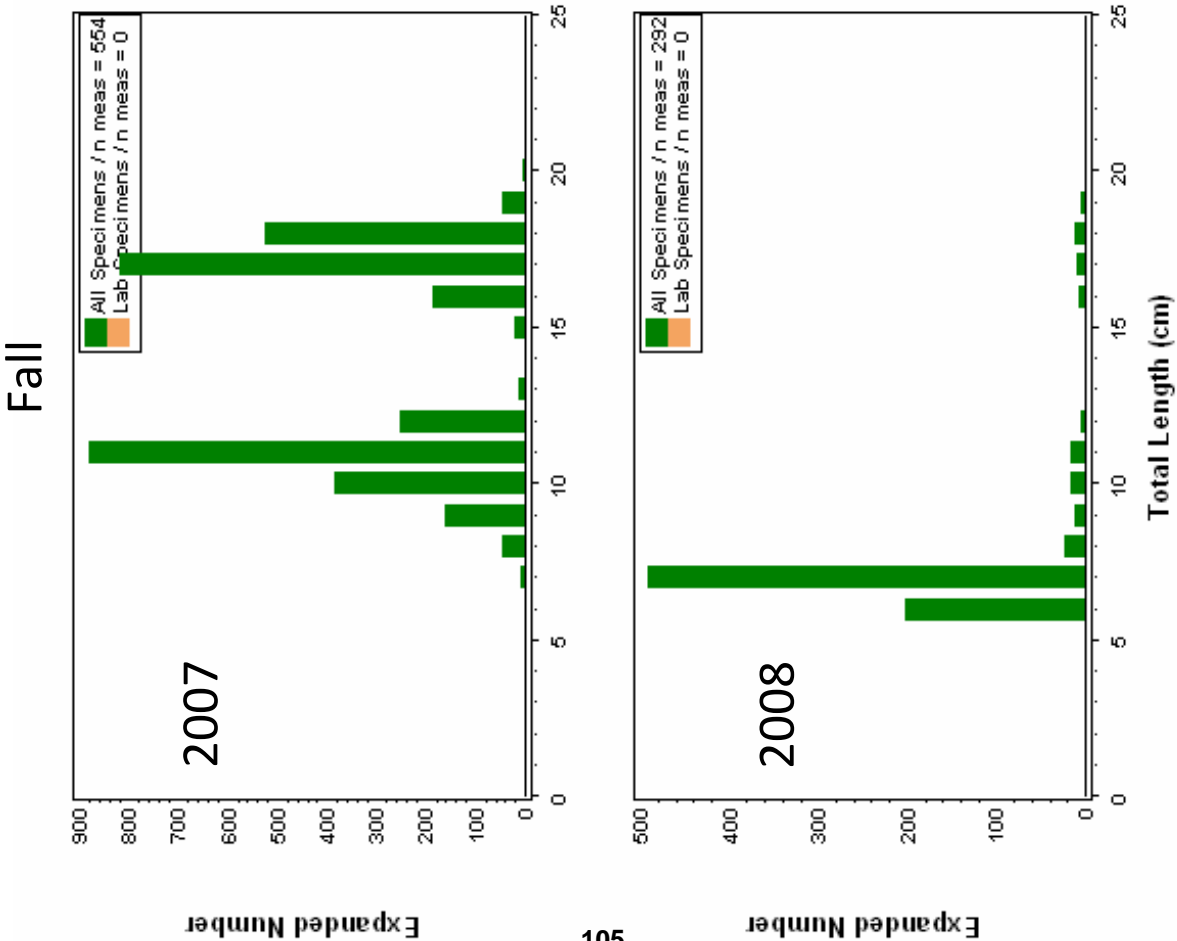


Figure 34. Length-frequency distributions, by cruise, for Atlantic thread herring. This species was absent from spring survey collections.





# Bay Anchovy (Priority D)

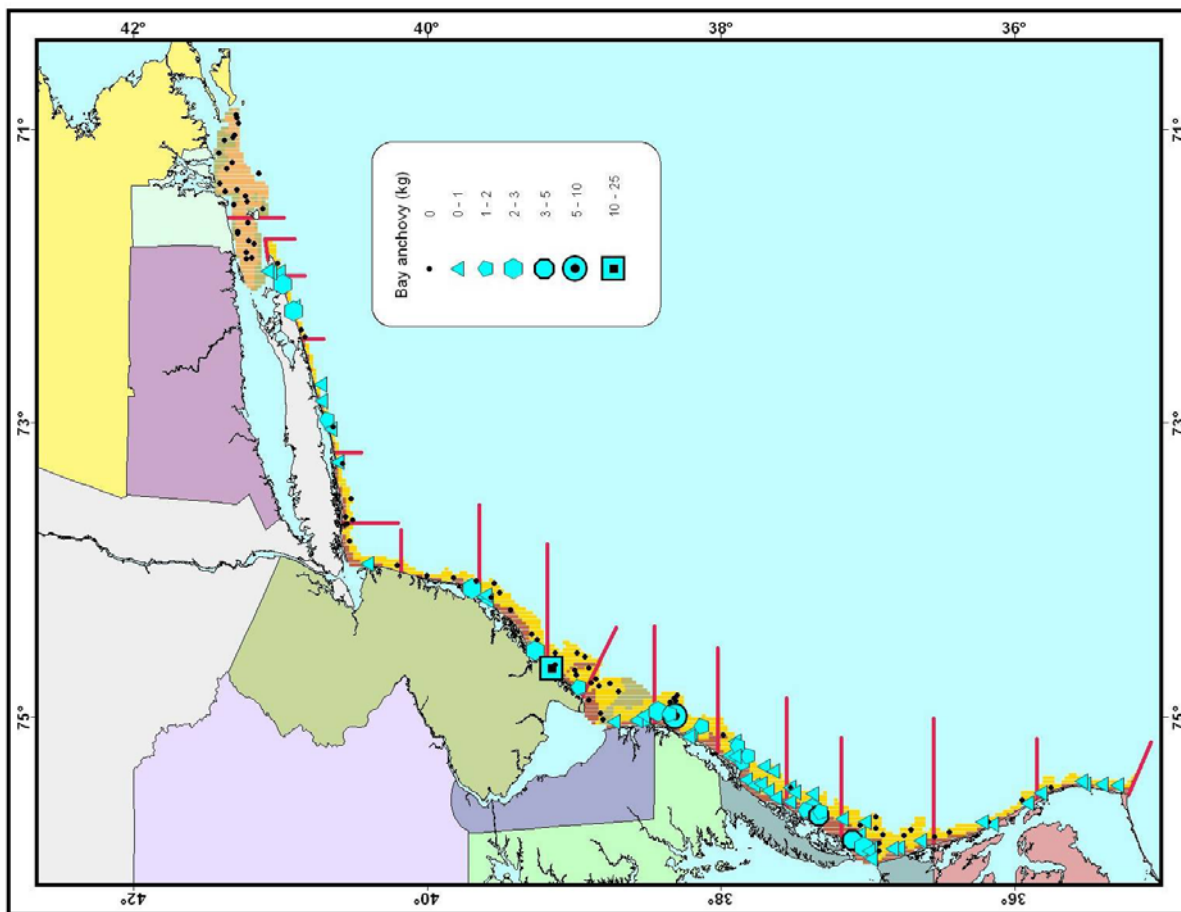


Table 13. Sampling rates and abundance indices of bay anchovy for four NEAMAP cruises.

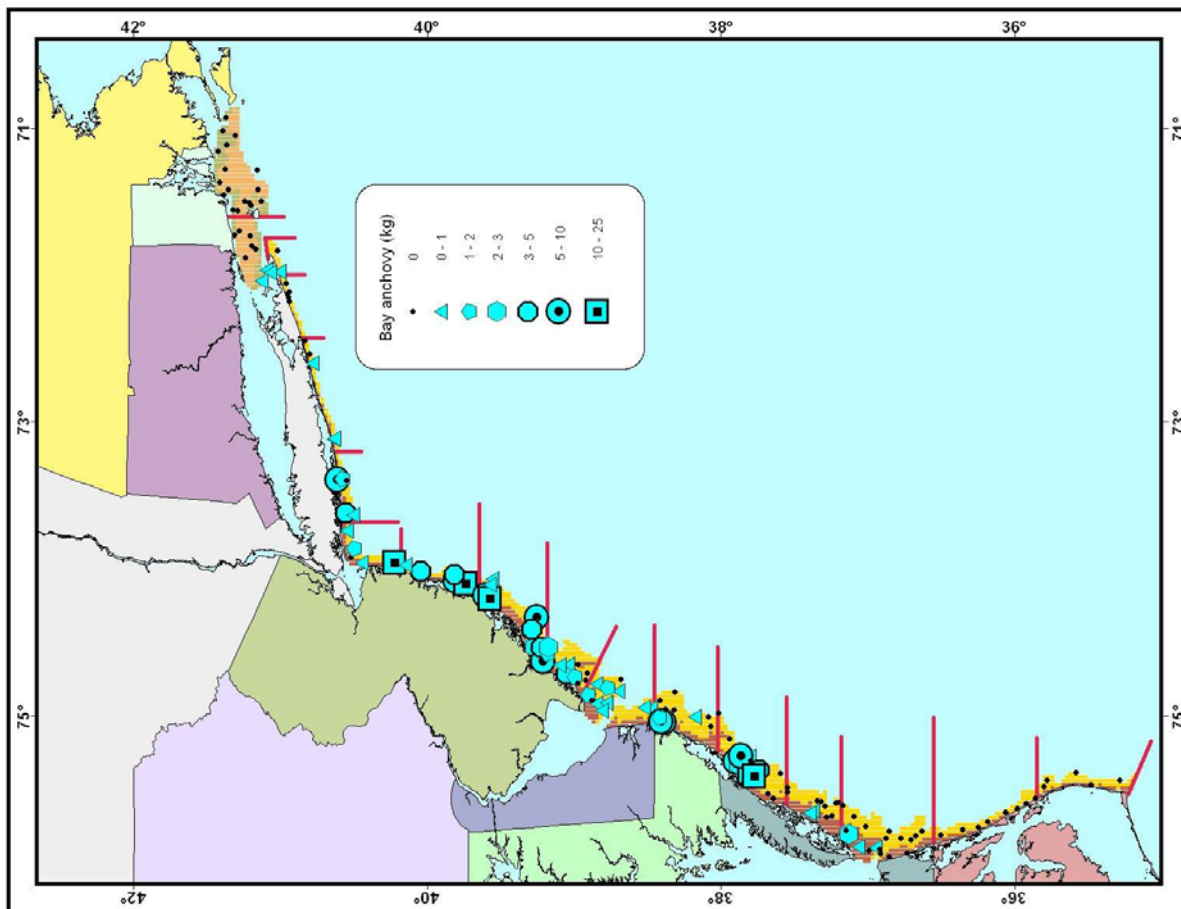
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	119,741	203.4	3,961	0		0		8.74	0.27
2008	Spring	23,926	75.8	3,838	0		0		7.02	0.40
	Fall	35,358	72.6	2,299	0		0		5.04	0.50
2009	Spring	62,807	145.9	7,112	0		0		12.03	0.23

Figure 35. Biomass (kg) of bay anchovy collected at each sampling site for four NEAMAP cruises.

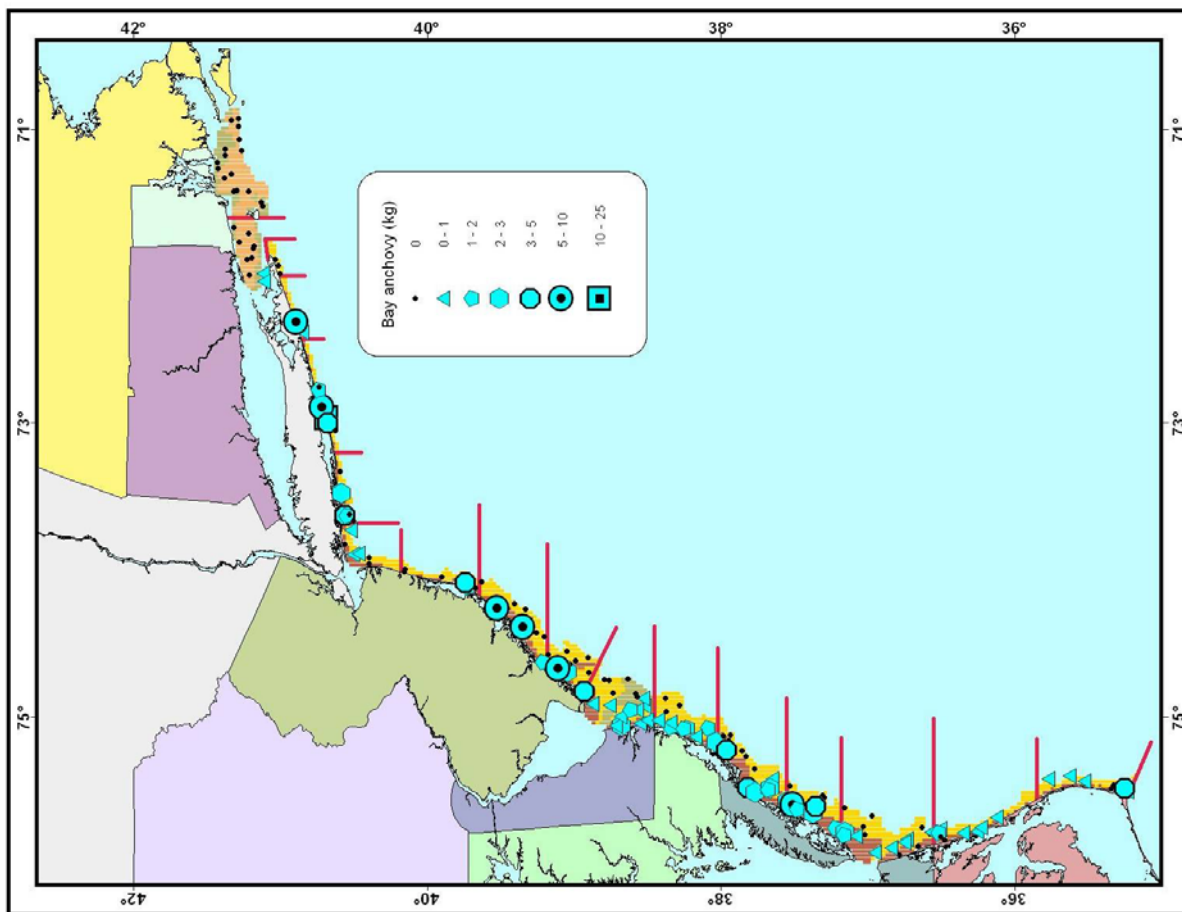
Spring 2008



Fall 2007



Spring 2009



Fall 2008

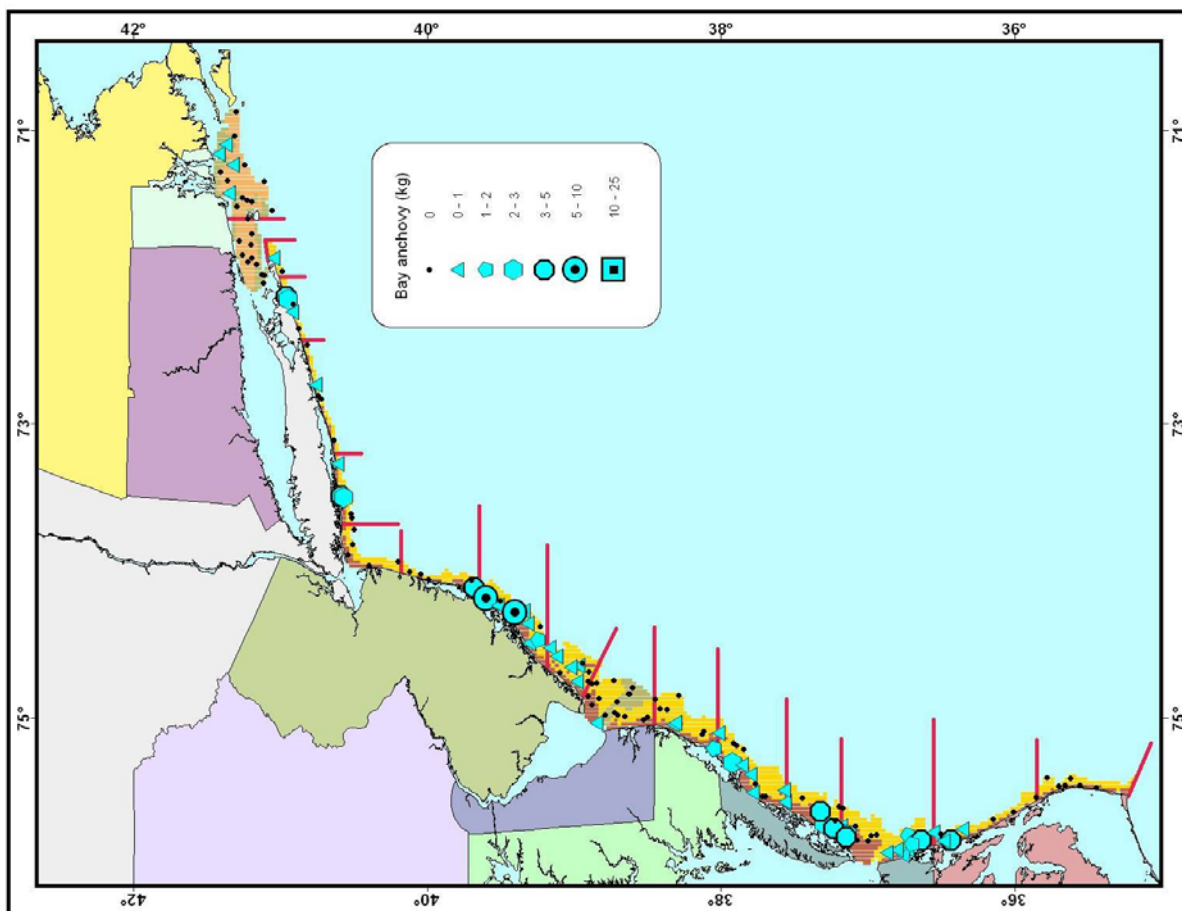


Figure 36. Preliminary indices of abundance, in terms of number and biomass, of bay anchovy for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

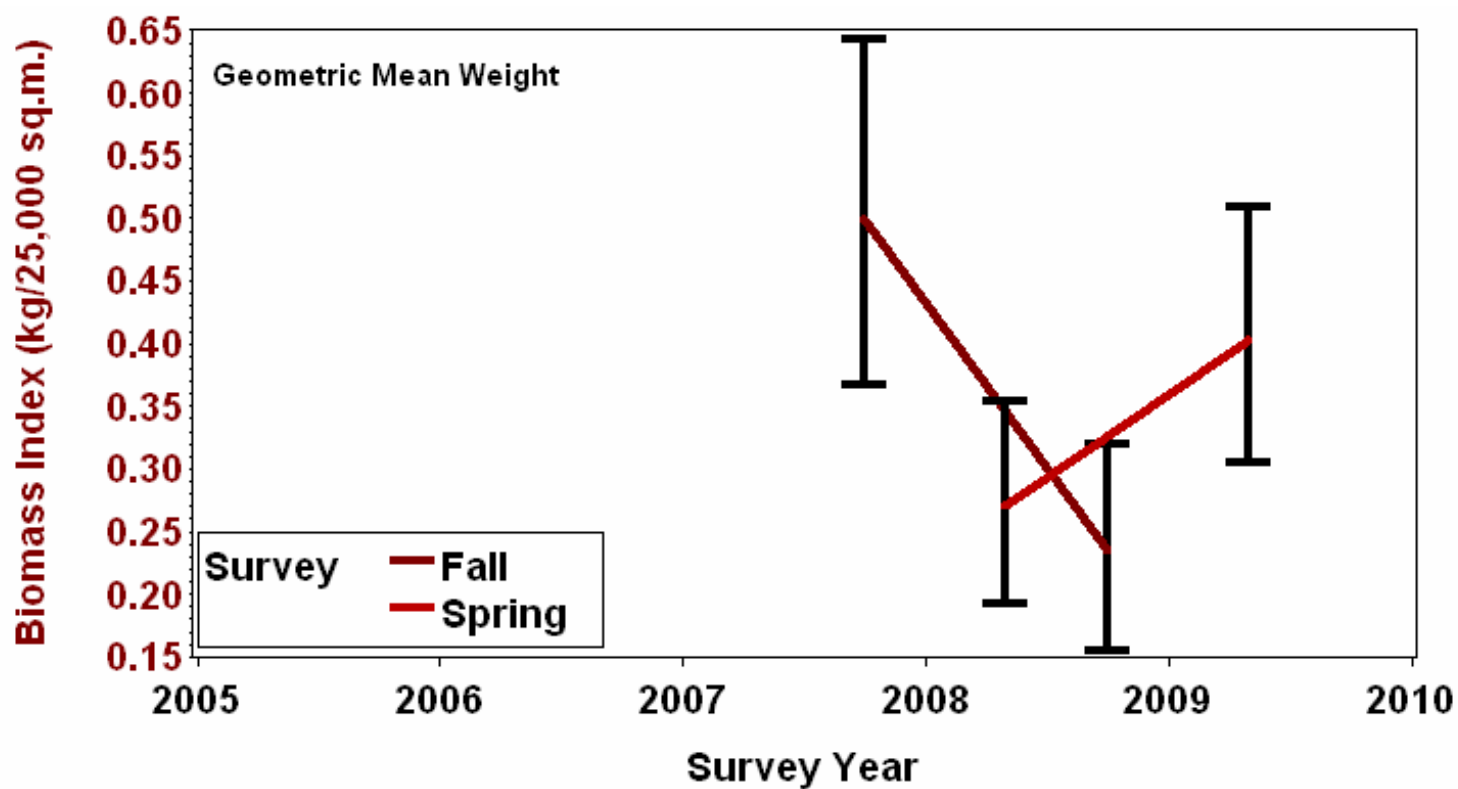
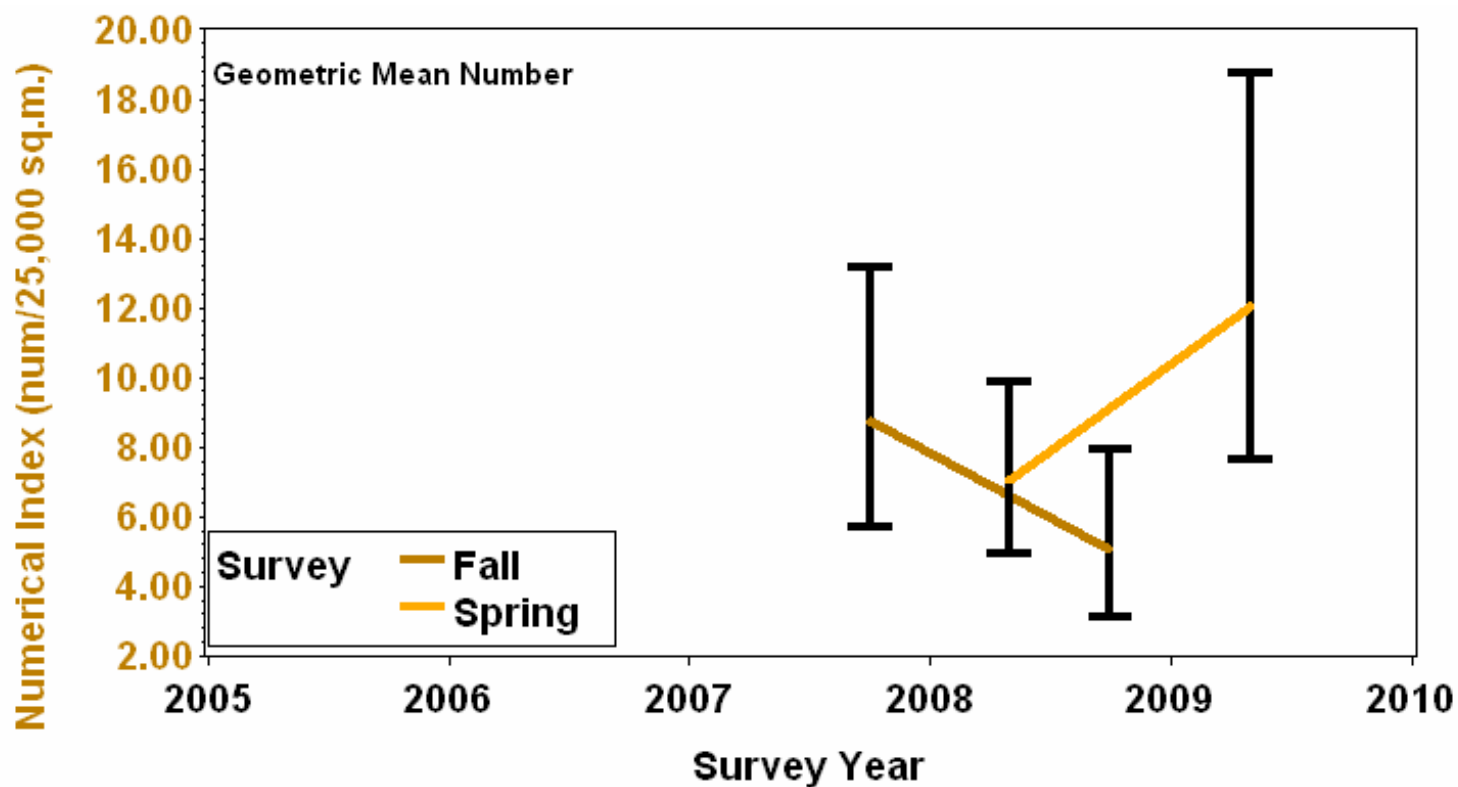
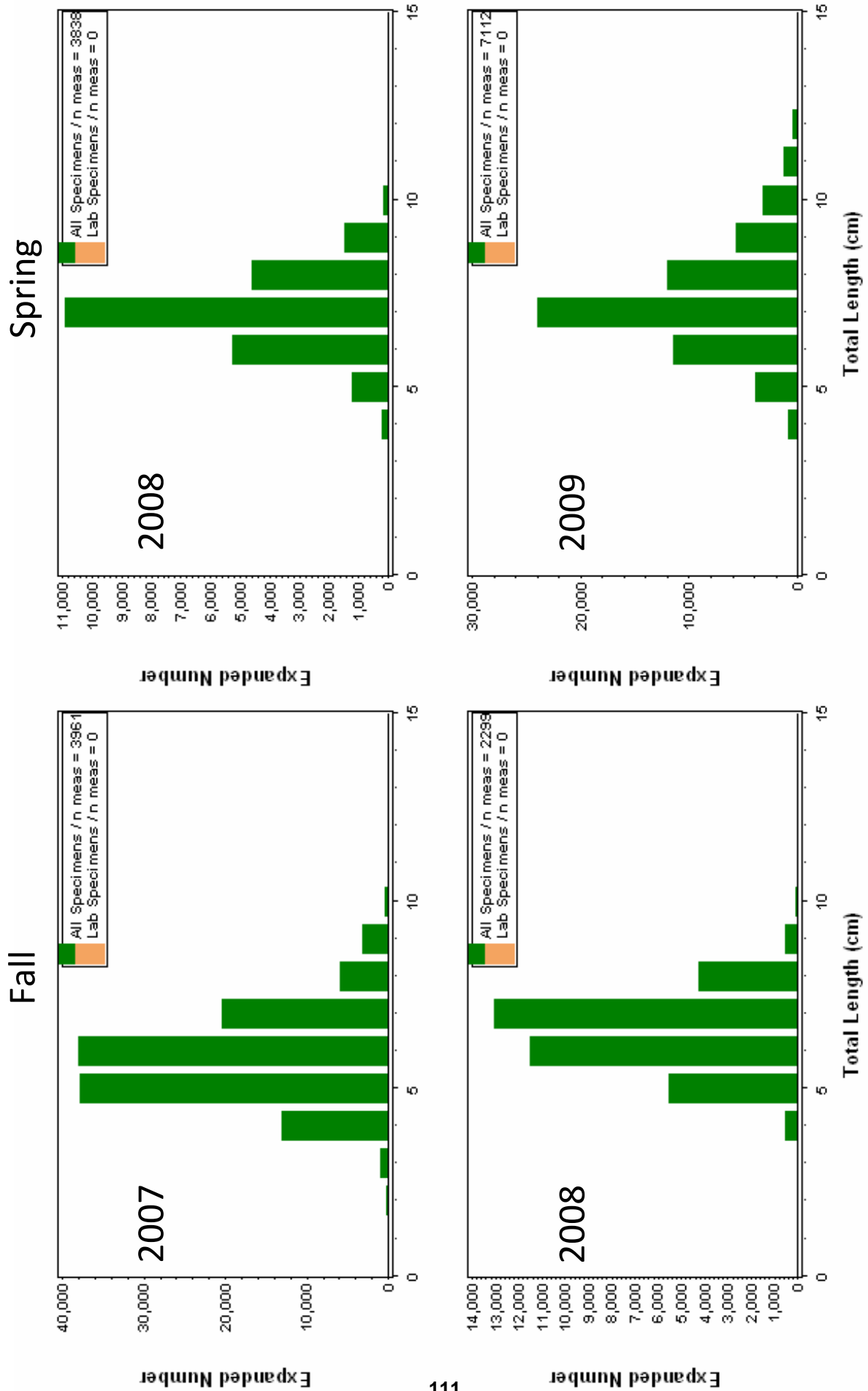


Figure 37. Length-frequency distributions, by cruise, for bay anchovy.







# Black Sea Bass (Priority A)

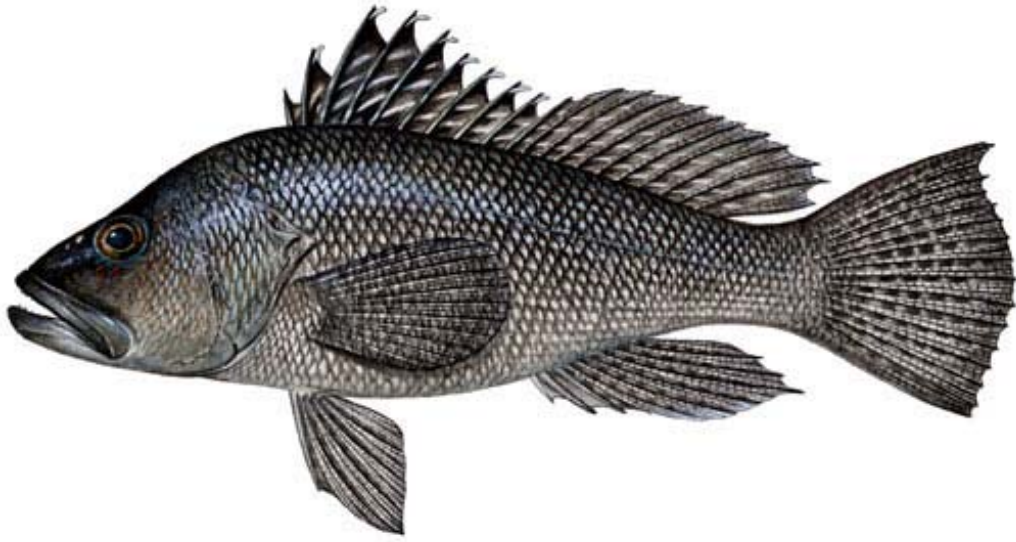
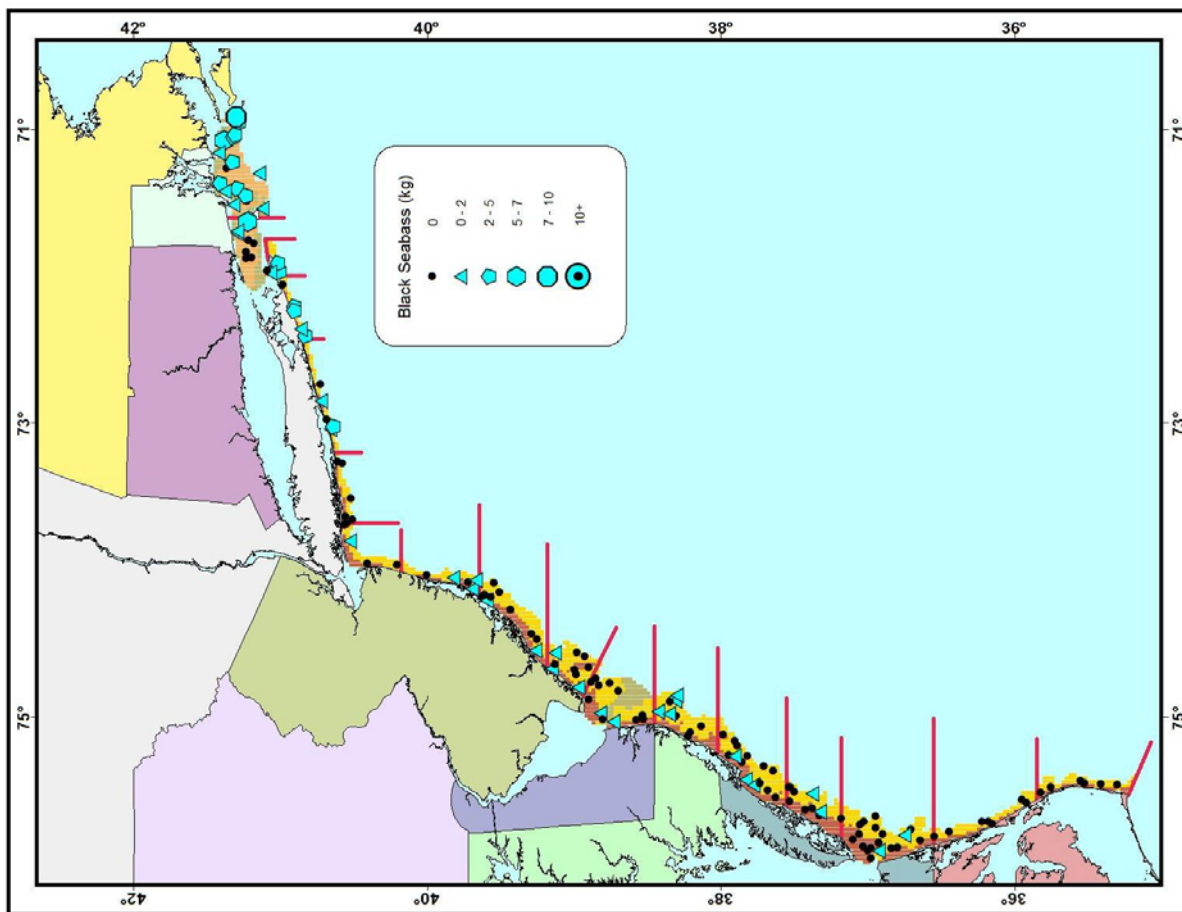


Table 14. Sampling rates and abundance indices of black sea bass for four NEAMAP cruises.

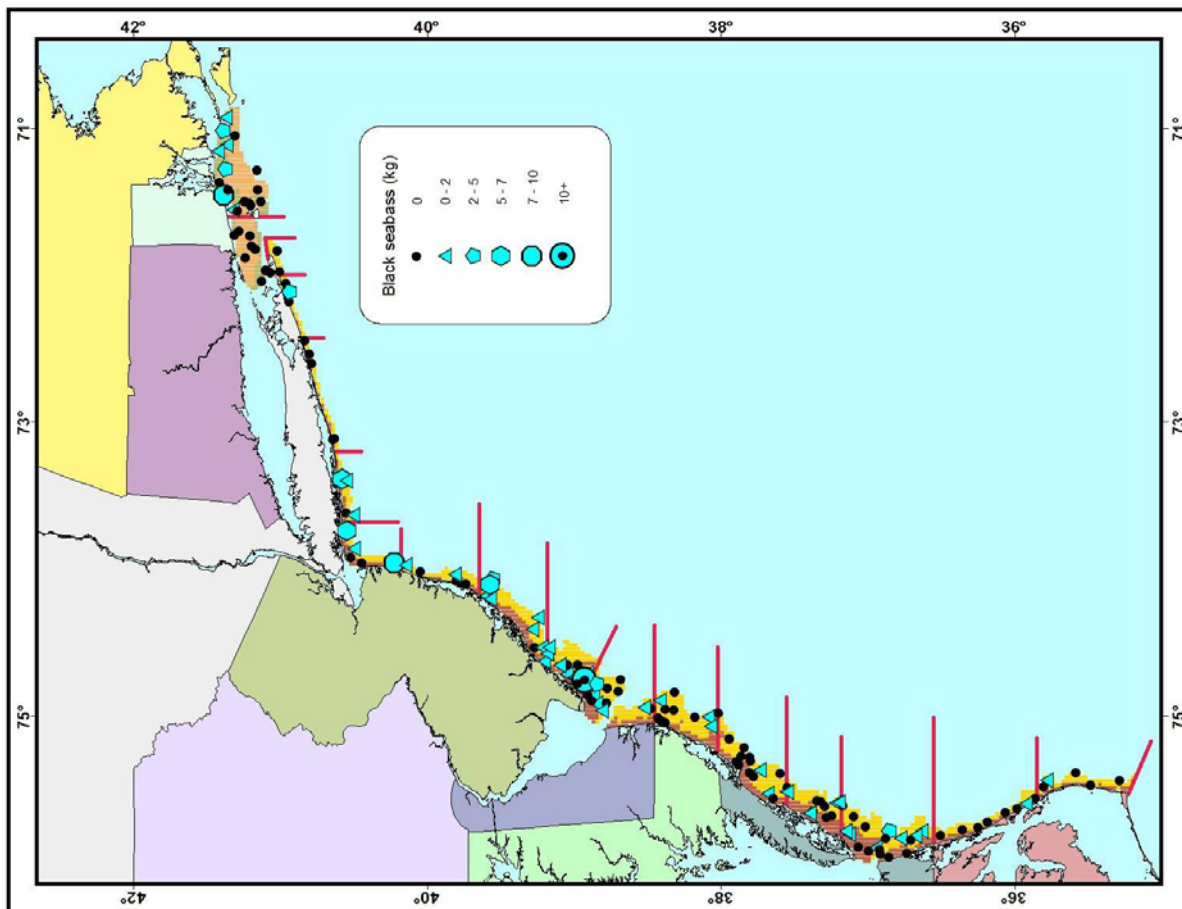
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	401	85.3	401	219	219	210	210	0.84	0.25
2008	Spring	166	83.9	166	140	0	119	115	0.51	0.20
	Fall	174	75.2	174	115	0	114	114	0.45	0.27
2009	Spring	236	67.5	236	167	0	162	155	0.45	0.15

Figure 38. Biomass (kg) of black sea bass collected at each sampling site for four NEAMAP cruises.

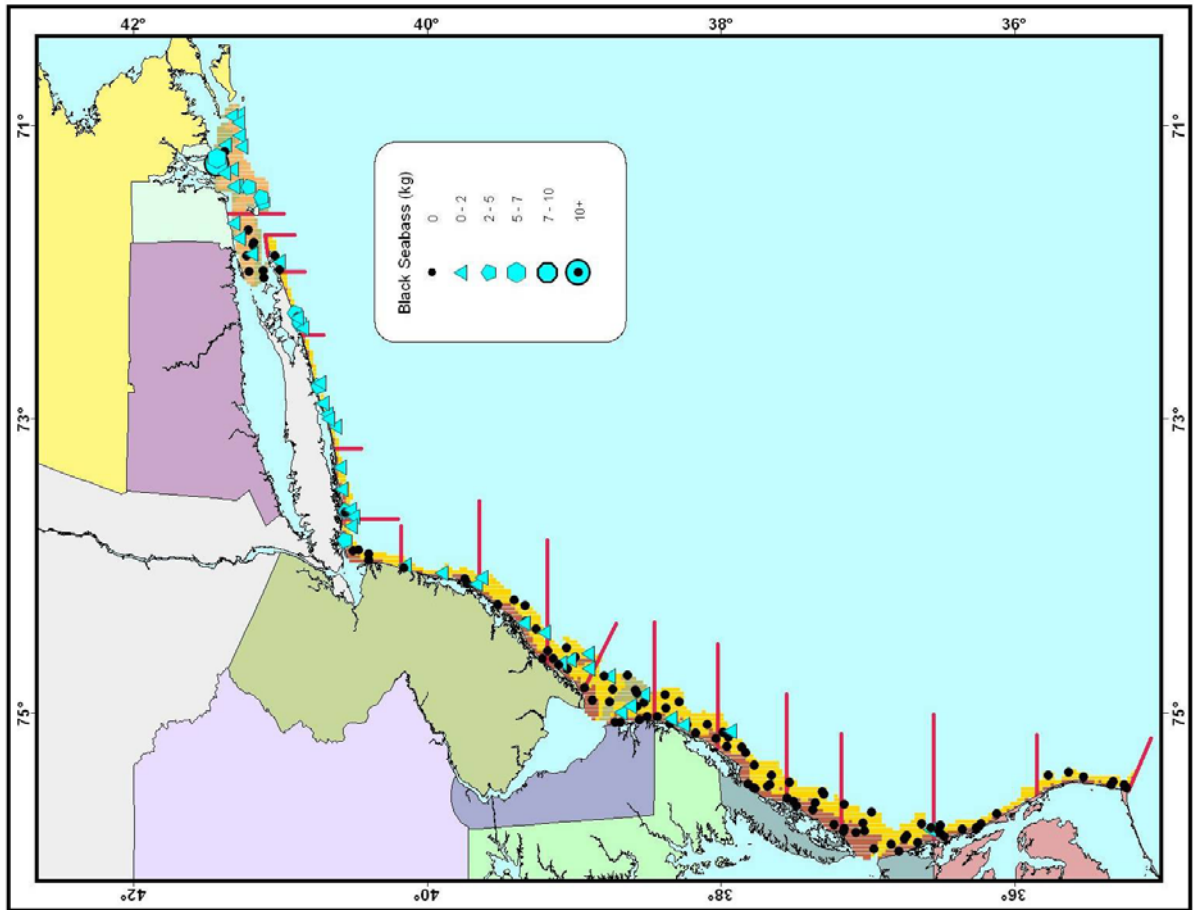
Spring 2008



Fall 2007



Spring 2009



Fall 2008

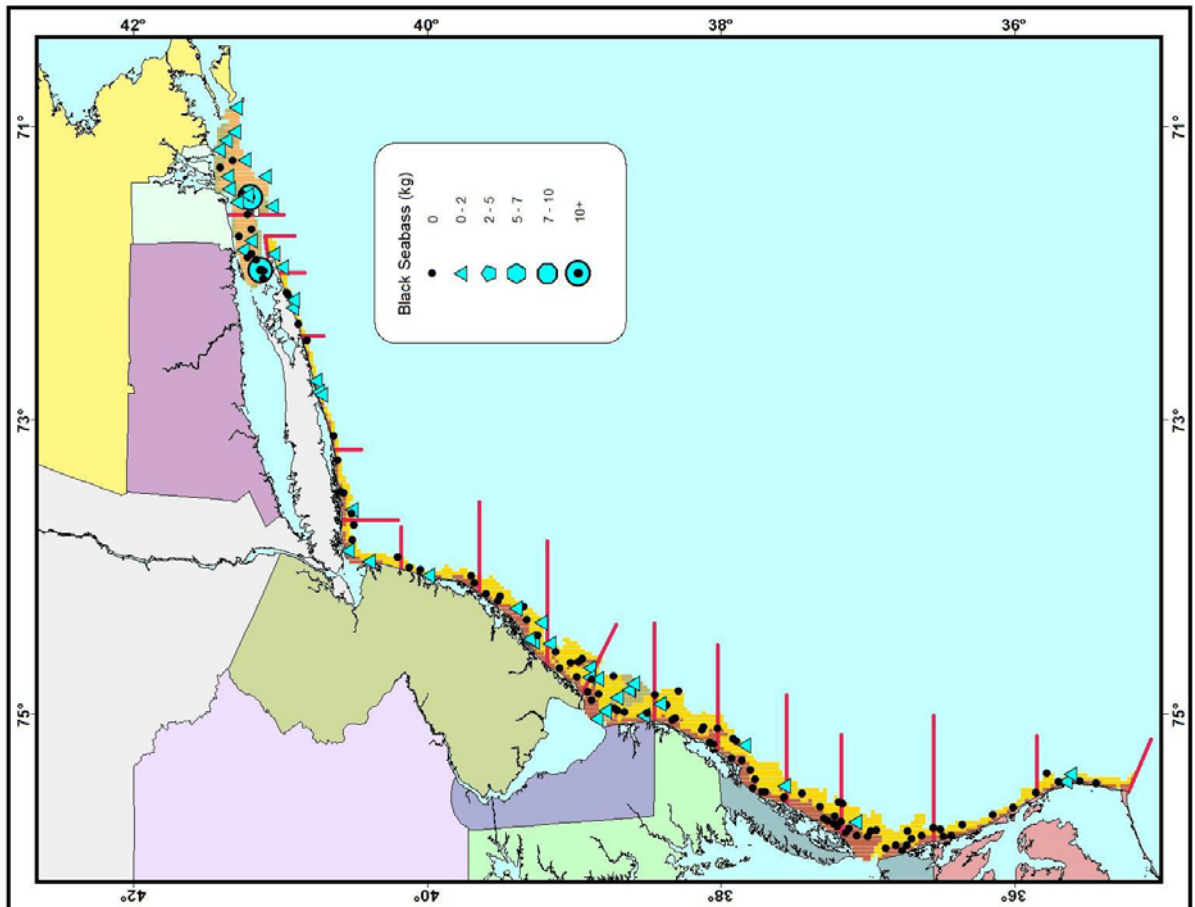


Figure 39. Preliminary indices of abundance, in terms of number and biomass, of black sea bass for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

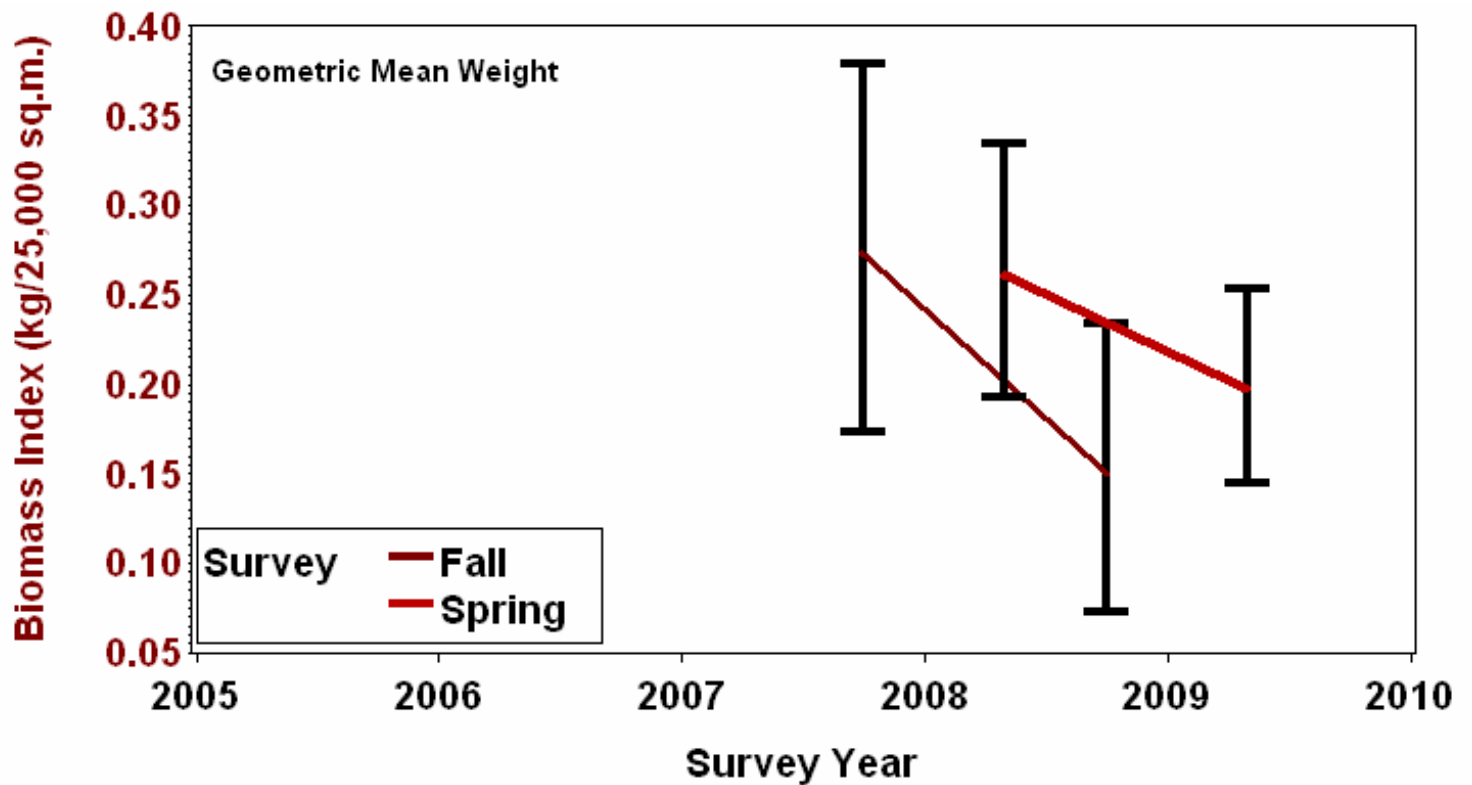
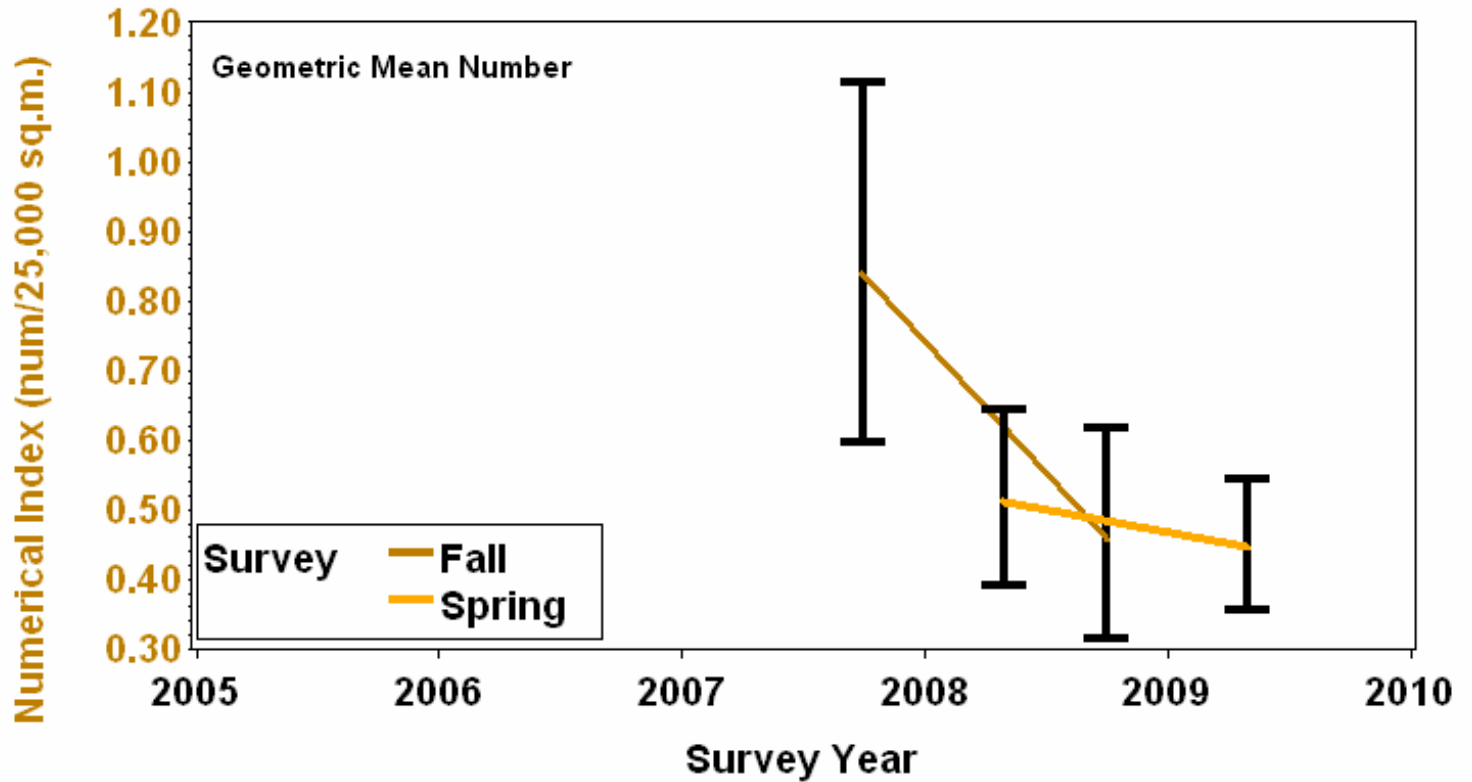


Figure 40. Length-frequency distributions, by cruise, for black sea bass. Numbers taken for full processing, by length, are represented by the orange bars.

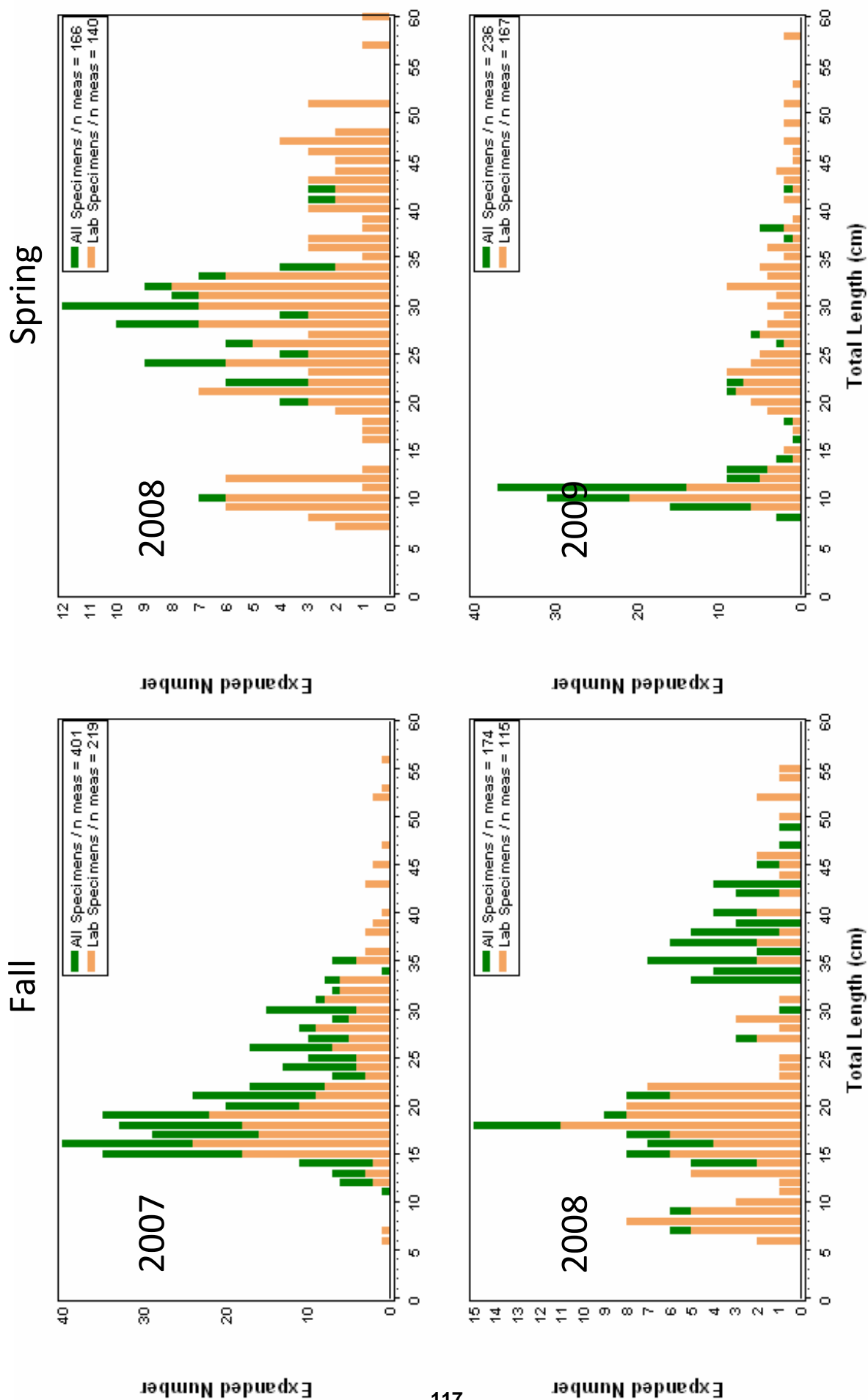


Figure 41. Sex ratio, by length group, for black sea bass collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

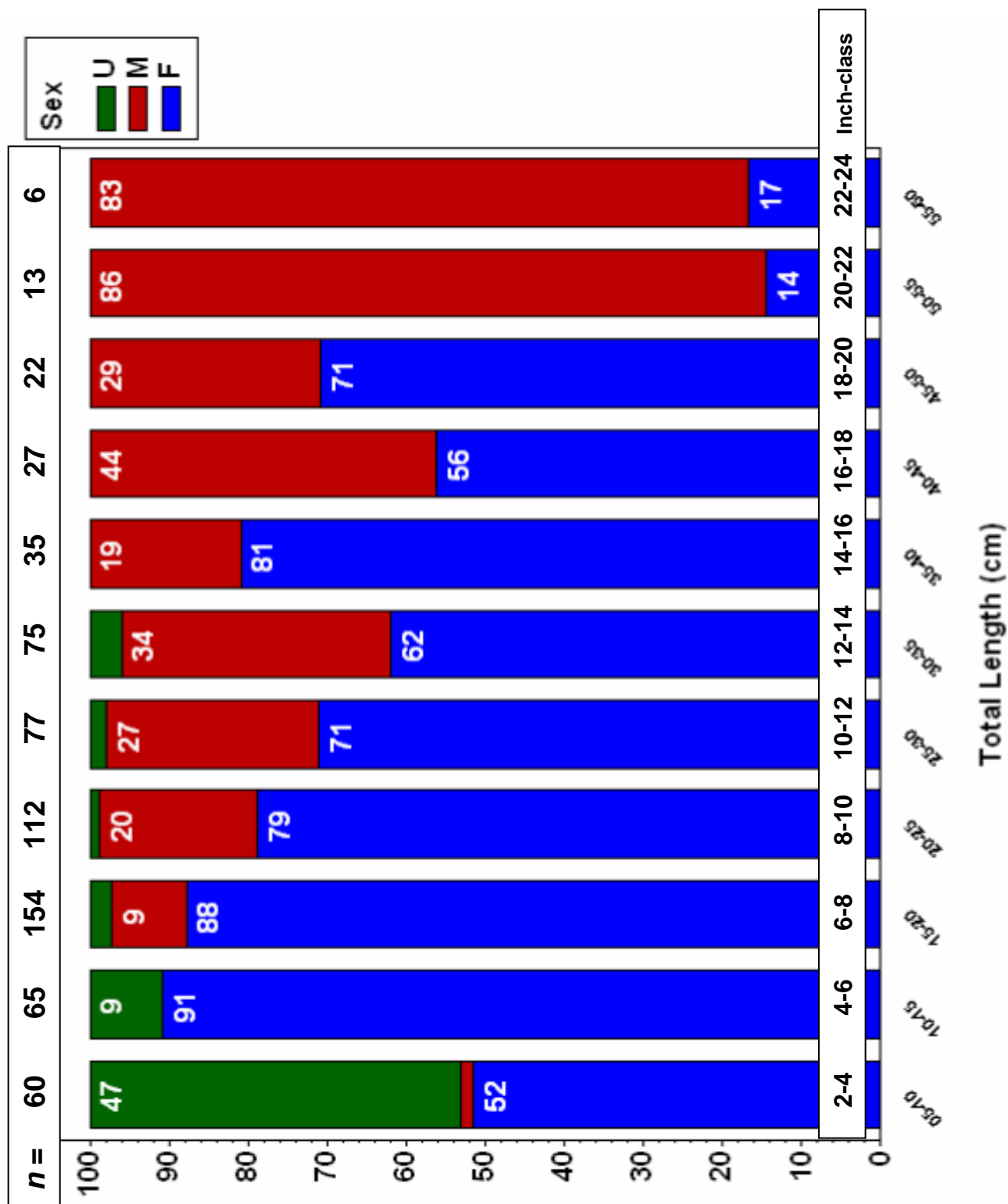


Figure 42. Age-frequency distribution for black sea bass collected during the Fall 2007 cruise. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.

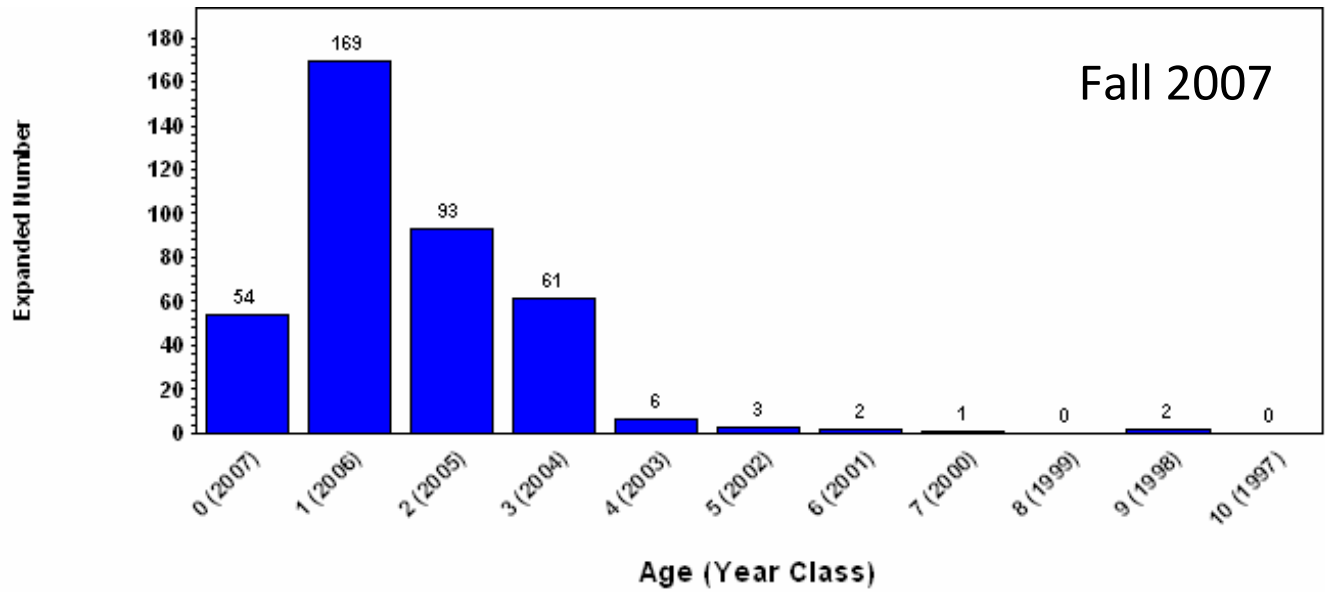
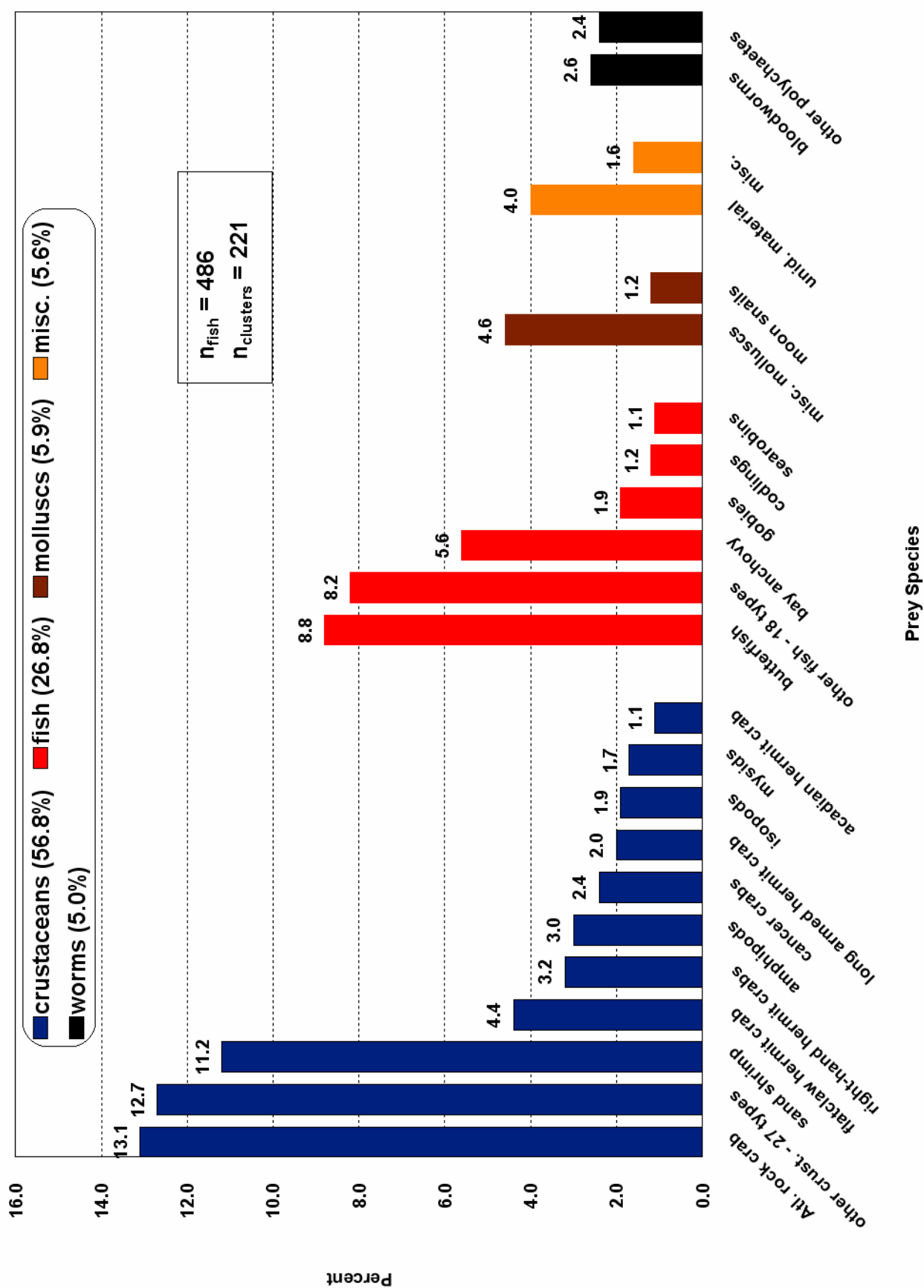




Figure 43. Diet composition, expressed using the percent weight index, of black sea bass collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of sea bass sampled.



# Blueback Herring (Priority C)

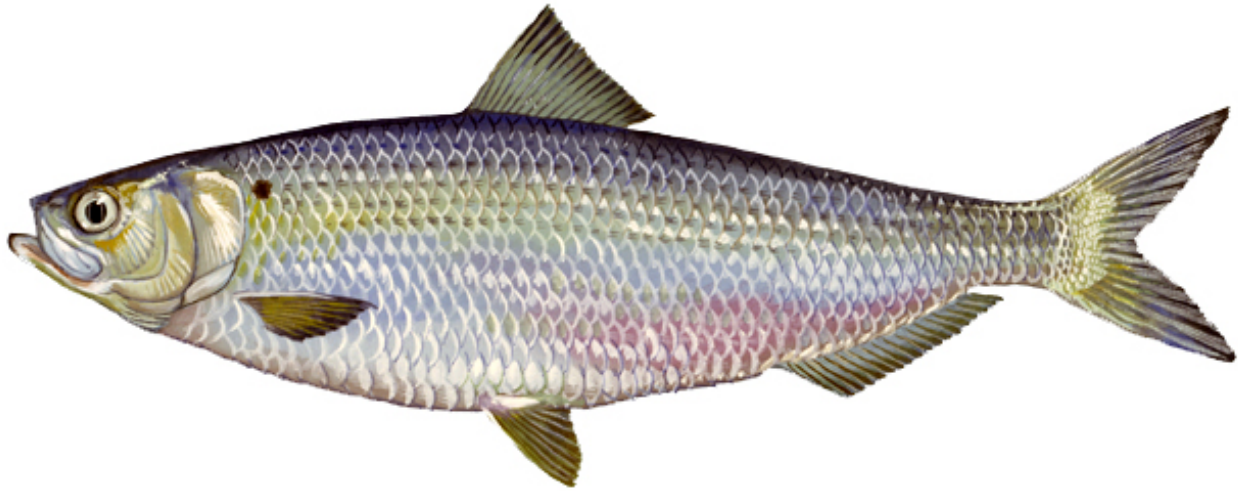
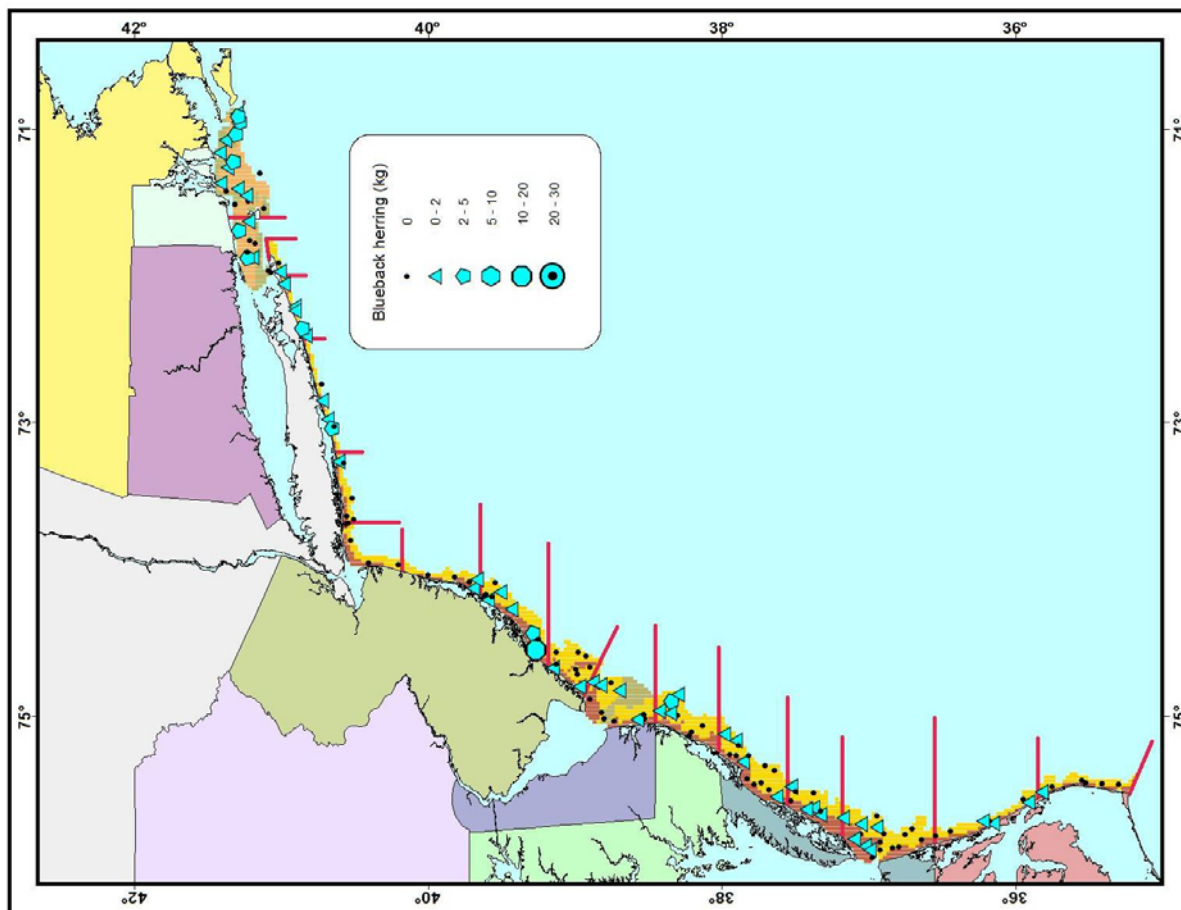


Table 15. Sampling rates and abundance indices of blueback herring for four NEAMAP cruises.

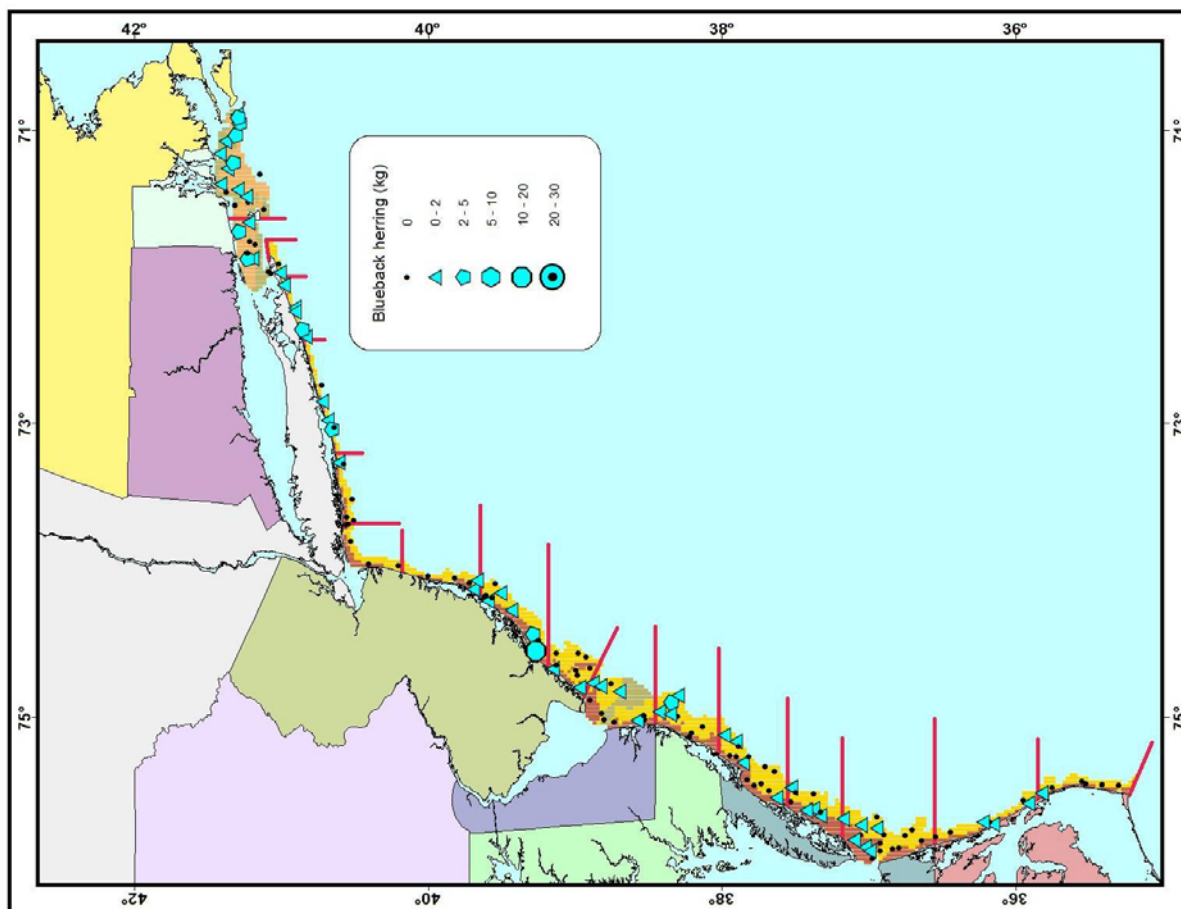
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	50	1.6	50	18	0	18	0	0.12	0.01
2008	Spring	3,692	62.2	1,774	237	0	235	0	1.75	0.20
	Fall	20	0.7	20	9	0	9	0	0.04	0.00
2009	Spring	5,603	160.3	2,808	315	0	315	0	2.30	0.34

Figure 44. Biomass (kg) of blueback herring collected at each sampling site for four NEAMAP cruises.

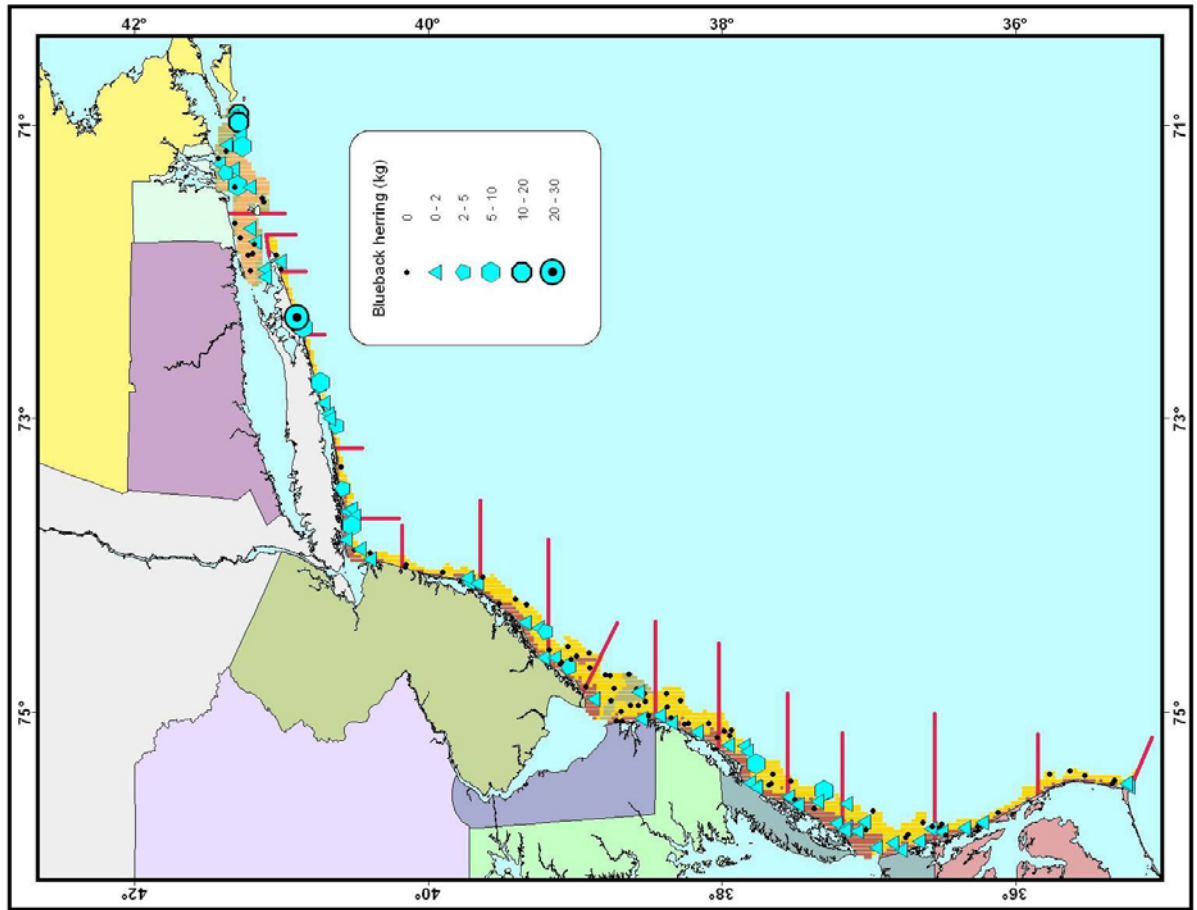
Spring 2008



Fall 2007



Spring 2009



Fall 2008

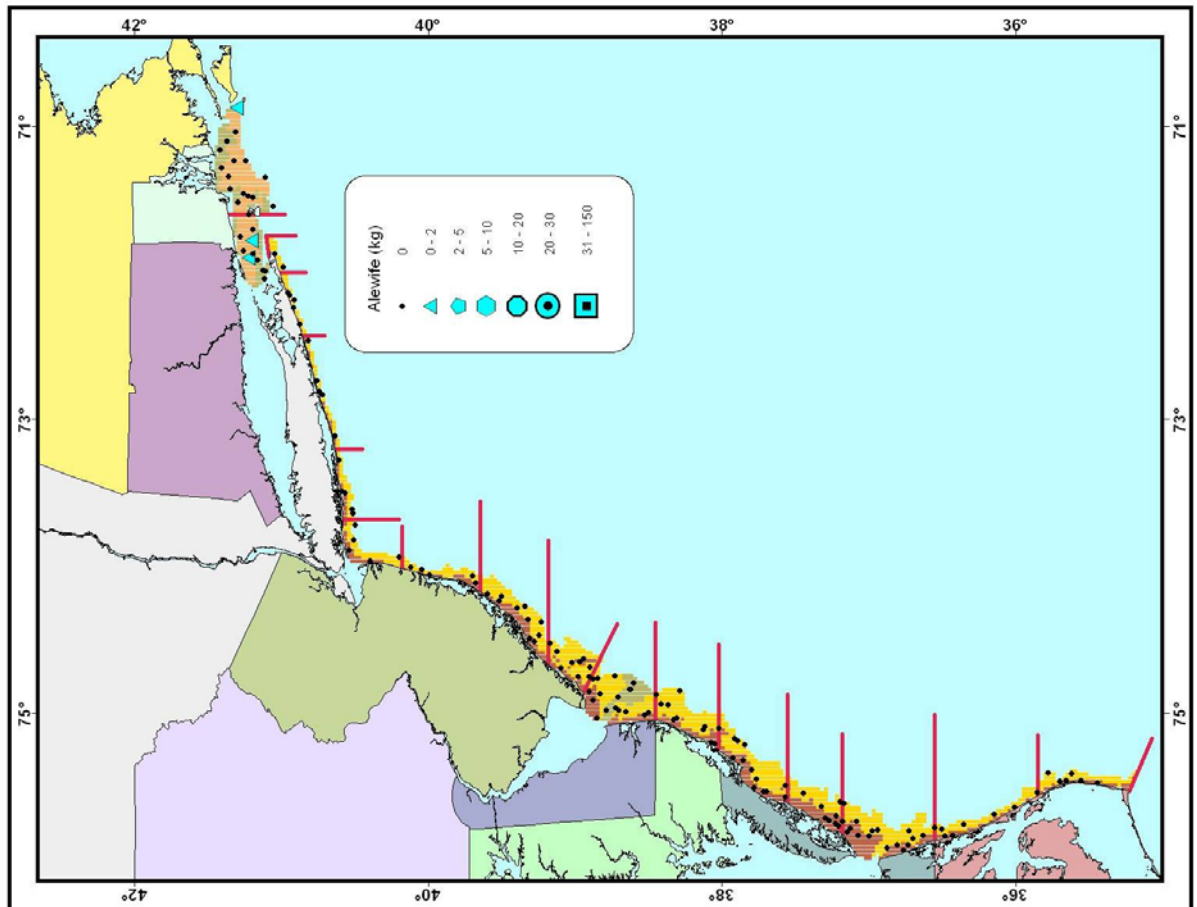


Figure 45. Preliminary indices of abundance, in terms of number and biomass, of blueback herring for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

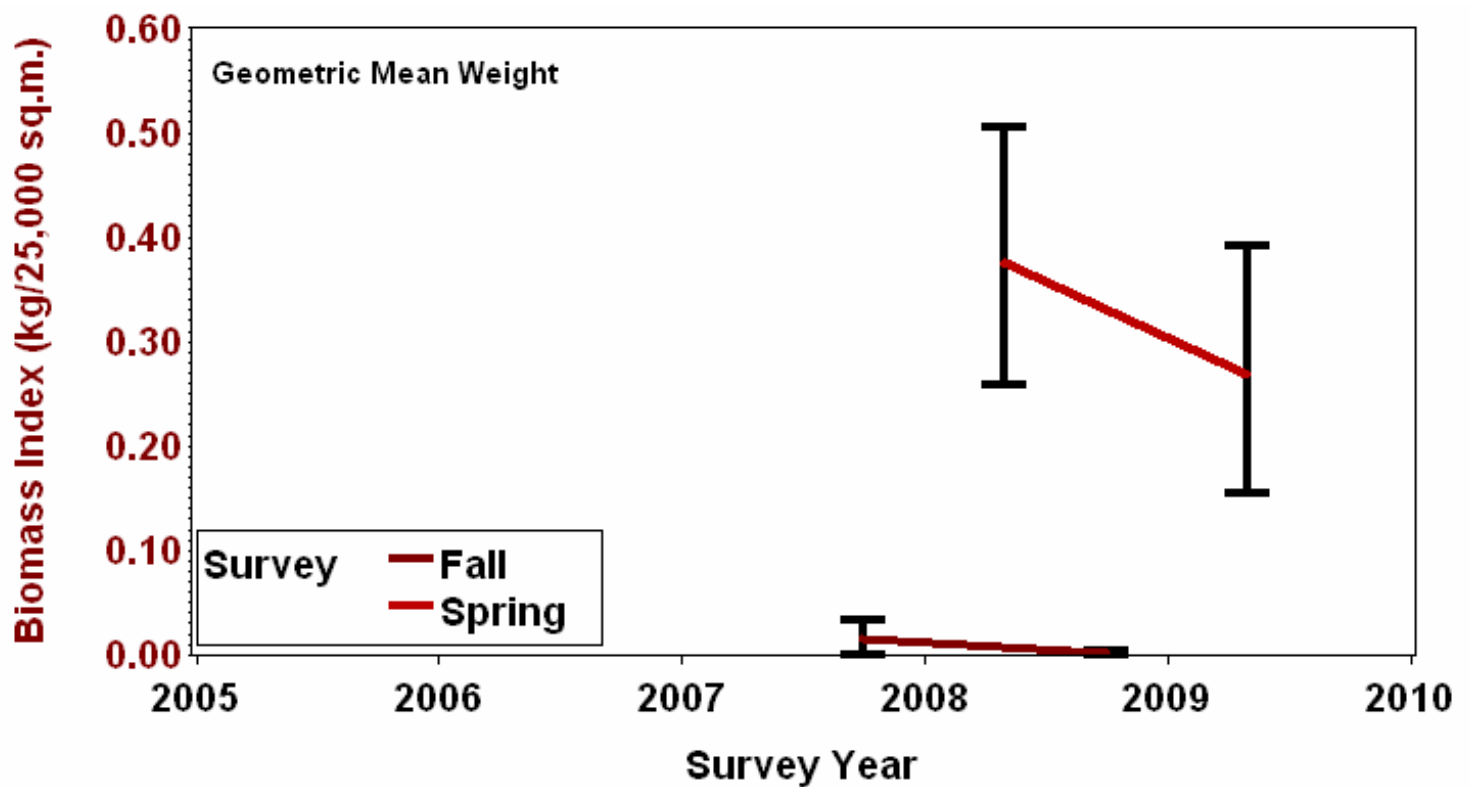
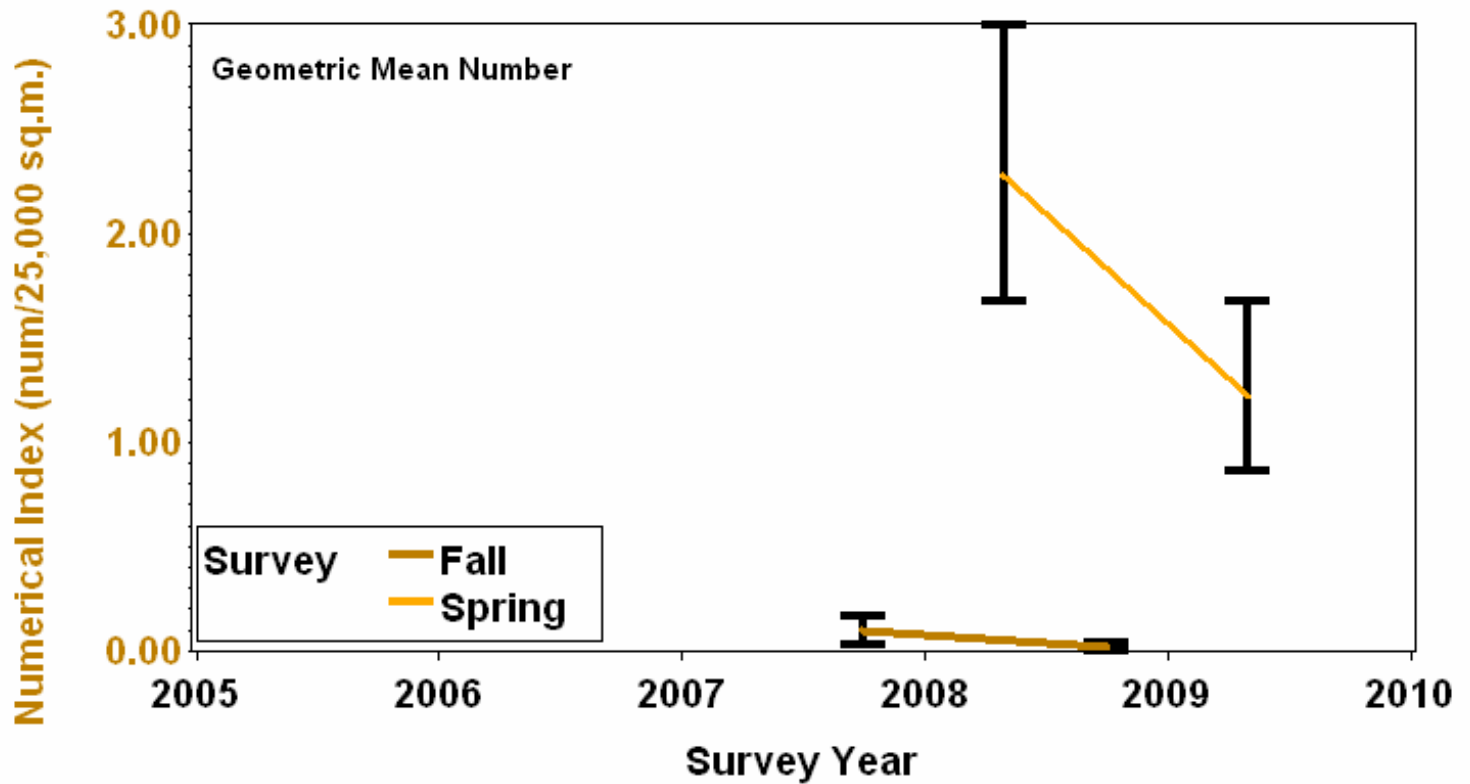


Figure 46. Length-frequency distributions, by cruise, for blueback herring. Numbers taken for full processing, by length, are represented by the orange bars.

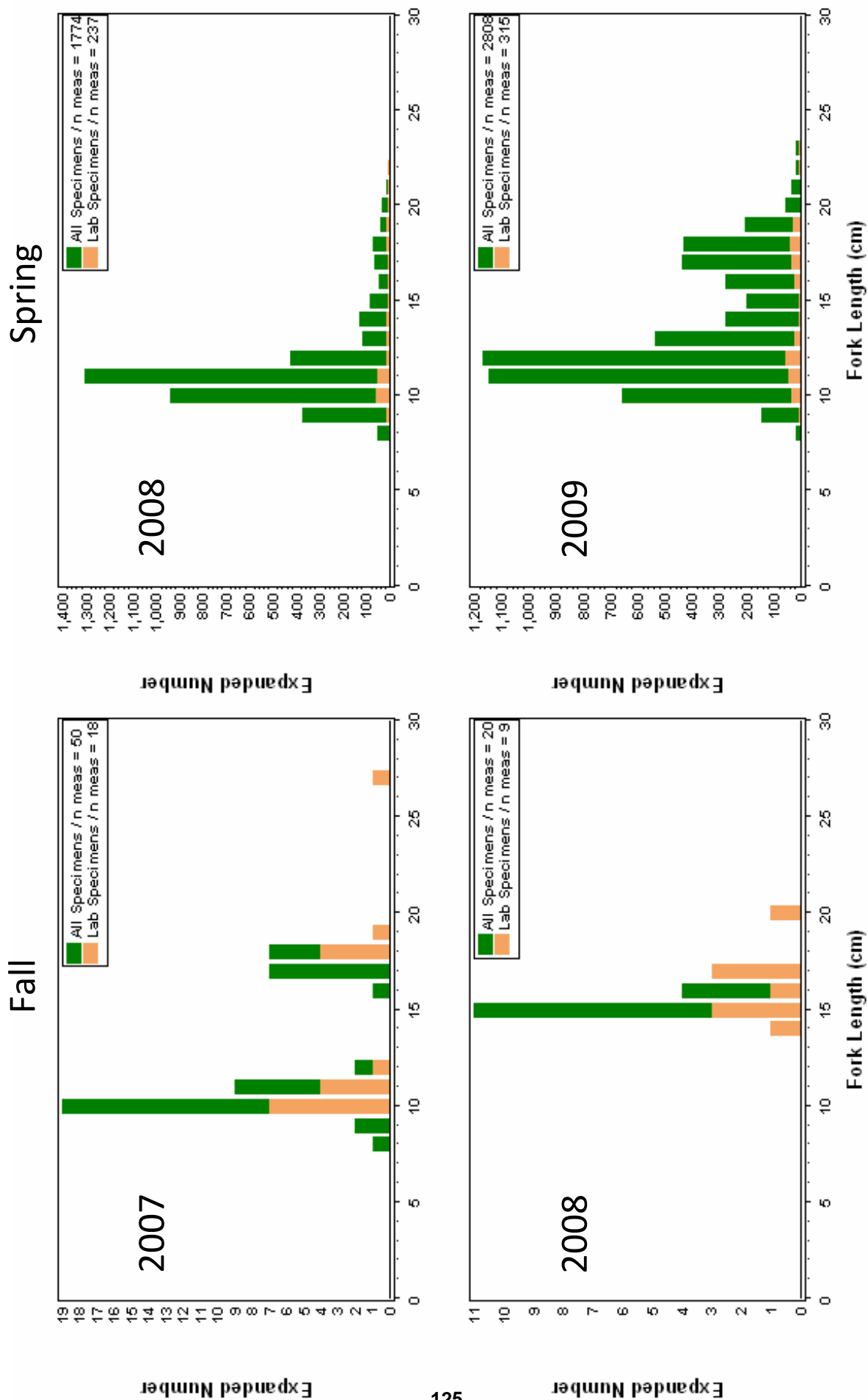
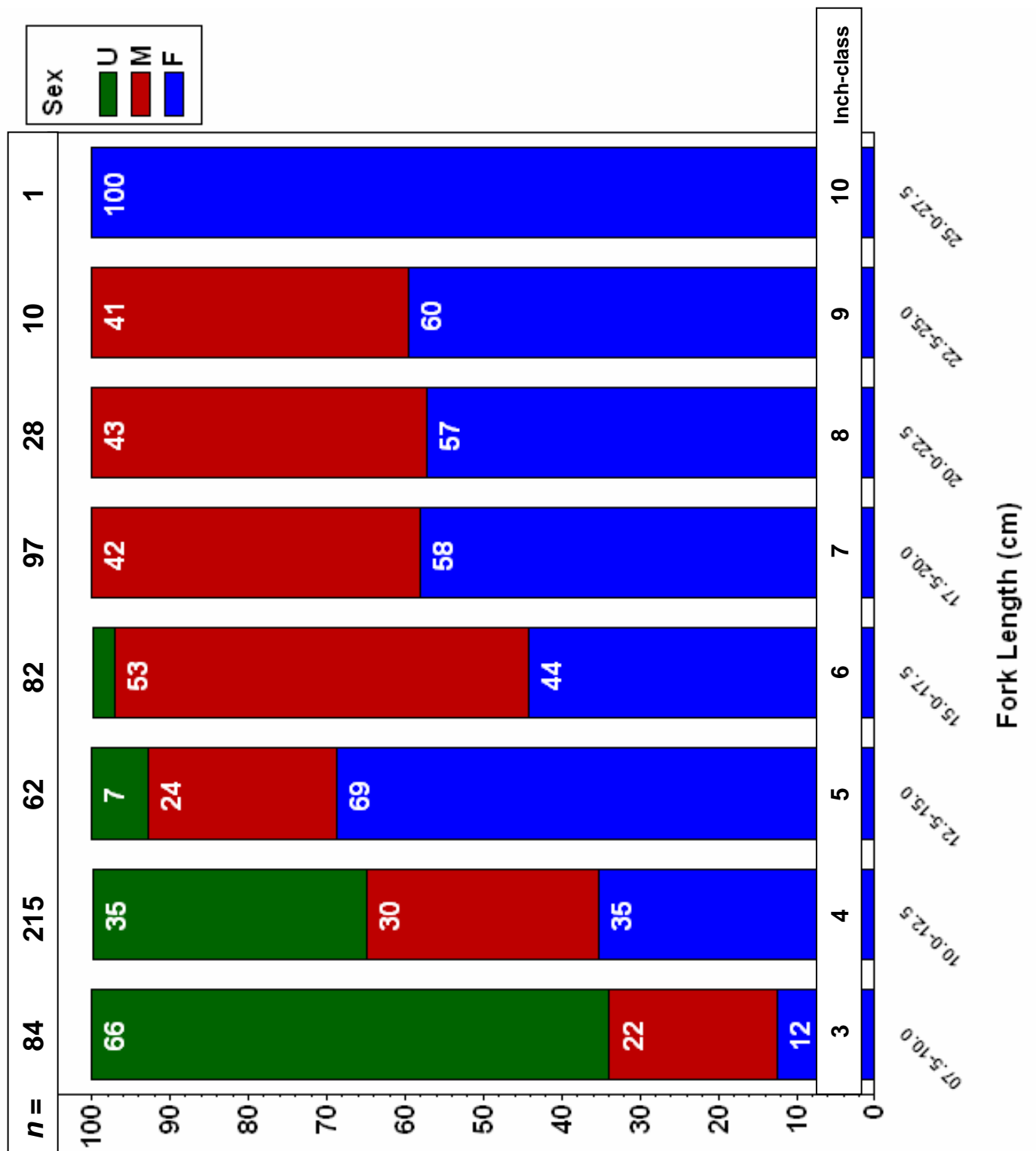


Figure 47. Sex ratio, by length group, for blueback herring collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



# Bluefish (Priority A)

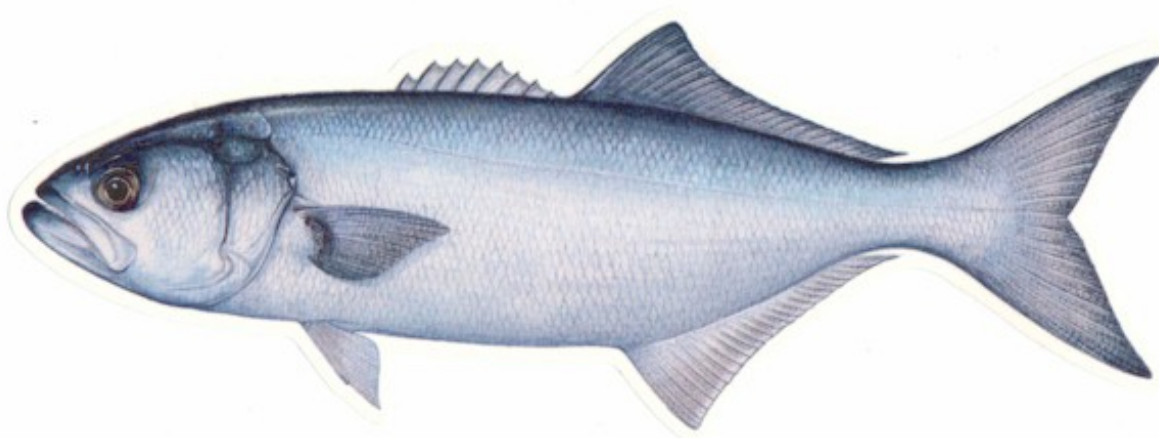


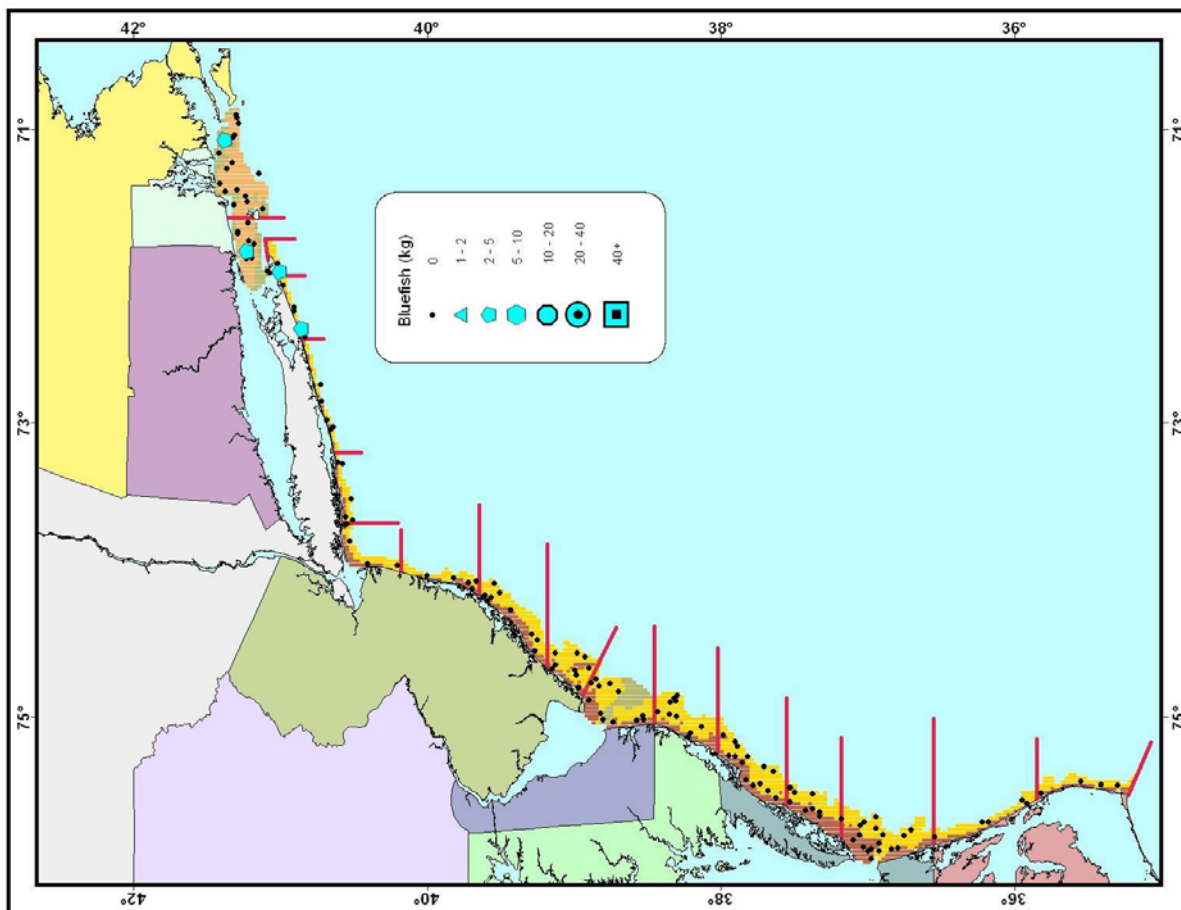
Table 16. Sampling rates and abundance indices of bluefish for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	4,635	394.5	2,613	588	588	485	476	4.35	1.29
2008	Spring	37	10.9	37	27	0	24	24	0.08	0.04
	Fall	7,120	908.7	2,214	529	0	406	388	5.52	1.33
2009	Spring	1,580	91.2	274	35	0	14	12	0.13	0.10

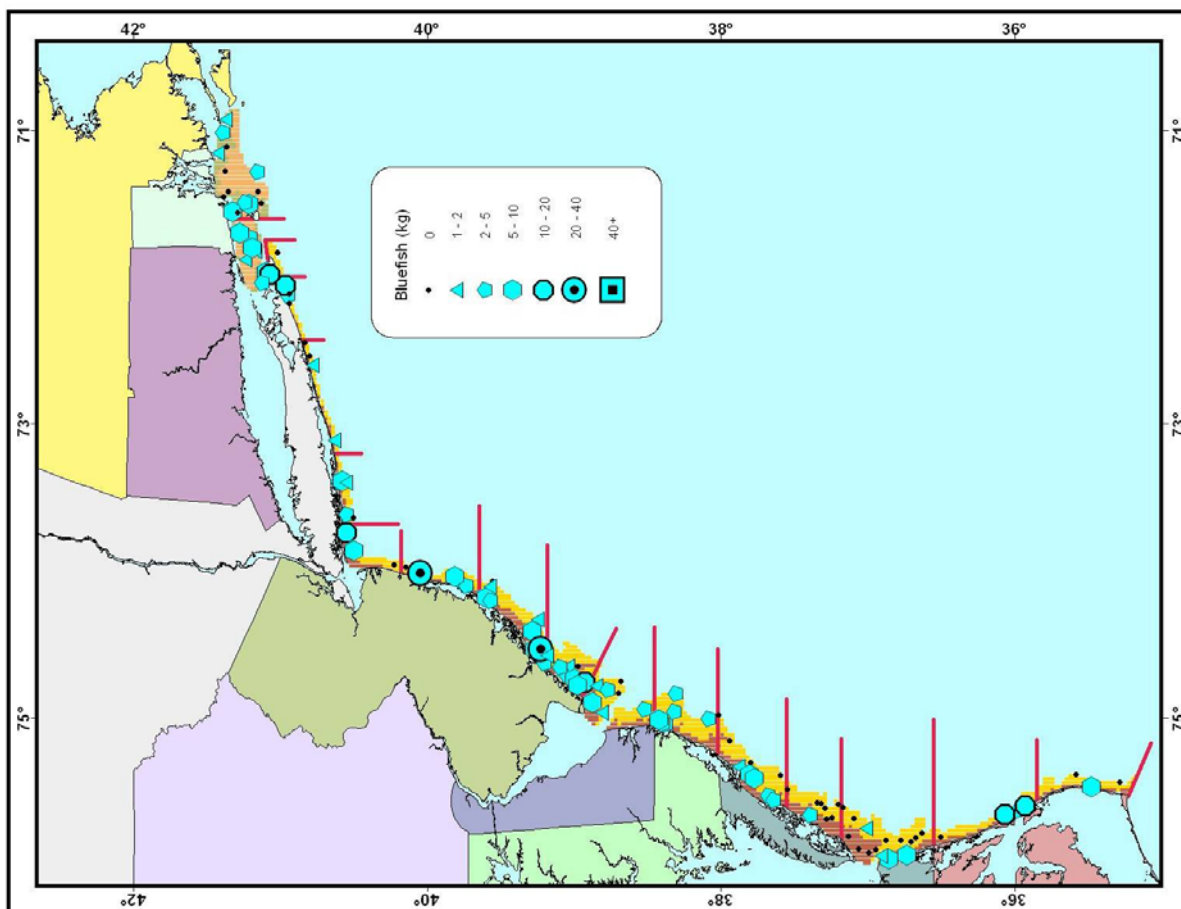


Figure 48. Biomass (kg) of bluefish collected at each sampling site for four NEAMAP cruises.

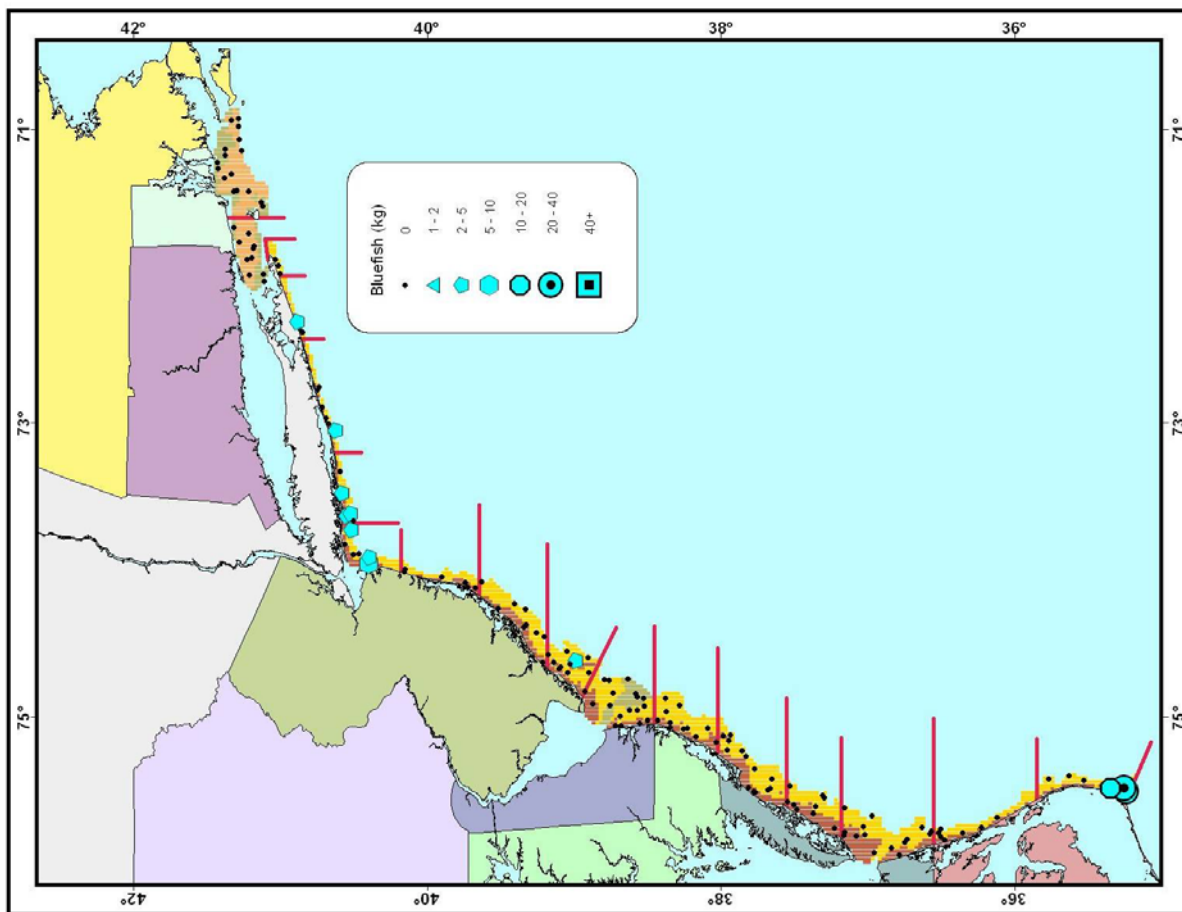
Spring 2008



Fall 2007



Spring 2009



Fall 2008

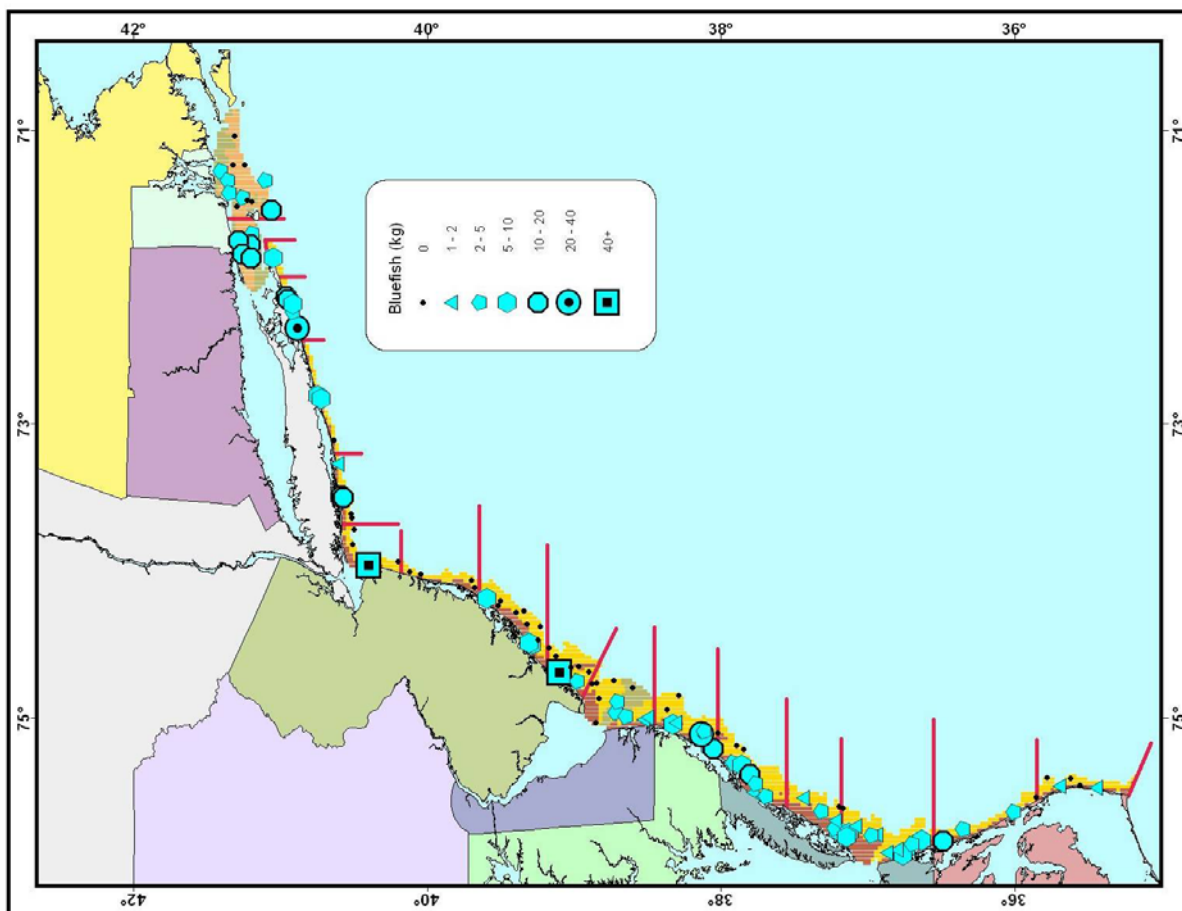


Figure 49. Preliminary indices of abundance, in terms of number and biomass, of bluefish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

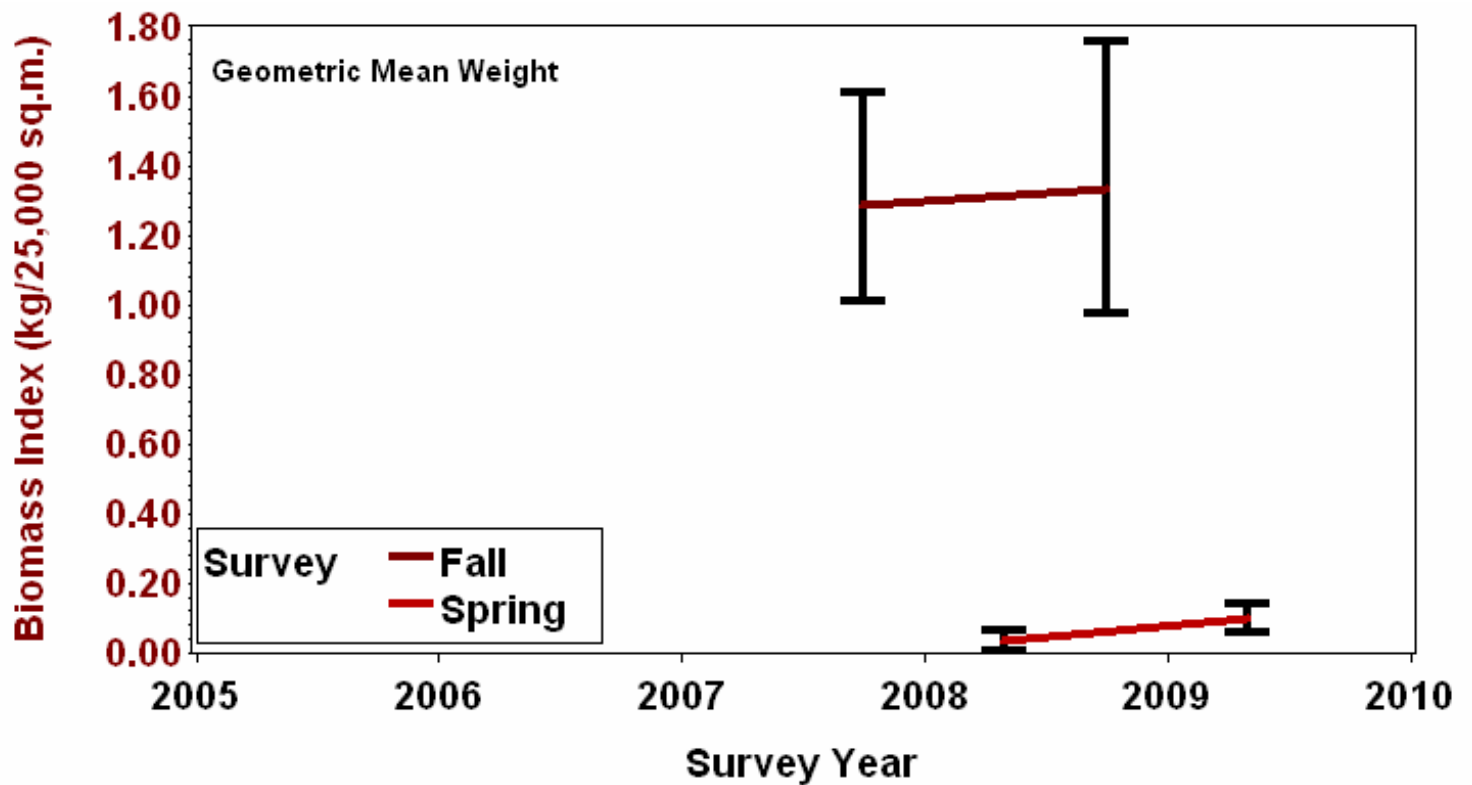
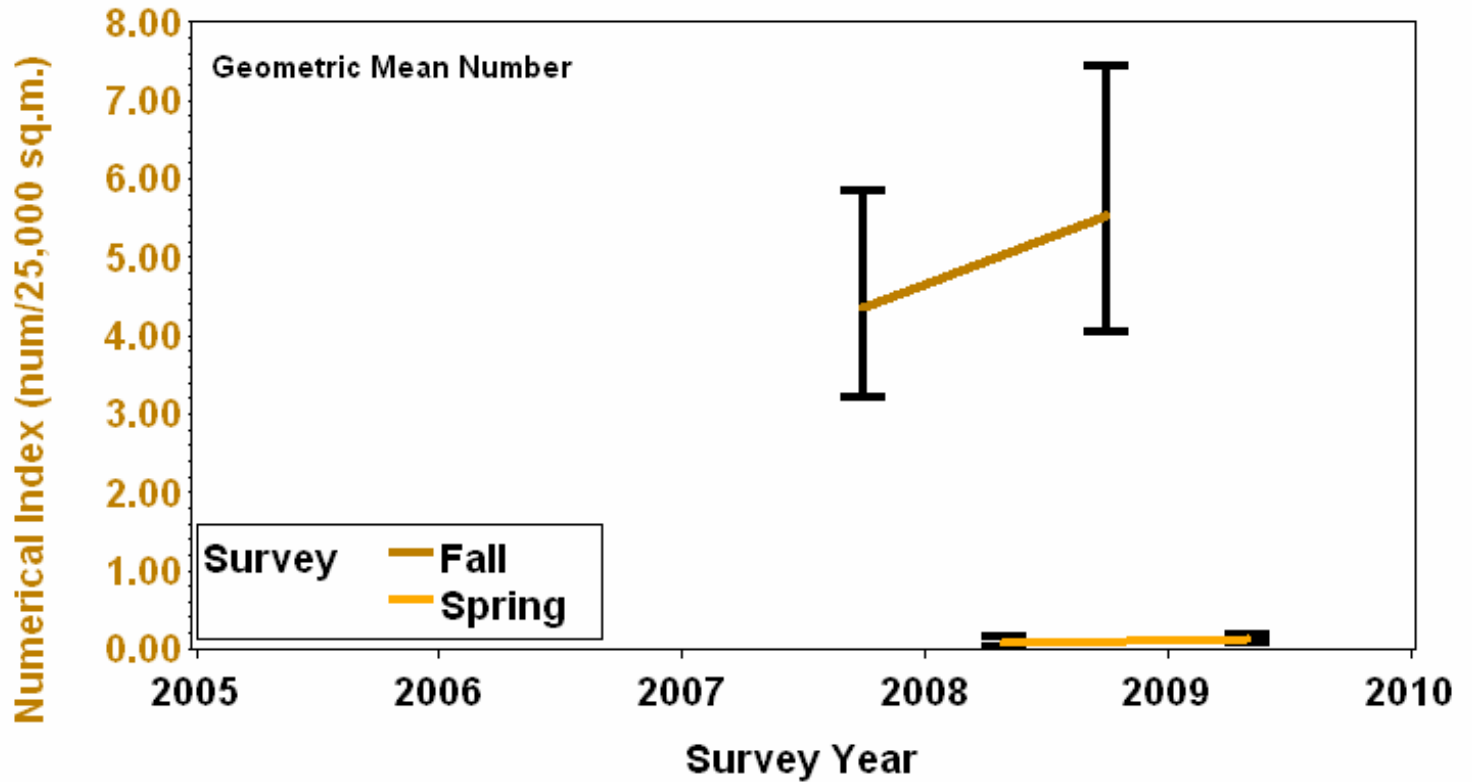


Figure 50. Length-frequency distributions, by cruise, for bluefish. Numbers taken for full processing, by length, are represented by the orange bars.

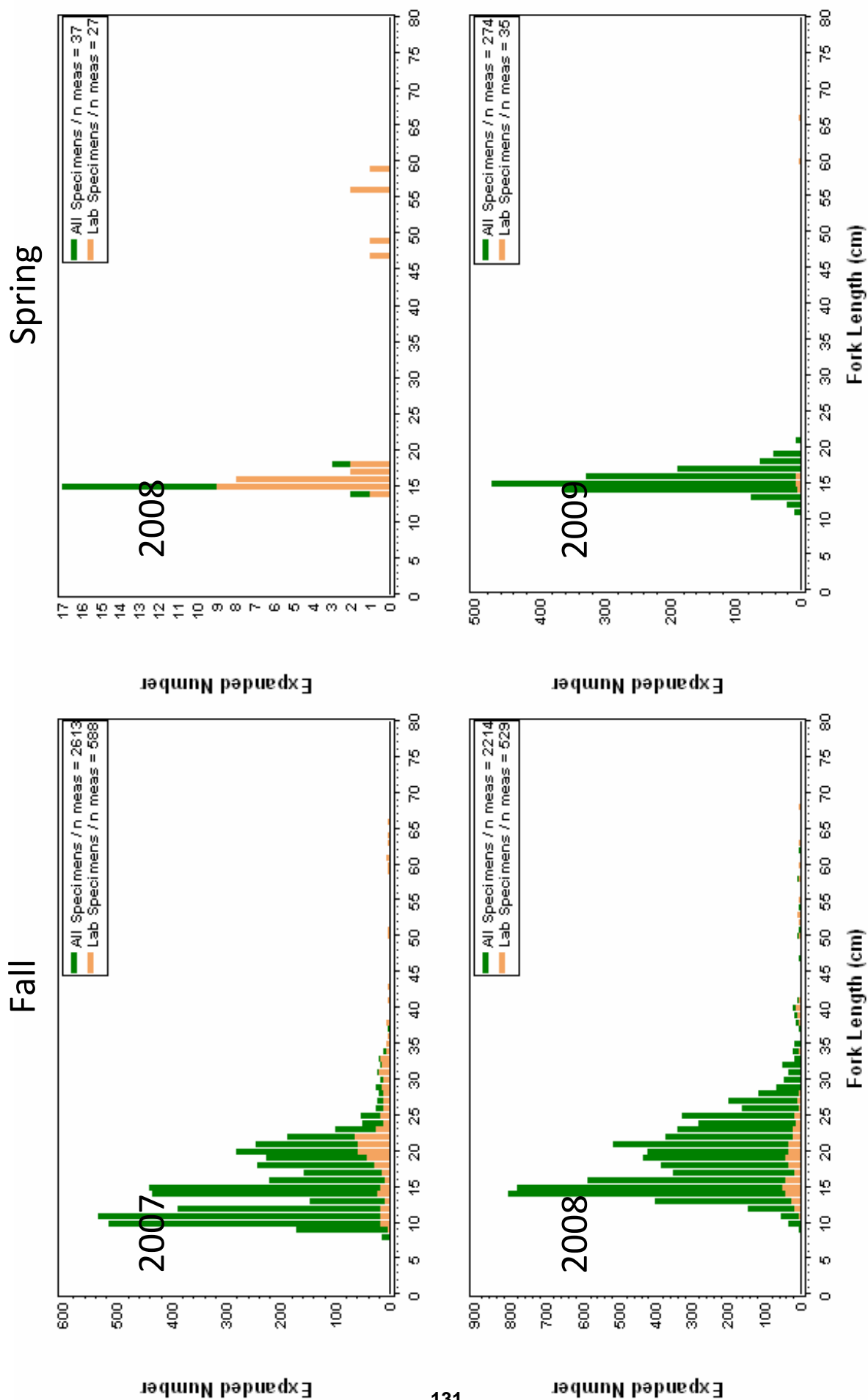


Figure 51. Sex ratio, by length group, for bluefish collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

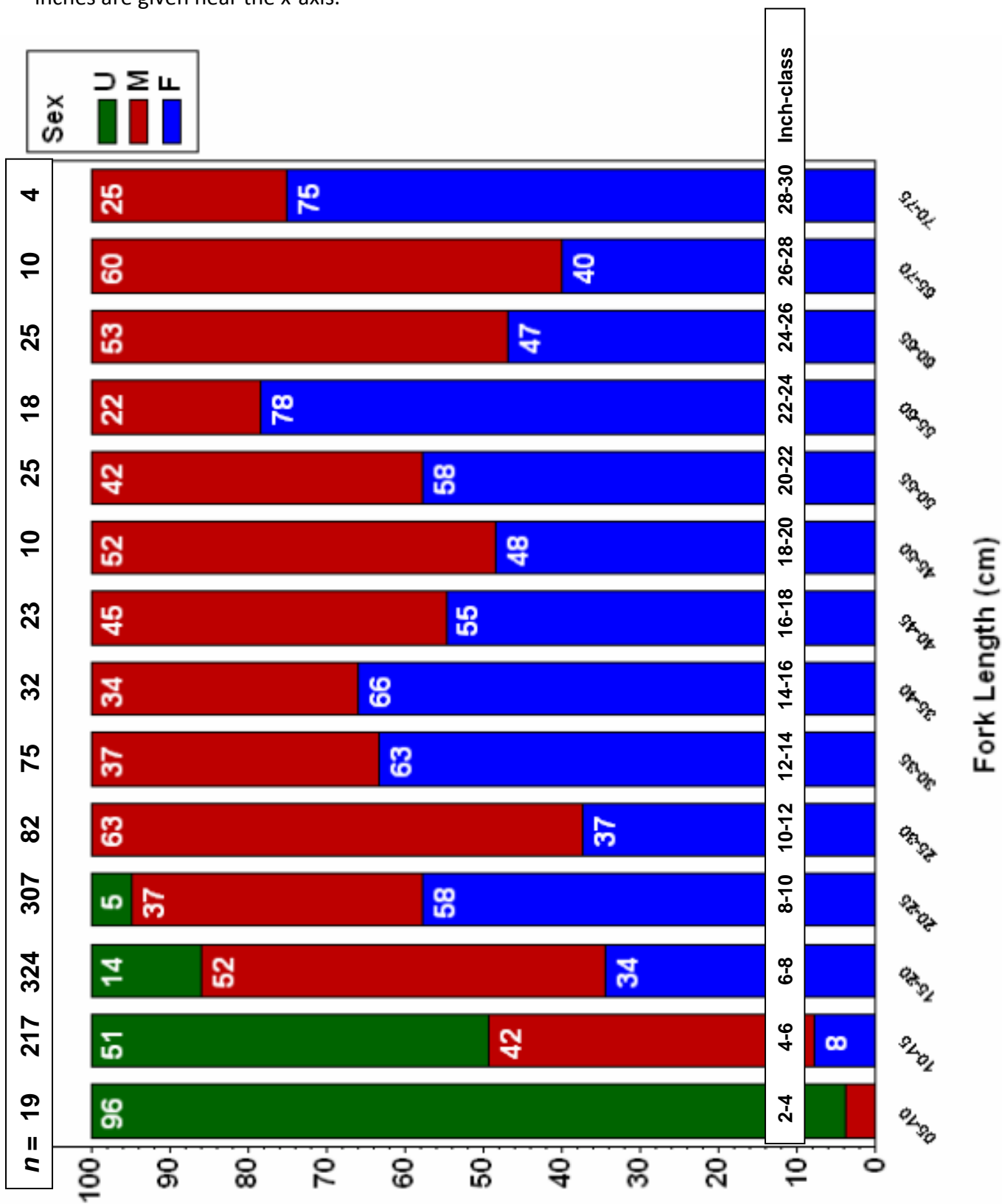


Figure 52. Age-frequency distribution for bluefish collected during the Fall 2007 cruise. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.

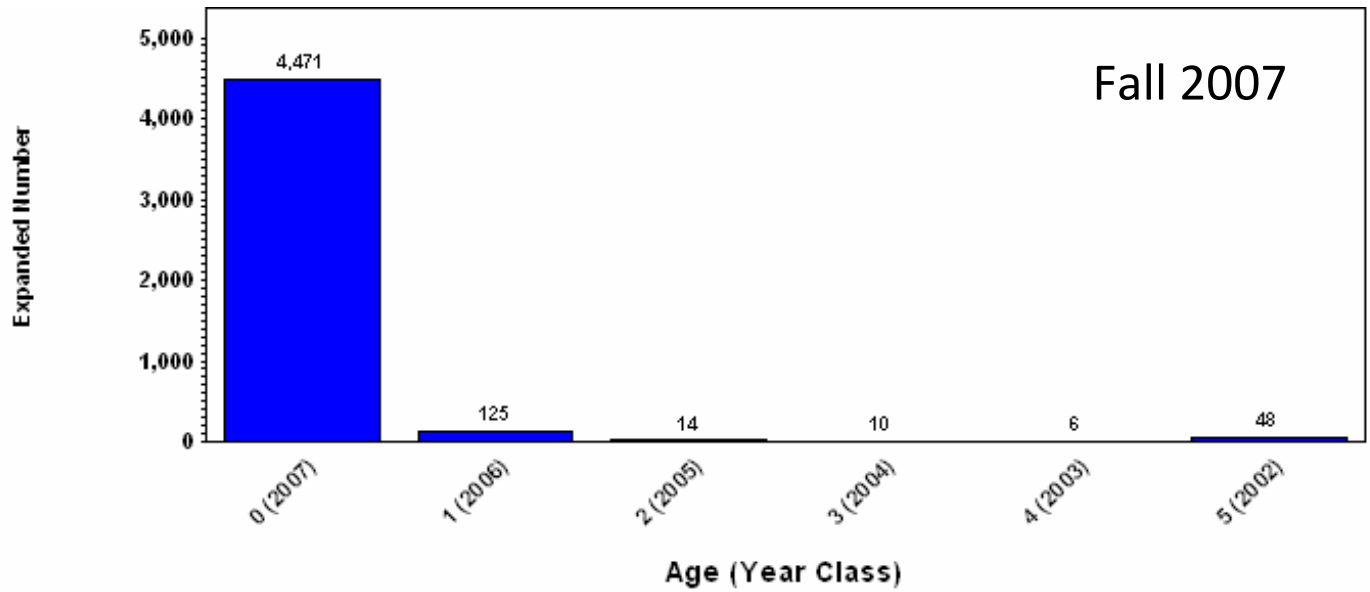
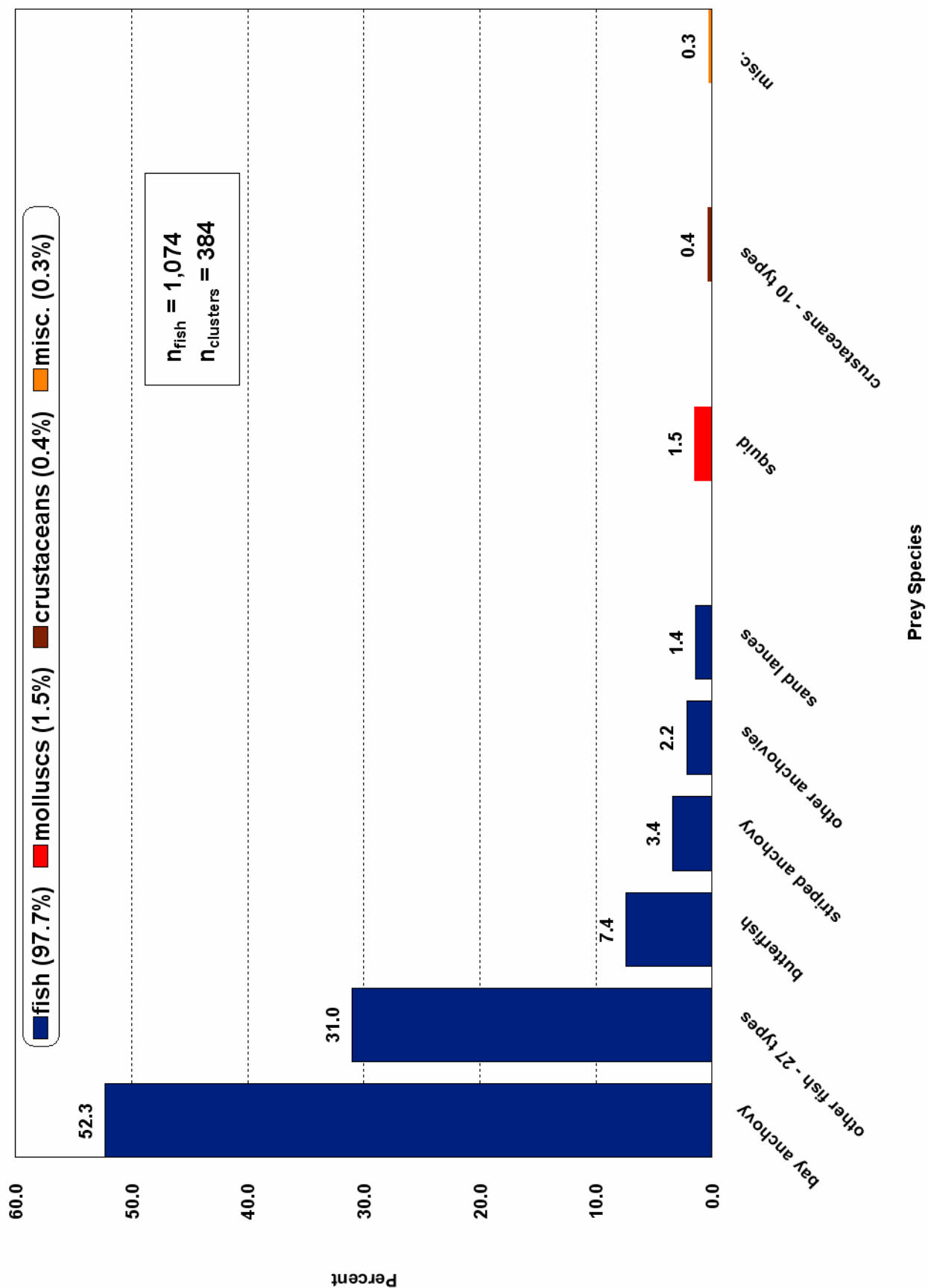


Figure 53. Diet composition, expressed using the percent weight index, of bluefish collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of bluefish sampled.



# Bluntnose Stingray (Priority E)

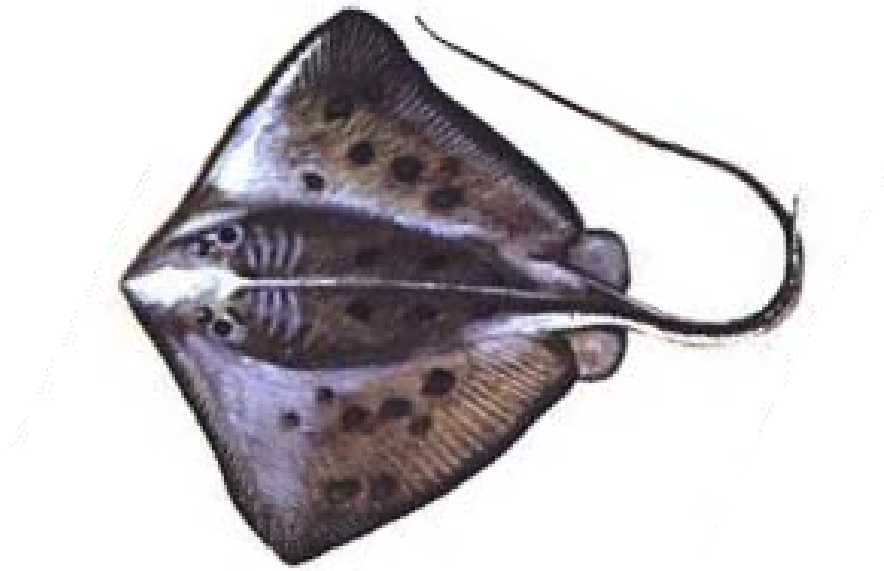


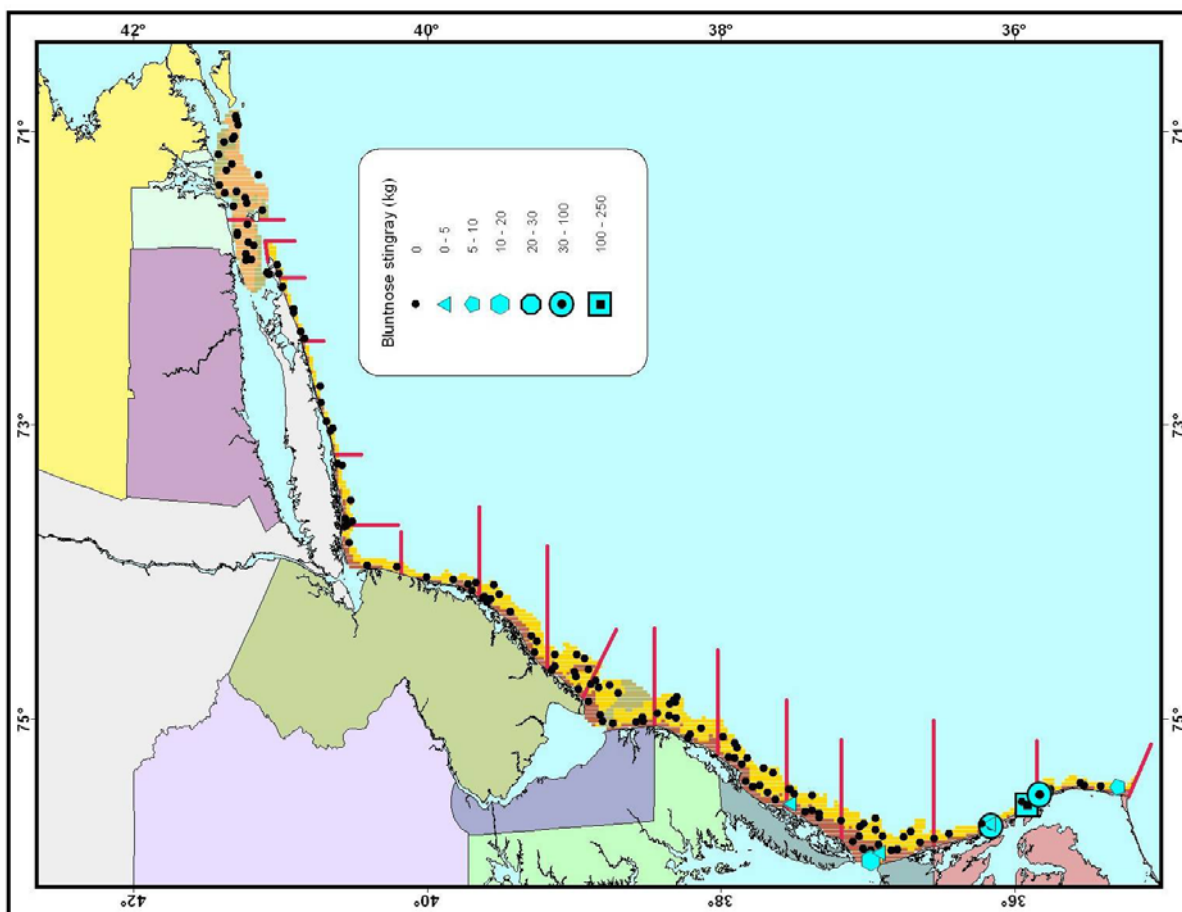
Table 17. Sampling rates and abundance indices of bluntnose stingray for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	349	1,178.9	307	0				0.55	0.90
2008	Spring	84	308.2	26	2	0	2	0	0.08	0.14
	Fall	62	215.0	62	0				0.18	0.31
2009	Spring	85	490.8	85	0				0.05	0.08

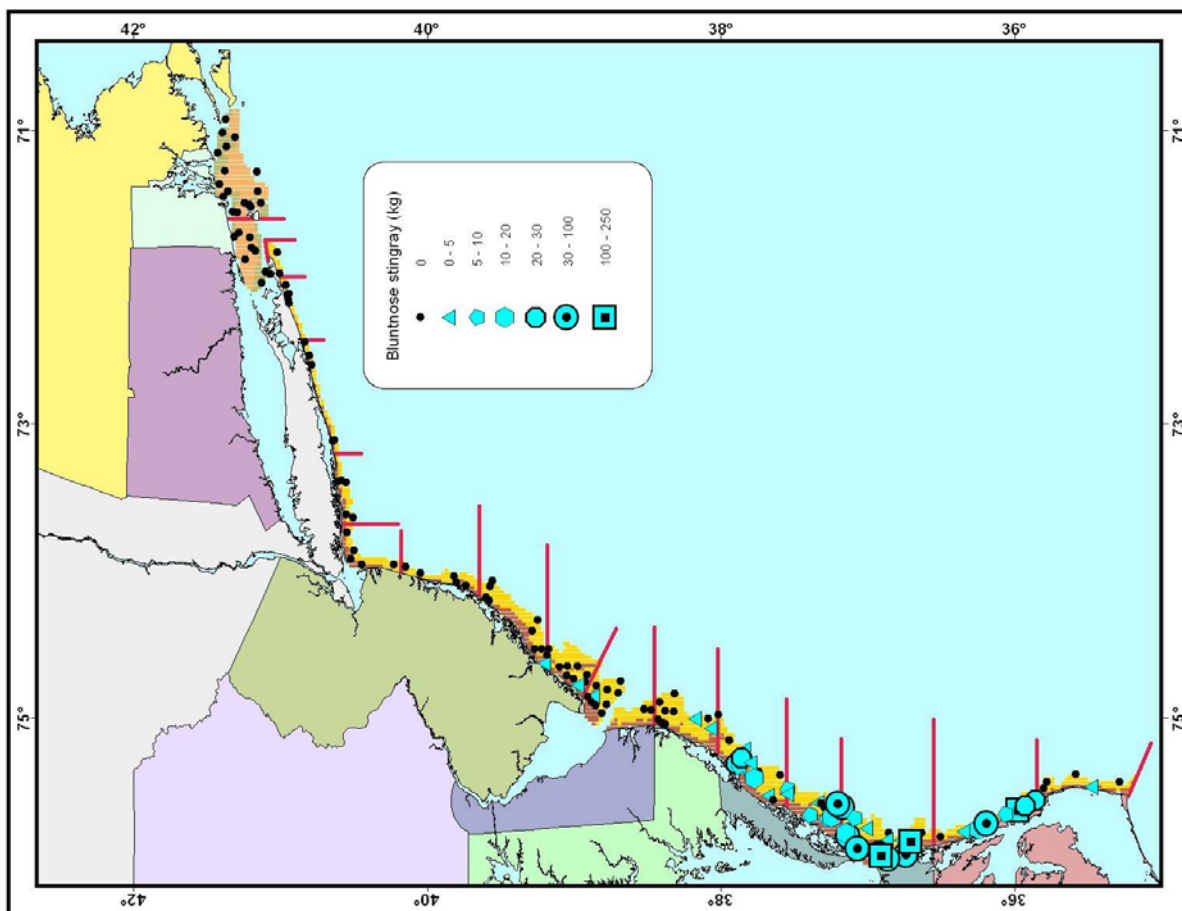


Figure 54. Biomass (kg) of bluntnose stingray collected at each sampling site for four NEAMAP cruises.

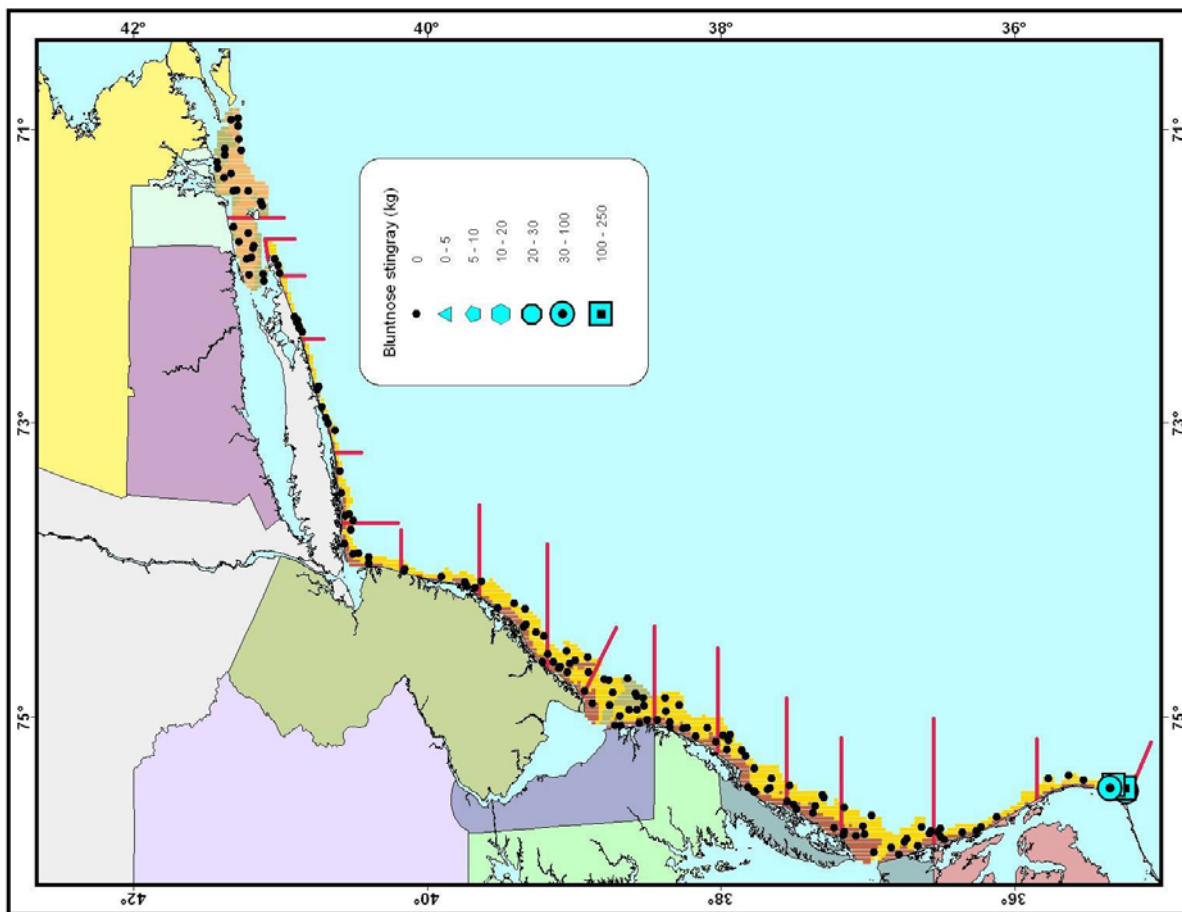
Spring 2008



Fall 2007



Spring 2009



Fall 2008

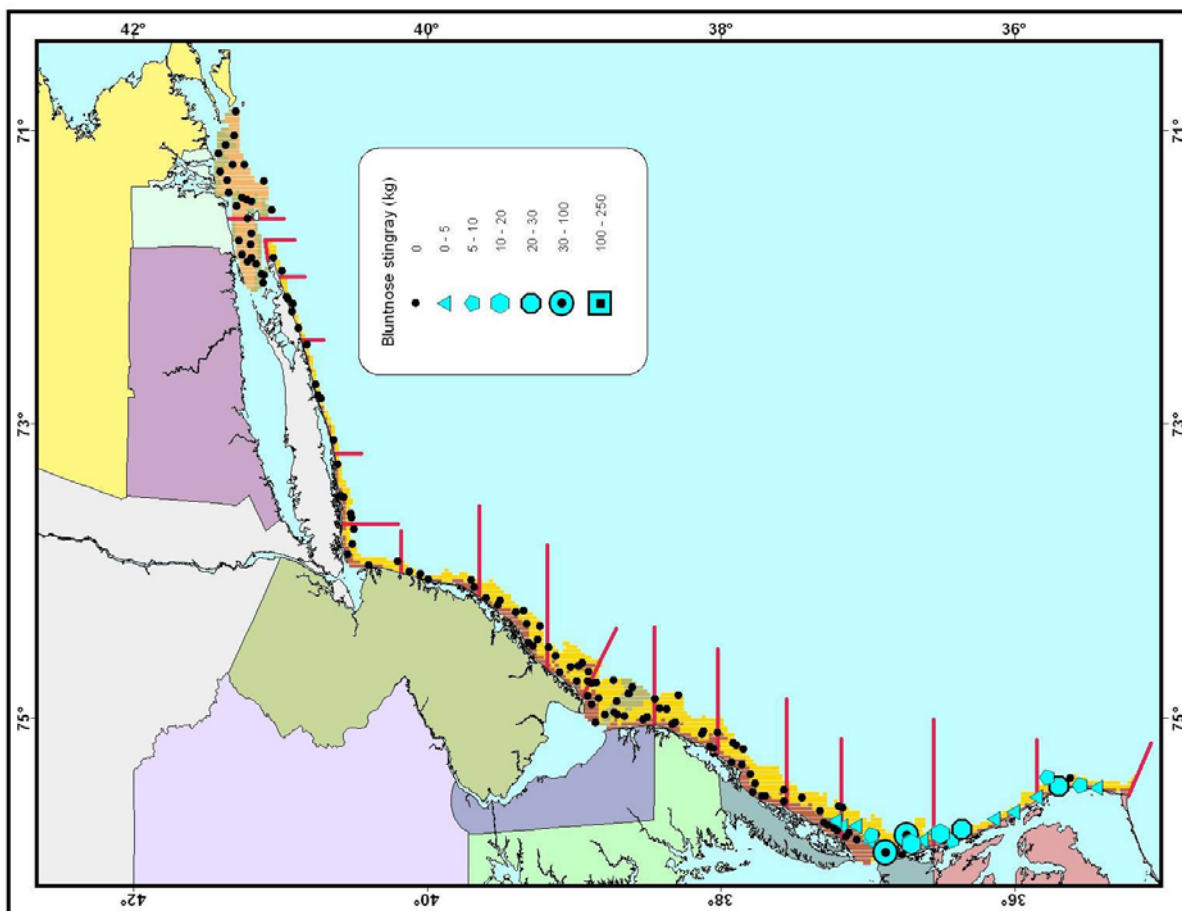


Figure 55. Preliminary indices of abundance, in terms of number and biomass, of bluntnose stingray for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

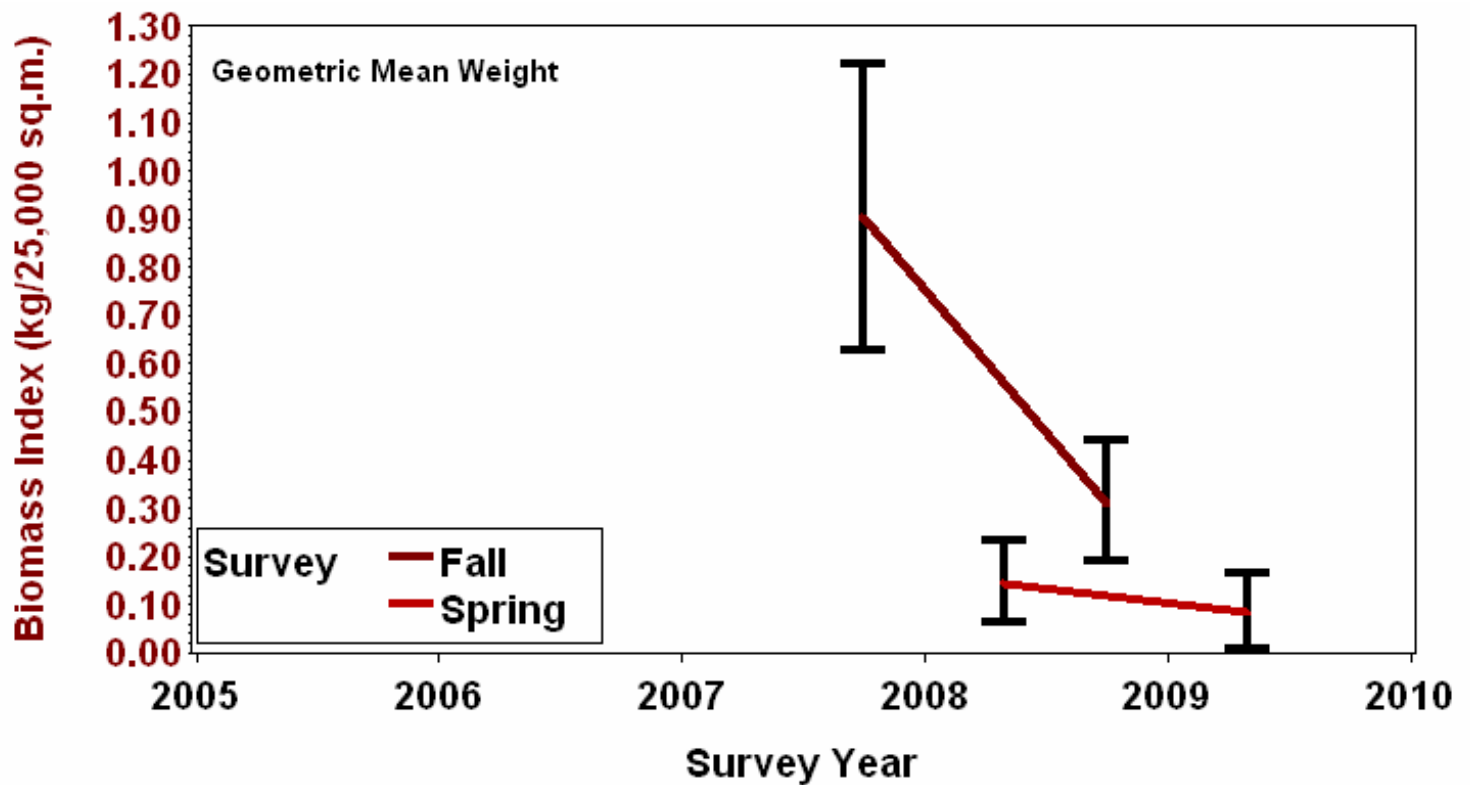
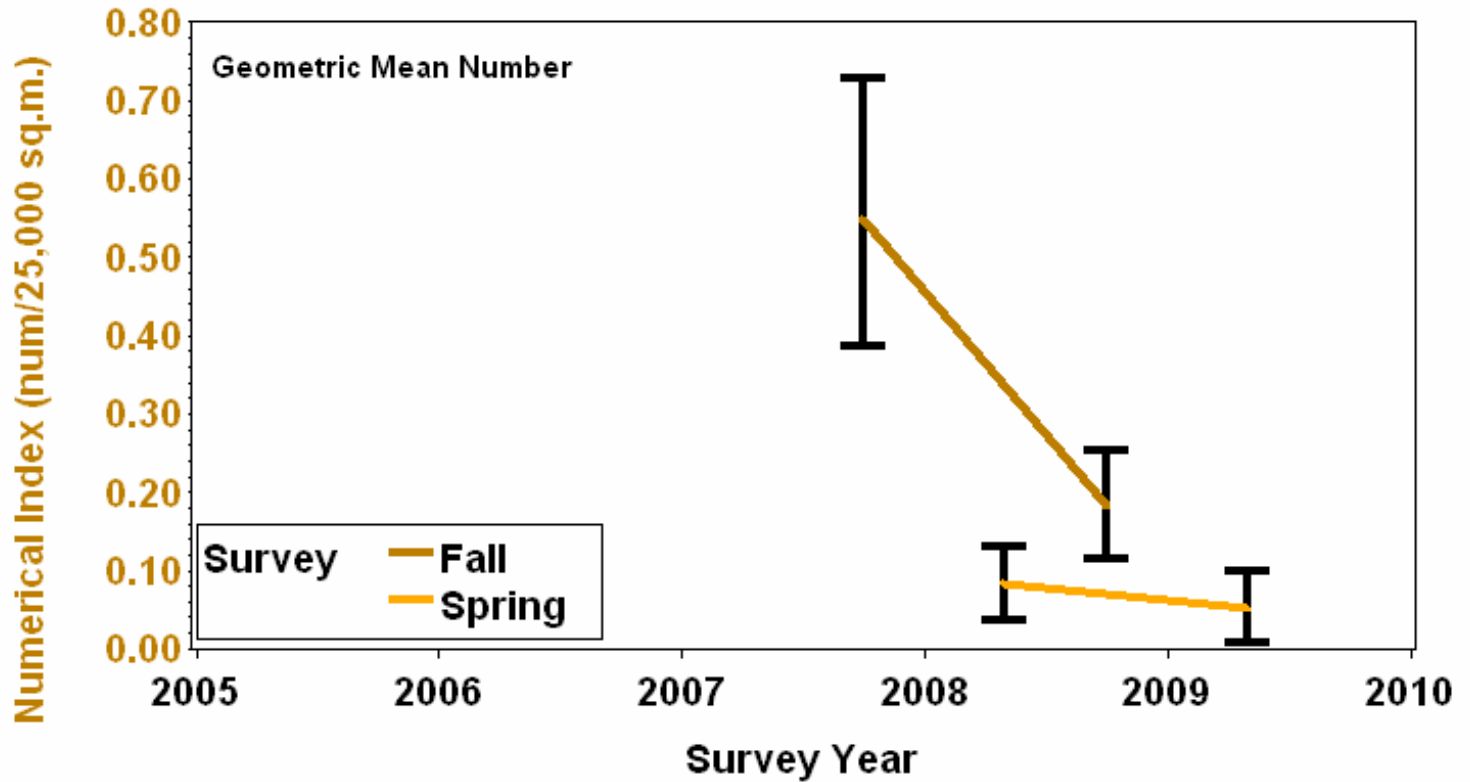
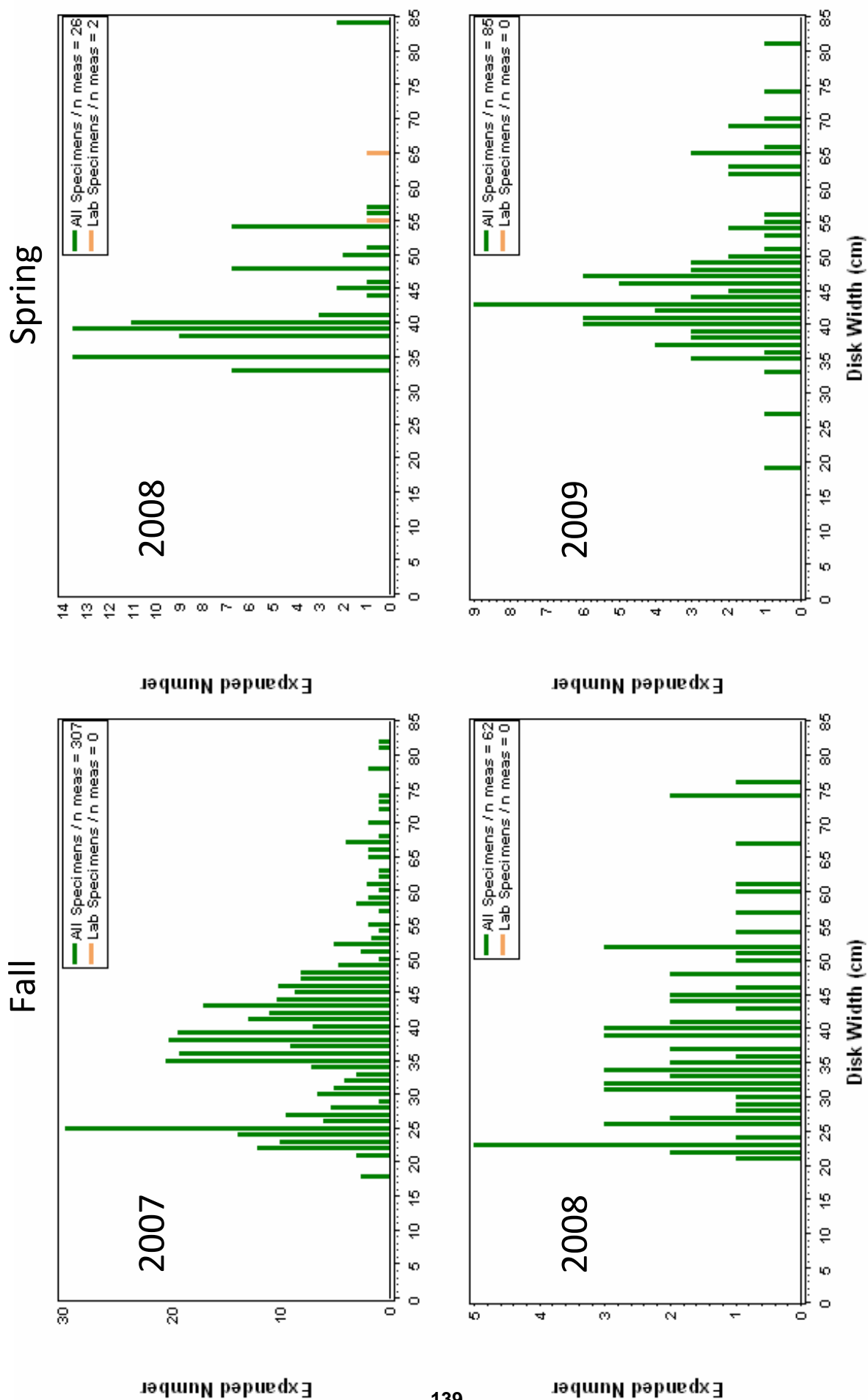


Figure 56. Length-frequency distributions, by cruise, for bluntnose stingray. Numbers taken for full processing, by length, are represented by the orange bars.





# Brown Shrimp (Priority E)

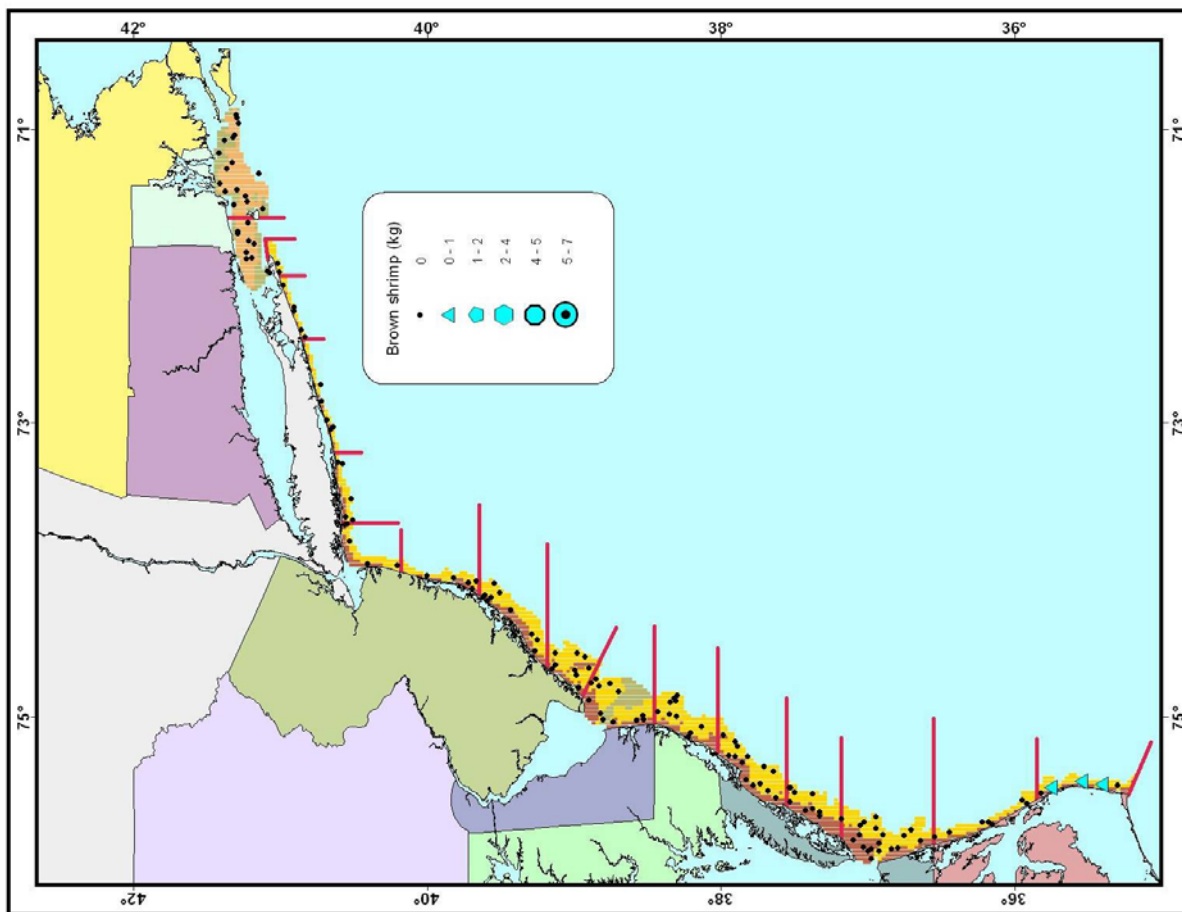


Table 18. Sampling rates and abundance indices of brown shrimp for four NEAMAP cruises.

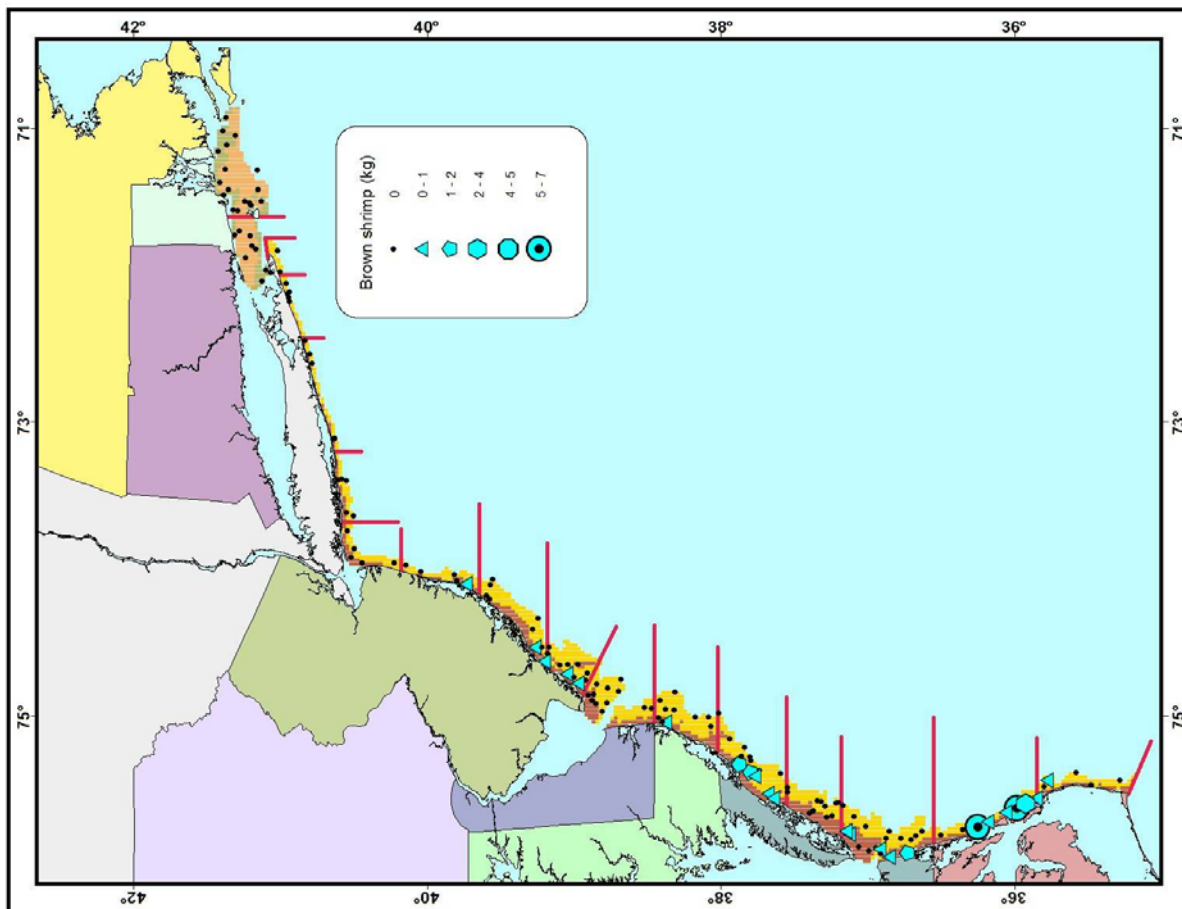
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	898	21.6	459	0		0		0.44	0.06
2008	Spring	5	0.2	5	0		0		0.02	0.00
	Fall	509	15.3	372	0		0		0.61	0.07
2009	Spring	7	0.1	7	0		0		0.01	0.00

Figure 57. Biomass (kg) of brown shrimp collected at each sampling site for four NEAMAP cruises.

Spring 2008

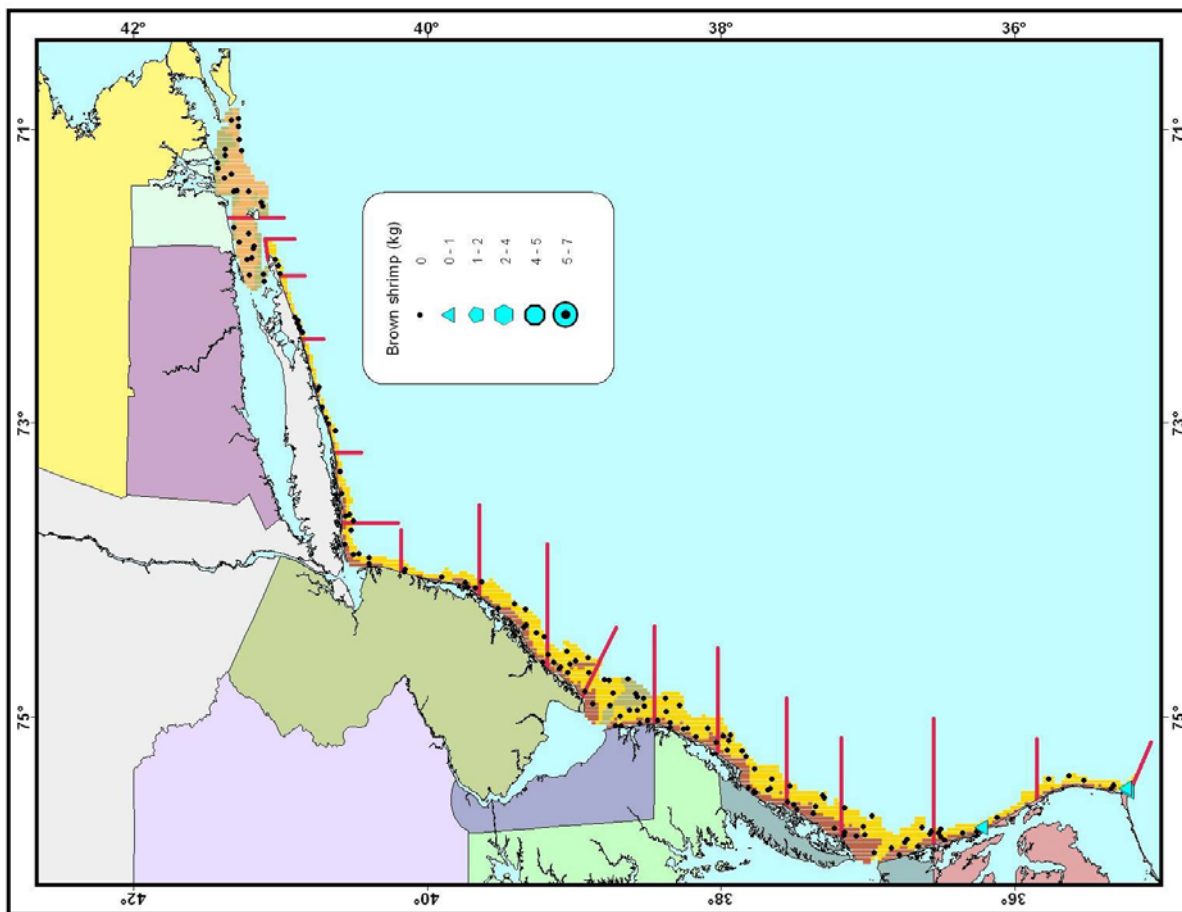


Fall 2007





Spring 2009



Fall 2008

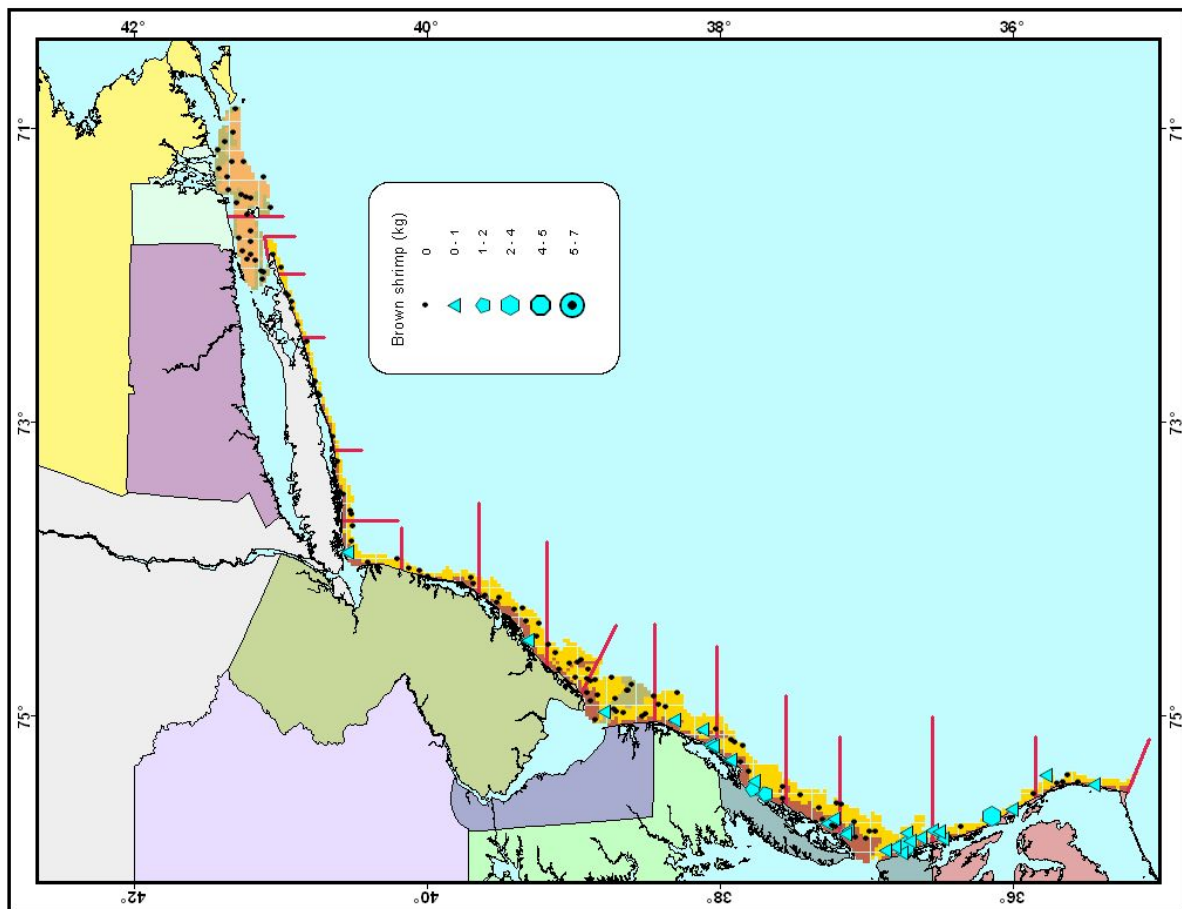




Figure 58. Preliminary indices of abundance, in terms of number and biomass, of brown shrimp for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

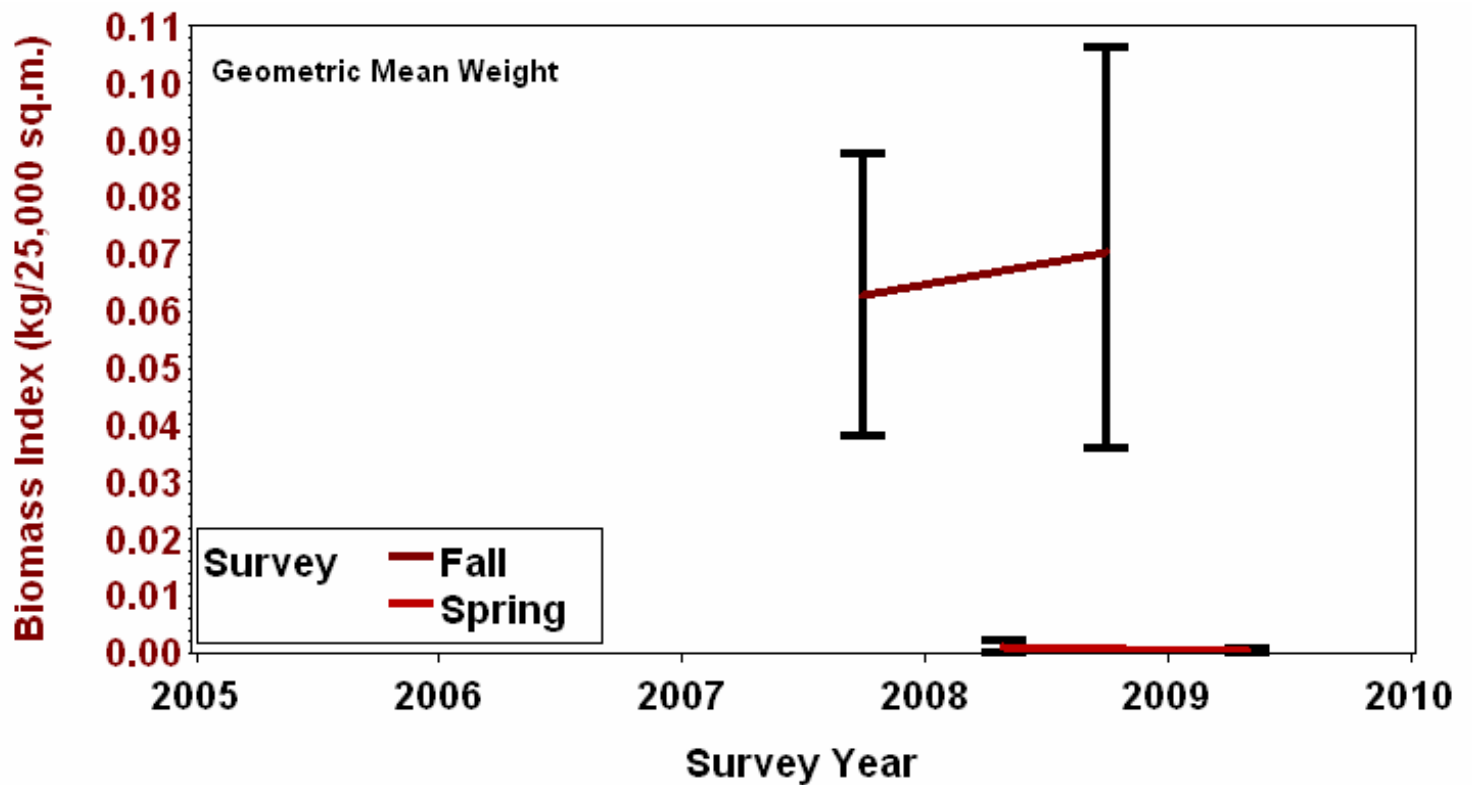
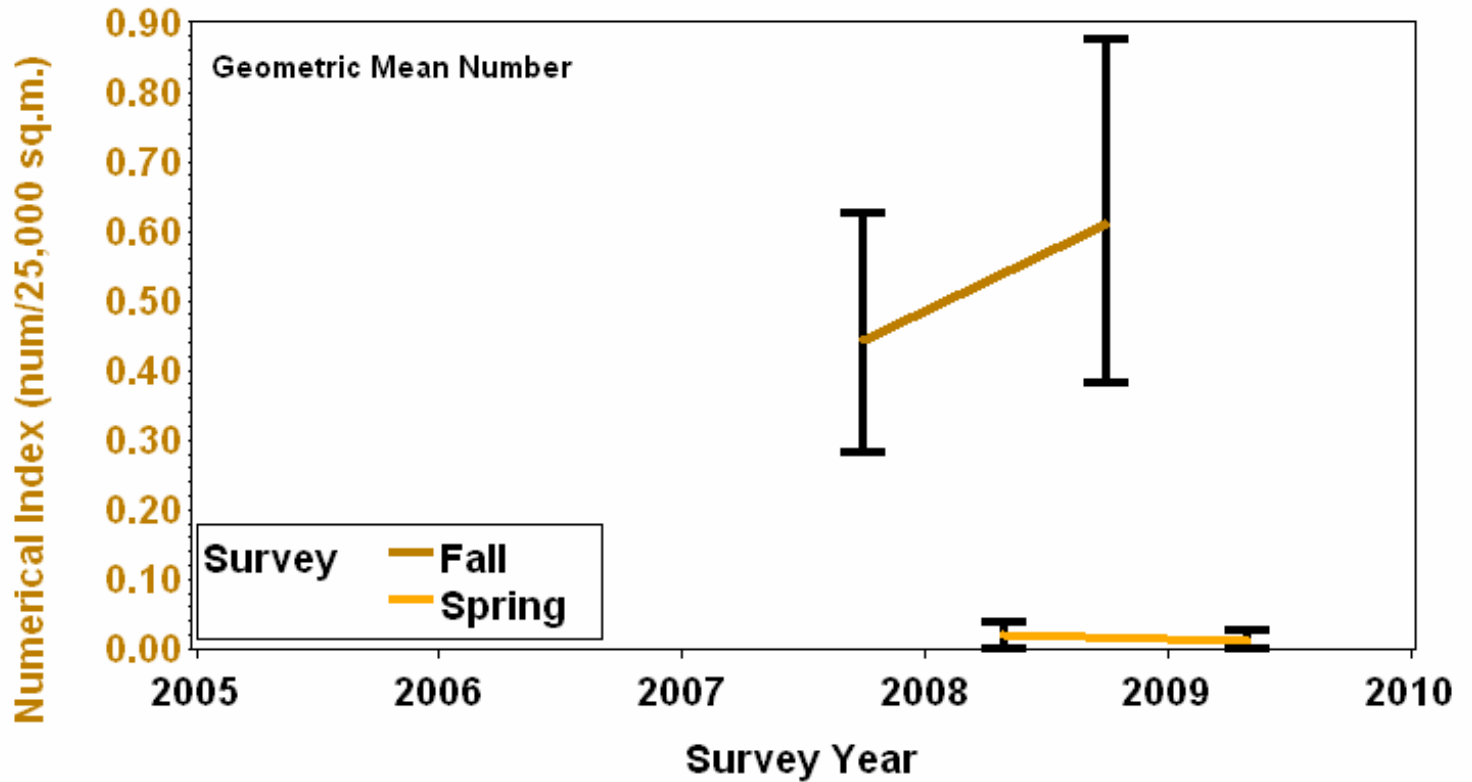
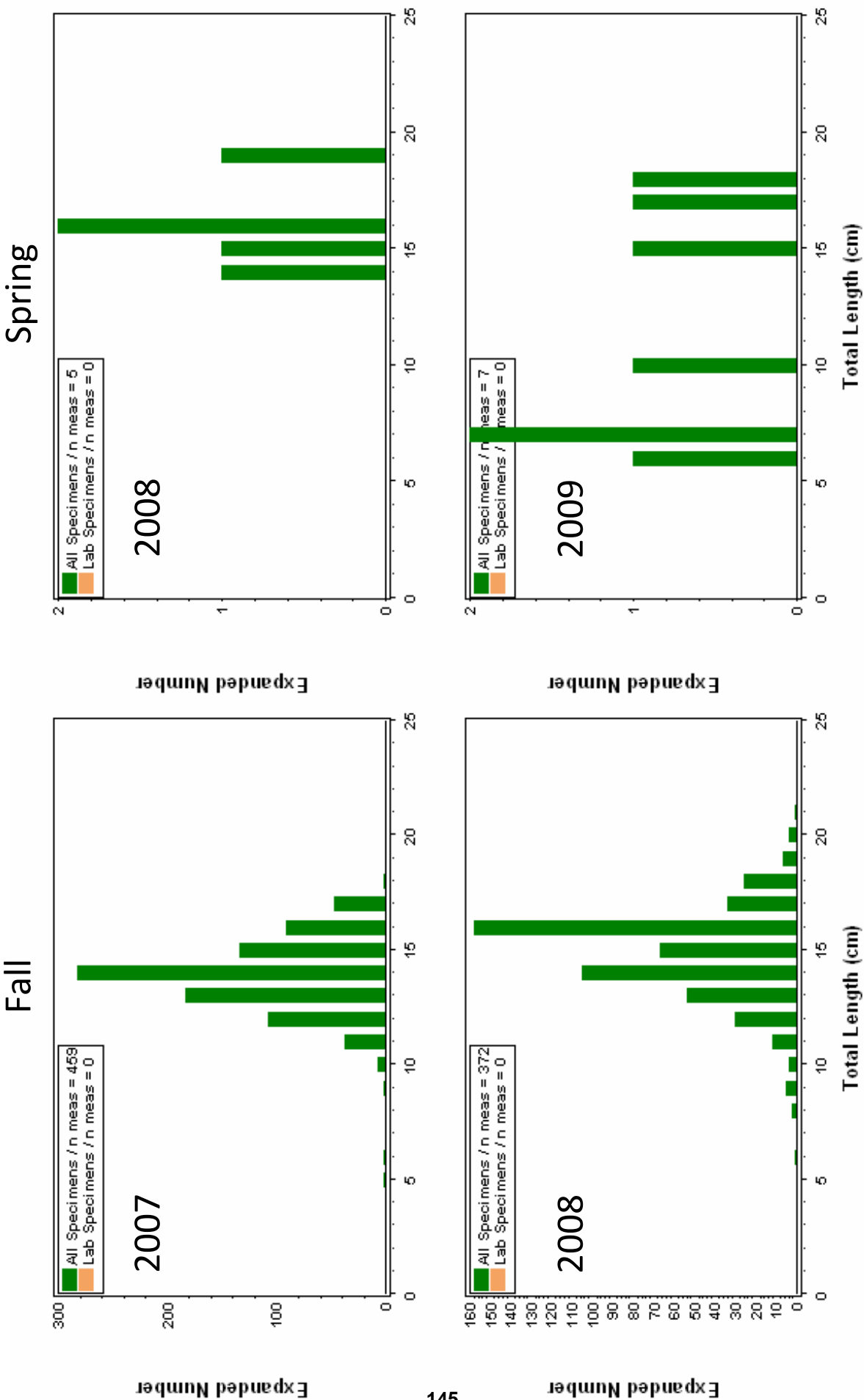


Figure 59. Length-frequency distributions, by cruise, for brown shrimp.





# Bullnose Ray (Priority E)

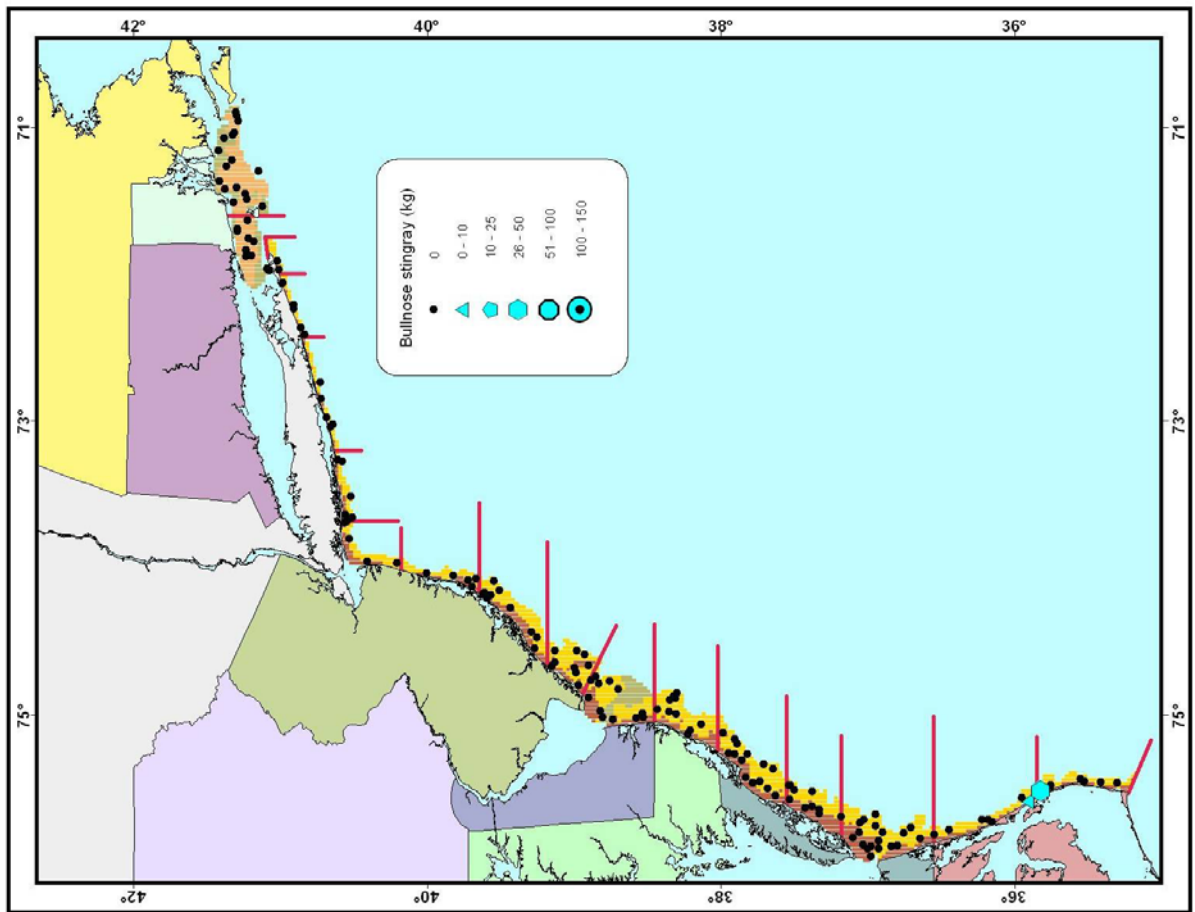


Table 19. Sampling rates and abundance indices of bullnose ray for four NEAMAP cruises.

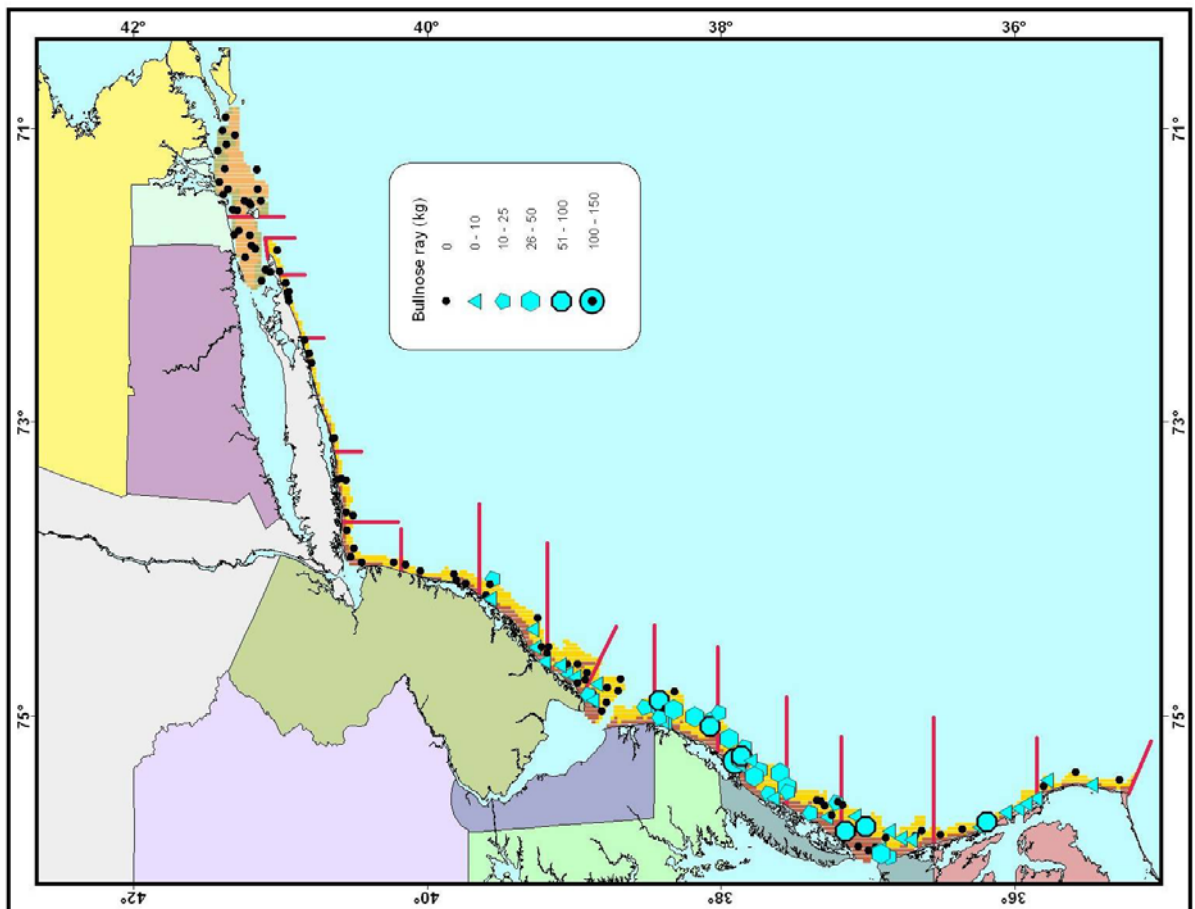
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	731	1,155.0	631	0		0		1.23	1.57
2008	Spring	3	50.4	3	0		0		0.01	0.03
	Fall	479	399.9	320	0		0		0.98	0.88
2009	Spring	5	42.5	5	0		0		0.01	0.02

Figure 60. Biomass (kg) of bullnose ray collected at each sampling site for four NEAMAP cruises.

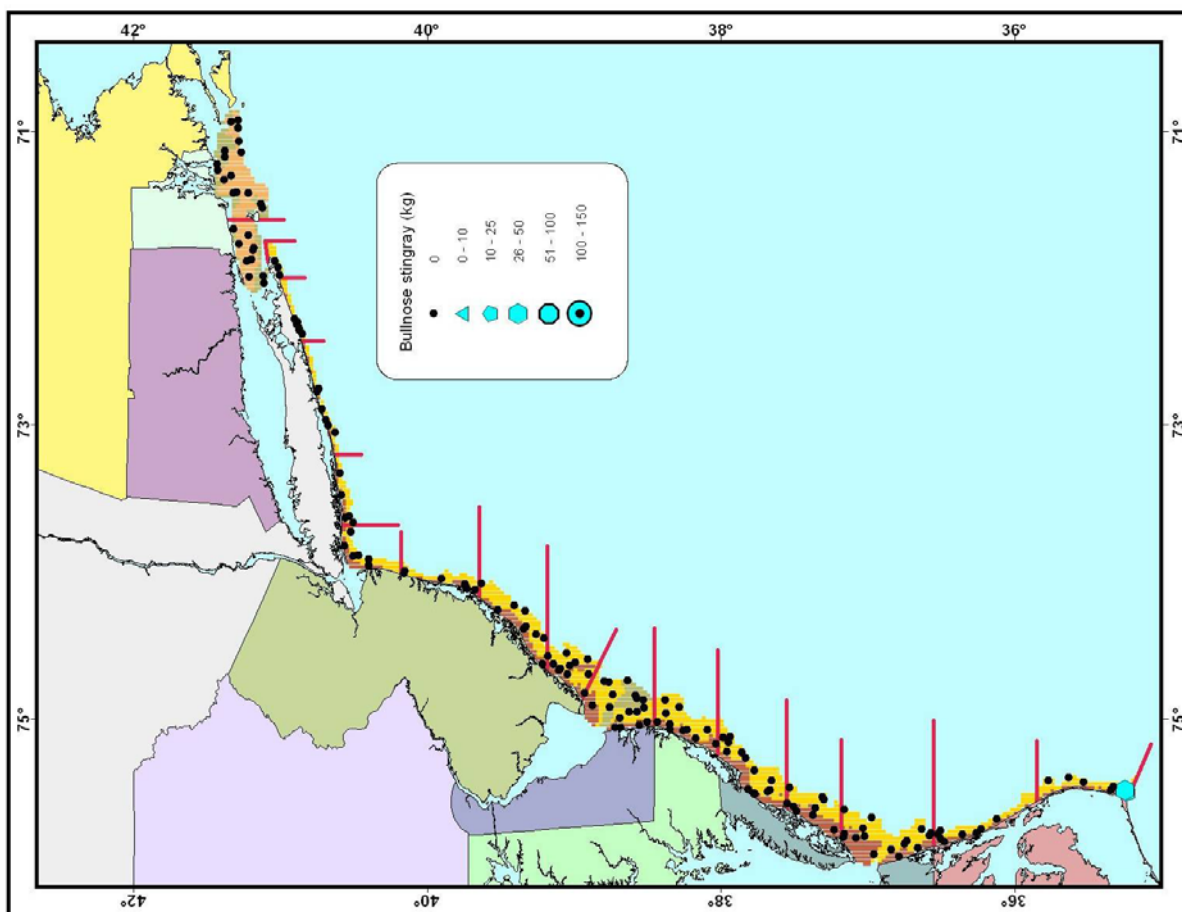
Spring 2008



Fall 2007



Spring 2009



Fall 2008

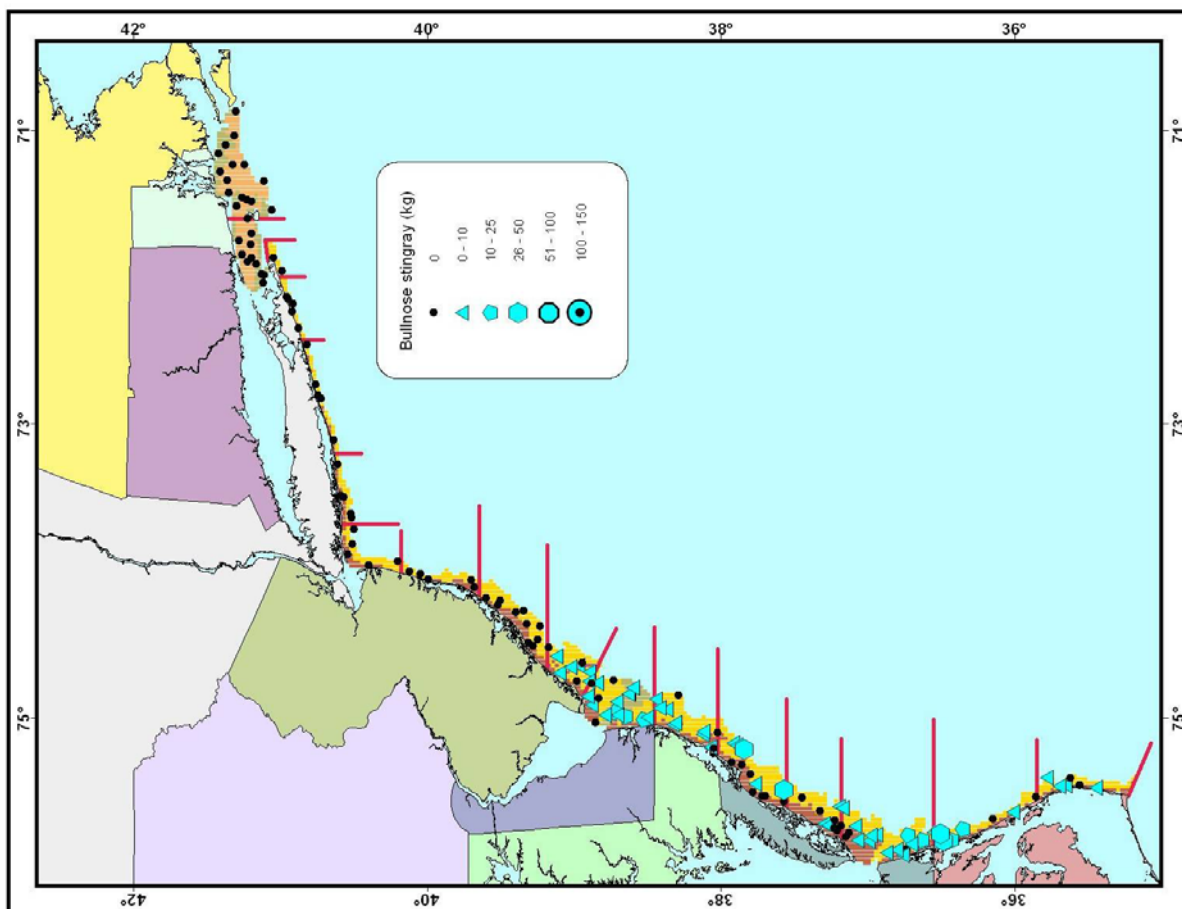


Figure 61. Preliminary indices of abundance, in terms of number and biomass, of bullnose ray for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

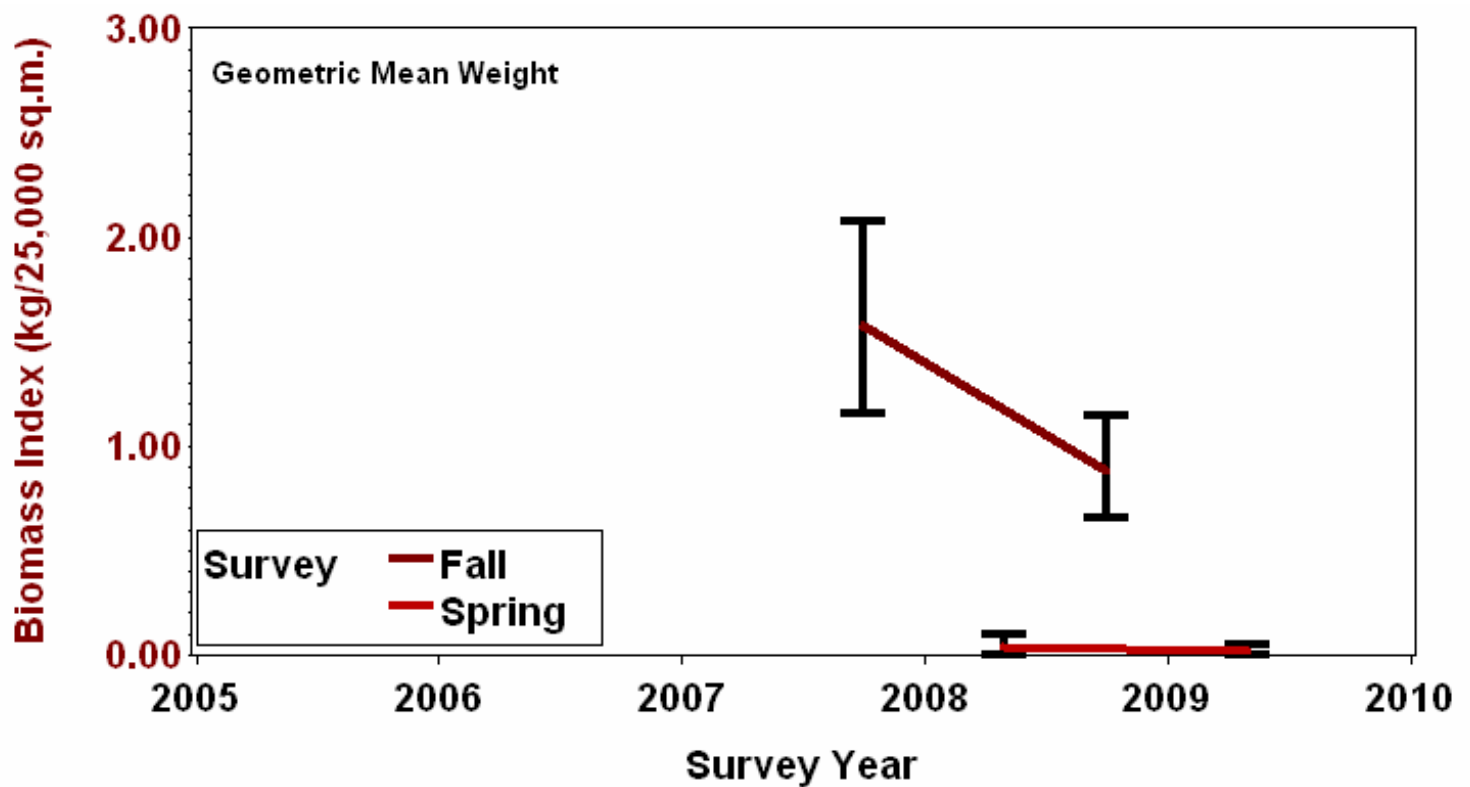
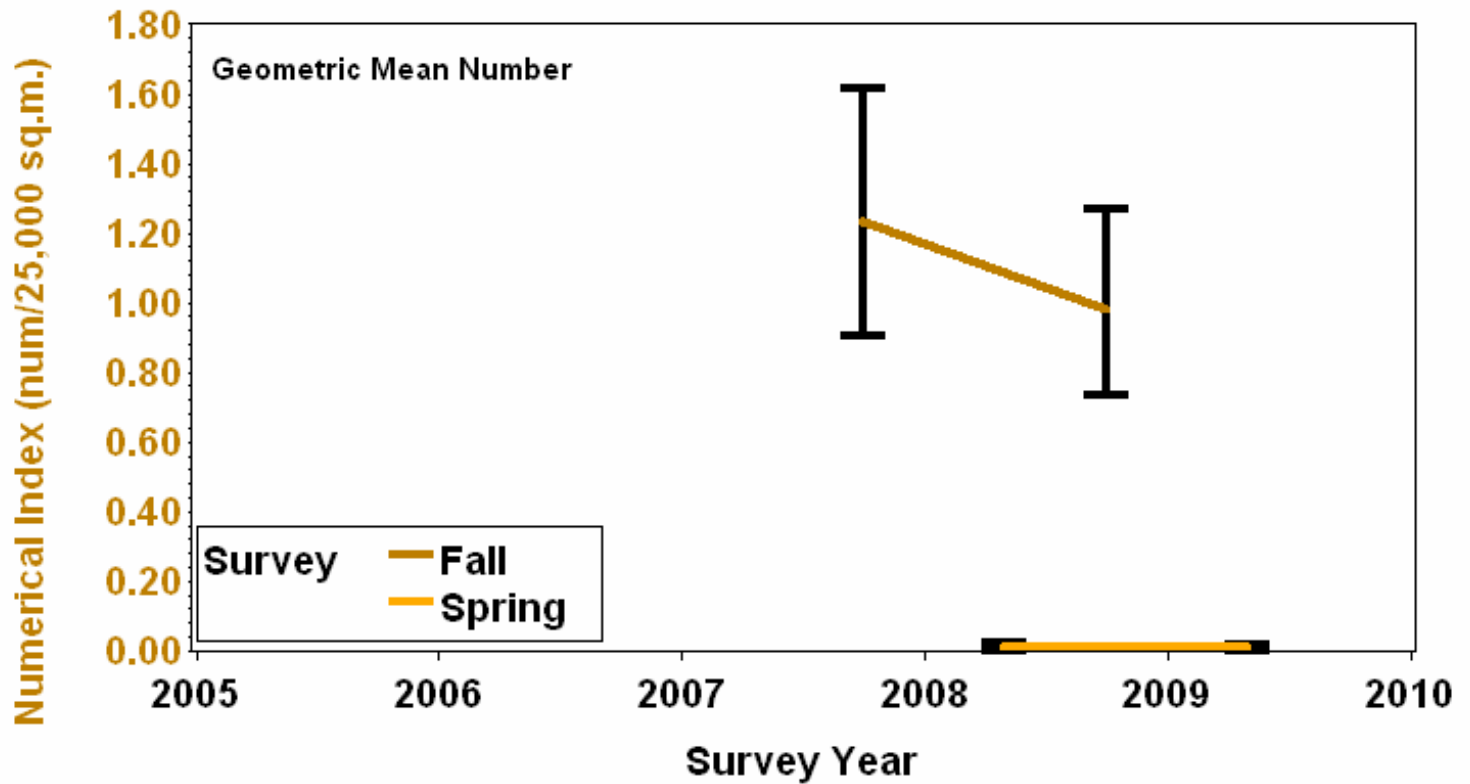
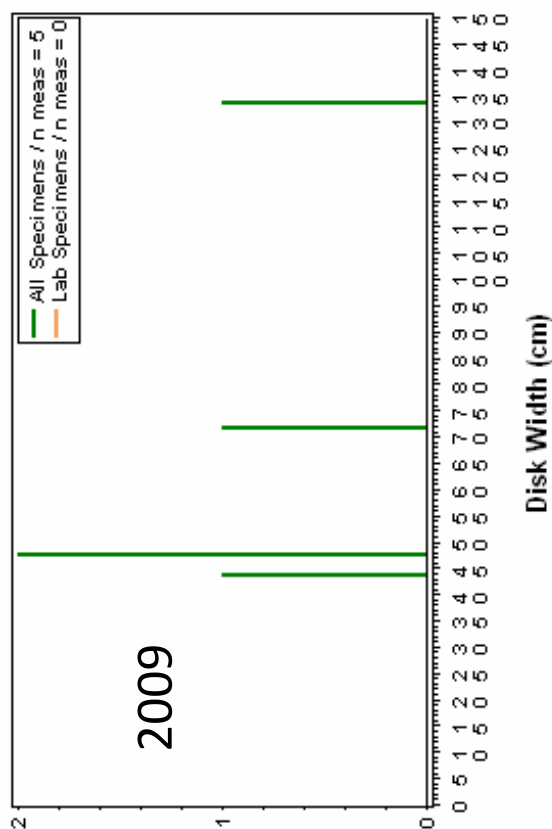
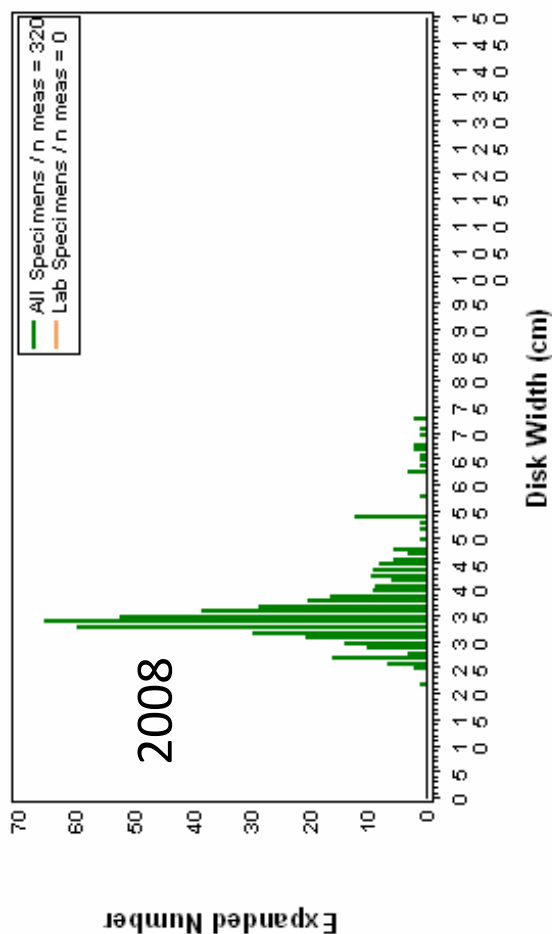
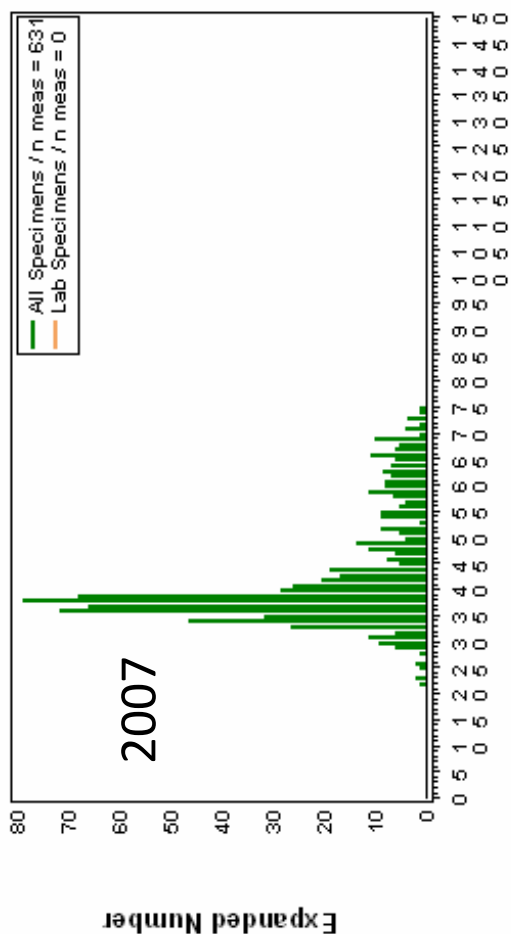


Figure 62. Length-frequency distributions, by cruise, for bullnose ray. This species was not collected during the Spring 2008 survey.

Spring

Fall







# Butterfish (Priority A)

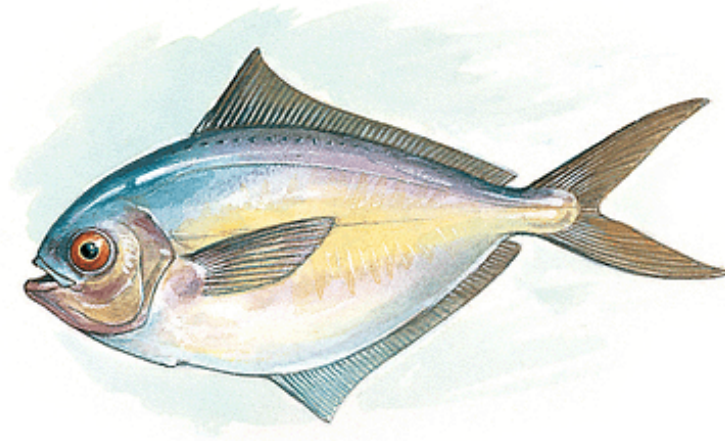
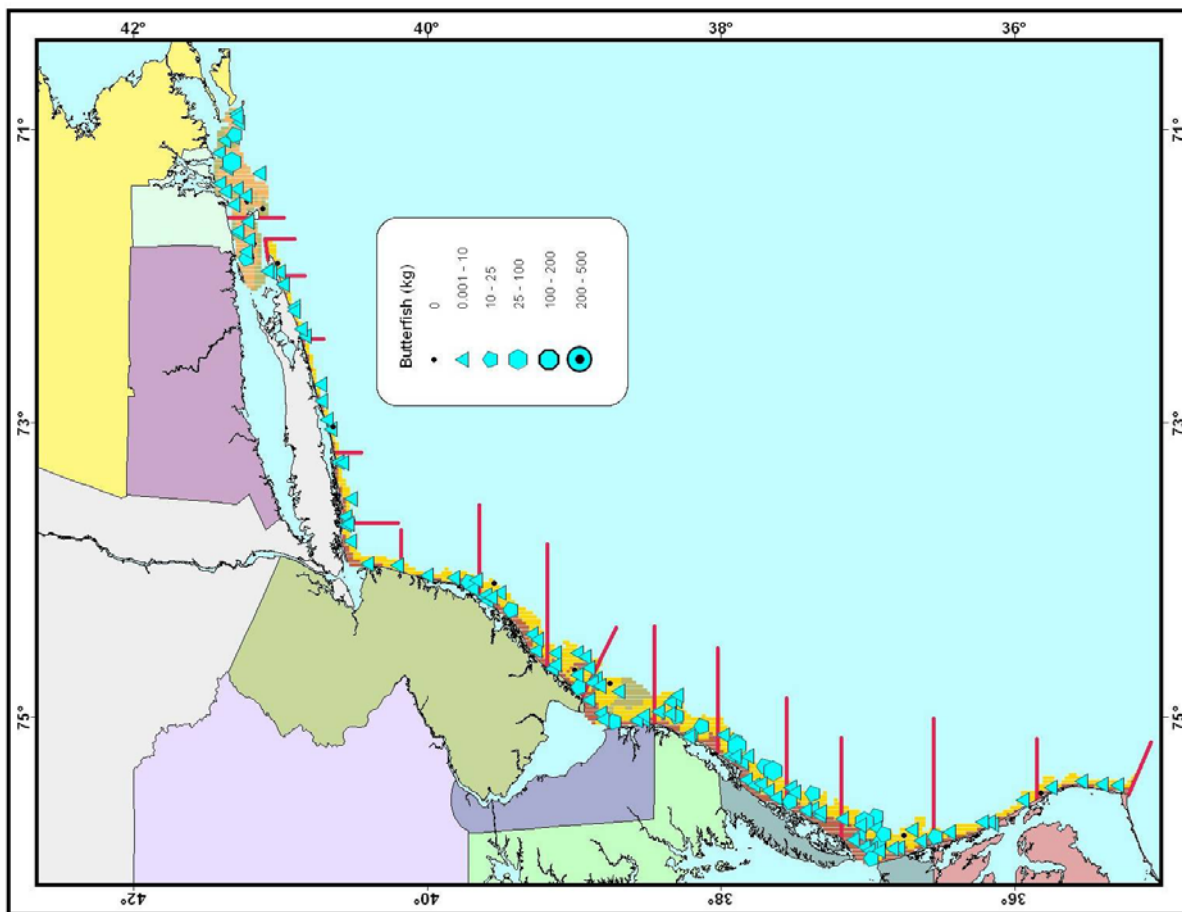


Table 20. Sampling rates and abundance indices of butterflyfish for four NEAMAP cruises.

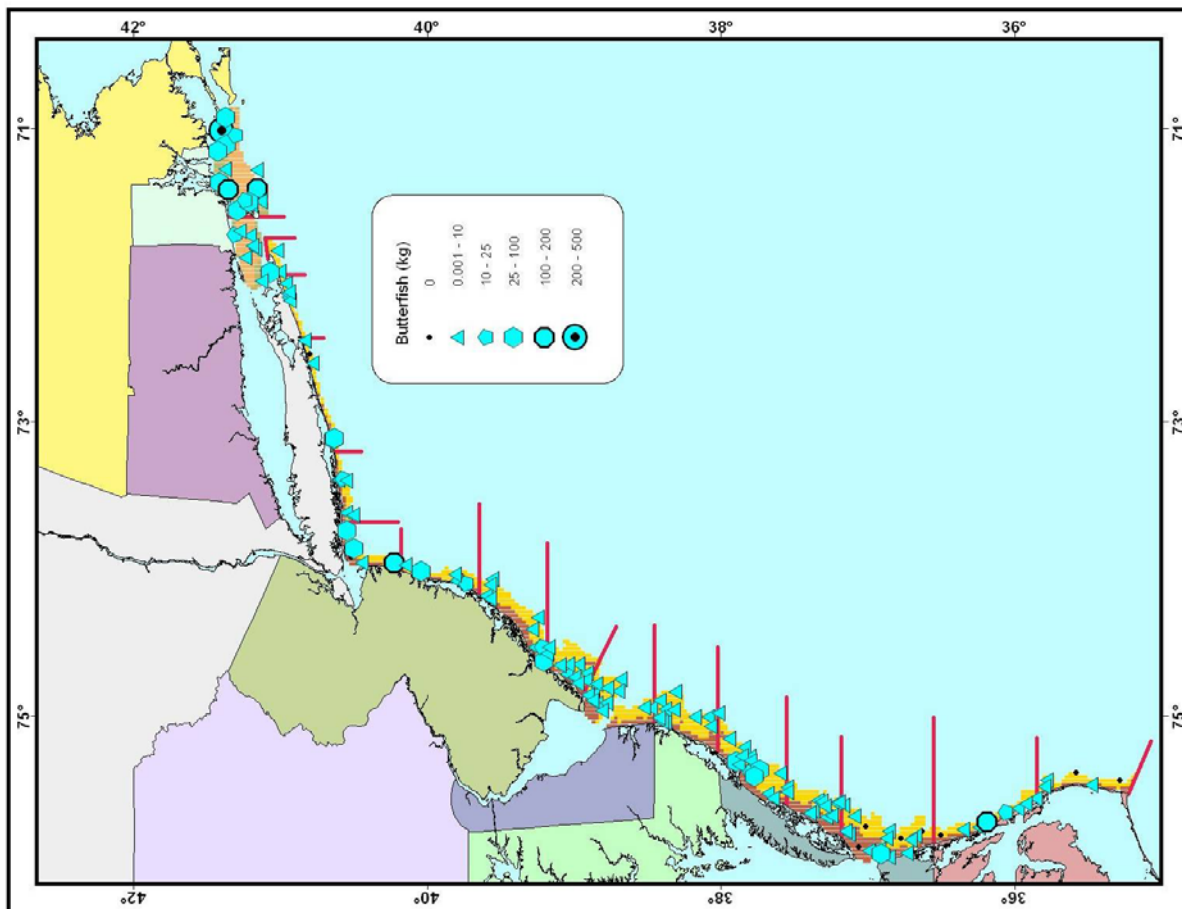
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	148,182	1,904.9	6,015	538	0	11	0	70.71	2.82
2008	Spring	47,742	689.2	8,315	746	0	0	0	44.53	2.29
	Fall	168,269	2,120.6	10,091	551	0	8	0	207.34	4.71
2009	Spring	35,588	816.5	16,089	1045	0	0	0	64.72	2.01

Figure 63. Biomass (kg) of butterfish collected at each sampling site for four NEAMAP cruises.

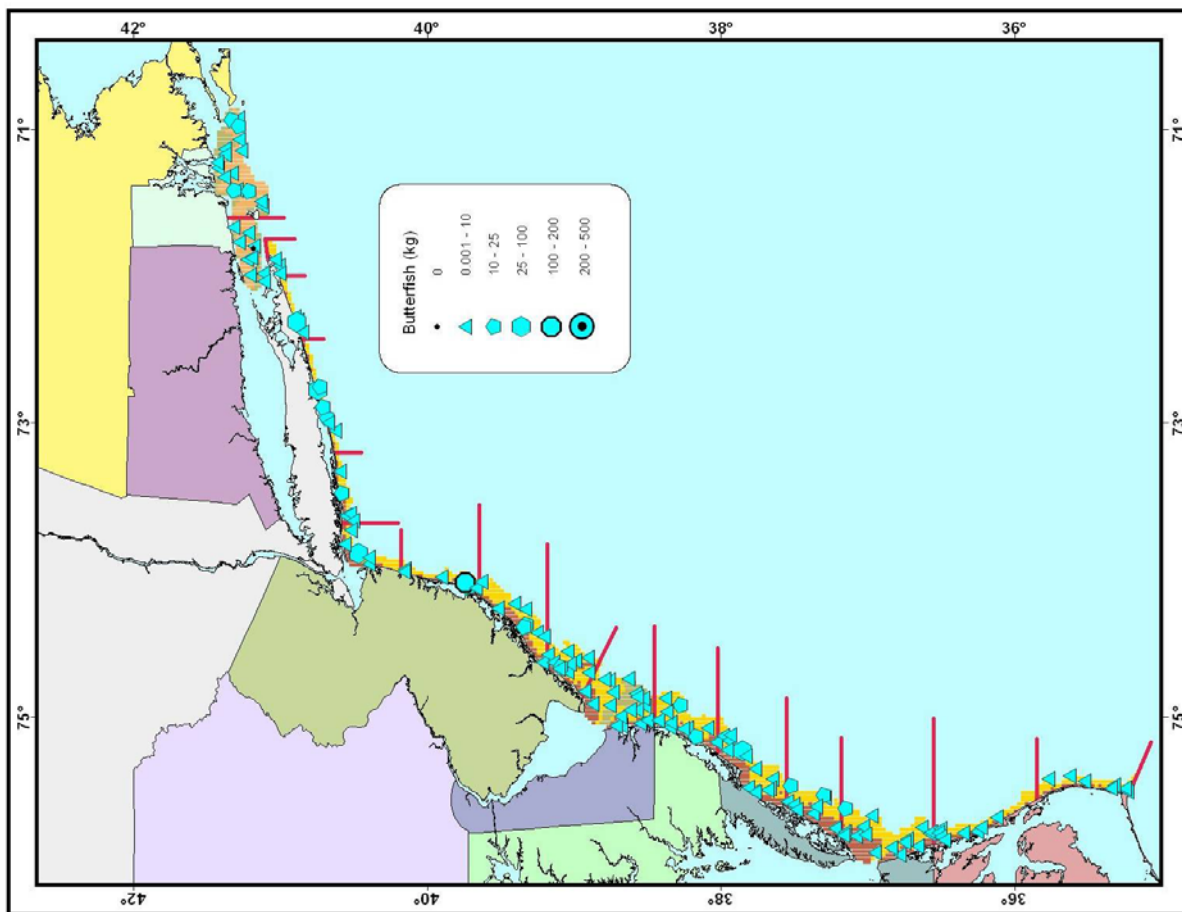
Spring 2008



Fall 2007



Spring 2009



Fall 2008

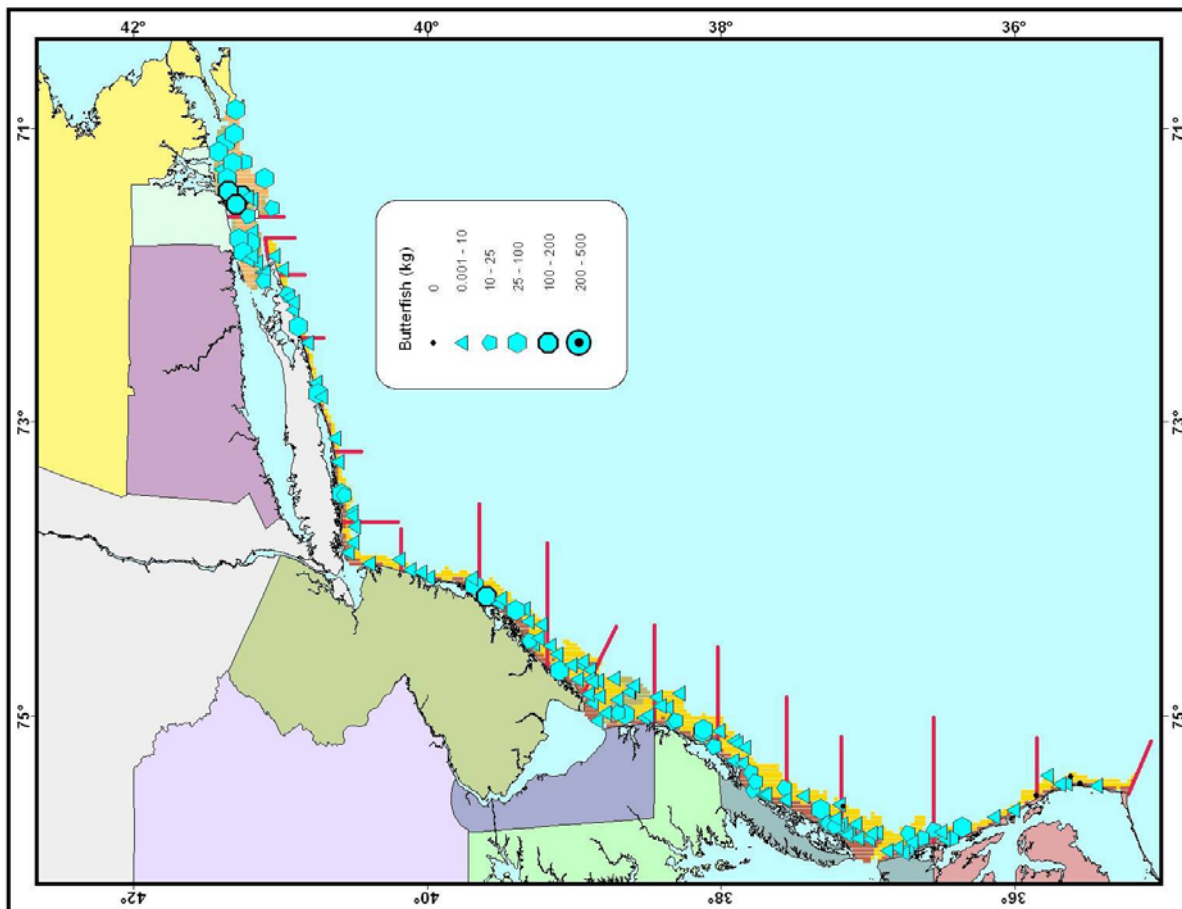


Figure 64. Preliminary indices of abundance, in terms of number and biomass, of butterfish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

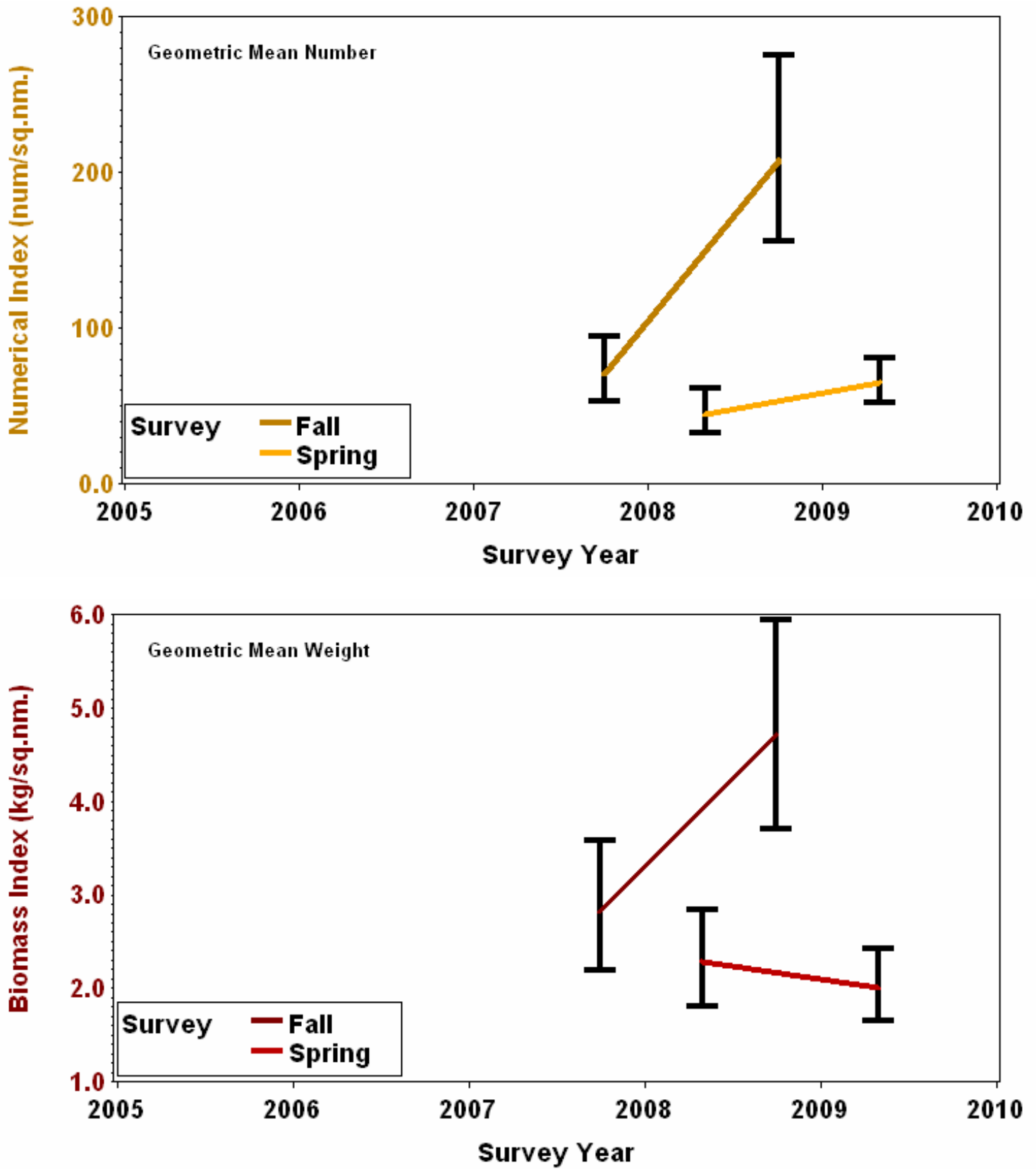


Figure 65. Length-frequency distributions, by cruise, for butterfish. Numbers taken for full processing, by length, are represented by the orange bars.

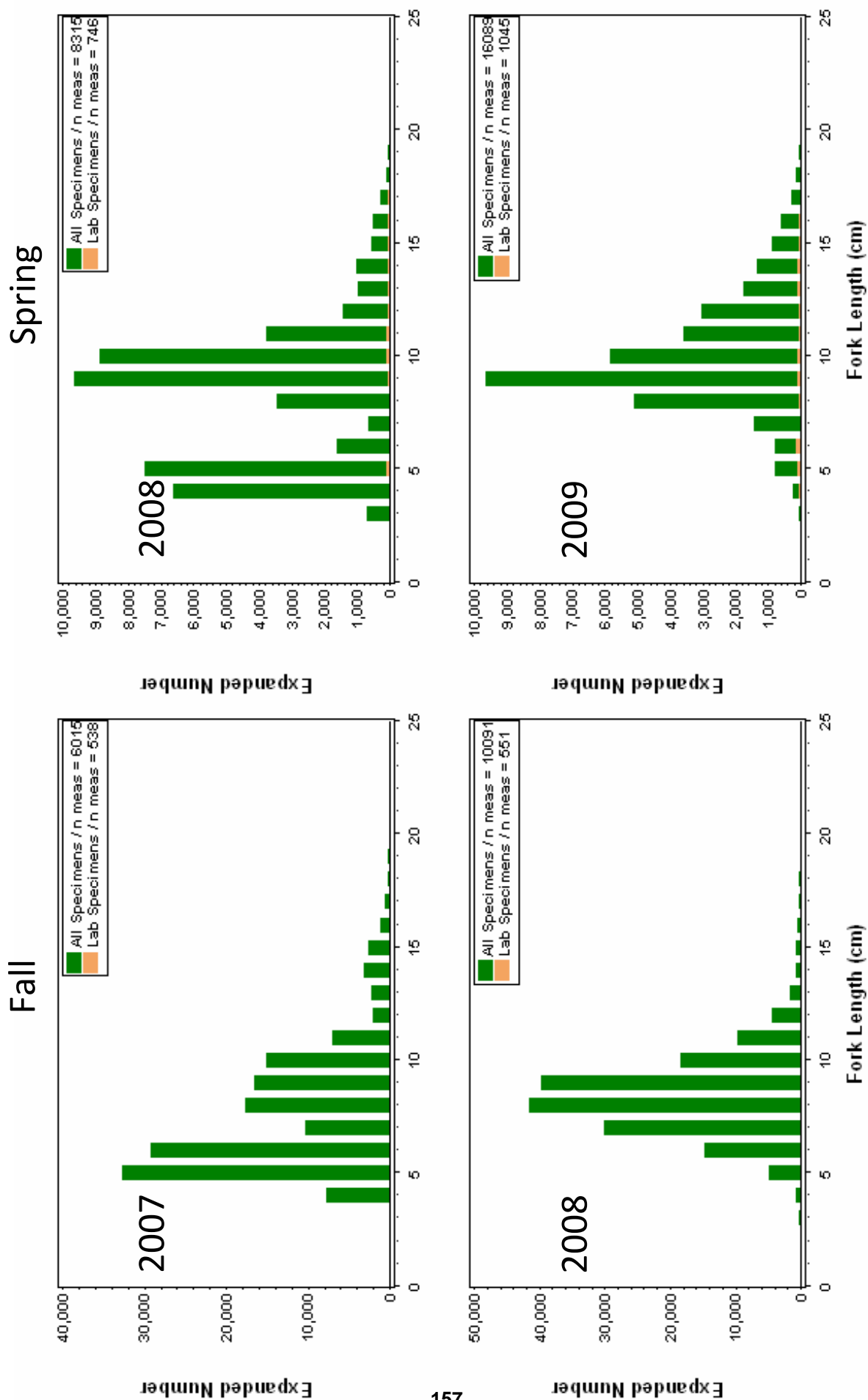
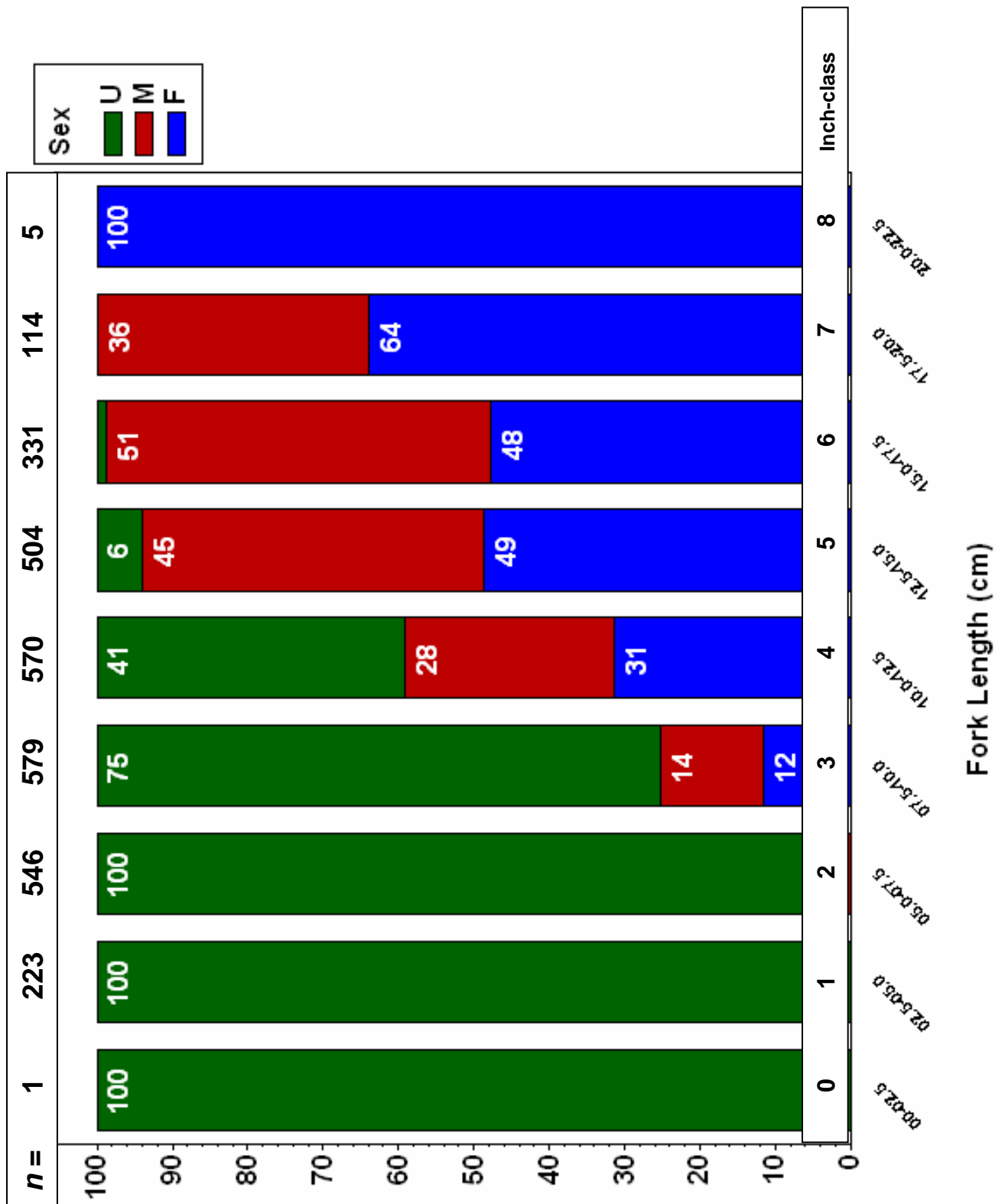


Figure 66. Sex ratio, by length group, for butterfish collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



# Clearnose Skate (Priority B)

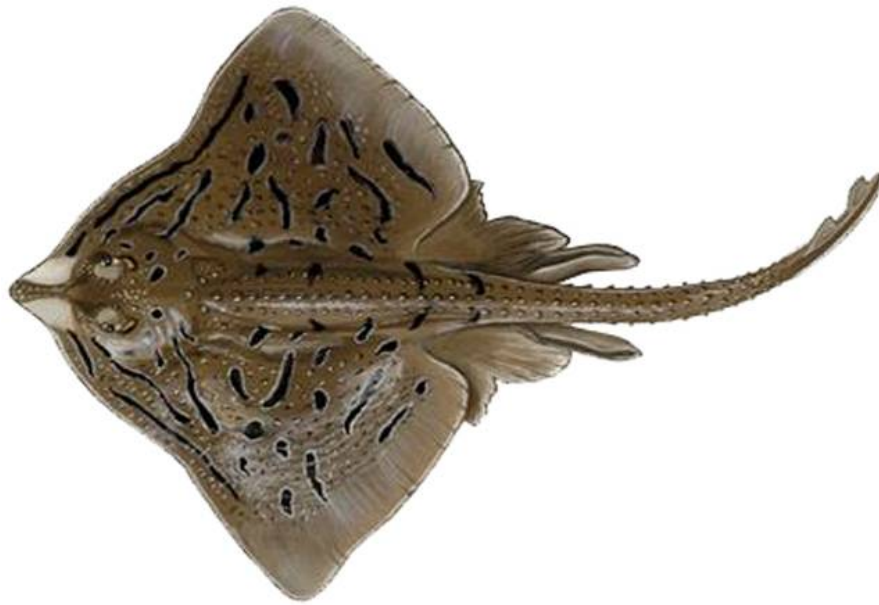


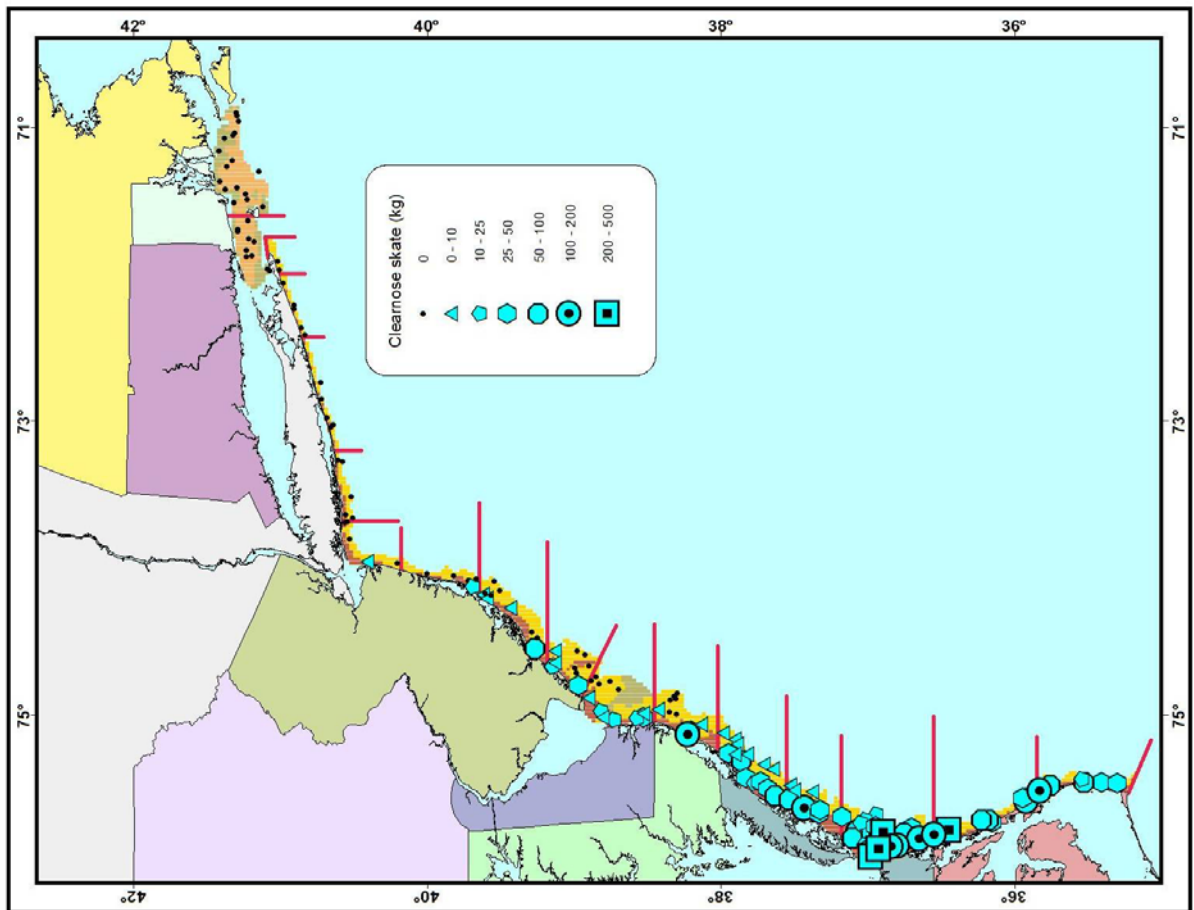
Table 21. Sampling rates and abundance indices of clearnose skate for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	1,499	1,847.7	1,355	340	0	324	288	4.92	5.78
2008	Spring	3,216	4,234.1	1,047	209	0	202	200	3.84	4.41
	Fall	885	1,196.2	806	289	0	287	272	3.06	3.71
2009	Spring	2,429	3,382.1	1,431	205	0	188	2	2.75	3.27

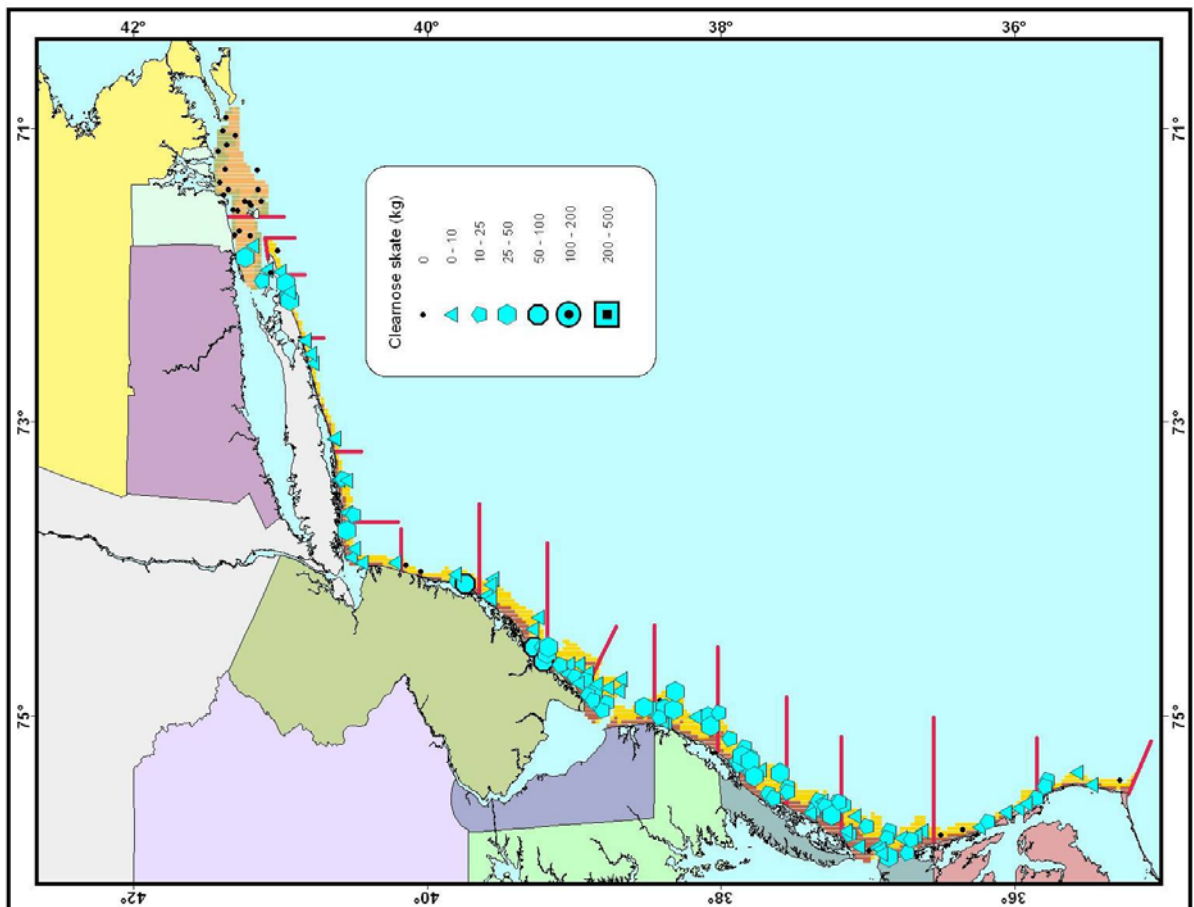


Figure 67. Biomass (kg) of clearnose skate collected at each sampling site for four NEAMAP cruises.

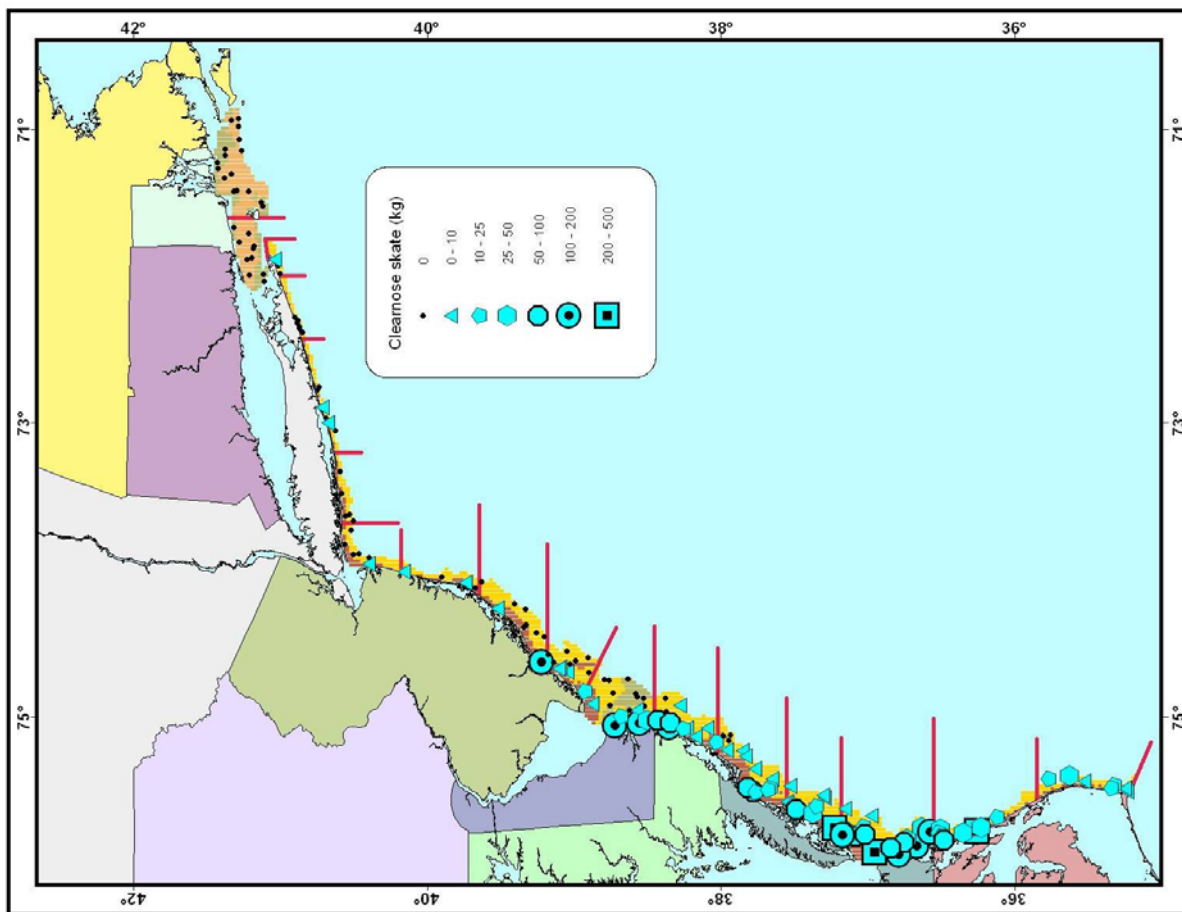
Spring 2008



Fall 2007



Spring 2009



Fall 2008

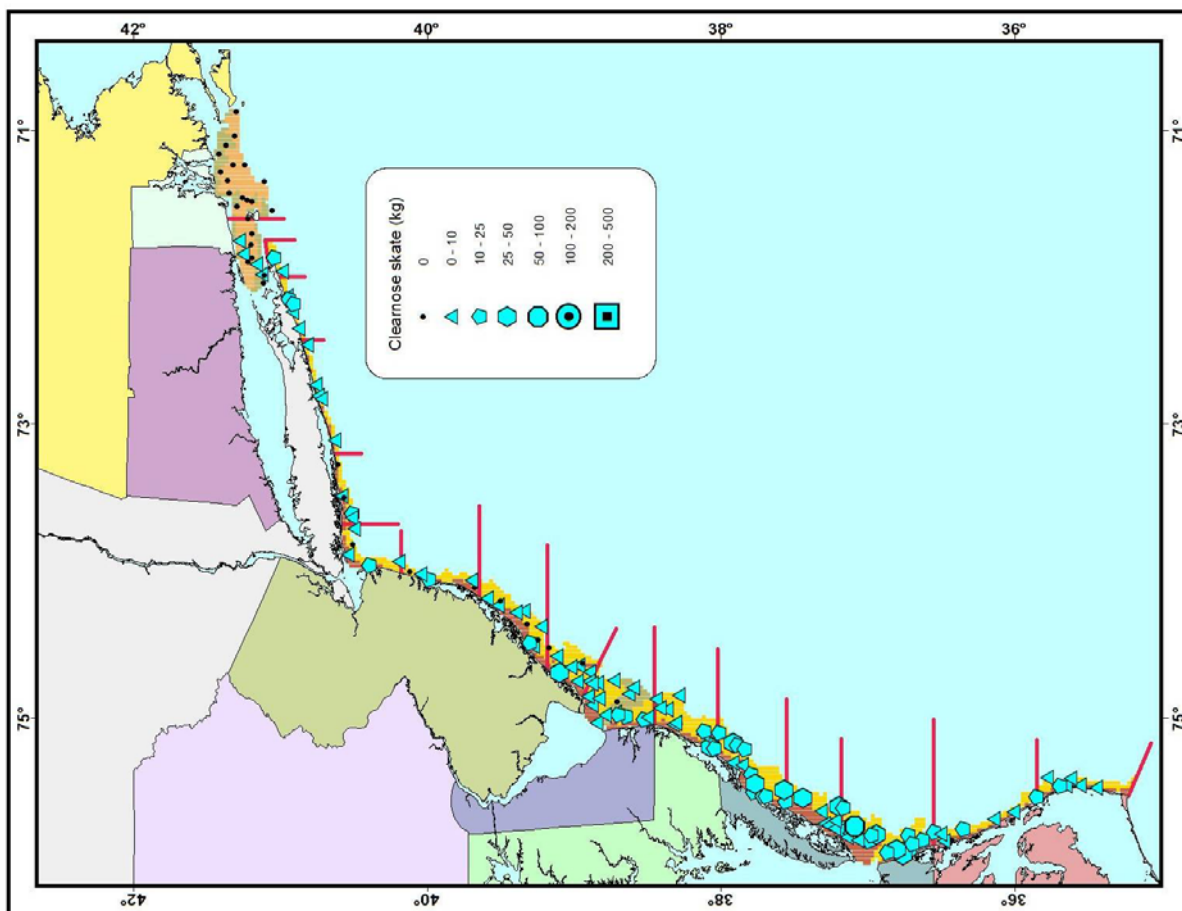


Figure 68. Preliminary indices of abundance, in terms of number and biomass, of clearnose skate for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

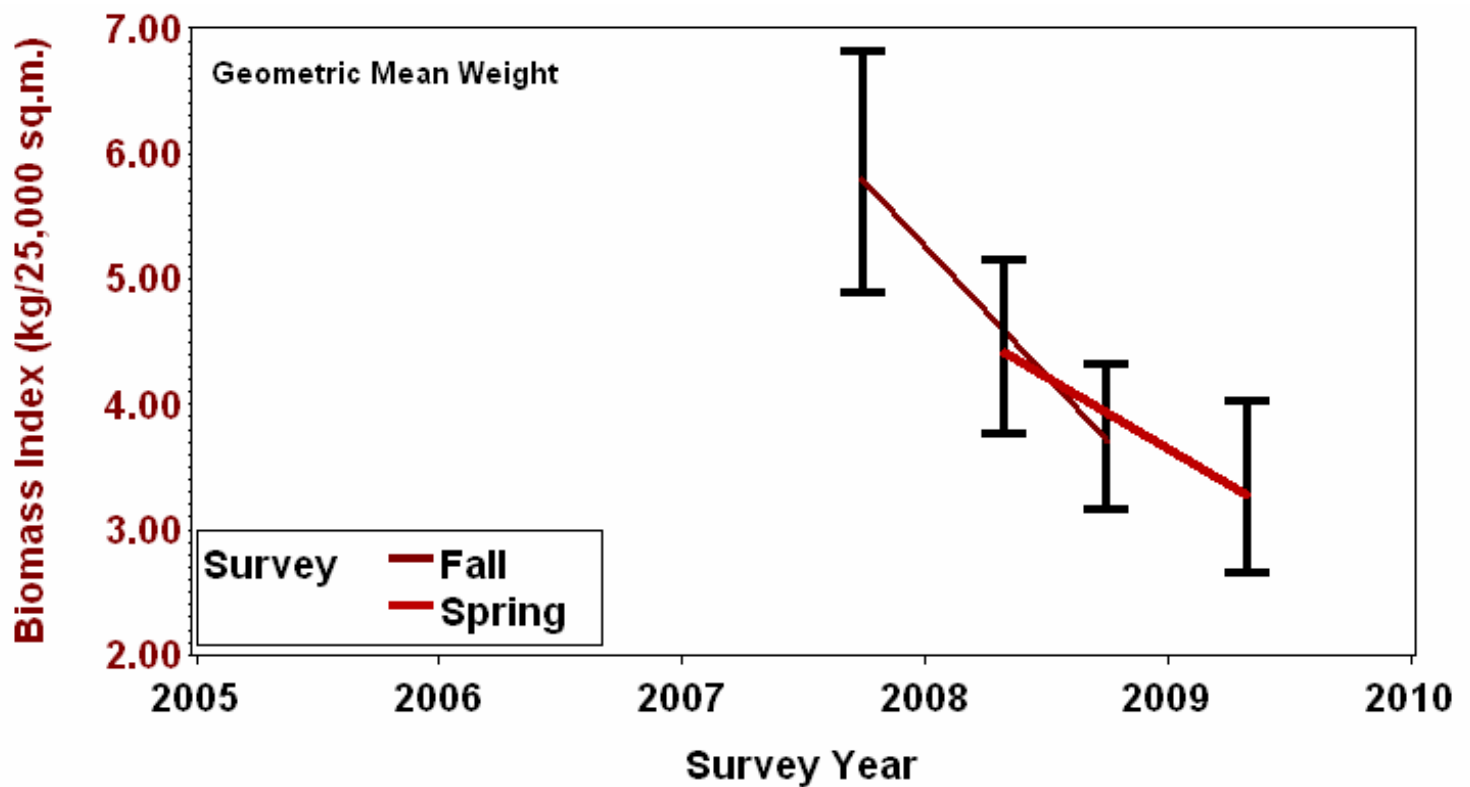
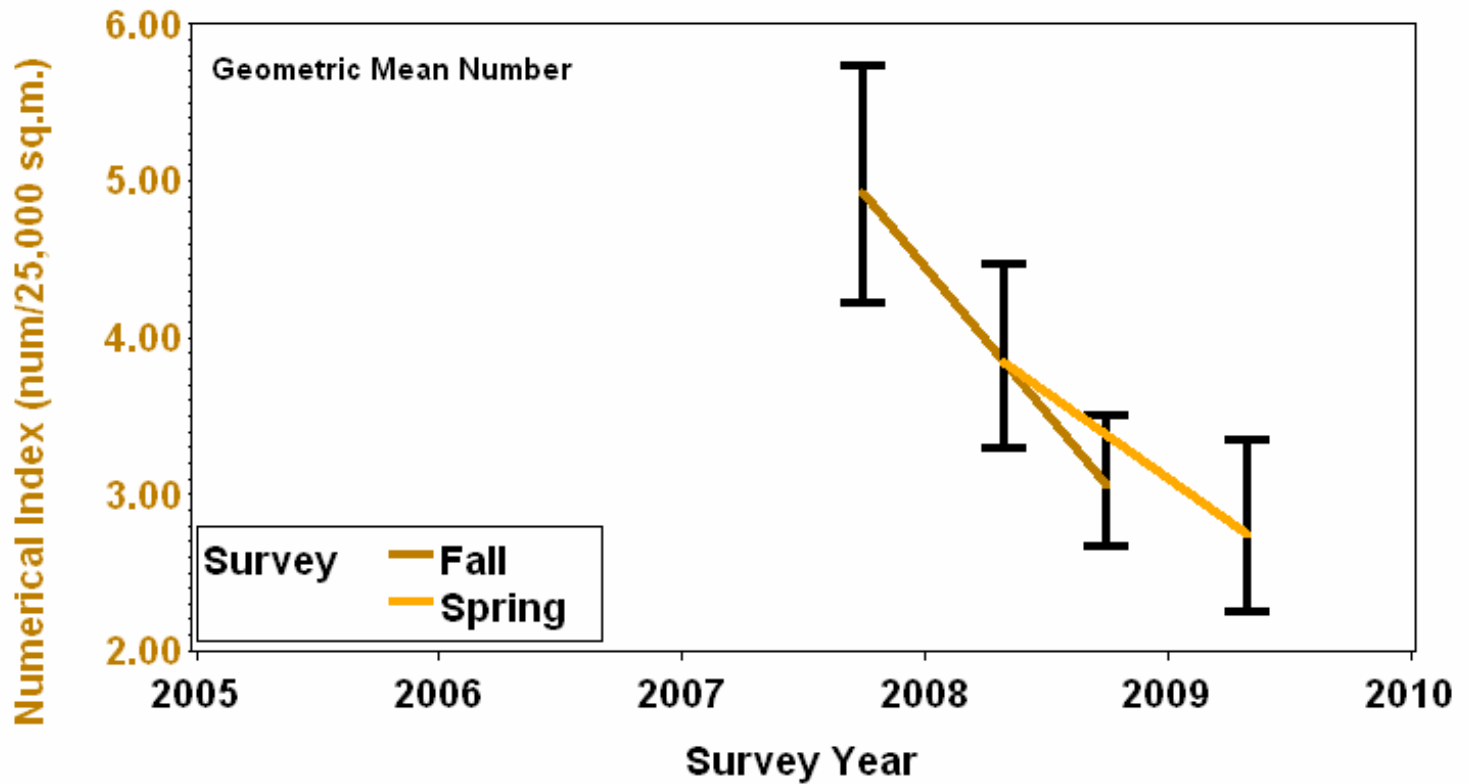


Figure 69. Length-frequency distributions, by cruise, for clearnose skate. Numbers taken for full processing, by length, are represented by the orange bars.

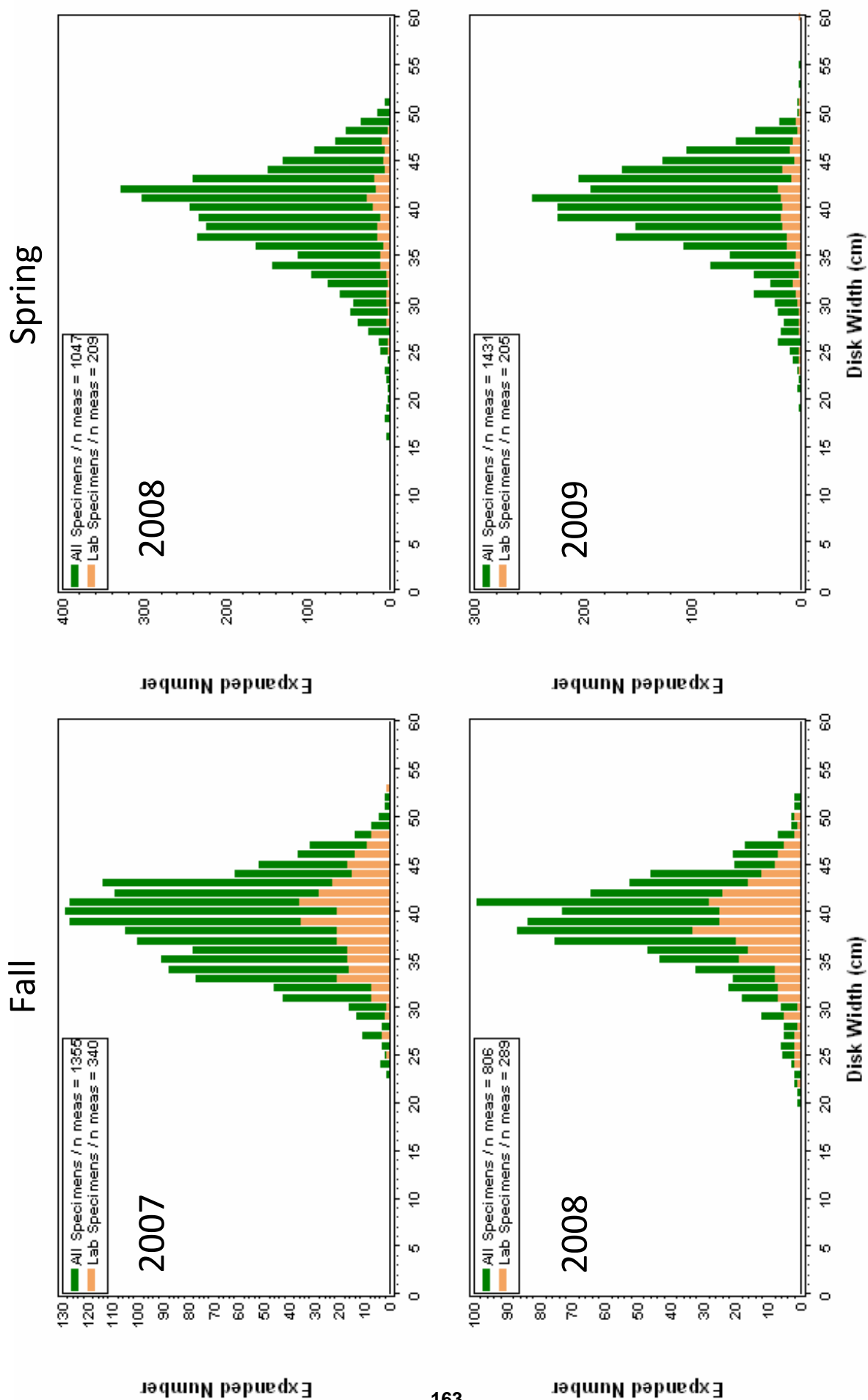


Figure 70. Sex ratio, by length group, for clearnose skate collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

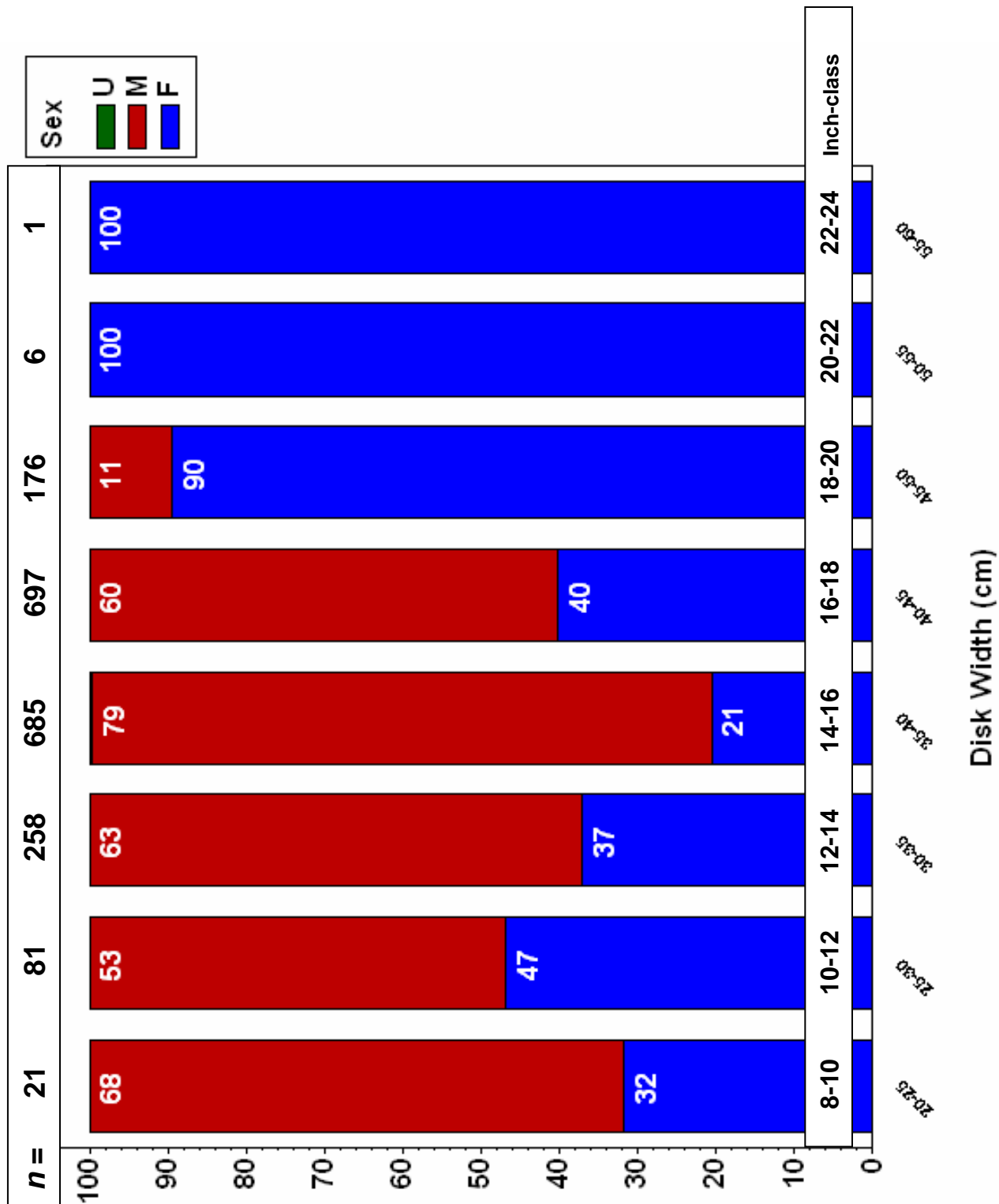
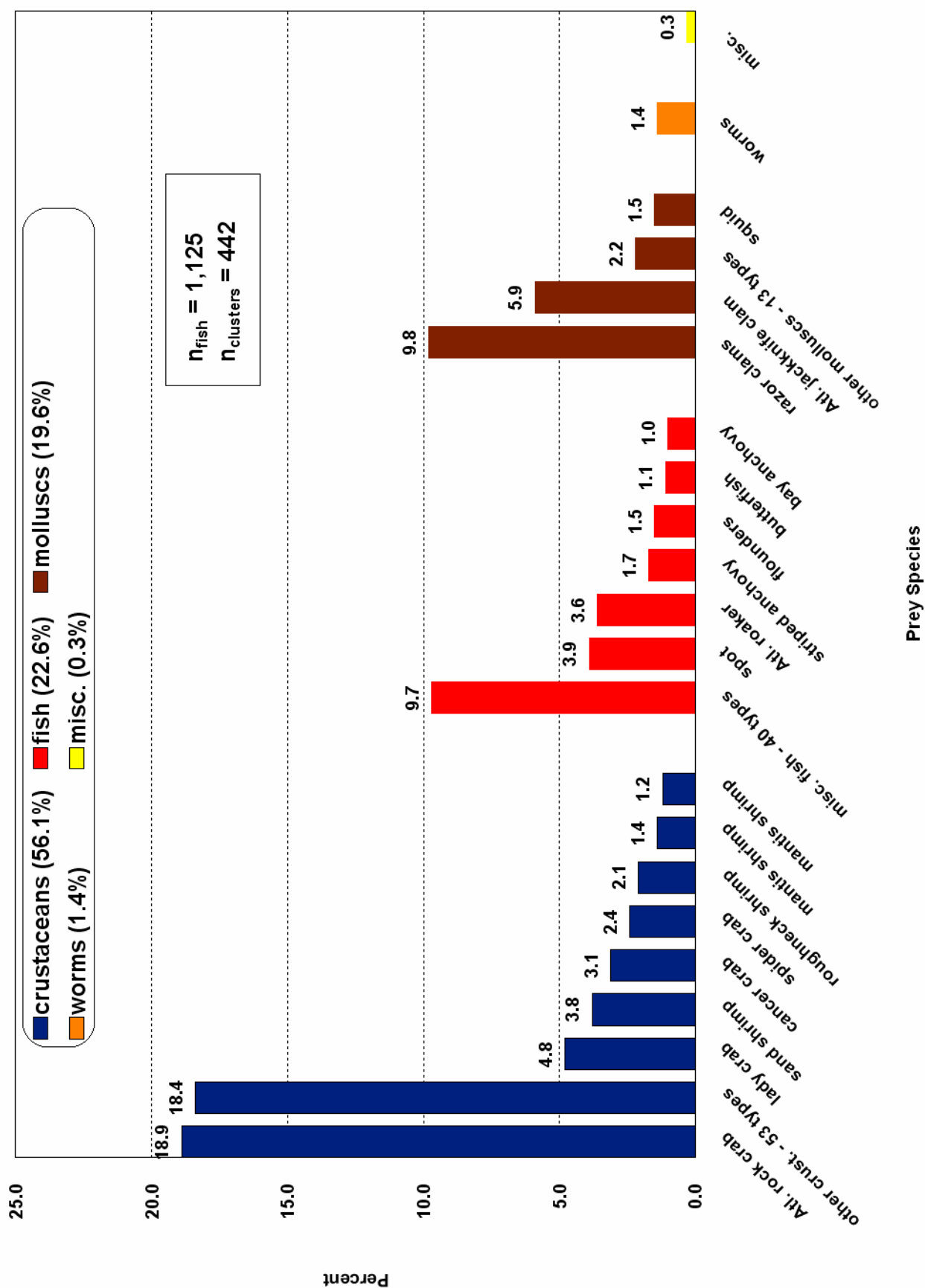


Figure 71. Diet composition, expressed using the percent weight index, of clearnose skate collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of clearnose skate sampled.





# Cownose Ray (Priority E)



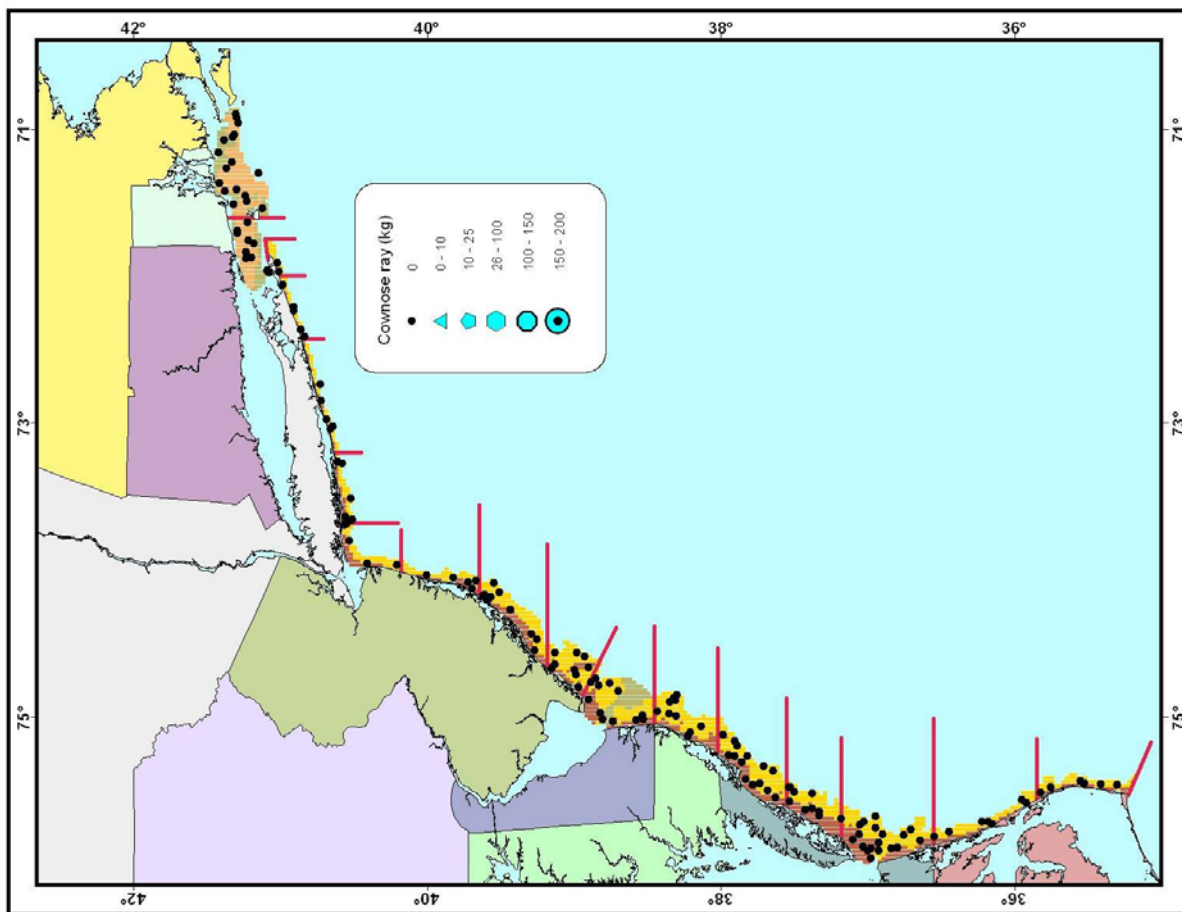
Table 22. Sampling rates and abundance indices of cownose ray for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	451	3,976.6	150	0		0		0.28	0.40
2008	Spring	0	0.0	0	0		0		0.00	0.00
	Fall	231	560.4	108	0		0		0.24	0.35
2009	Spring	4	11.4	4	0		0		0.01	0.02

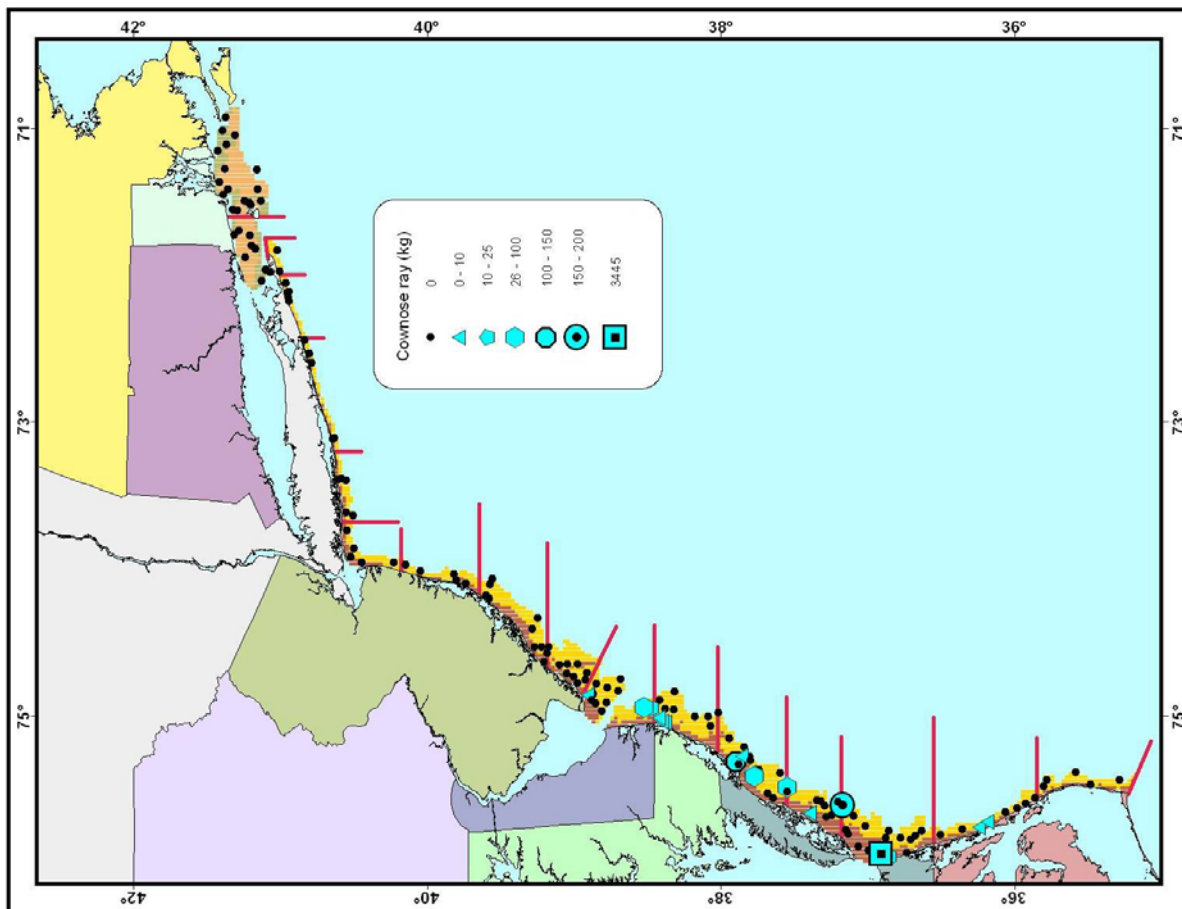


Figure 72. Biomass (kg) of cownose ray collected at each sampling site for four NEAMAP cruises.

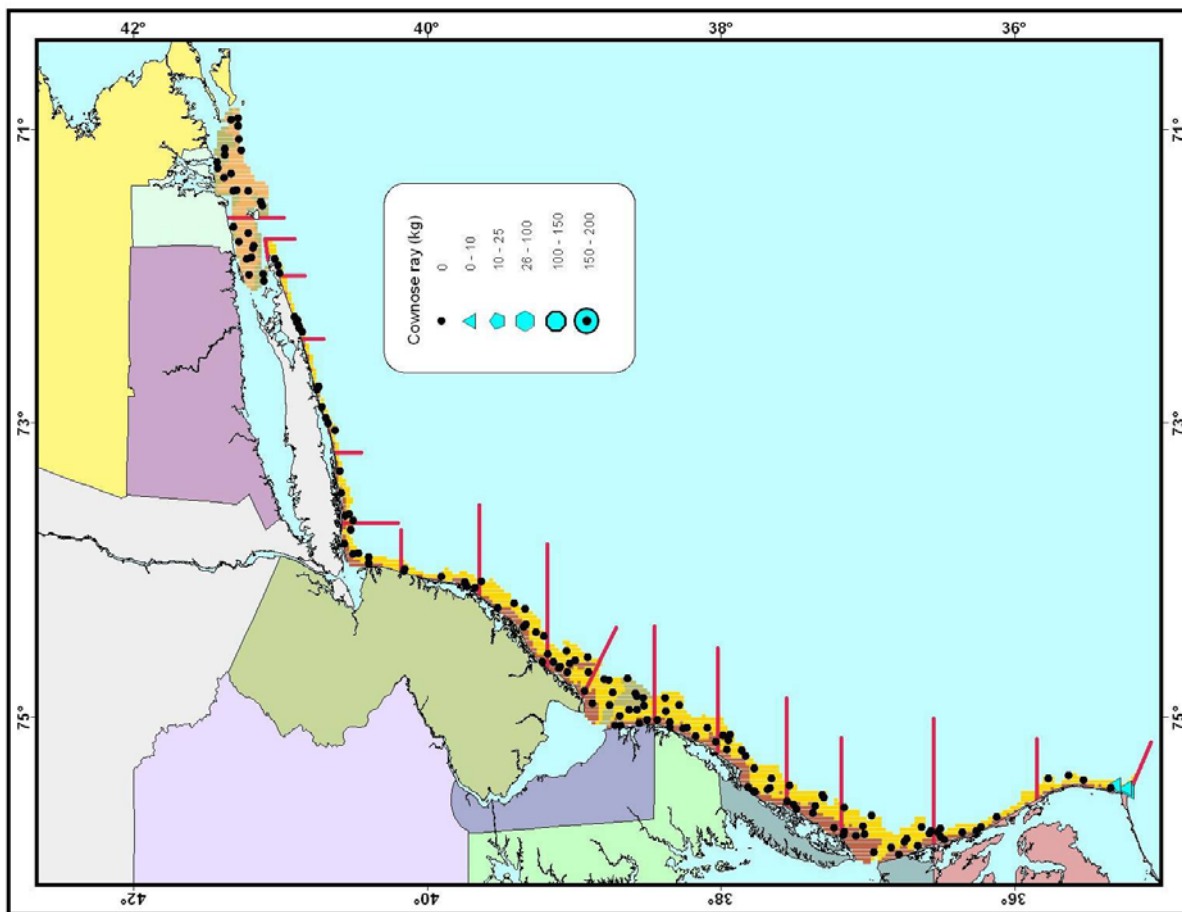
Spring 2008



Fall 2007



Spring 2009



Fall 2008

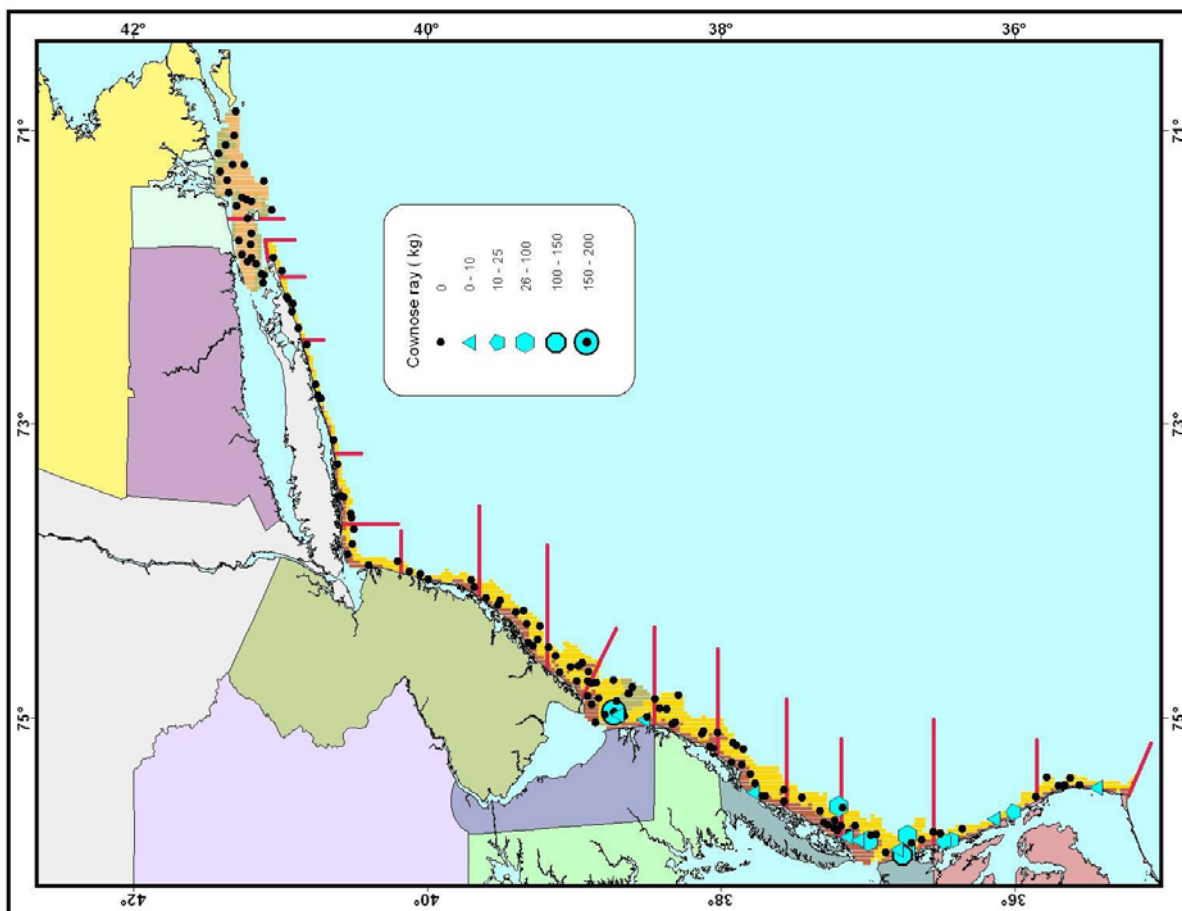


Figure 73. Preliminary indices of abundance, in terms of number and biomass, of cownose ray for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

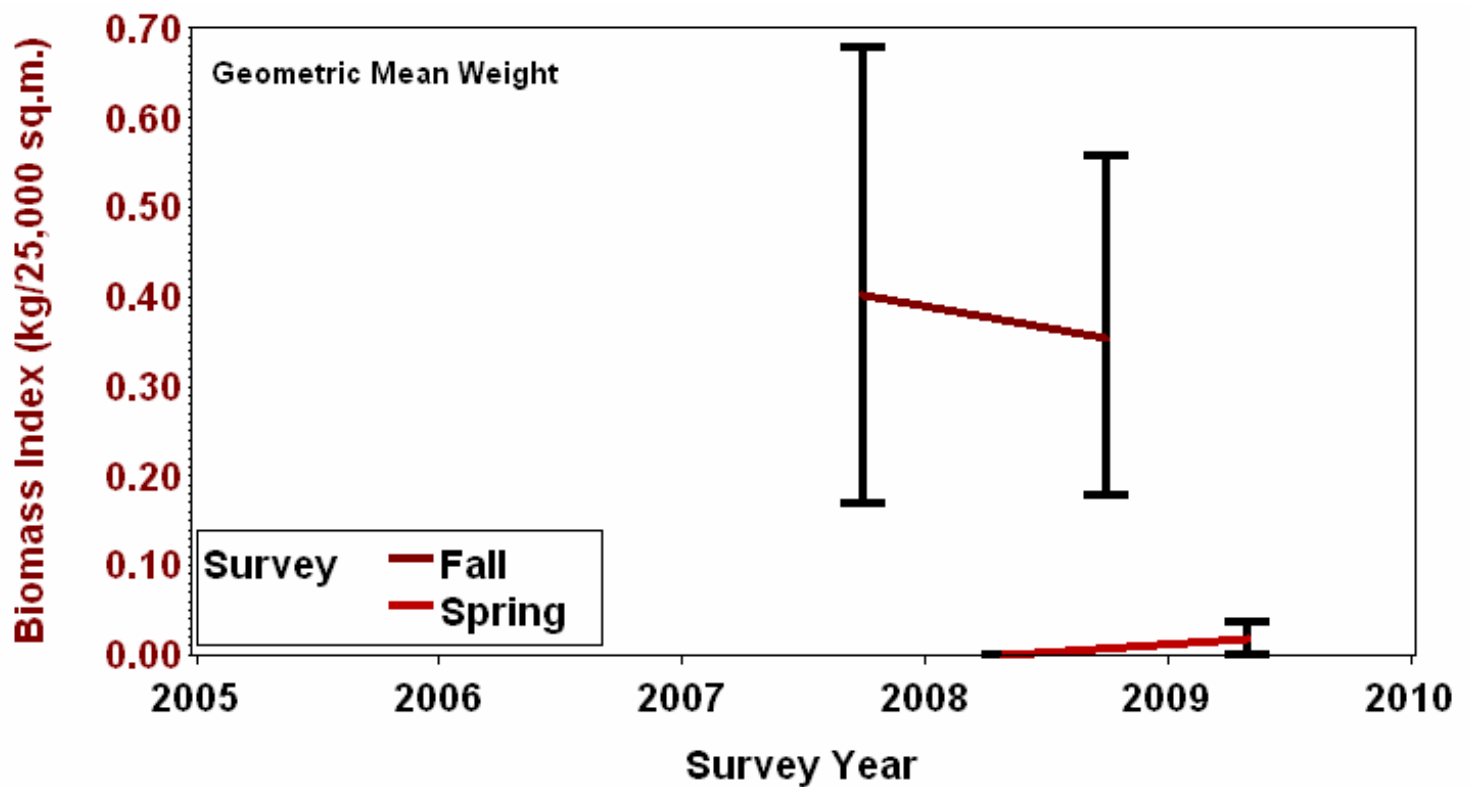
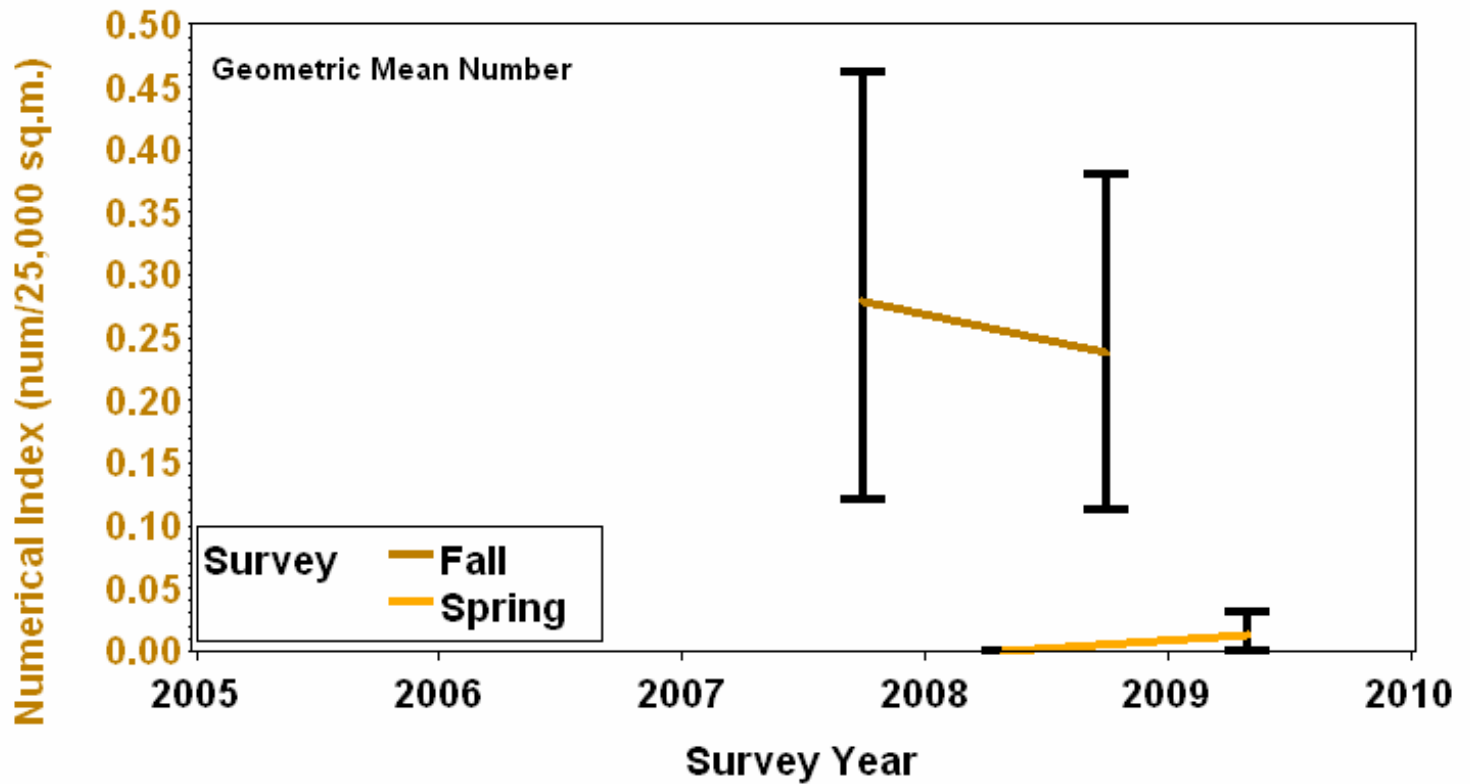
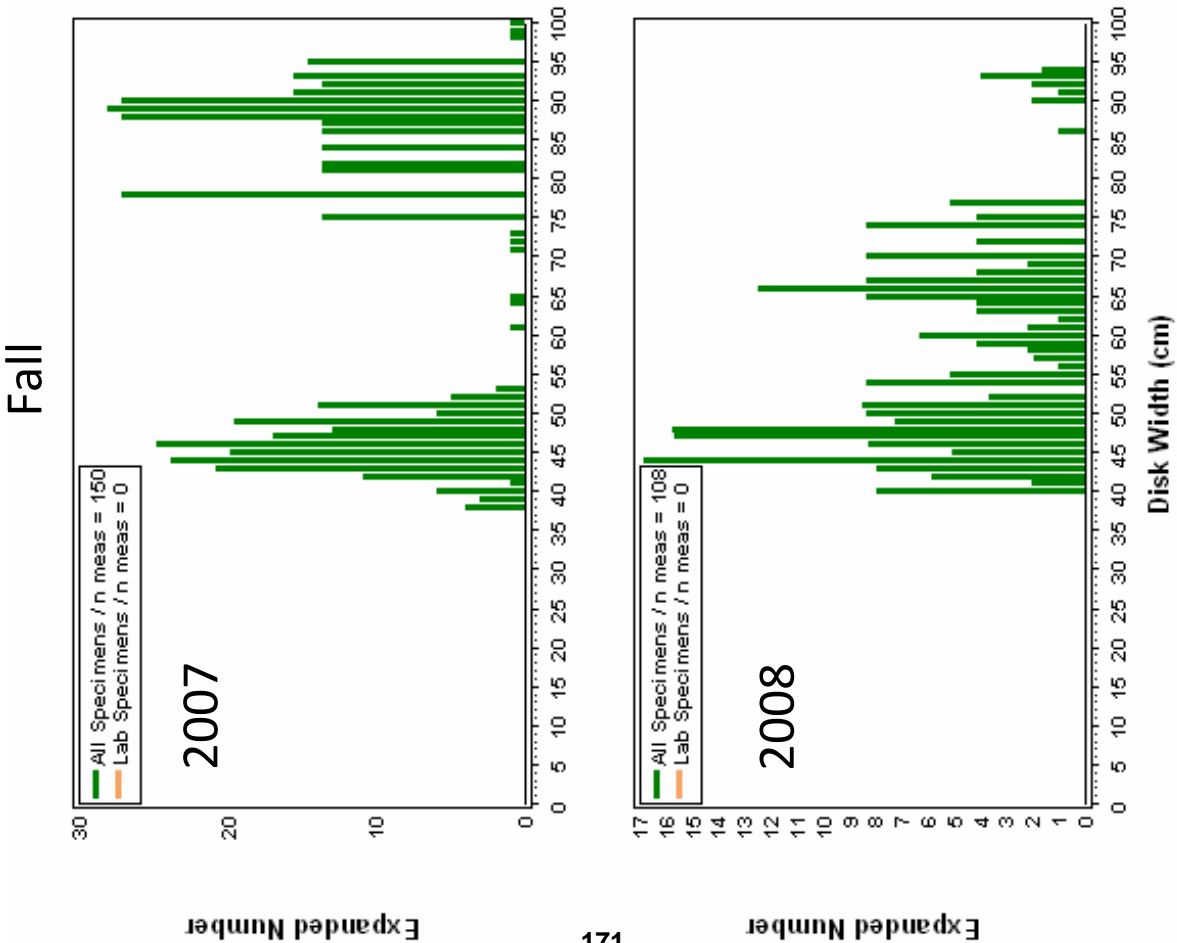


Figure 74. Length-frequency distributions, by cruise, for cownose ray. This species was absent from spring survey collections.





# Horseshoe Crab (Priority E)

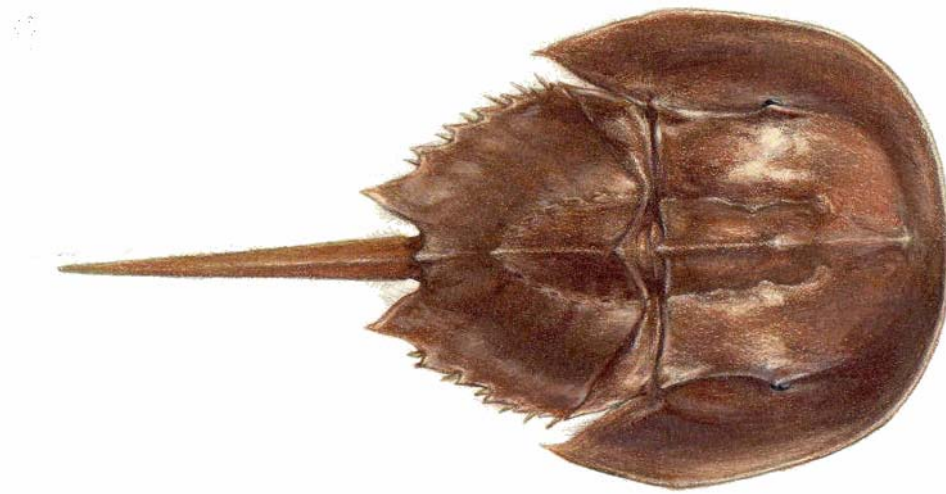
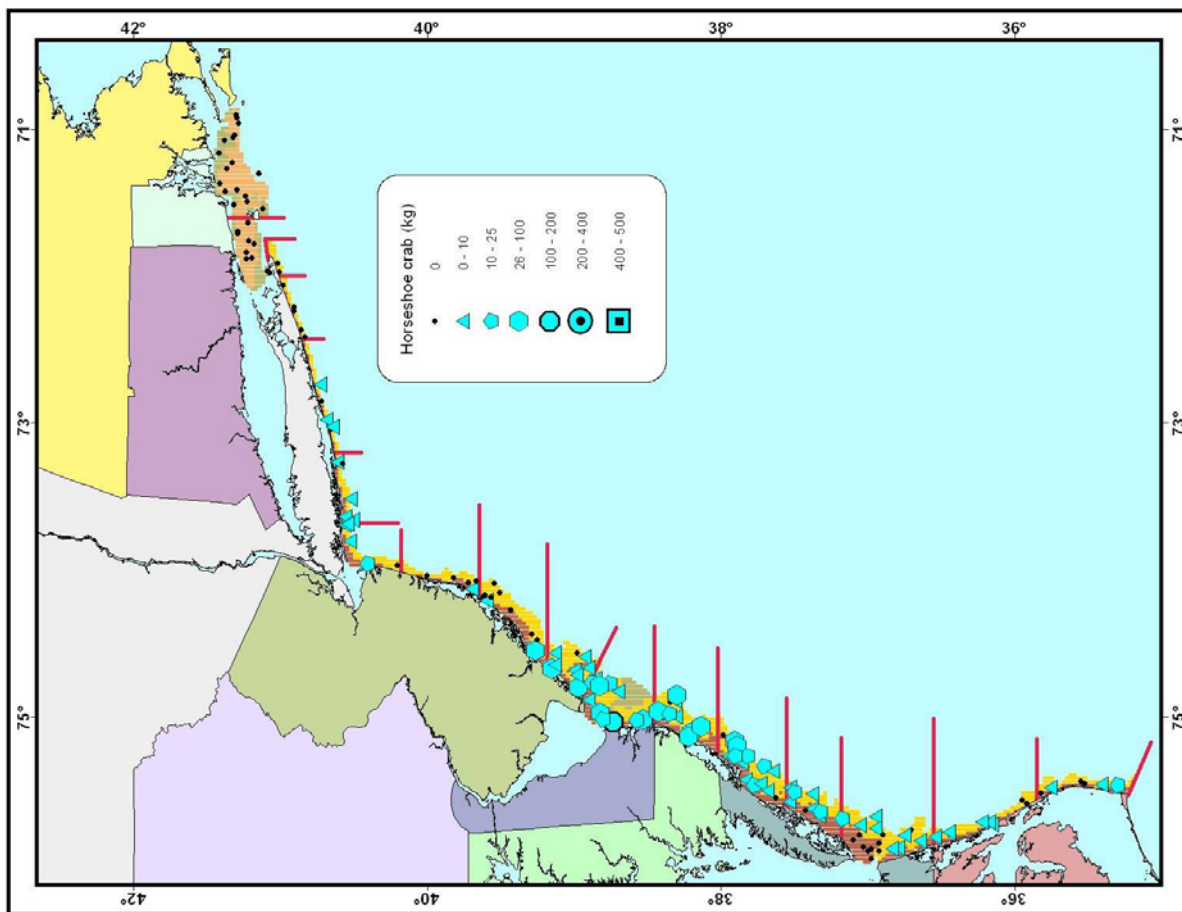


Table 23. Sampling rates and abundance indices of horseshoe crab for four NEAMAP cruises.

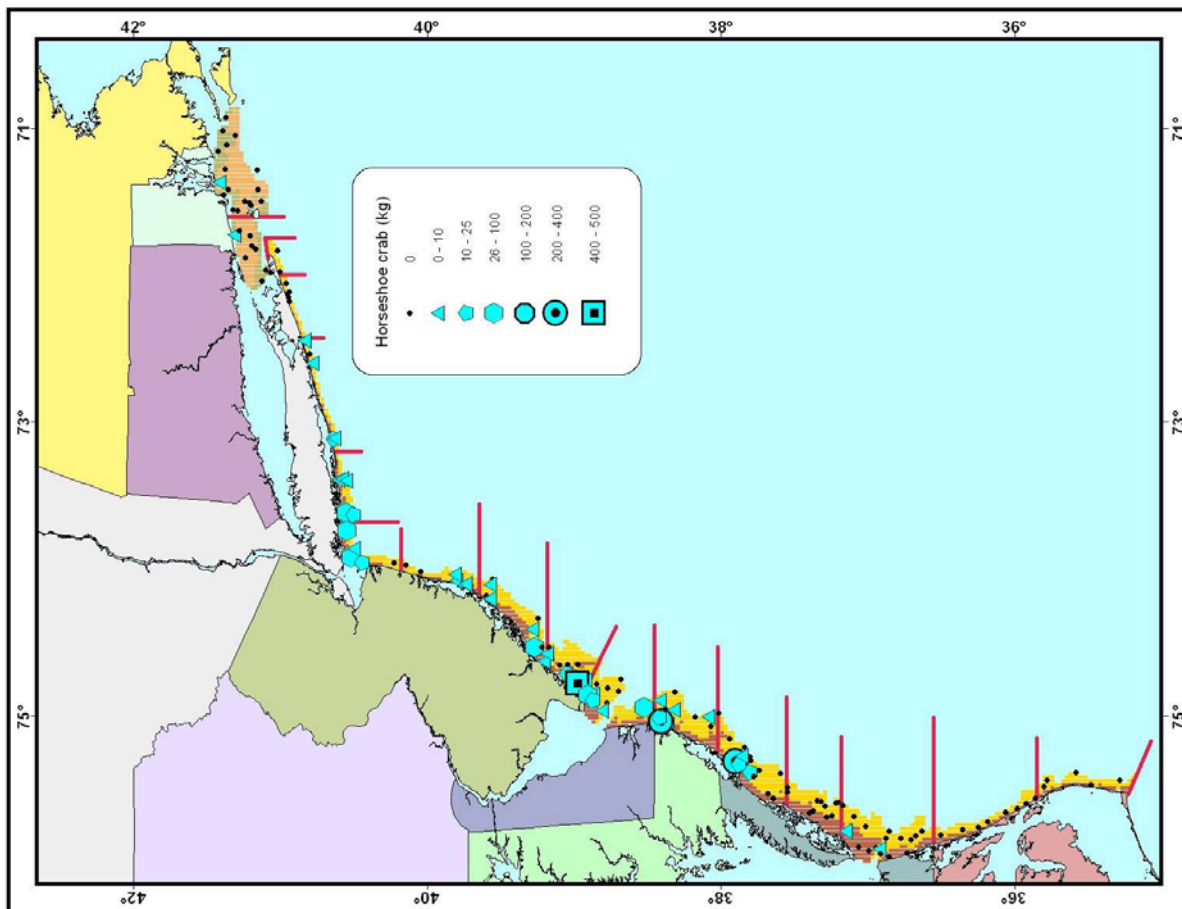
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	795	1,447.9	342	0		0		0.78	1.04
2008	Spring	1,201	1,229.6	774	0		0		2.23	2.42
	Fall	1,149	1,839.4	473	0		0		1.32	1.73
2009	Spring	2,388	2,702.1	1,673	0		0		4.21	4.80

Figure 75. Biomass (kg) of horseshoe crab collected at each sampling site for four NEAMAP cruises.

Spring 2008

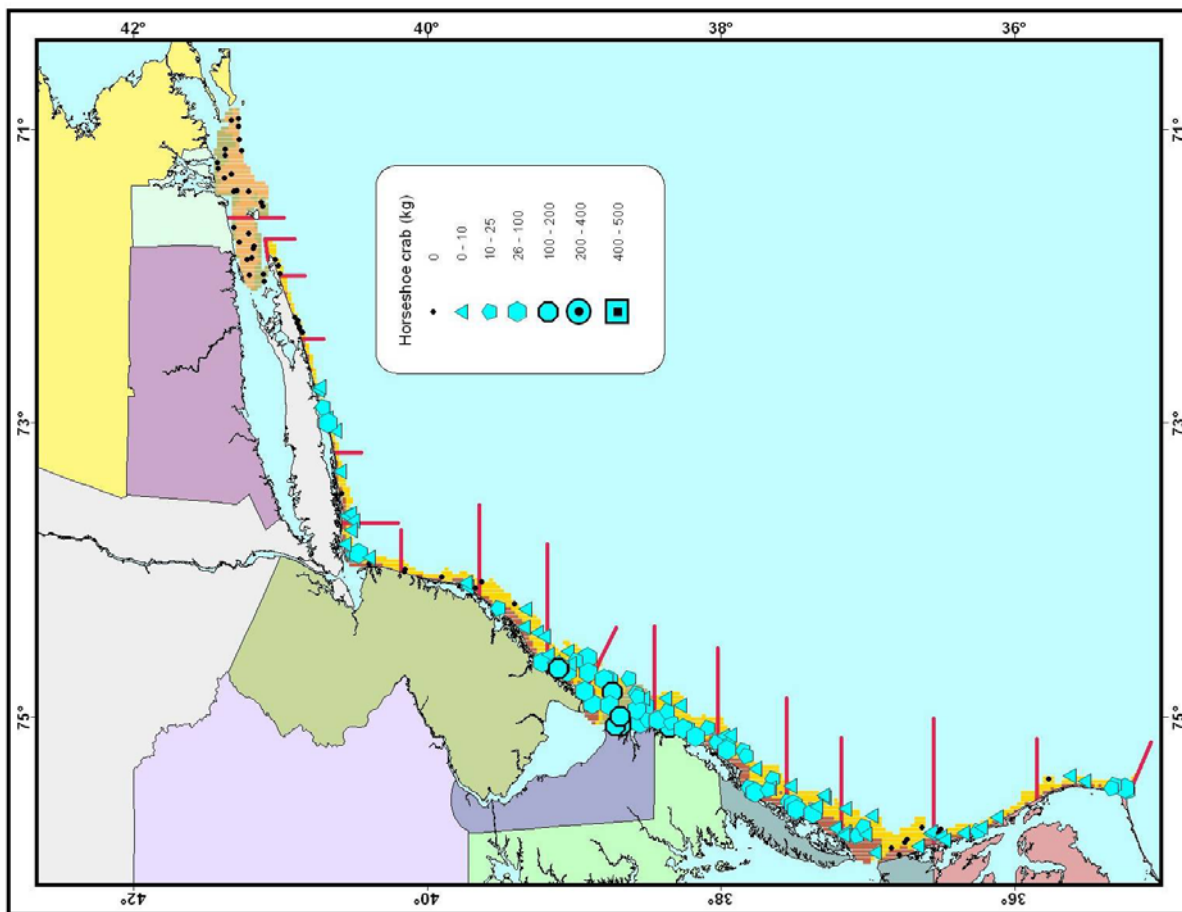


Fall 2007





Spring 2009



Fall 2008

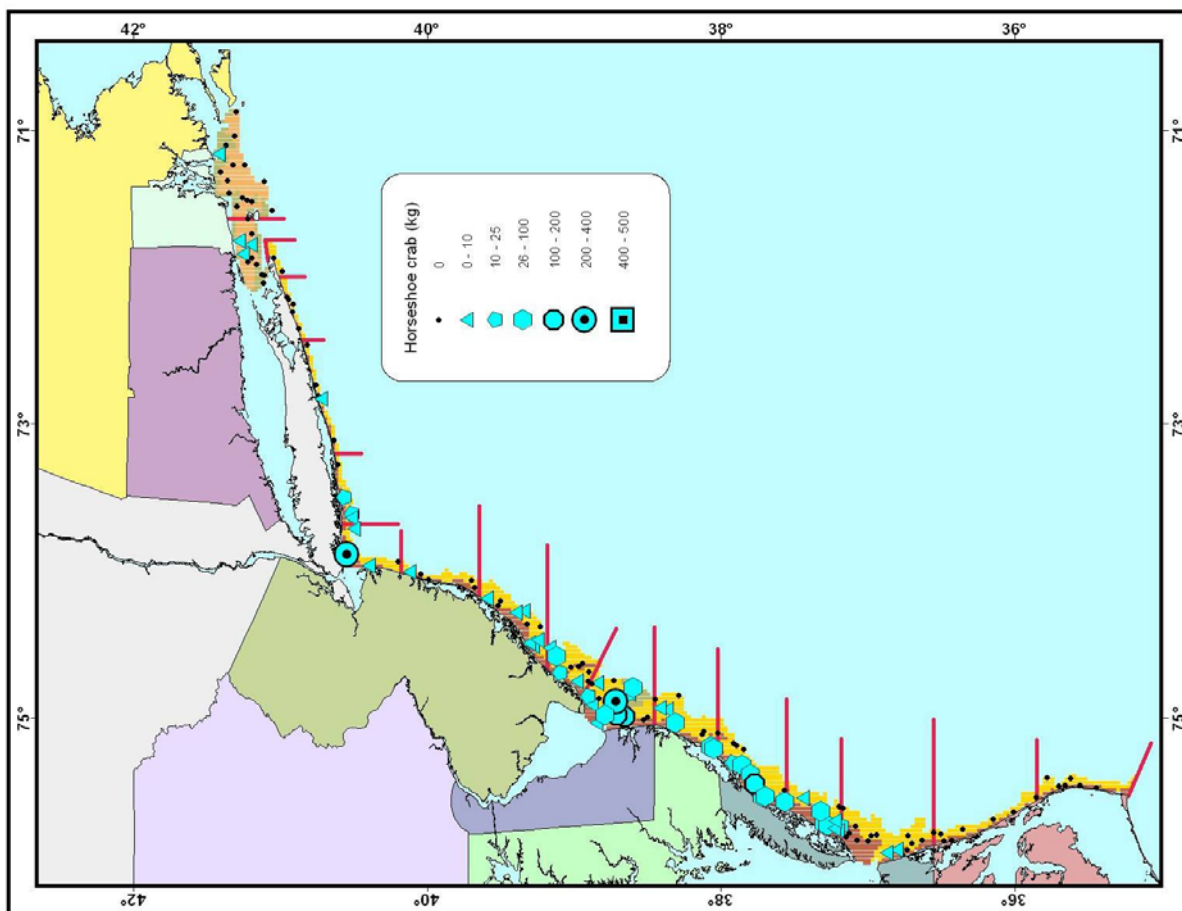




Figure 76. Preliminary indices of abundance, in terms of number and biomass, of horseshoe crab for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

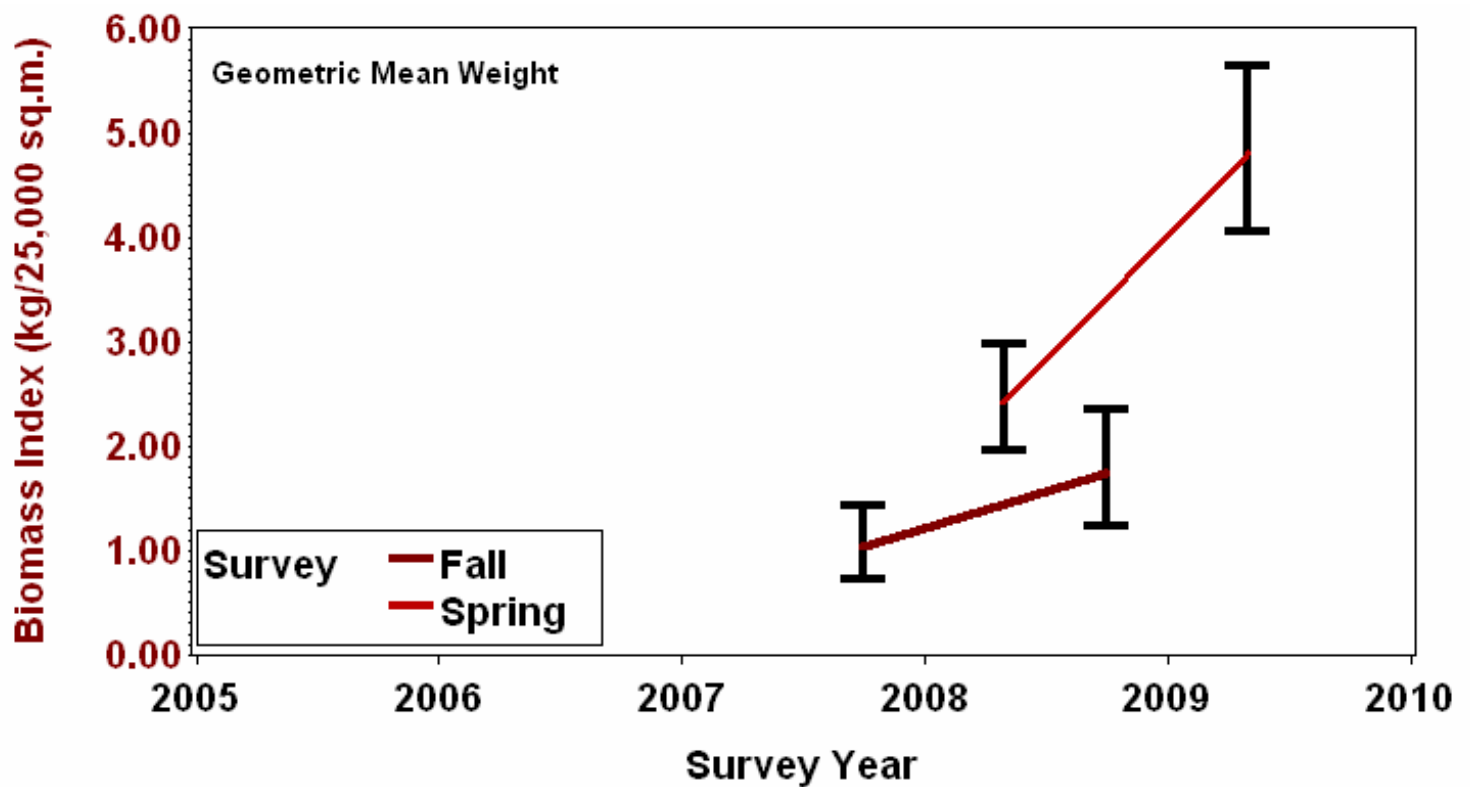
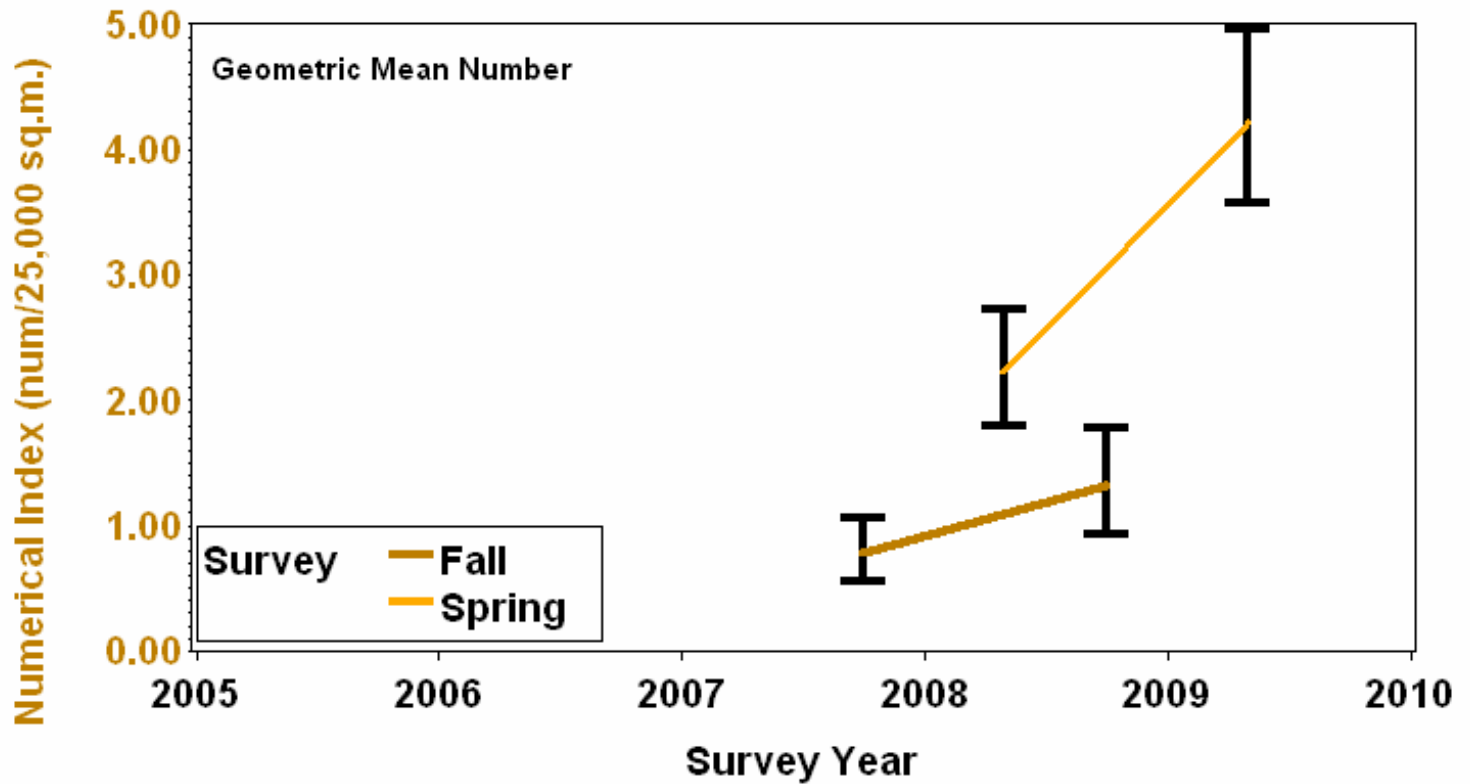


Figure 77. Length-frequency distributions, by cruise, for horseshoe crab.

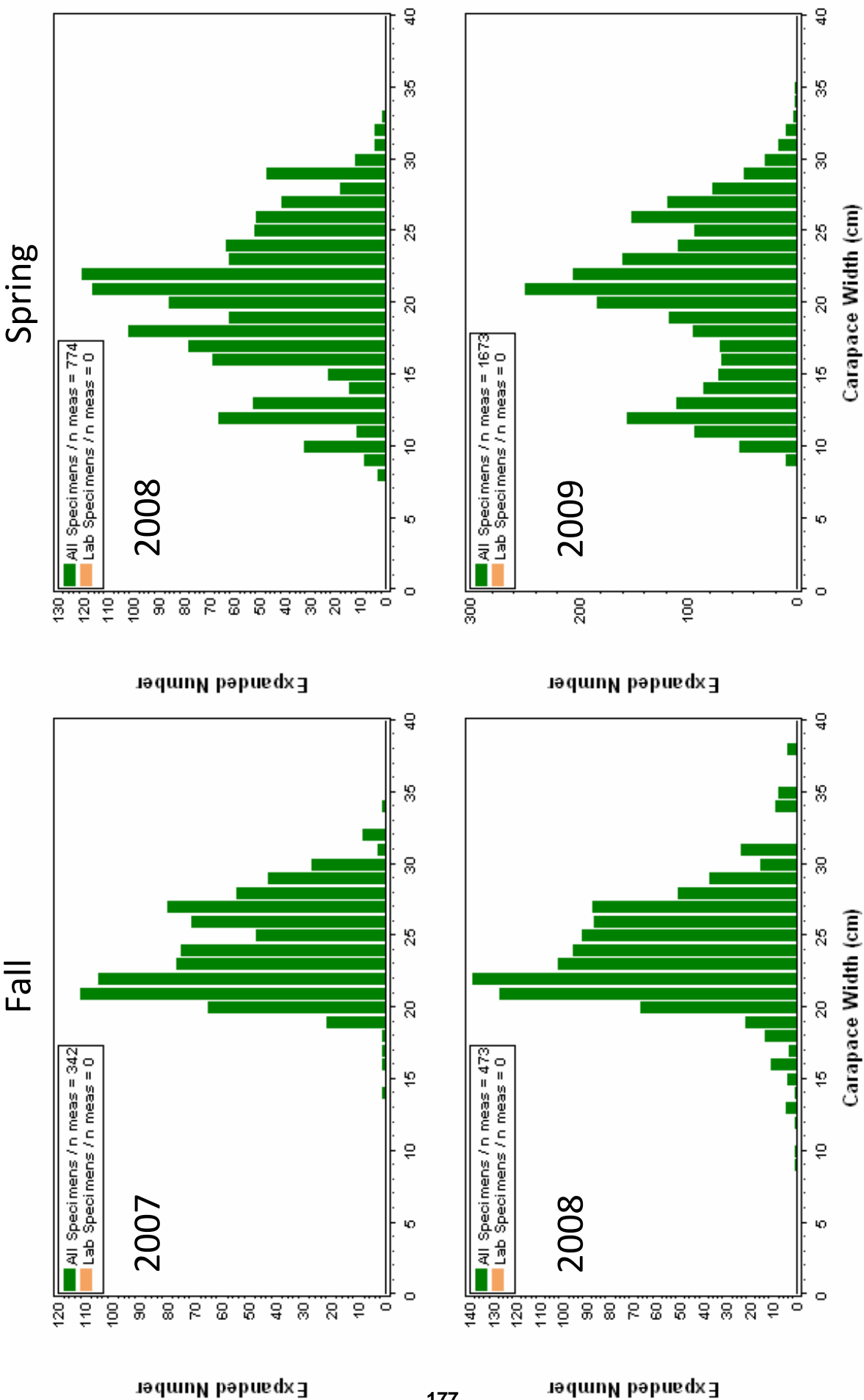
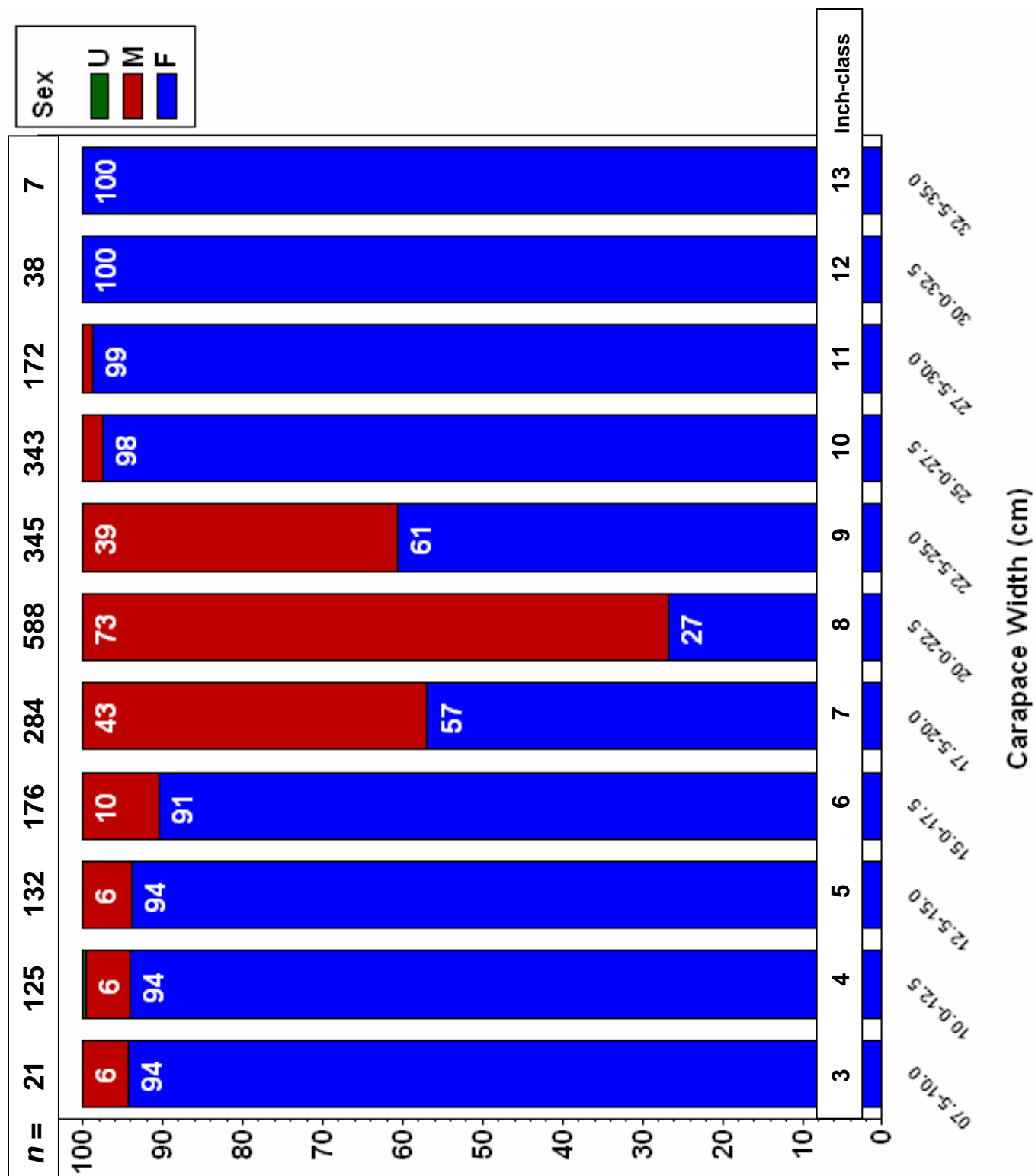


Figure 78. Sex ratio, by length group, for horseshoe crab collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis..



# Kingfish spp. (Priority D)

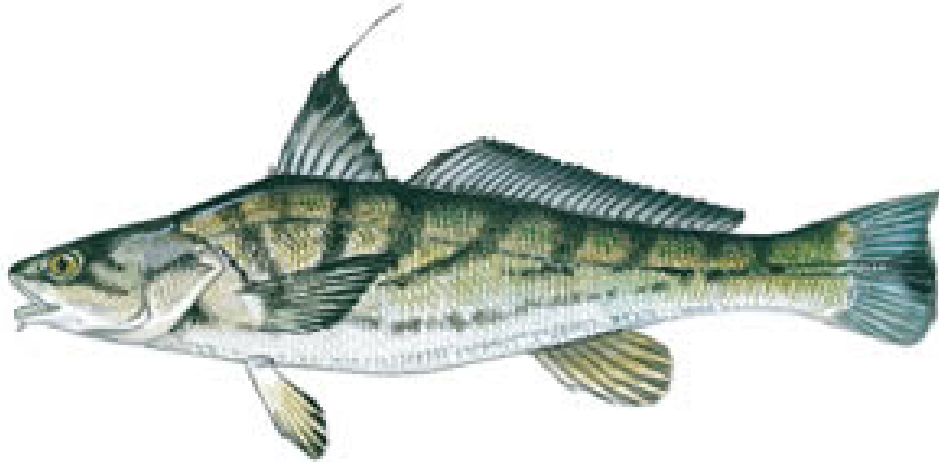
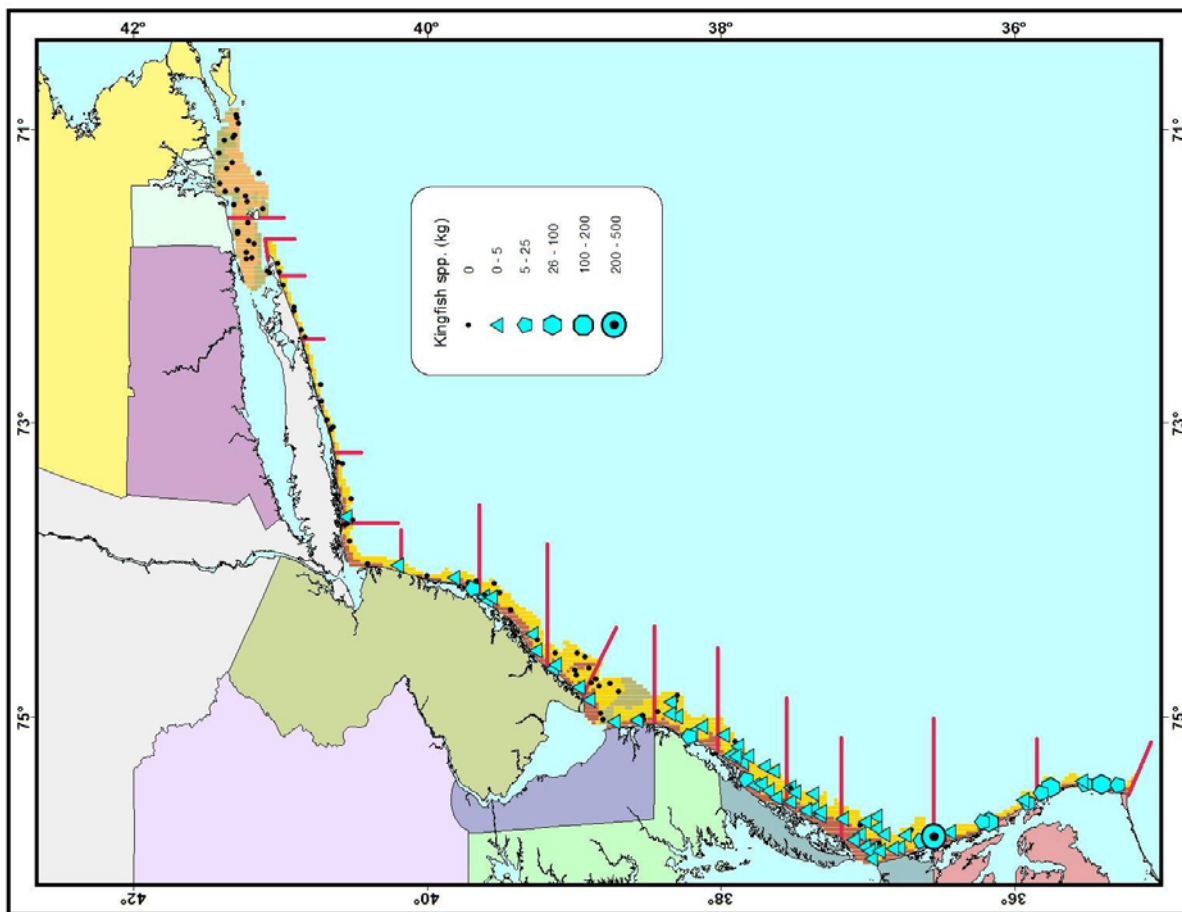


Table 24. Sampling rates and abundance indices of kingfish for four NEAMAP cruises.

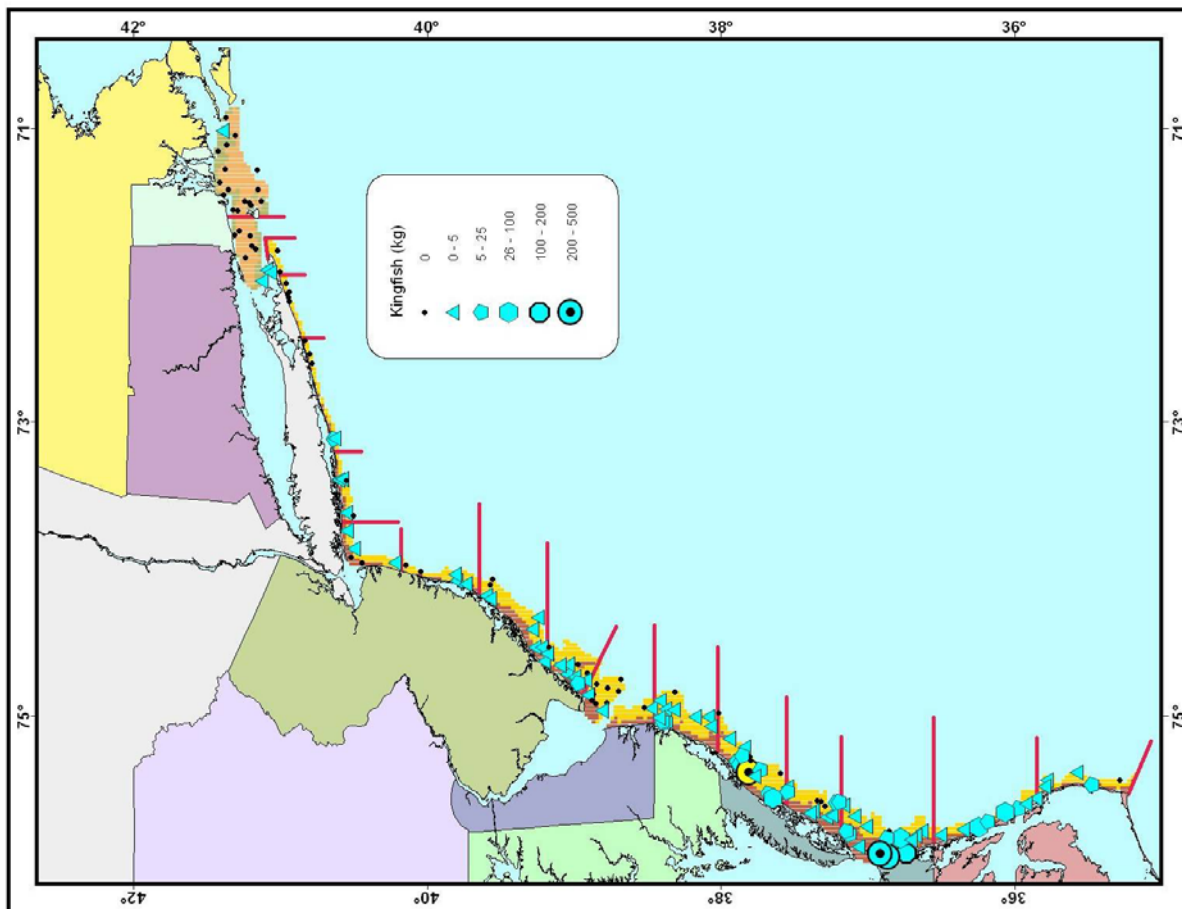
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	9,124	1,398.8	1,707	0		0		3.81	1.21
2008	Spring	6,638	699.8	759	0		0		1.86	0.62
	Fall	8,026	1,254.4	1,502	0		0		4.88	1.77
2009	Spring	1,742	207.8	483	0		0		0.62	0.21

Figure 79. Biomass (kg) of kingfish collected at each sampling site for four NEAMAP cruises.

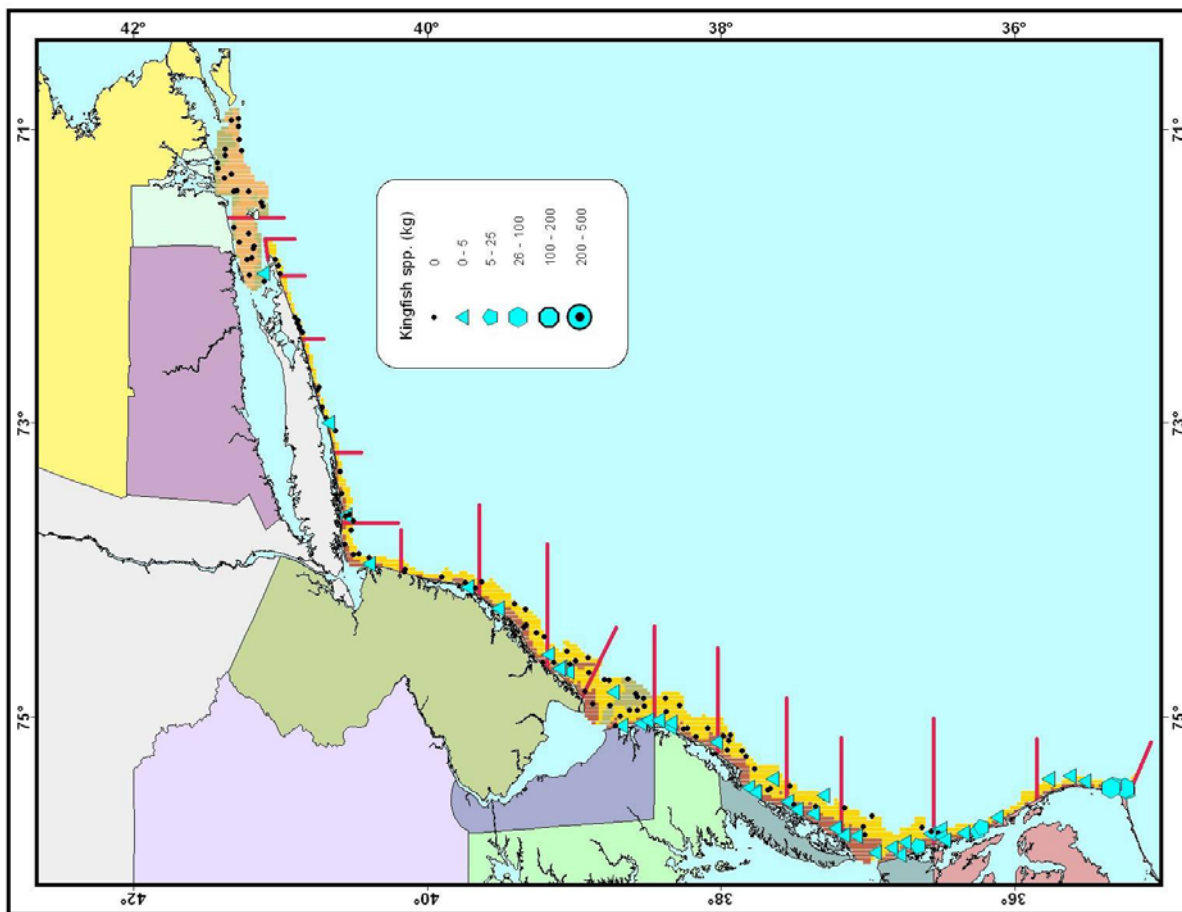
Spring 2008



Fall 2007



Spring 2009



Fall 2008

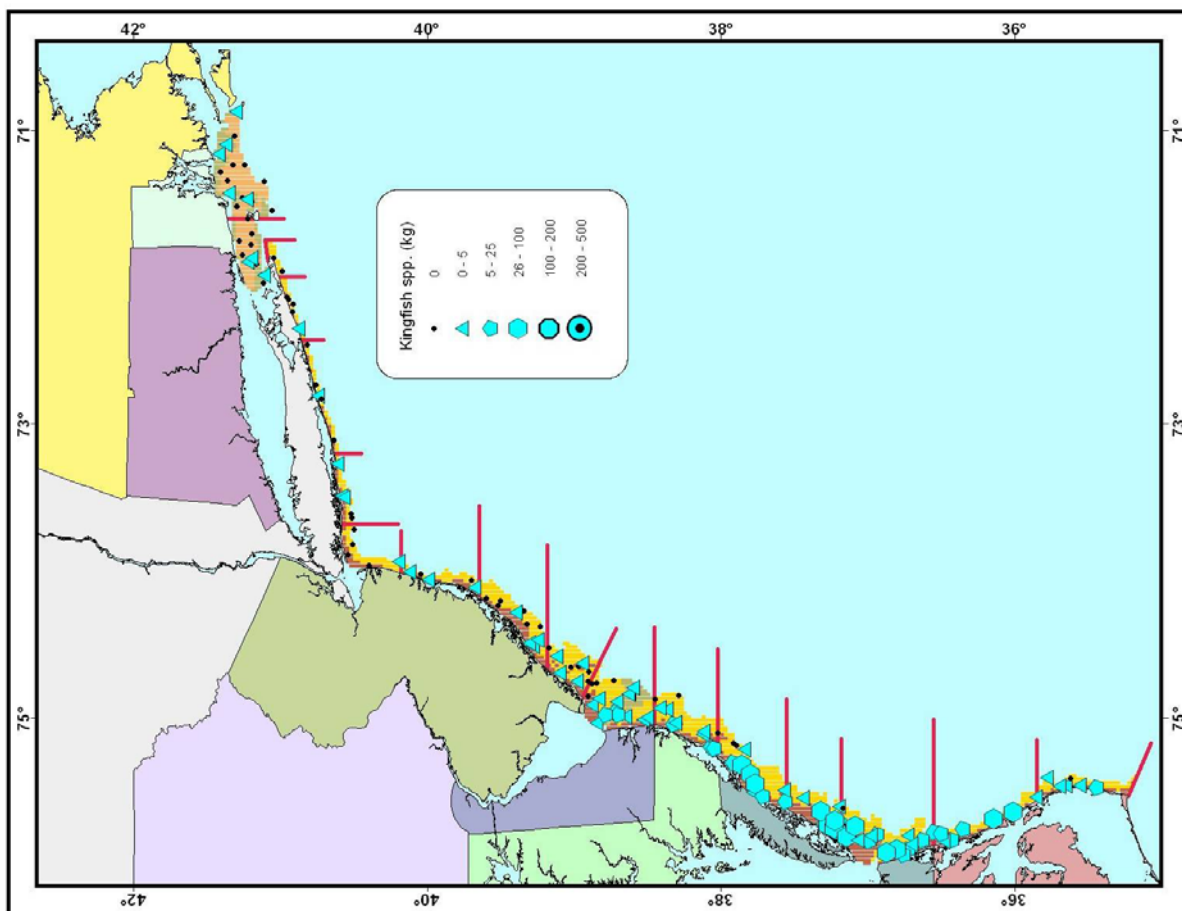


Figure 80. Preliminary indices of abundance, in terms of number and biomass, of kingfish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

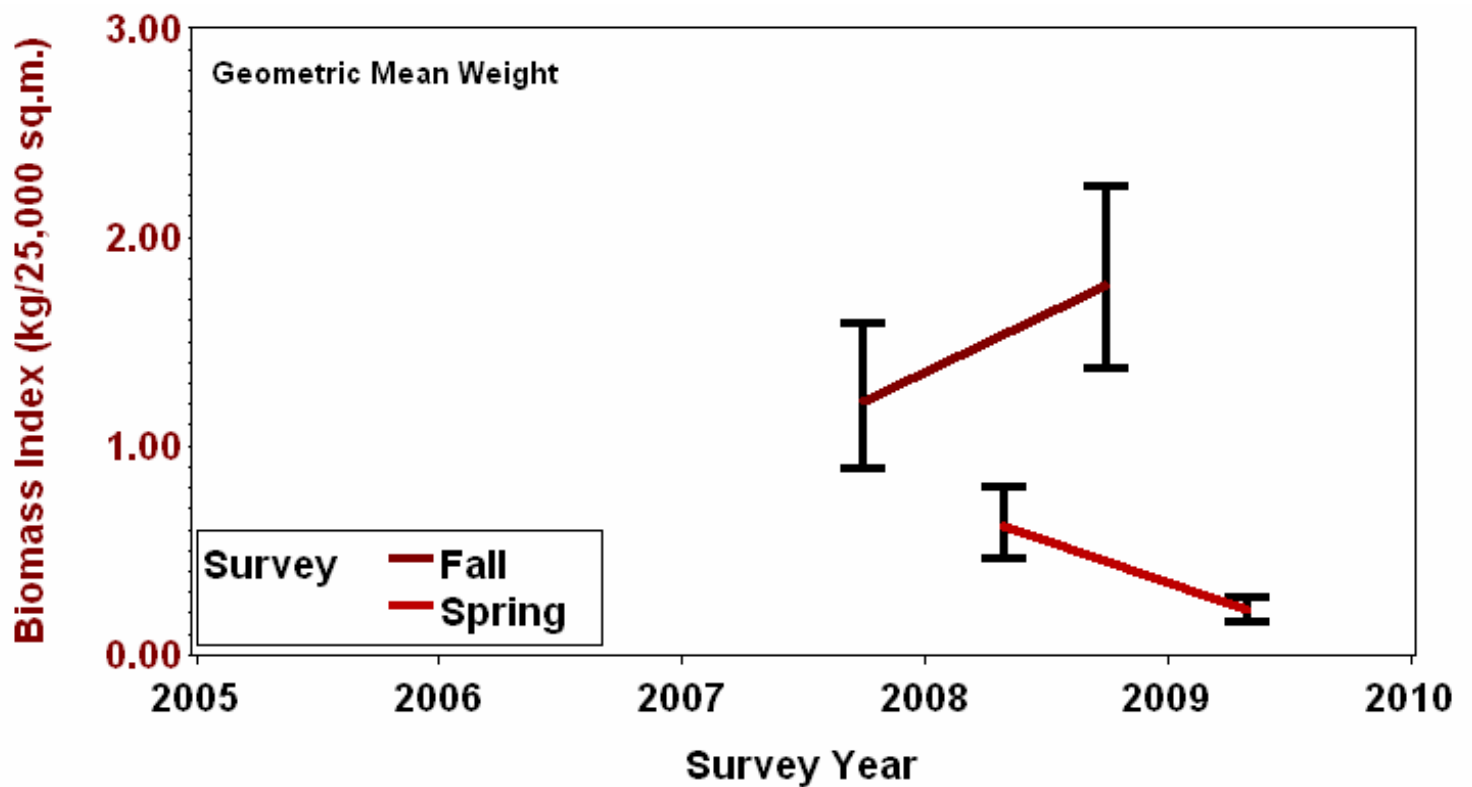
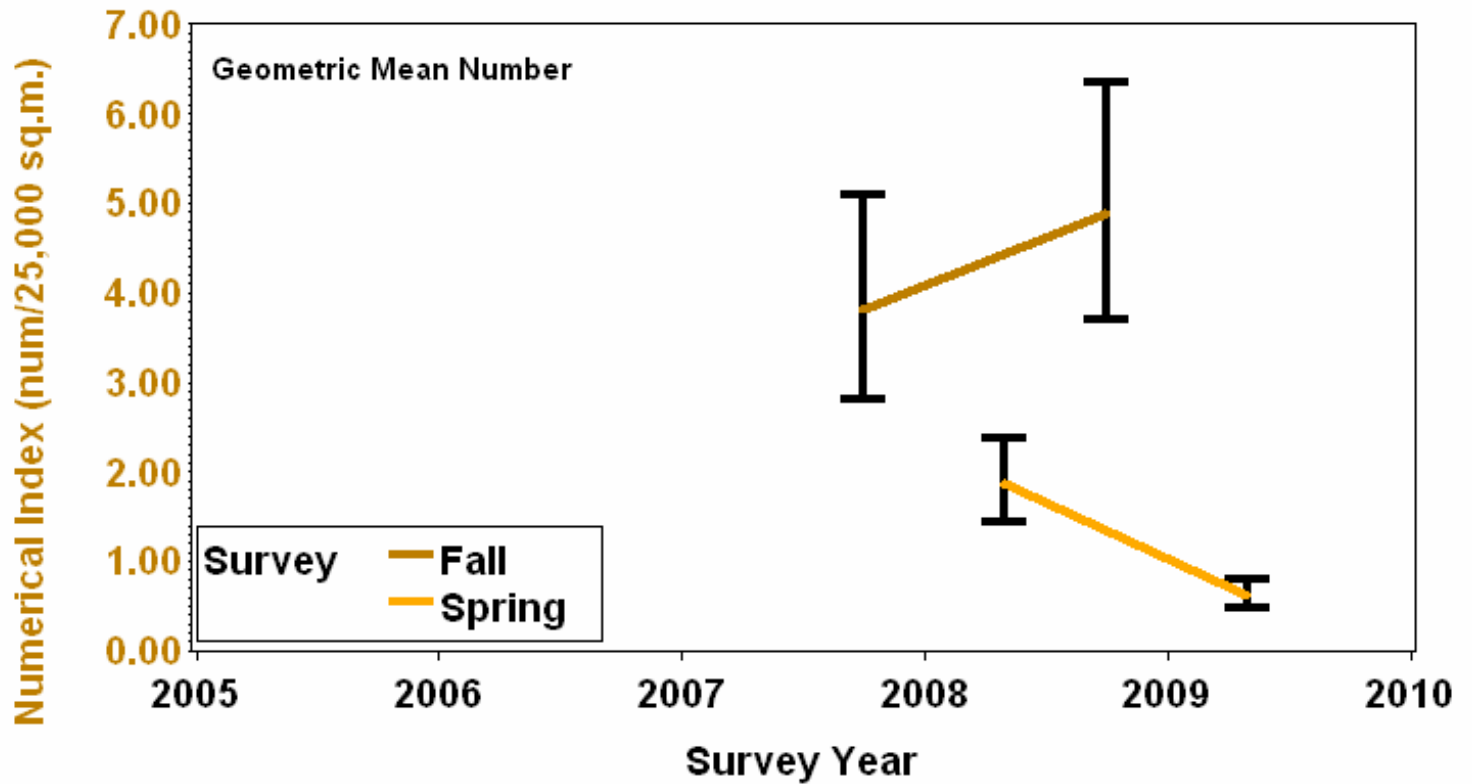
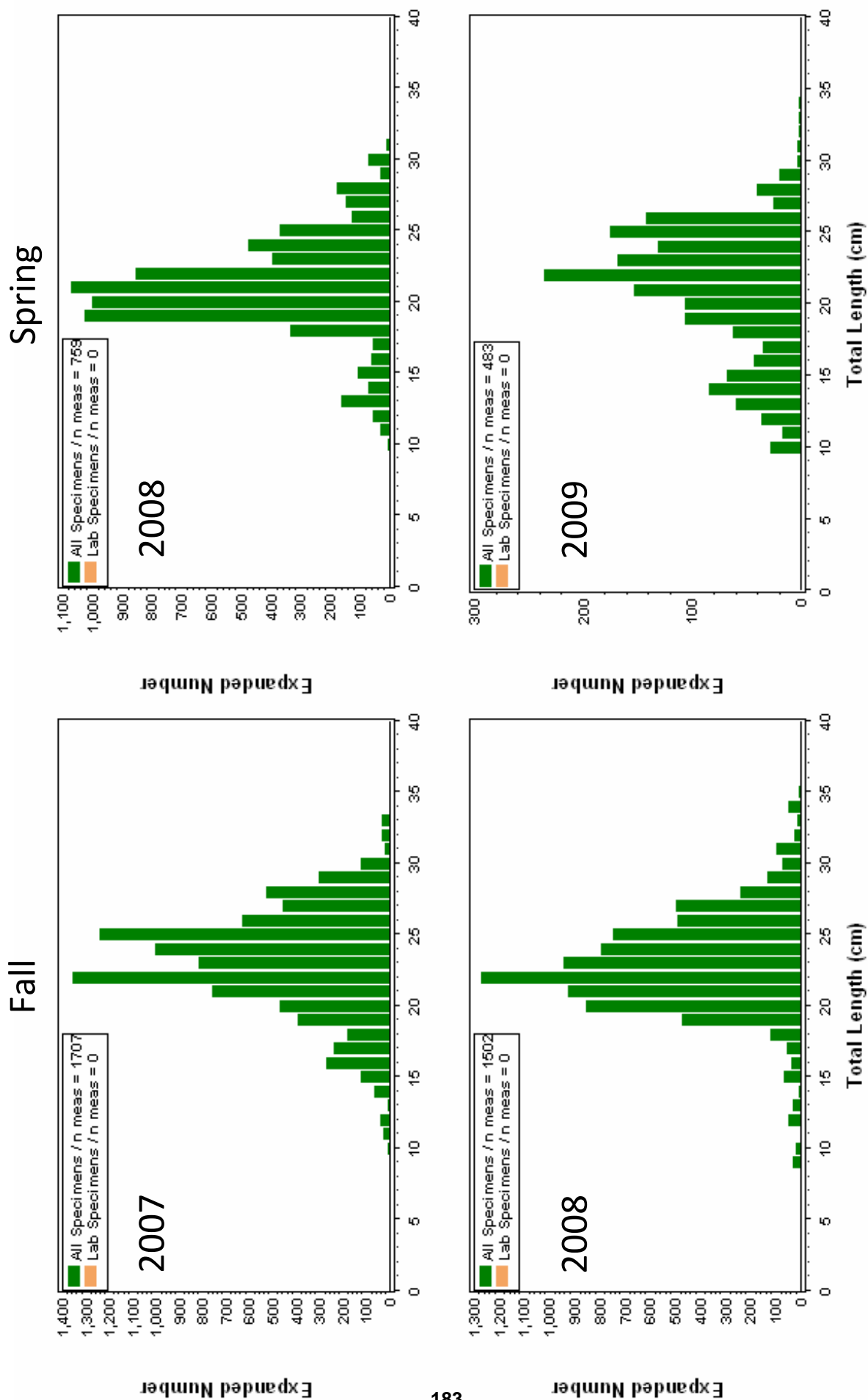


Figure 81. Length-frequency distributions, by cruise, for kingfish.







# Little Skate (Priority B)

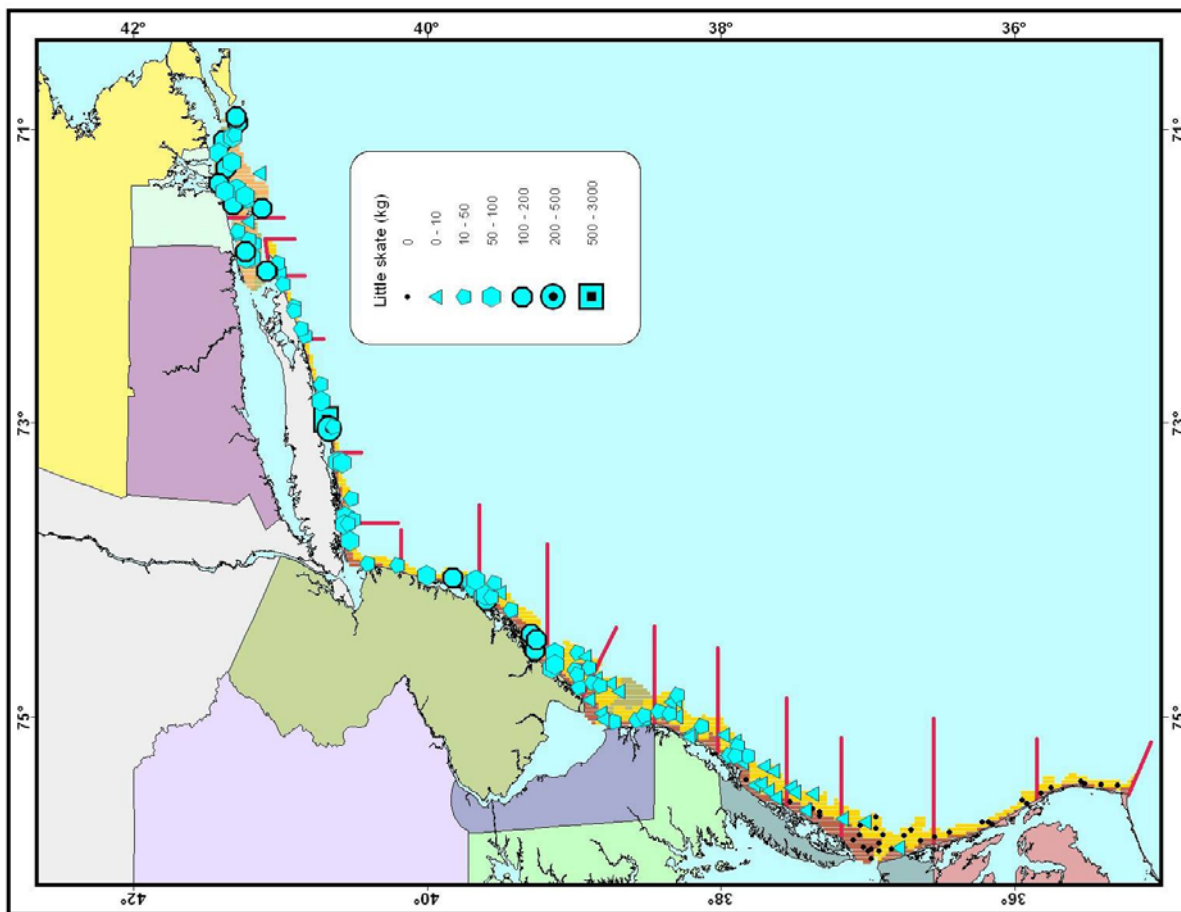


Table 25. Sampling rates and abundance indices of little skate for four NEAMAP cruises.

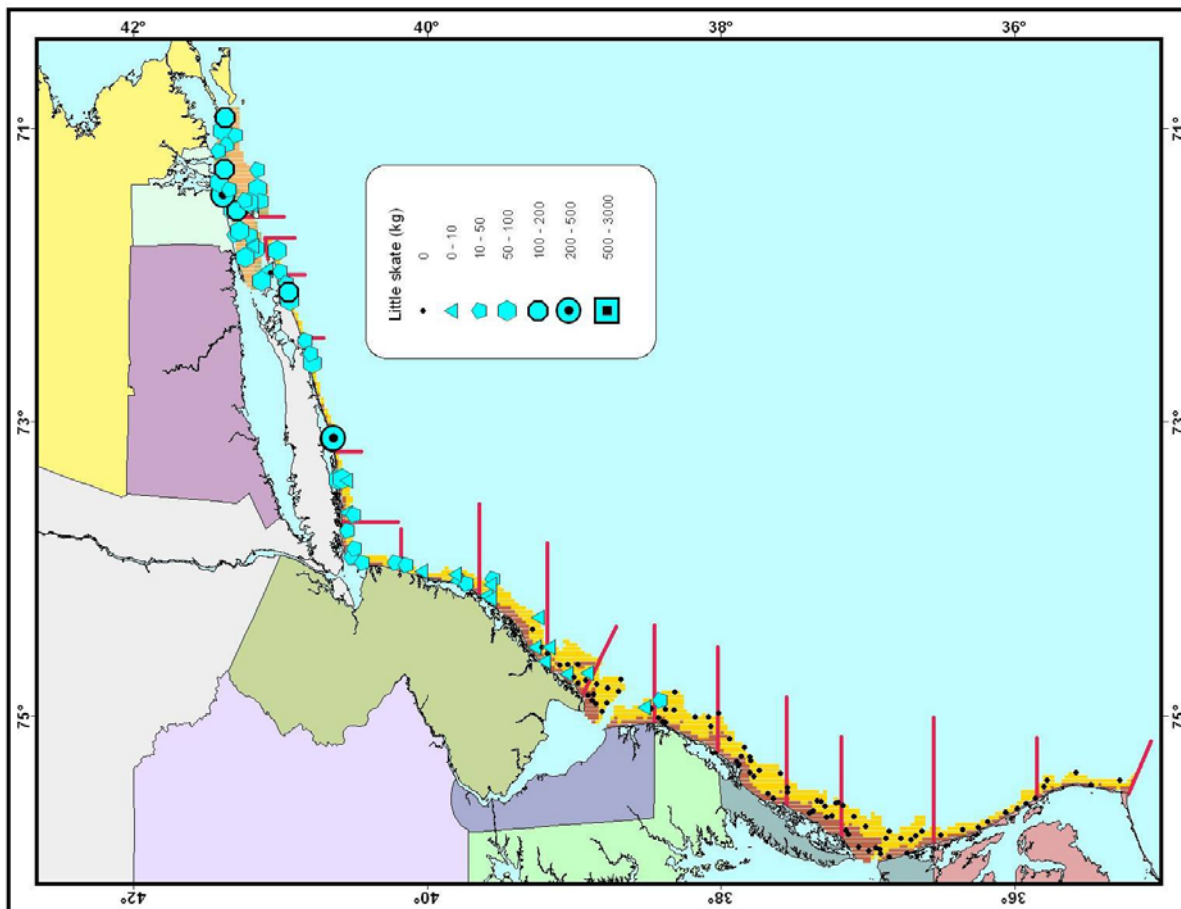
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	5,288	3,026.2	2,659	194	0	187	180	3.53	2.71
2008	Spring	9,876	5,868.4	2,994	315	0	303	298	15.03	10.41
	Fall	7,014	4,104.8	2,247	263	0	259	251	6.31	4.51
2009	Spring	23,391	12,463.6	5,115	397	0	383	35	21.06	13.15

Figure 82. Biomass (kg) of little skate collected at each sampling site for four NEAMAP cruises.

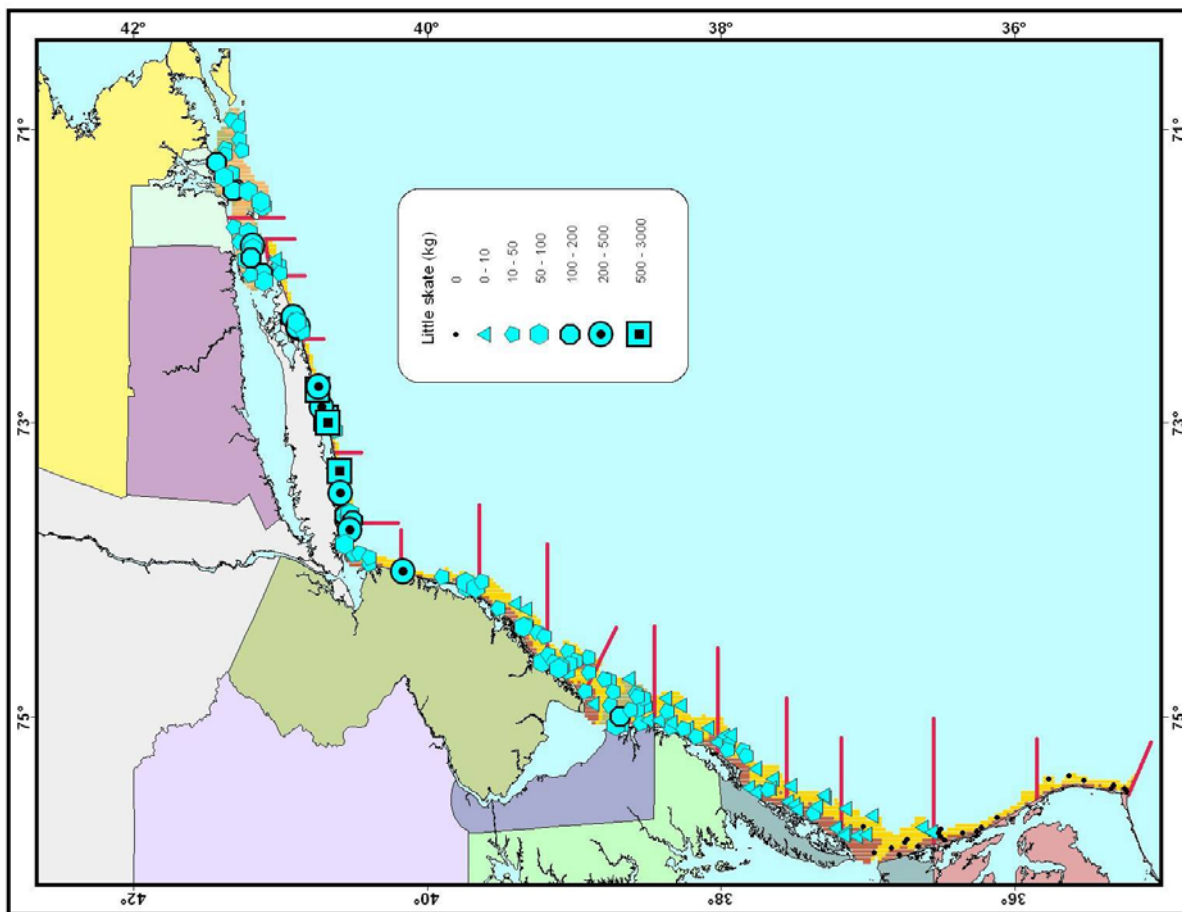
Spring 2008



Fall 2007



Spring 2009



Fall 2008

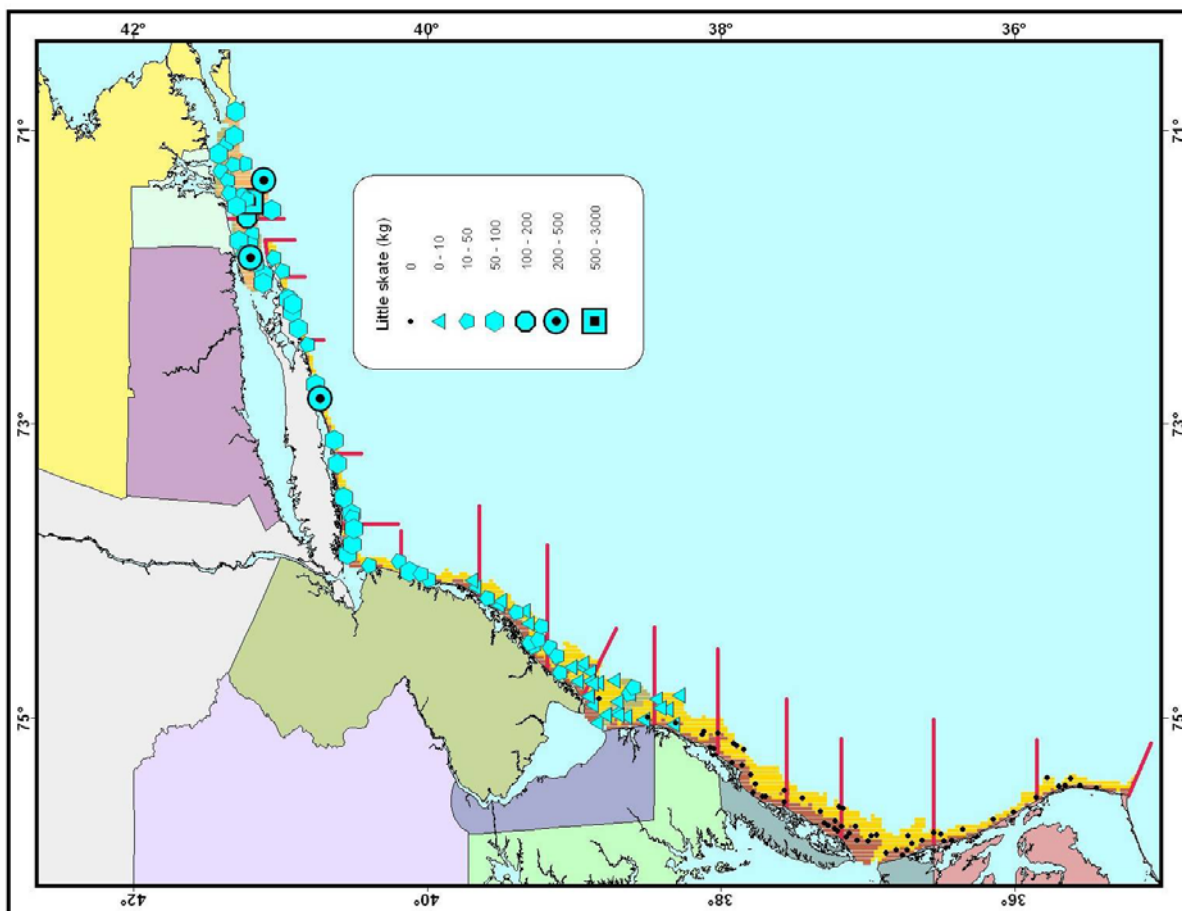


Figure 83. Preliminary indices of abundance, in terms of number and biomass, of little skate for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

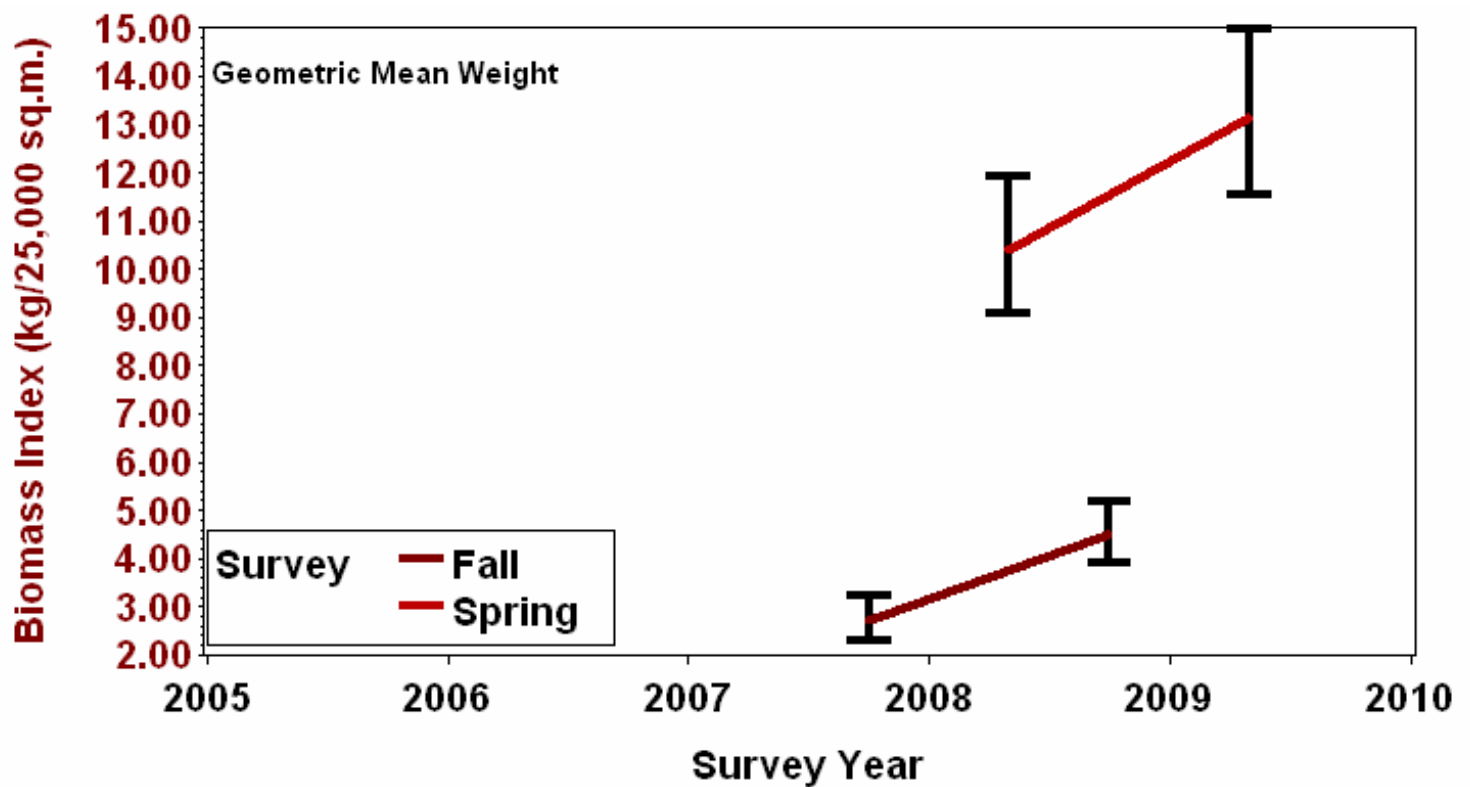
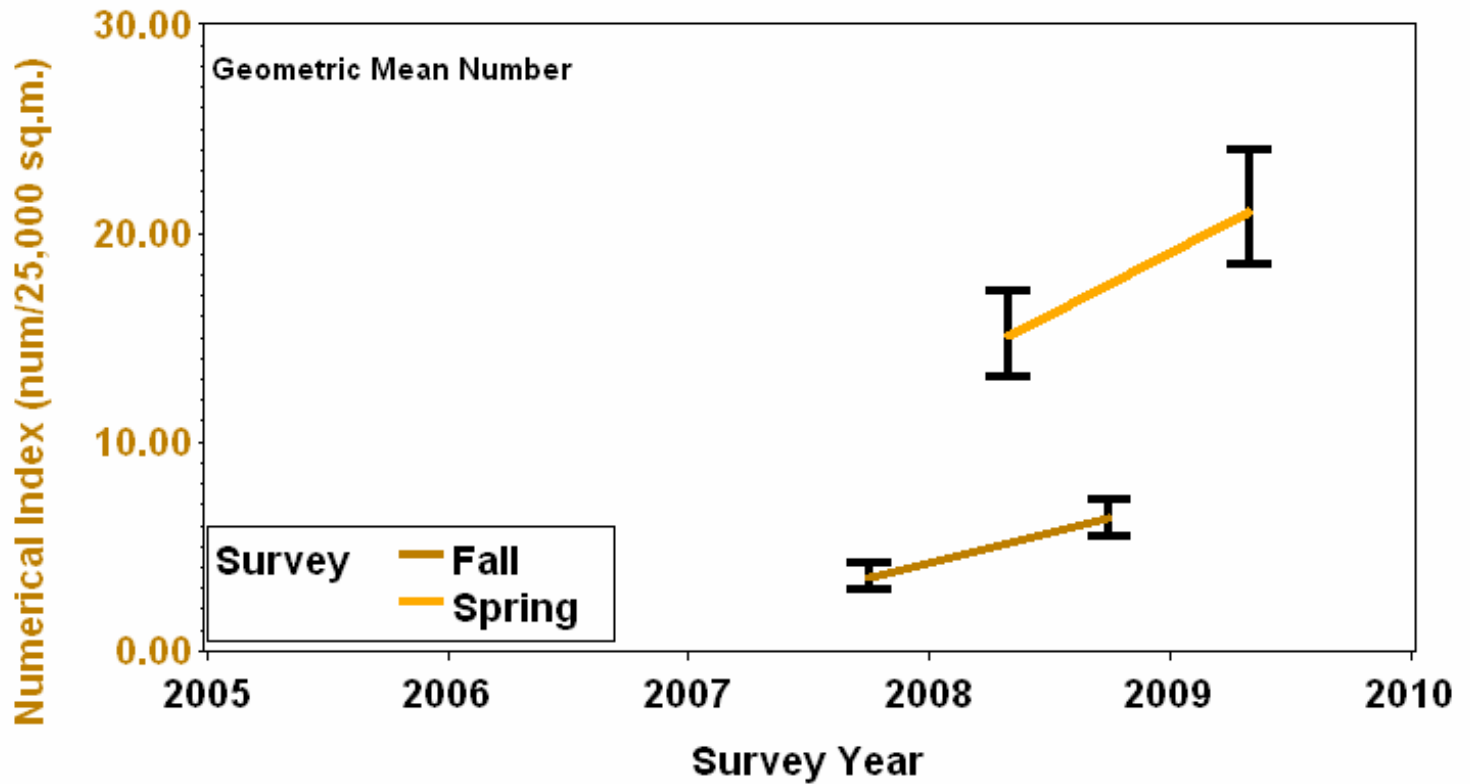


Figure 84. Length-frequency distributions, by cruise, for little skate. Numbers taken for full processing, by length, are represented by the orange bars.

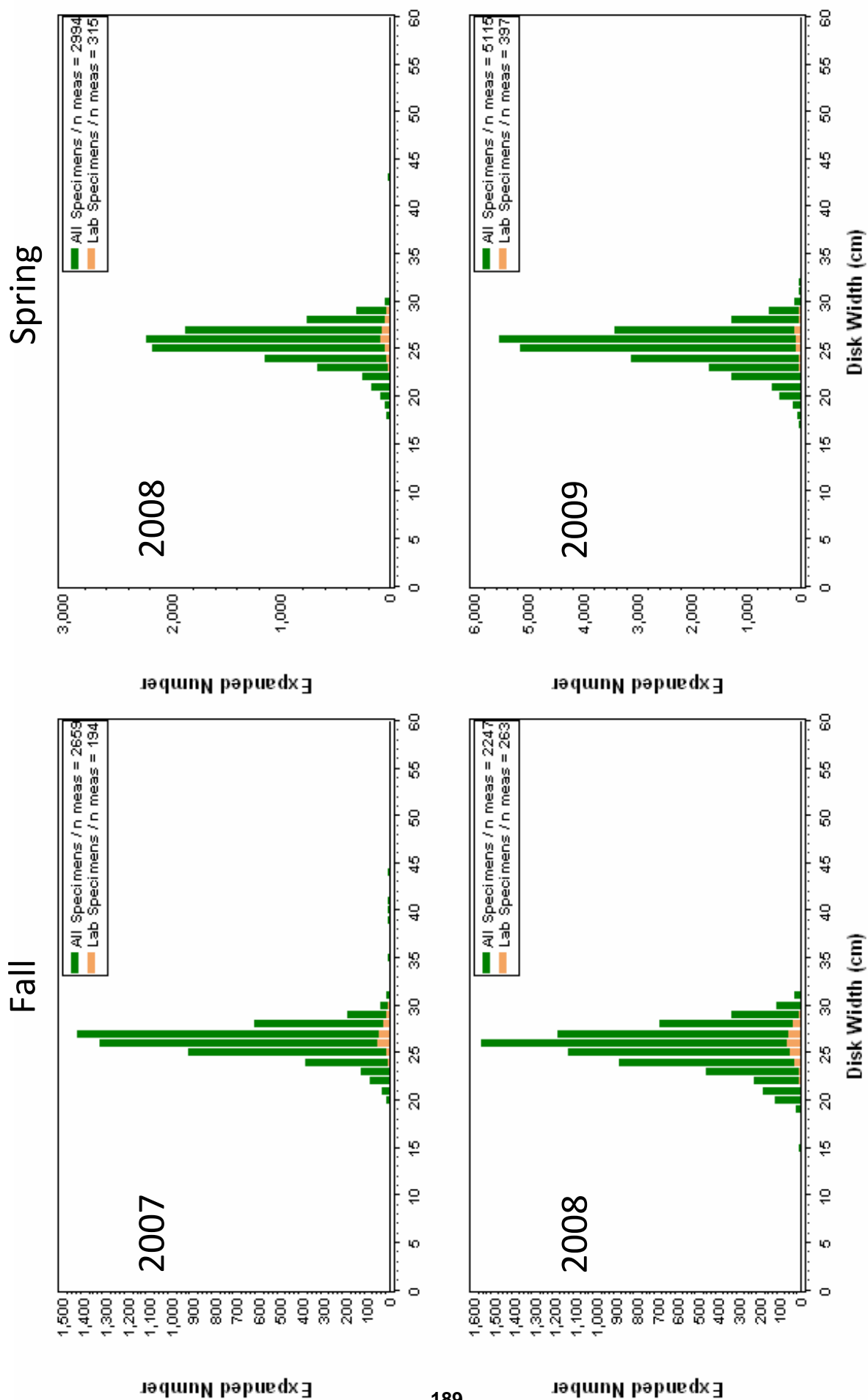


Figure 85. Sex ratio, by length group, for little skate collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

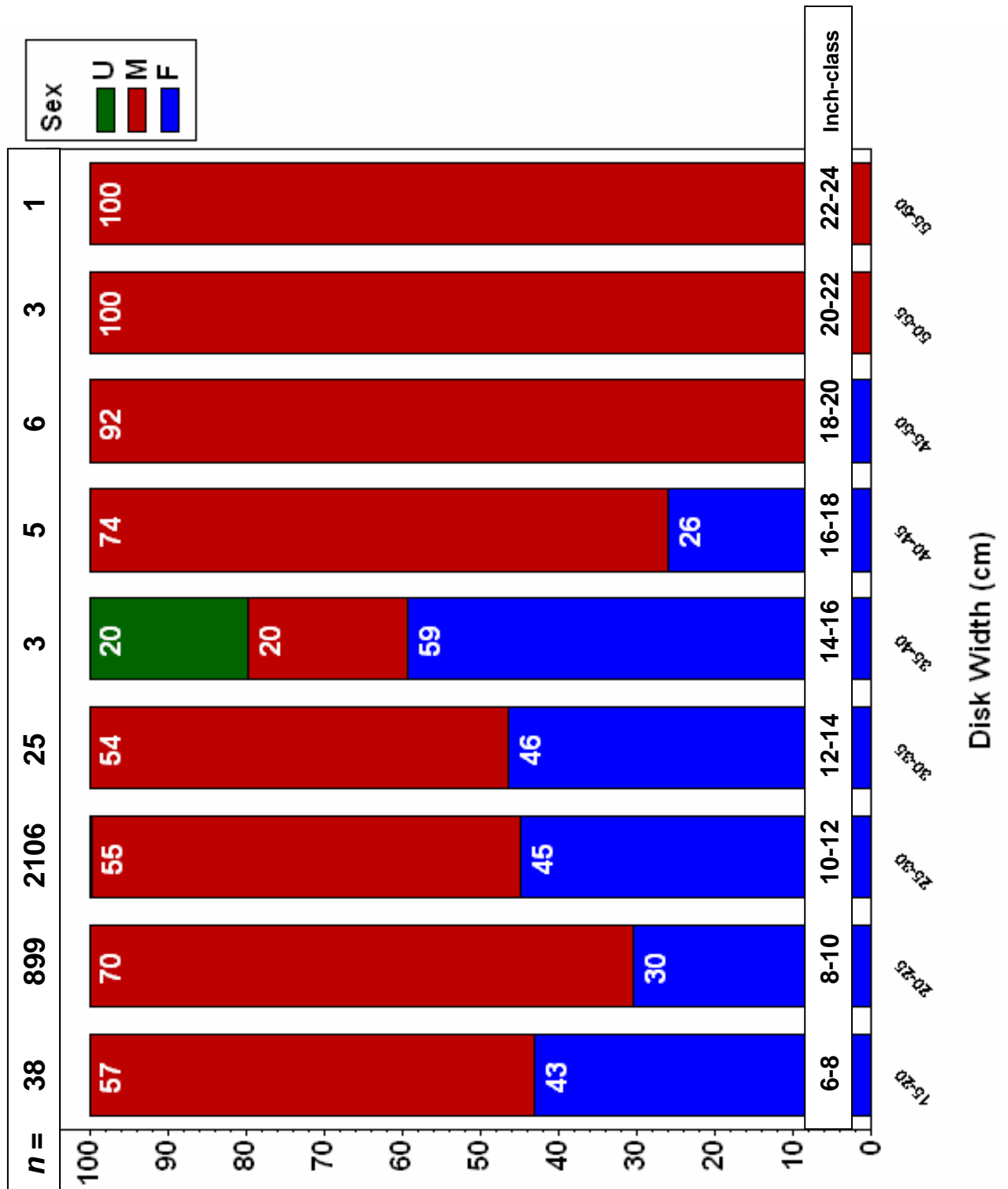
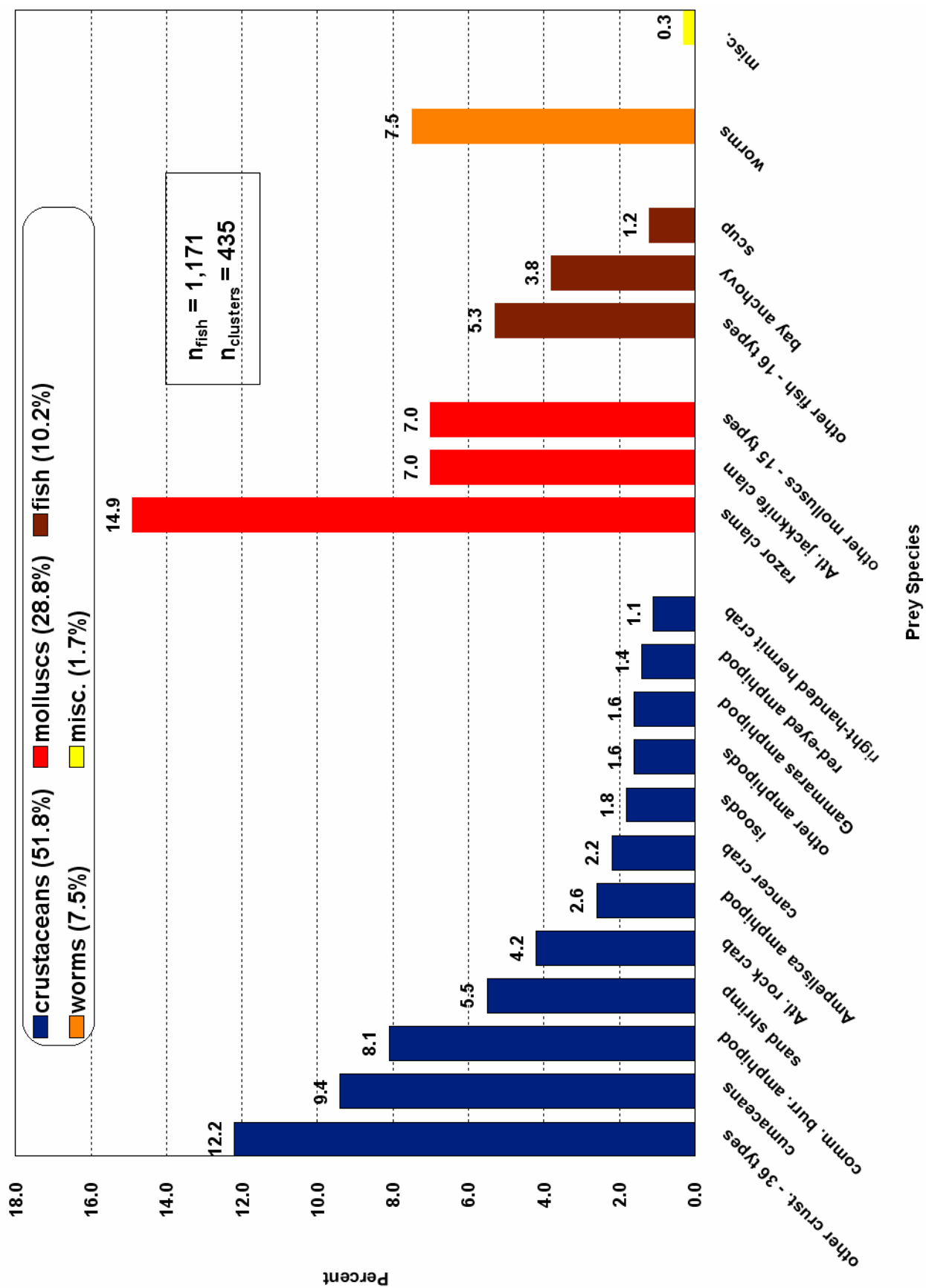


Figure 86. Diet composition, expressed using the percent weight index, of little skate collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of little skate sampled.







# Loligo Squid (Priority E)

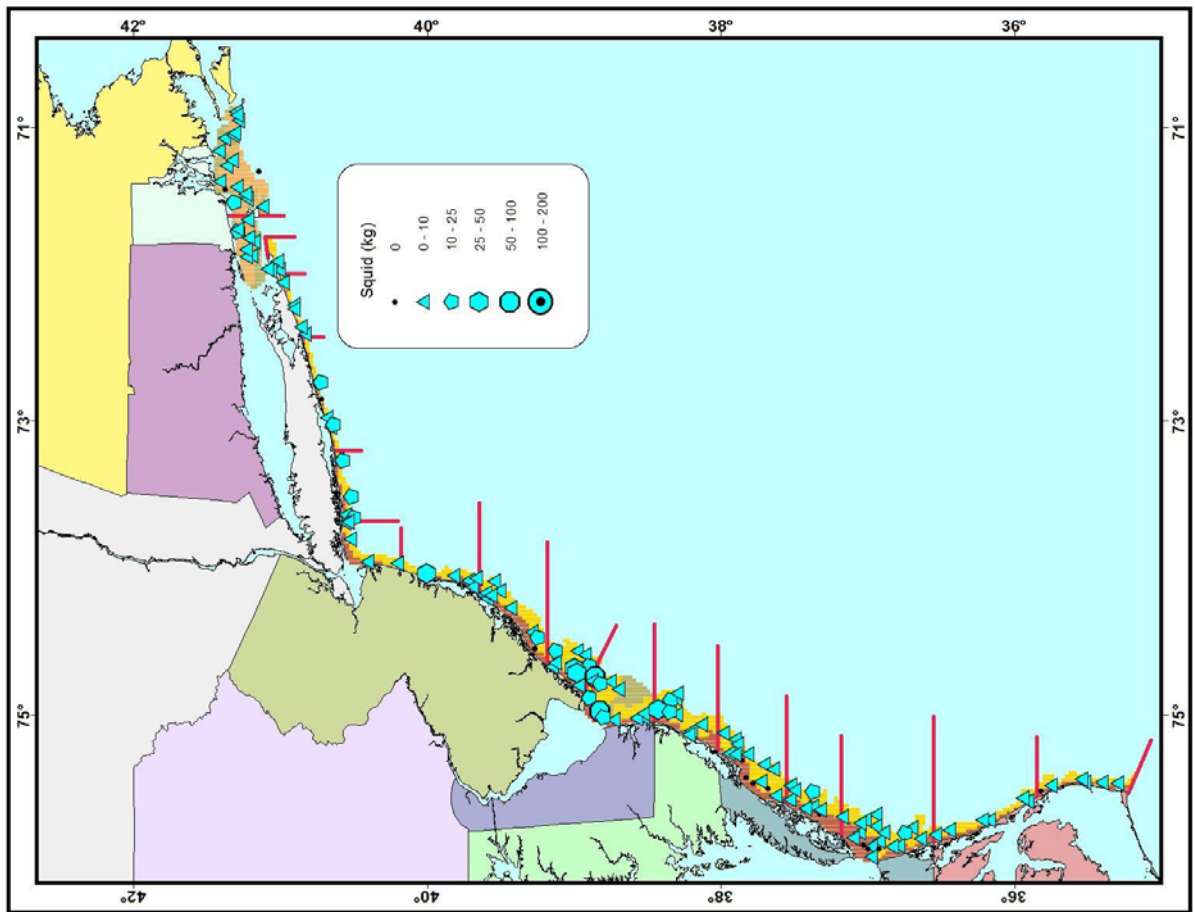


Table 26. Sampling rates and abundance indices of *Loligo* squid for four NEAMAP cruises.

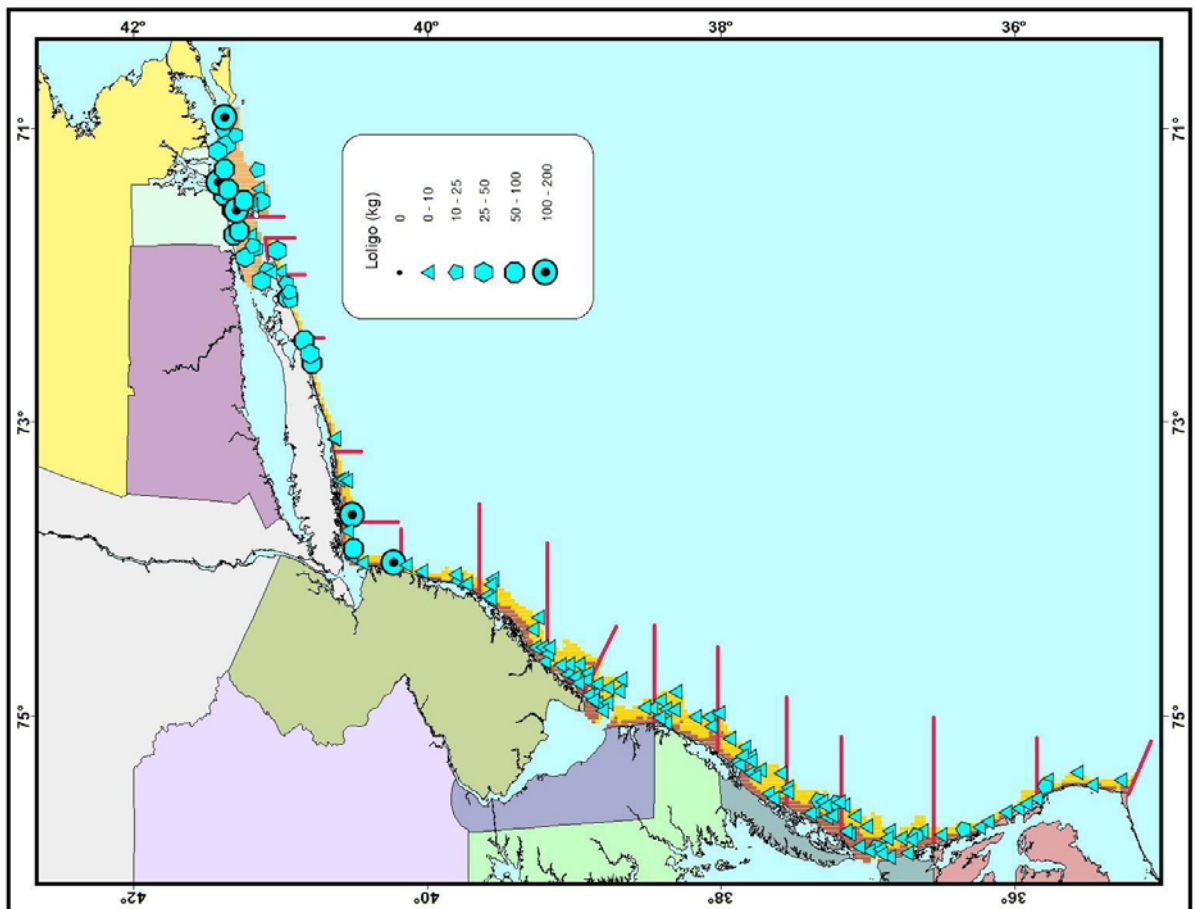
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	119,512	2,278.6	9,625	0		0		147.03	5.03
2008	Spring	19,549	776.2	5,127	0		0		35.23	2.42
	Fall	93,383	1,357.9	5,998	0		0		48.16	2.83
2009	Spring	12,451	501.6	5,710	0		0		23.38	1.59

Figure 87. Biomass (kg) of *Loligo* squid collected at each sampling site for four NEAMAP cruises.

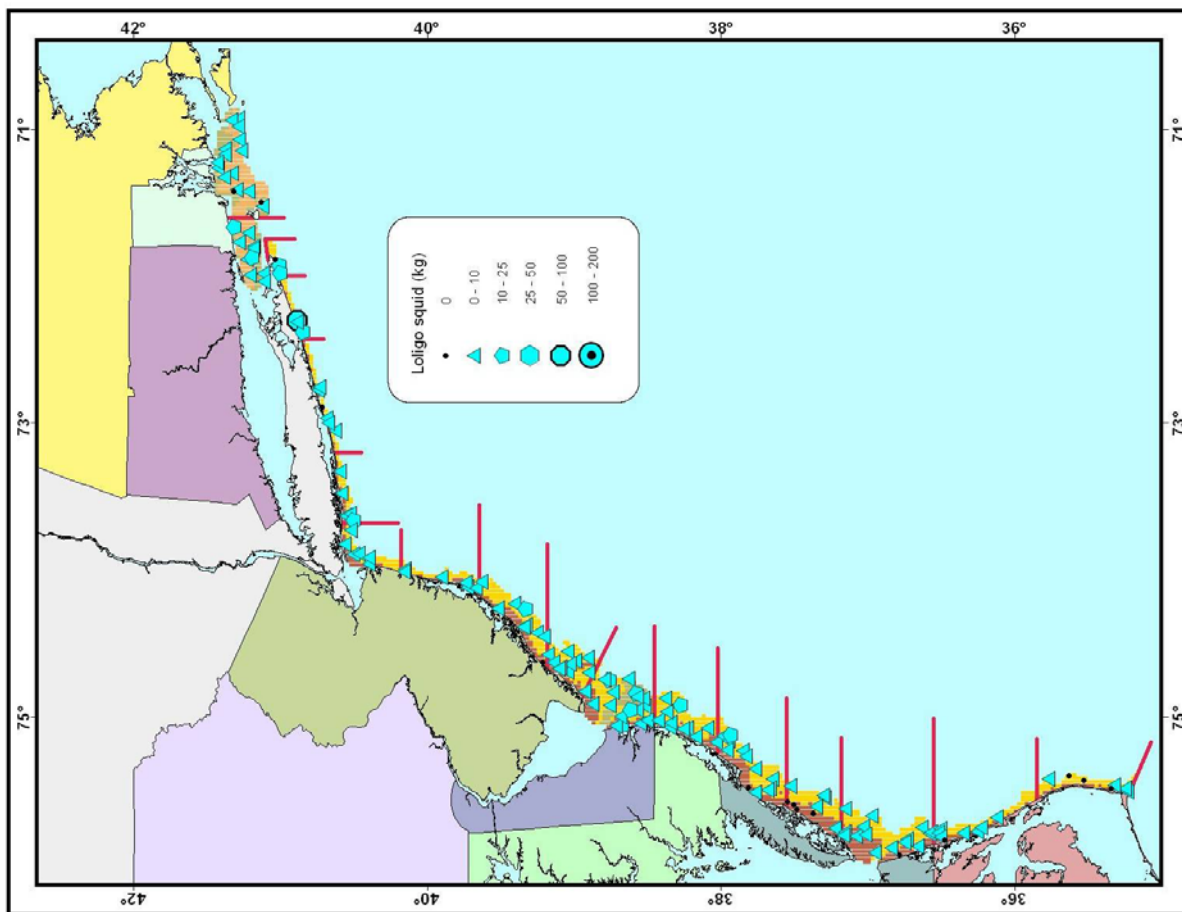
Spring 2008



Fall 2007



Spring 2009



Fall 2008

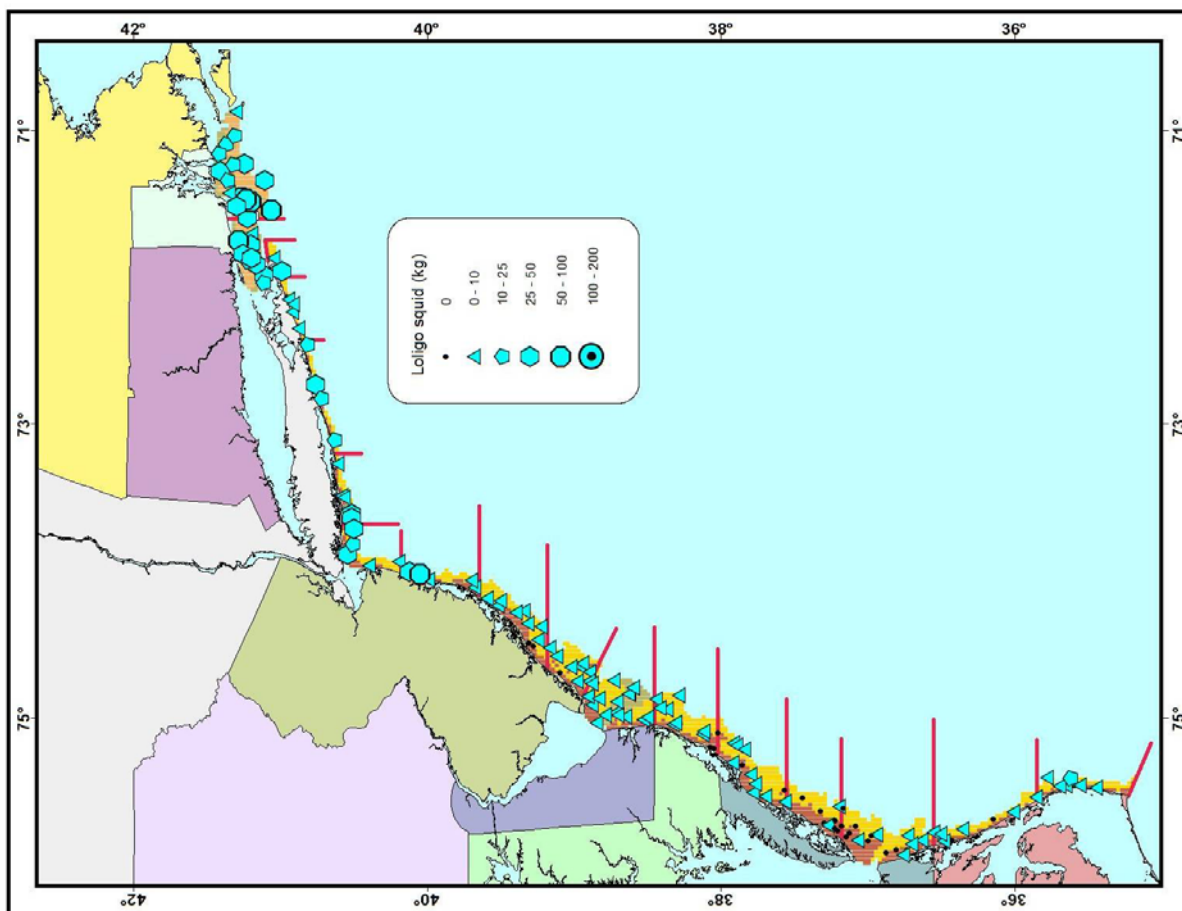


Figure 88. Preliminary indices of abundance, in terms of number and biomass, of *Loligo* squid for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

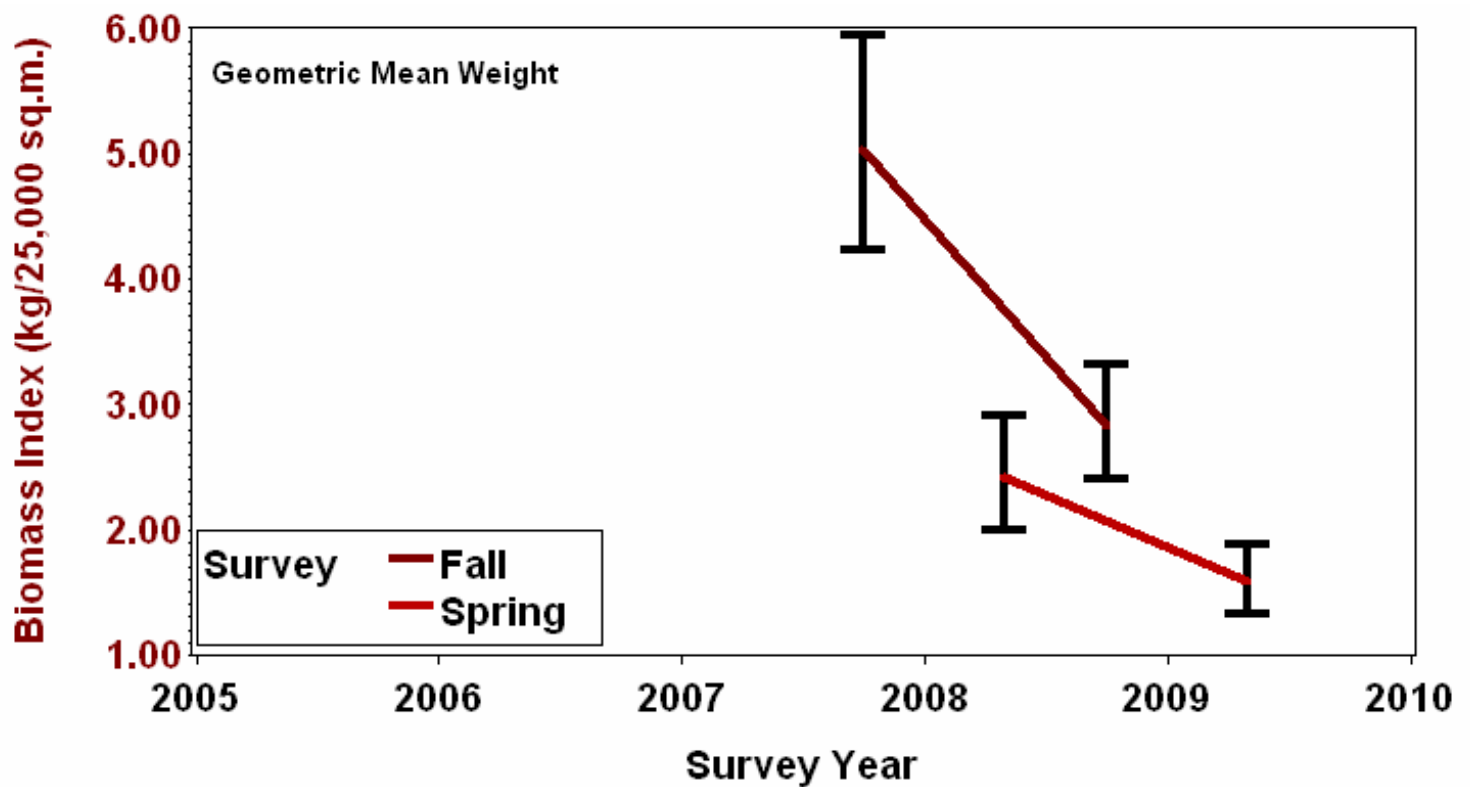
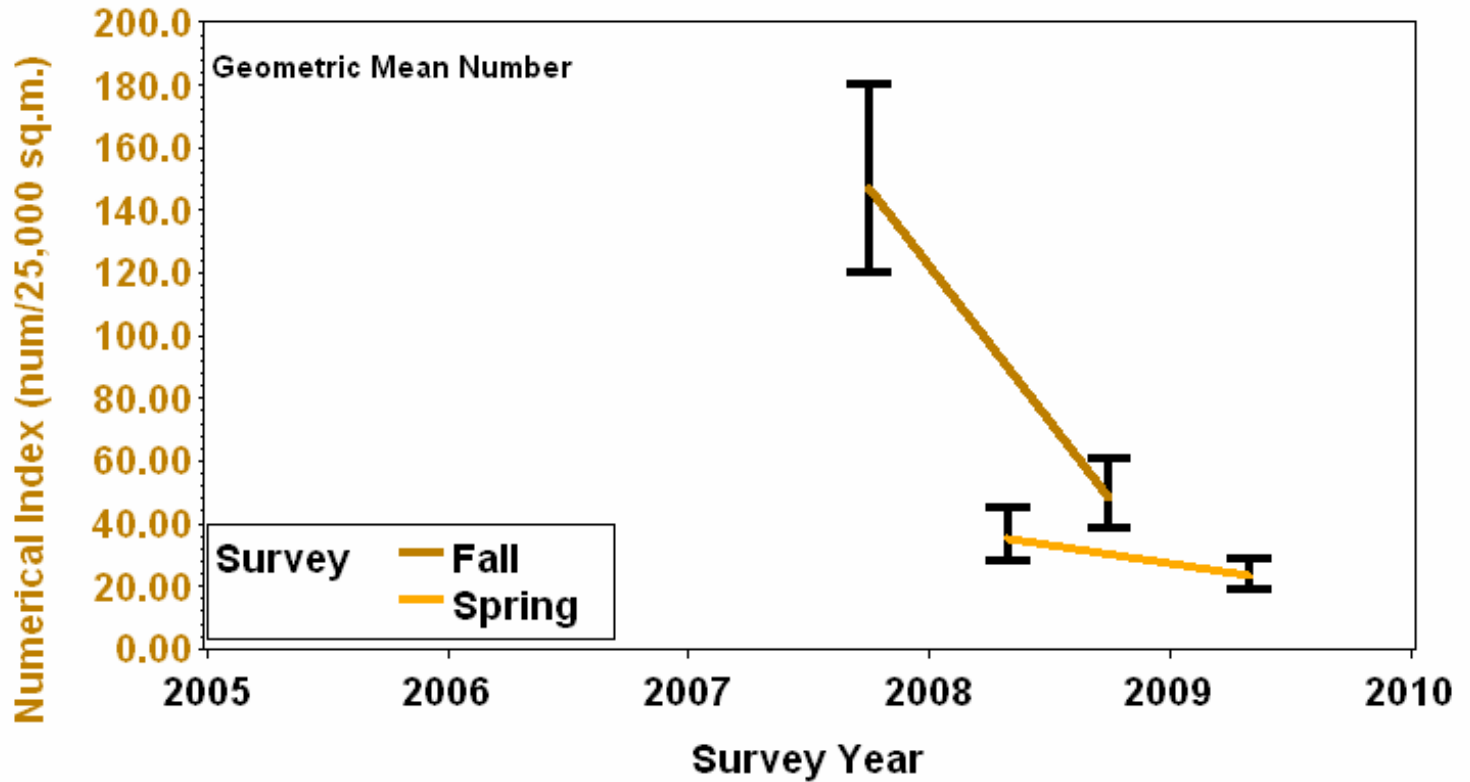
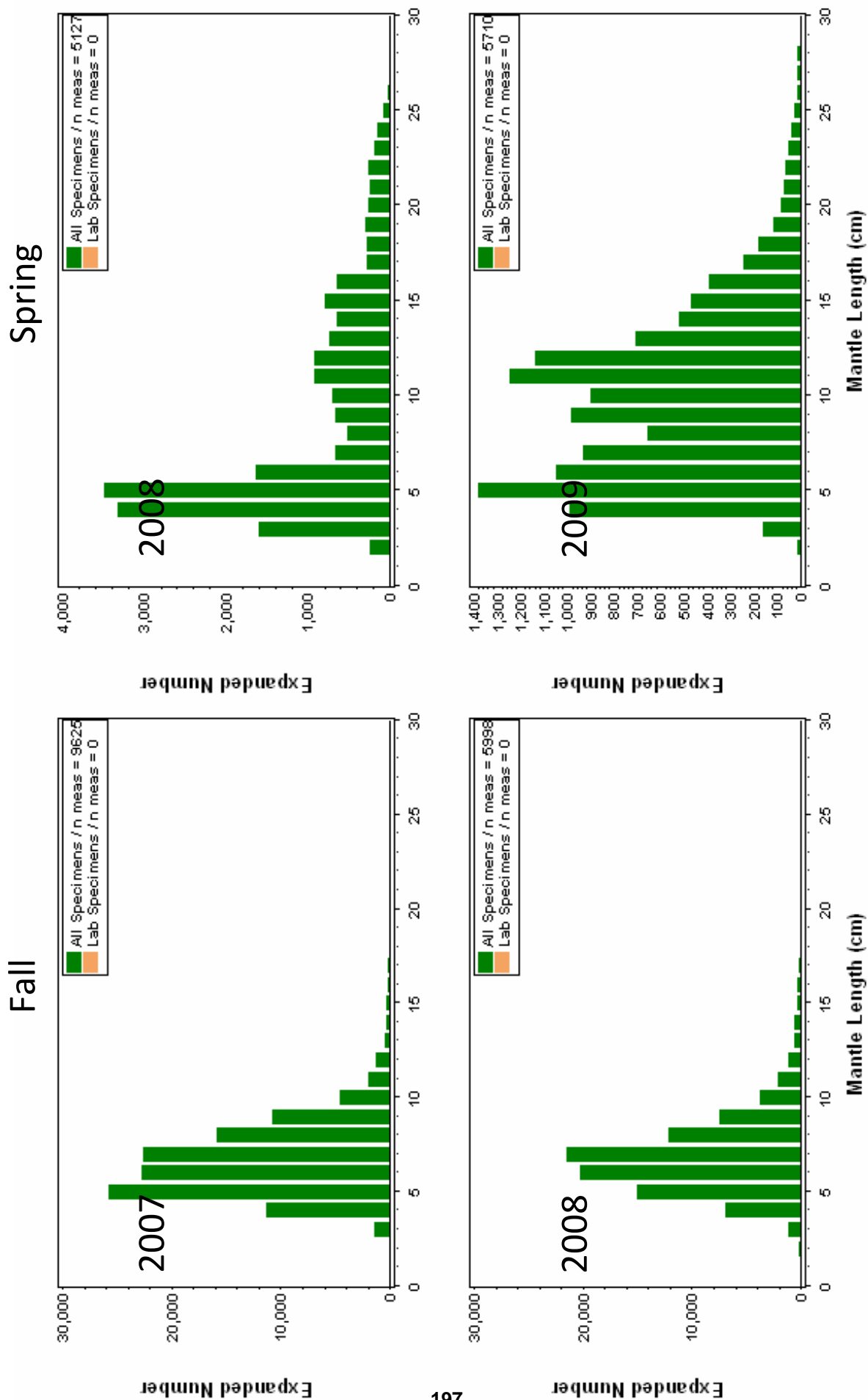


Figure 89. Length-frequency distributions, by cruise, for *Loligo* squid.





# Northern Searobin (Priority D)



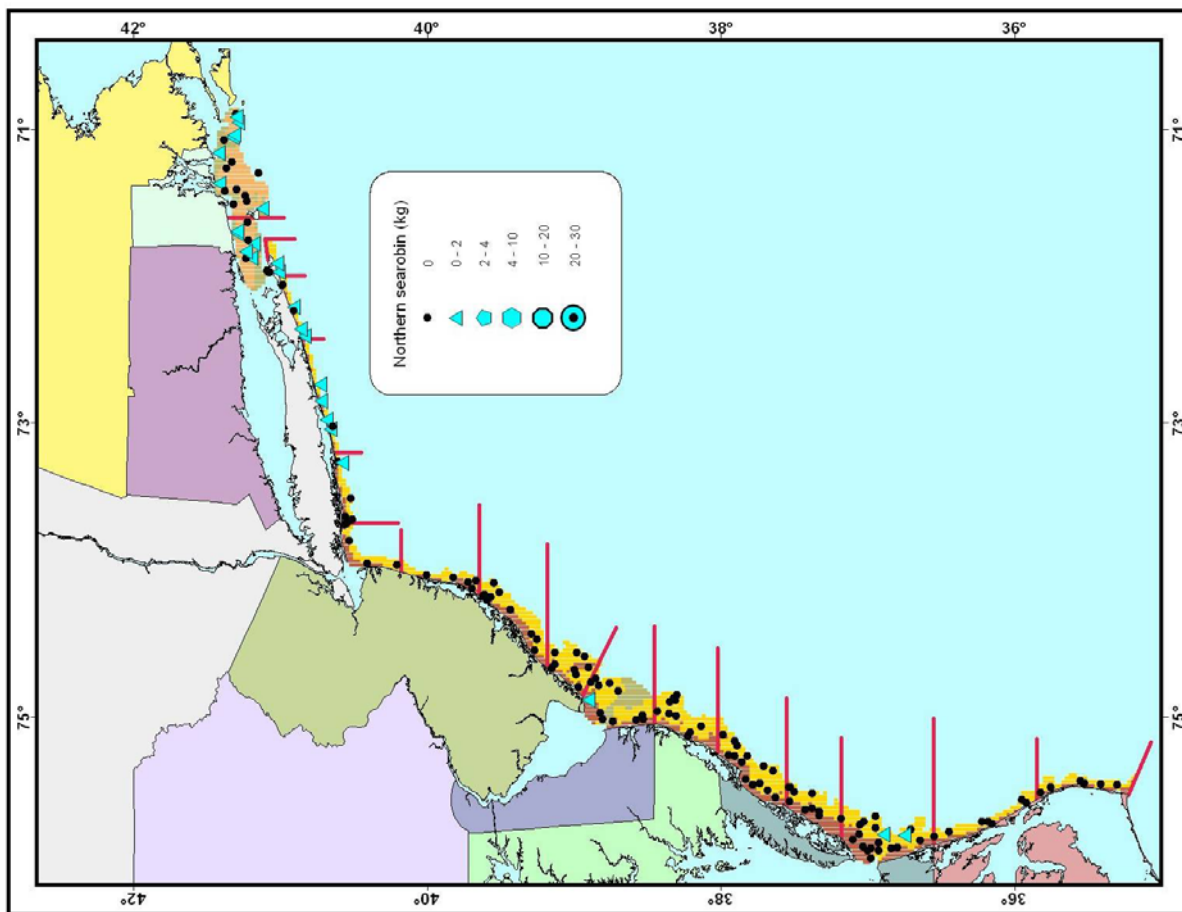
Table 27. Sampling rates and abundance indices of northern searobin for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	881	104.2	782	0		0		1.06	0.25
2008	Spring	45	1.4	45	0		0		0.15	0.01
	Fall	179	25.3	179	0		0		0.38	0.09
2009	Spring	116	13.4	116	0		0		0.22	0.04

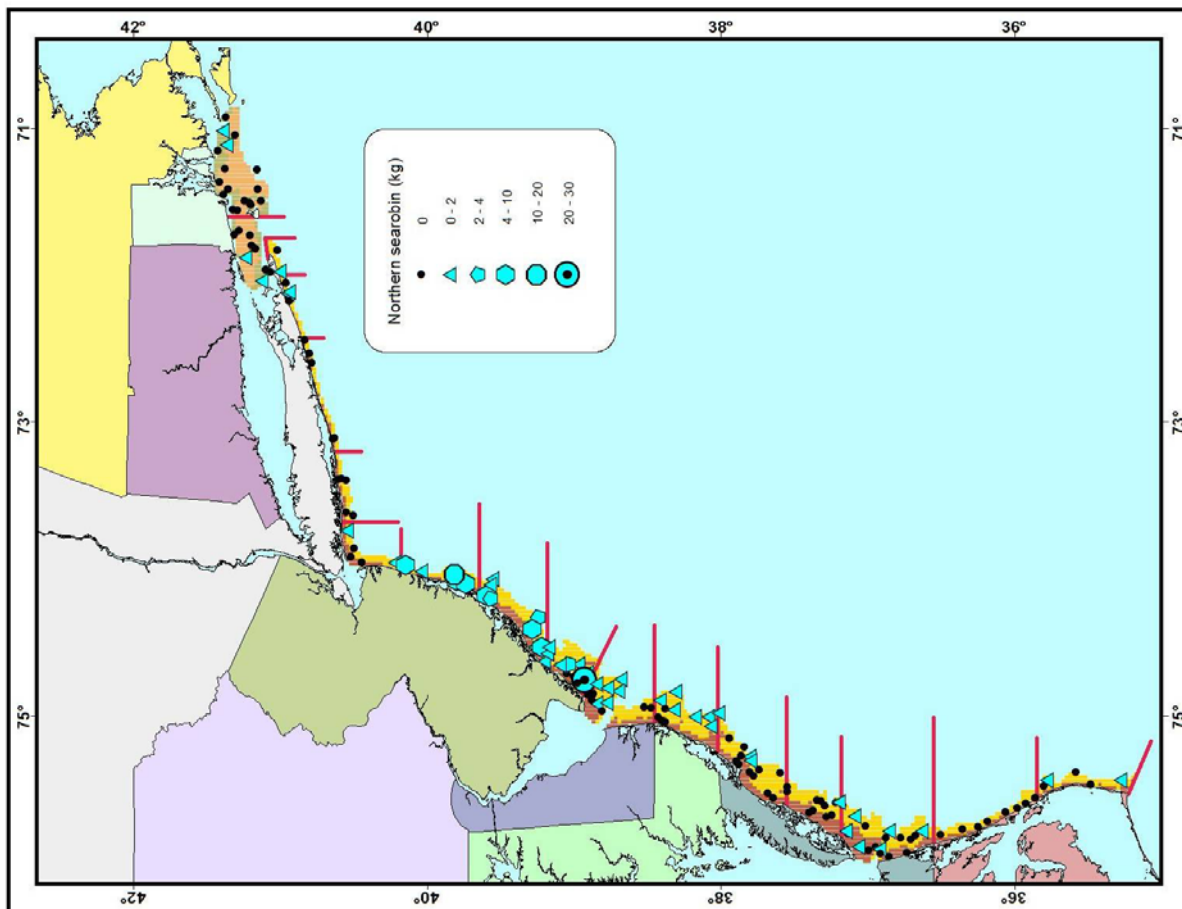


Figure 90. Biomass (kg) of northern searobin collected at each sampling site for four NEAMAP cruises.

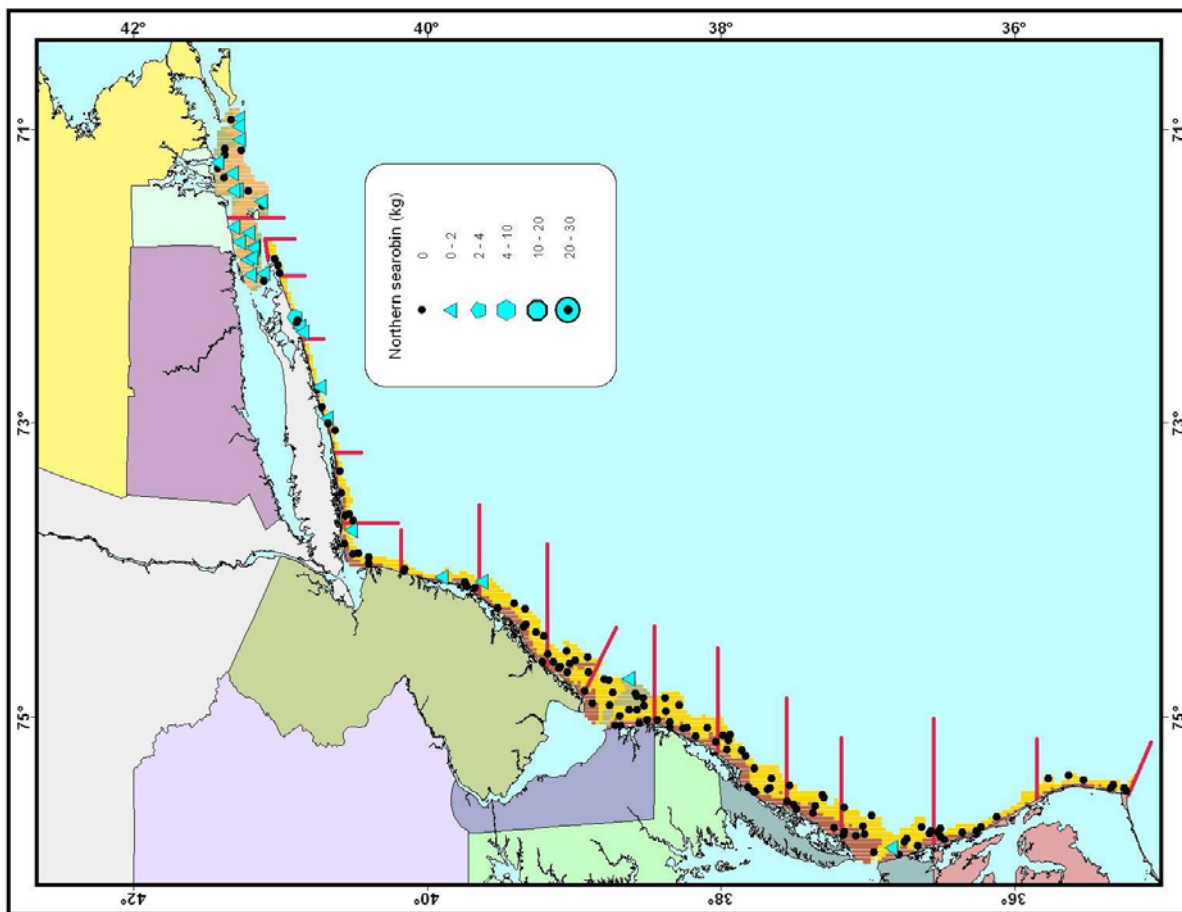
Spring 2008



Fall 2007



Spring 2009



Fall 2008

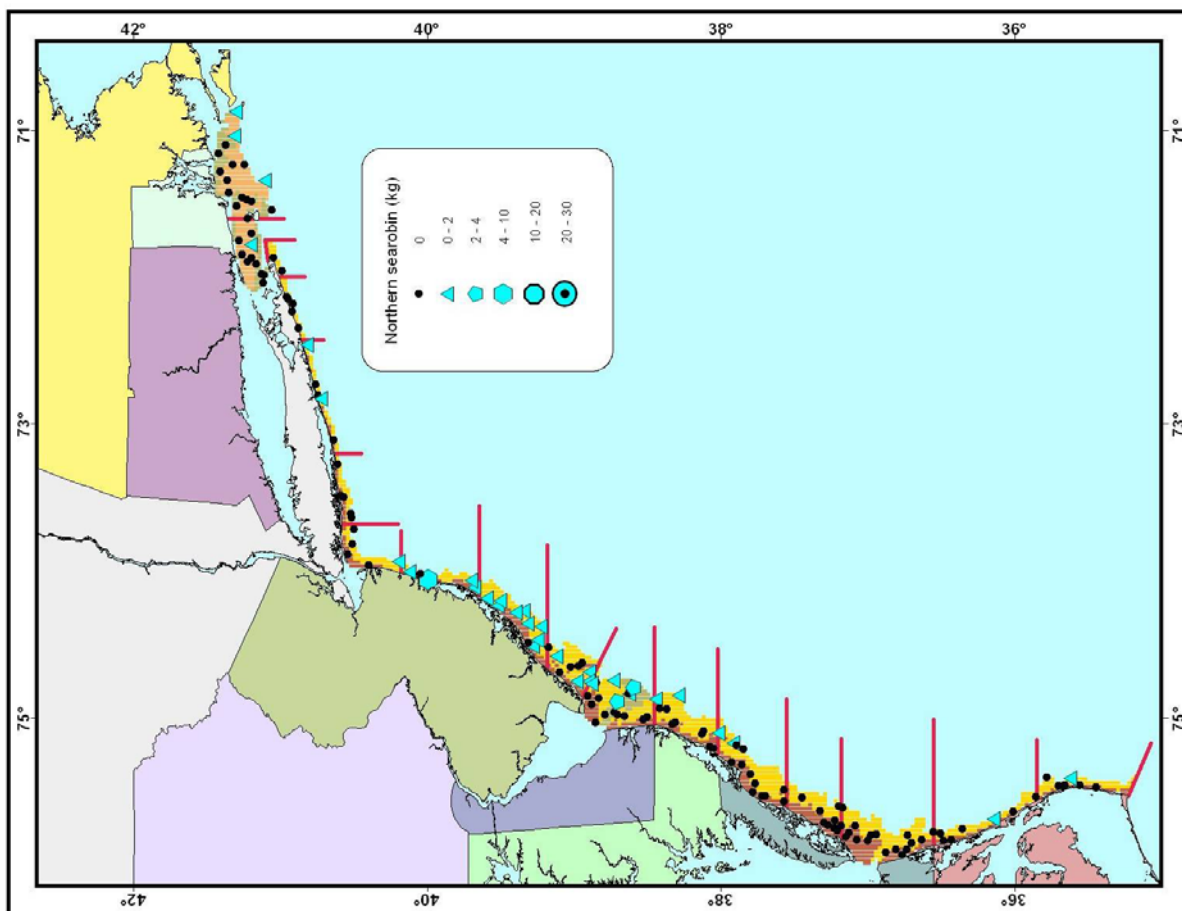


Figure 91. Preliminary indices of abundance, in terms of number and biomass, of northern searobin for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

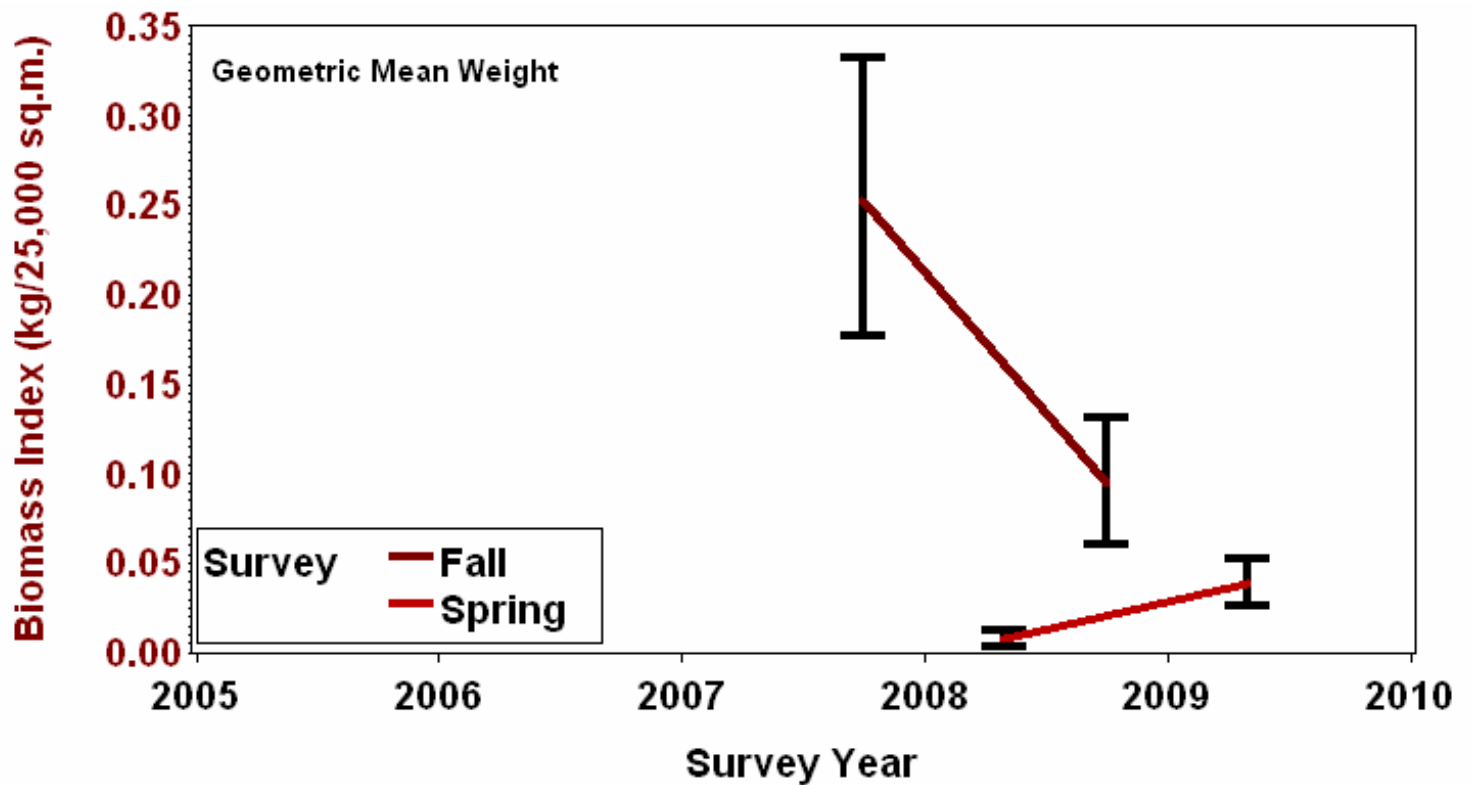
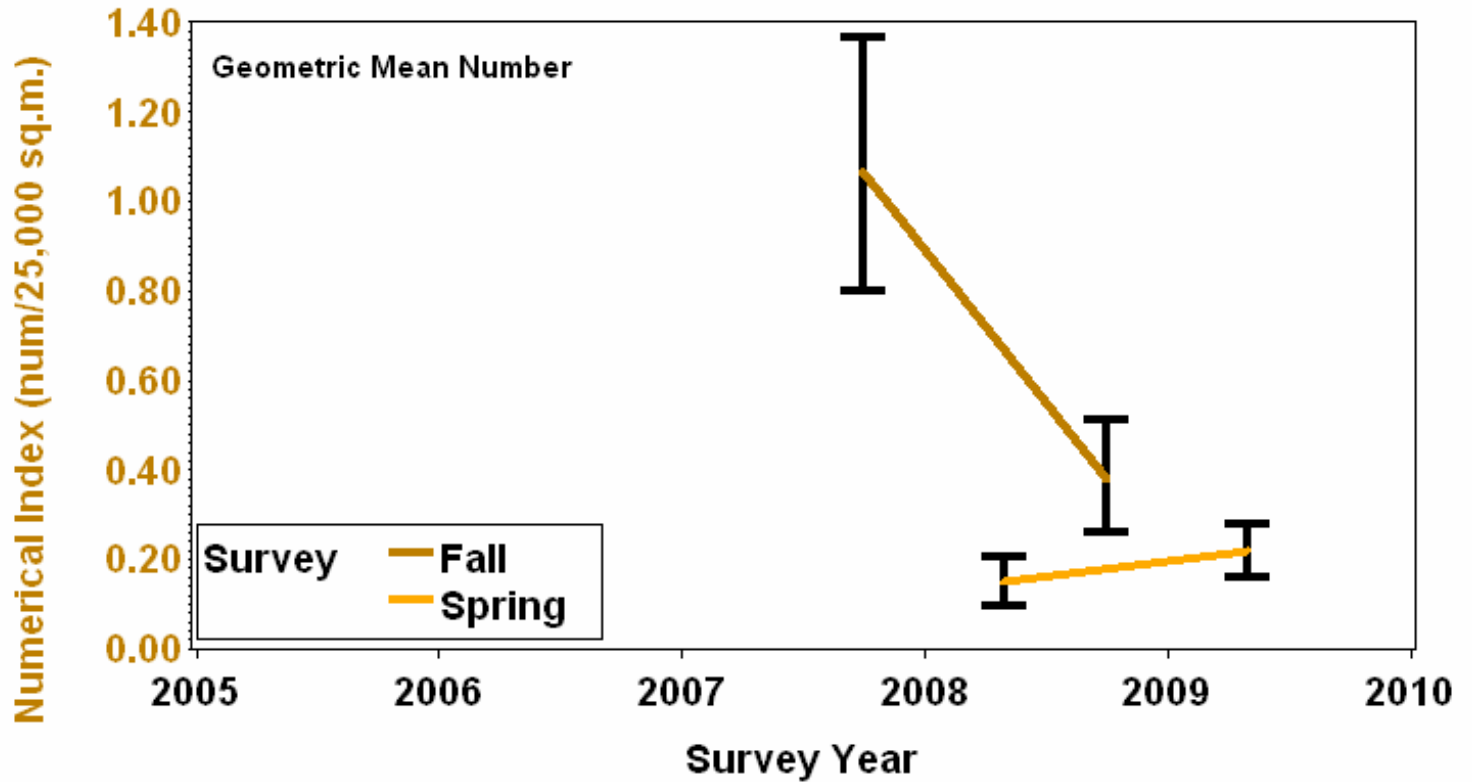
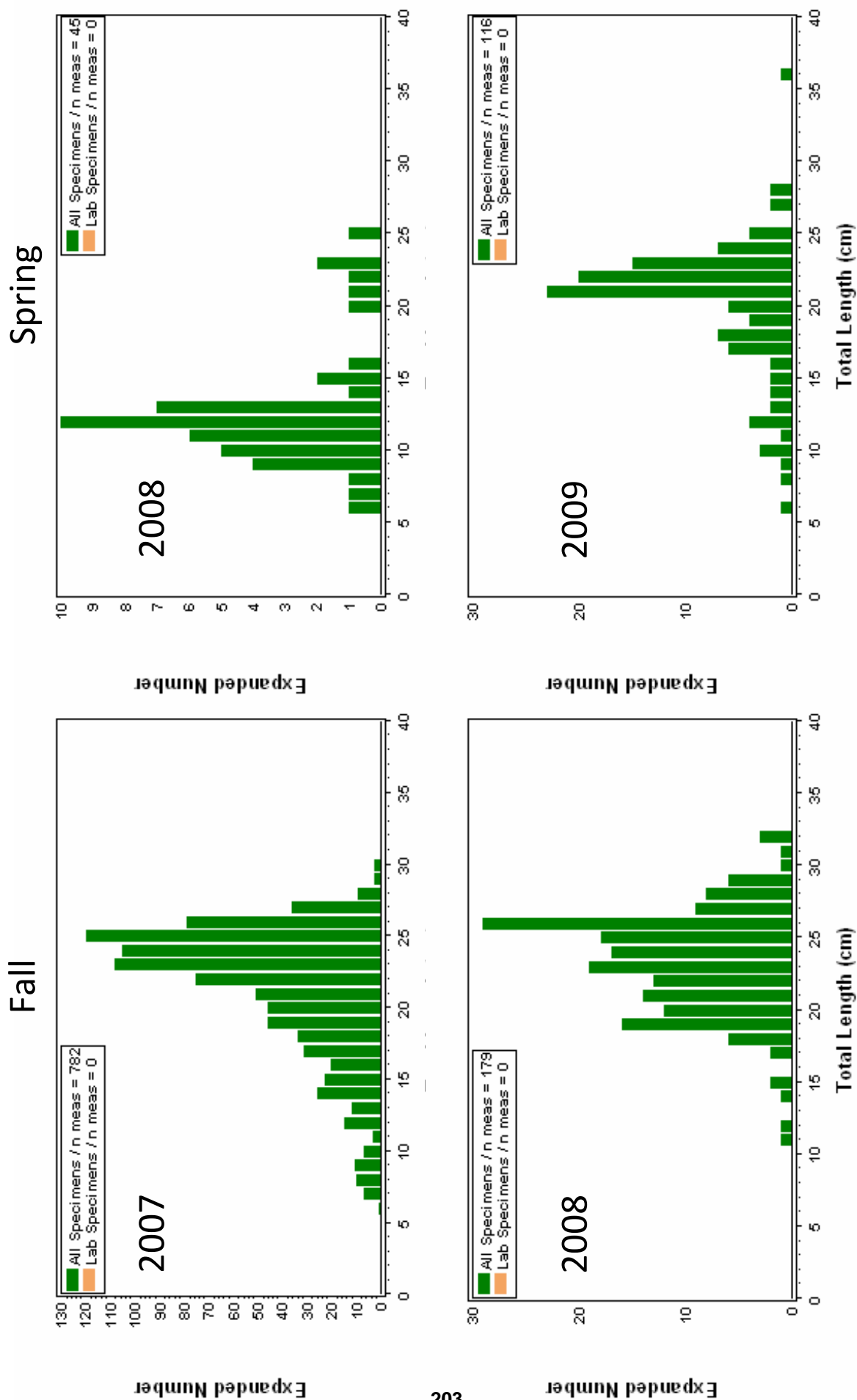


Figure 92. Length-frequency distributions, by cruise, for northern searobin.





# Pinfish (Priority D)

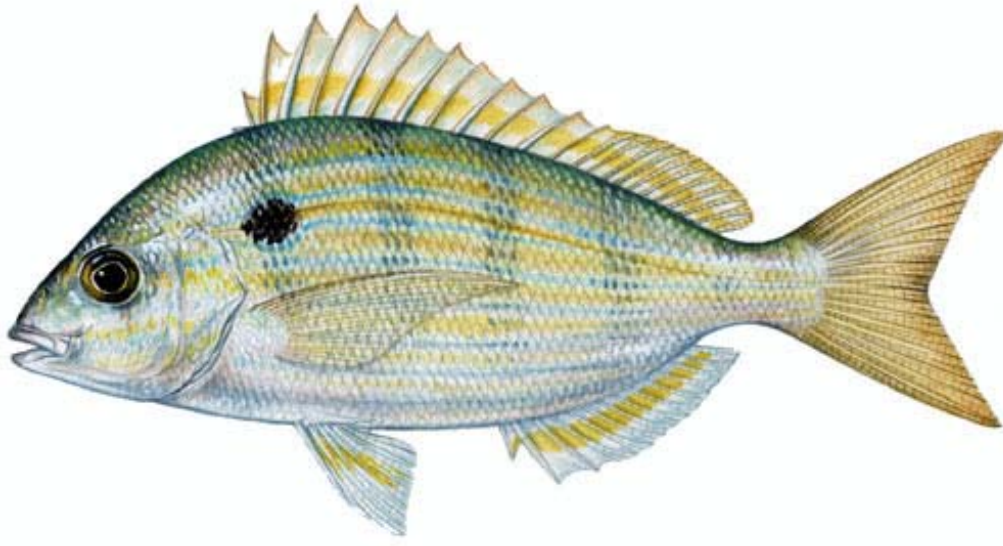
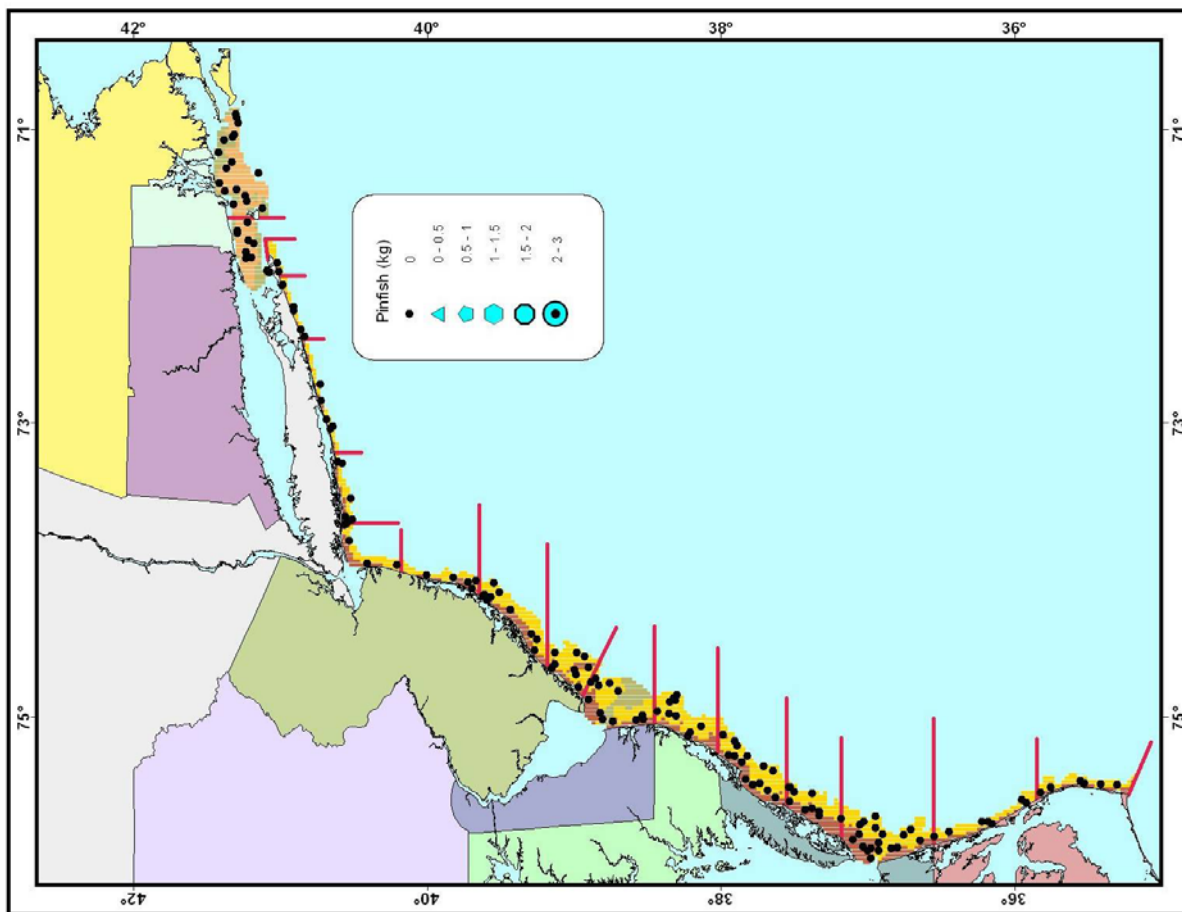


Table 28. Sampling rates and abundance indices of pinfish for four NEAMAP cruises.

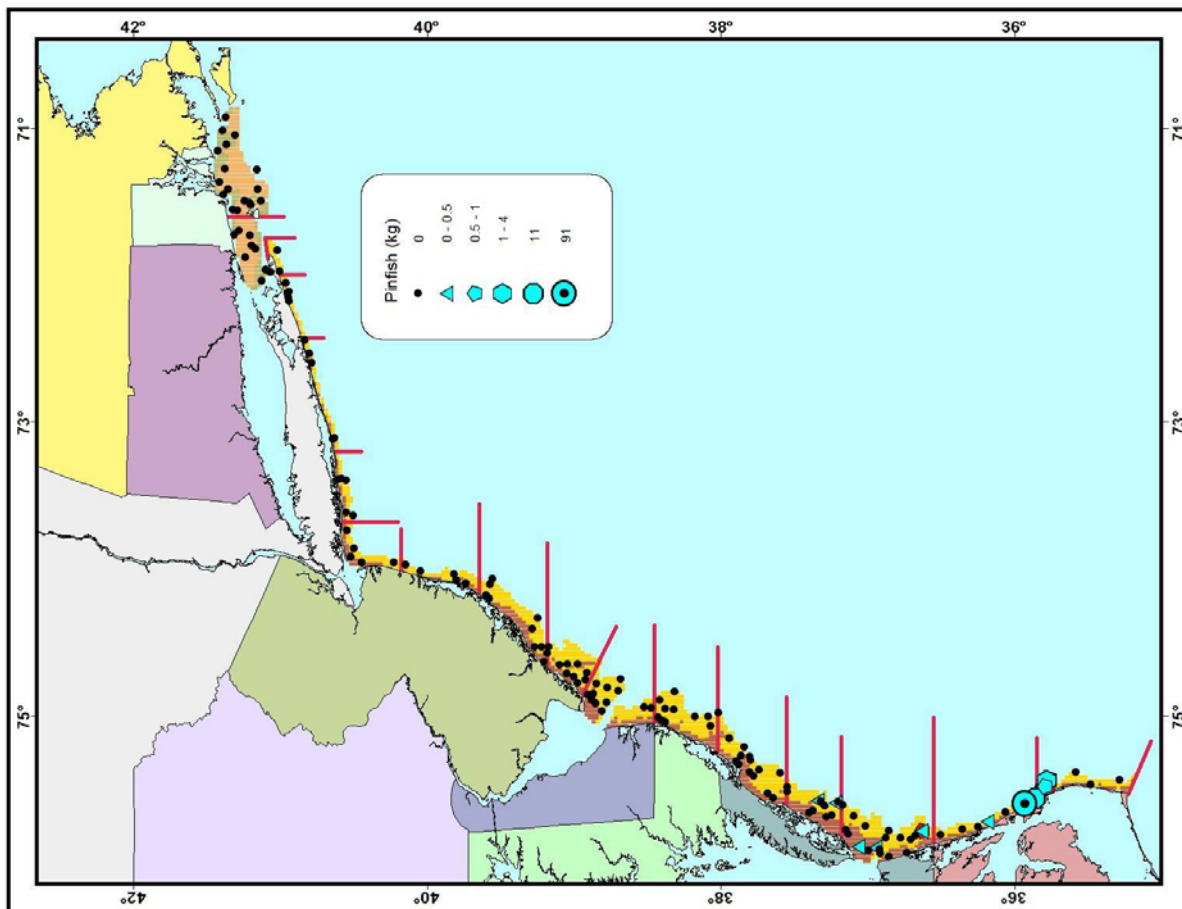
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	2,744	107.3	331	0		0		0.17	0.06
2008	Spring	0	0.0	0	0		0		0.00	0.00
	Fall	184	8.2	184	0		0		0.23	0.03
2009	Spring	8	0.2	8	0		0		0.02	0.00

Figure 93. Biomass (kg) of pinfish collected at each sampling site for four NEAMAP cruises.

Spring 2008

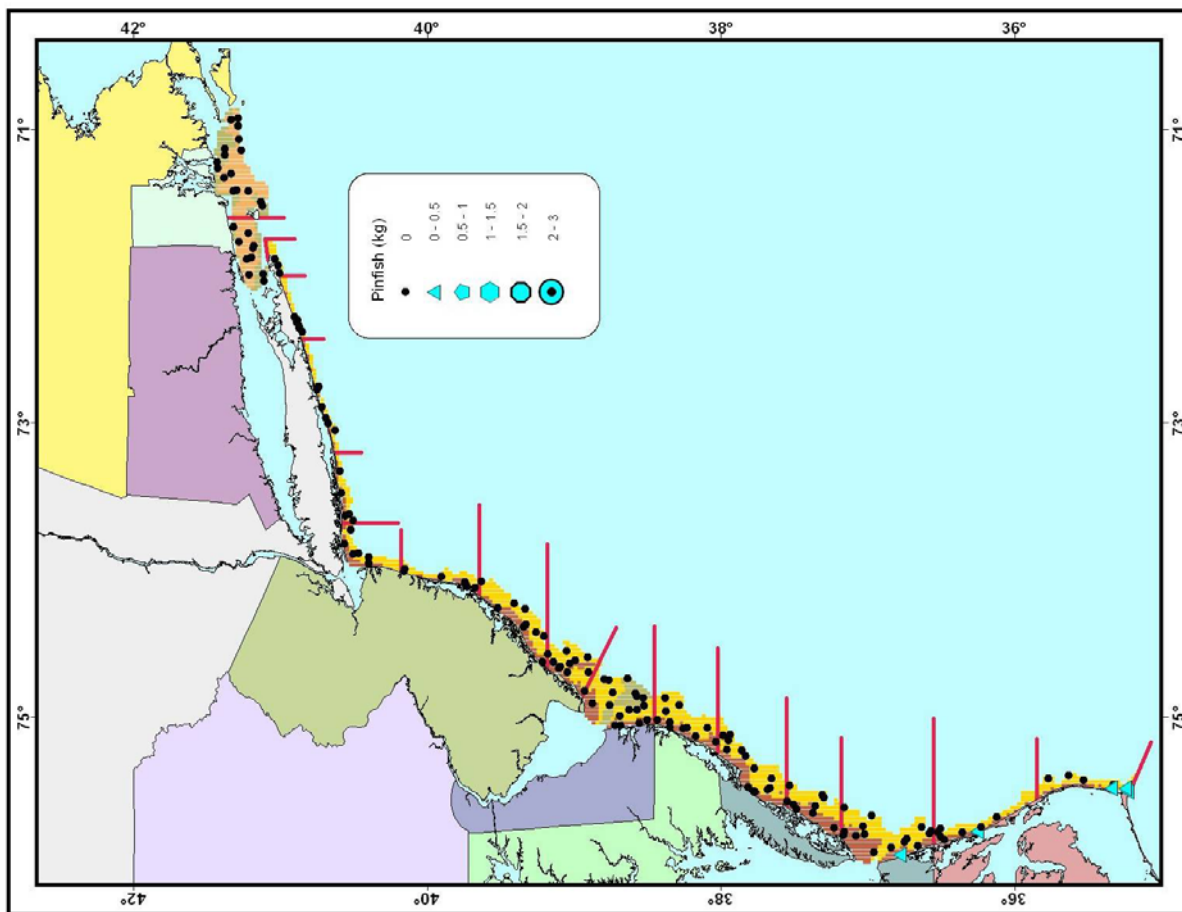


Fall 2007





Spring 2009



Fall 2008

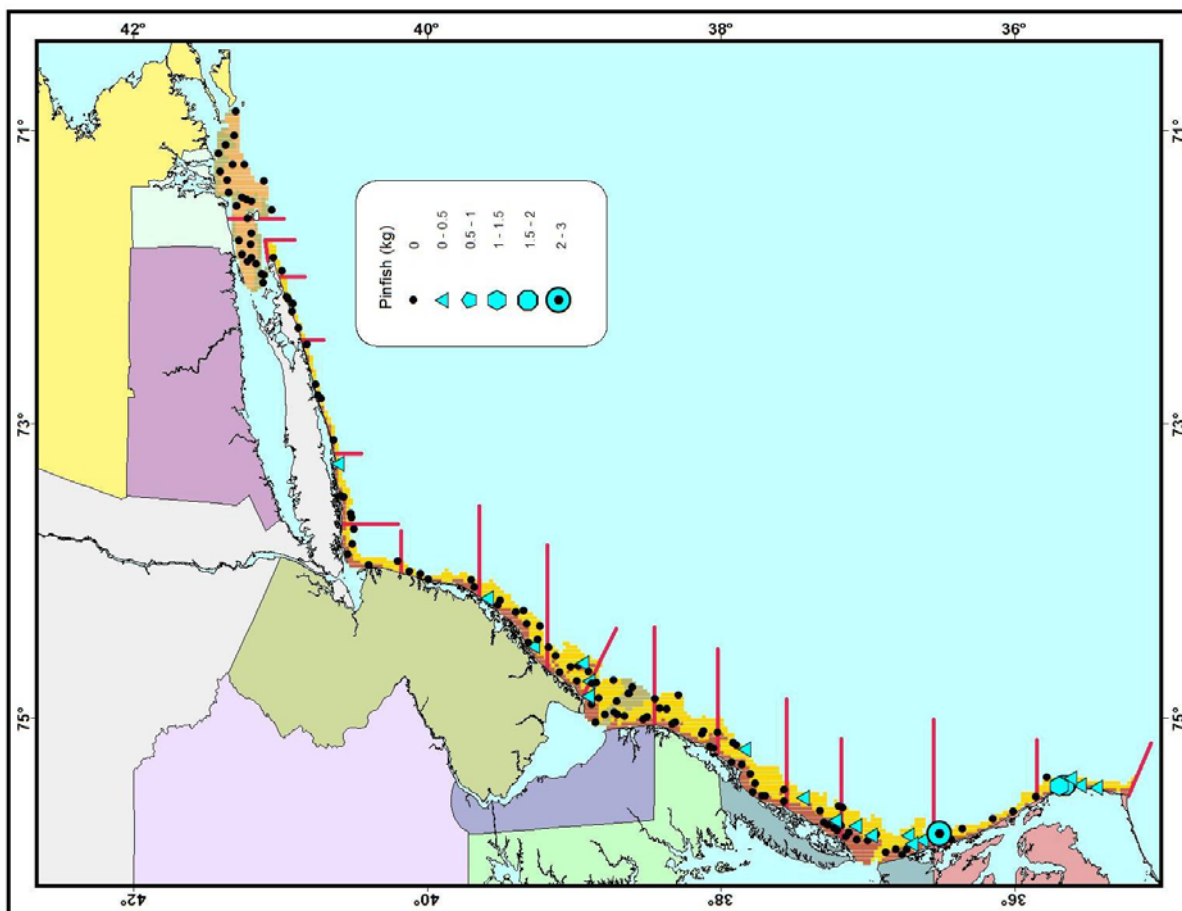




Figure 94. Preliminary indices of abundance, in terms of number and biomass, of pinfish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

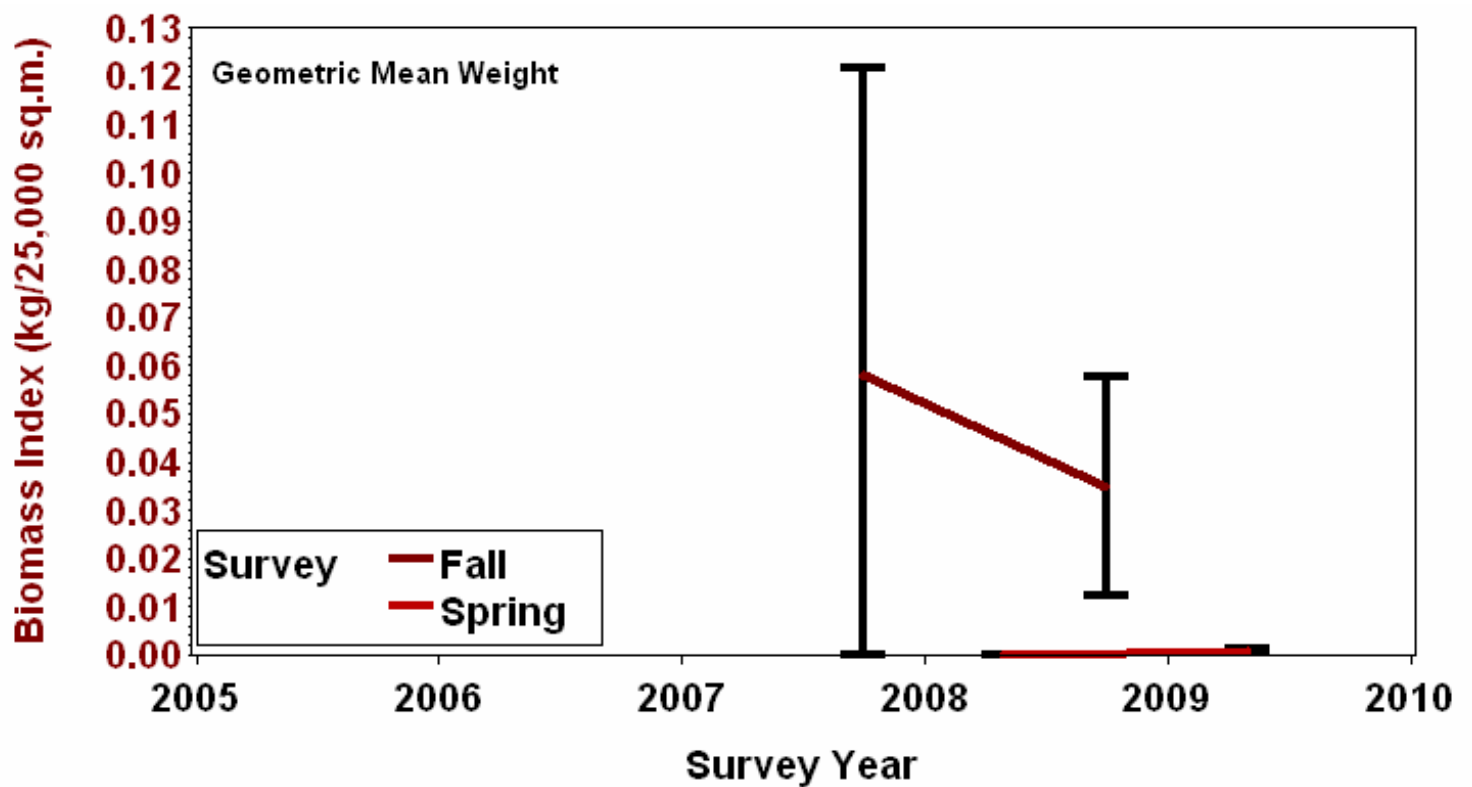
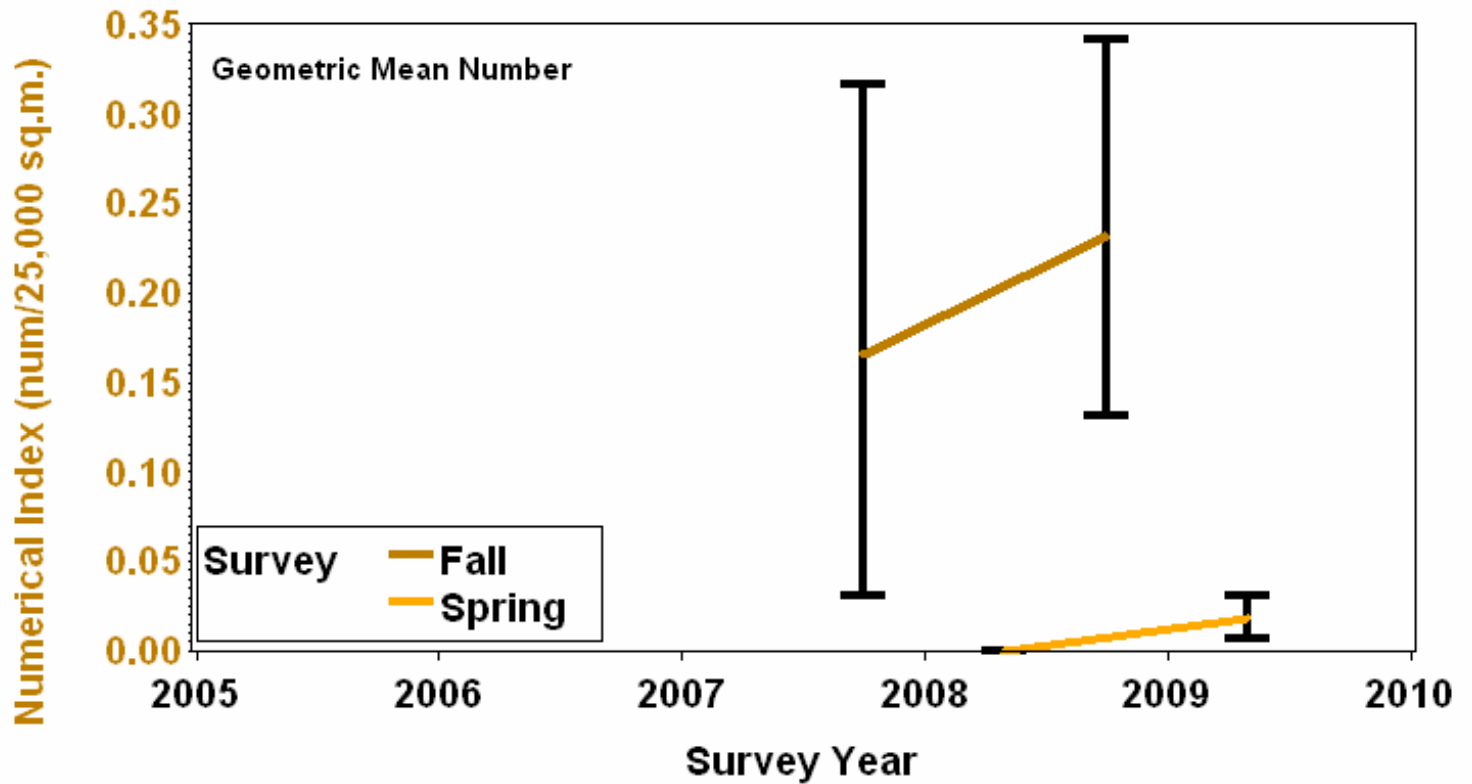
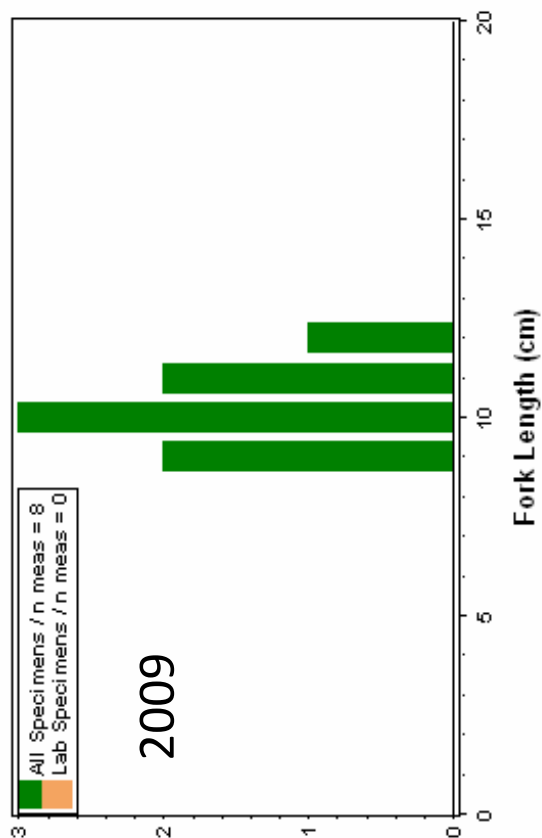
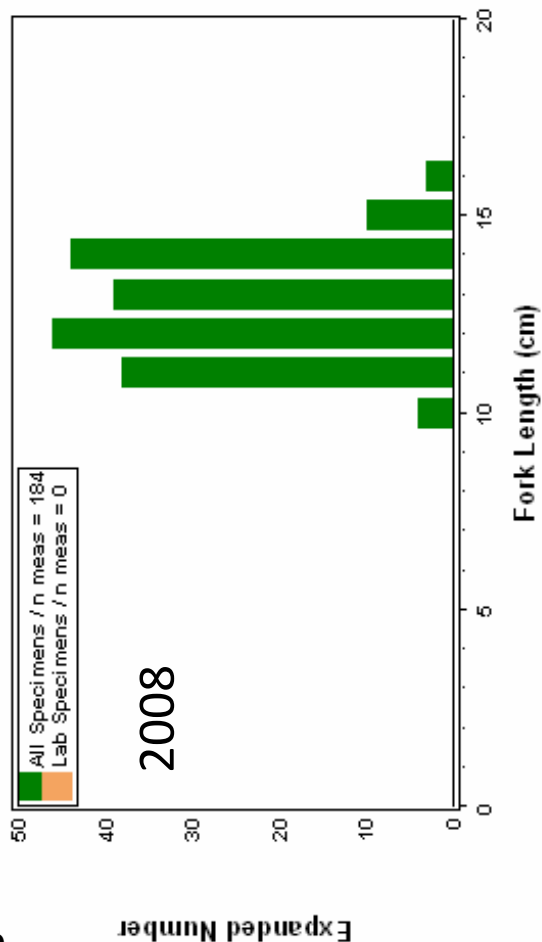
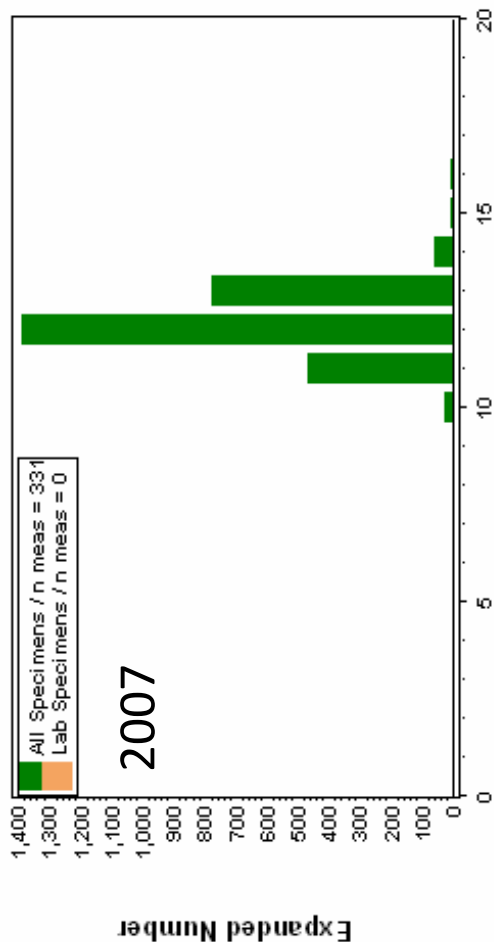


Figure 95. Length-frequency distributions, by cruise, for pinfish. This species was not collected during the Spring 2008 survey.

Spring



Fall





# Red Hake (Priority D)

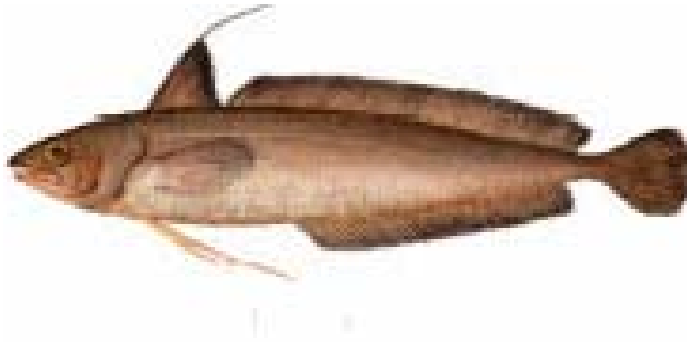
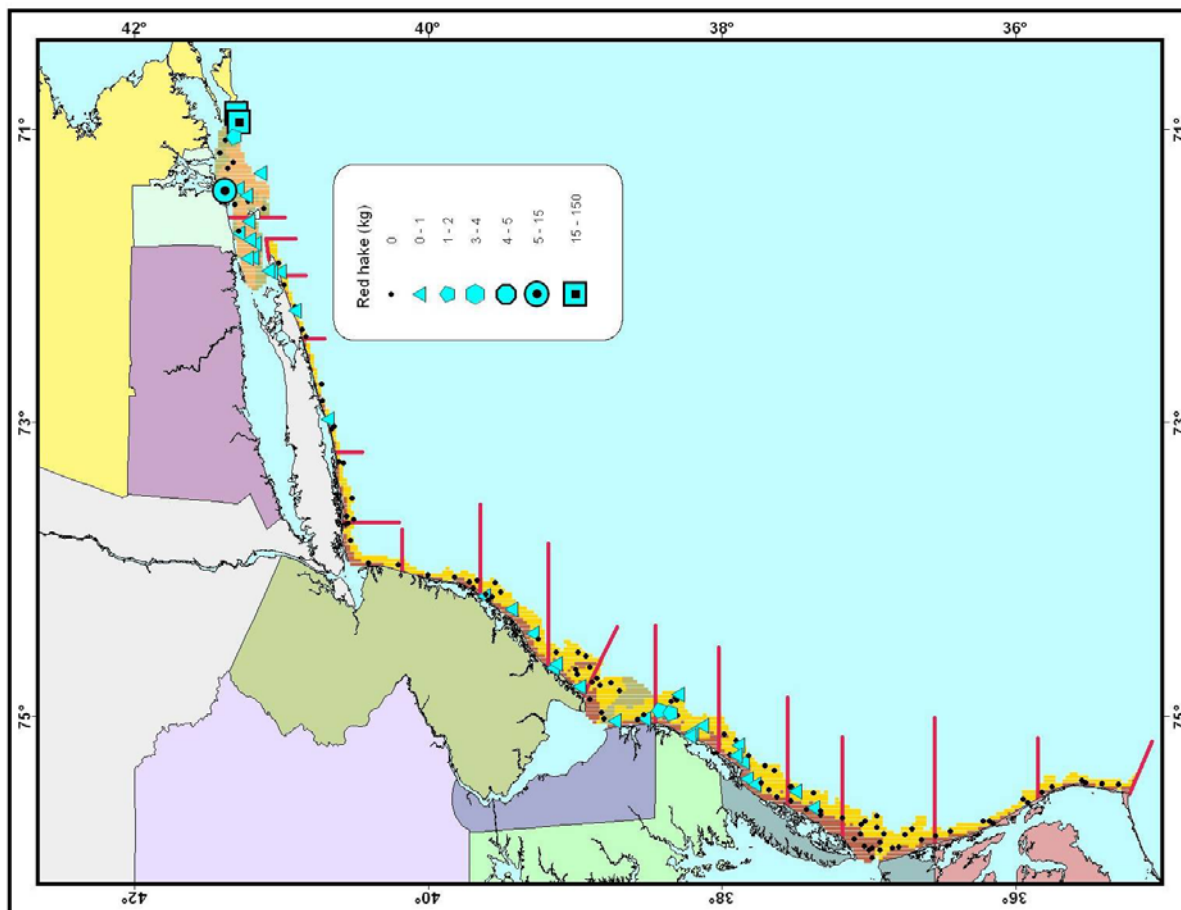


Table 29. Sampling rates and abundance indices of red hake for four NEAMAP cruises.

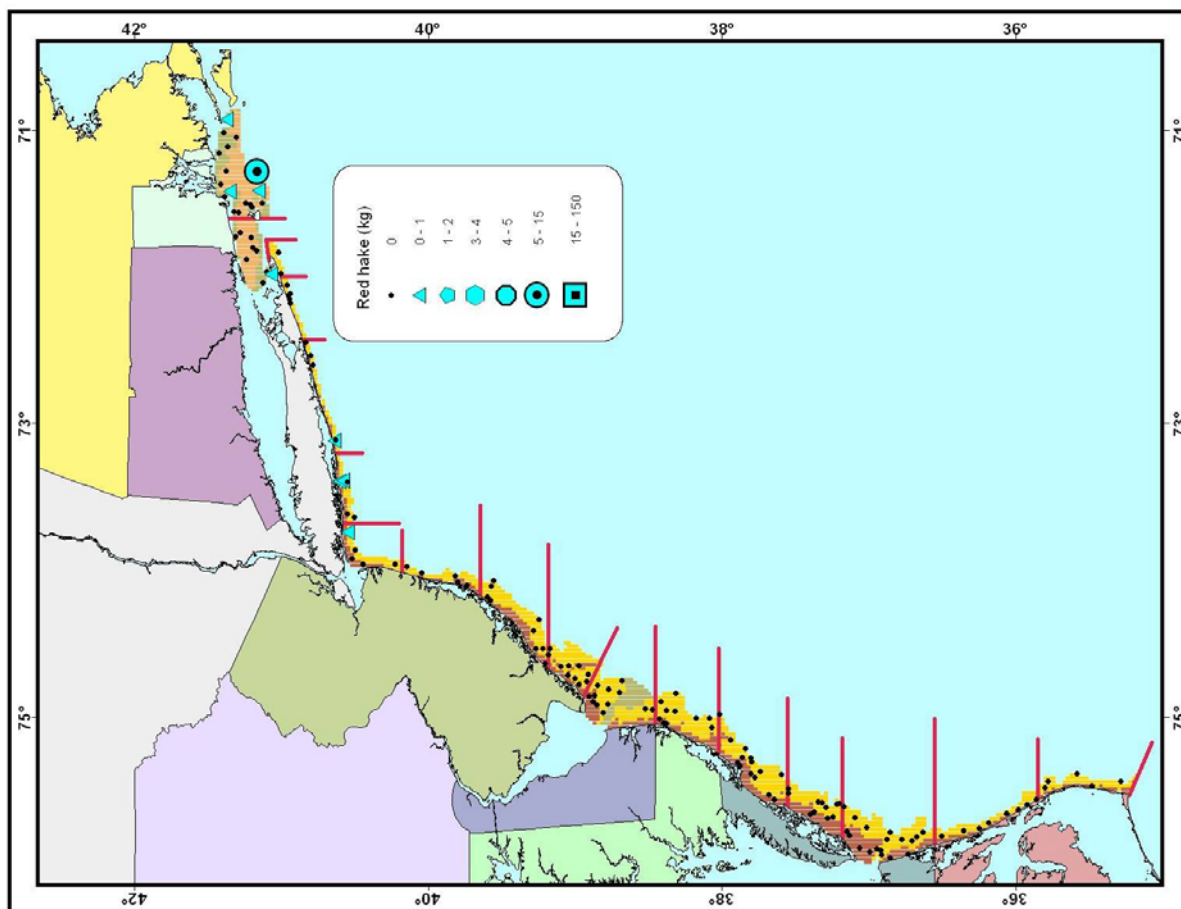
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	74	8.4	74	0		0		0.09	0.02
2008	Spring	1,464	168.4	454	0		0		0.82	0.21
	Fall	145	18.2	98	0		0		0.12	0.05
2009	Spring	301	27.7	301	0		0		0.47	0.07

Figure 96. Biomass (kg) of red hake collected at each sampling site for four NEAMAP cruises.

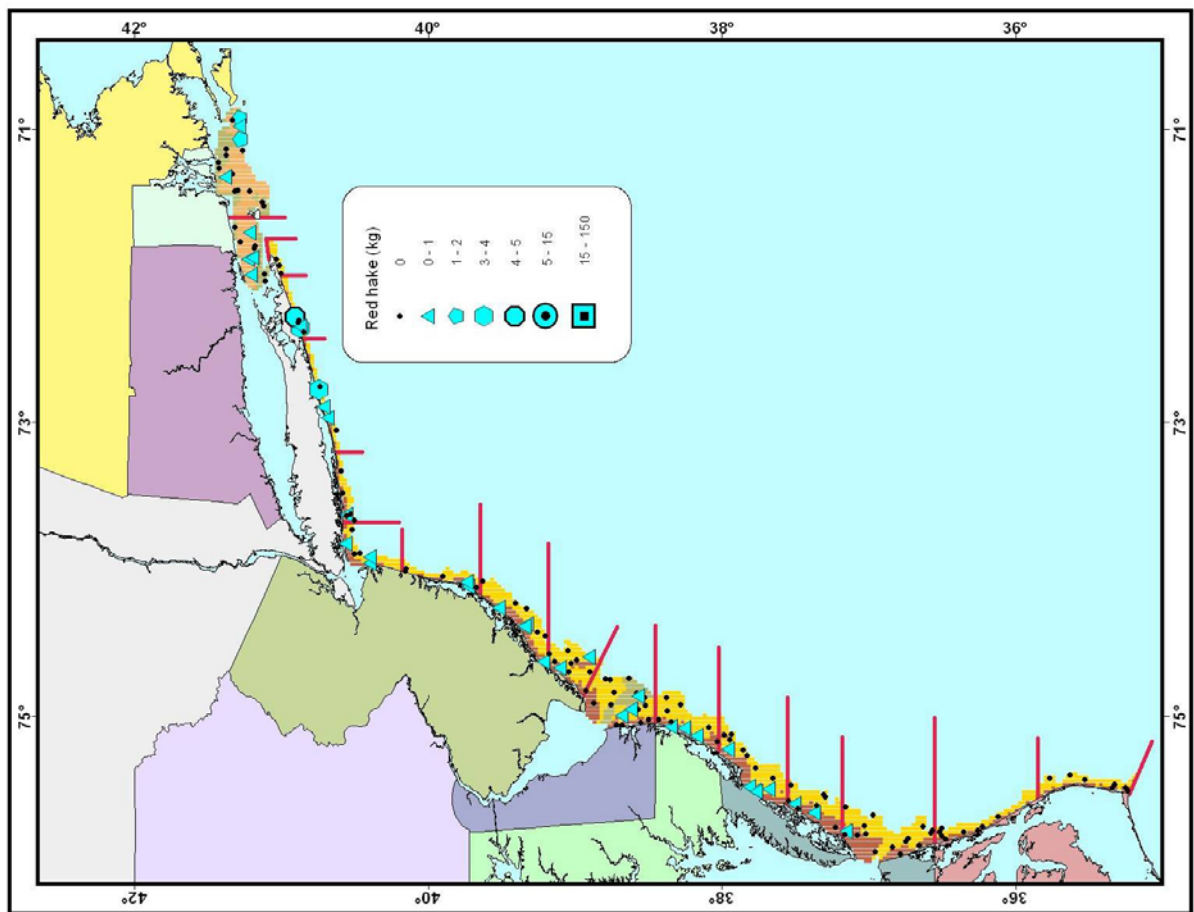
Spring 2008



Fall 2007



Spring 2009



Fall 2008

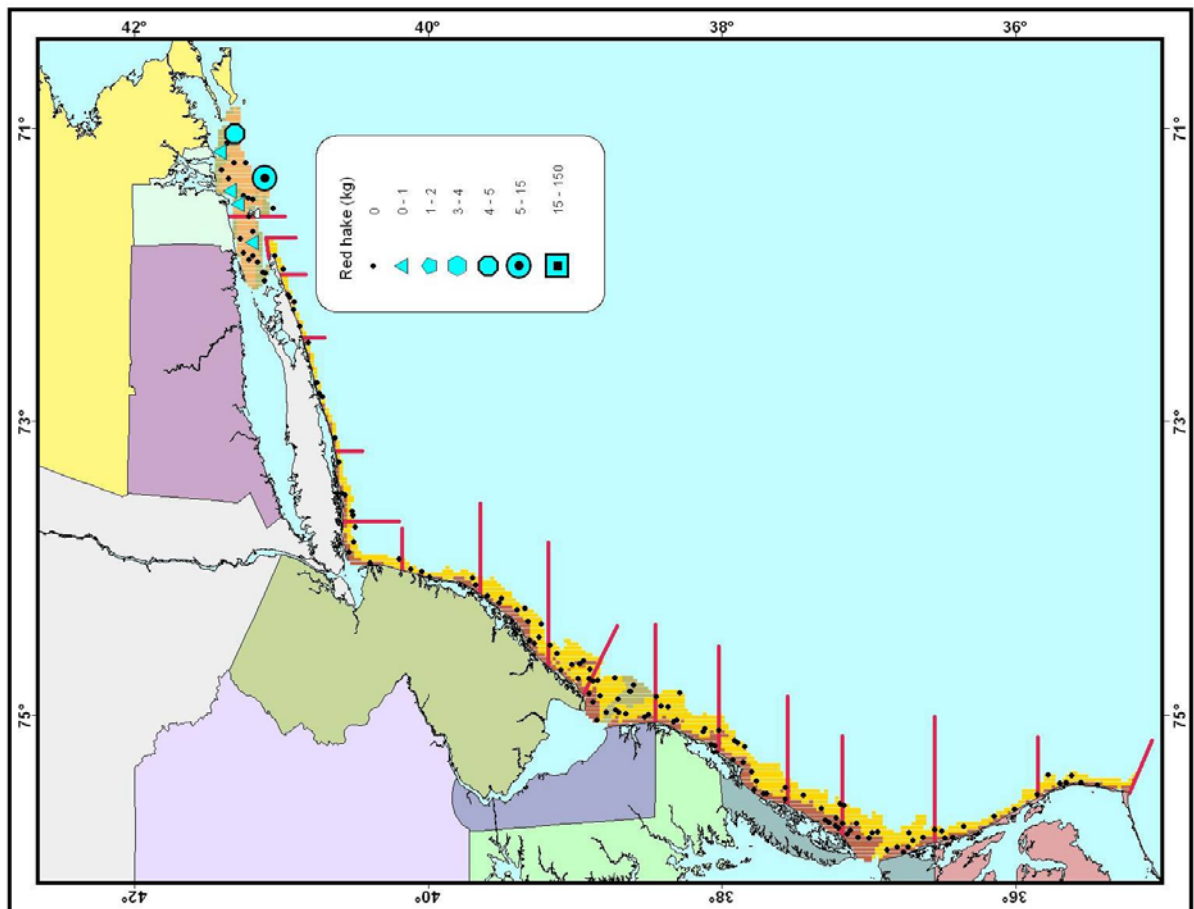


Figure 97. Preliminary indices of abundance, in terms of number and biomass, of red hake for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

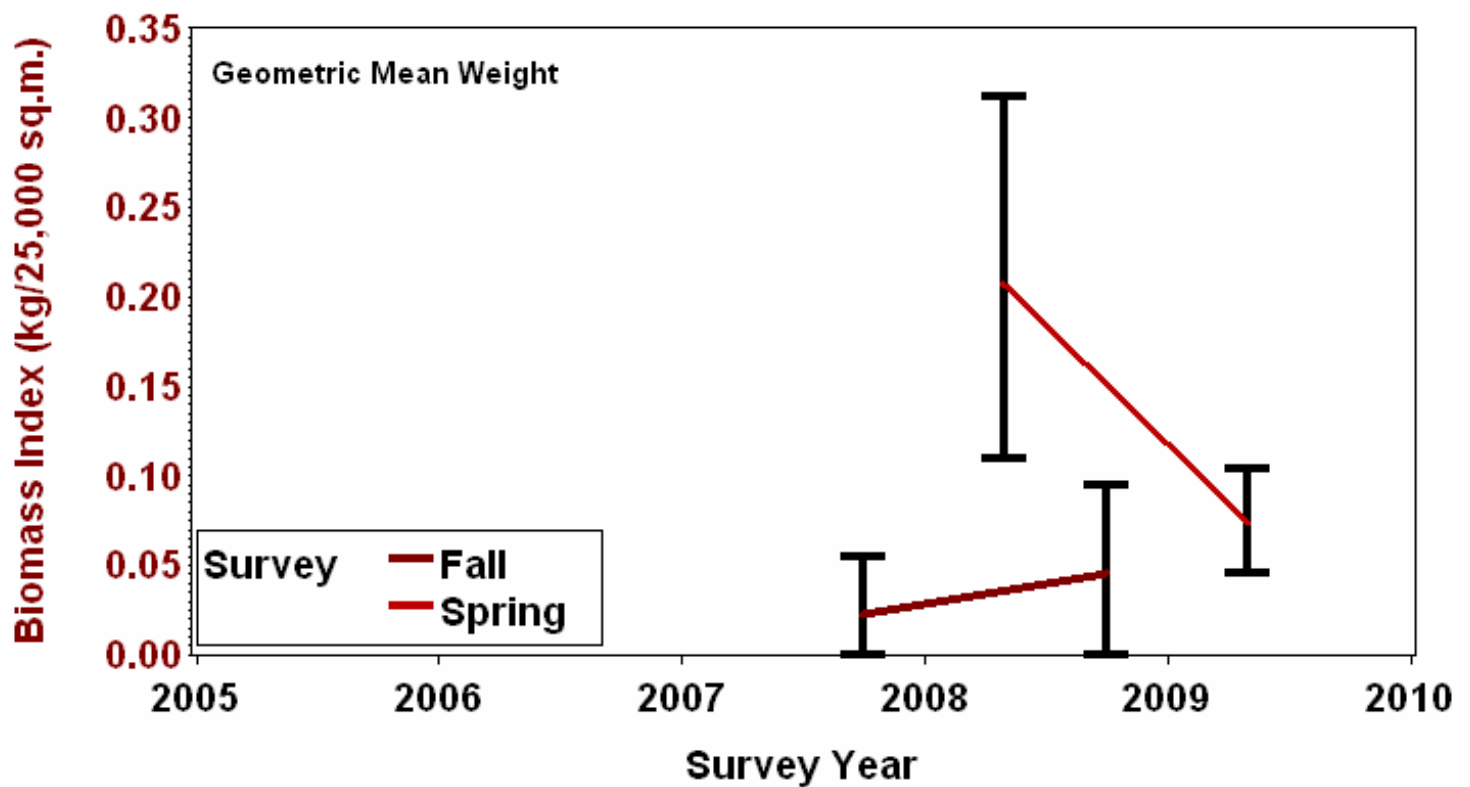
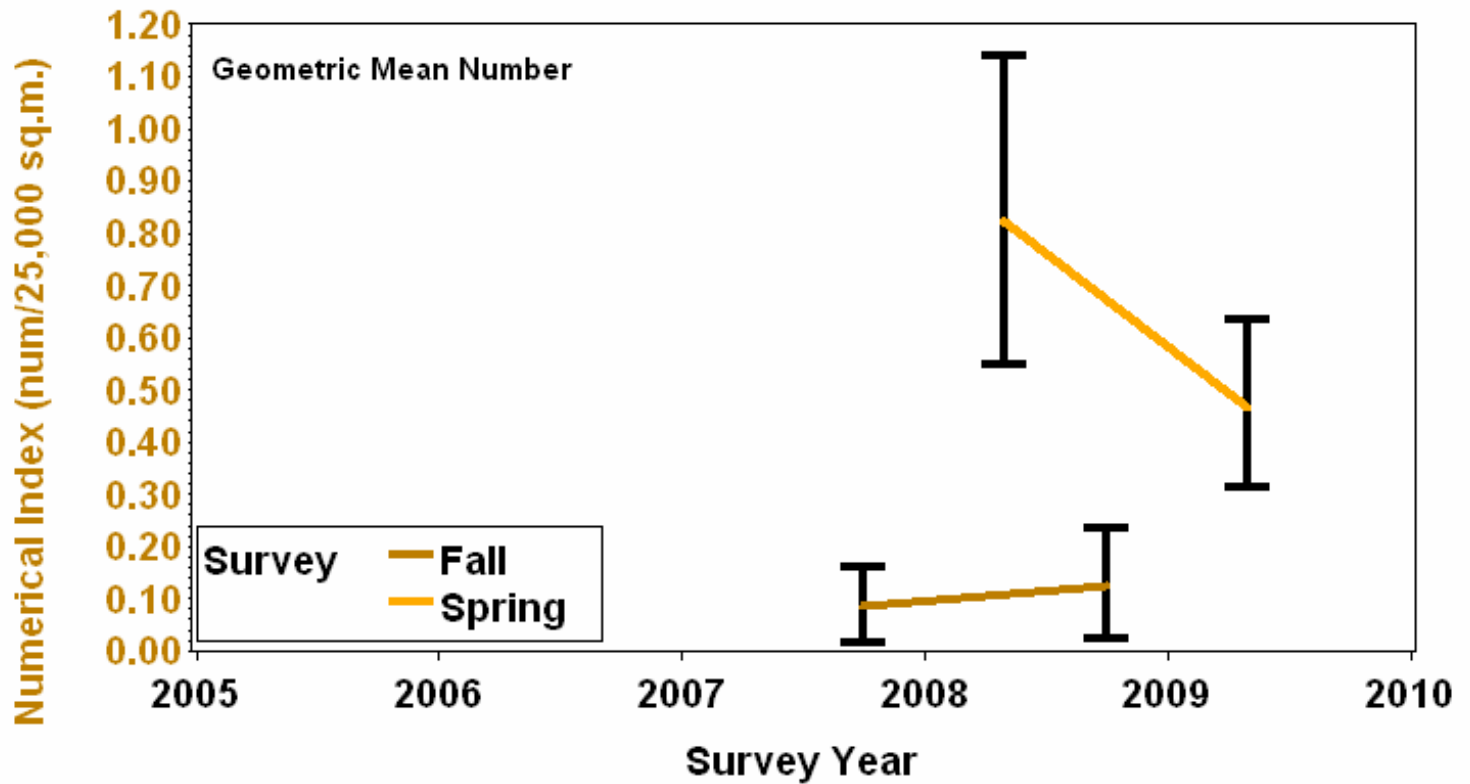
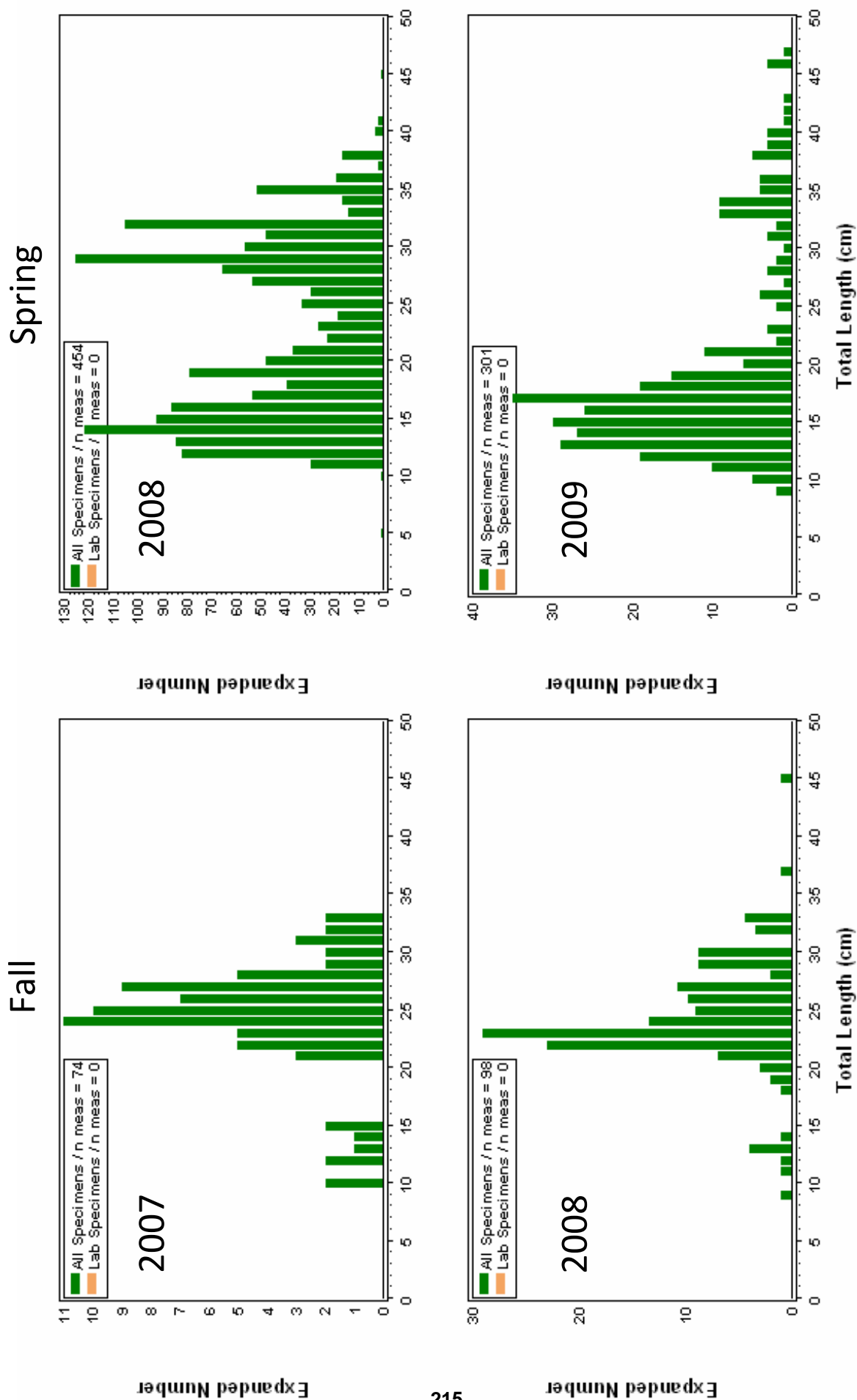


Figure 98. Length-frequency distributions, by cruise, for red hake.







# Scup (Priority A)

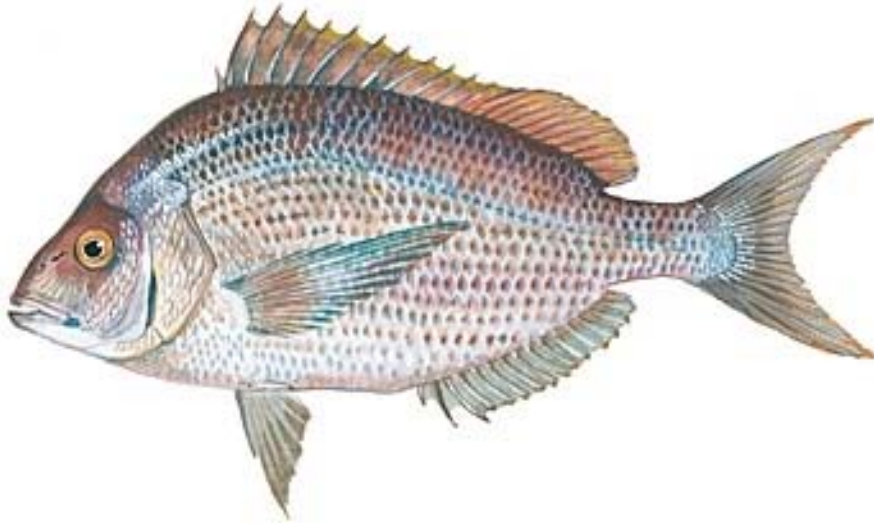
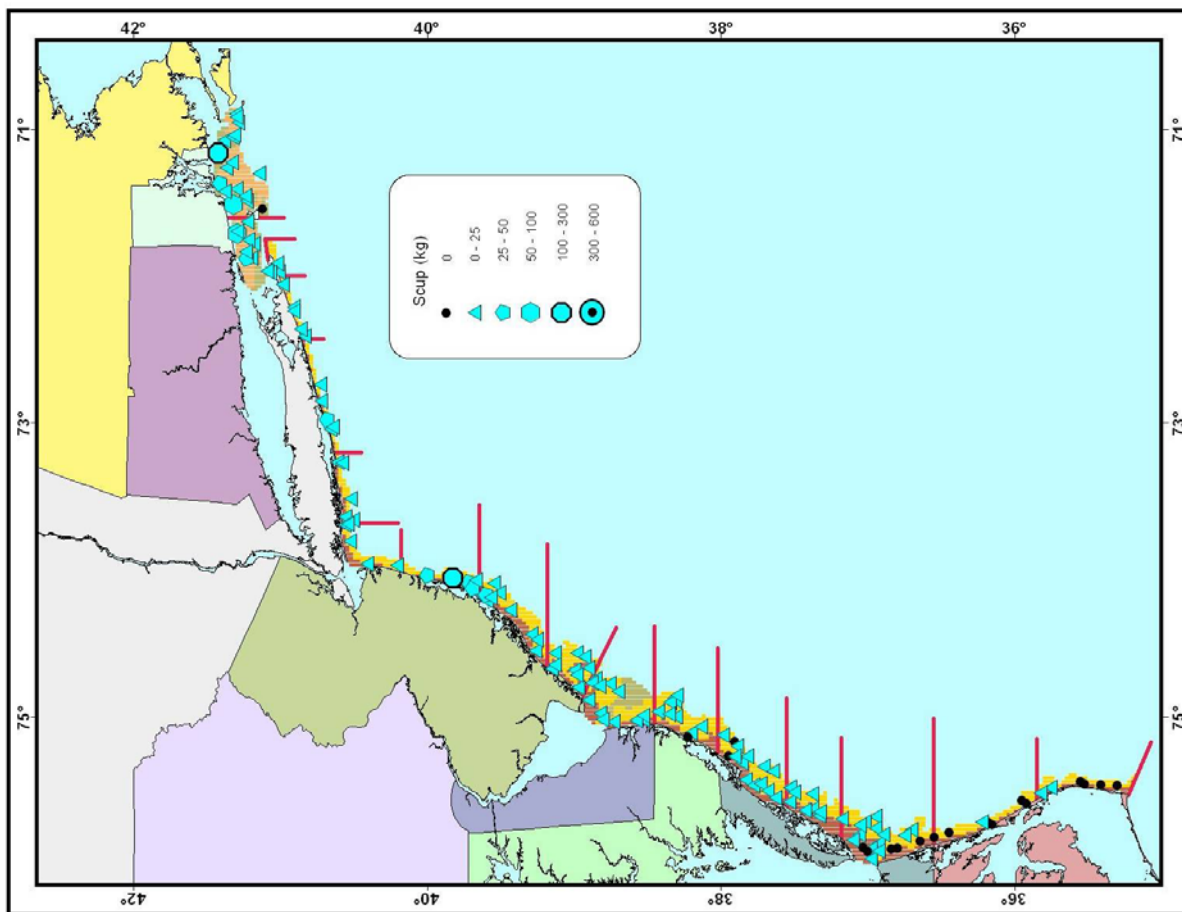


Table 30. Sampling rates and abundance indices of scup for four NEAMAP cruises.

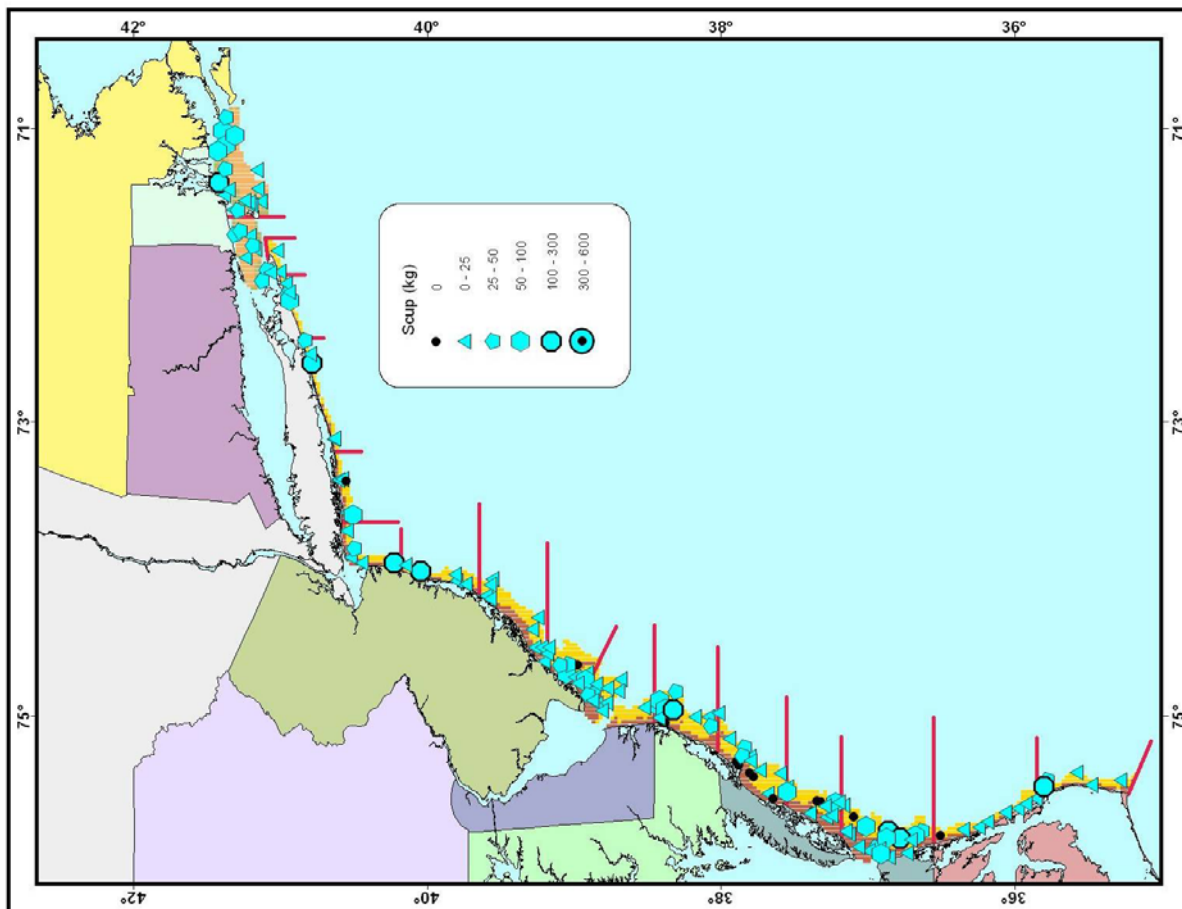
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	276,237	3,928.8	13,721	811	808	800	793	117.07	7.48
2008	Spring	51,629	1,256.1	7,167	869	0	754	744	24.82	2.05
	Fall	77,858	2,503.2	6,946	670	0	668	655	24.78	3.15
2009	Spring	16,884	2,827.3	7,043	740	0	708	681	6.79	1.32

Figure 99. Biomass (kg) of scup collected at each sampling site for four NEAMAP cruises.

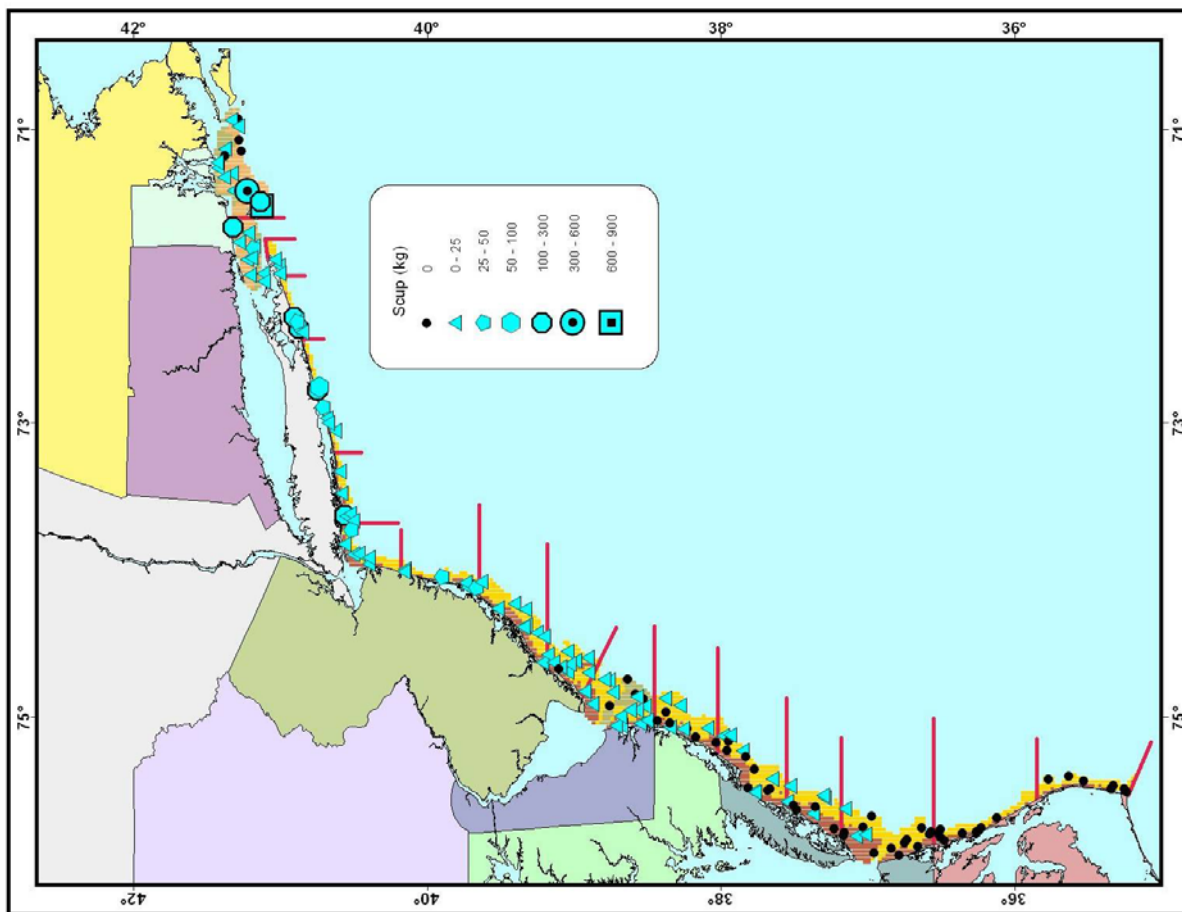
Spring 2008



Fall 2007



Spring 2009



Fall 2008

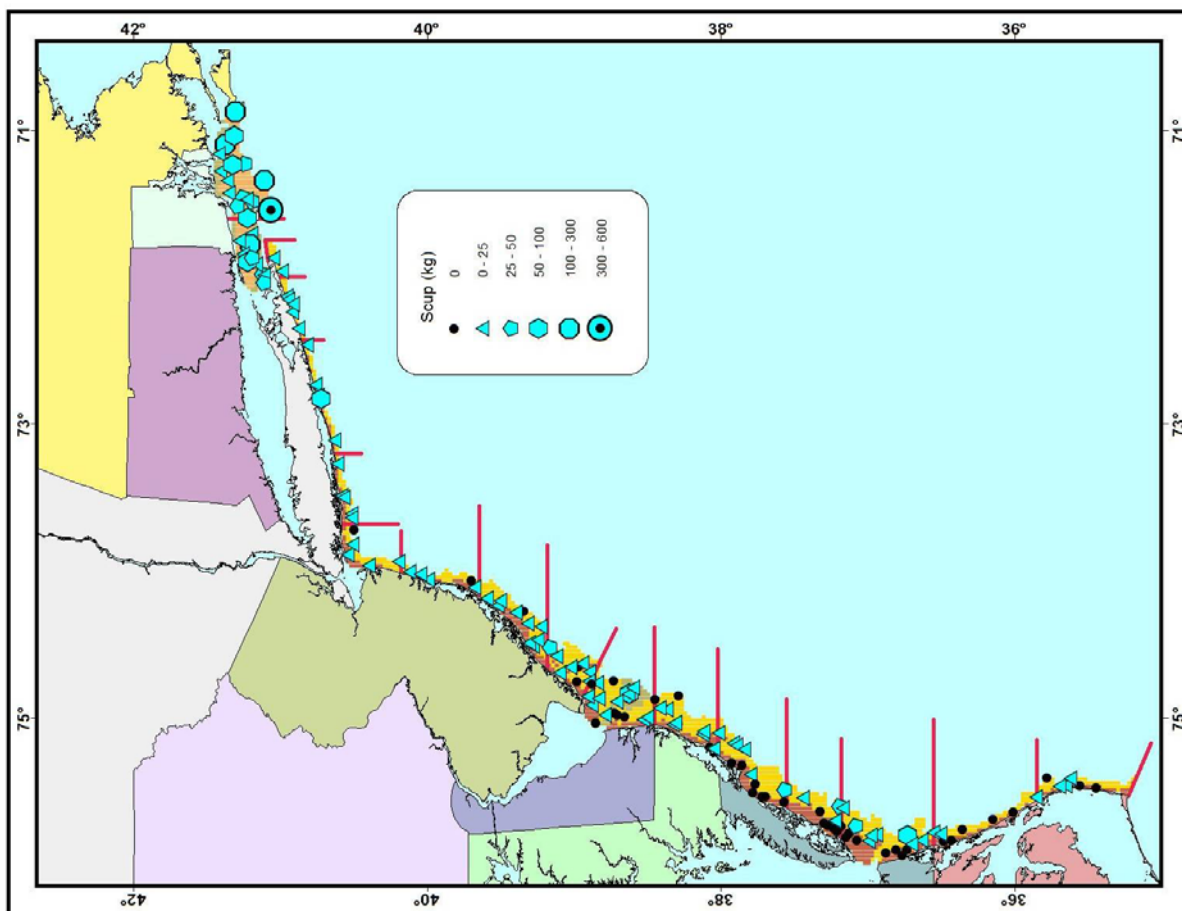


Figure 100. Preliminary indices of abundance, in terms of number and biomass, of scup for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

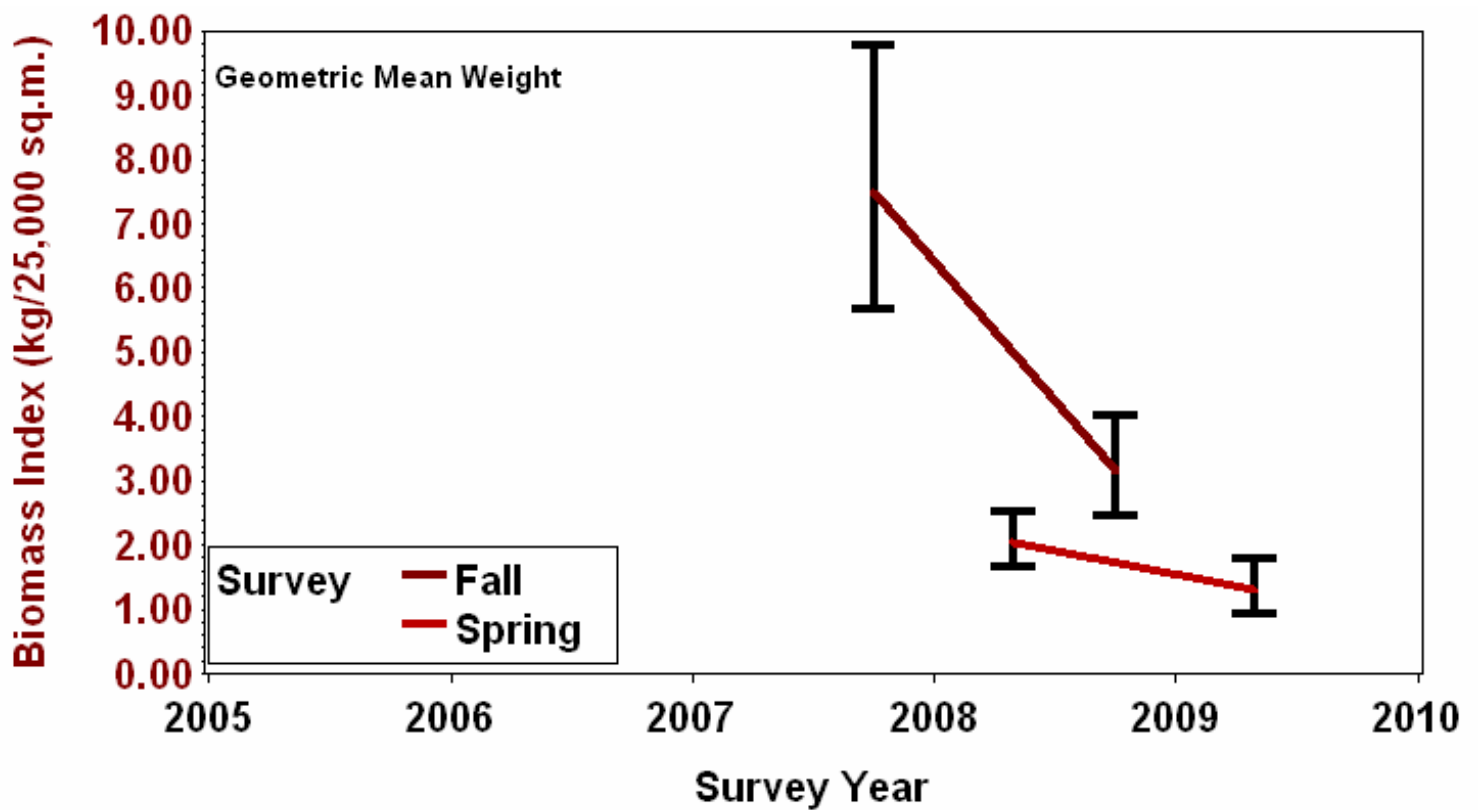
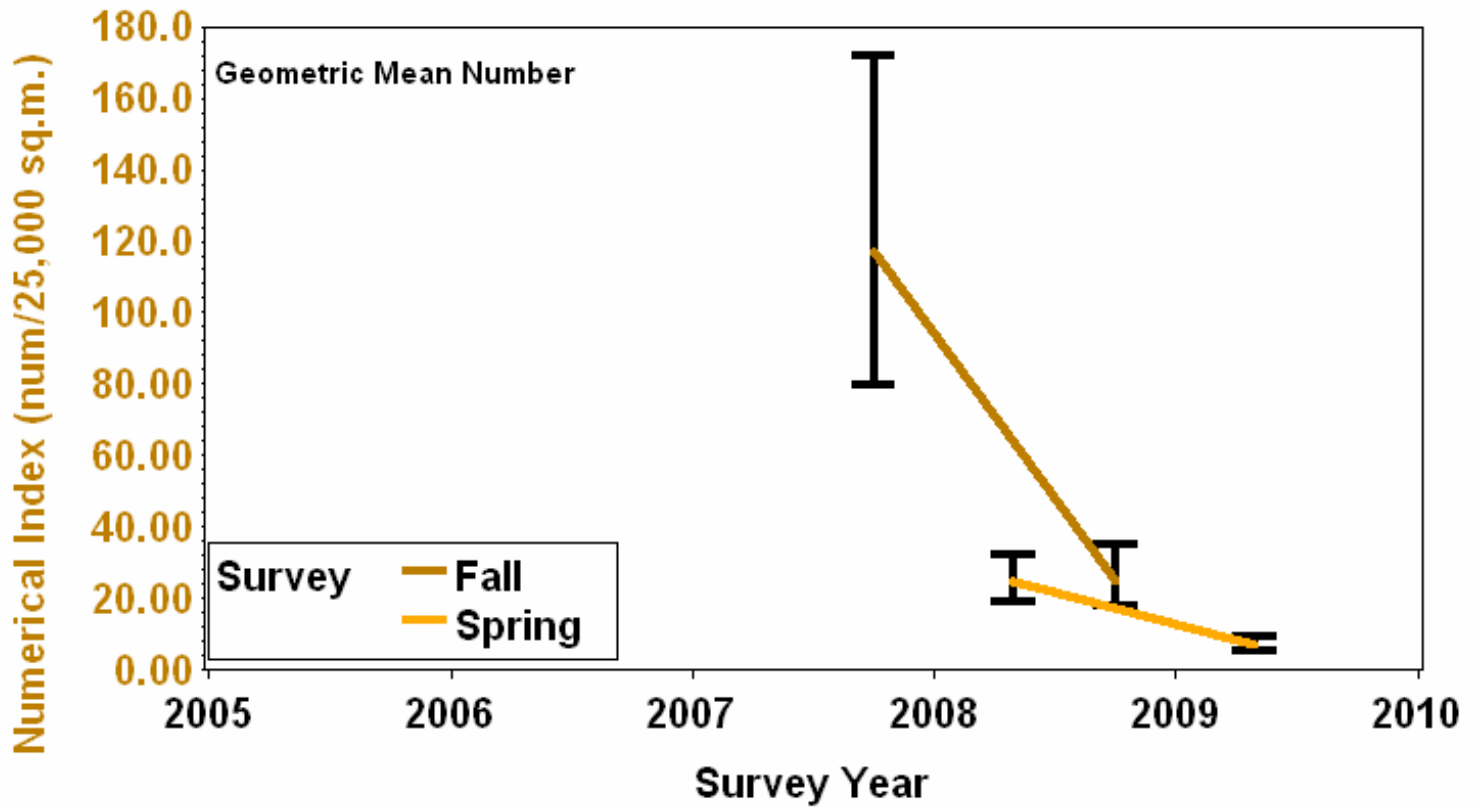


Figure 101. Length-frequency distributions, by cruise, for scup. Numbers taken for full processing, by length, are represented by the orange bars.

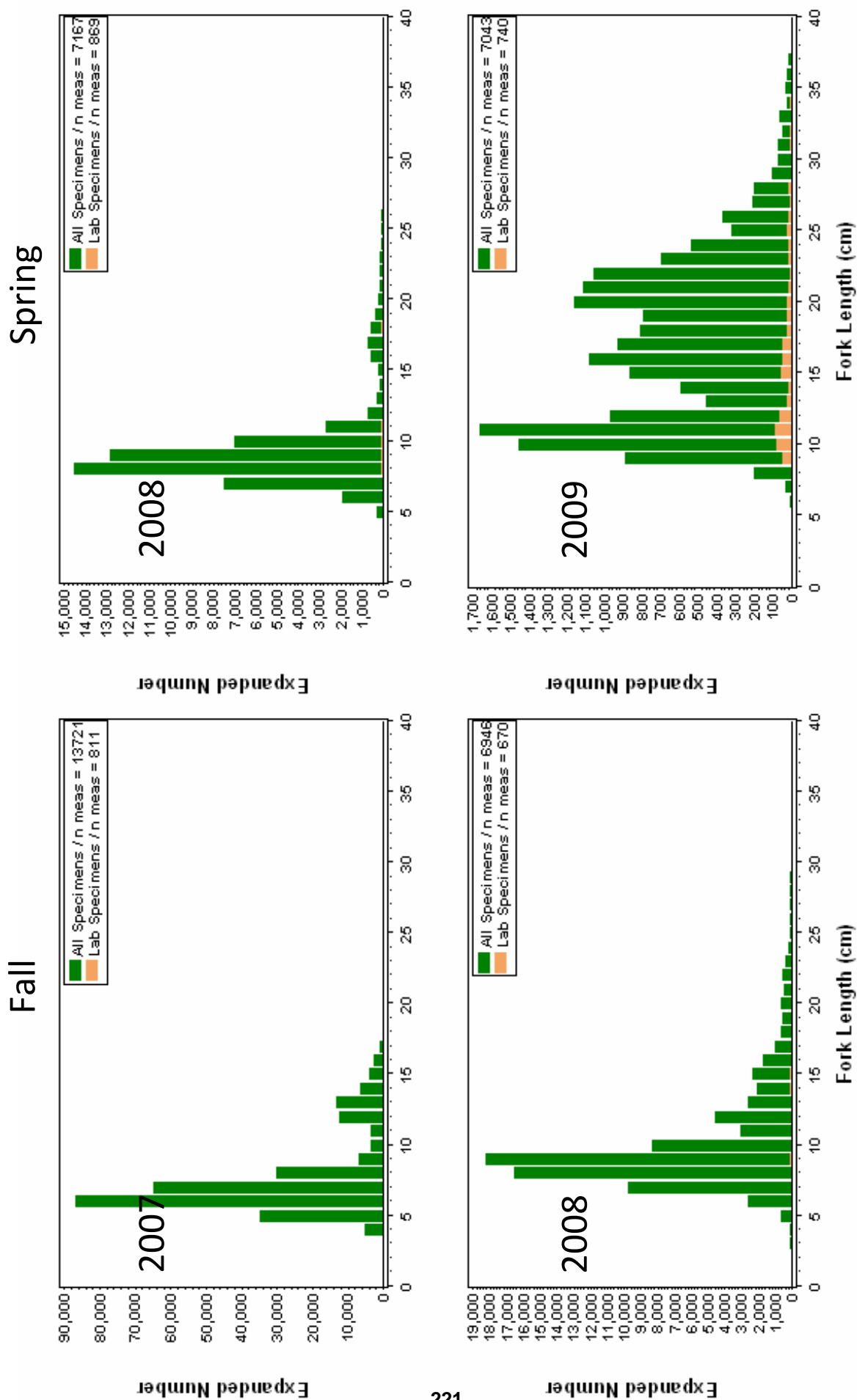


Figure 102. Sex ratio, by length group, for scup collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

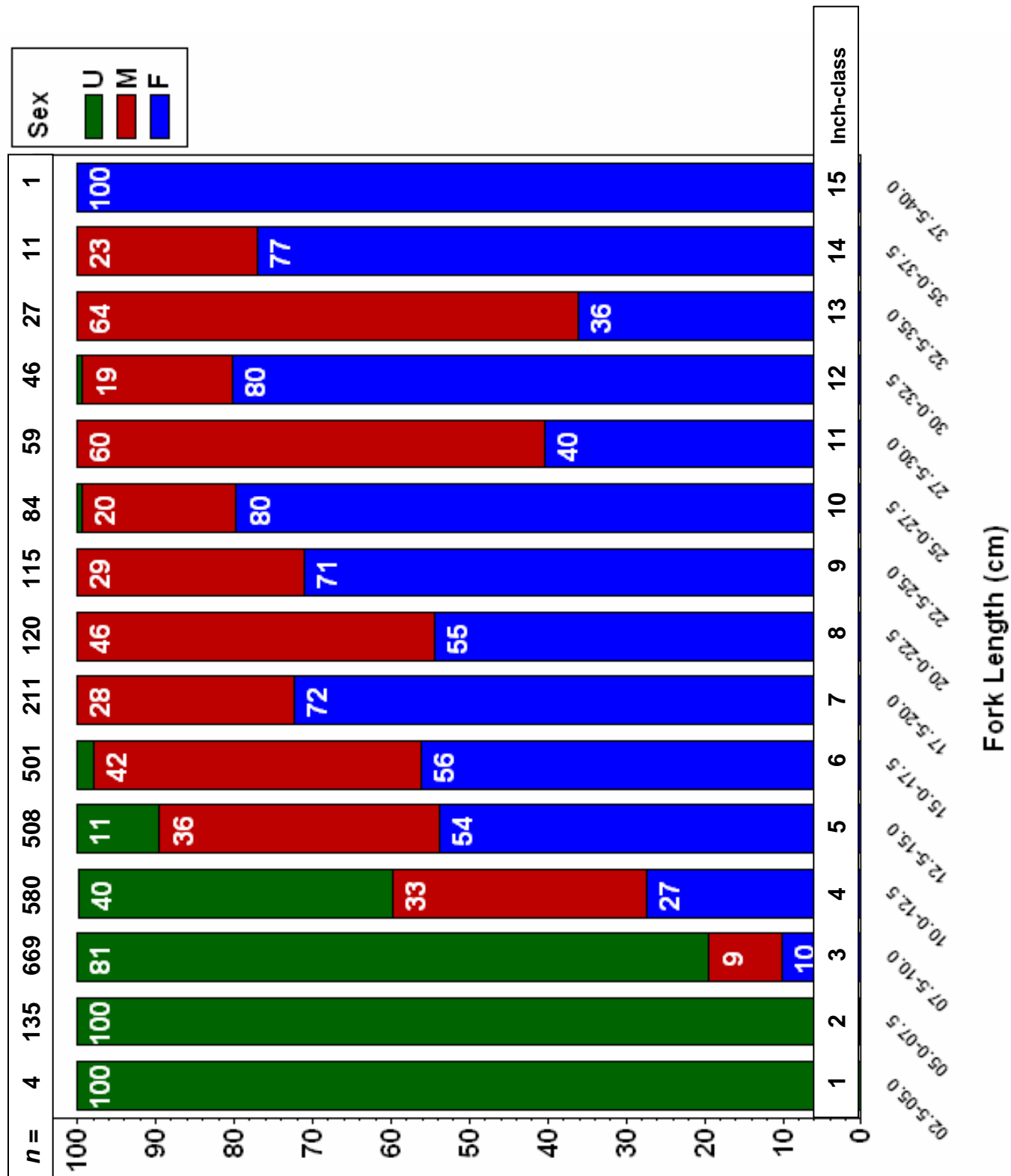


Figure 103. Age-frequency distribution for scup collected during the Fall 2007 cruise. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.

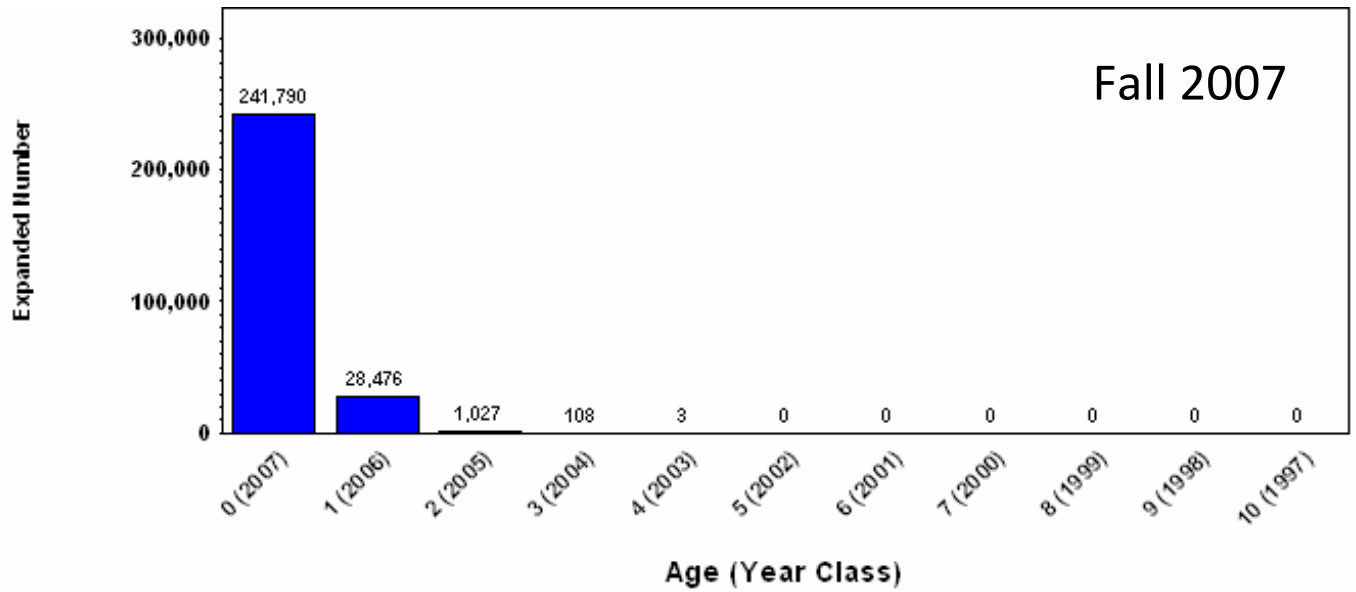
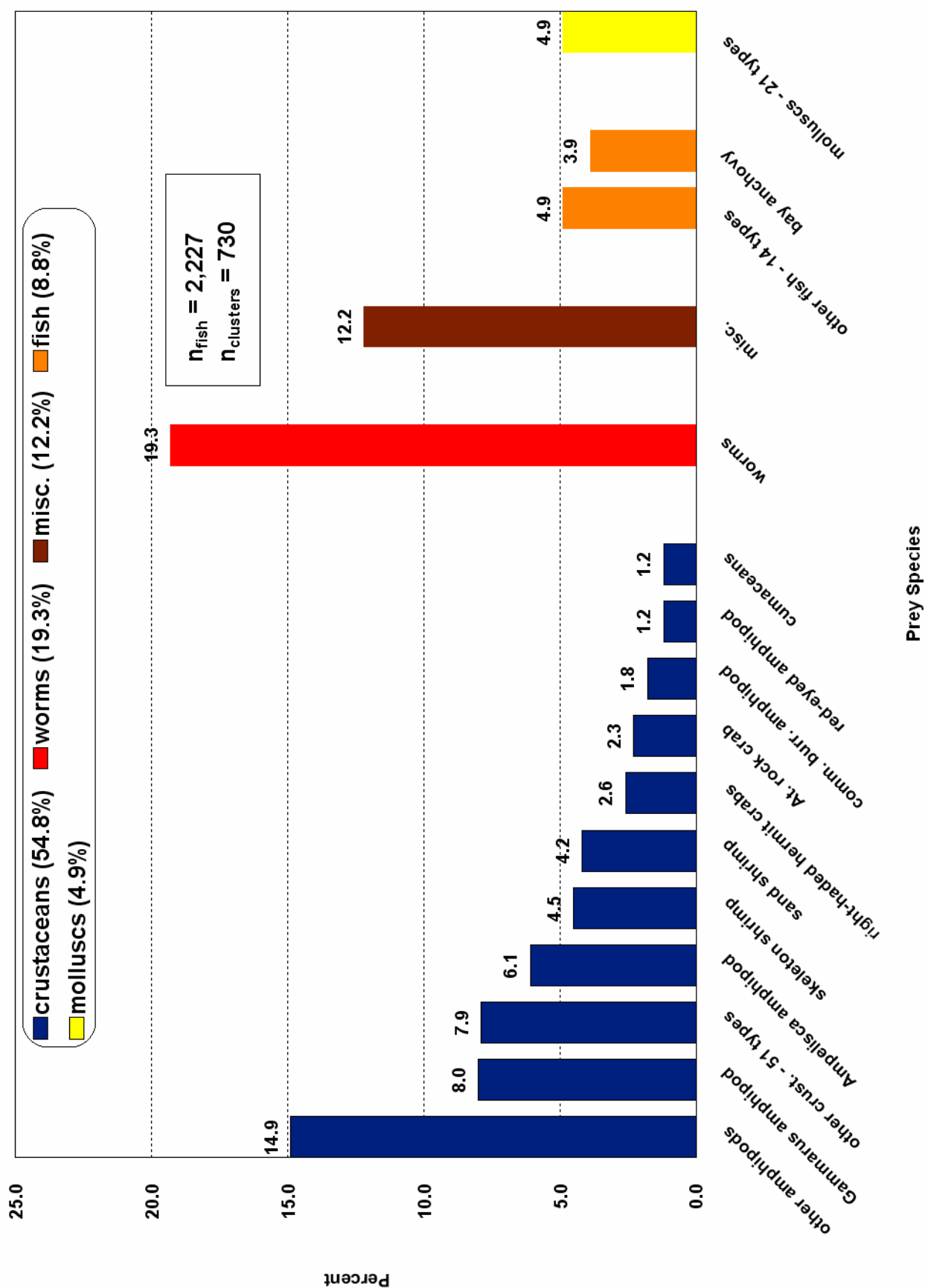




Figure 104. Diet composition, expressed using the percent weight index, of scup collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of scup sampled.



# Silver Hake (Priority A)

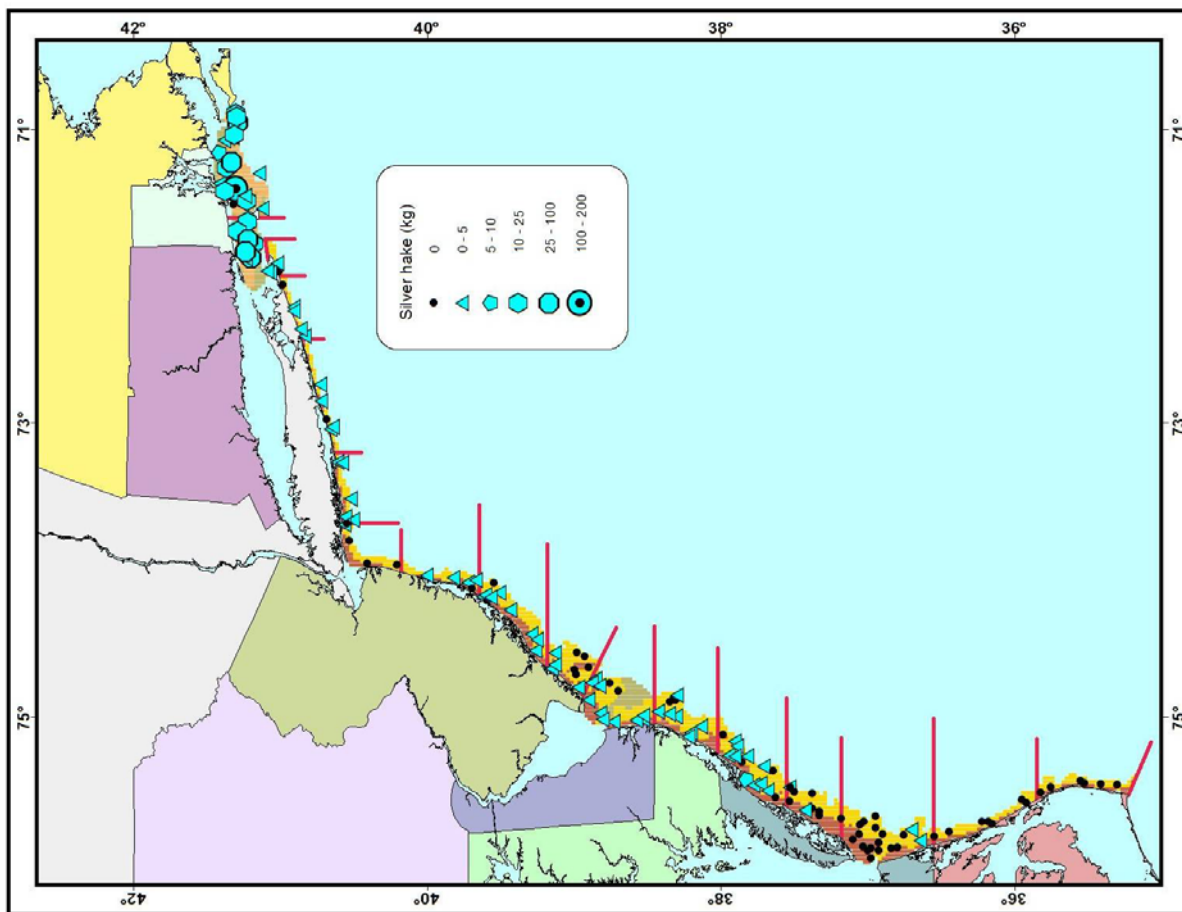


Table 31. Sampling rates and abundance indices of silver hake for four NEAMAP cruises.

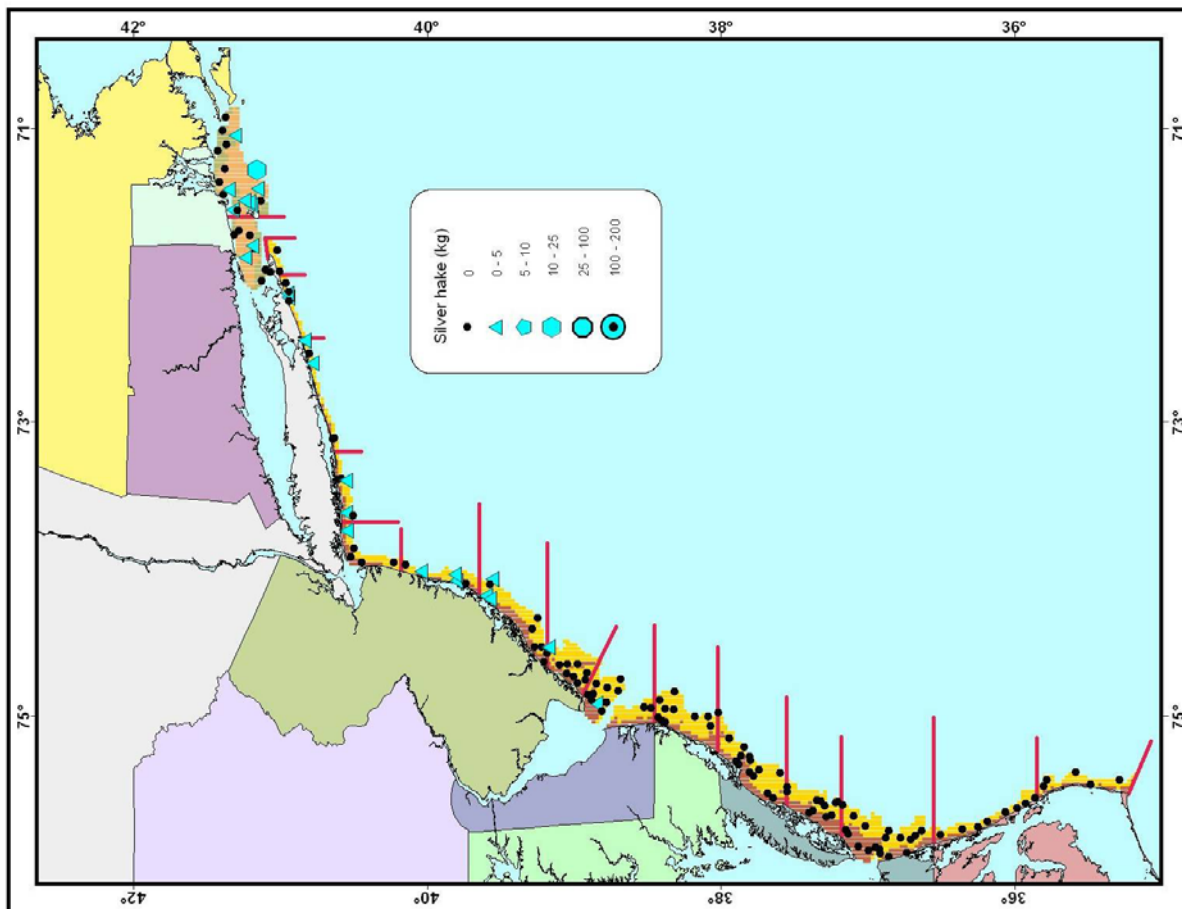
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	346	24.8	346	59	0	59	59	0.32	0.06
2008	Spring	28,765	549.8	3,063	409	0	397	390	6.13	0.73
	Fall	3,125	183.9	515	96	0	88	86	0.48	0.09
2009	Spring	5,153	105.7	1,789	406	0	402	392	3.10	0.28

Figure 105. Biomass (kg) of silver hake collected at each sampling site for four NEAMAP cruises.

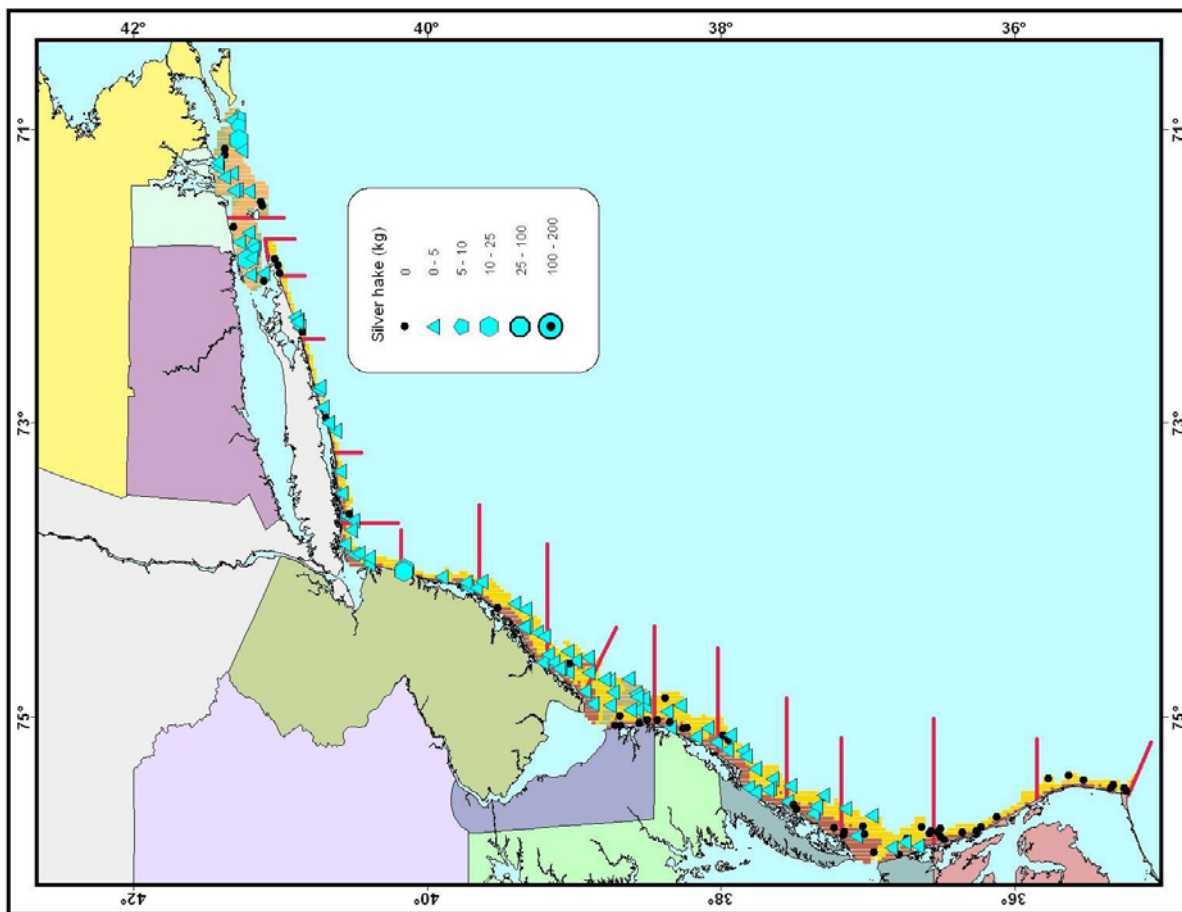
Spring 2008



Fall 2007



Spring 2009



Fall 2008

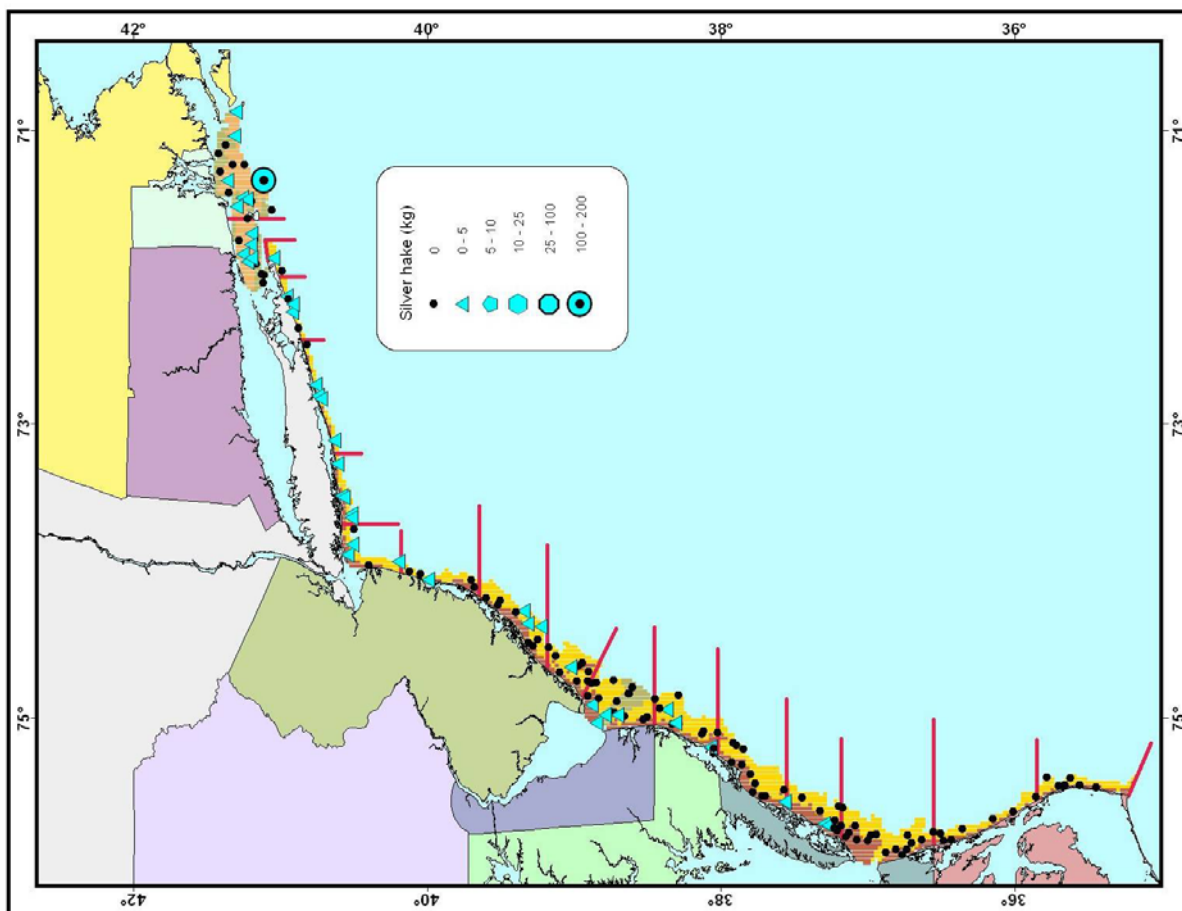


Figure 106. Preliminary indices of abundance, in terms of number and biomass, of silver hake for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

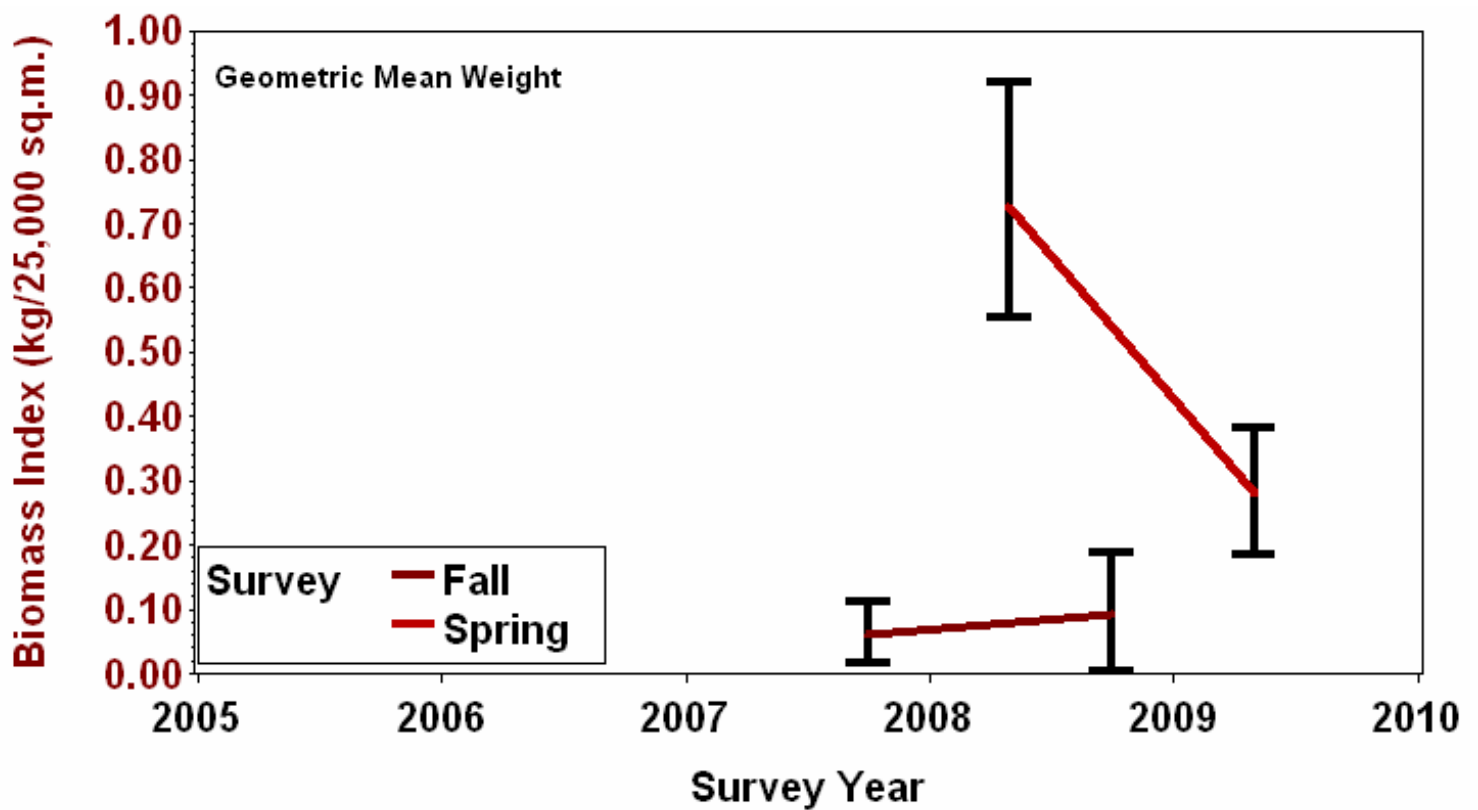
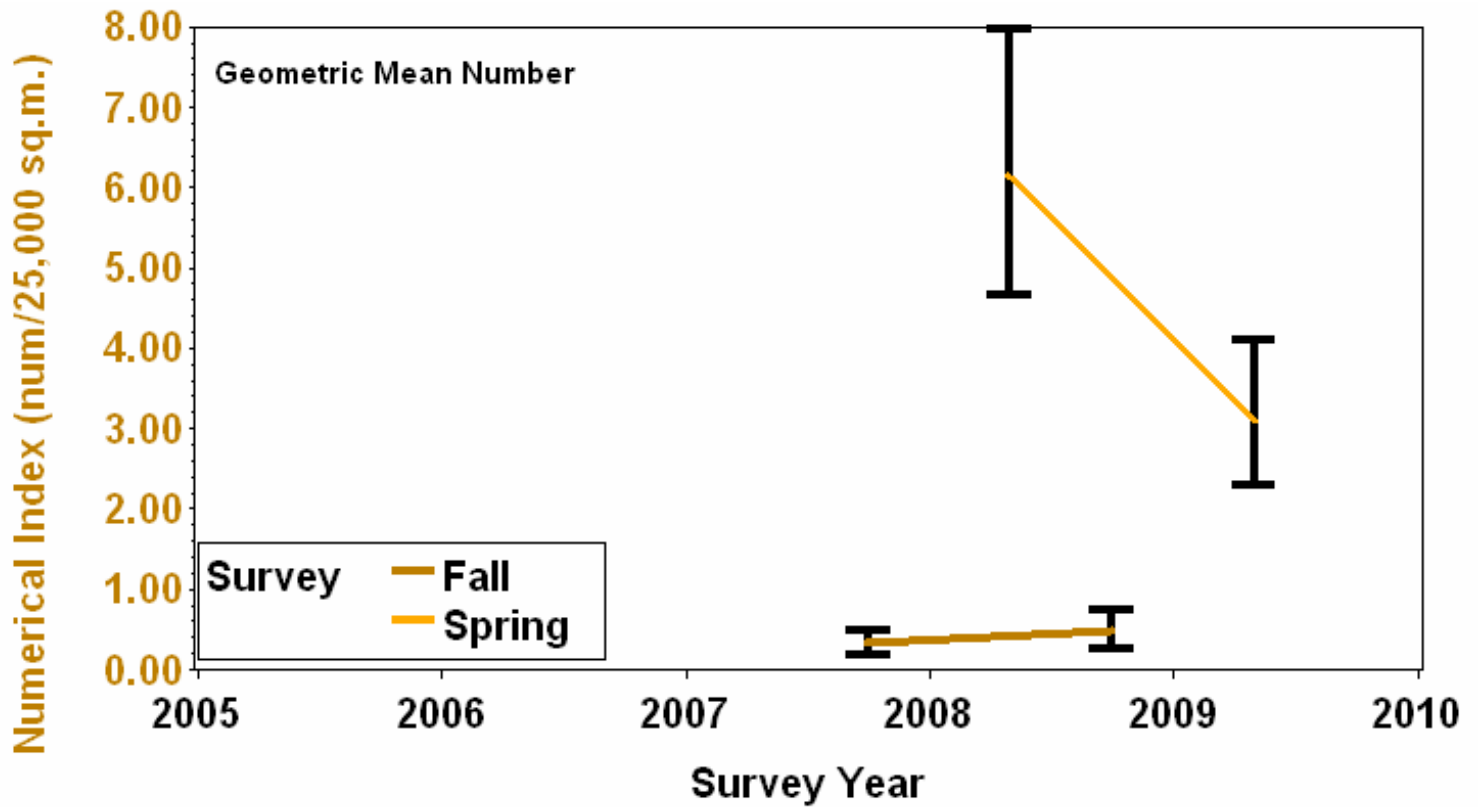


Figure 107. Length-frequency distributions, by cruise, for silver hake. Numbers taken for full processing, by length, are represented by the orange bars.

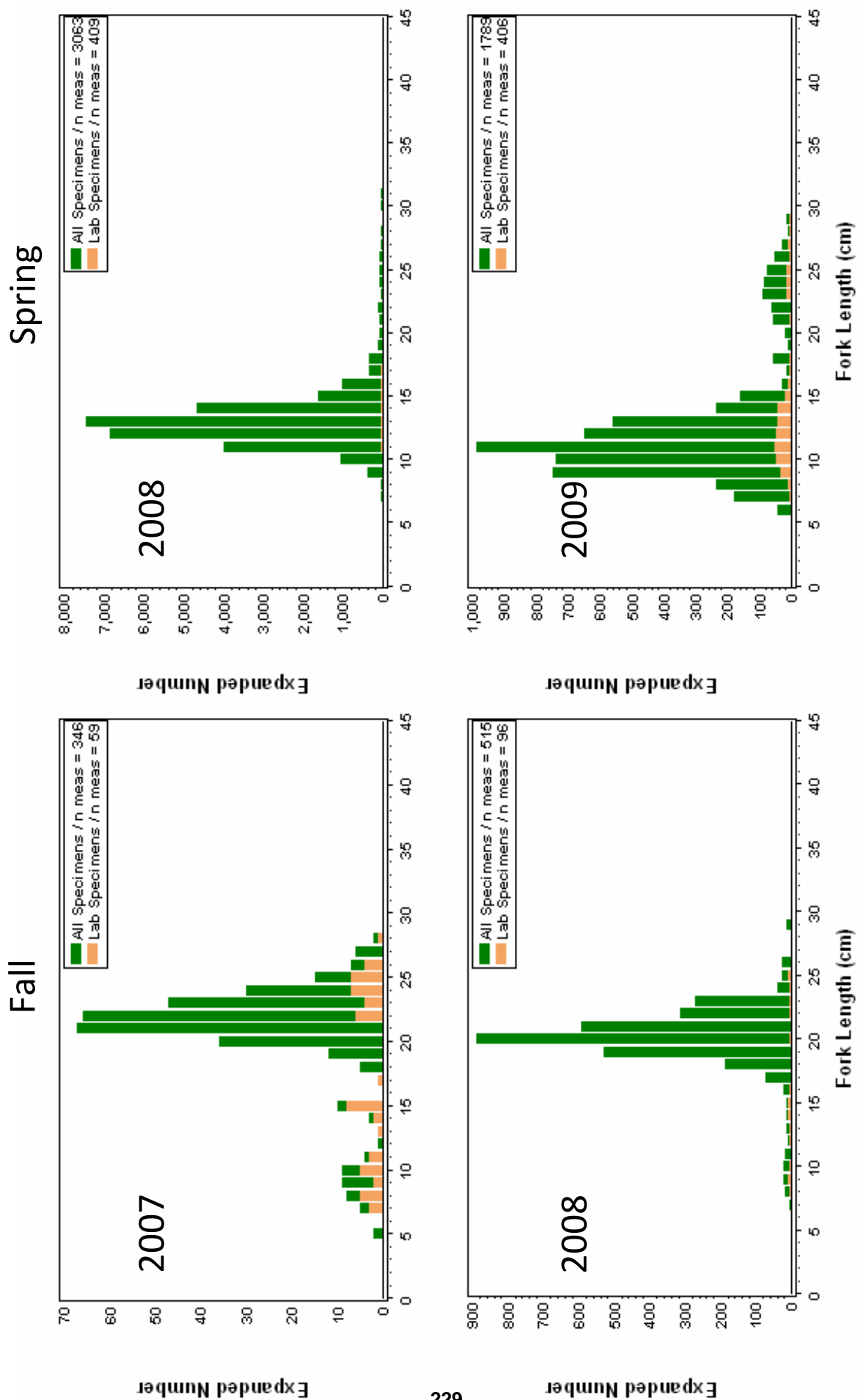


Figure 108. Sex ratio, by length group, for silver hake collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

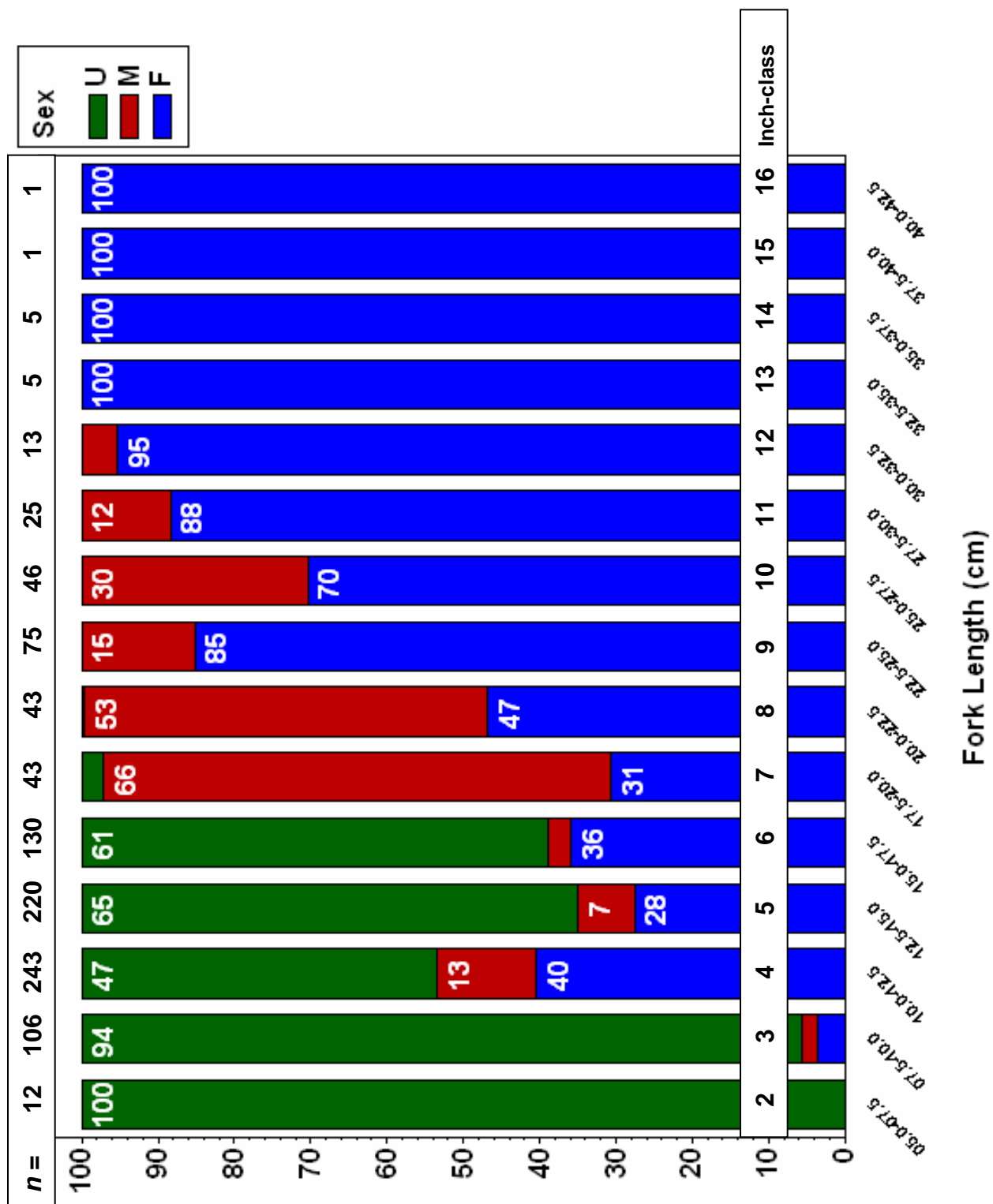
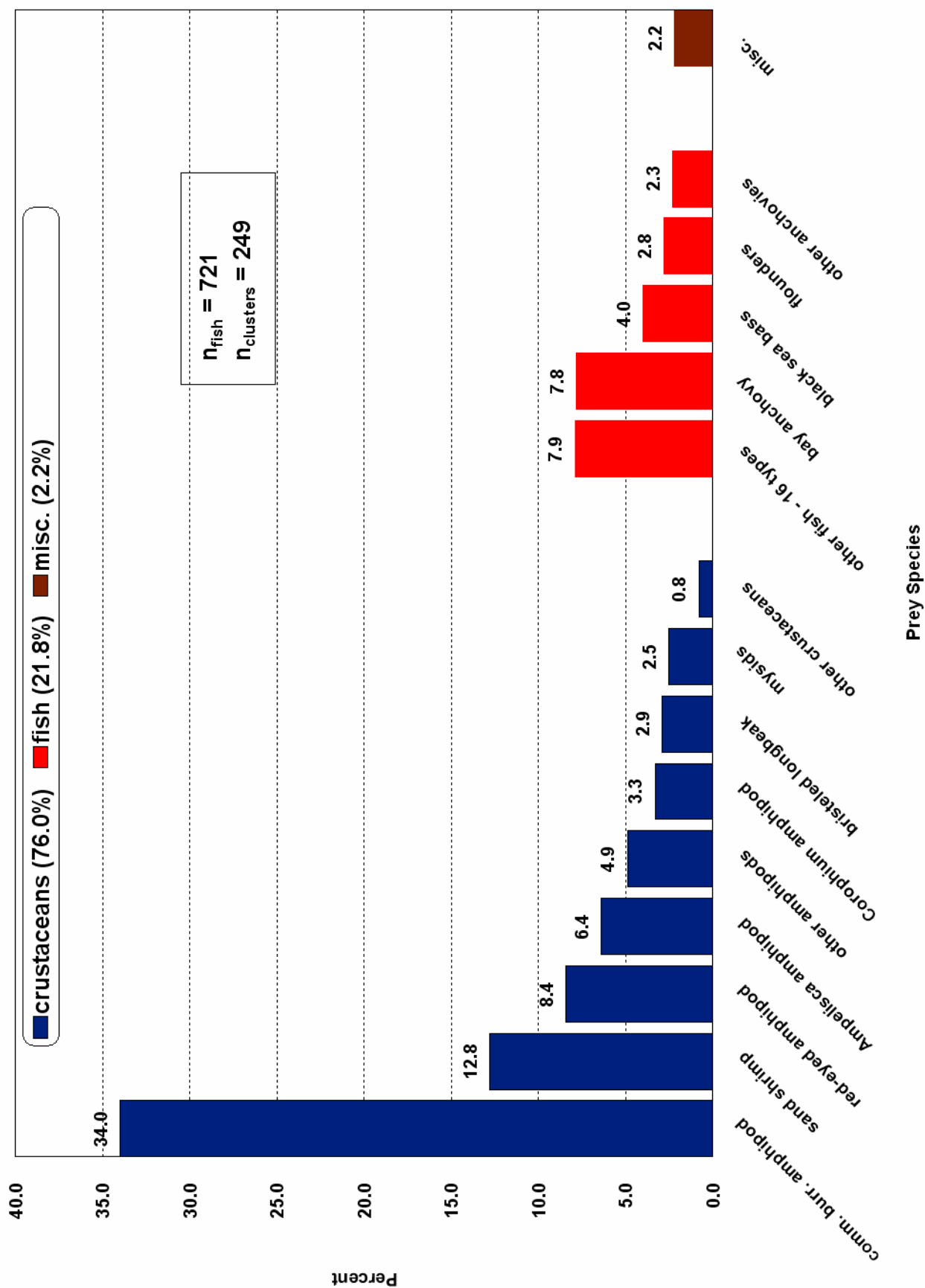


Figure 109. Diet composition, expressed using the percent weight index, of silver hake collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of hake sampled.







# Silver Perch (Priority D)

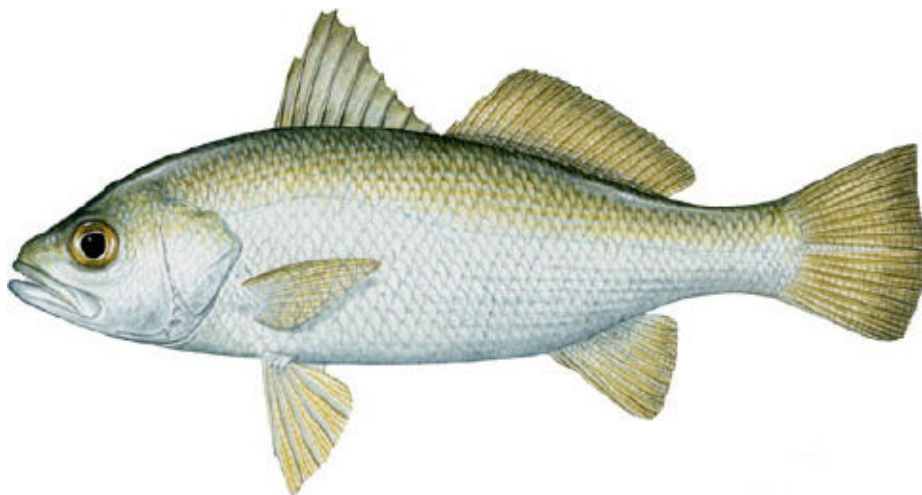
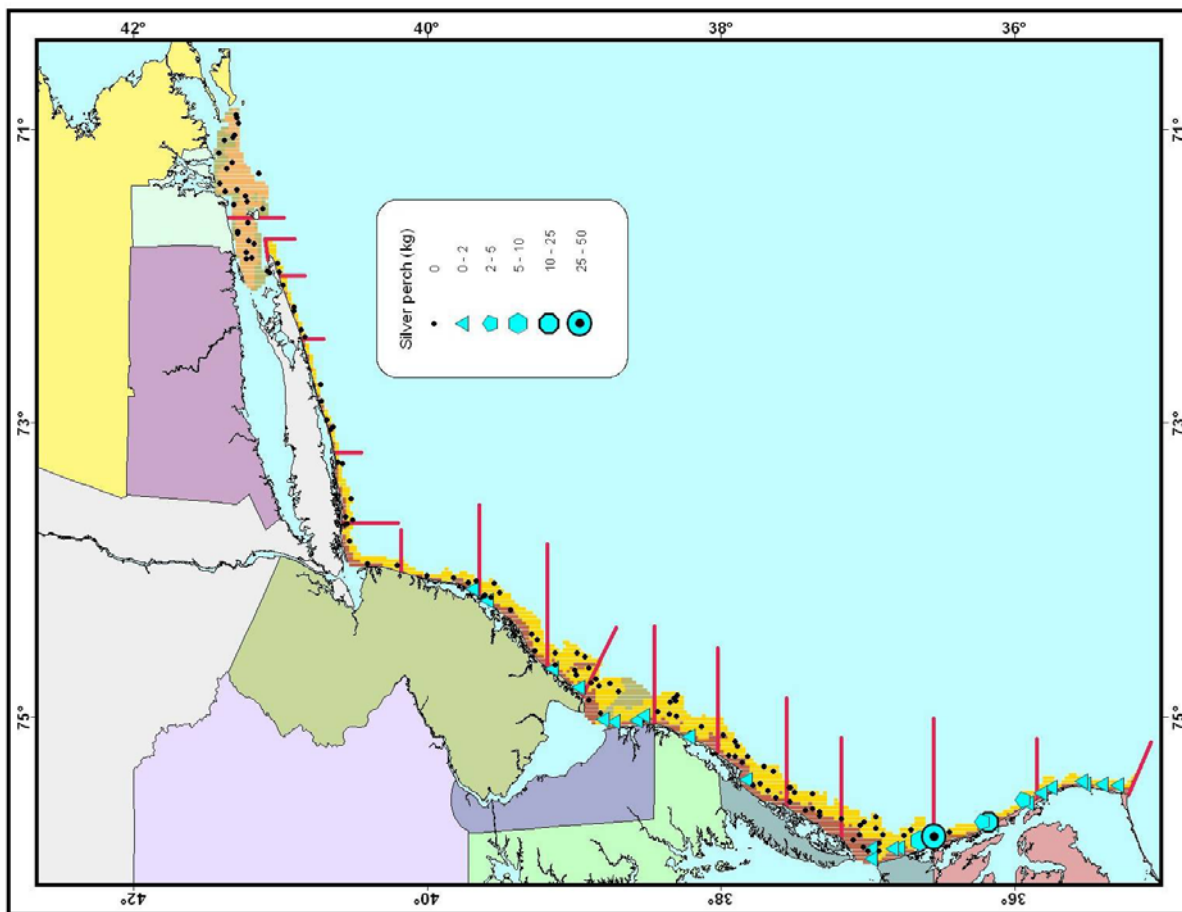


Table 32. Sampling rates and abundance indices of silver perch for four NEAMAP cruises.

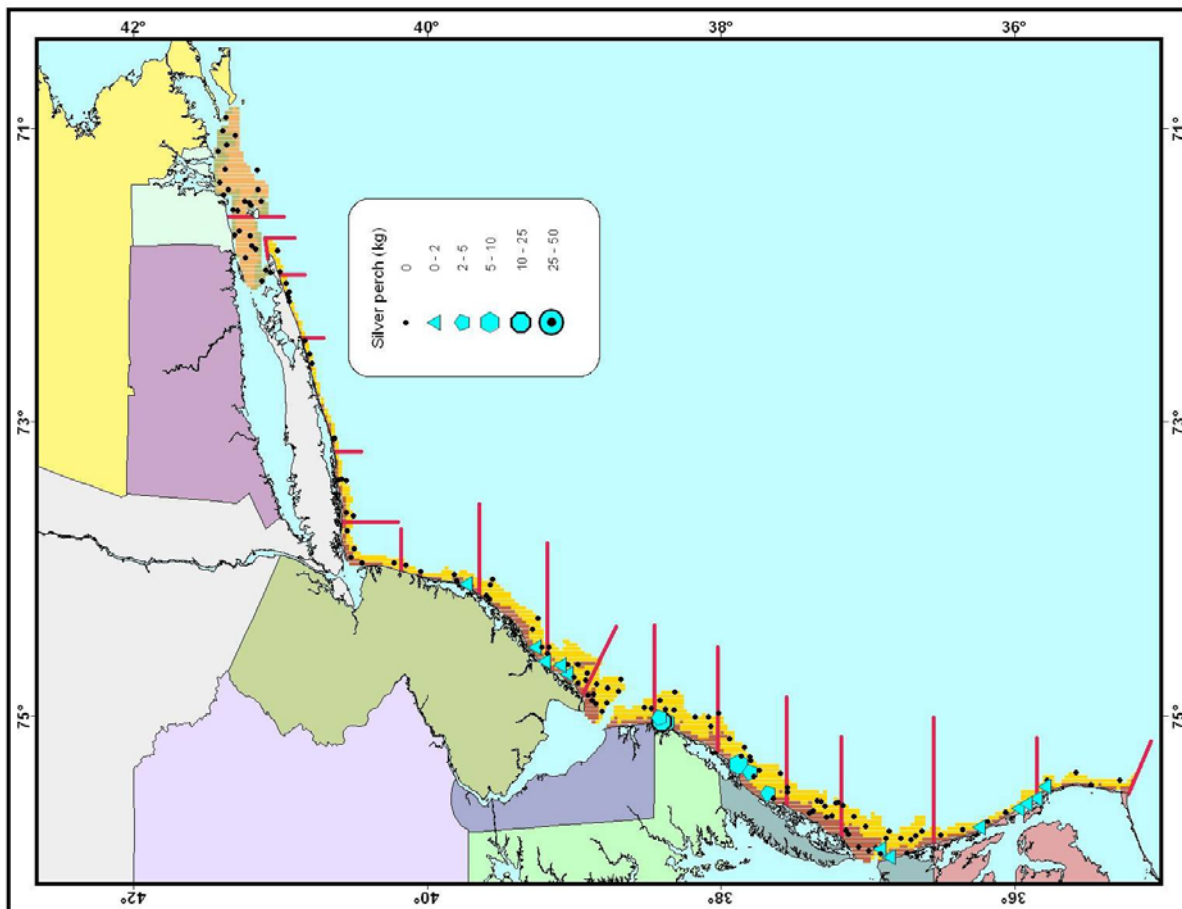
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	1,398	39.0	141	0		0		0.37	0.09
2008	Spring	2,663	90.8	316	0		0		0.53	0.12
	Fall	1,793	58.0	845	0		0		0.96	0.19
2009	Spring	1,657	41.1	218	0		0		0.27	0.06

Figure 110. Biomass (kg) of silver perch collected at each sampling site for four NEAMAP cruises.

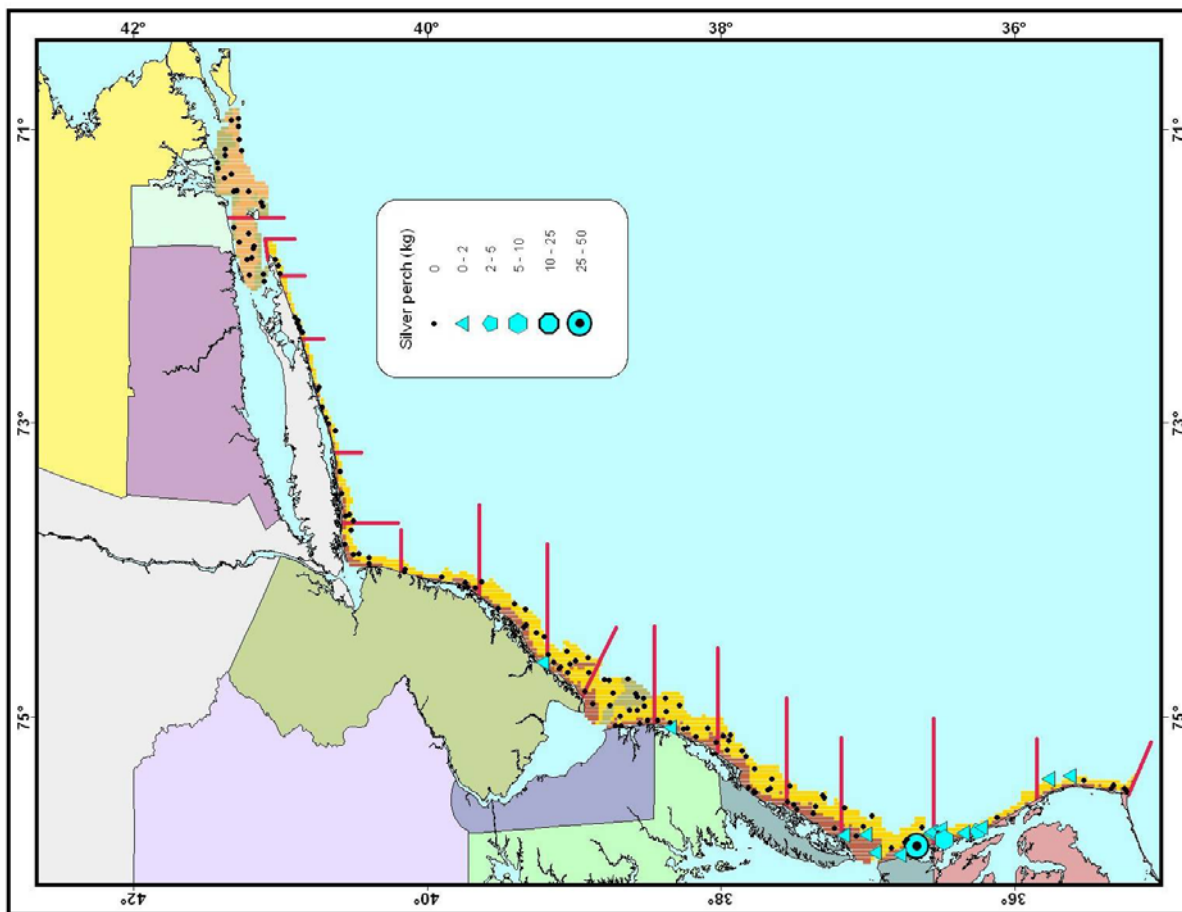
Spring 2008



Fall 2007



Spring 2009



Fall 2008

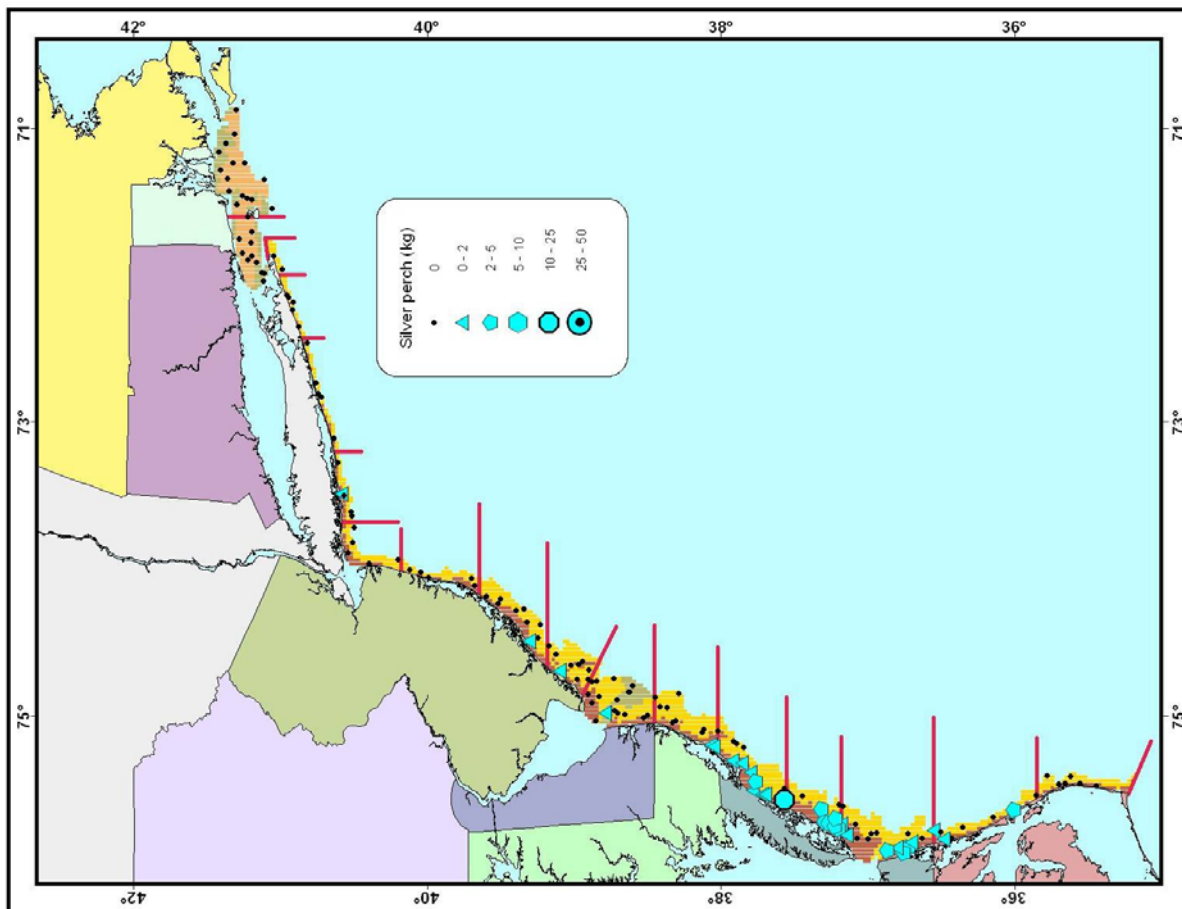


Figure 111. Preliminary indices of abundance, in terms of number and biomass, of silver perch for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

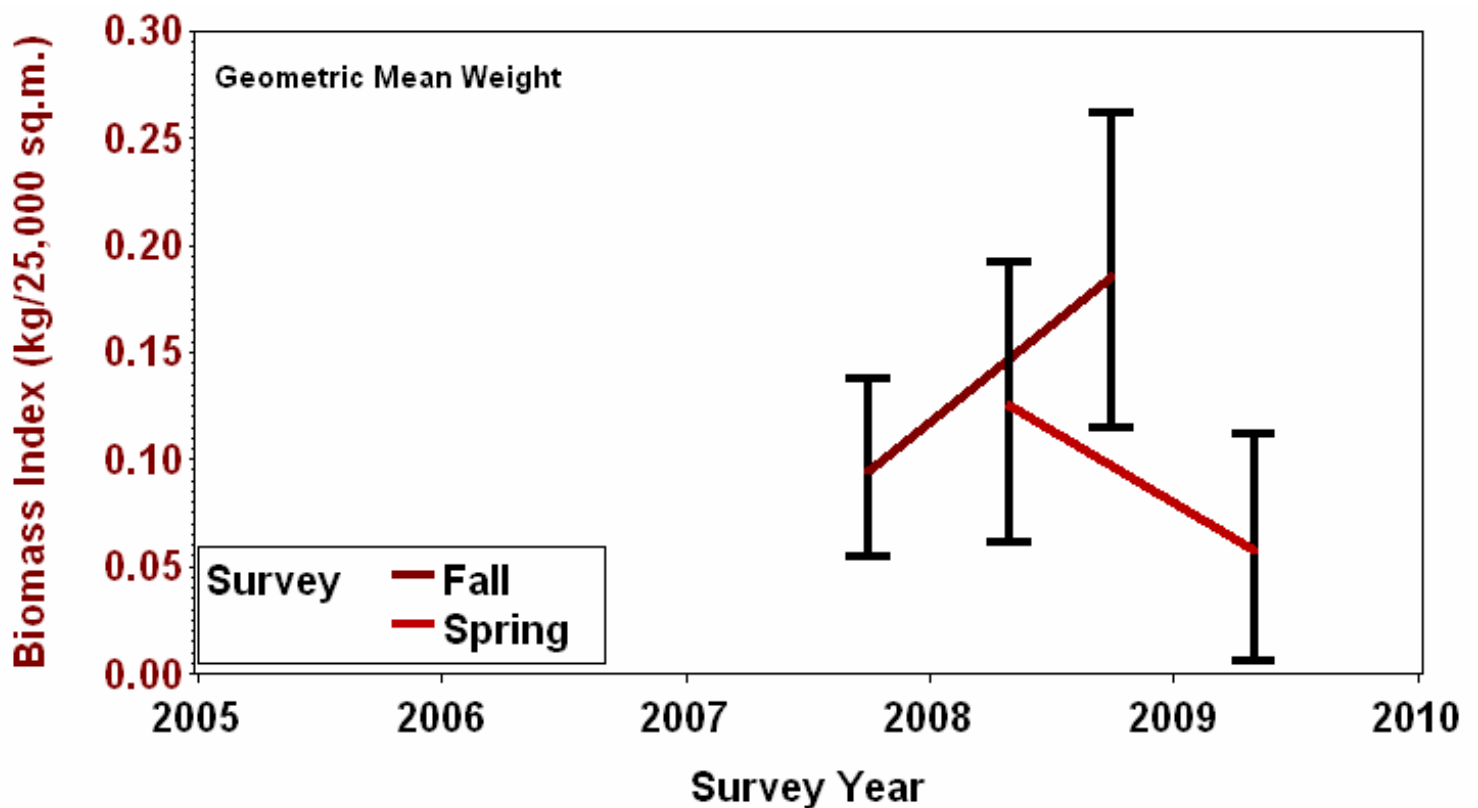
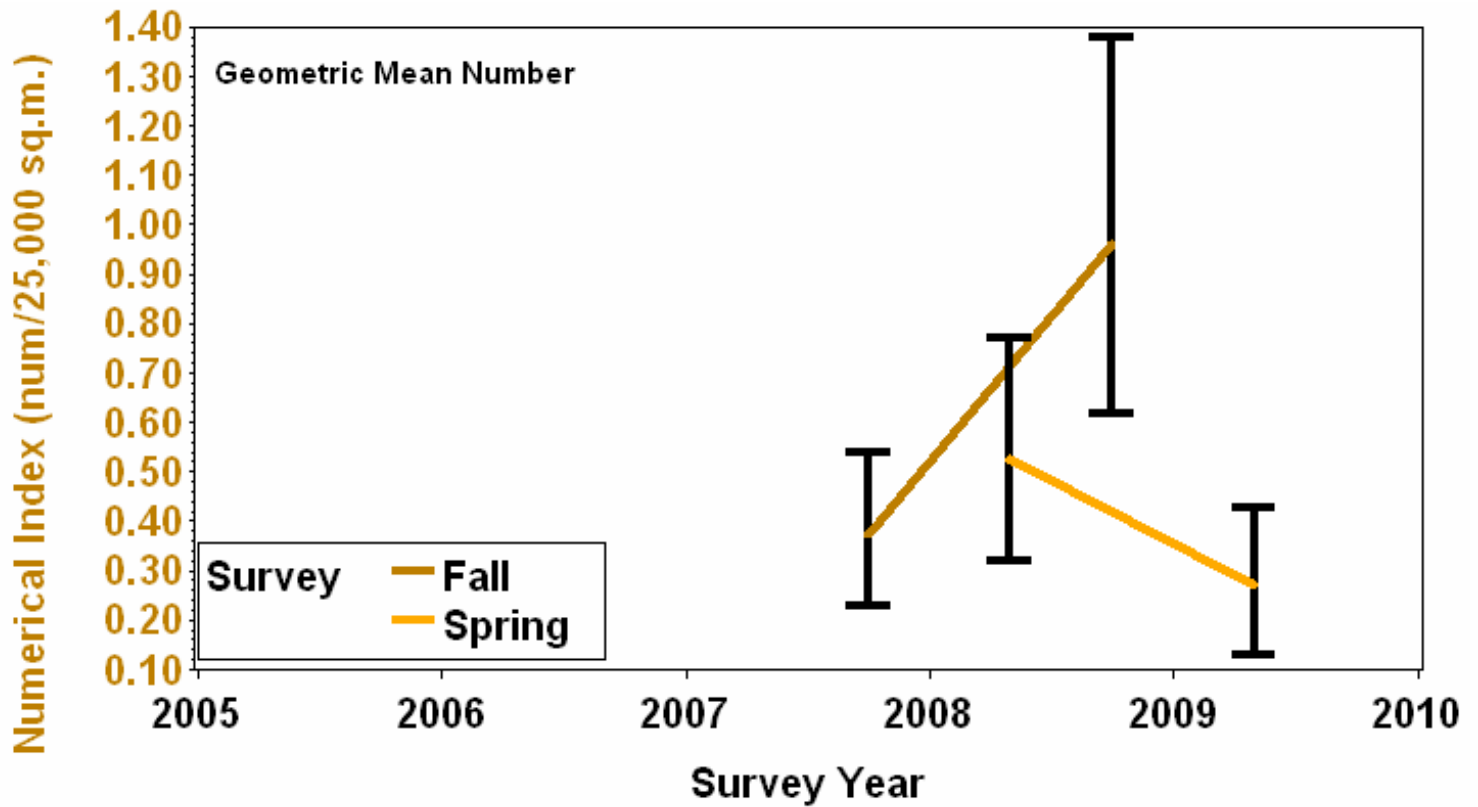
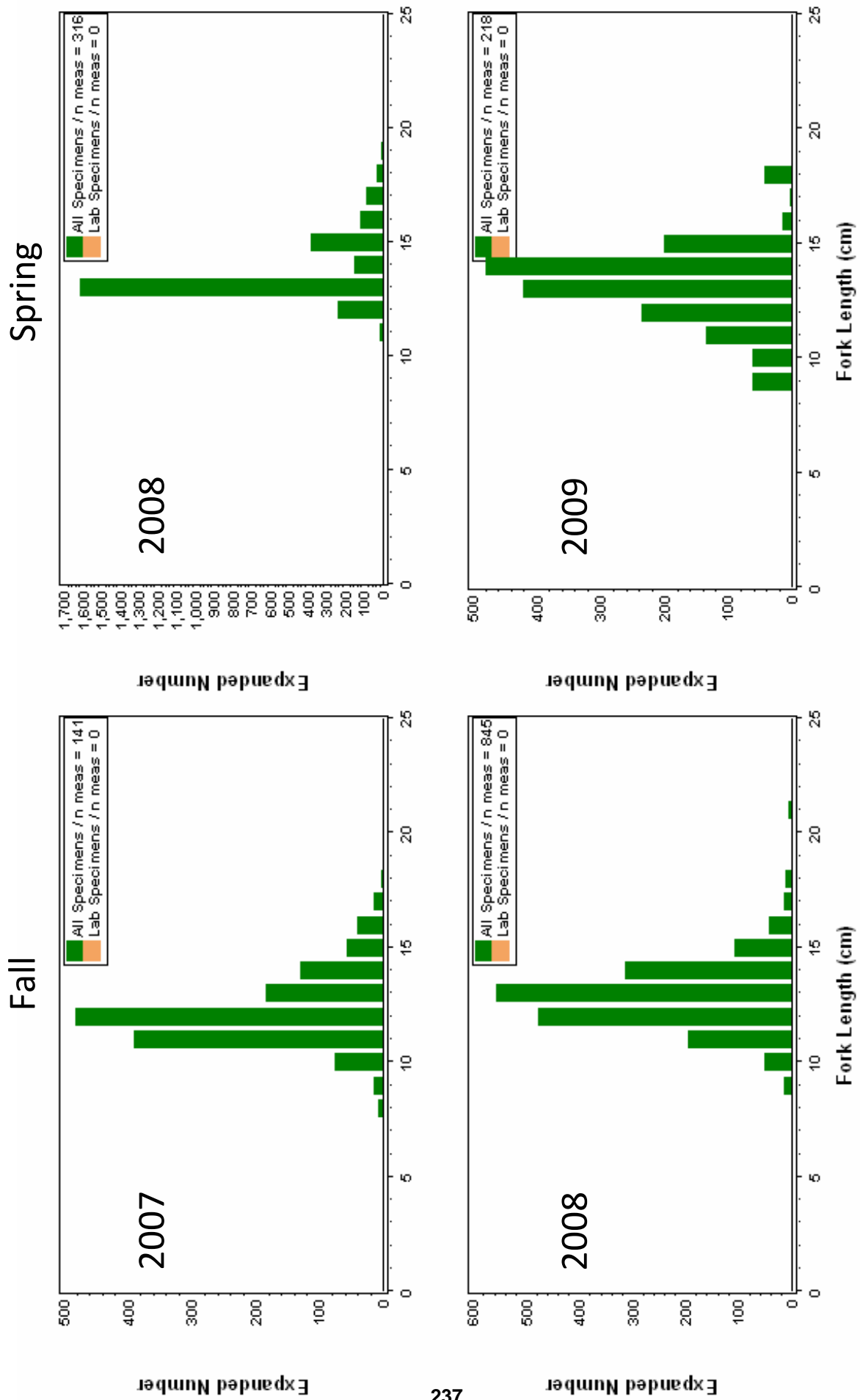


Figure 112. Length-frequency distributions, by cruise, for silver perch.





# Smooth Butterfly Ray (Priority E)



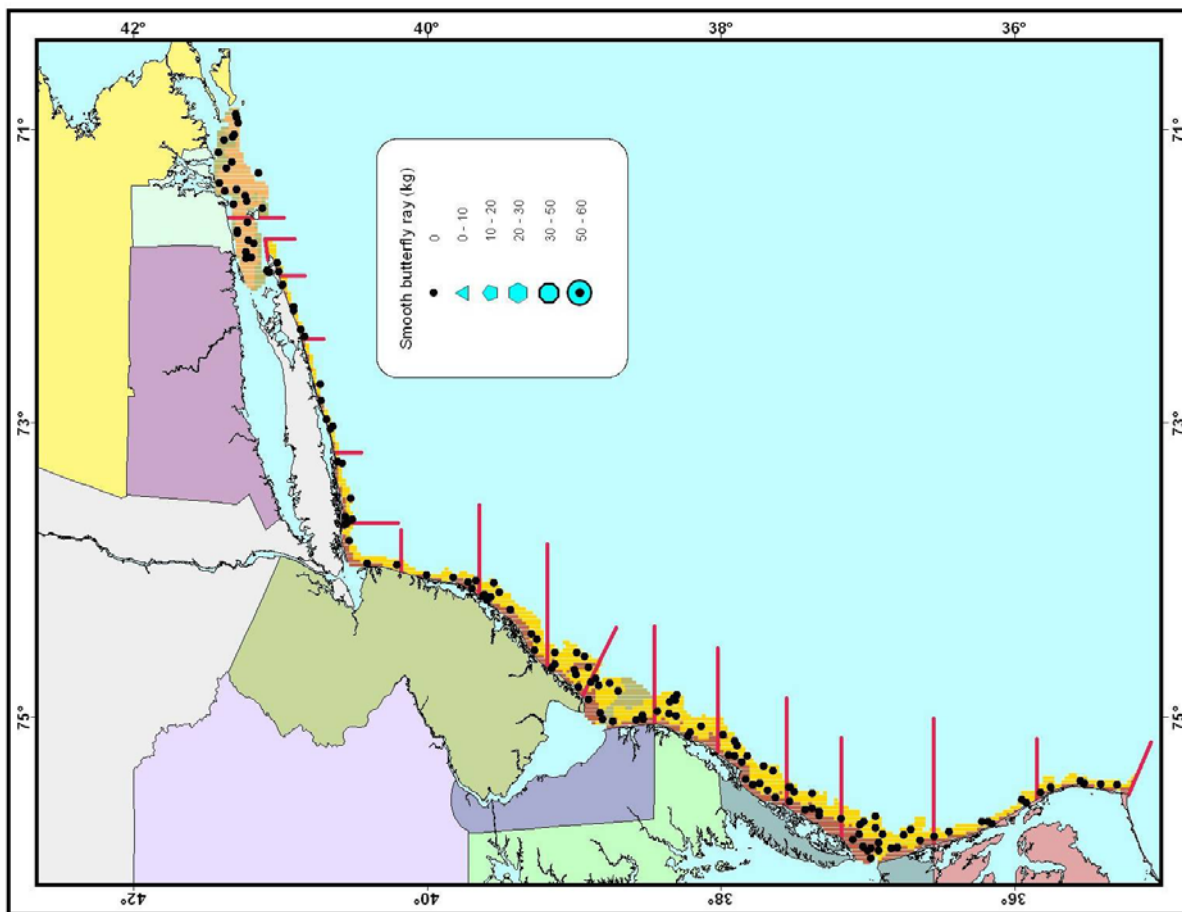
Table 33. Sampling rates and abundance indices of smooth butterfly ray for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	292	557.1	292	0		0		0.41	0.64
2008	Spring	0	0.0	0	0		0		0.00	0.00
	Fall	227	346.6	195	0		0		0.49	0.59
2009	Spring	2	4.5	2	0		0		0.00	0.01

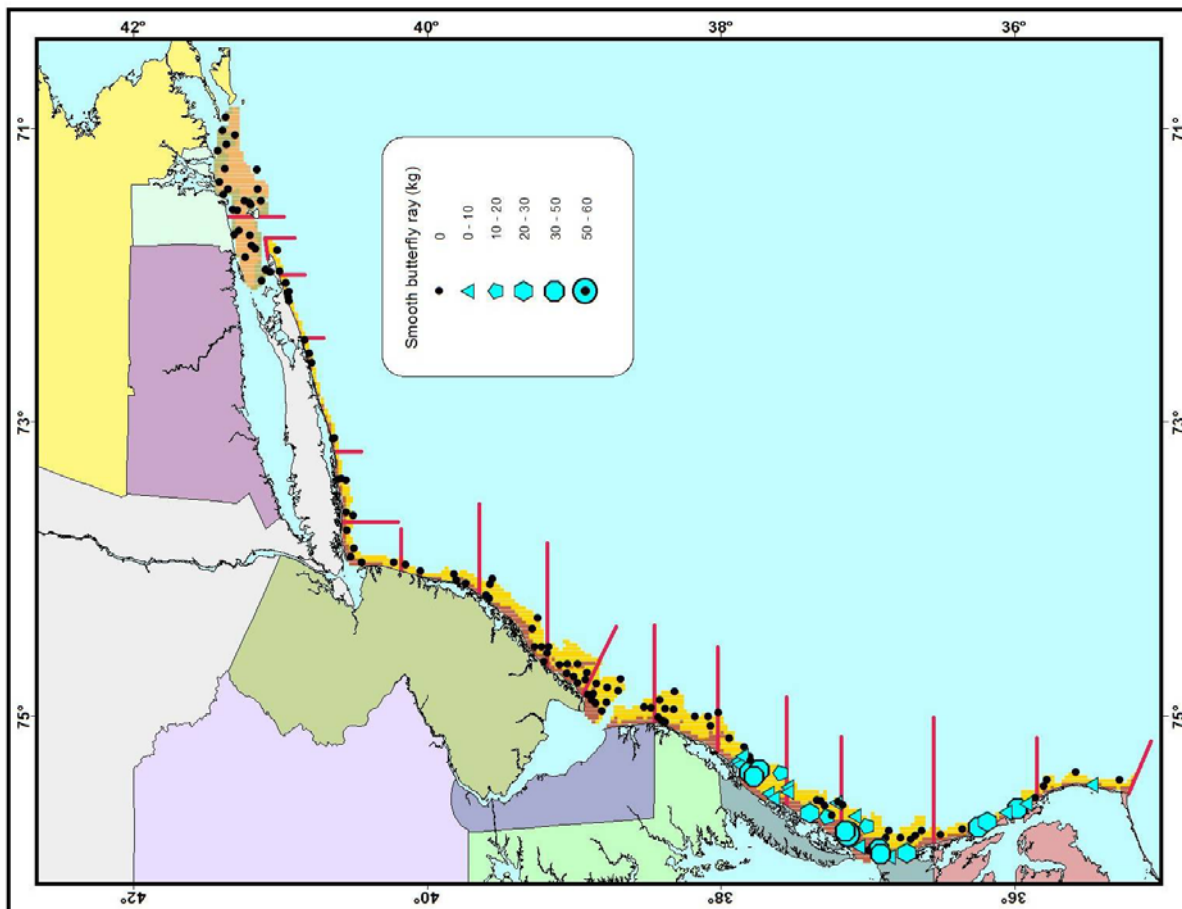


Figure 113. Biomass (kg) of smooth butterfly ray collected at each sampling site for four NEAMAP cruises.

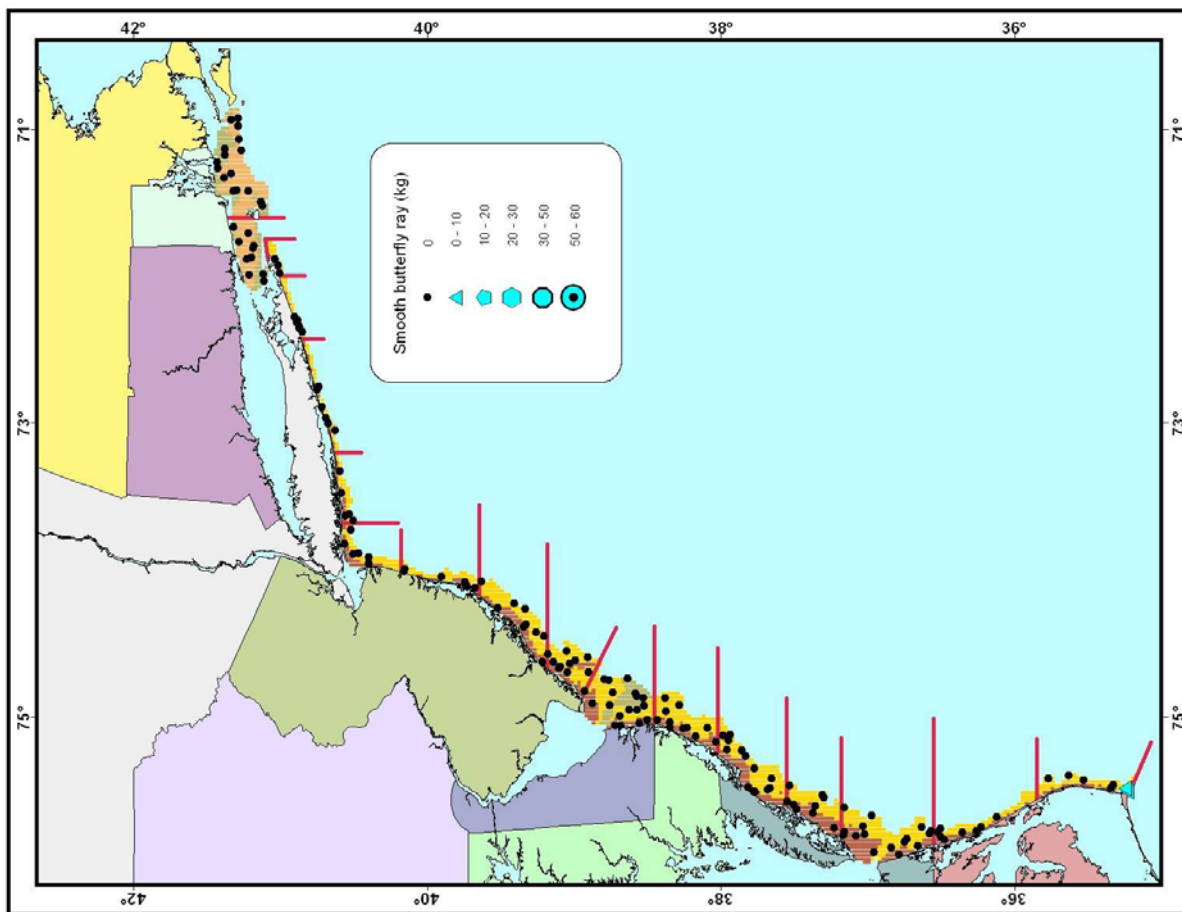
Spring 2008



Fall 2007



Spring 2009



Fall 2008

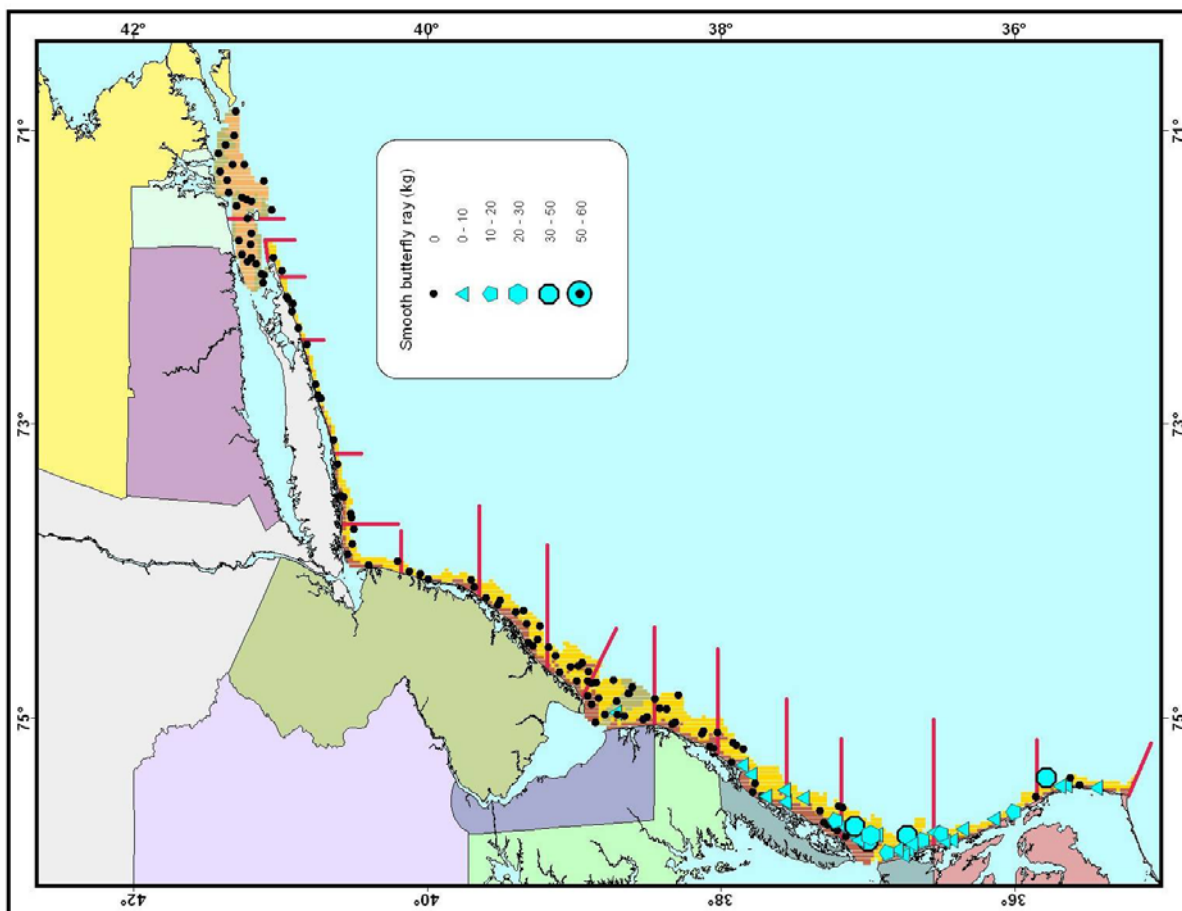


Figure 114. Preliminary indices of abundance, in terms of number and biomass, of smooth butterfly ray for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

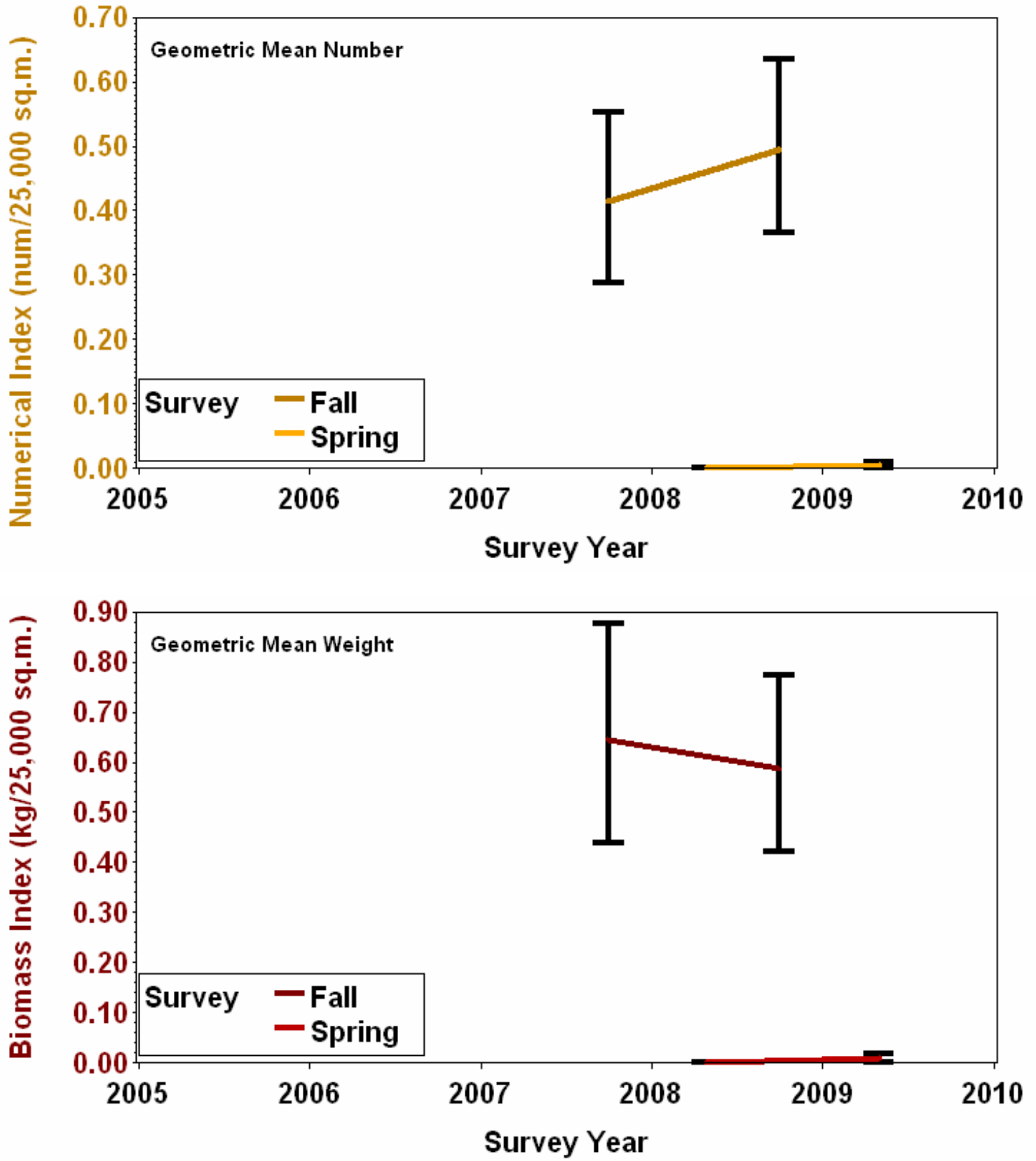
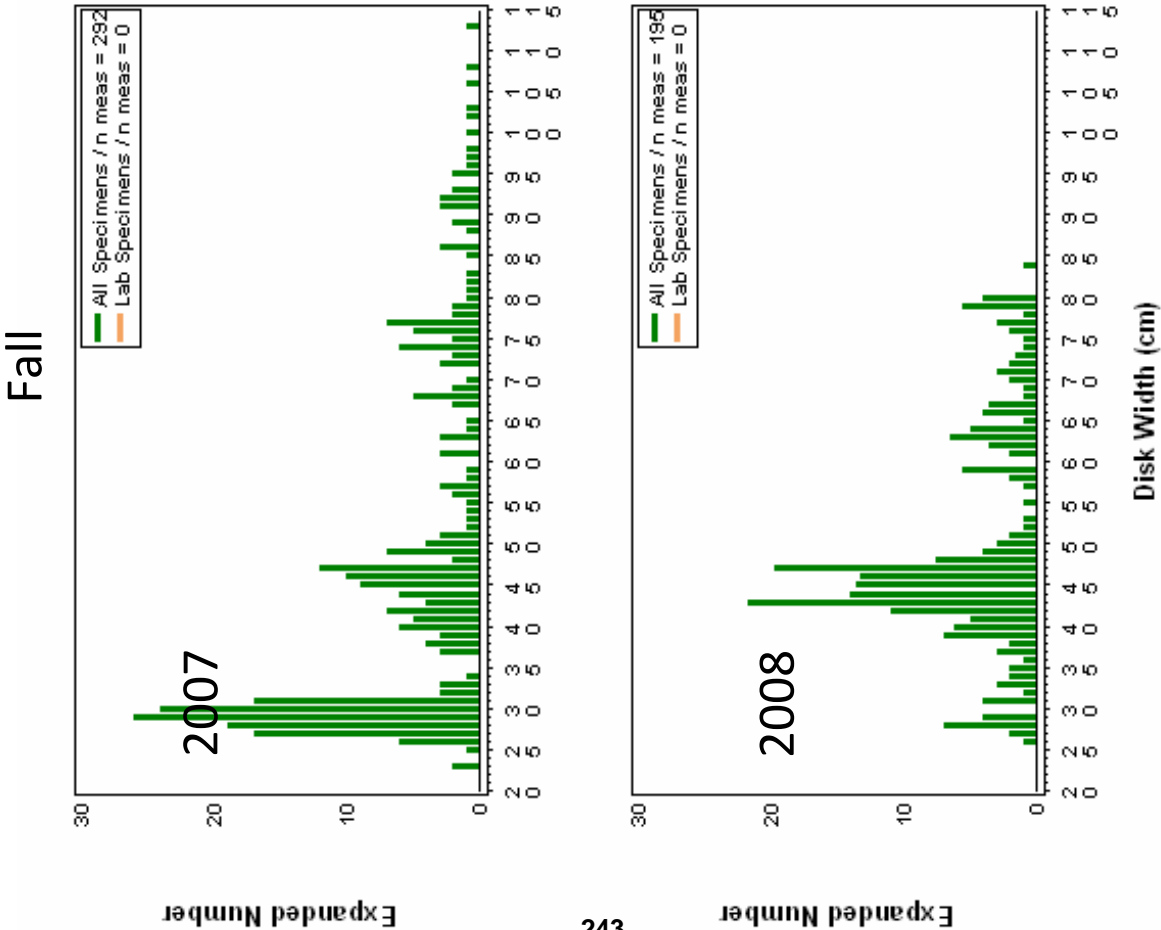


Figure 115. Length-frequency distributions, by cruise, for smooth butterfly ray. This species was absent from spring survey collections.





# Smooth Dogfish (Priority B)

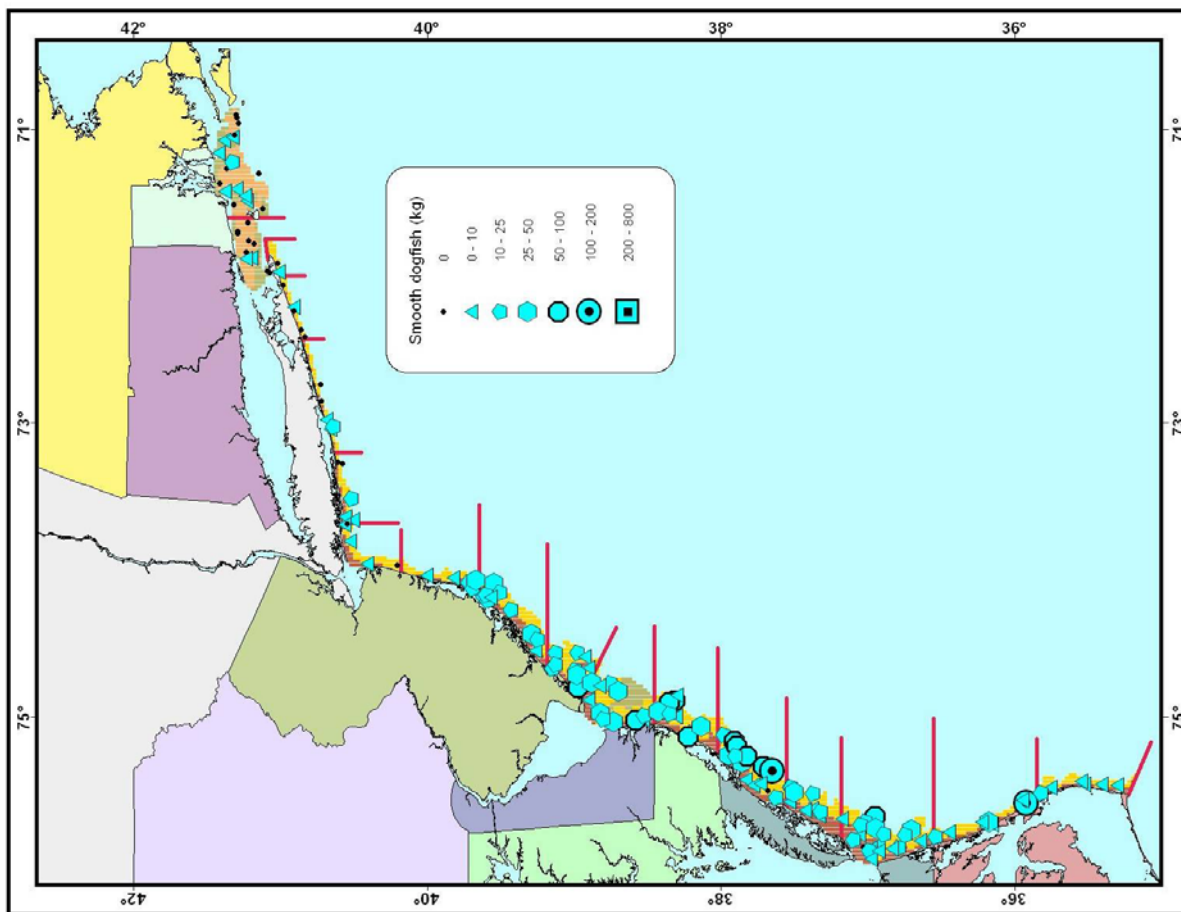


Table 34. Sampling rates and abundance indices of smooth dogfish for four NEAMAP cruises.

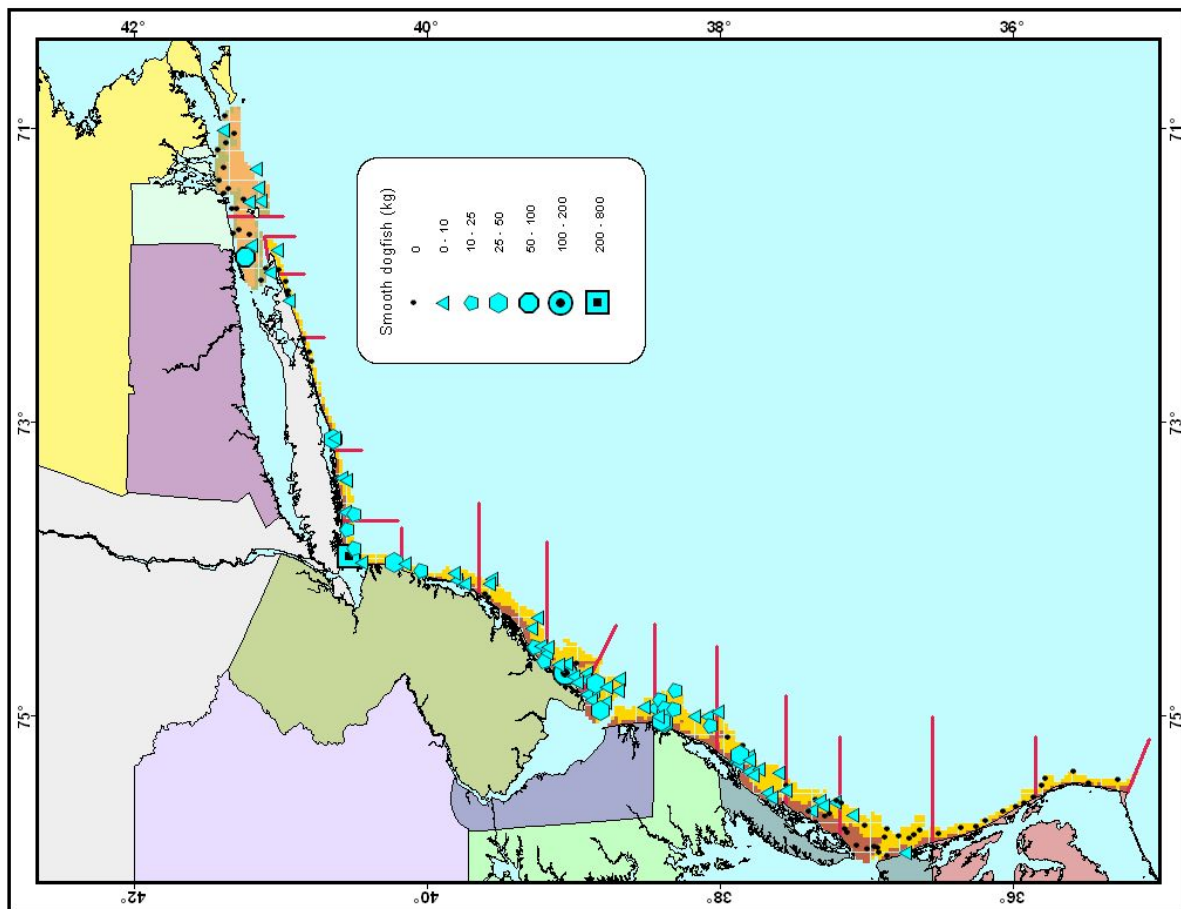
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	1,690	1,555.6	765	202	0	200	192	1.95	1.75
2008	Spring	927	2,501.7	688	297	0	288	286	3.34	7.49
	Fall	414	365.4	386	162	0	161	160	1.07	0.95
2009	Spring	947	2,741.4	725	236	0	221	207	2.24	4.55

Figure 116. Biomass (kg) of smooth dogfish collected at each sampling site for four NEAMAP cruises.

Spring 2008

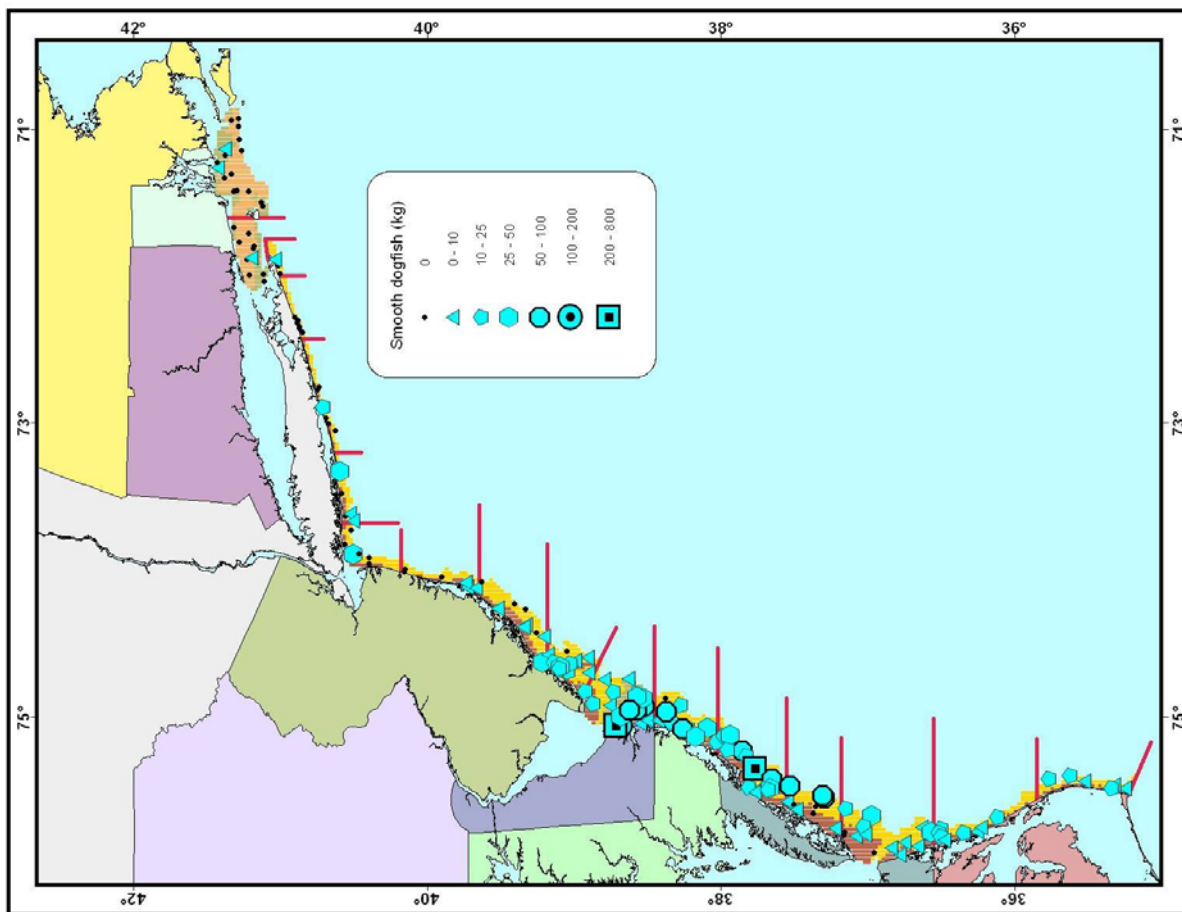


Fall 2007





Spring 2009



Fall 2008

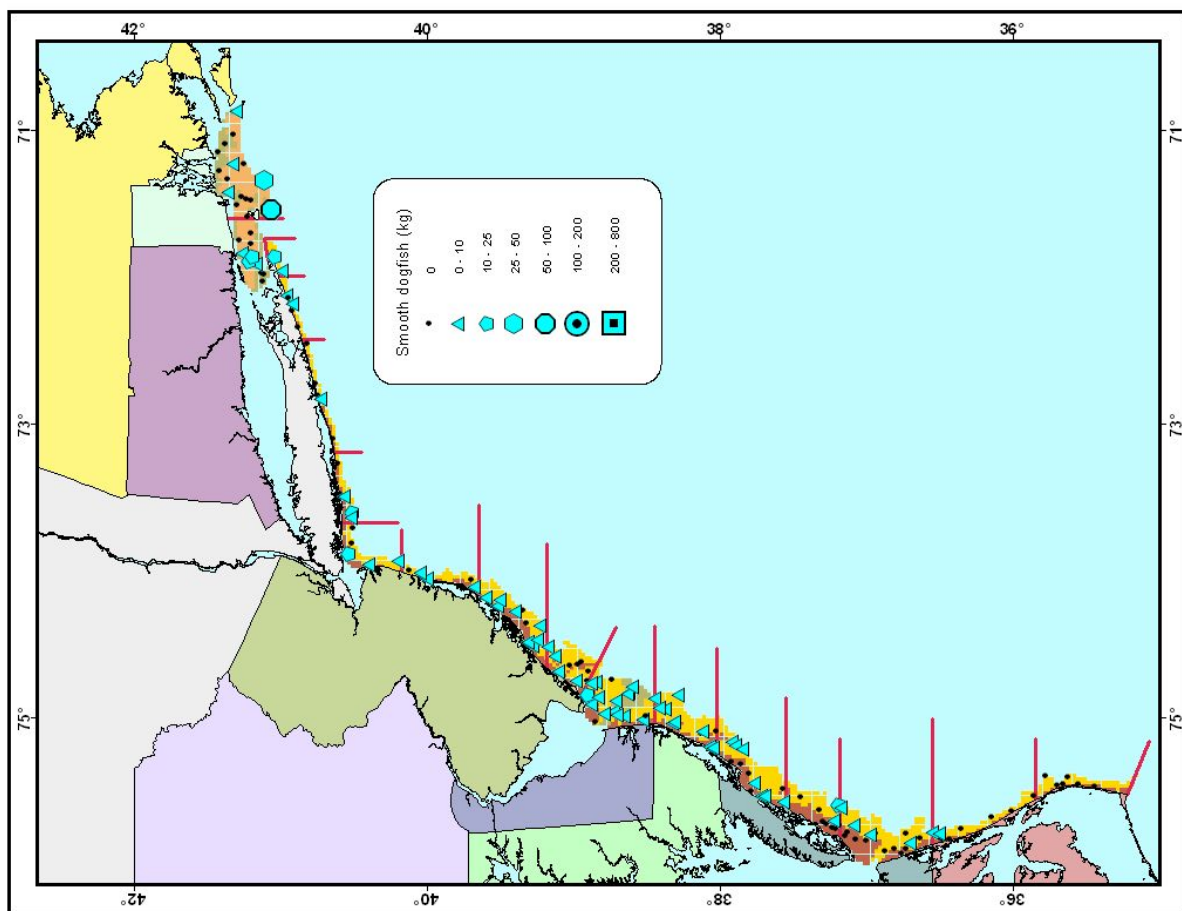




Figure 117. Preliminary indices of abundance, in terms of number and biomass, of smooth dogfish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

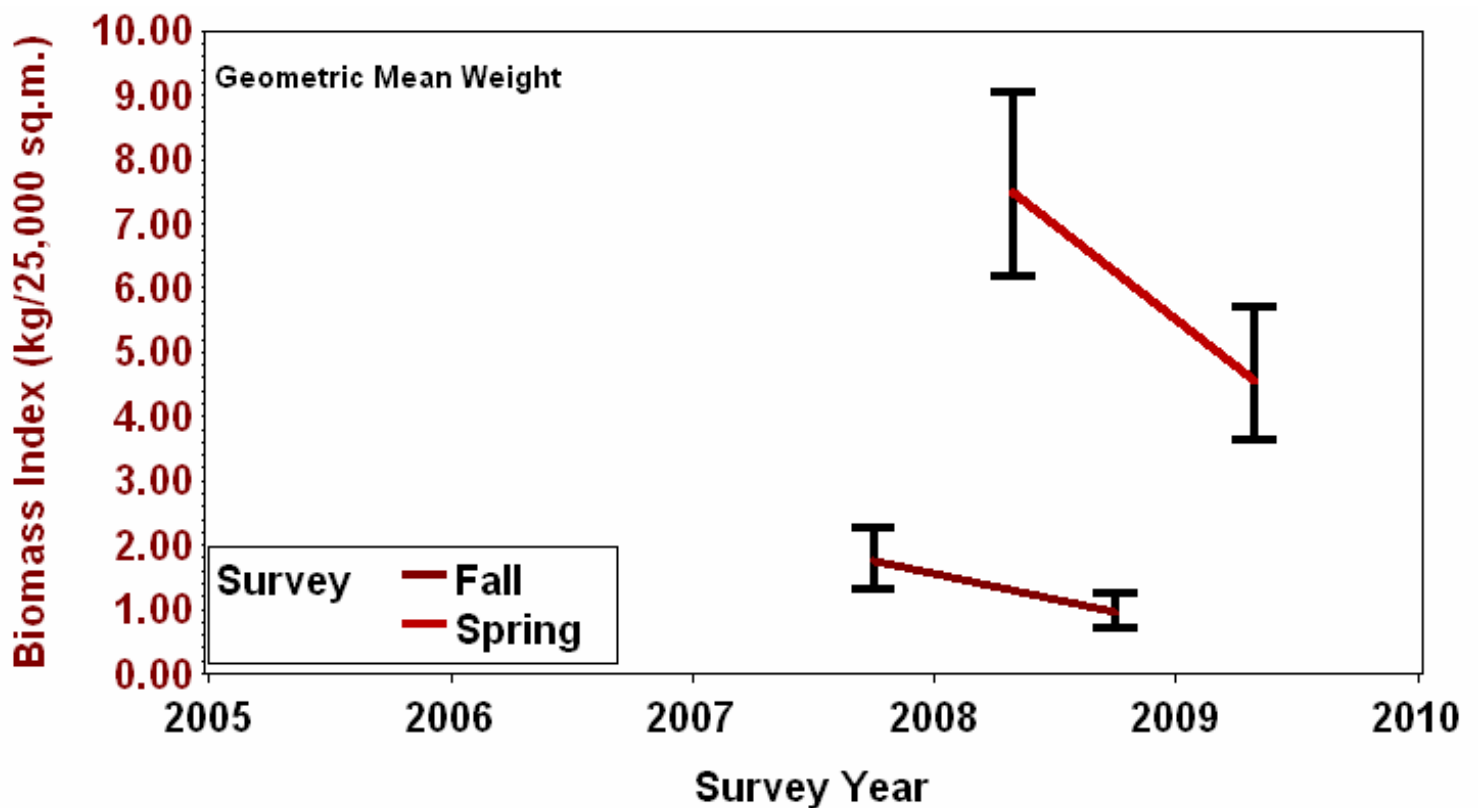
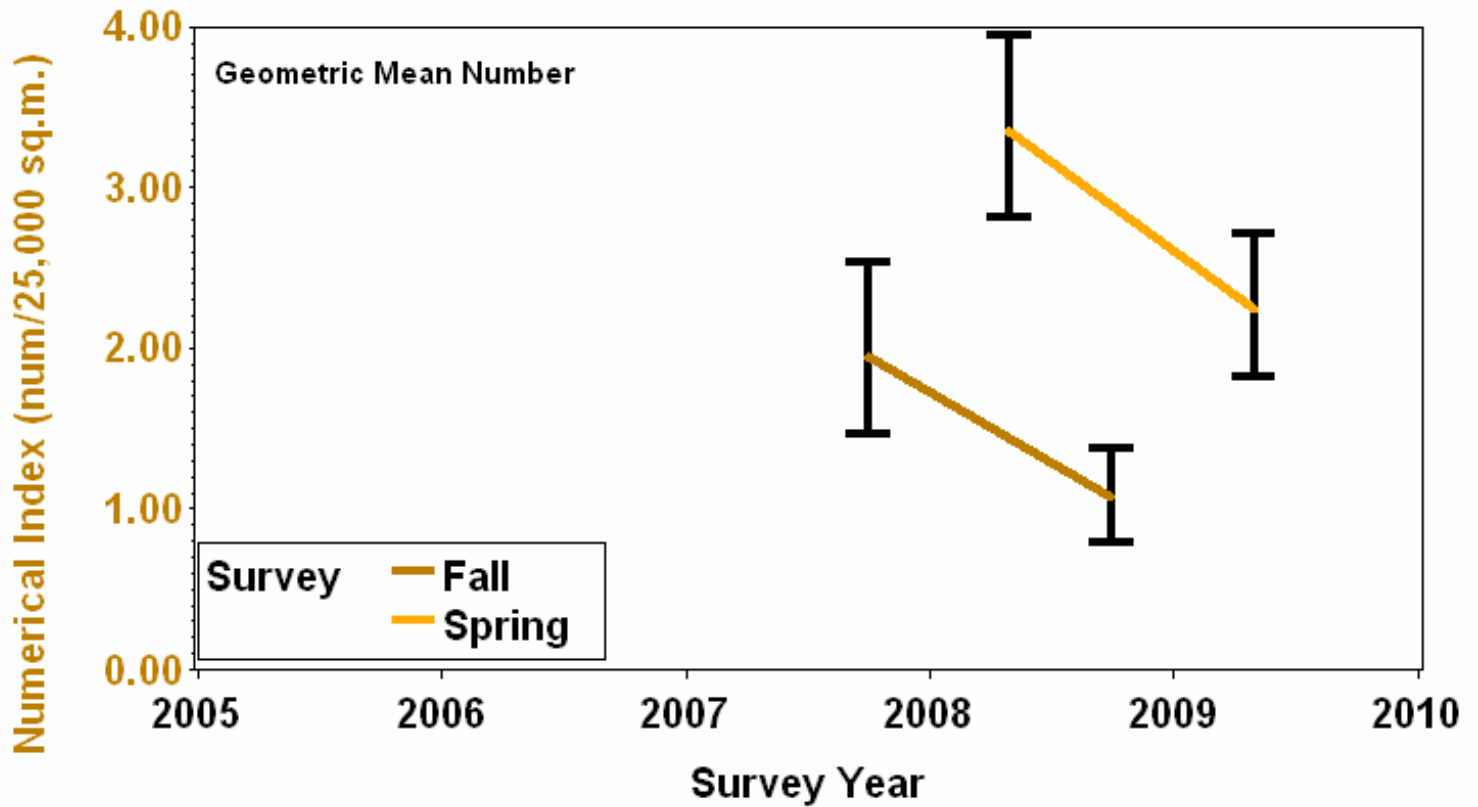


Figure 118. Length-frequency distributions, by cruise, for smooth dogfish. Numbers taken for full processing, by length, are represented by the orange bars.

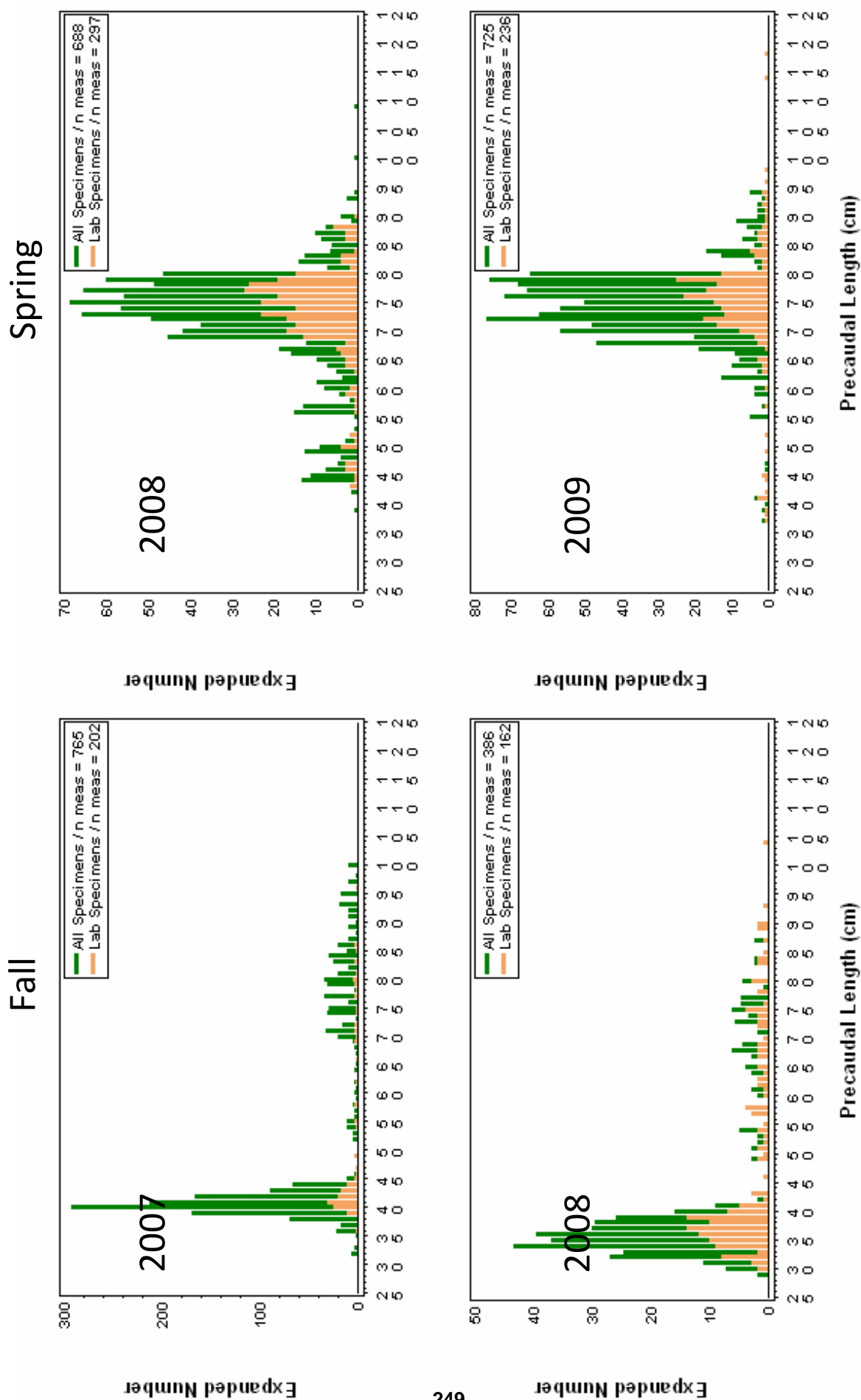


Figure 119. Sex ratio, by length group, for smooth dogfish collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

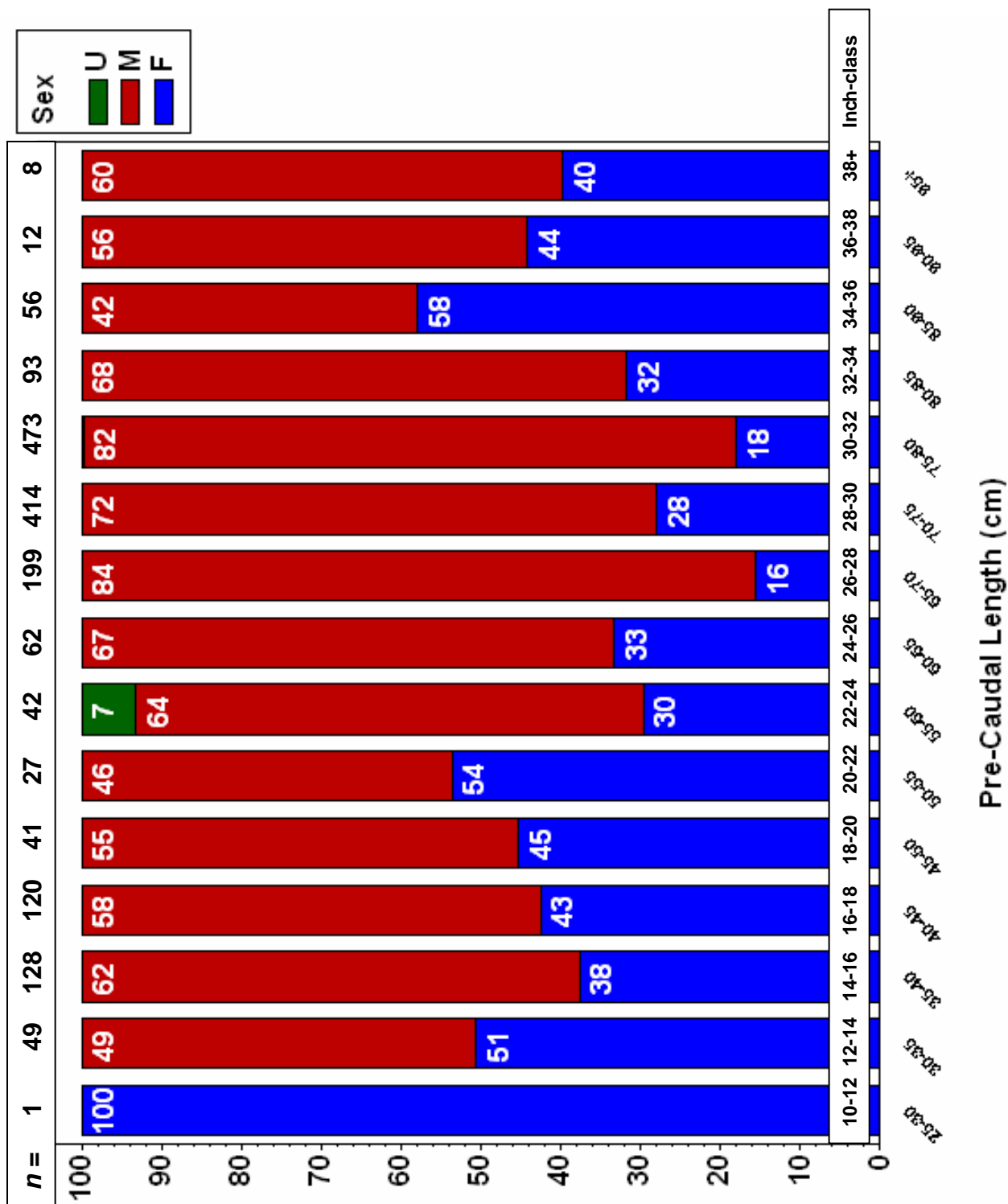
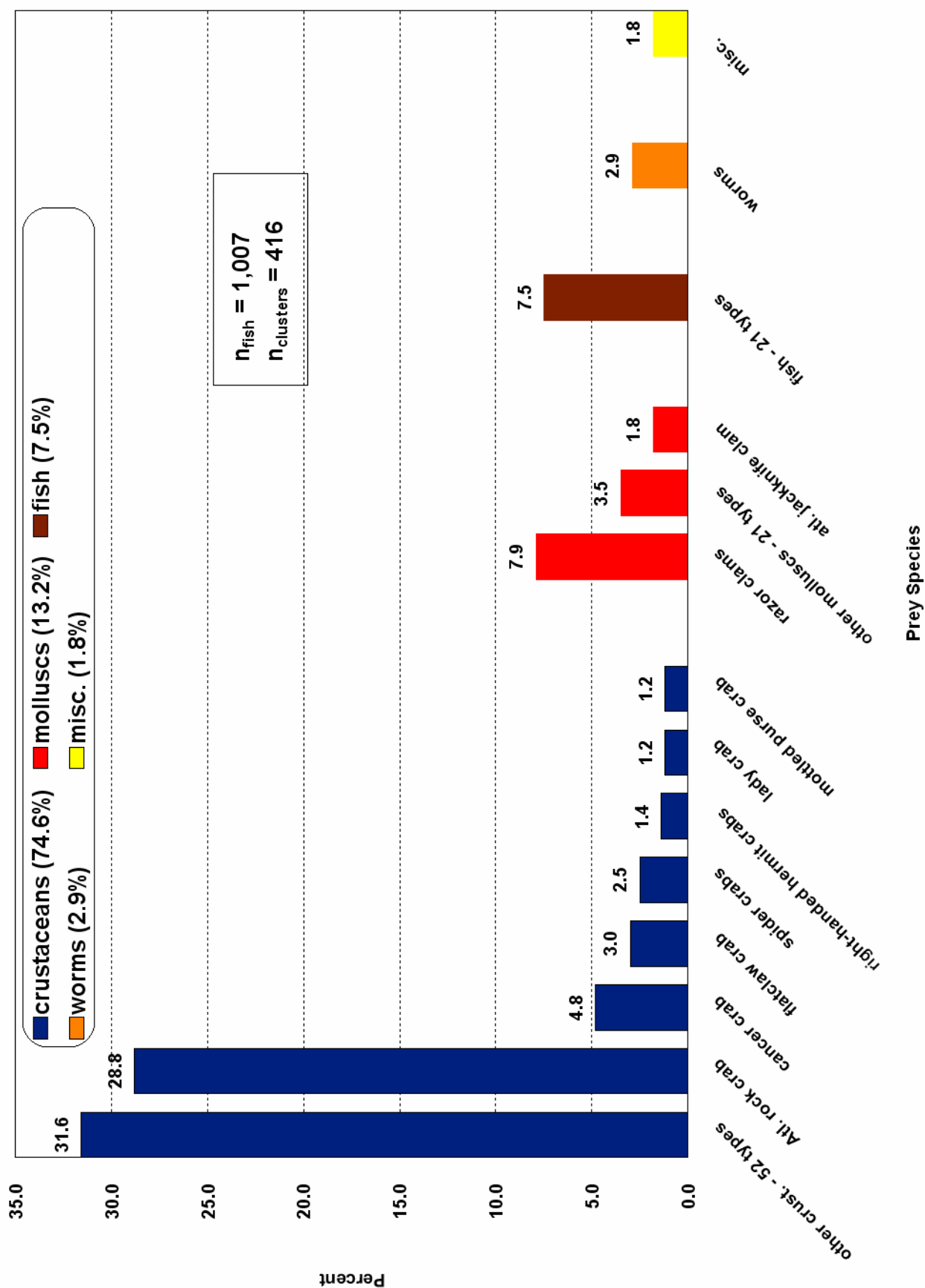


Figure 120. Diet composition, expressed using the percent weight index, of smooth dogfish collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of dogfish sampled.





# Spanish Mackerel (Priority B)

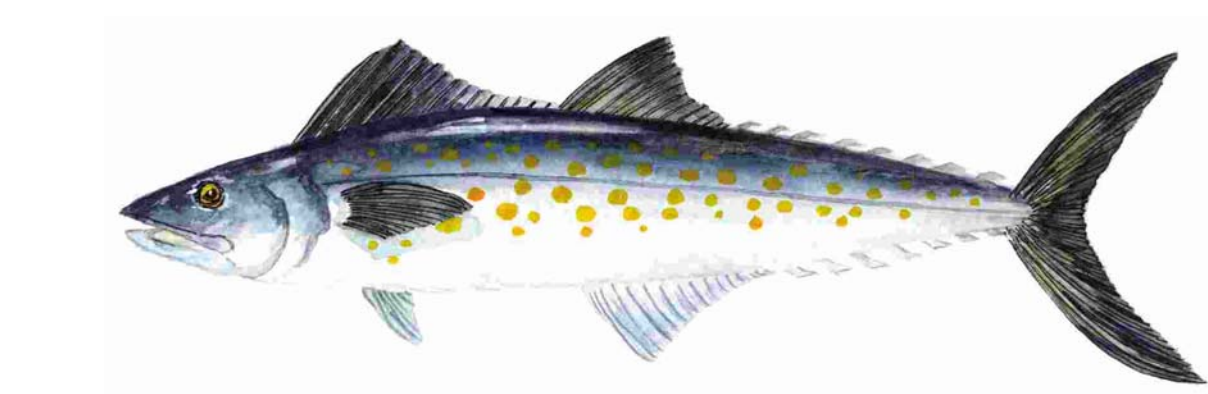
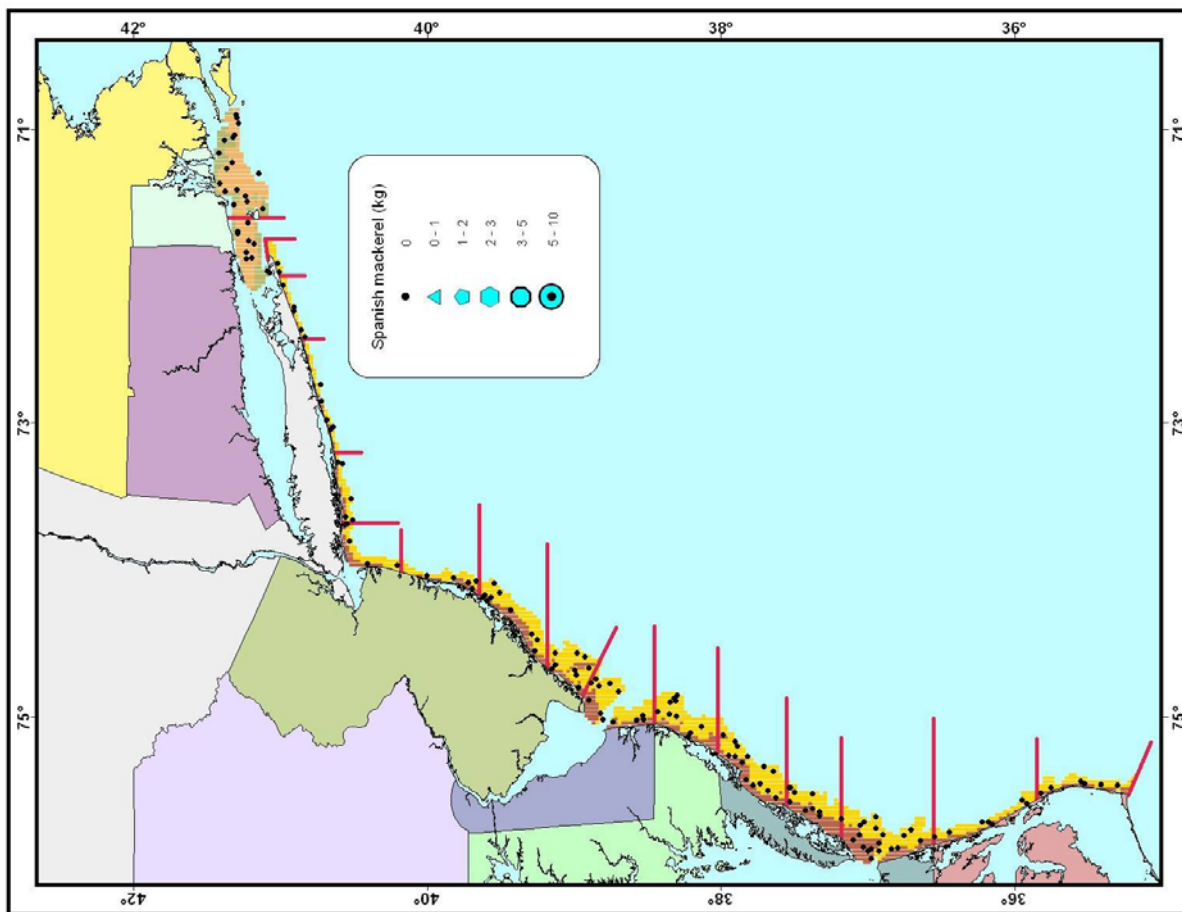


Table 35. Sampling rates and abundance indices of Spanish mackerel for four NEAMAP cruises.

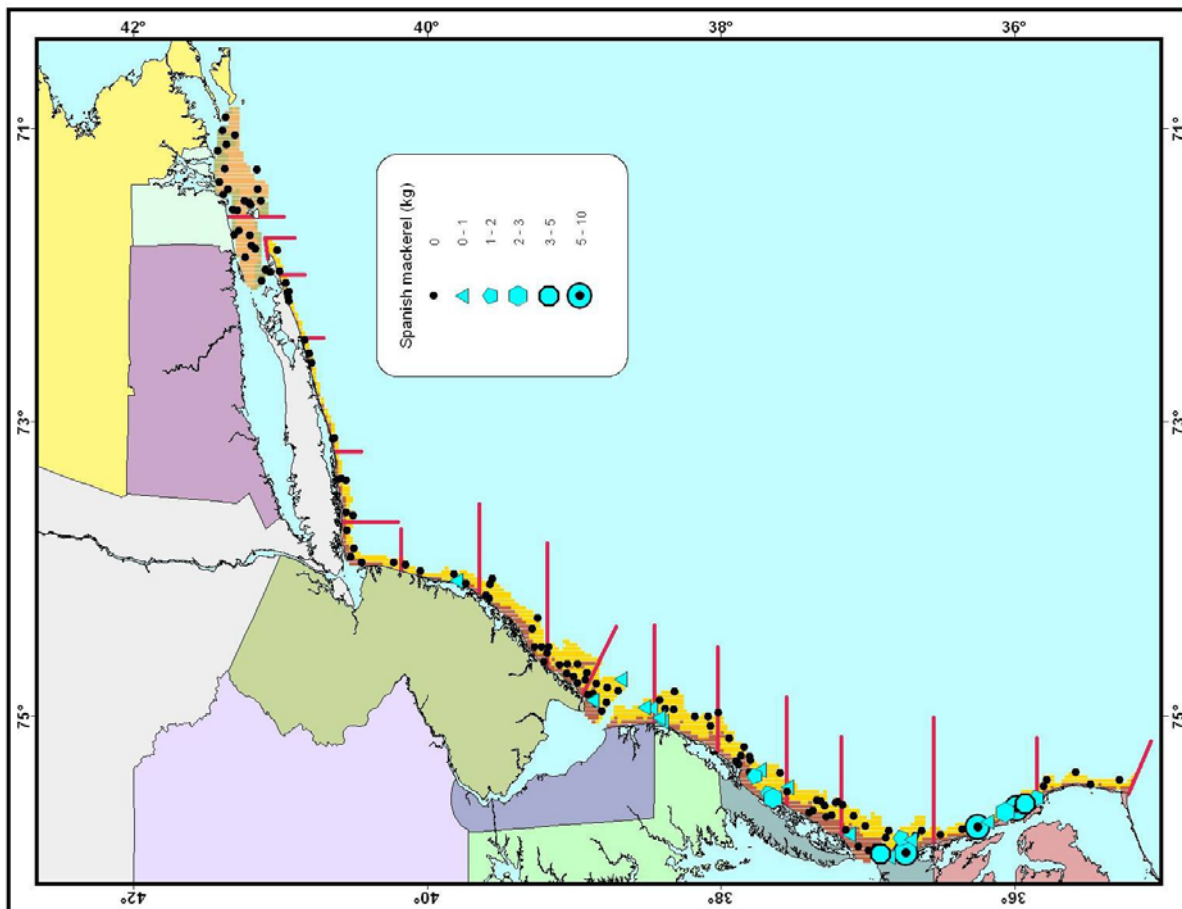
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	161	42.5	161	0		0		0.26	0.13
2008	Spring	0	0.0	0	0		0		0.00	0.00
	Fall	14	2.0	14	0		0		0.02	0.01
2009	Spring	0	0.0	0	0		0		0.00	0.00

Figure 121. Biomass (kg) of Spanish mackerel collected at each sampling site for four NEAMAP cruises.

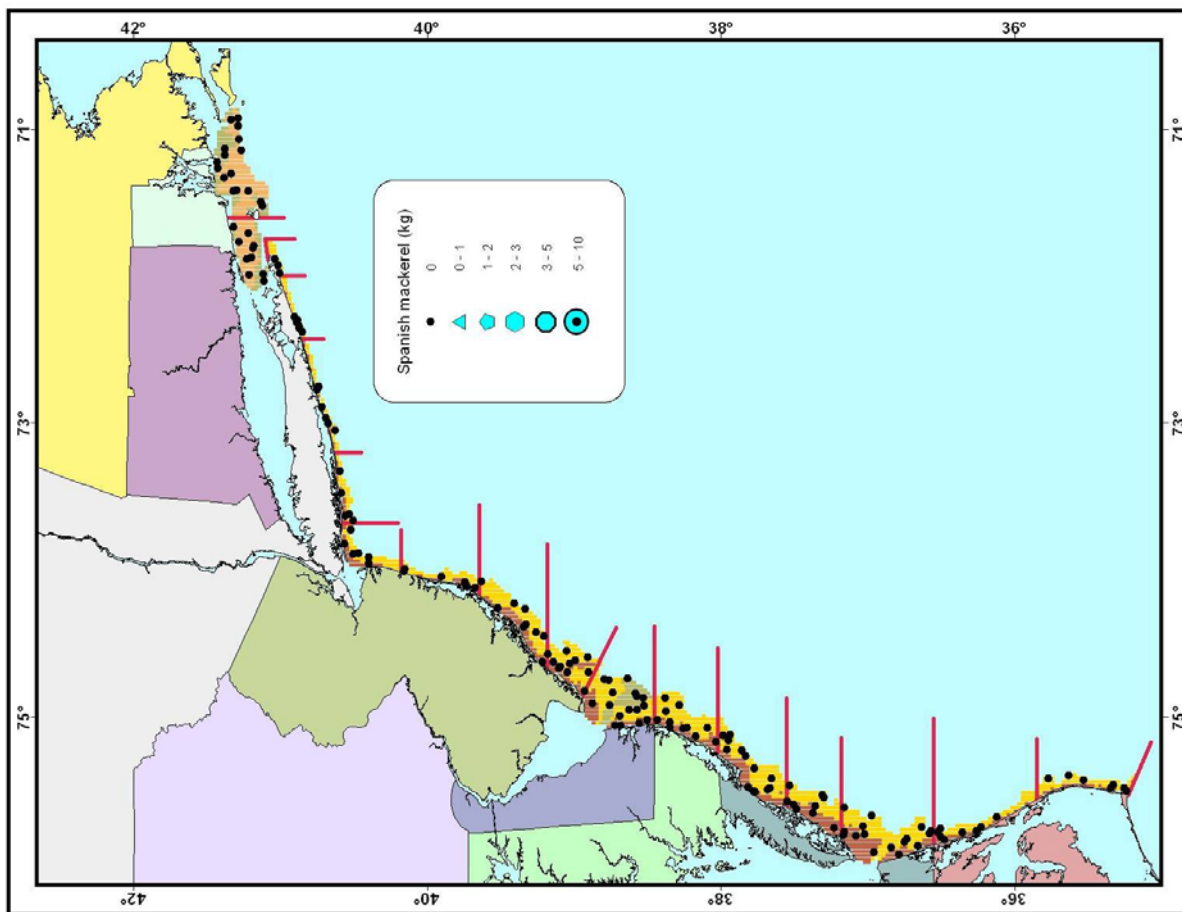
Spring 2008



Fall 2007



Spring 2009



Fall 2008

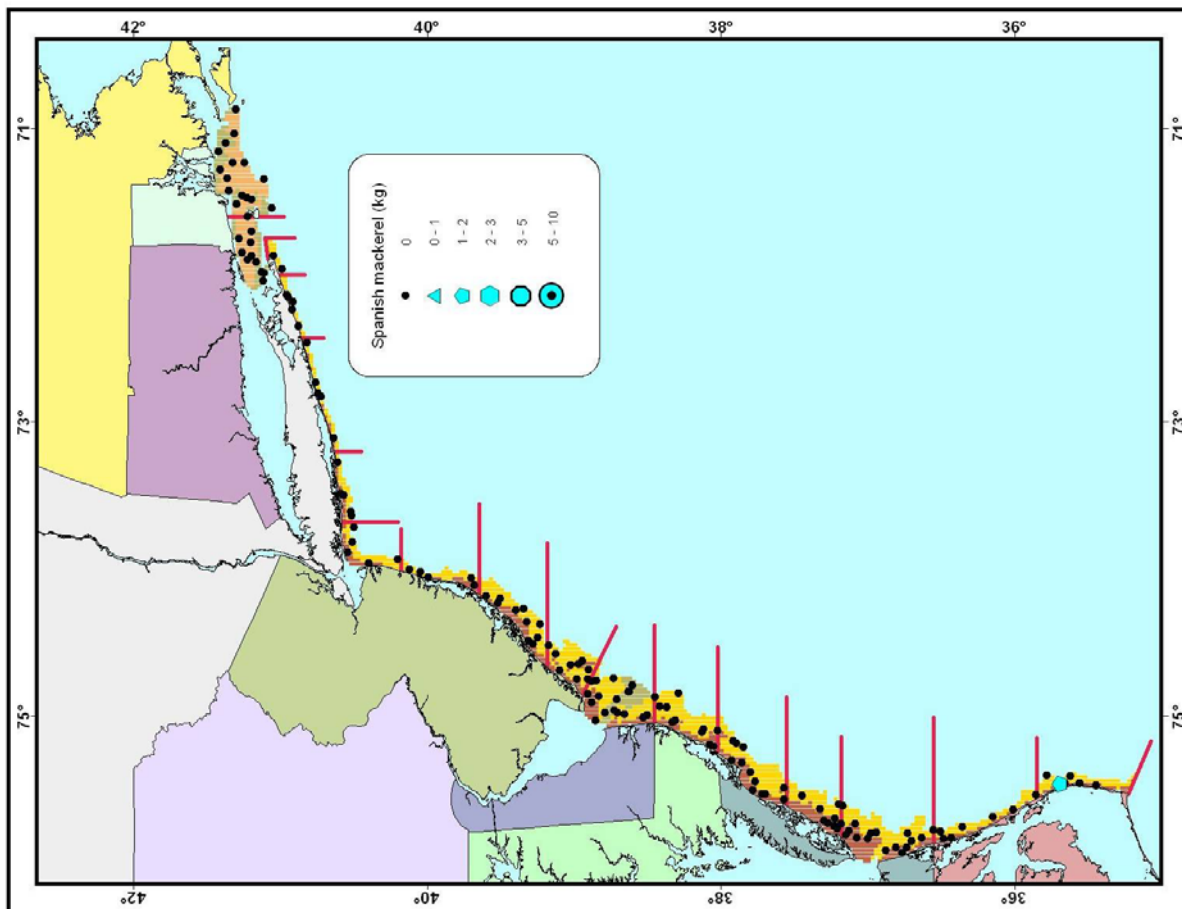




Figure 122. Preliminary indices of abundance, in terms of number and biomass, of Spanish mackerel for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

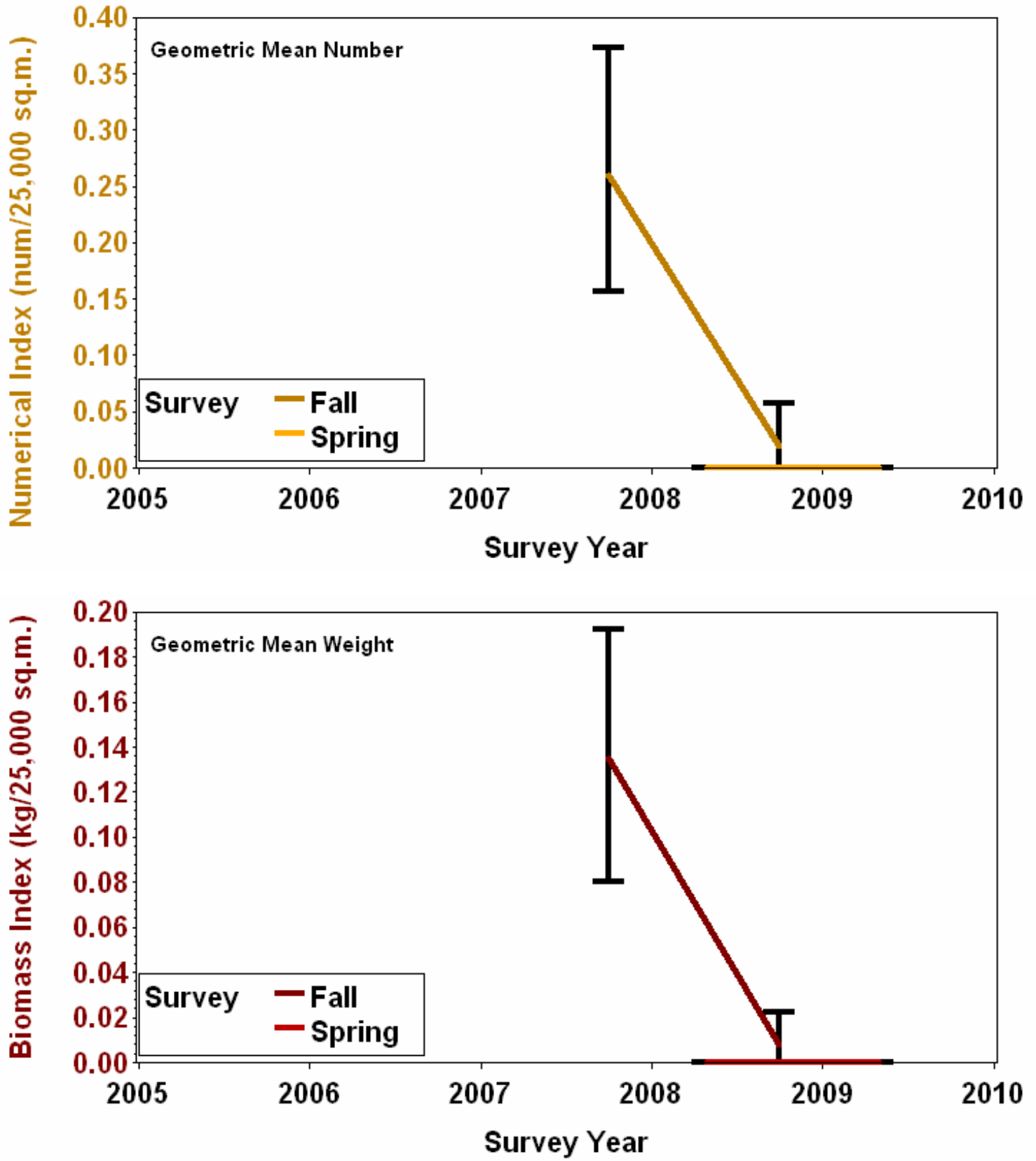
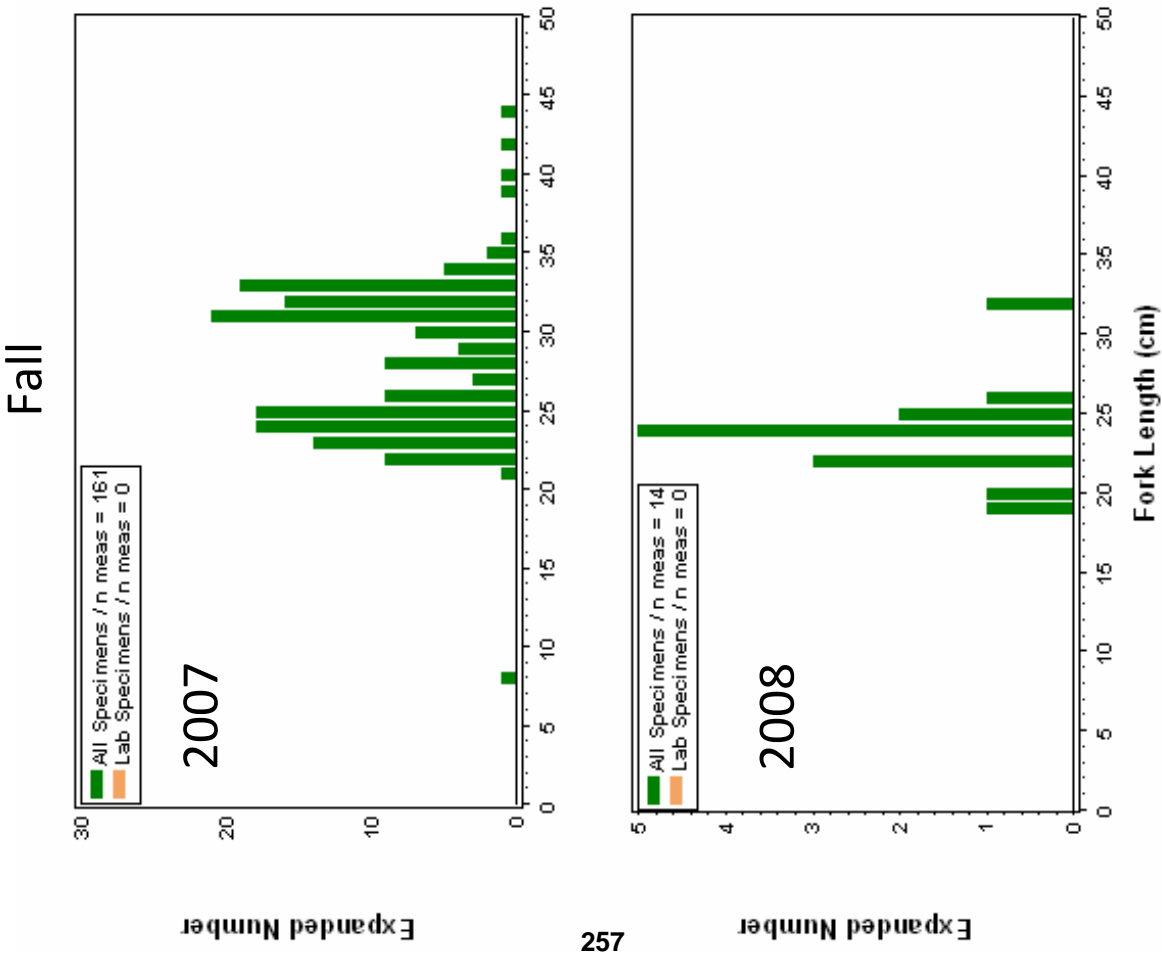


Figure 123. Length-frequency distributions, by cruise, for Spanish mackerel. This species was absent from spring survey collections.





# Spiny Dogfish (Priority B)

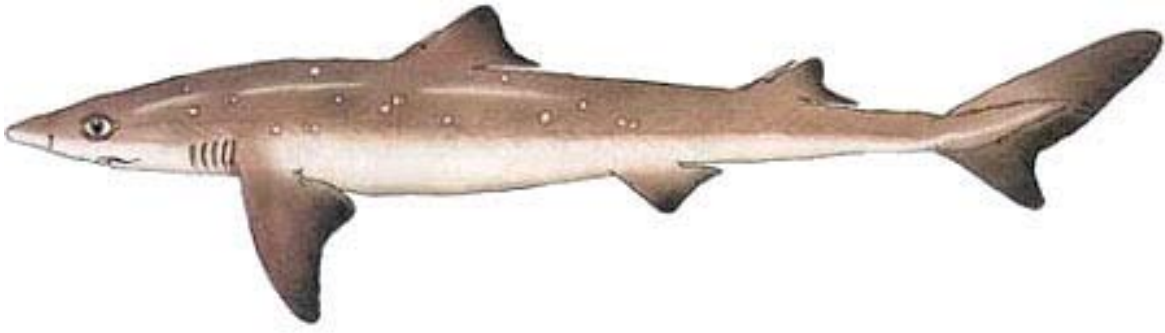
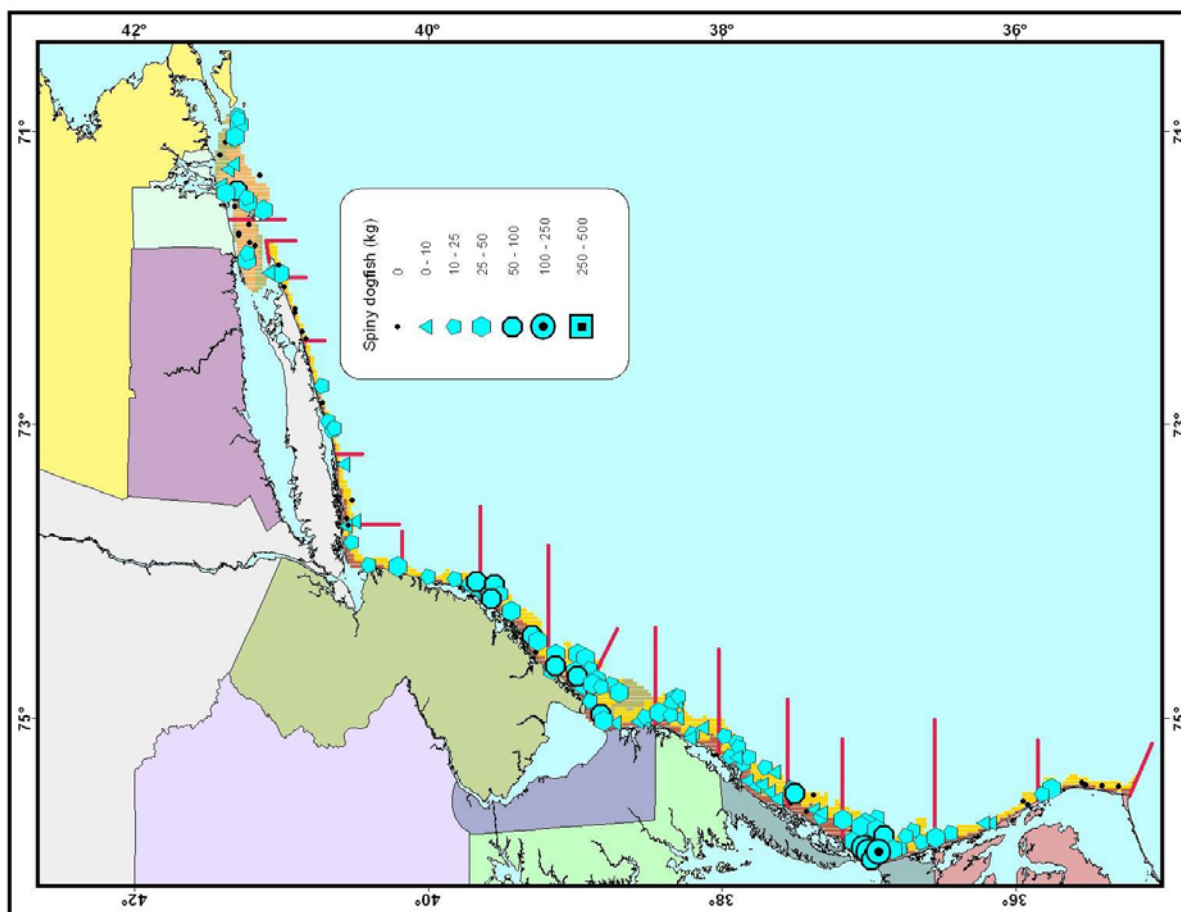


Table 36. Sampling rates and abundance indices of spiny dogfish for four NEAMAP cruises.

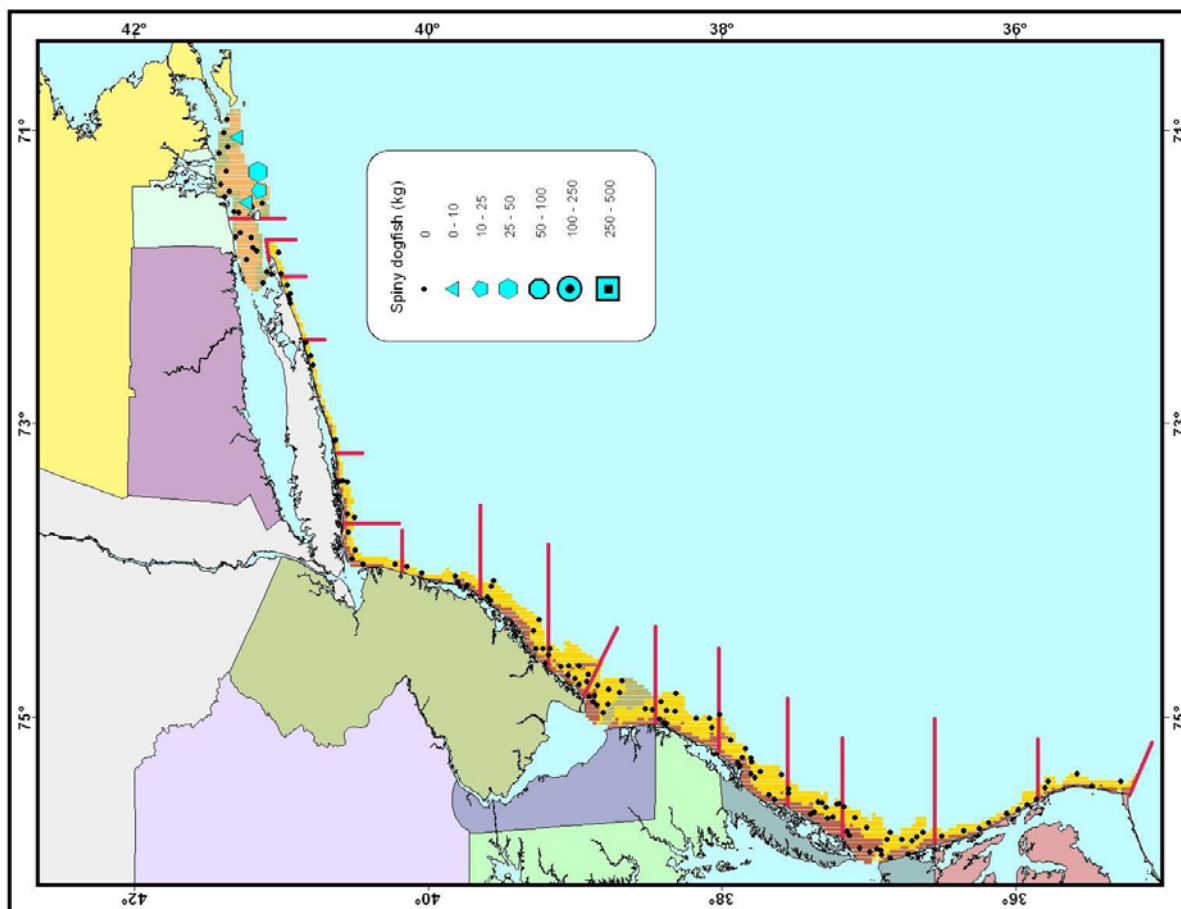
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	17	51.3	17	13	0	12	12	0.05	0.07
2008	Spring	1,329	3,389.8	947	322	0	243	243	4.90	10.59
	Fall	735	1,621.1	161	41	0	39	39	0.36	0.37
2009	Spring	1,271	3,562.7	1,137	359	0	259	7	4.97	12.36

Figure 124. Biomass (kg) of spiny dogfish collected at each sampling site for four NEAMAP cruises.

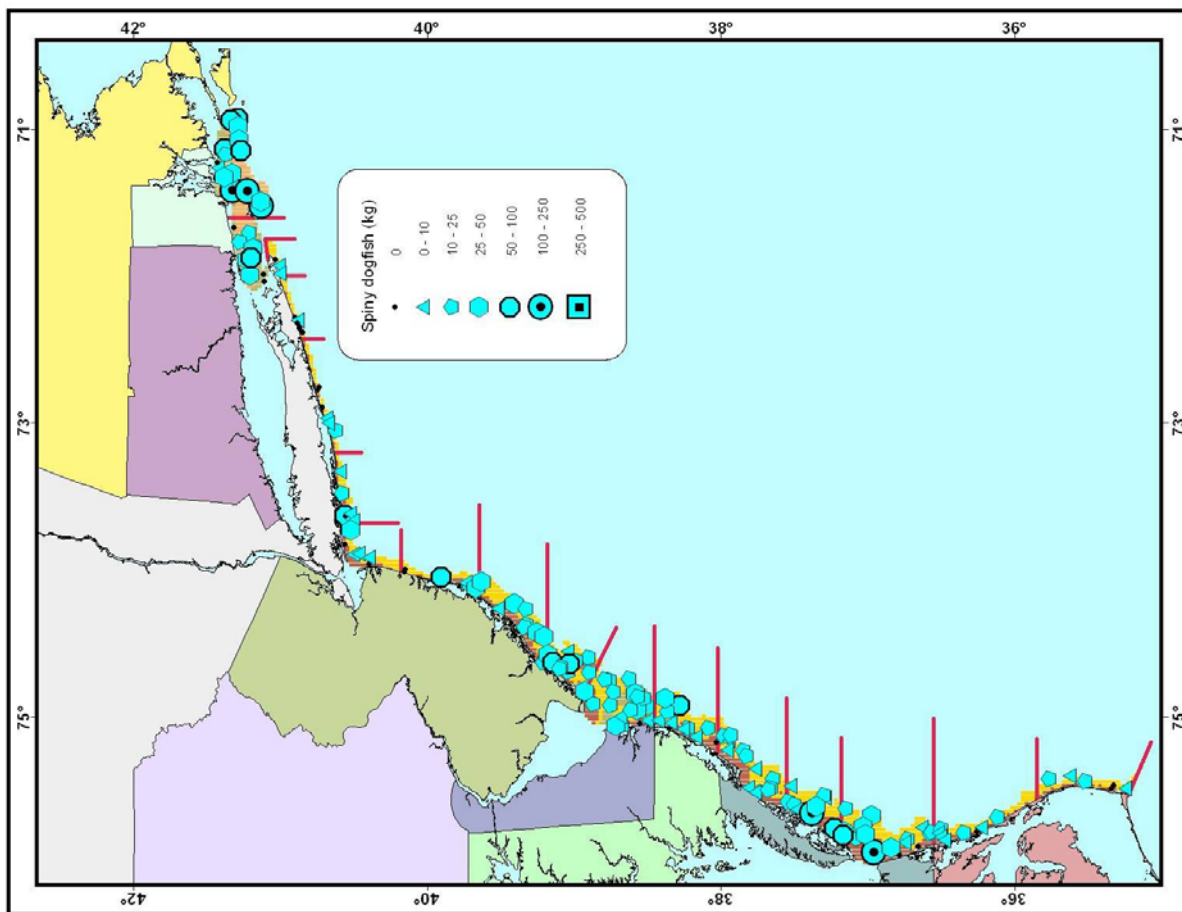
Spring 2008



Fall 2007



Spring 2009



Fall 2008

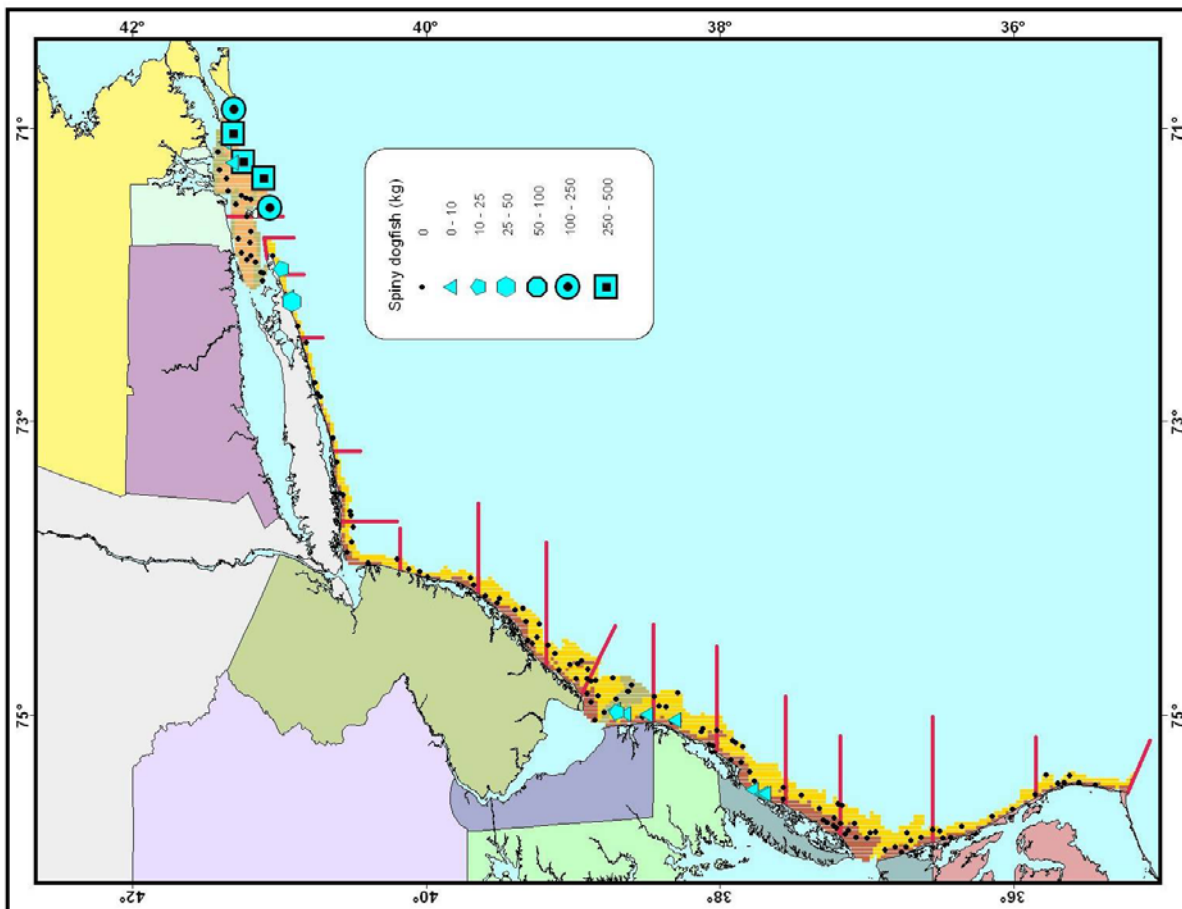


Figure 125. Preliminary indices of abundance, in terms of number and biomass, of spiny dogfish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

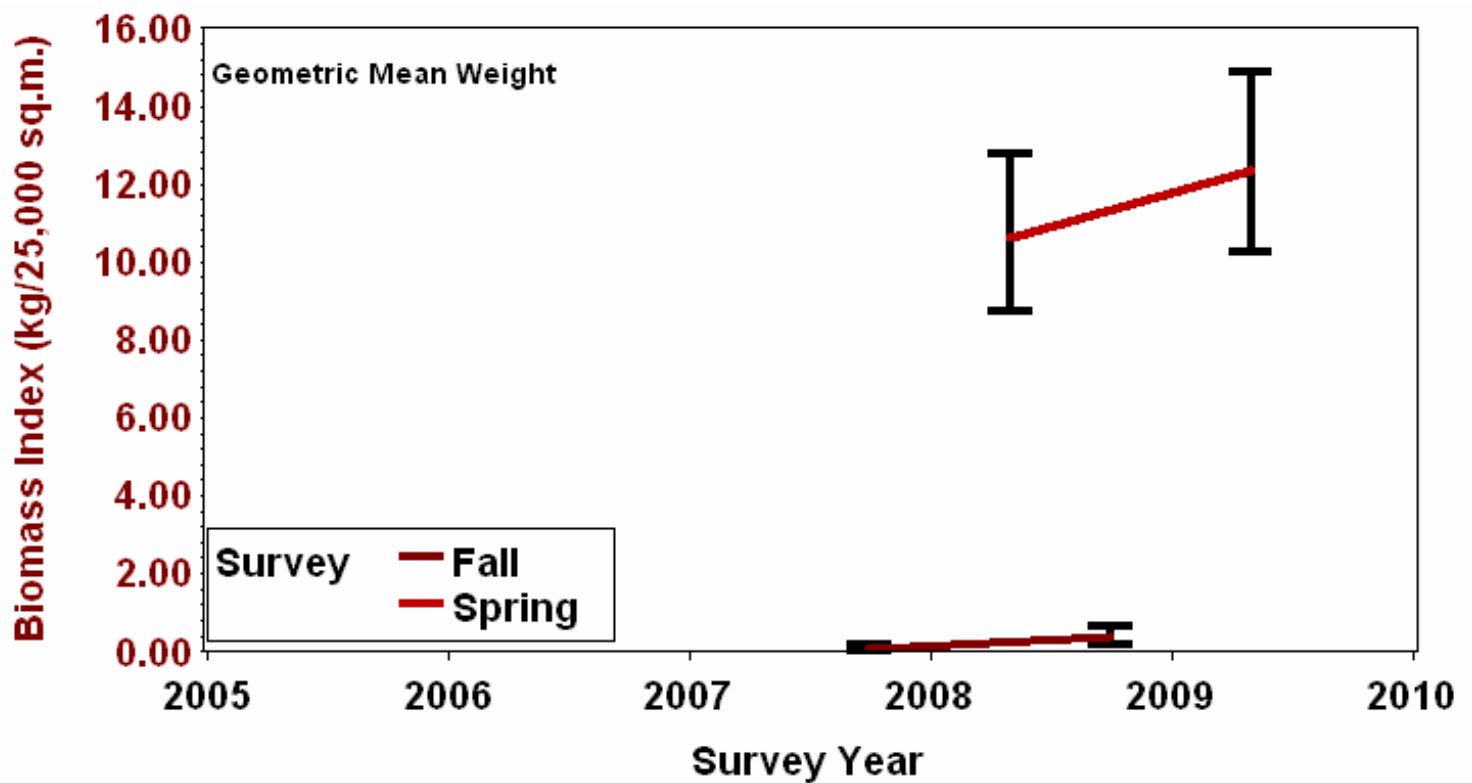
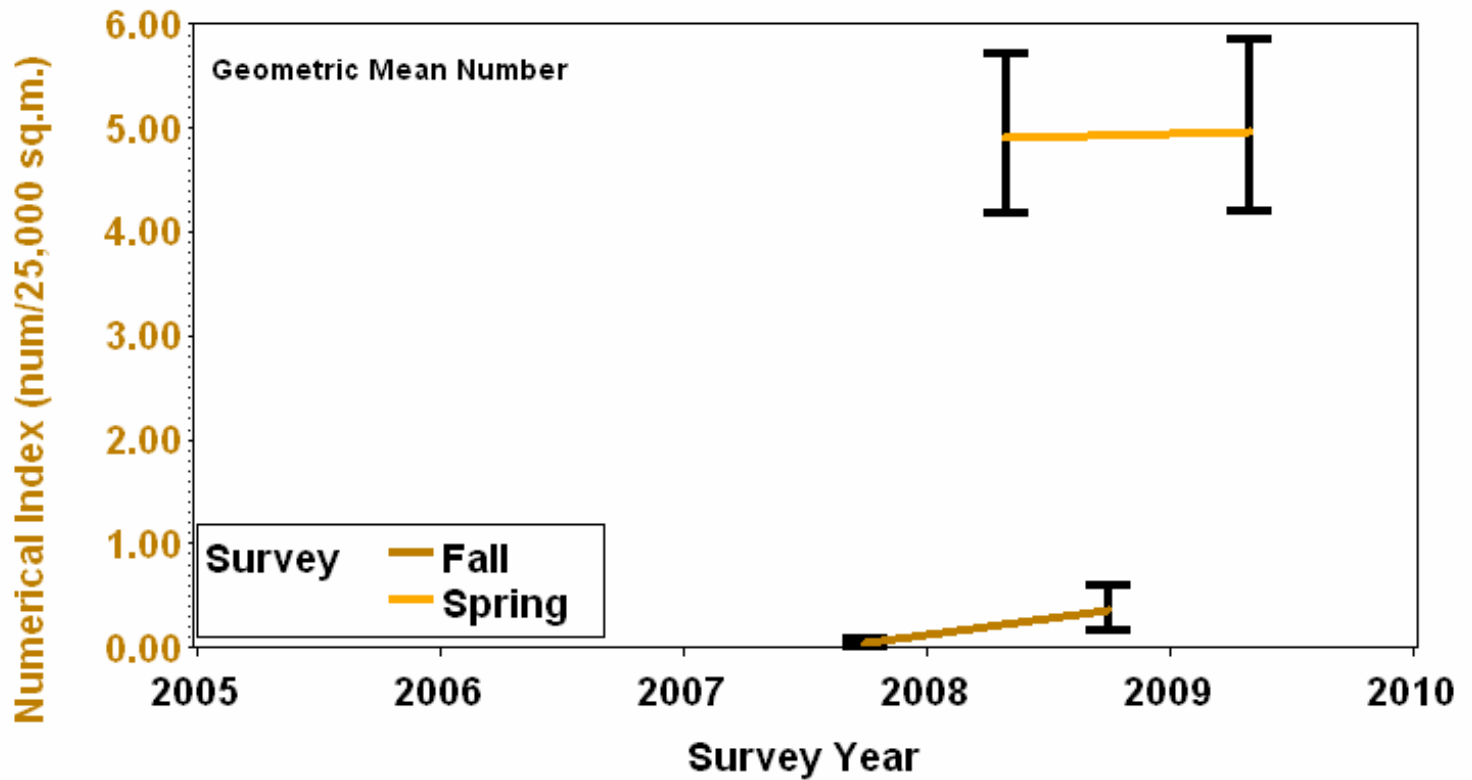


Figure 126. Length-frequency distributions, by cruise, for spiny dogfish. Numbers taken for full processing, by length, are represented by the orange bars.

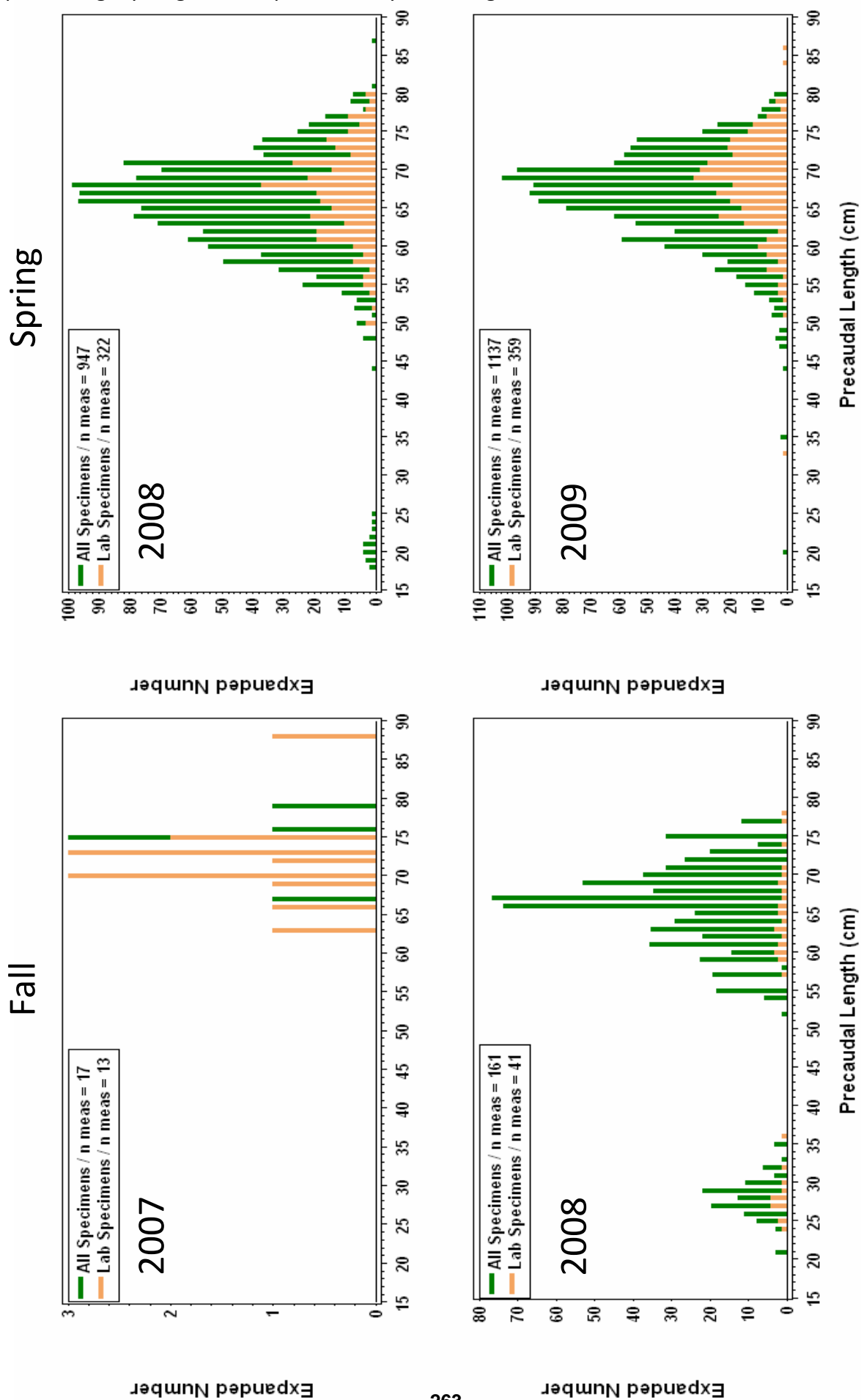




Figure 127. Sex ratio, by length group, for spiny dogfish collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

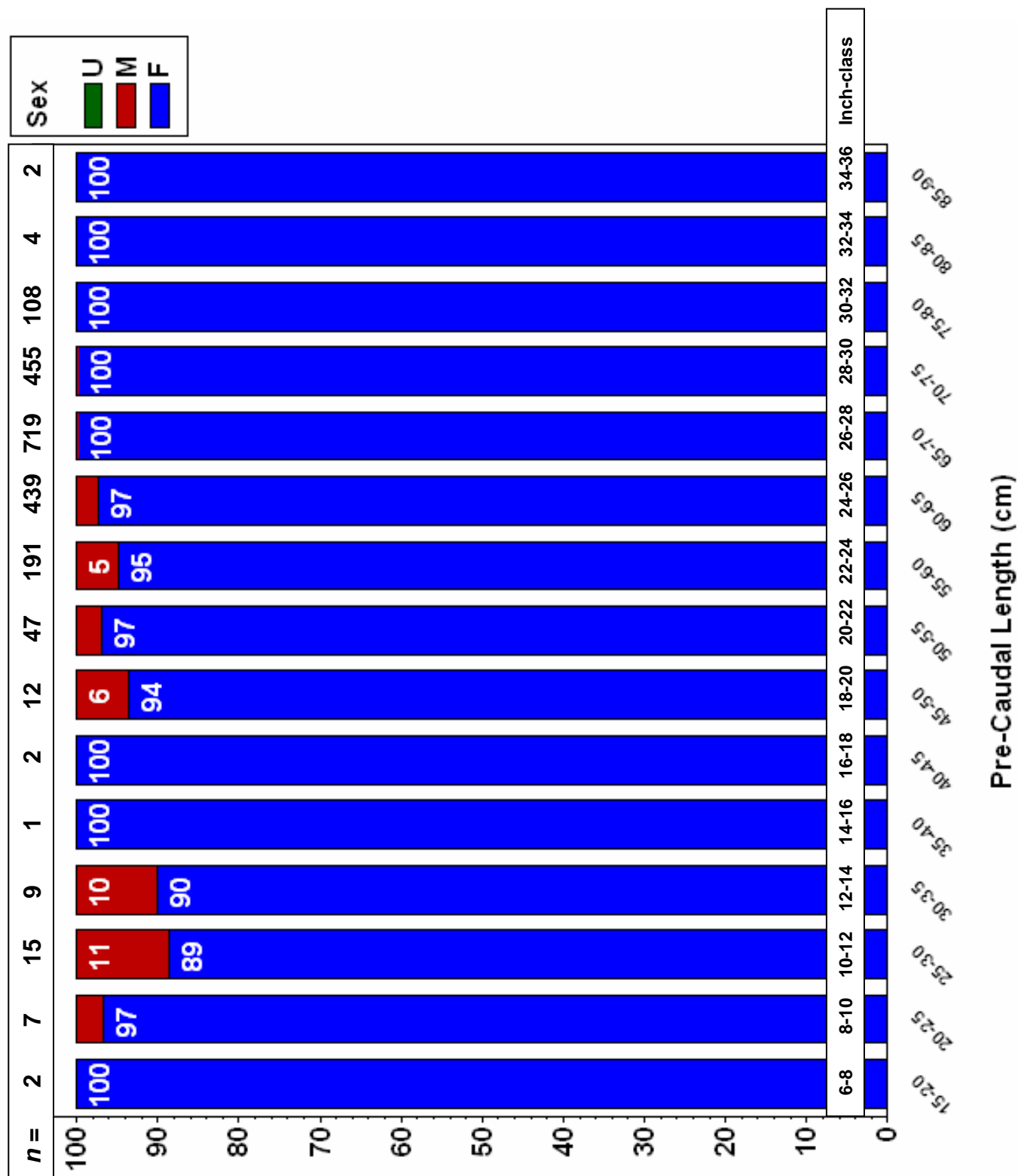
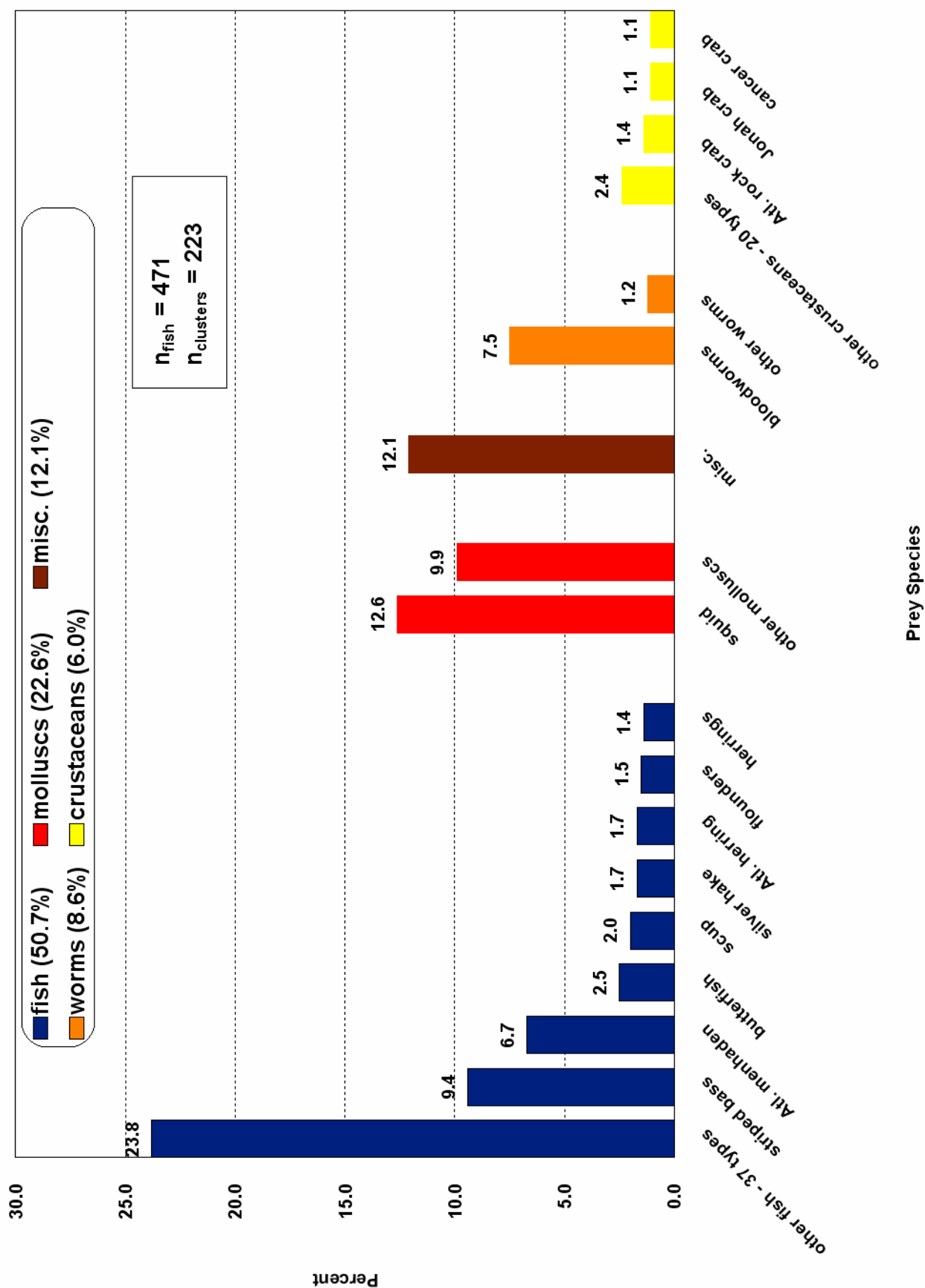


Figure 128. Diet composition, expressed using the percent weight index, of spiny dogfish collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of spiny dogfish sampled.





# Spot (Priority B)

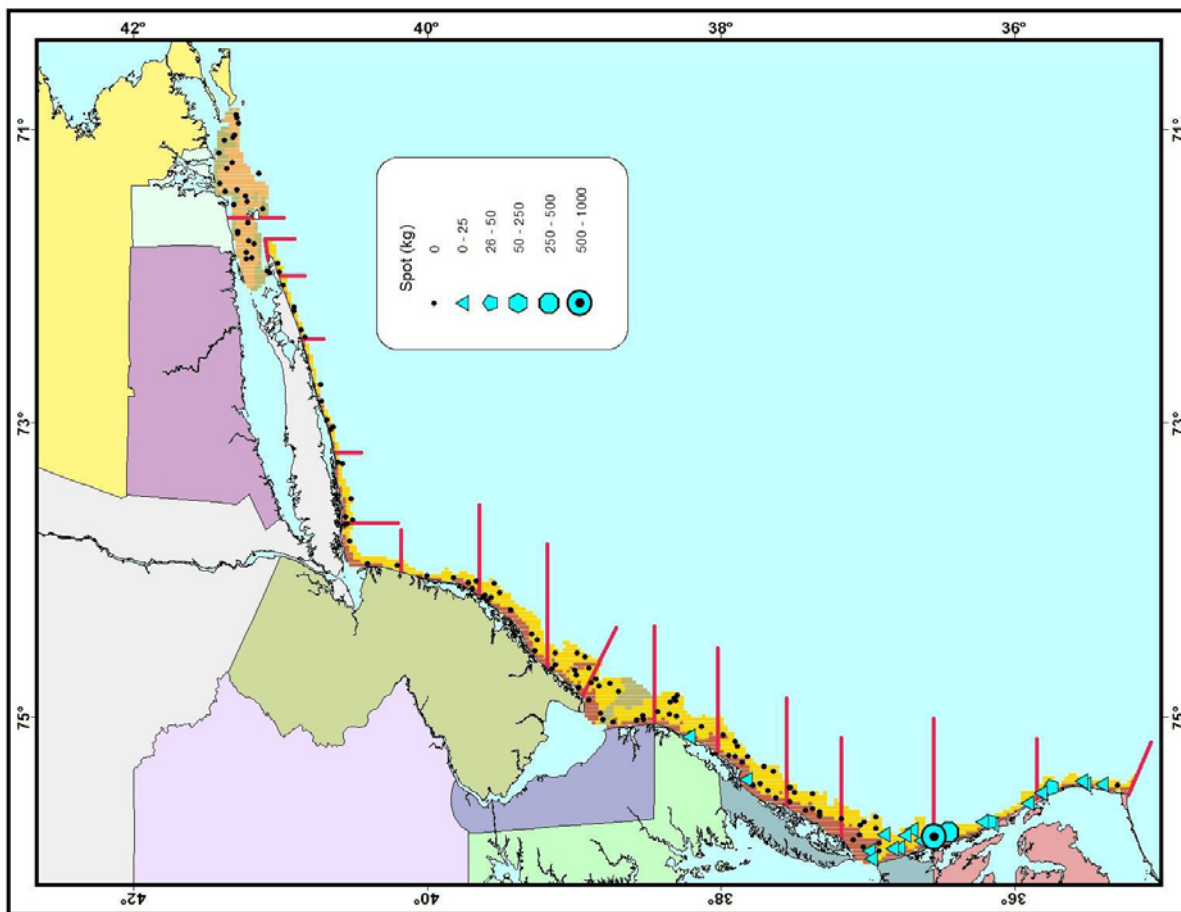


Table 37. Sampling rates and abundance indices of spot for four NEAMAP cruises.

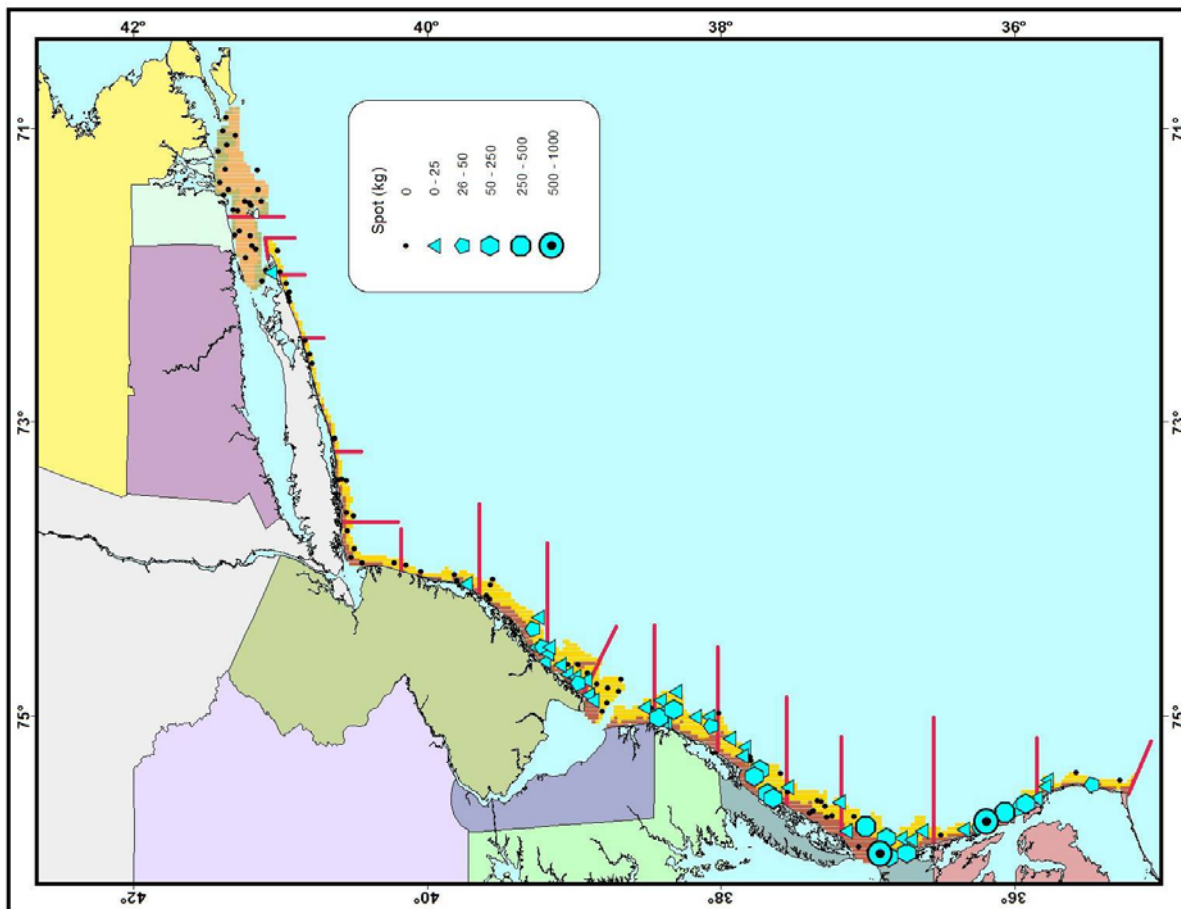
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	44,437	3,942.0	2,507	160	0	9	0	5.32	1.87
2008	Spring	28,561	1,059.2	1,220	61	0	0		0.91	0.33
	Fall	56,878	3,872.0	3,435	213	0	0		11.77	3.05
2009	Spring	29,643	824.9	3,454	59	0	0		0.91	0.34

Figure 129. Biomass (kg) of spot collected at each sampling site for four NEAMAP cruises.

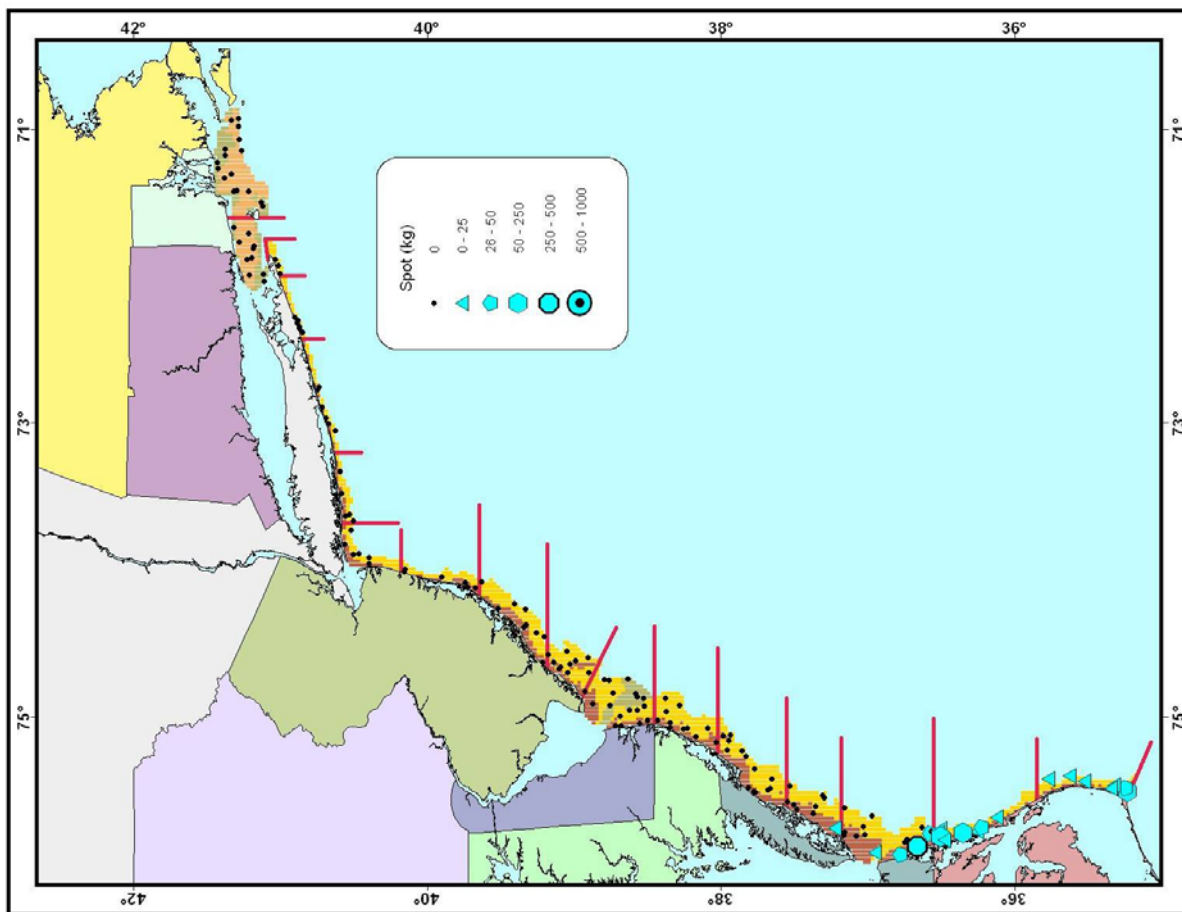
Spring 2008



Fall 2007



Spring 2009



Fall 2008

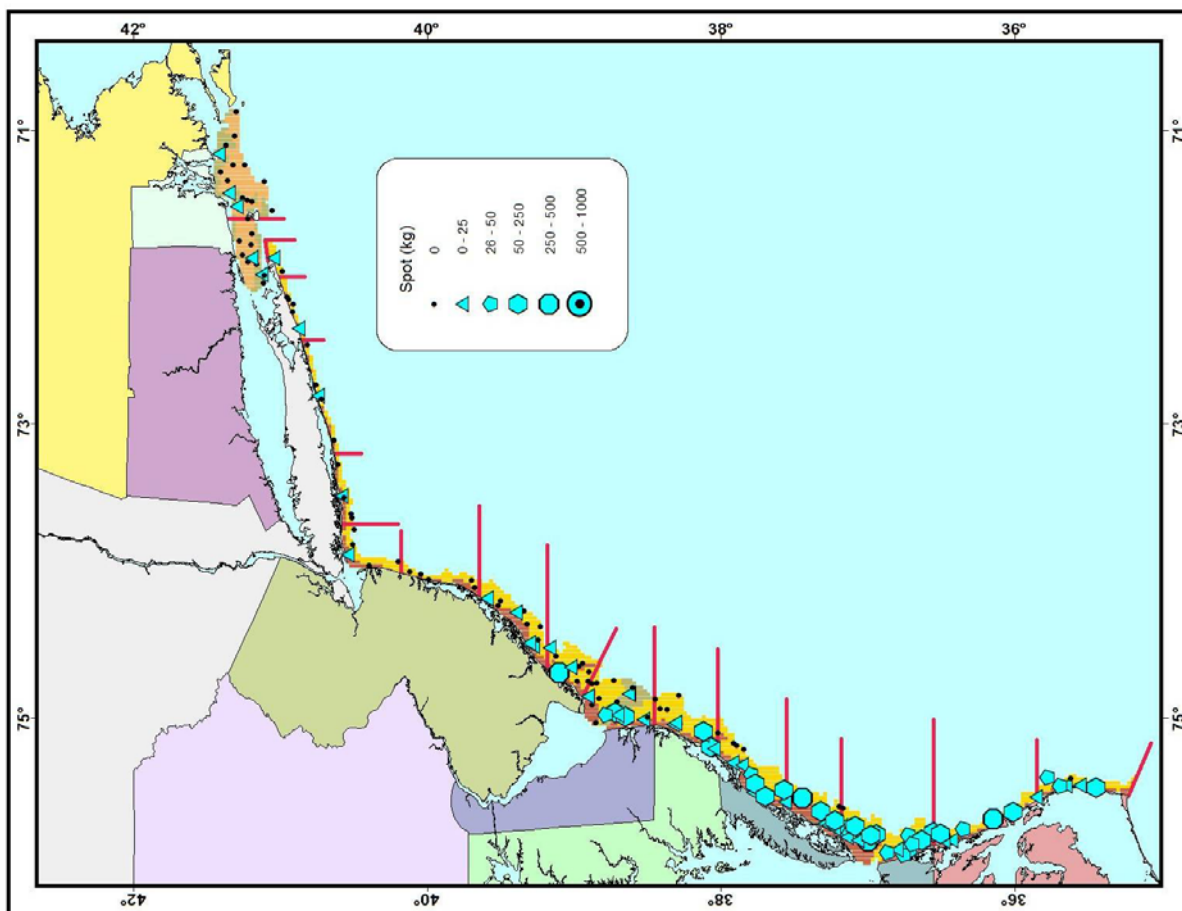


Figure 130. Preliminary indices of abundance, in terms of number and biomass, of spot for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

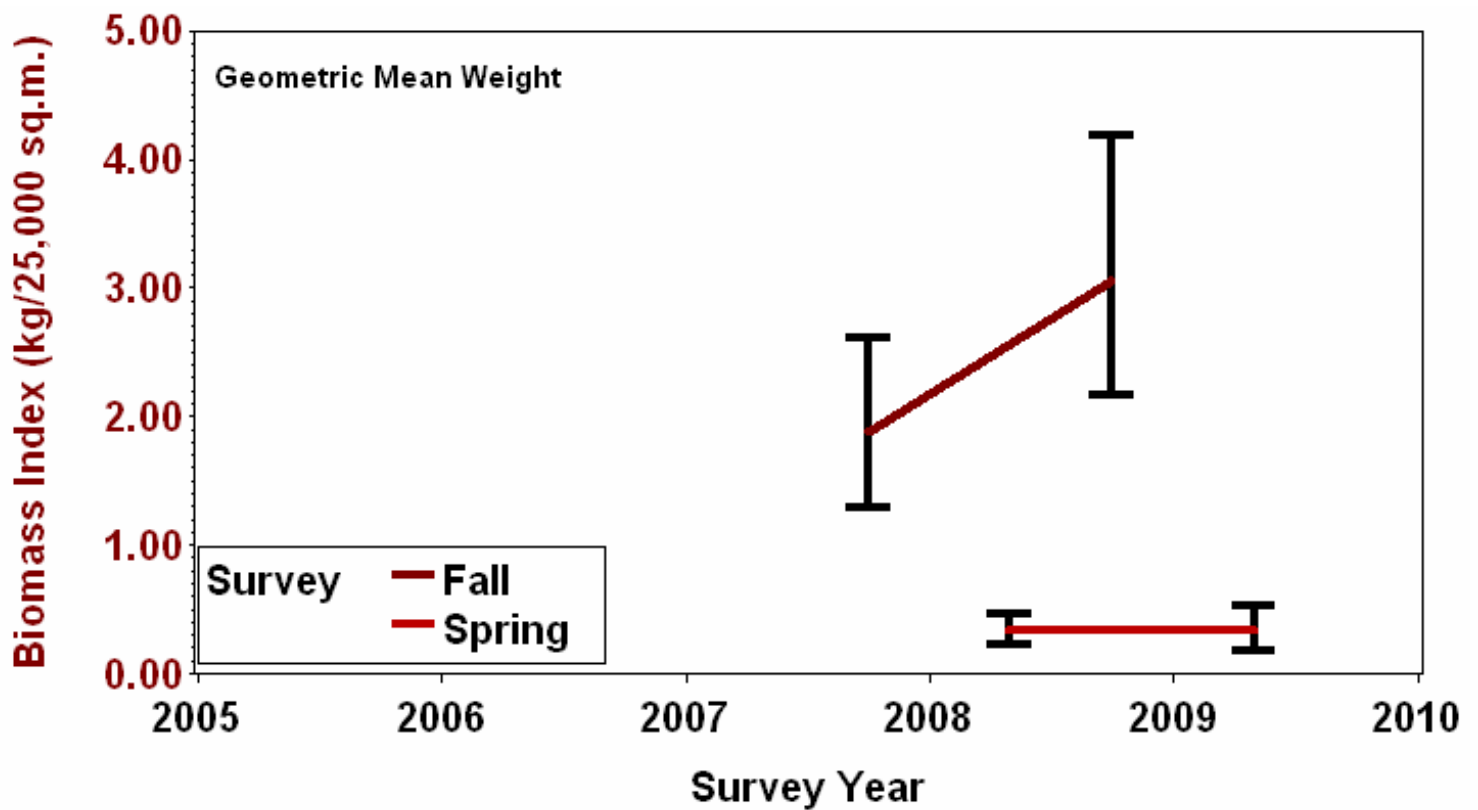
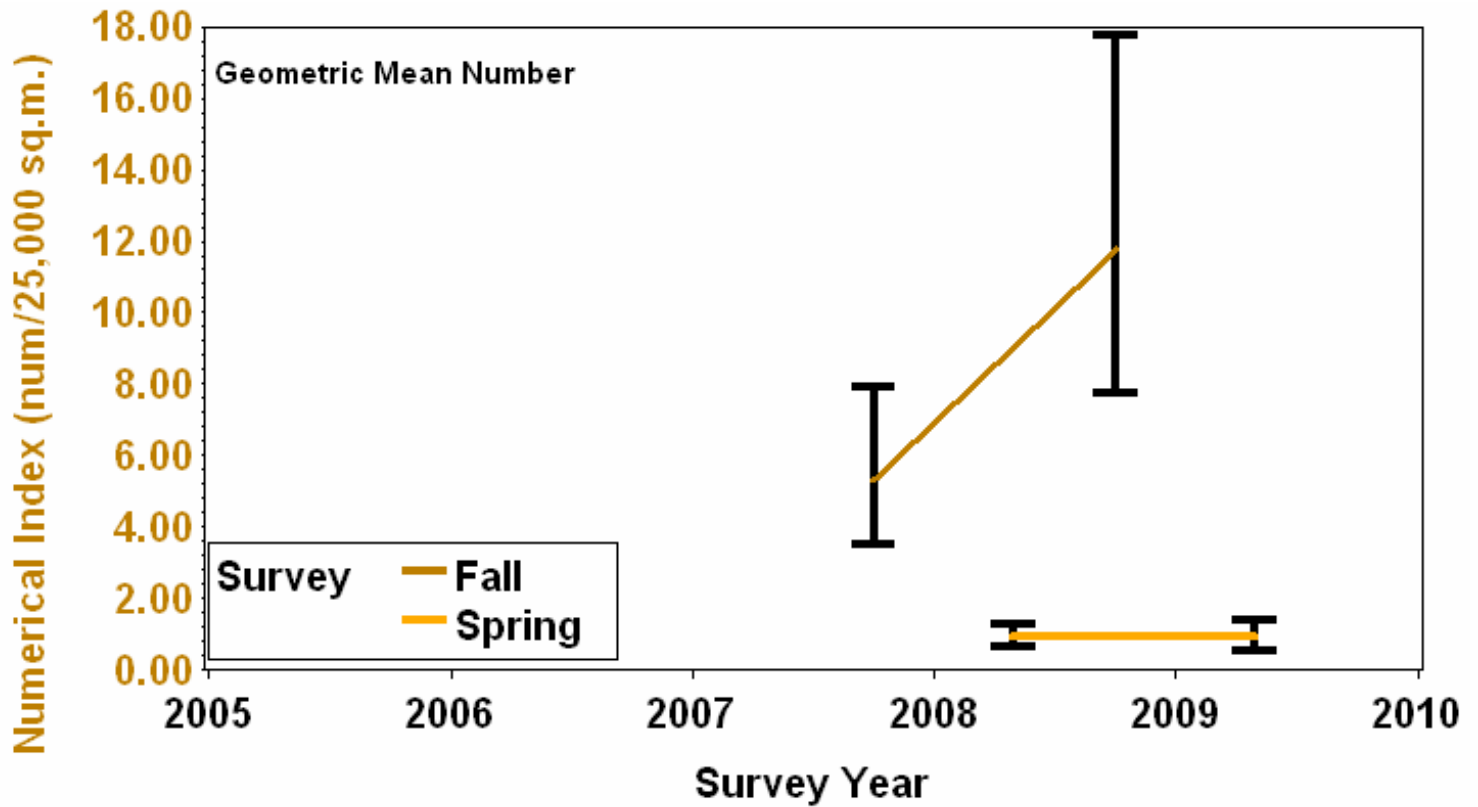


Figure 131. Length-frequency distributions, by cruise, for spot. Numbers taken for full processing, by length, are represented by the orange bars (difficult to see due to scale of y-axis).

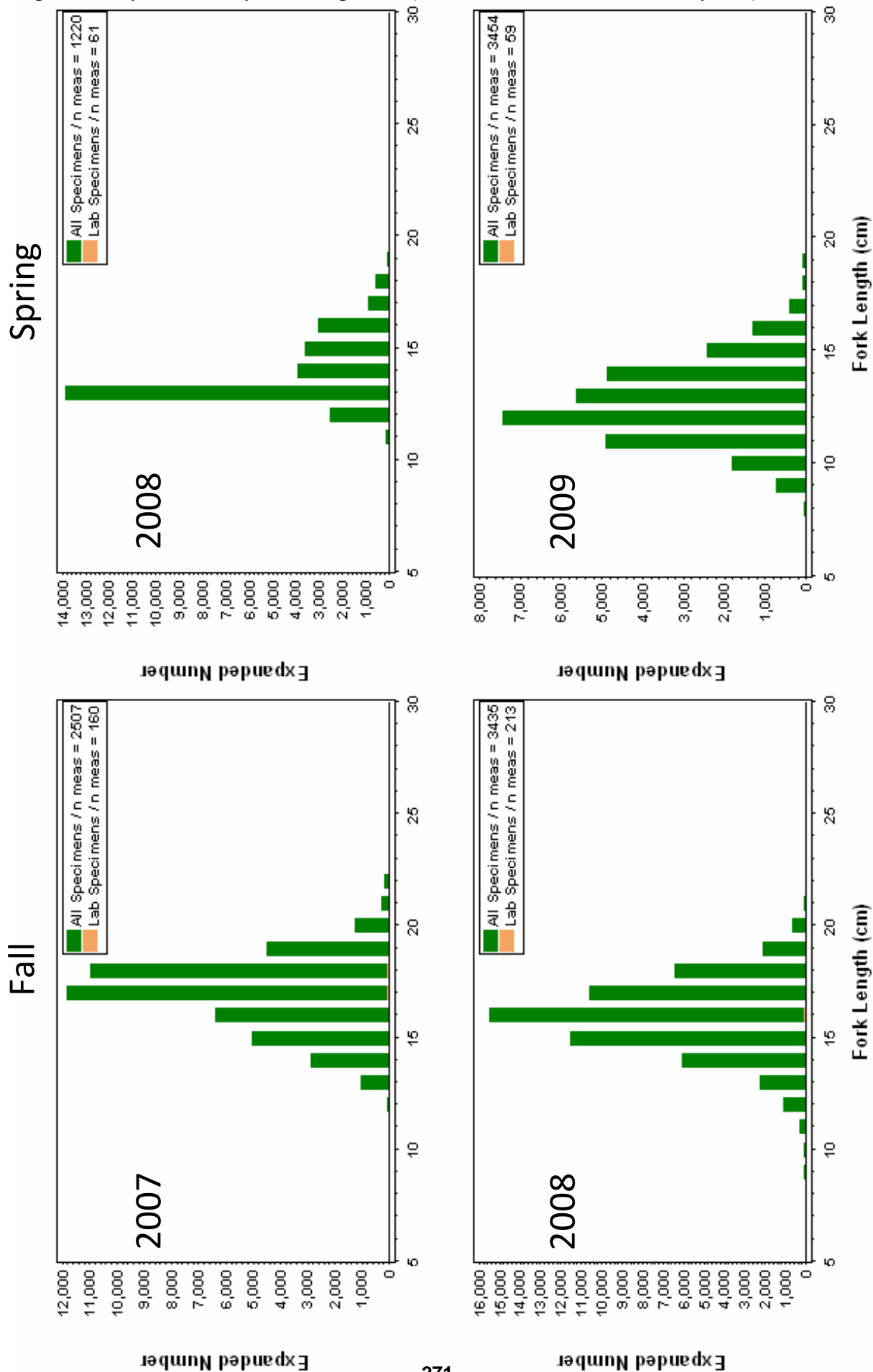
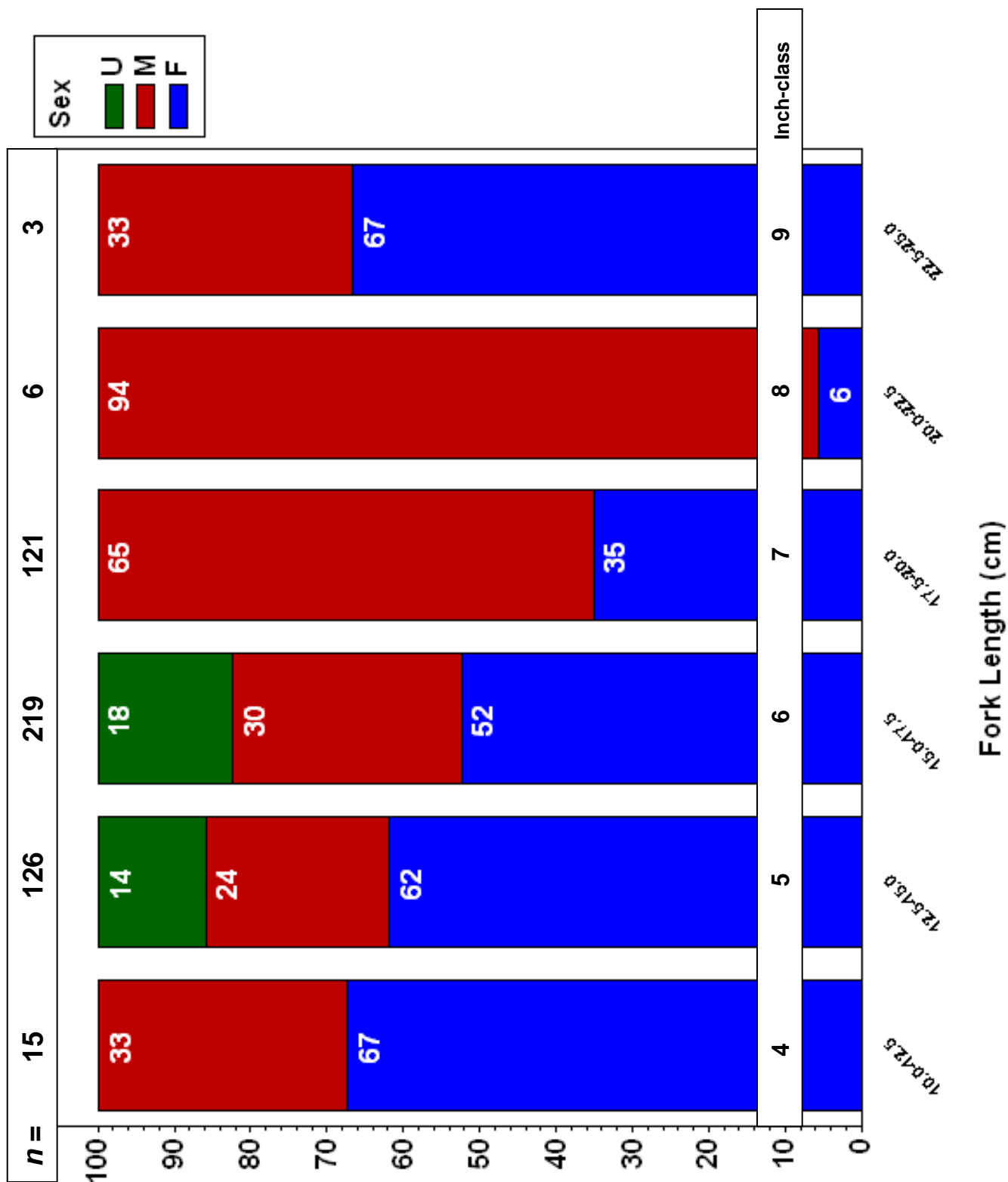




Figure 132. Sex ratio, by length group, for spot collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



# Spotted Hake (Priority D)

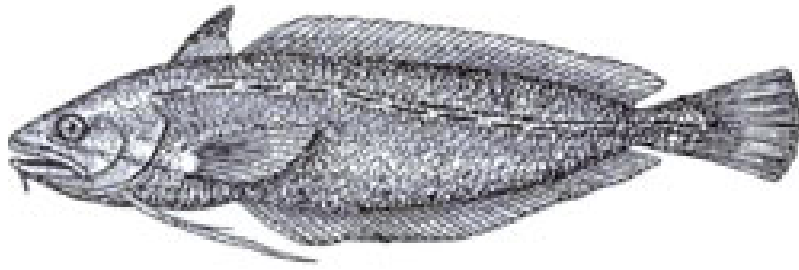
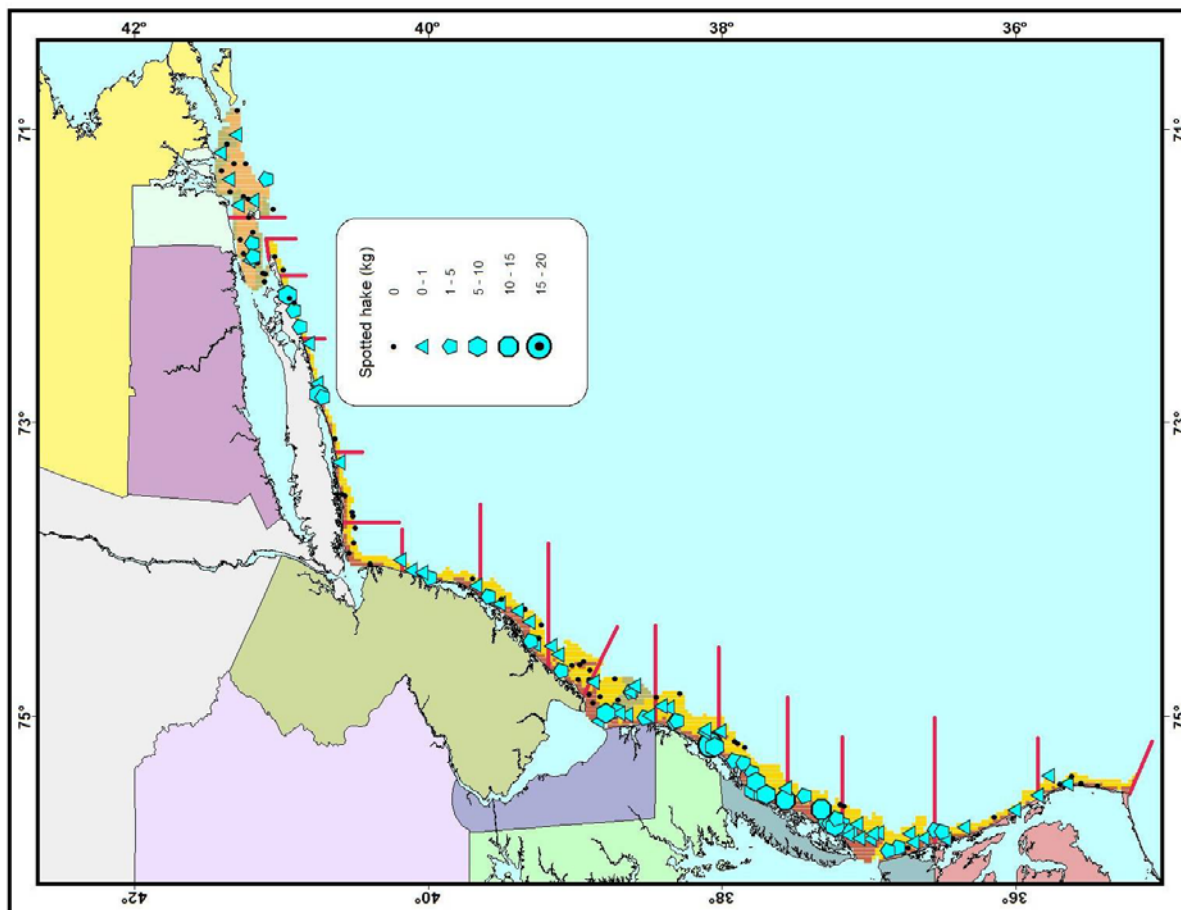


Table 38. Sampling rates and abundance indices of spotted hake for four NEAMAP cruises.

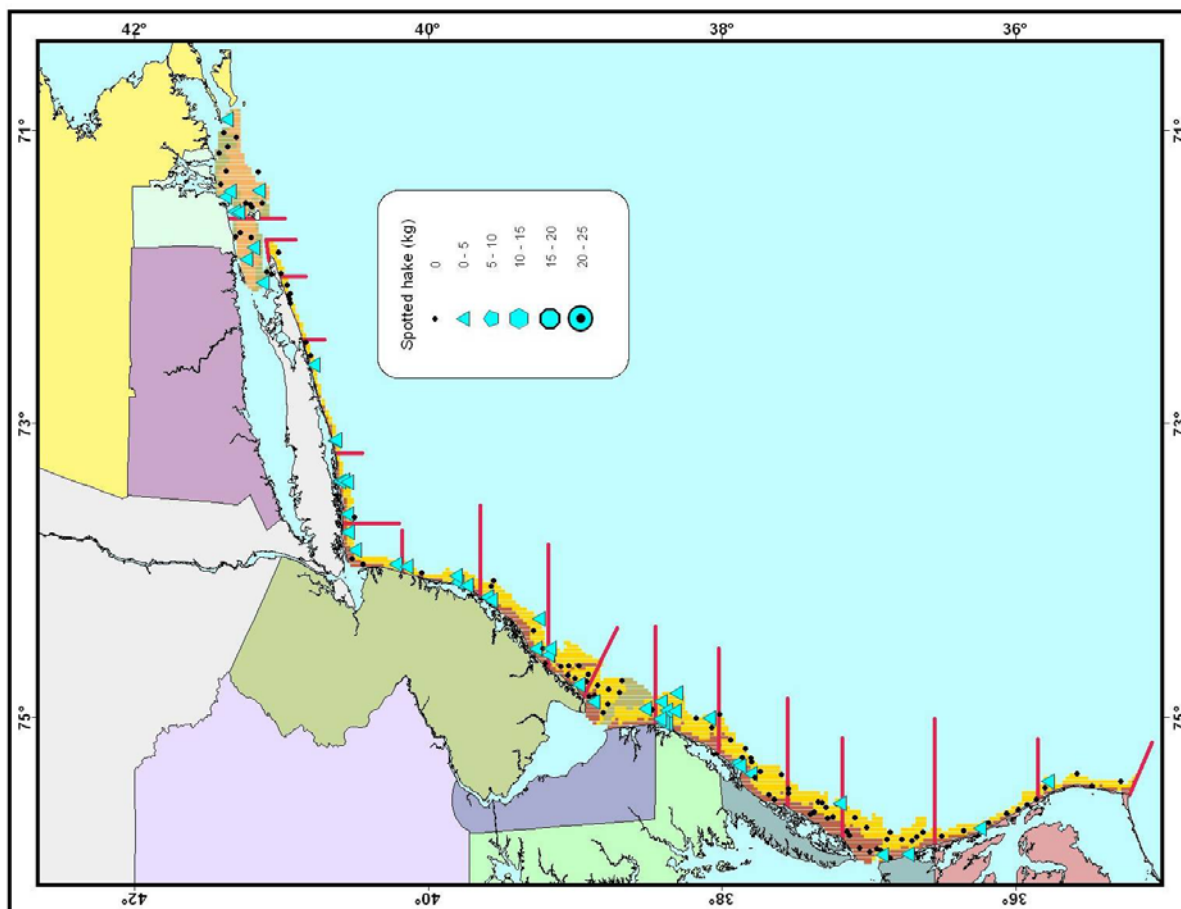
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	207	25.7	207	0		0		0.53	0.12
2008	Spring	11,717	241.7	3,162	3	0	3	0	9.17	0.77
	Fall	1,956	183.0	1,053	0		0		2.54	0.58
2009	Spring	7,648	116.7	4,599	0		0		6.27	0.35

Figure 133. Biomass (kg) of spotted hake collected at each sampling site for four NEAMAP cruises.

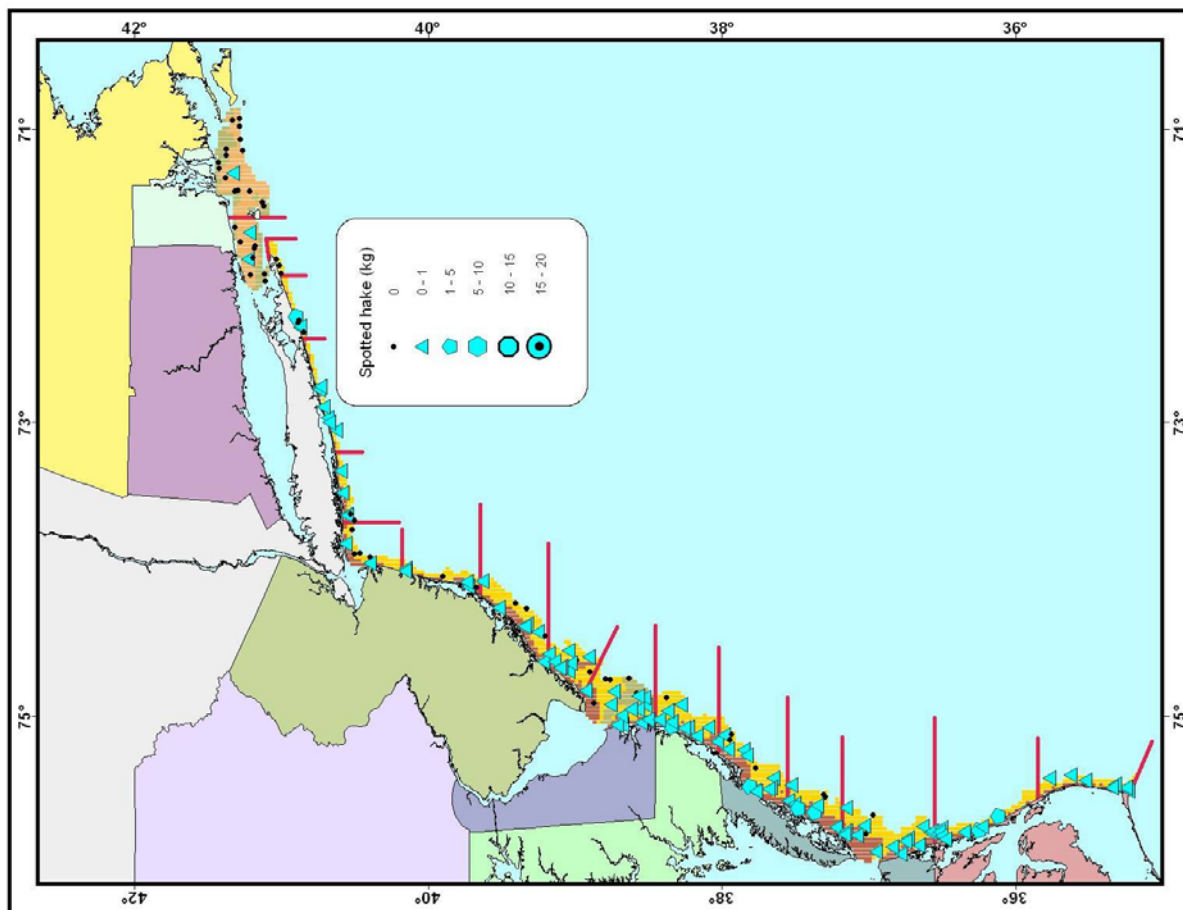
Spring 2008



Fall 2007



Spring 2009



Fall 2008

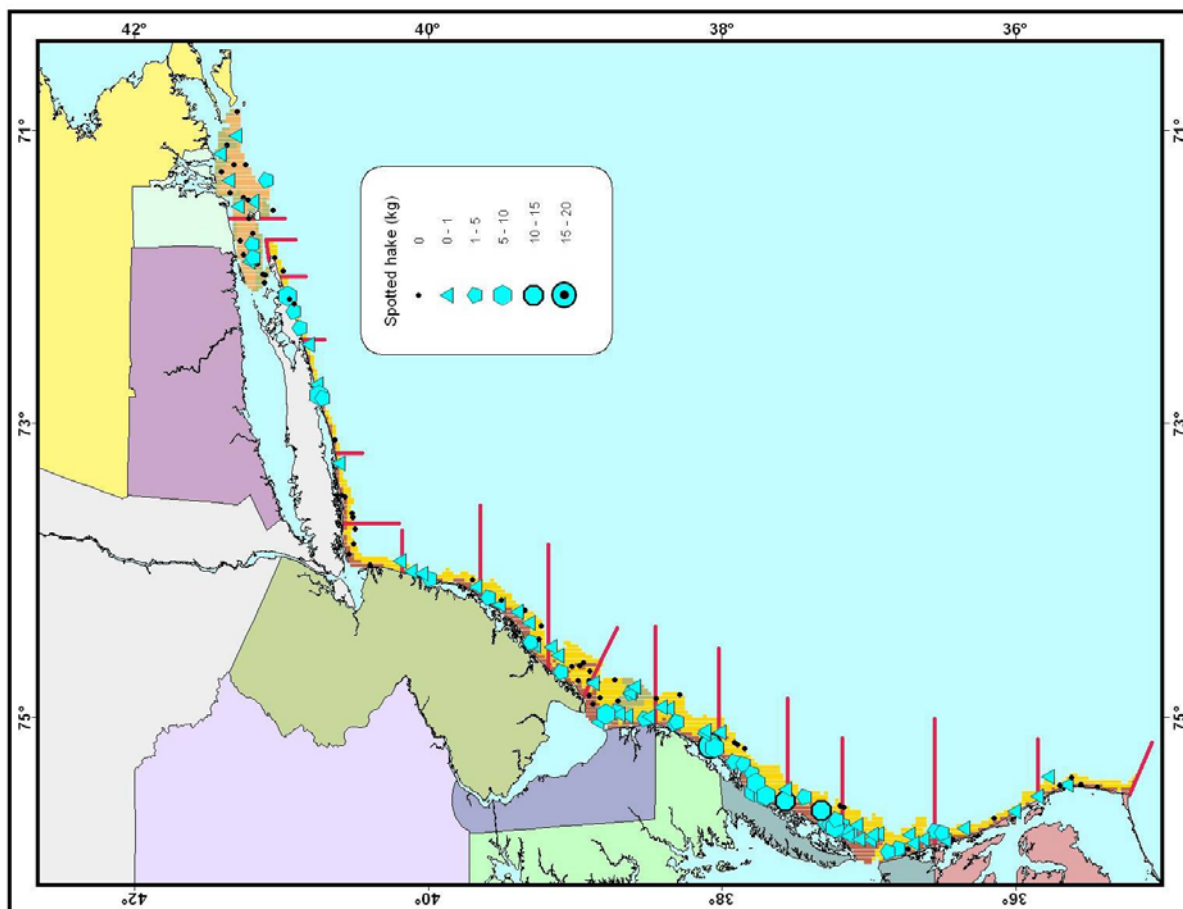


Figure 134. Preliminary indices of abundance, in terms of number and biomass, of spotted hake for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

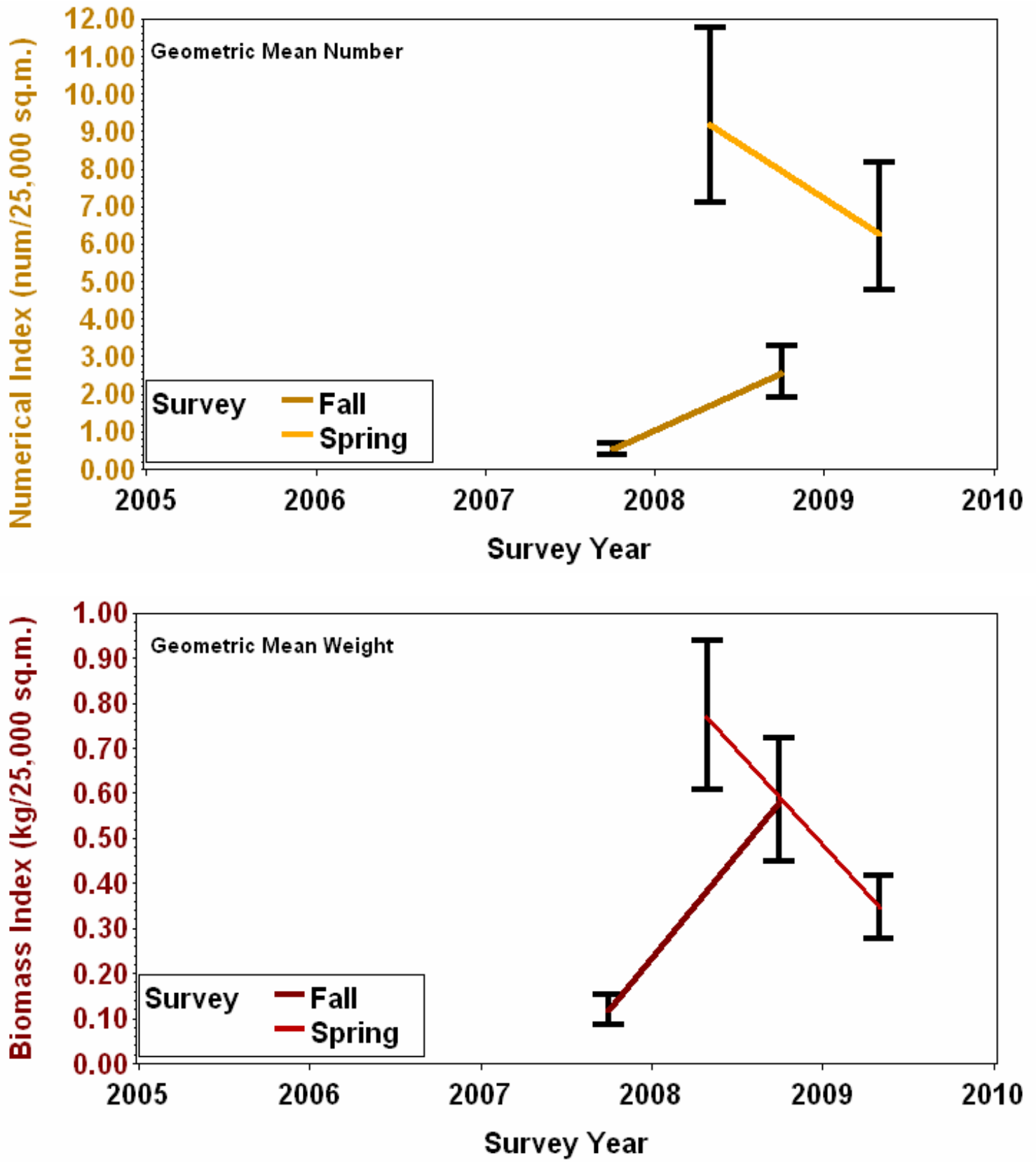
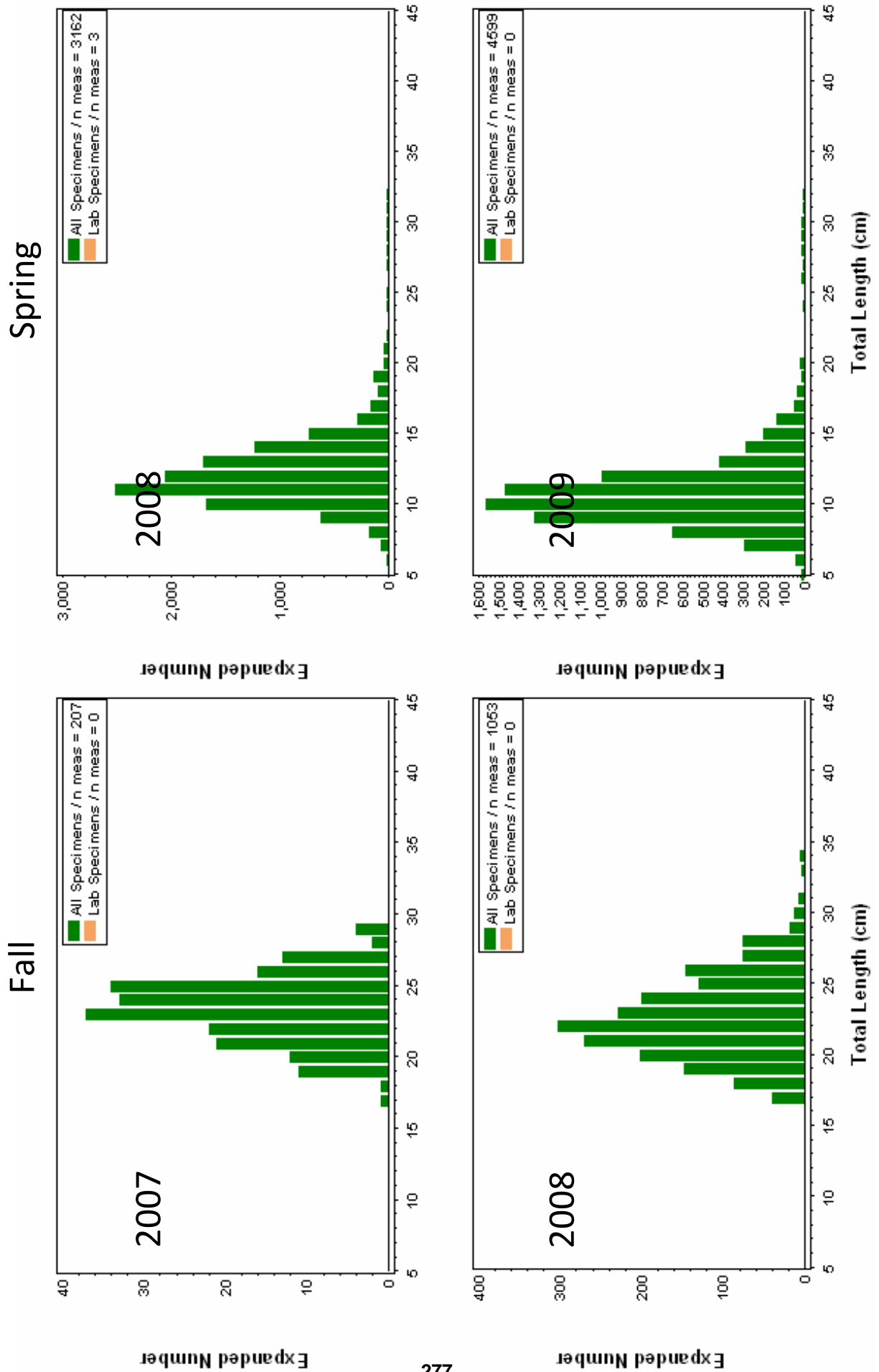


Figure 135. Length-frequency distributions, by cruise, for spotted hake.





# Striped Anchovy (Priority D)

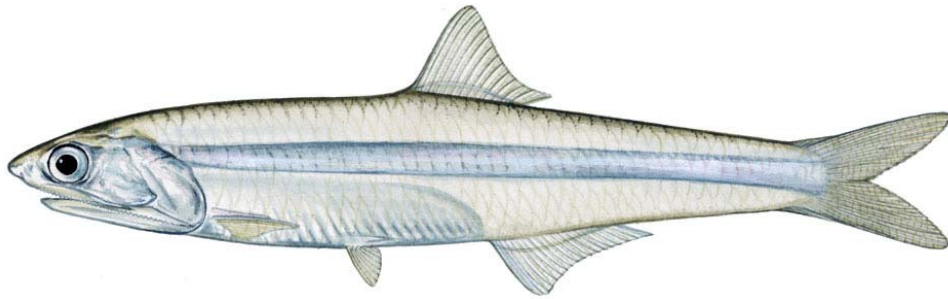


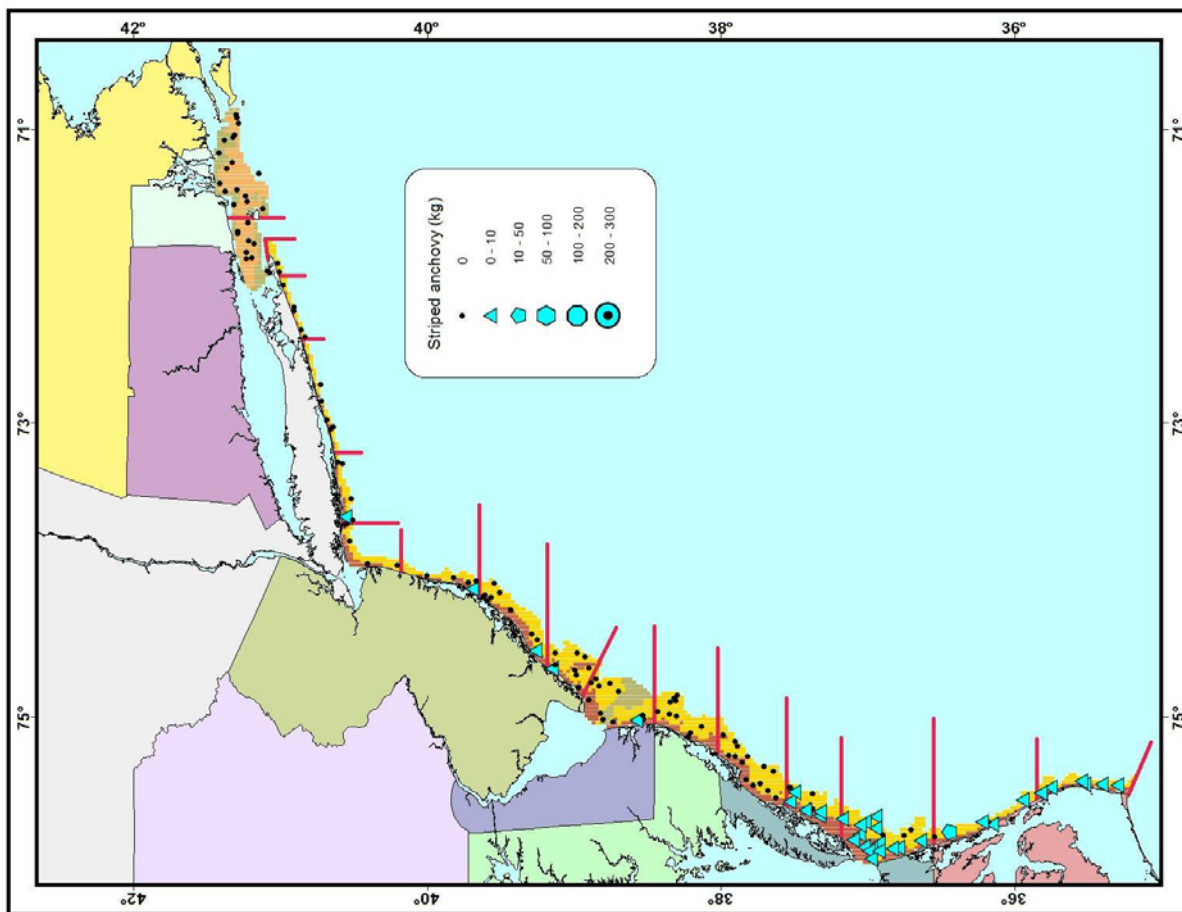
Table 39. Sampling rates and abundance indices of striped anchovy for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	224,369	2,519.3	4,990	0		0		17.22	1.42
2008	Spring	1,198	19.0	471	0		0		0.70	0.06
	Fall	84,833	1,009.1	3,357	0		0		11.01	1.21
2009	Spring	104	1.5	104	0		0		0.03	0.01

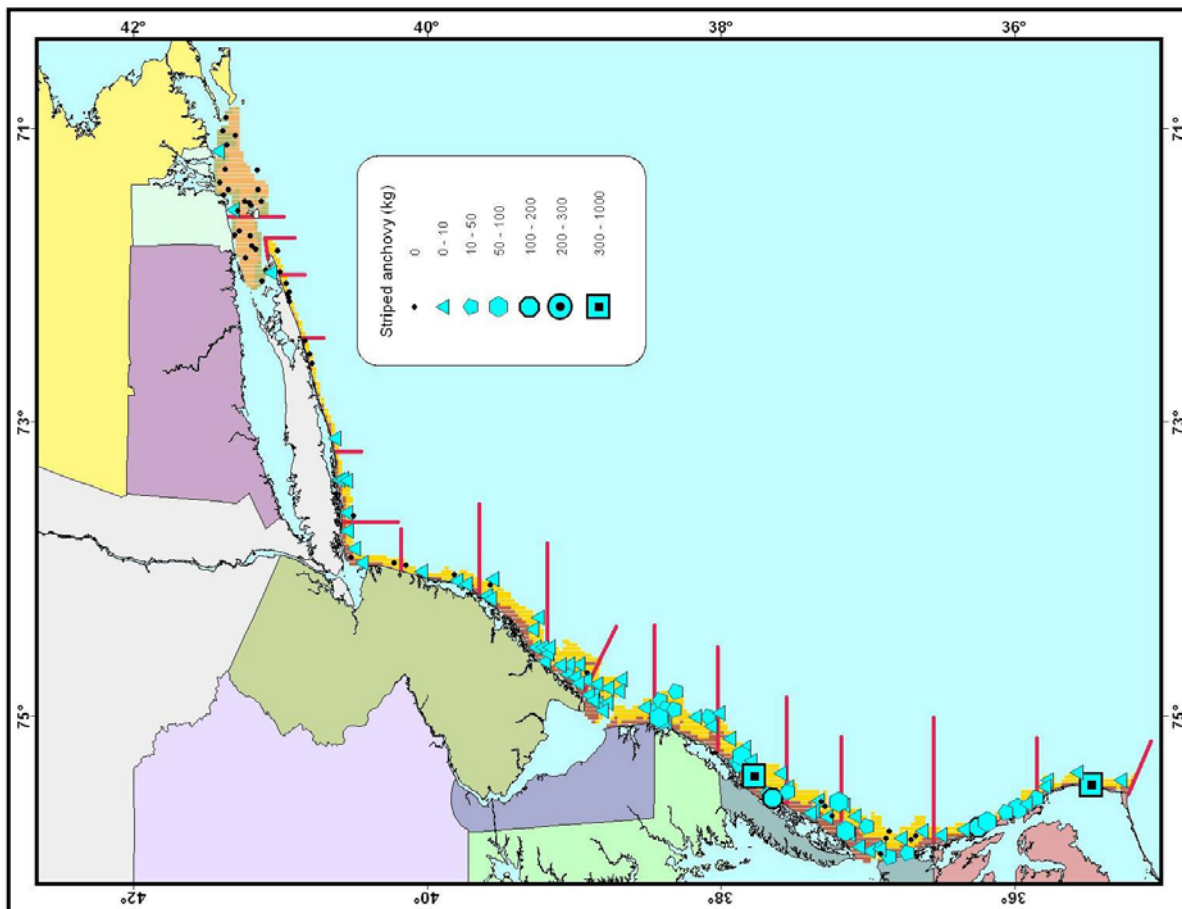


Figure 136. Biomass (kg) of striped anchovy collected at each sampling site for four NEAMAP cruises.

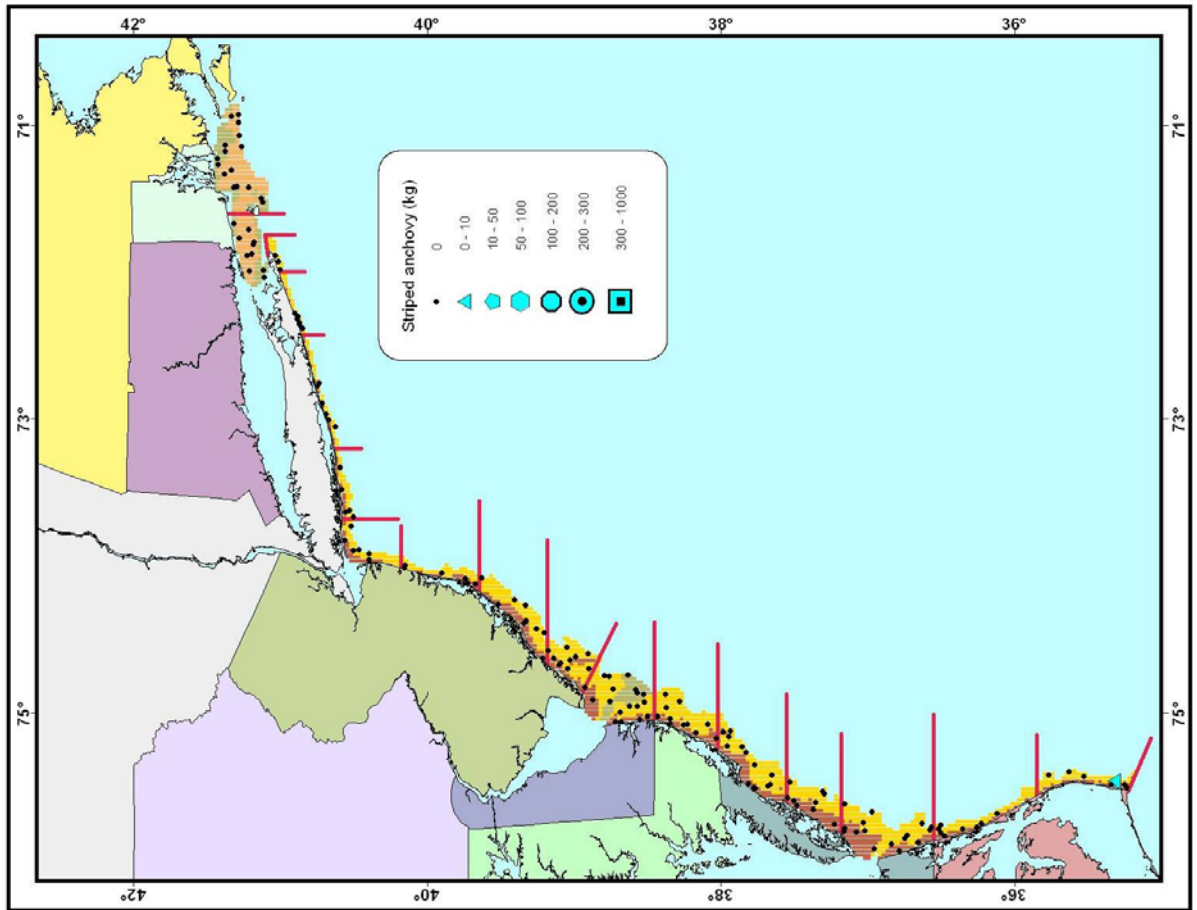
Spring 2008



Fall 2007



Spring 2009



Fall 2008

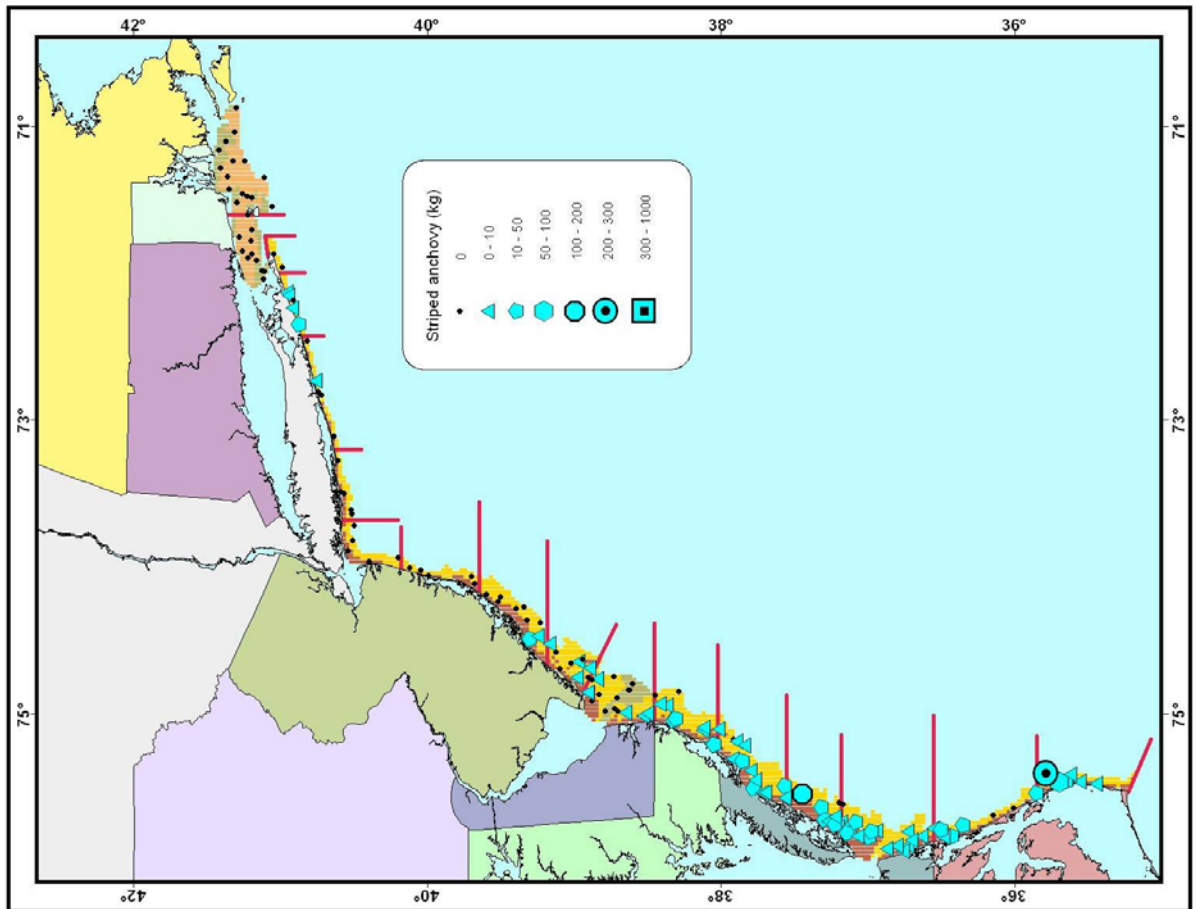


Figure 137. Preliminary indices of abundance, in terms of number and biomass, of striped anchovy for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

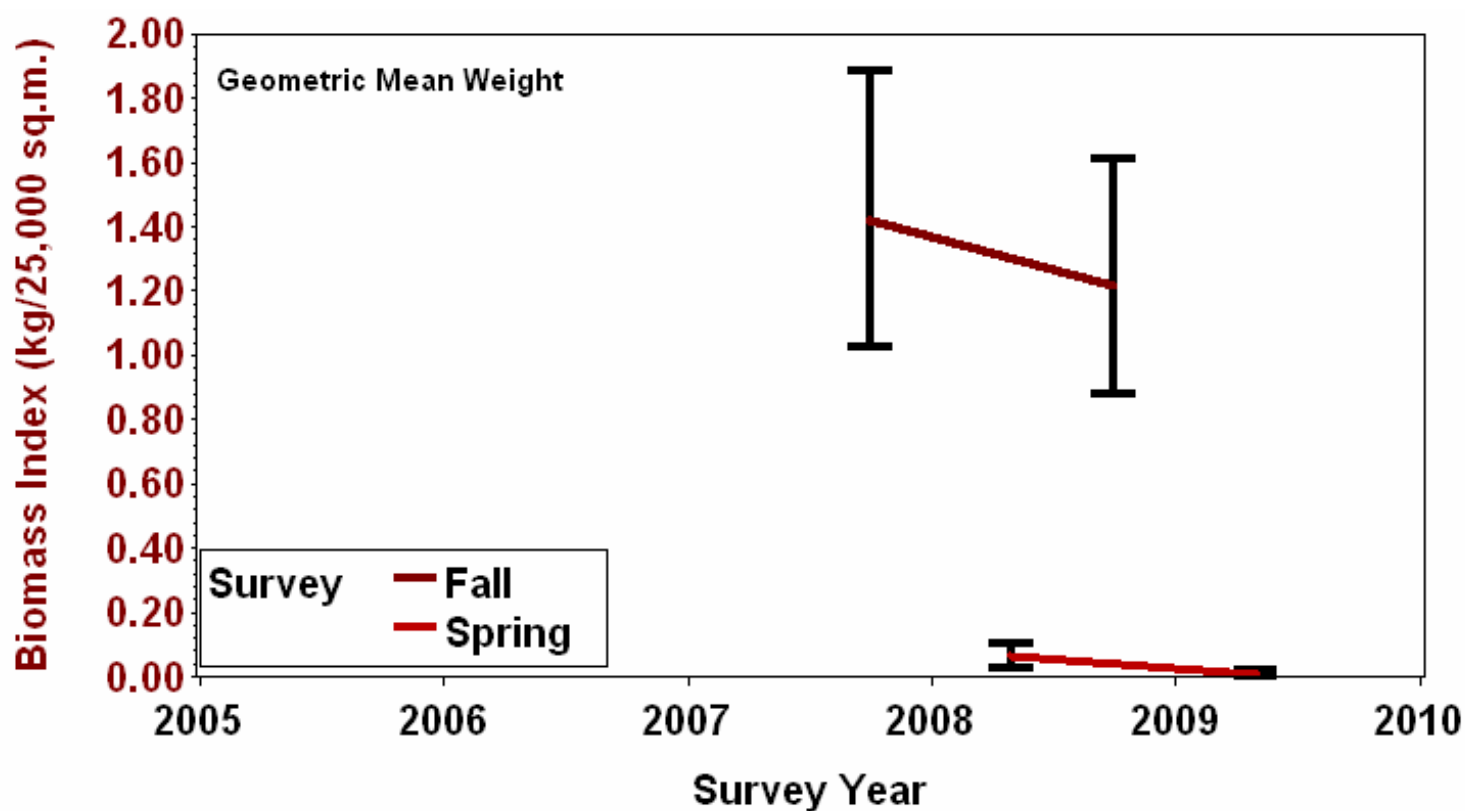
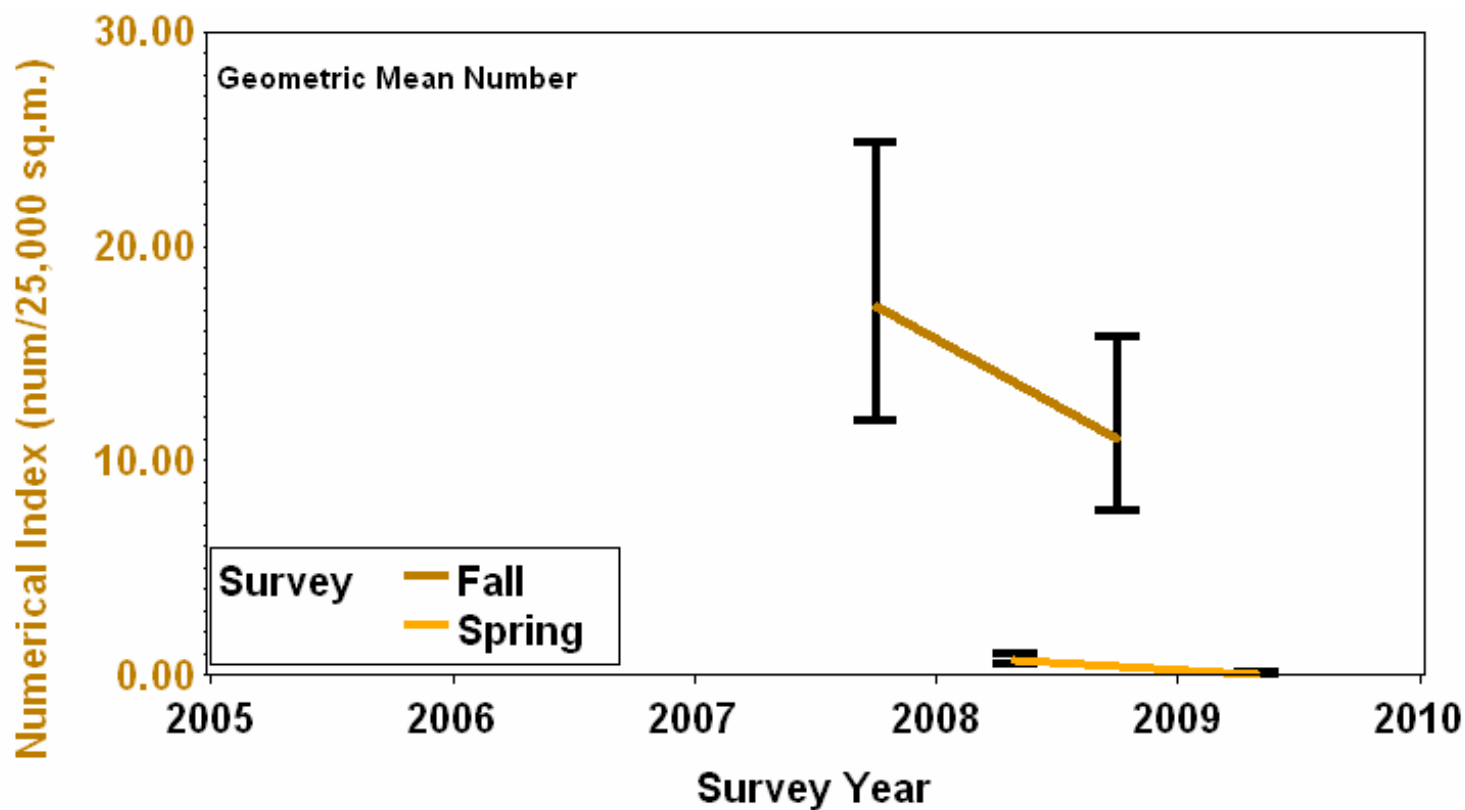
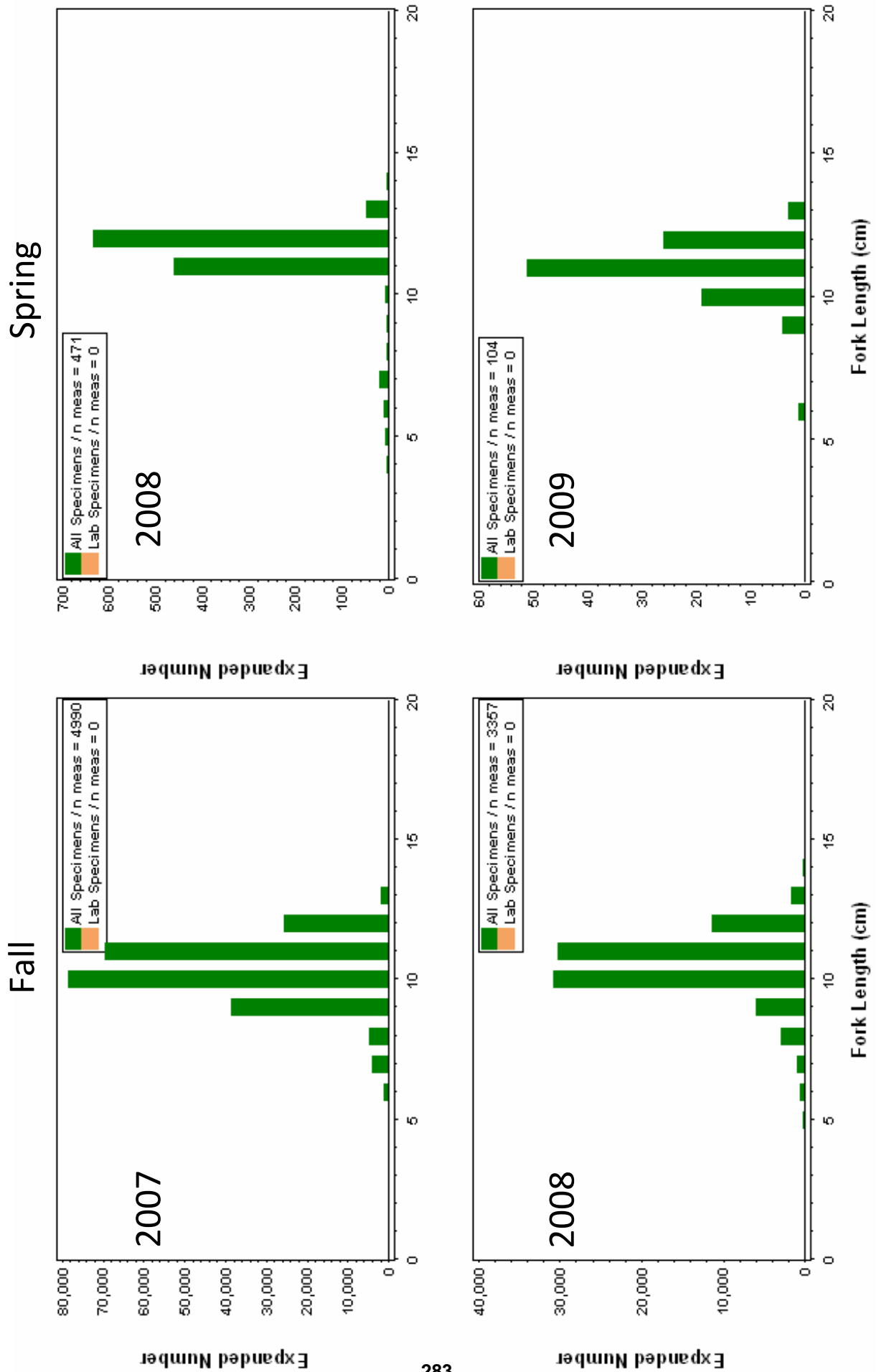


Figure 138. Length-frequency distributions, by cruise, for striped anchovy.





# Striped Bass (Priority A)

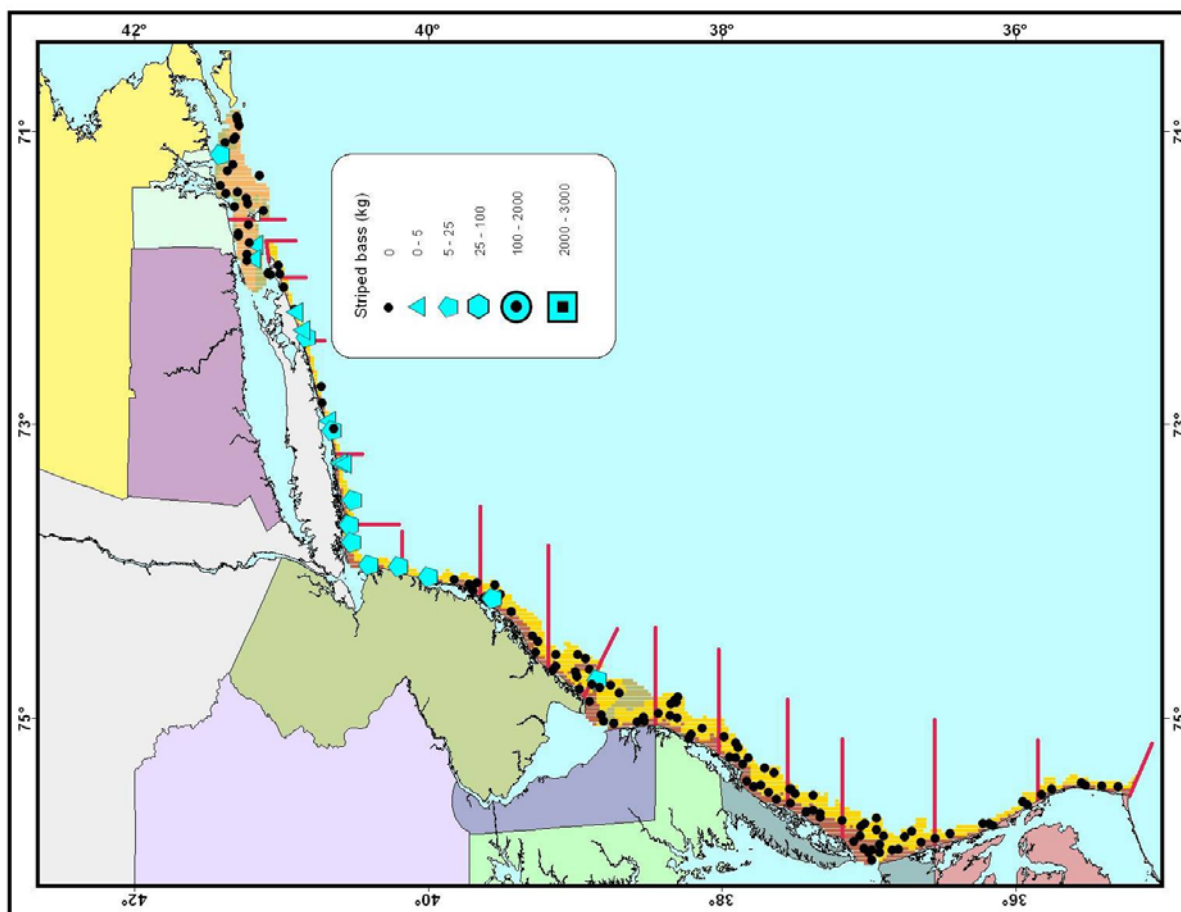


Table 40. Sampling rates and abundance indices of striped bass for four NEAMAP cruises.

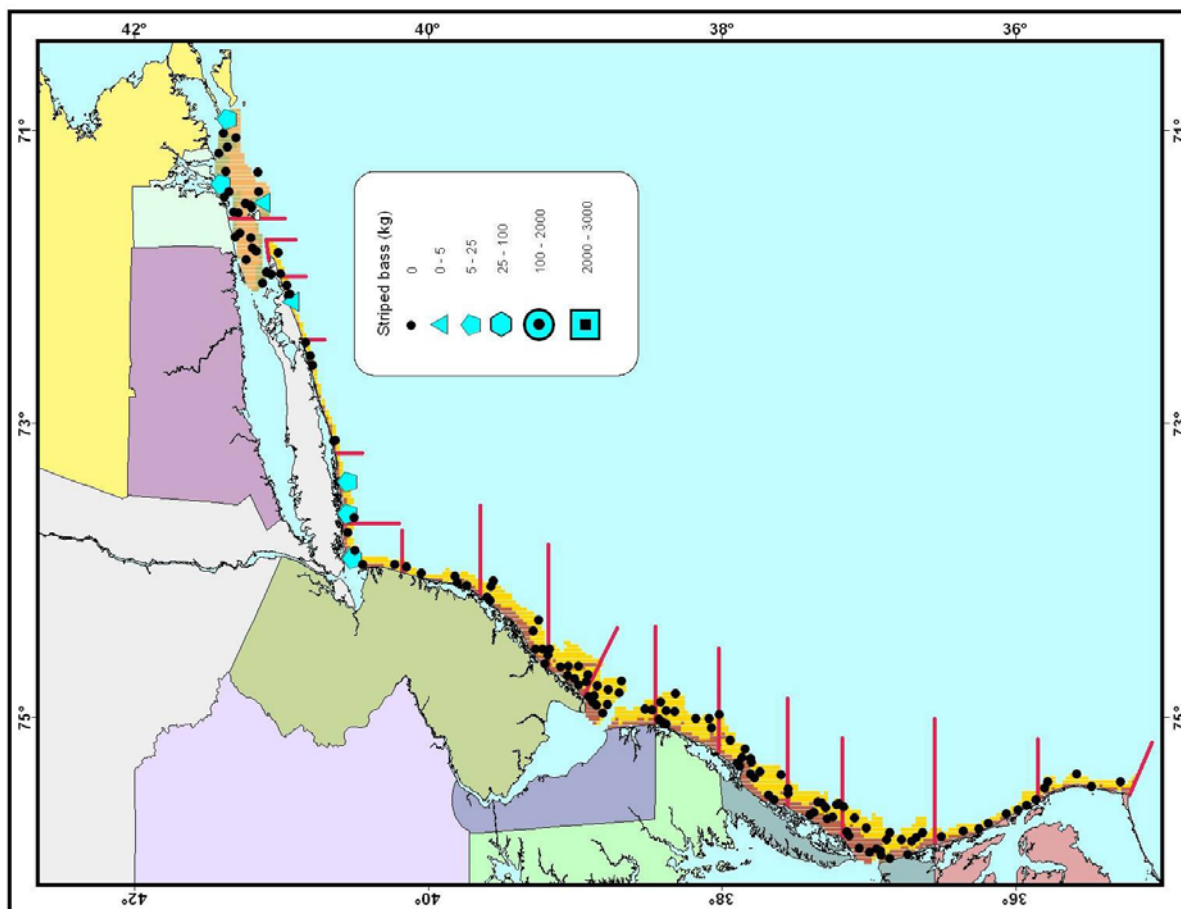
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	17	66.3	17	16	16	16	16	0.05	0.10
2008	Spring	40	171.1	40	39	40	33	30	0.12	0.27
	Fall	1,559	4,611.9	95	43	59	21	19	0.18	0.30
2009	Spring	162	388.9	162	77	0	47	39	0.17	0.30

Figure 139. Biomass (kg) of striped bass collected at each sampling site for four NEAMAP cruises.

Spring 2008

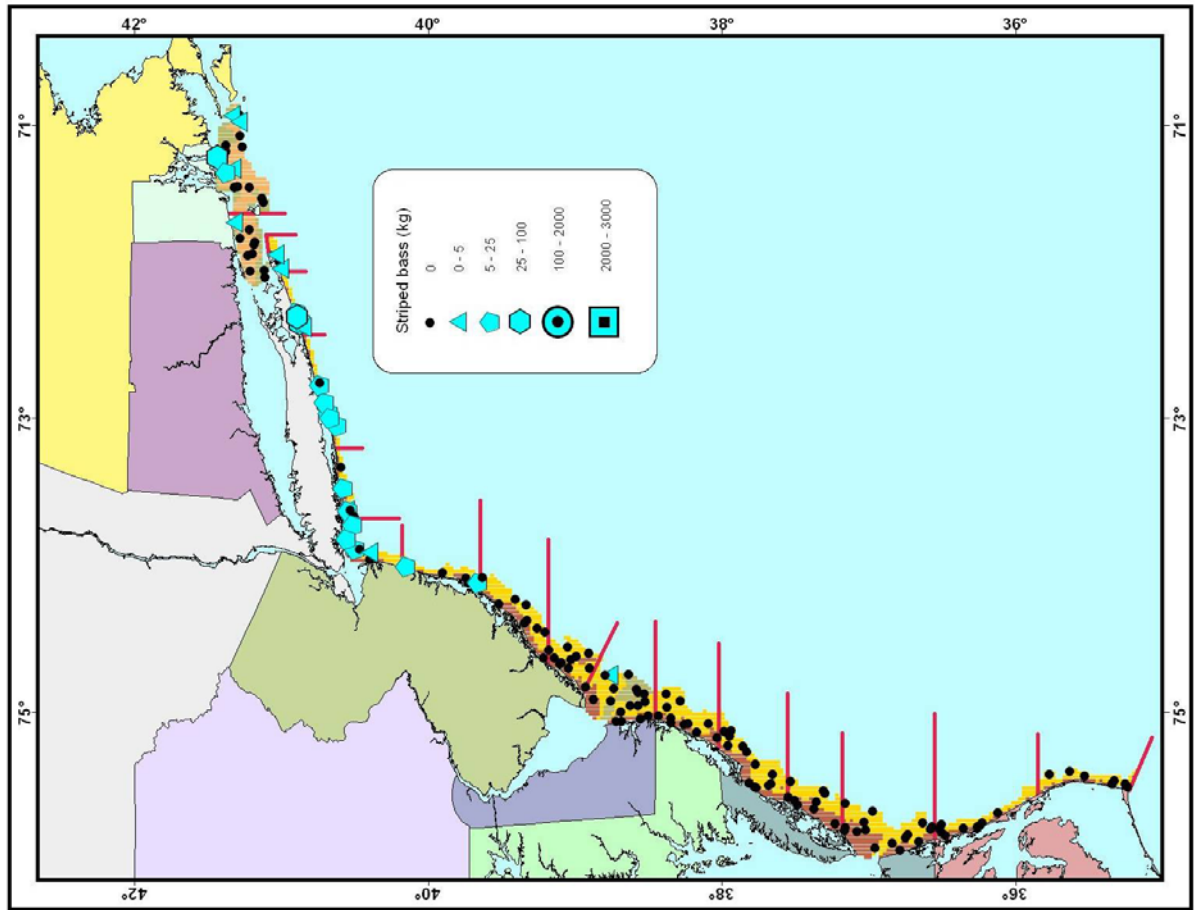


Fall 2007





Spring 2009



Fall 2008

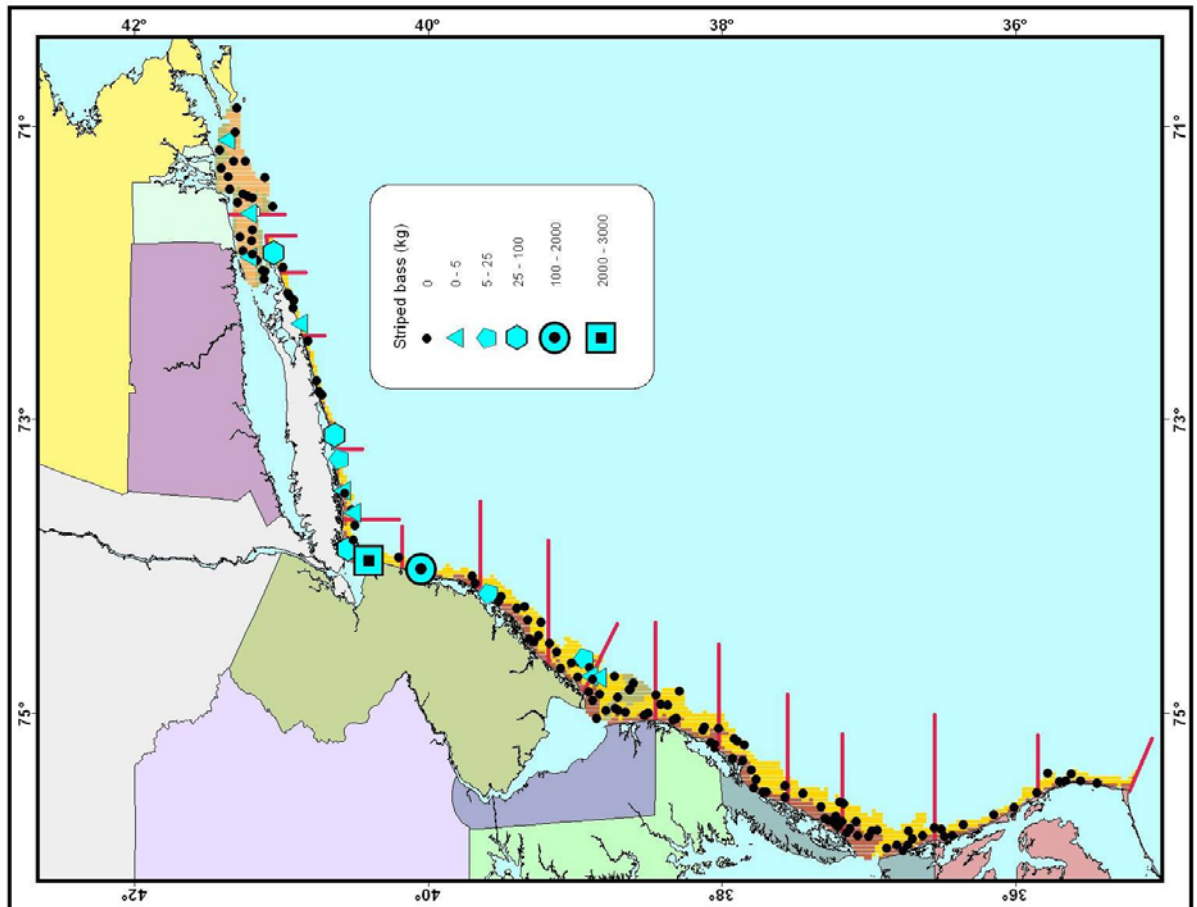




Figure 140. Preliminary indices of abundance, in terms of number and biomass, of striped bass for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

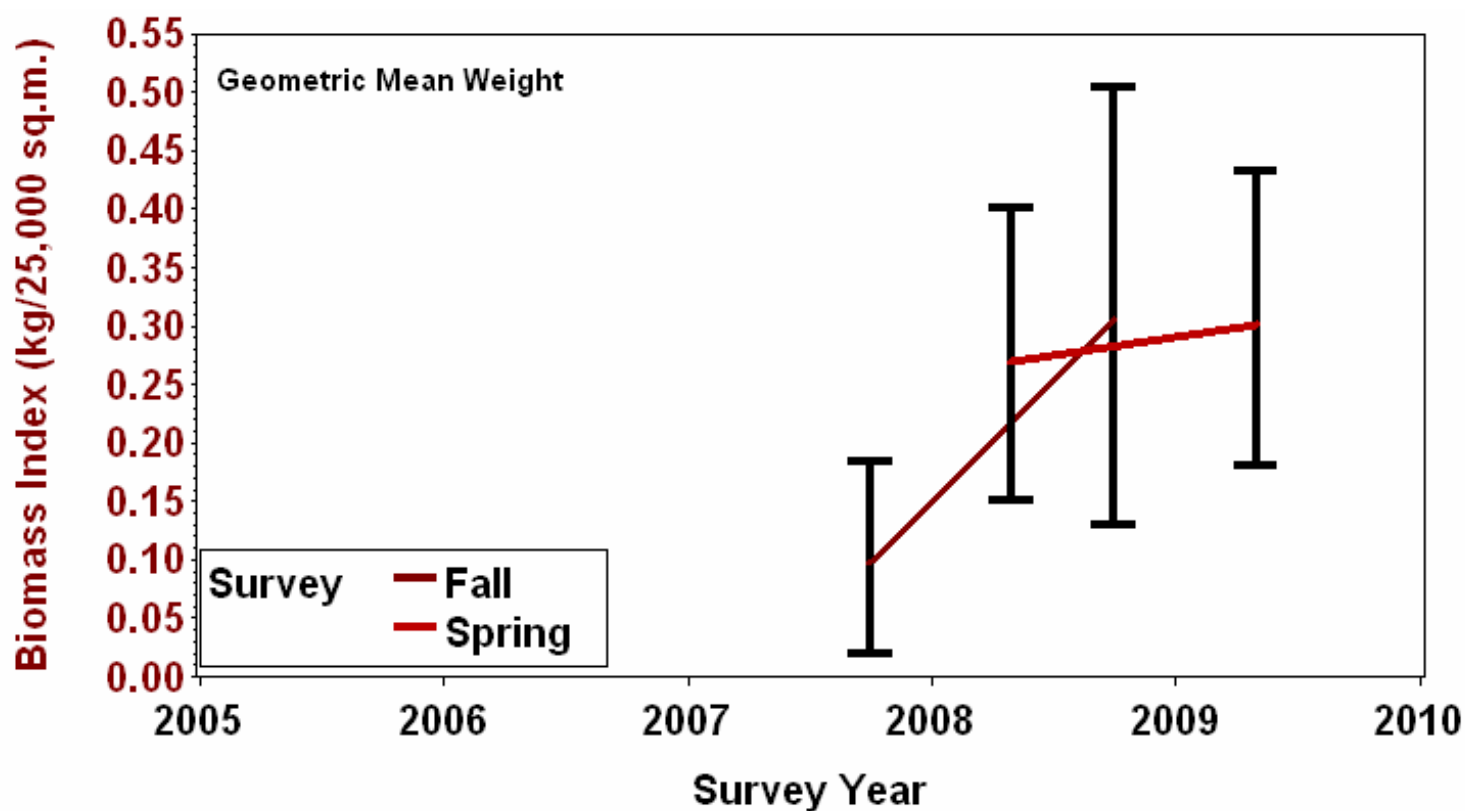
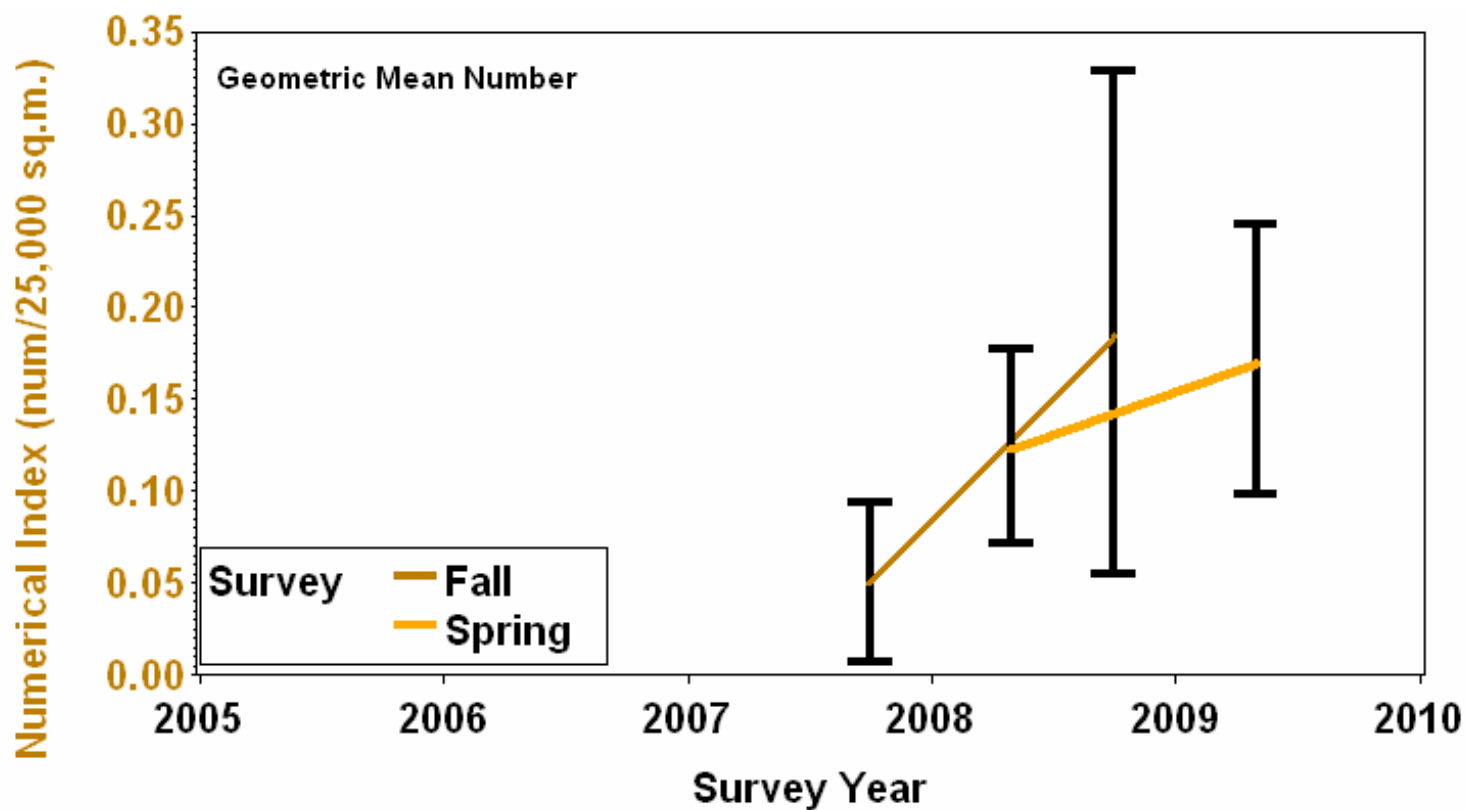


Figure 141. Length-frequency distributions, by cruise, for striped bass. Numbers taken for full processing, by length, are represented by the orange bars.

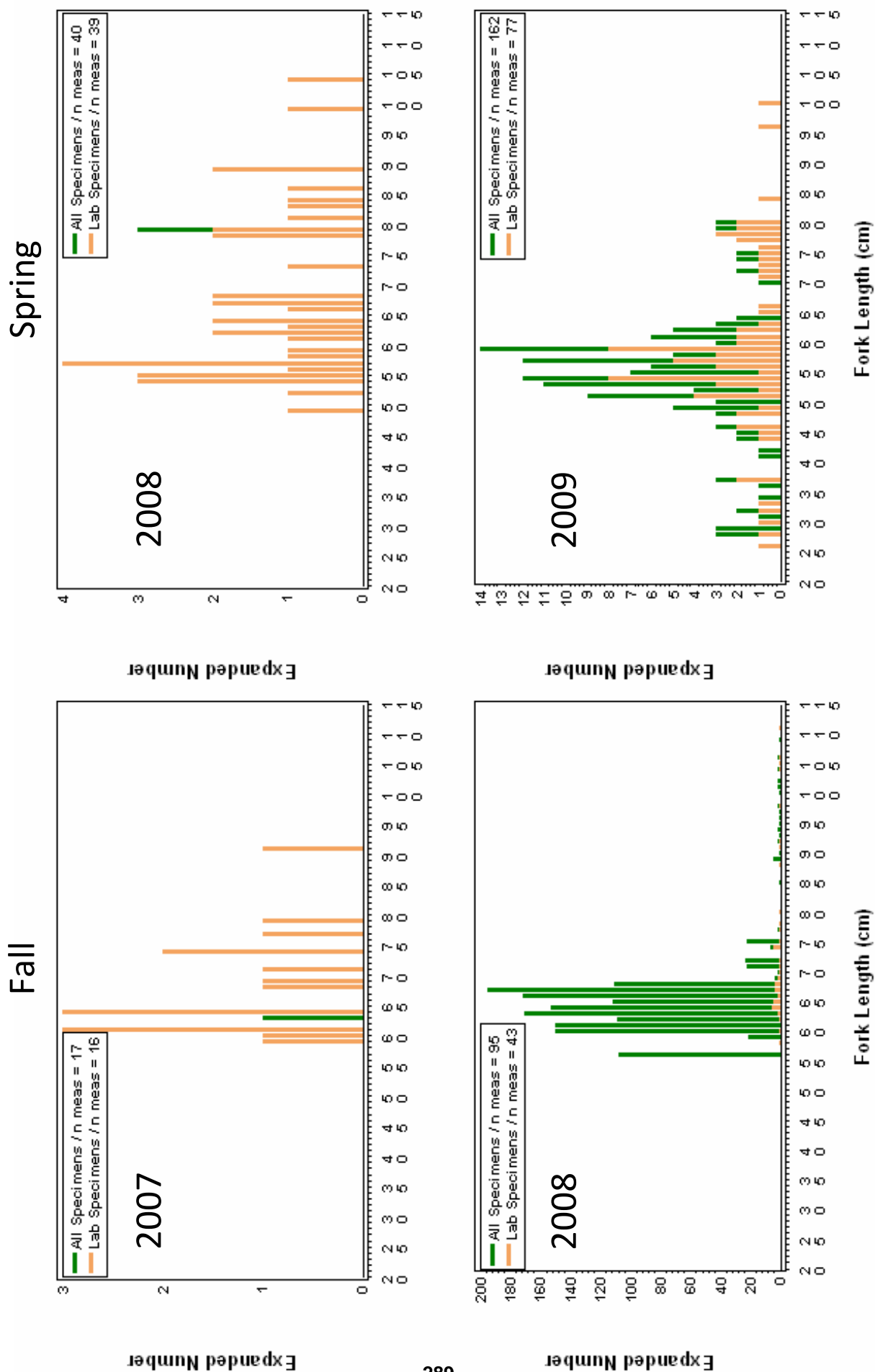


Figure 142. Sex ratio, by length group, for striped bass collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

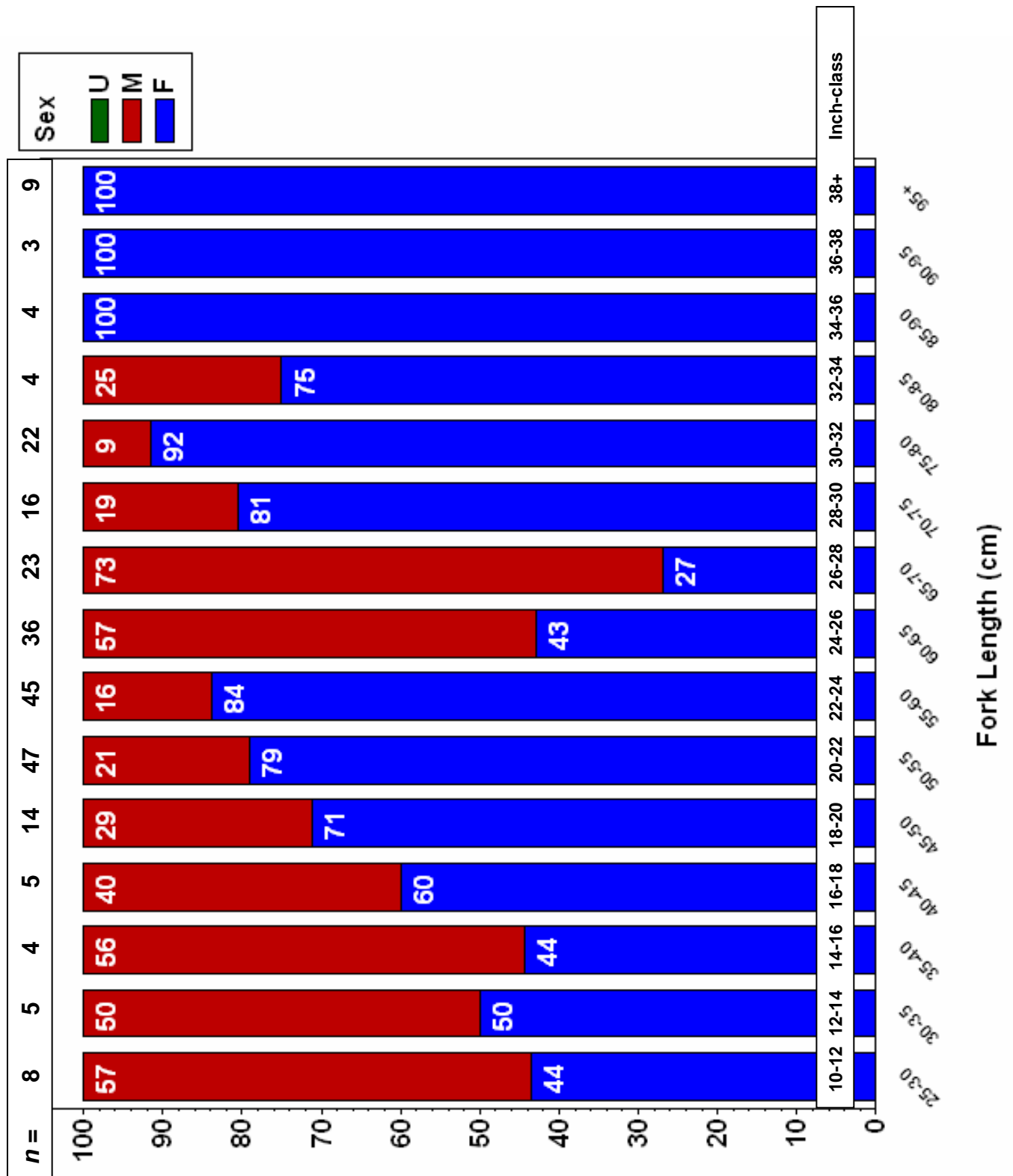


Figure 143. Age-frequency distribution, by cruise, for striped bass. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.

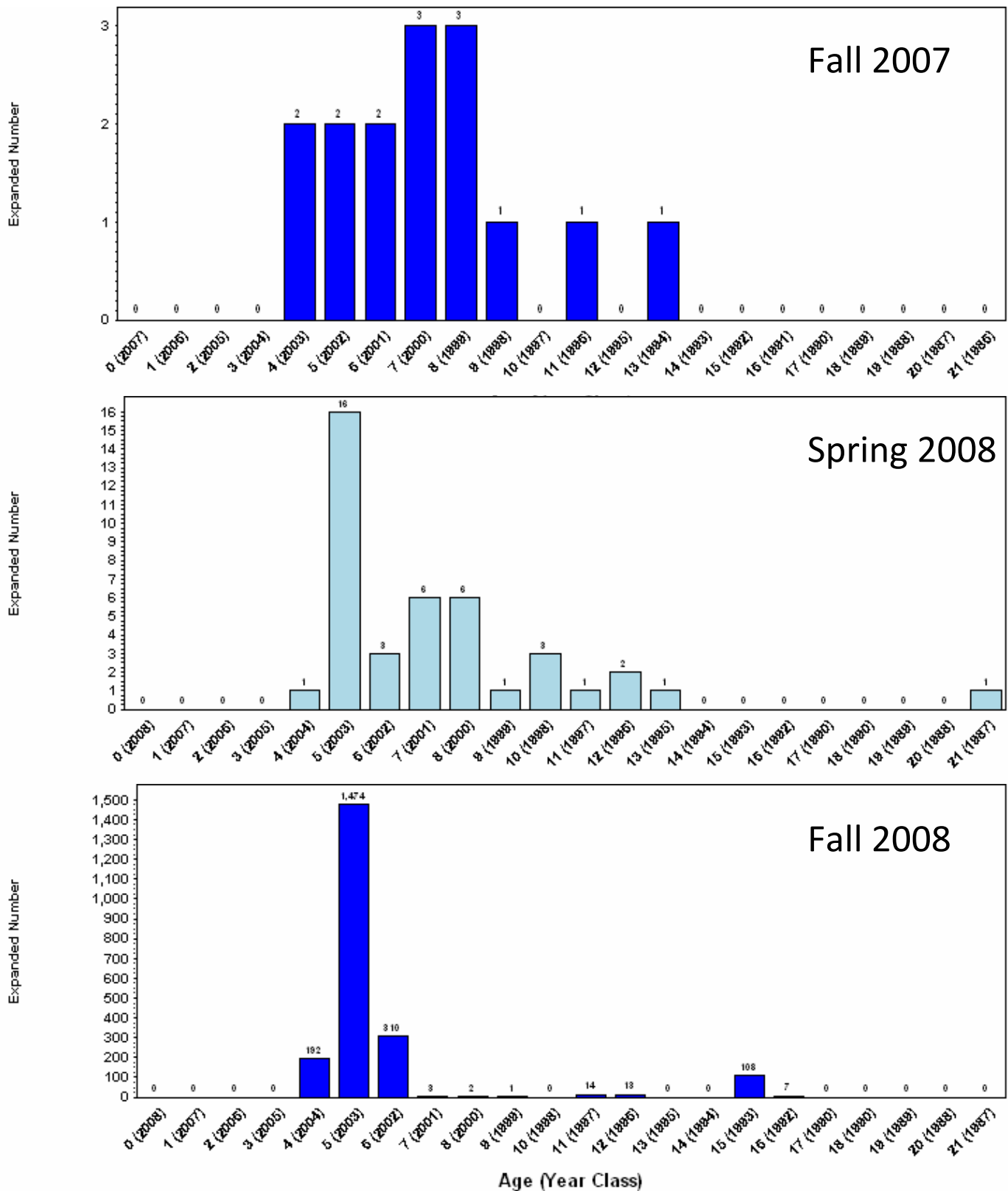
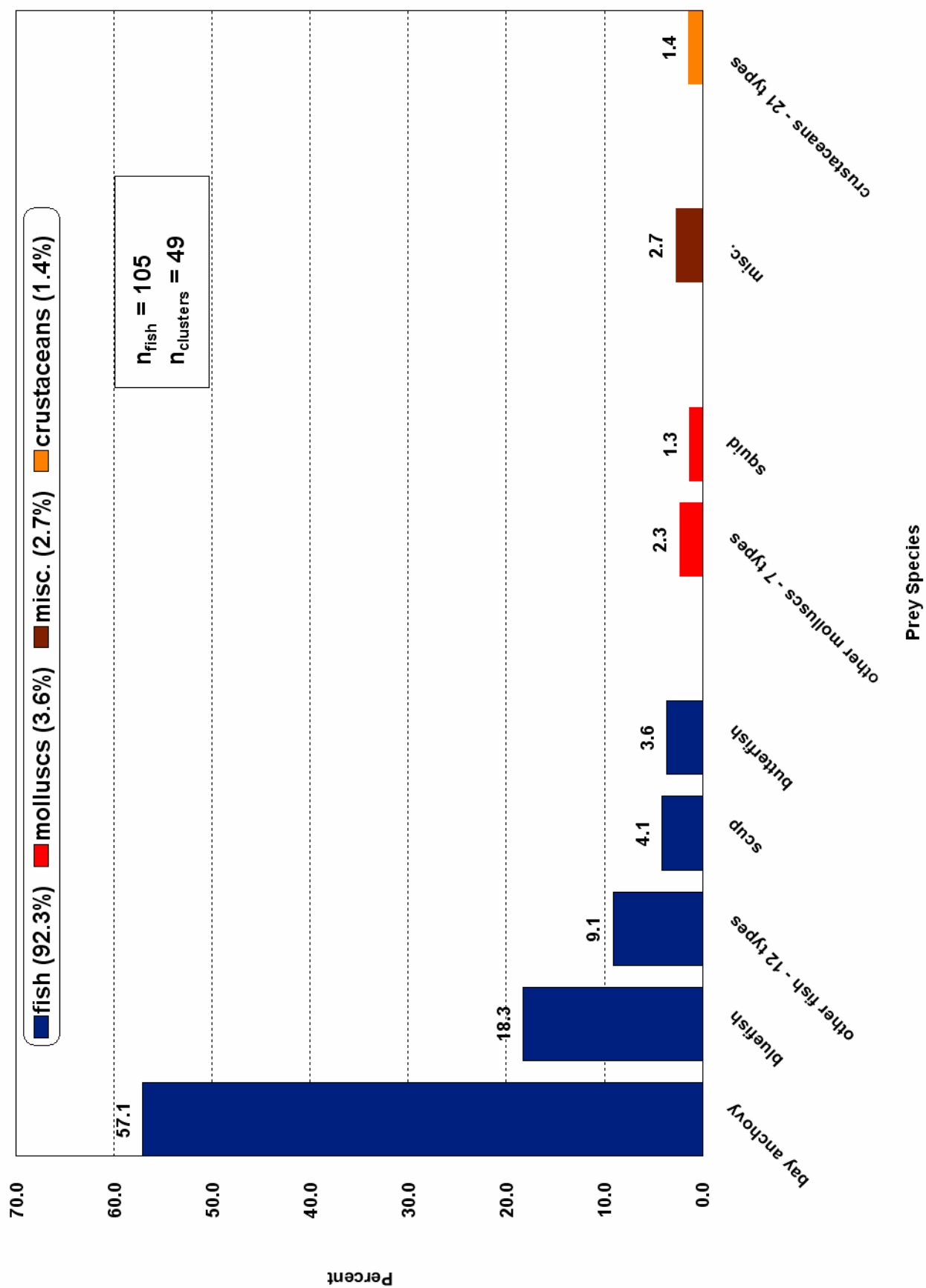


Figure 144. Diet composition, expressed using the percent weight index, of striped bass collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of stripers sampled.



# Striped Searobin (Priority D)

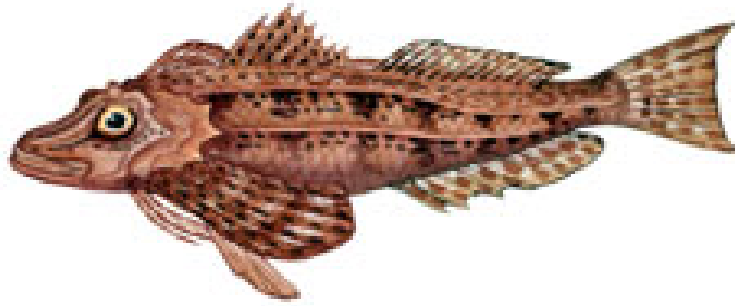
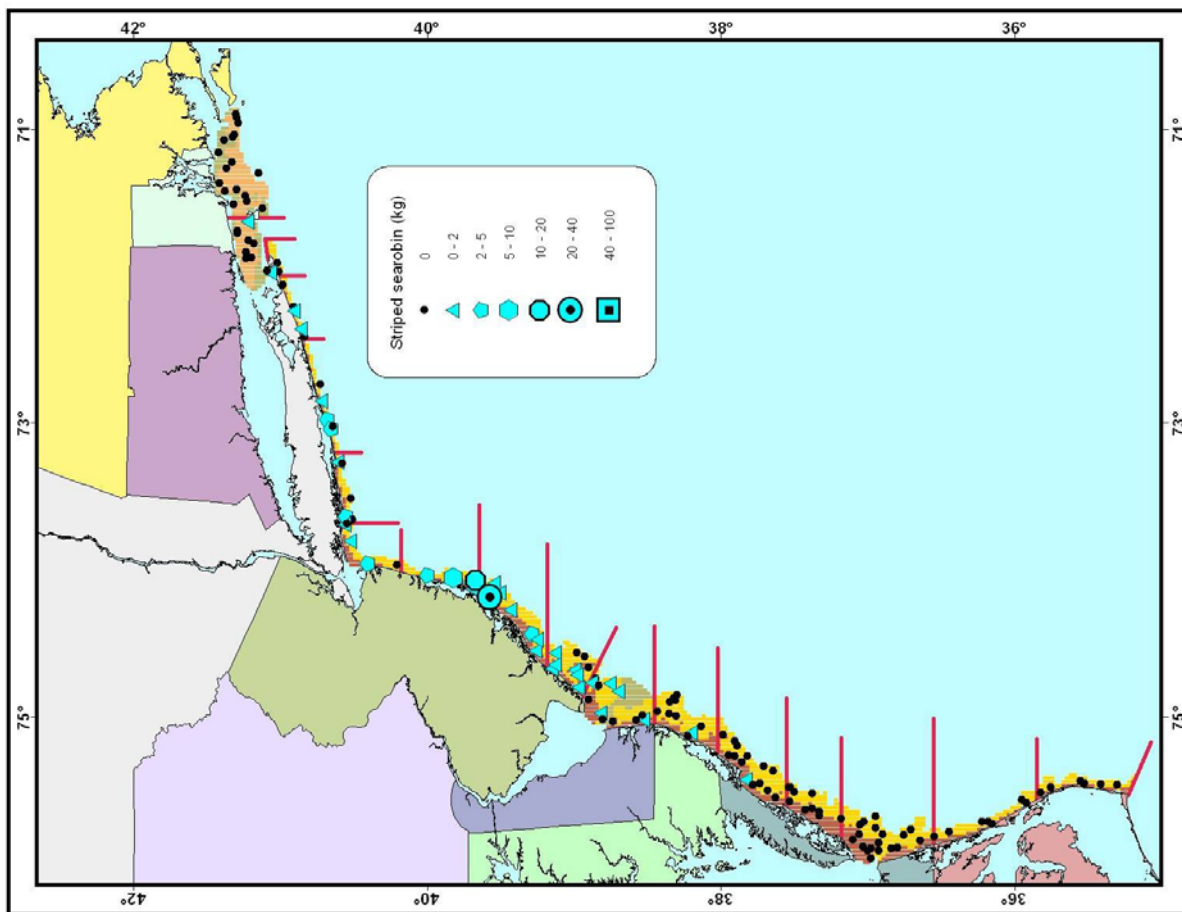


Table 41. Sampling rates and abundance indices of striped searobin for four NEAMAP cruises.

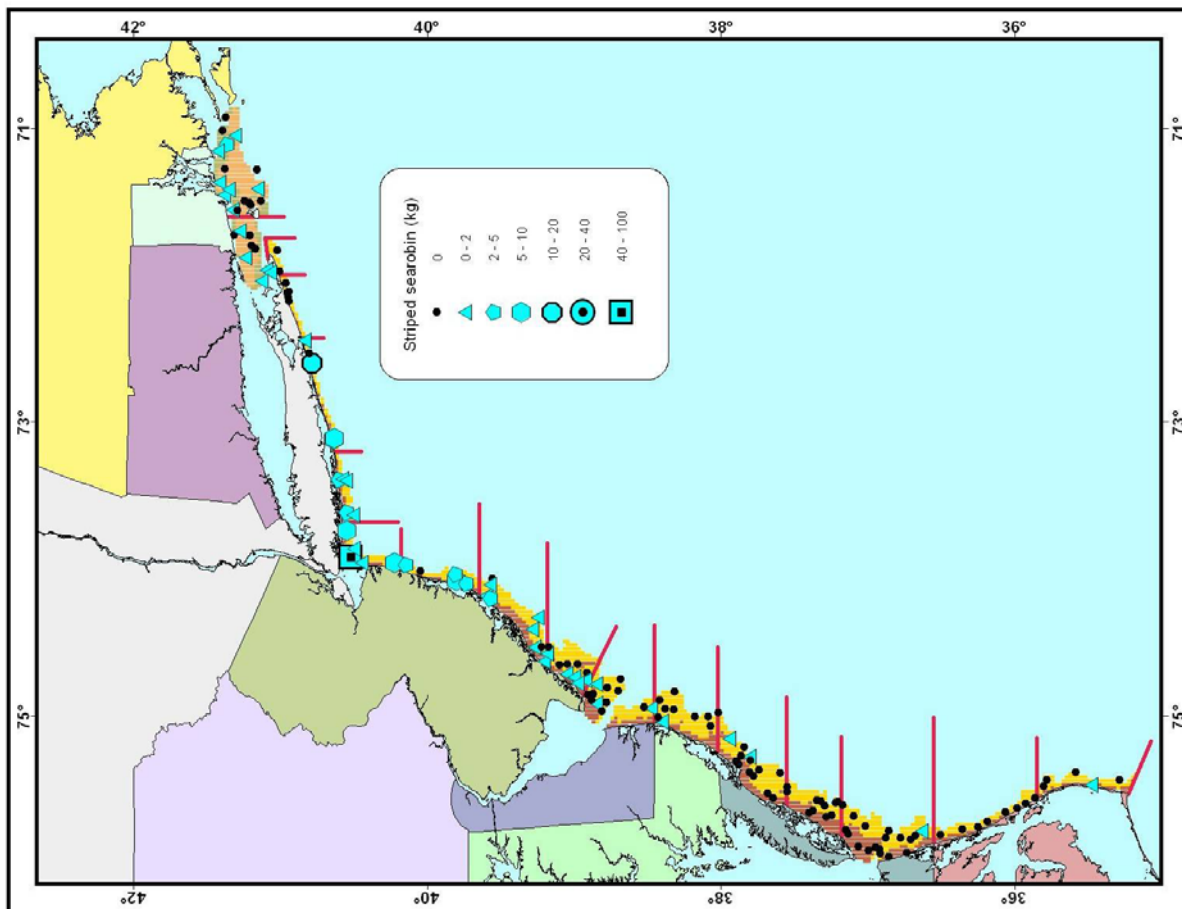
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	760	171.5	546	0		0		0.74	0.25
2008	Spring	414	86.4	246	0		0		0.53	0.22
	Fall	425	121.5	345	0		0		0.62	0.26
2009	Spring	865	332.0	383	0		0		0.35	0.21

Figure 145. Biomass (kg) of striped searobin collected at each sampling site for four NEAMAP cruises.

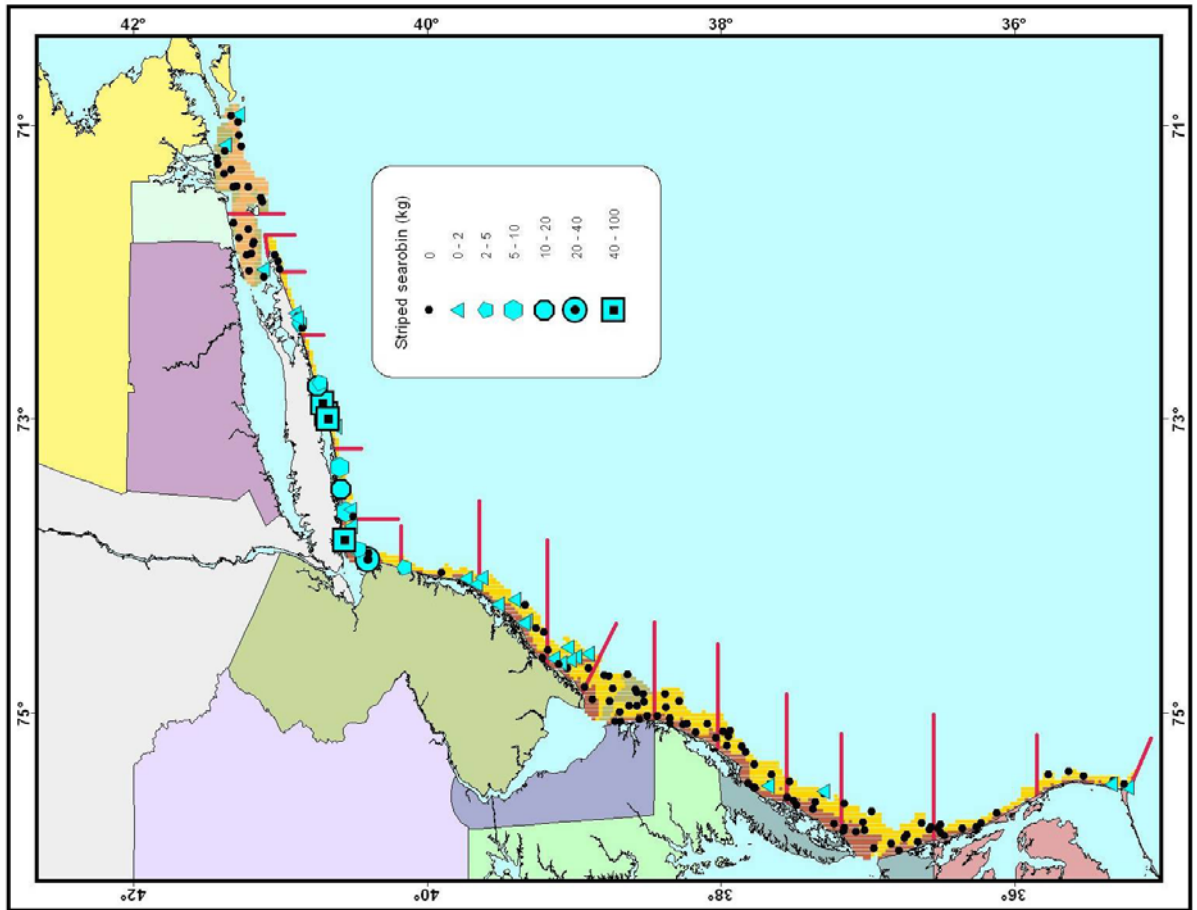
Spring 2008



Fall 2007



Spring 2009



Fall 2008

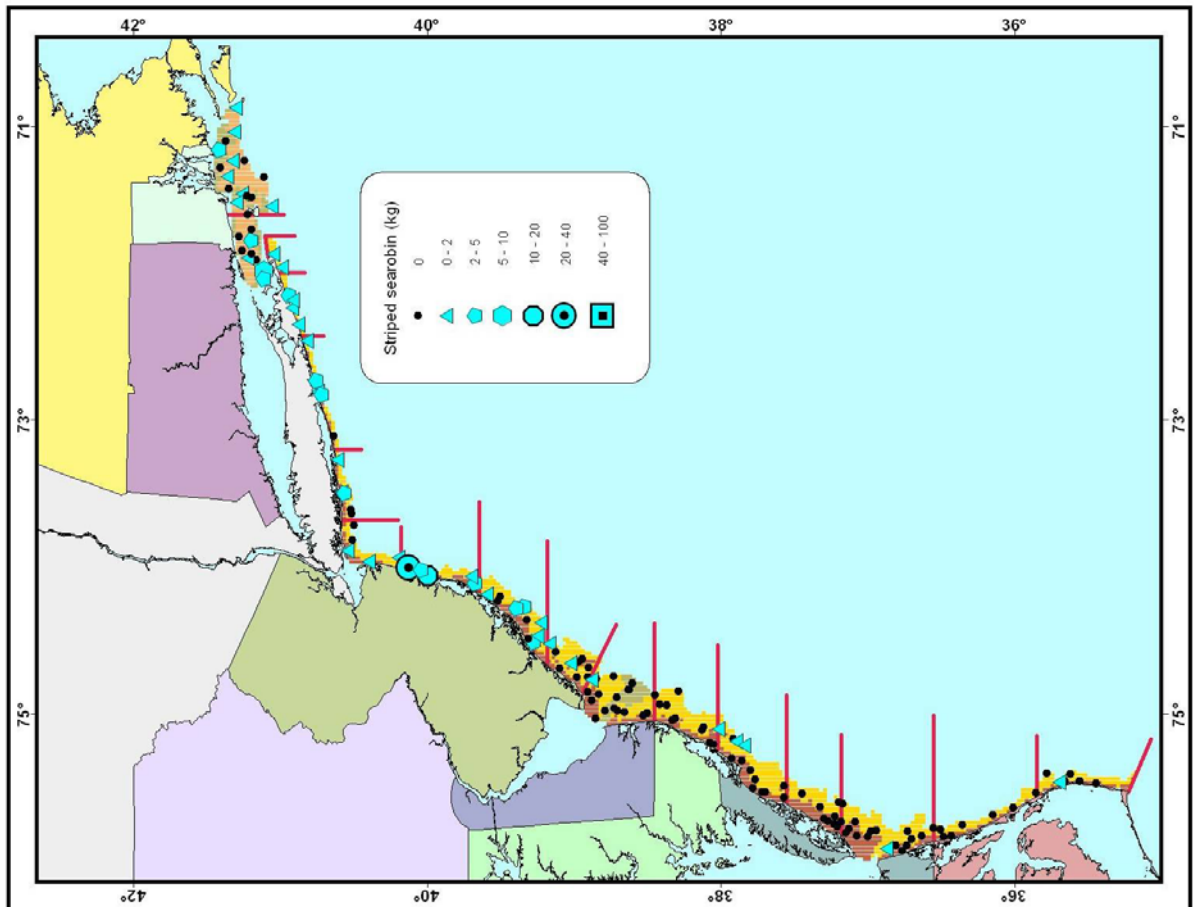




Figure 146. Preliminary indices of abundance, in terms of number and biomass, of striped searobin for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

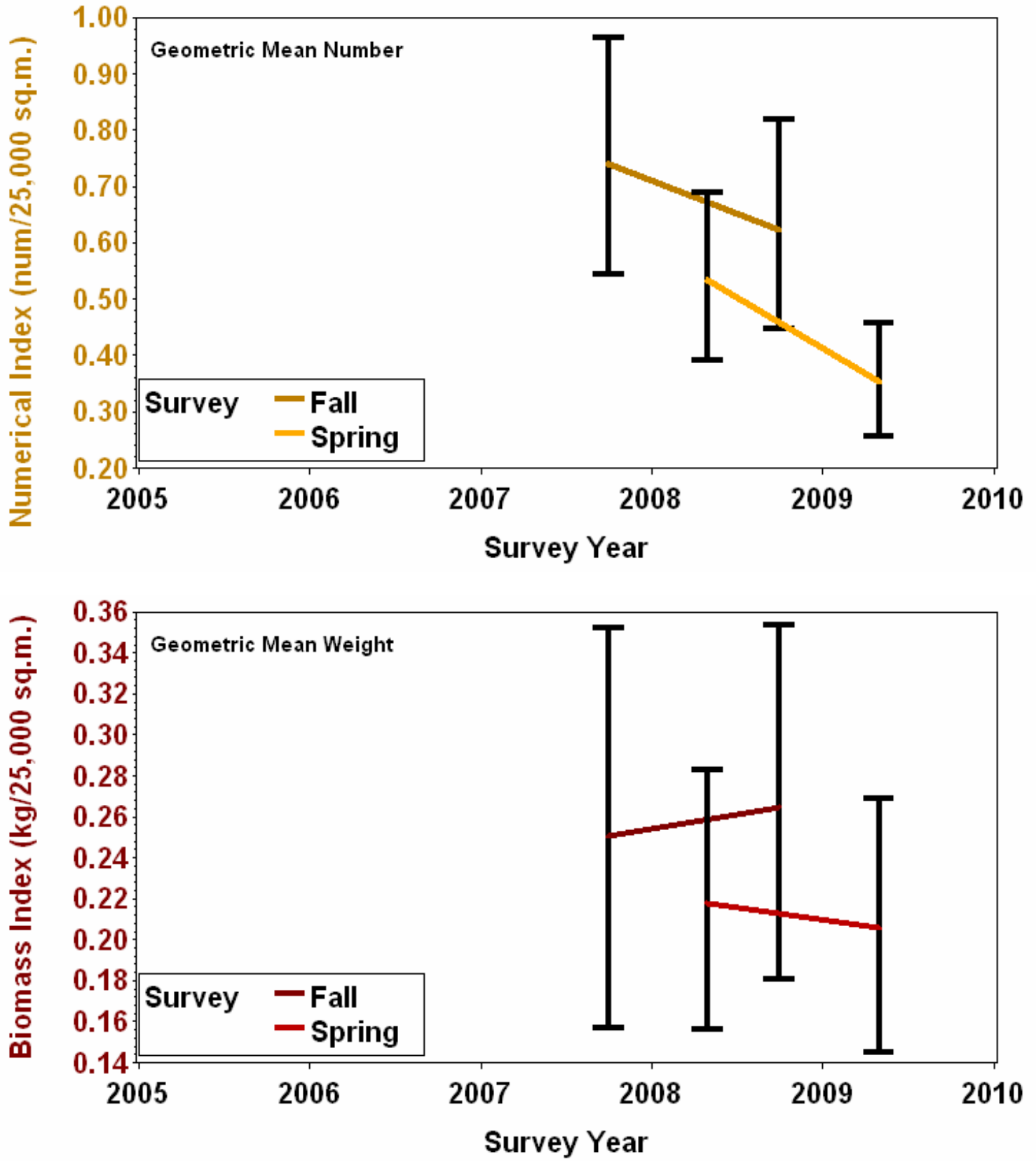
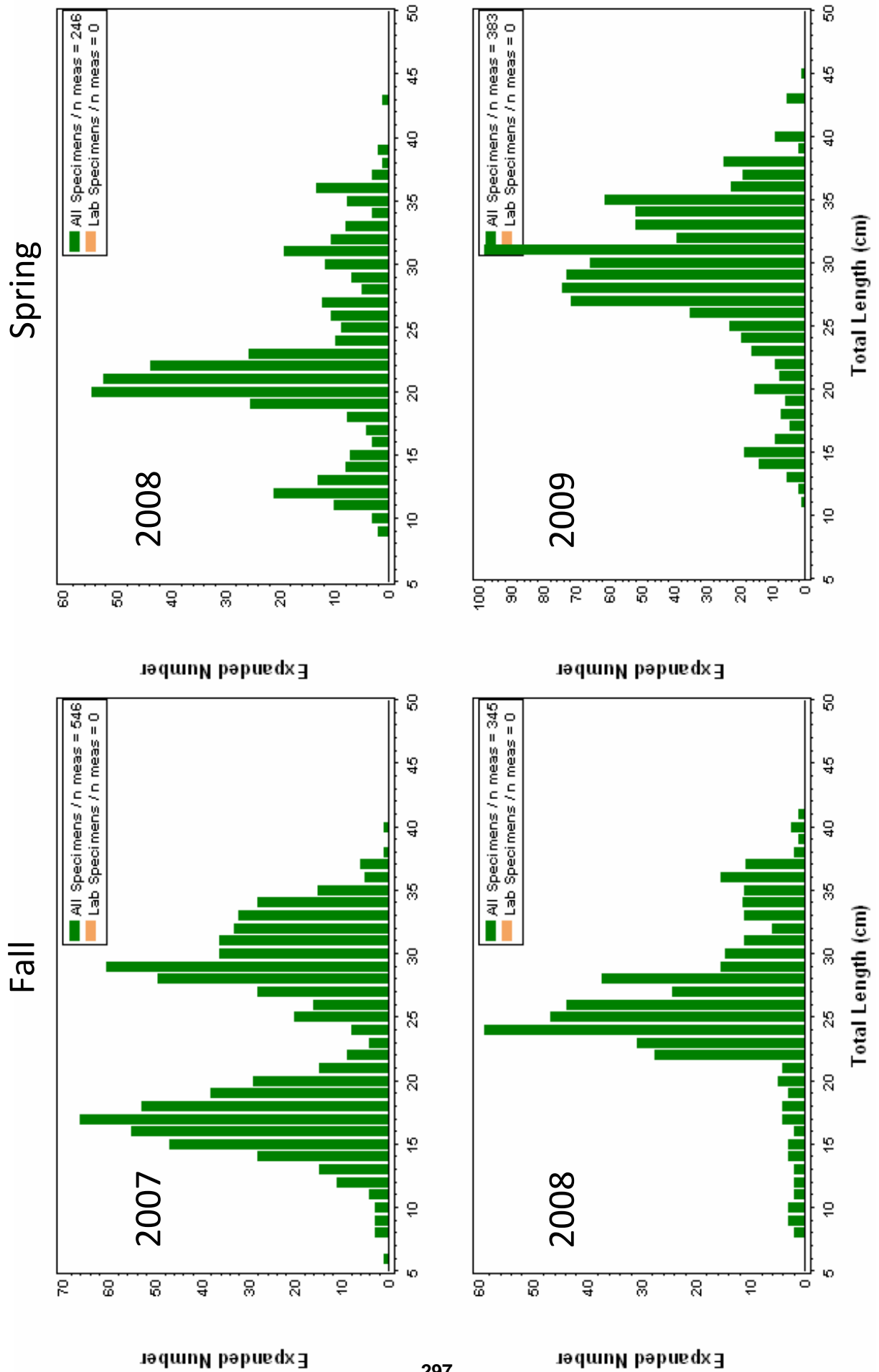


Figure 147. Length-frequency distributions, by cruise, for striped searobin.





# Summer Flounder (Priority A)

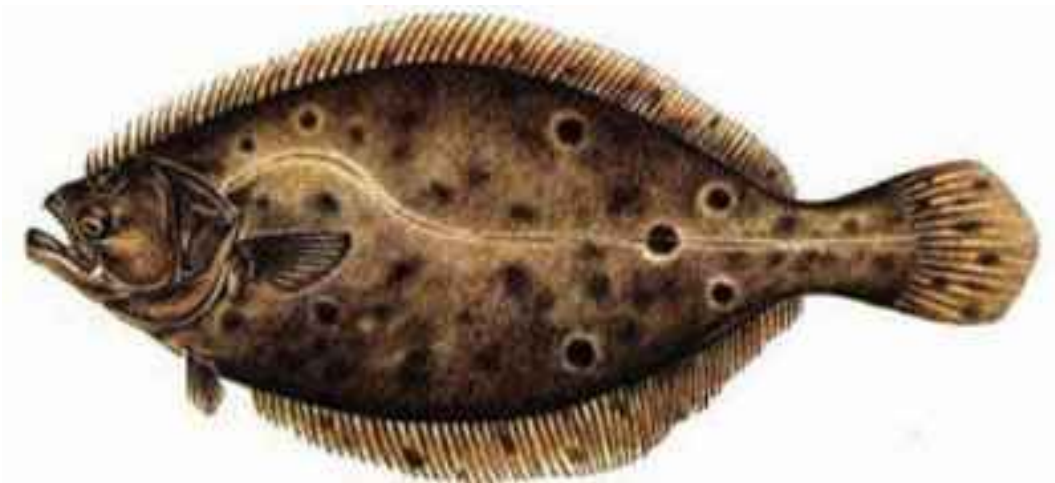
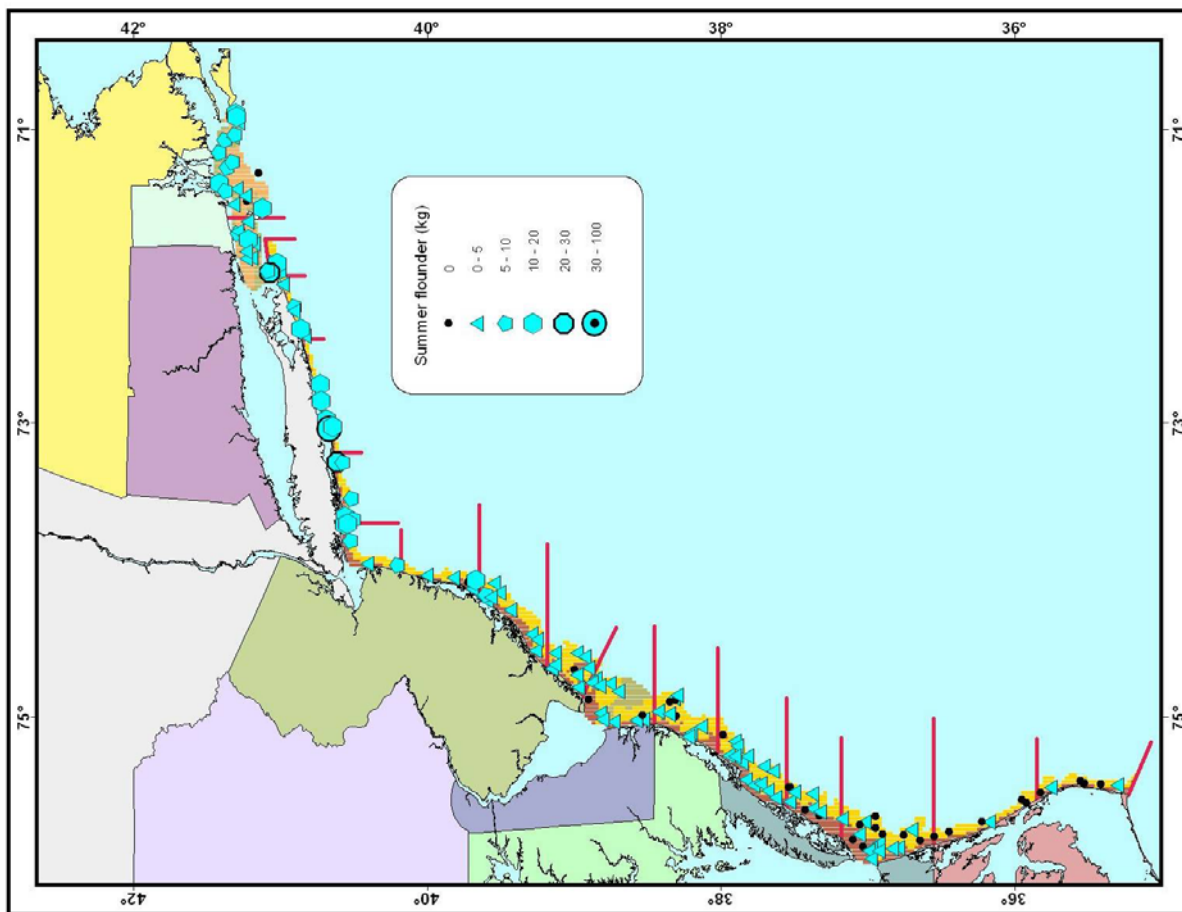


Table 42. Sampling rates and abundance indices of summer flounder for four NEAMAP cruises.

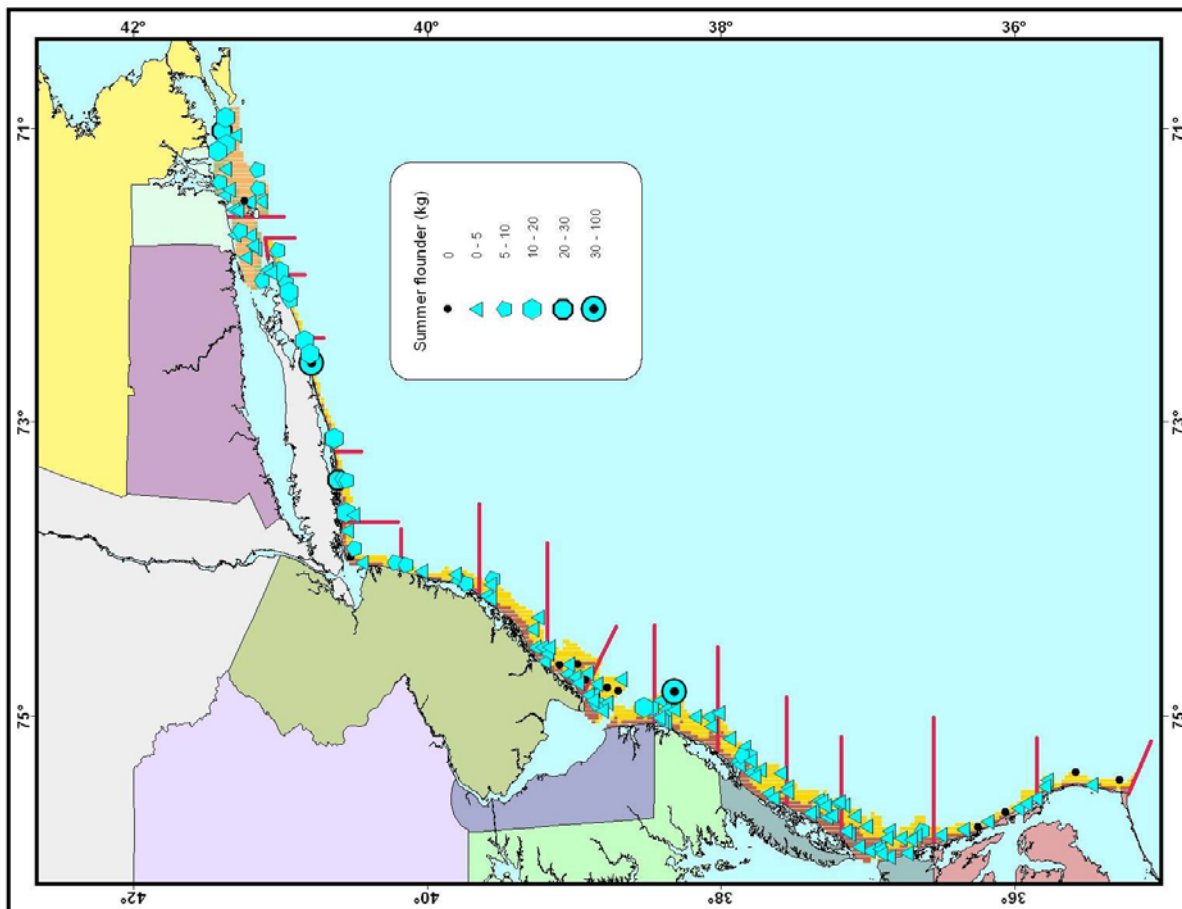
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	957	625.4	923	713	713	445	437	3.91	2.37
2008	Spring	768	527.0	768	522	522	373	363	2.76	1.73
	Fall	683	418.0	676	440	440	310	304	2.55	1.54
2009	Spring	974	518.3	974	620	0	360	6	2.41	1.39

Figure 148. Biomass (kg) of summer flounder collected at each sampling site for four NEAMAP cruises.

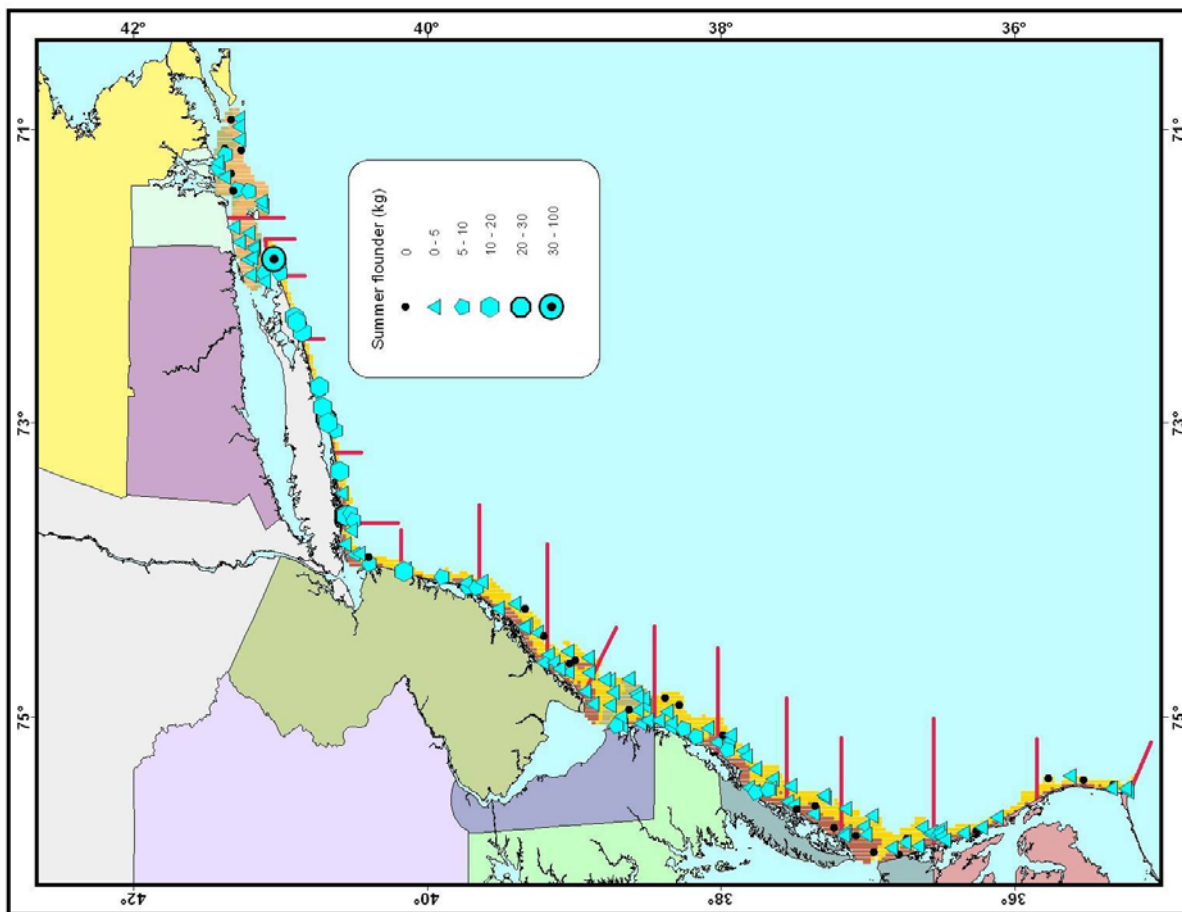
Spring 2008



Fall 2007



Spring 2009



Fall 2008

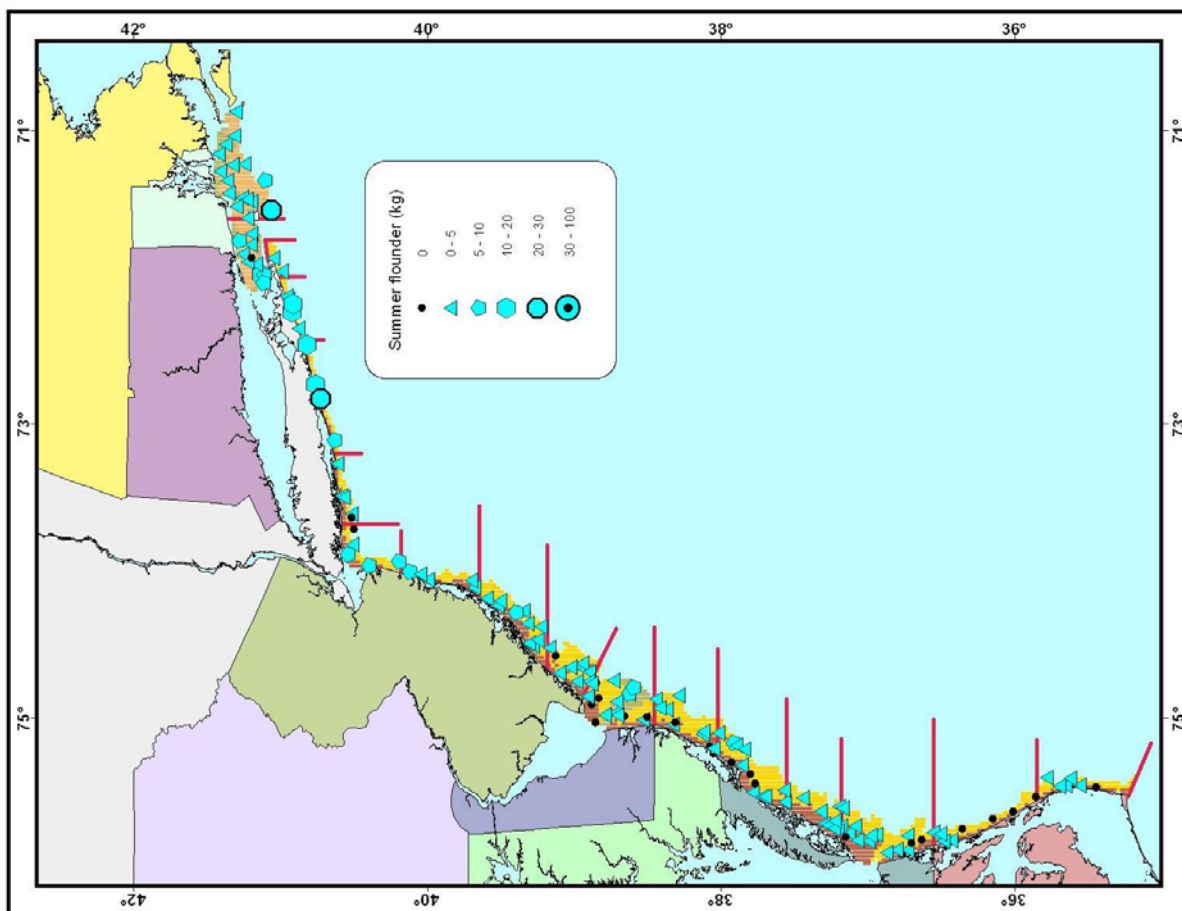


Figure 149. Preliminary indices of abundance, in terms of number and biomass, of summer flounder for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

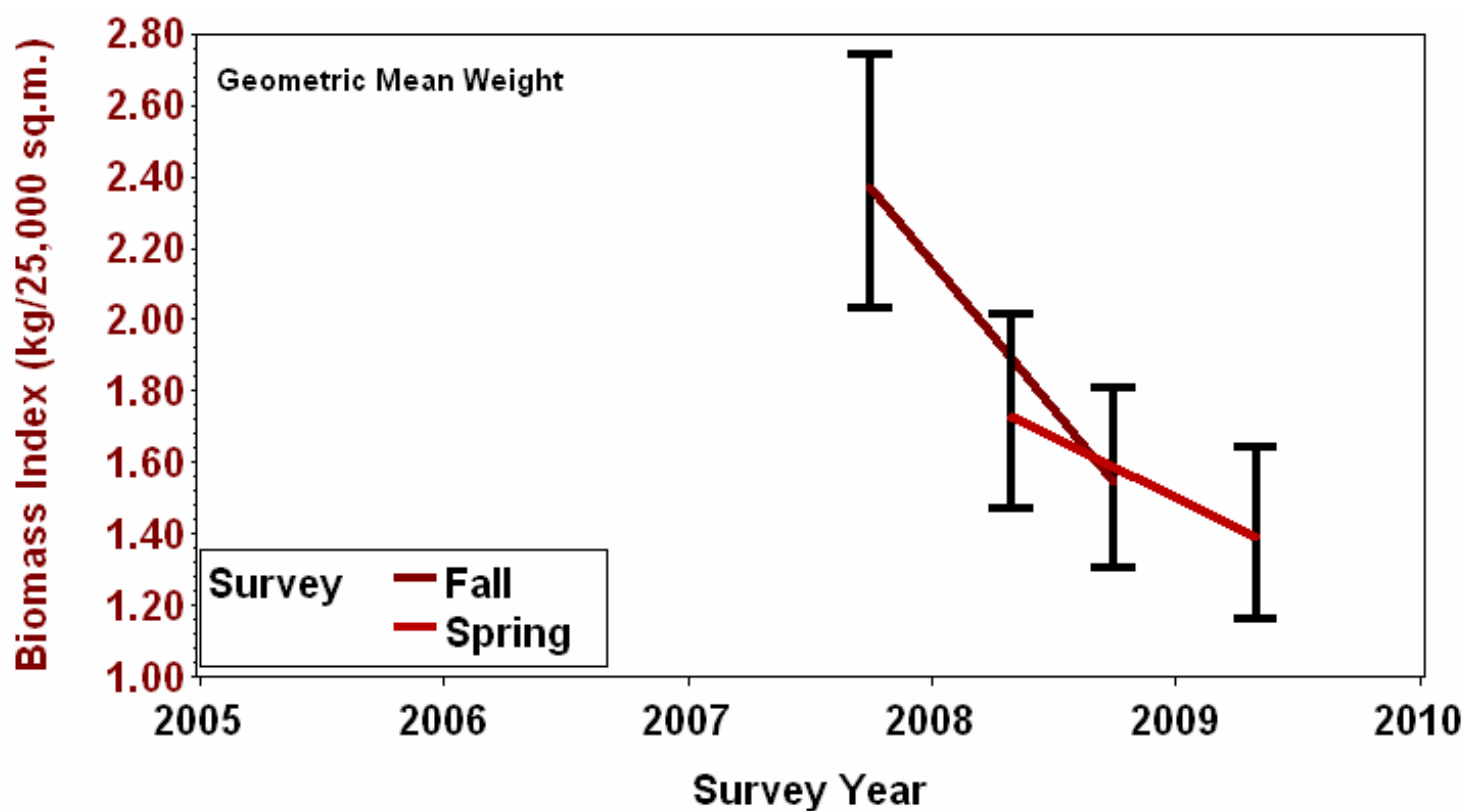
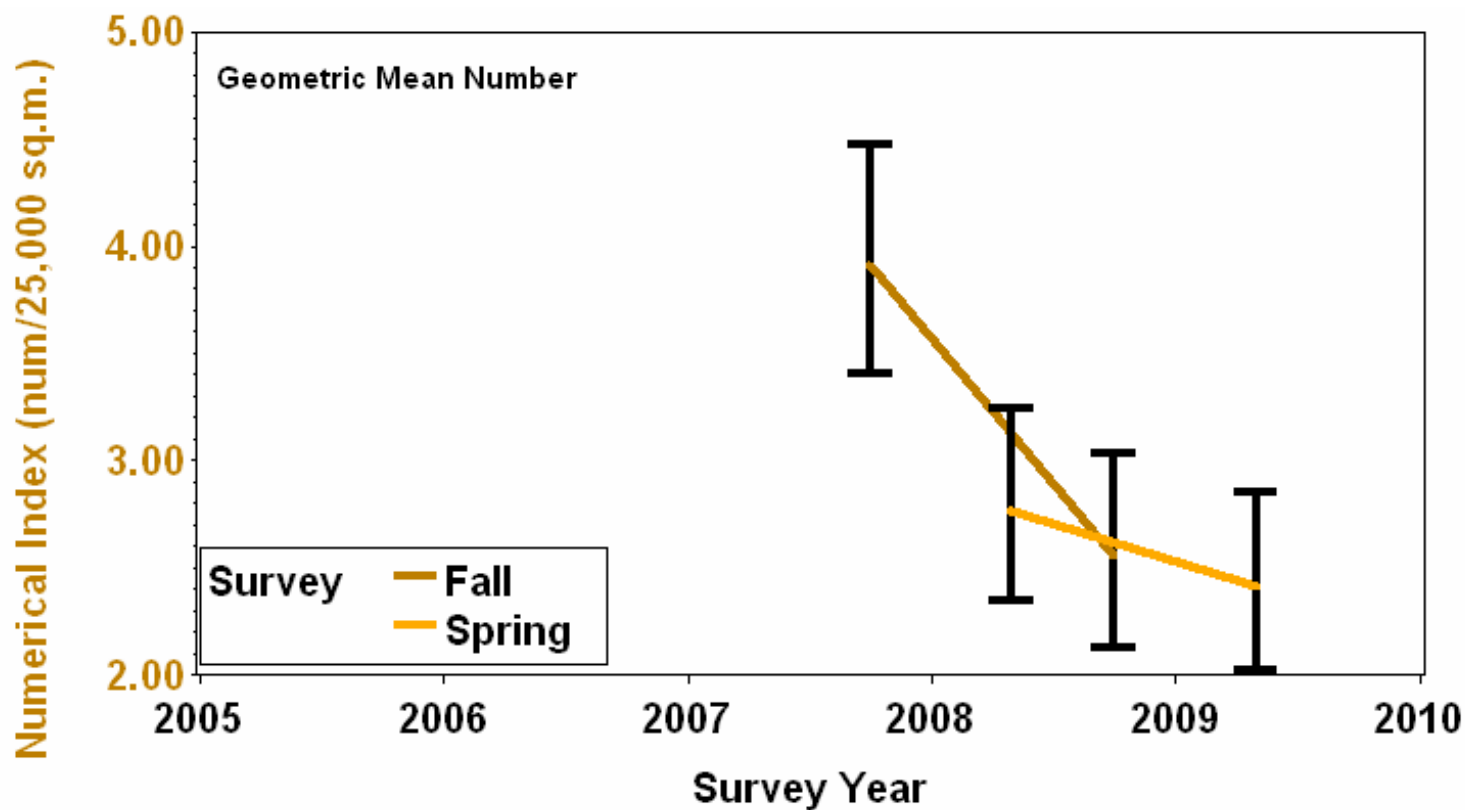


Figure 150. Length-frequency distributions, by cruise, for summer flounder. Numbers taken for full processing, by length, are represented by the orange bars.

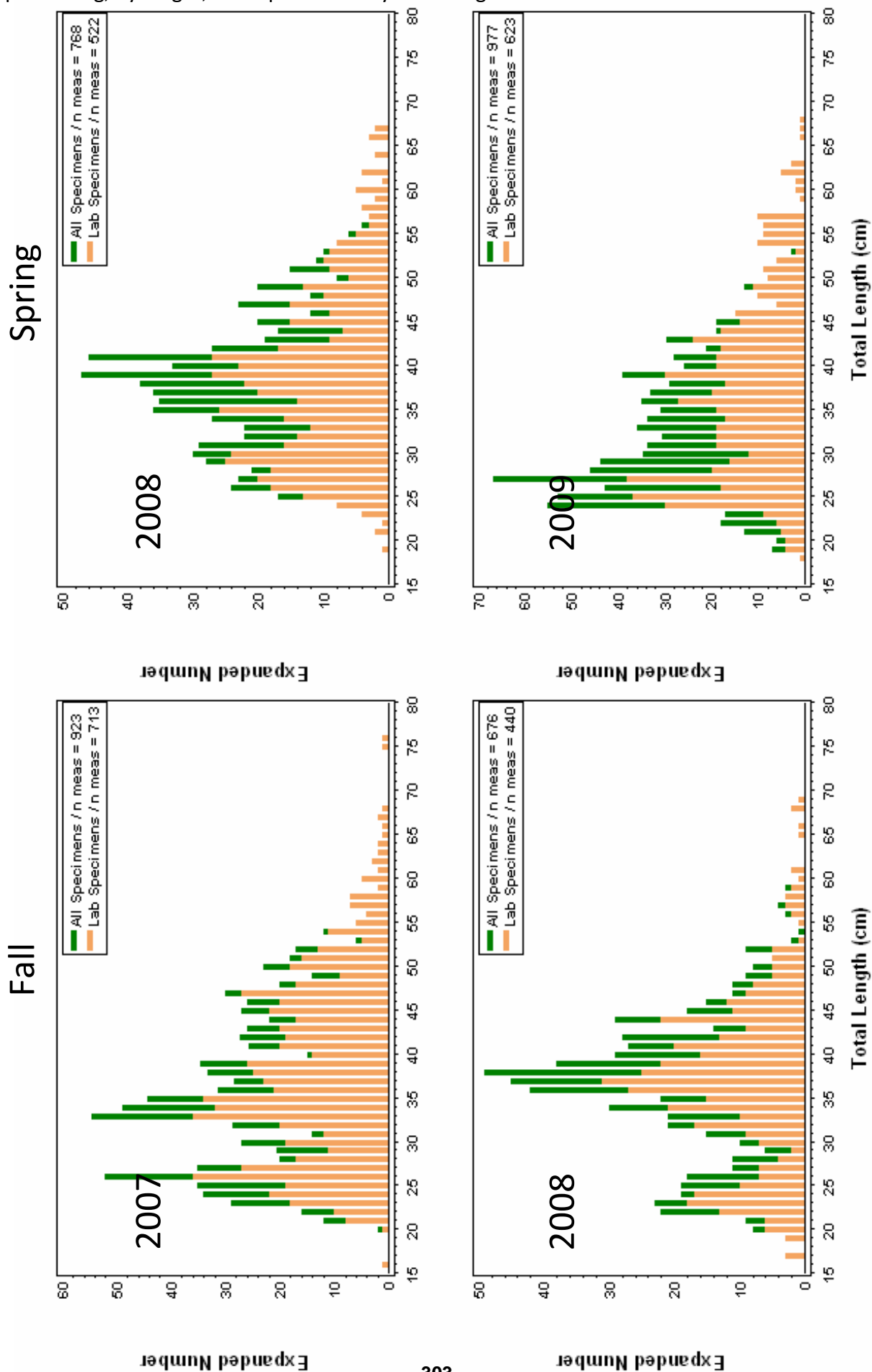




Figure 151. Sex ratio, by length group, for summer flounder collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

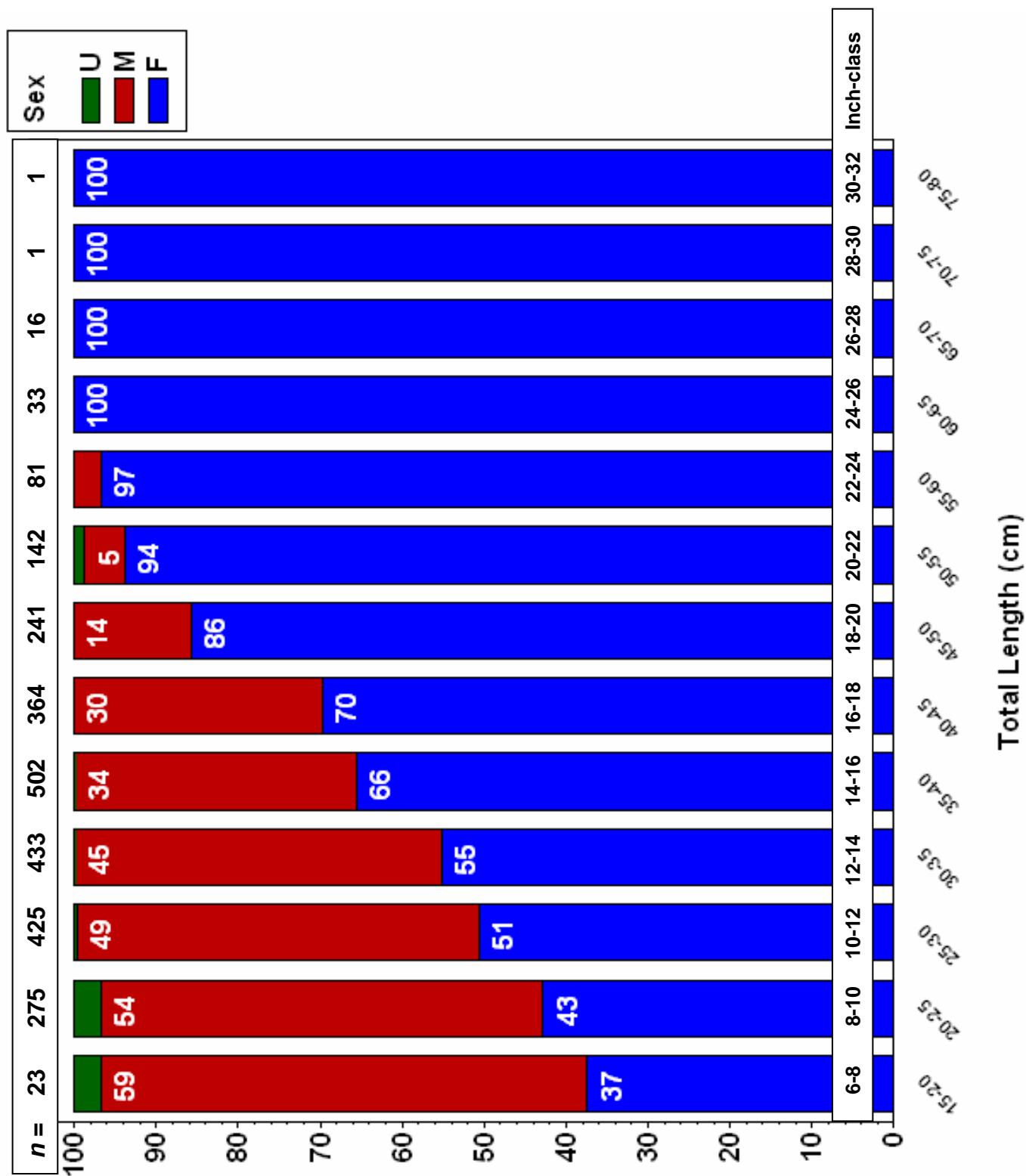


Figure 152. Age-frequency distribution, by cruise, for summer flounder. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.

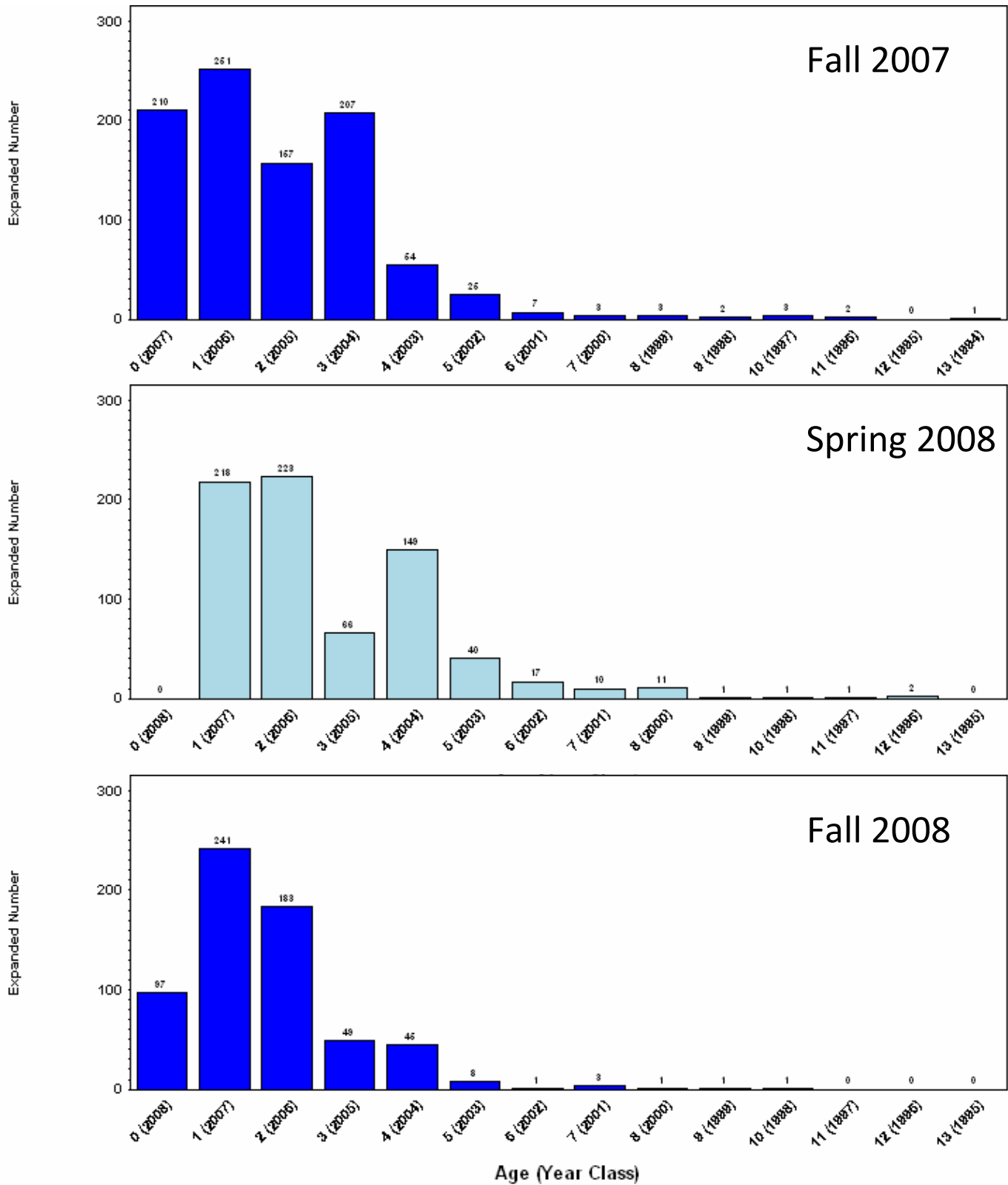
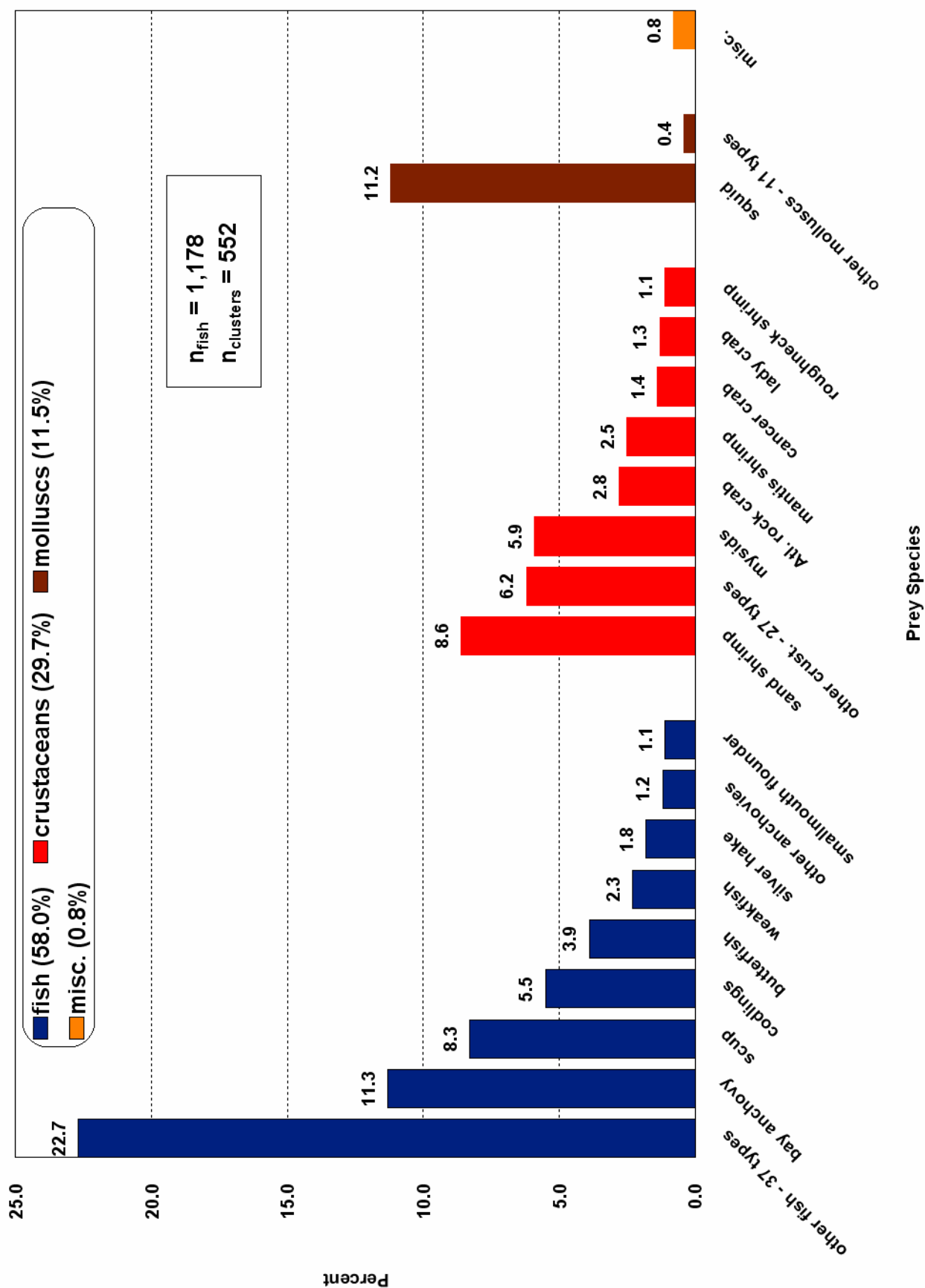


Figure 153. Diet composition, expressed using the percent weight index, of summer flounder collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of flounder sampled.



# Weakfish (Priority A)

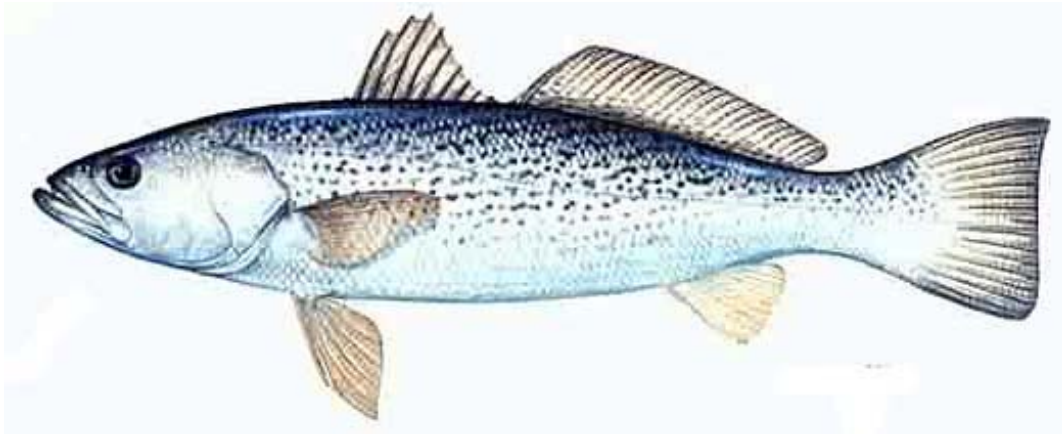
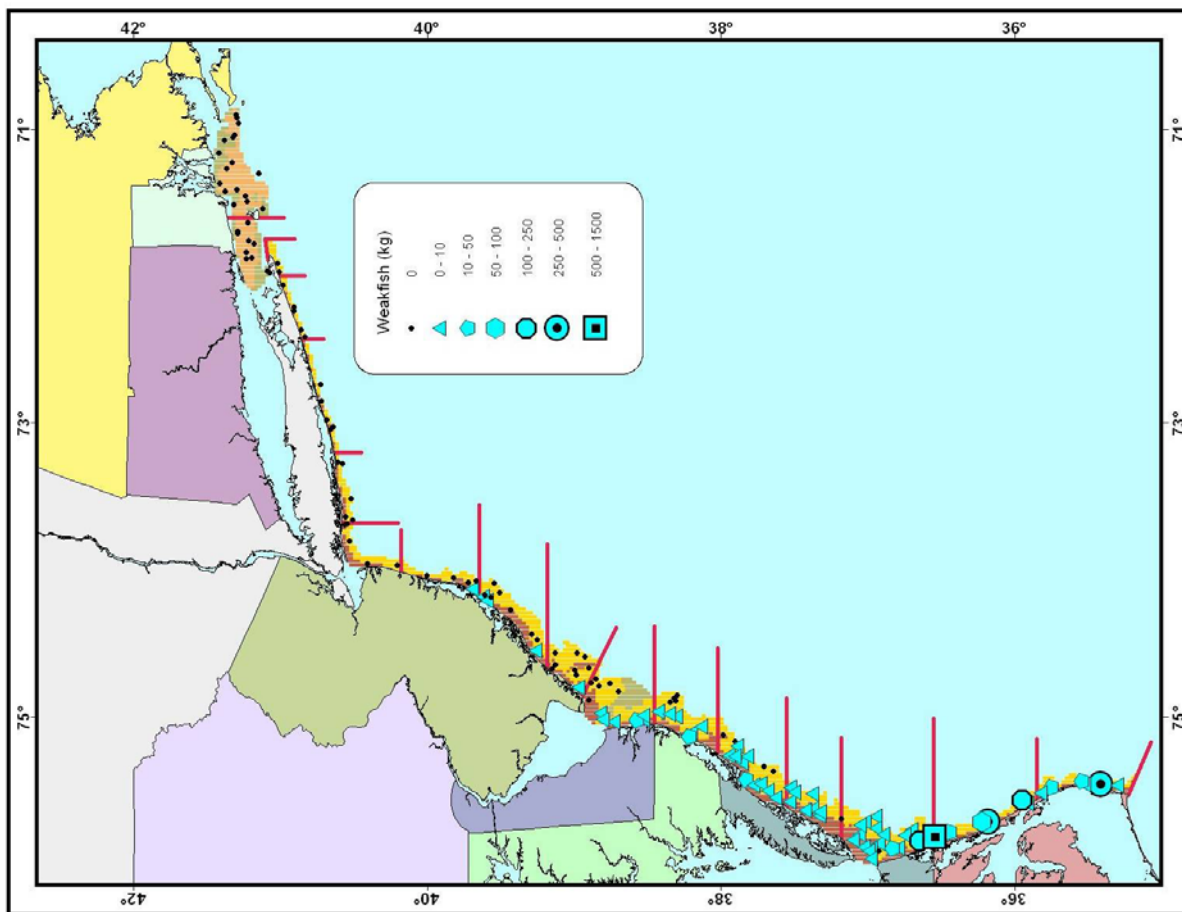


Table 43. Sampling rates and abundance indices of weakfish for four NEAMAP cruises.

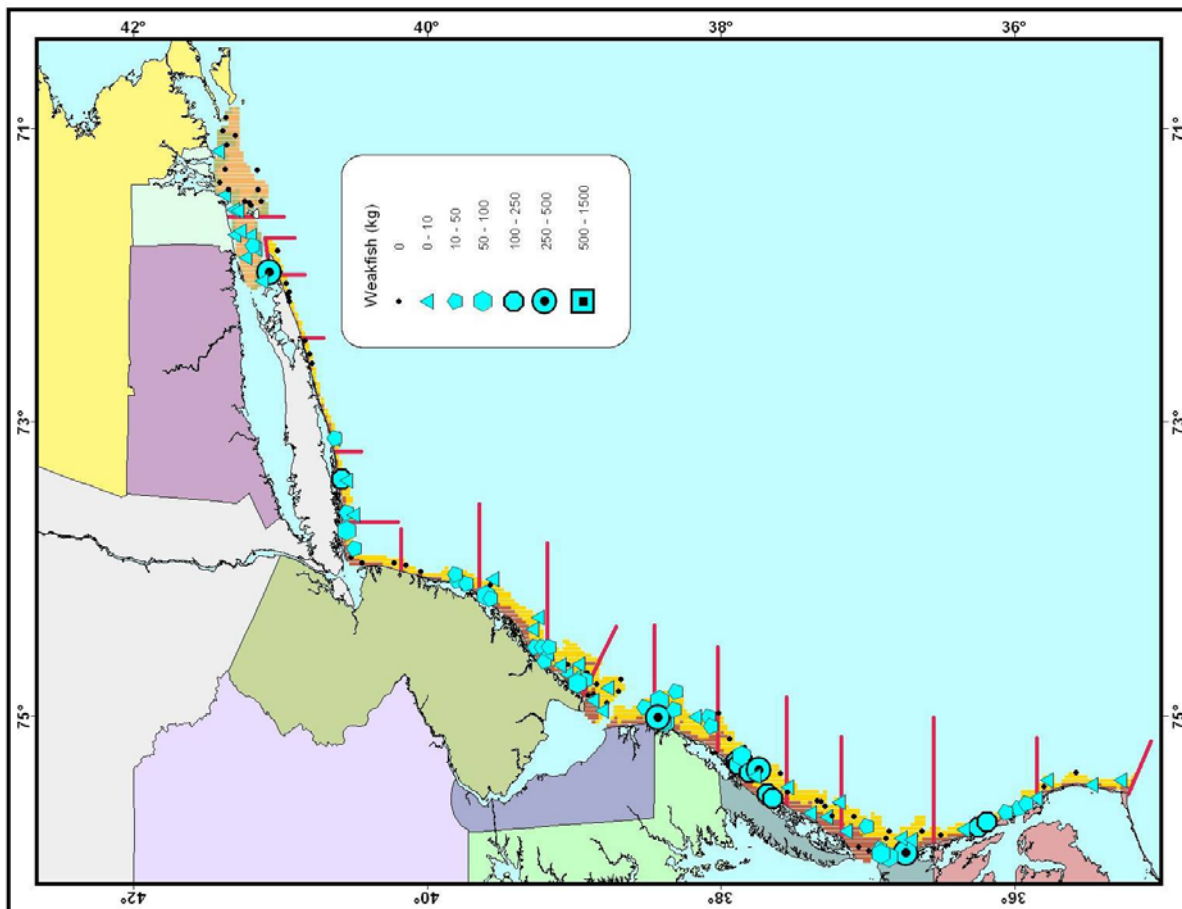
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	60,990	4,168.1	5,747	572	572	471	465	11.27	3.05
2008	Spring	39,580	2,198.8	2,174	305	305	279	277	3.12	0.81
	Fall	44,779	3,990.4	3,879	464	464	333	320	9.65	2.82
2009	Spring	8,785	339.3	1,654	189	0	143	134	1.14	0.28

Figure 154. Biomass (kg) of weakfish collected at each sampling site for four NEAMAP cruises.

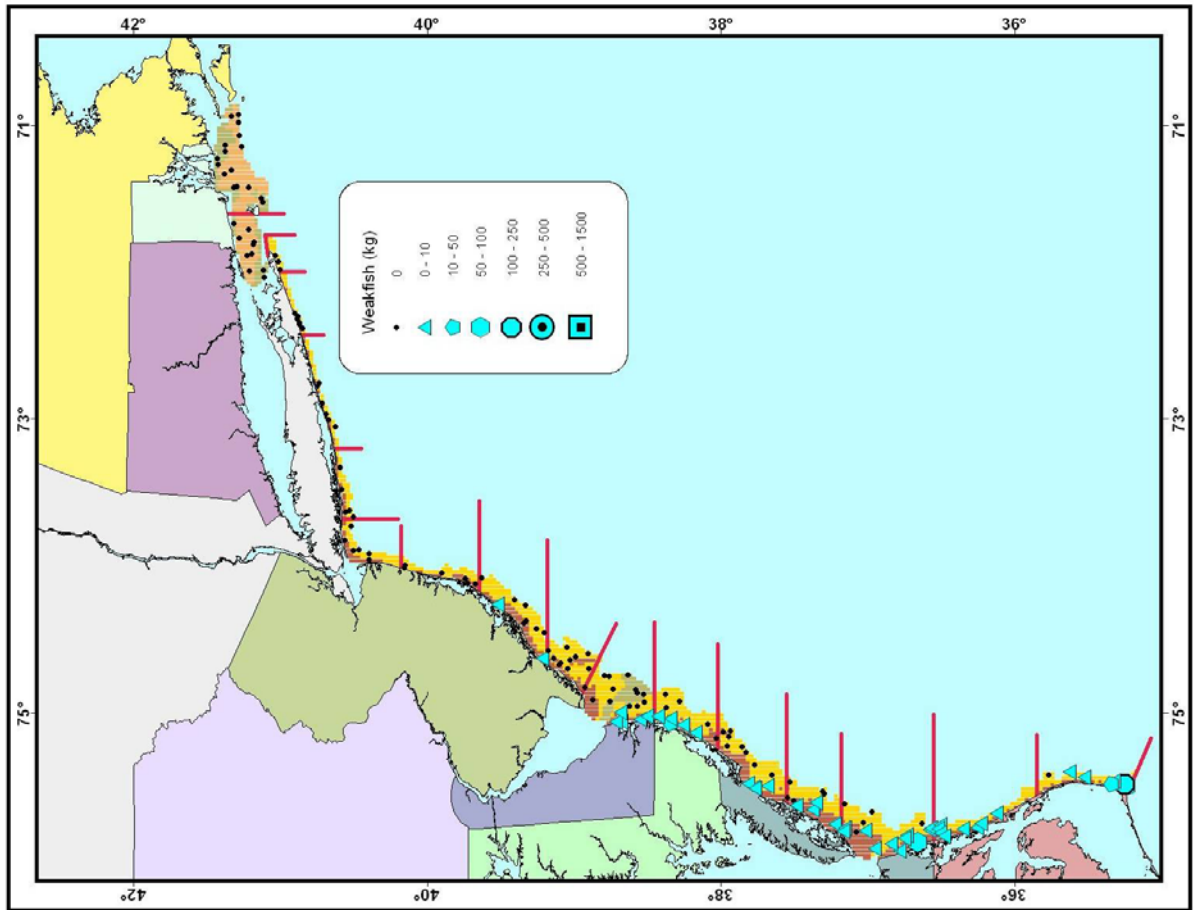
Spring 2008



Fall 2007



Spring 2009



Fall 2008

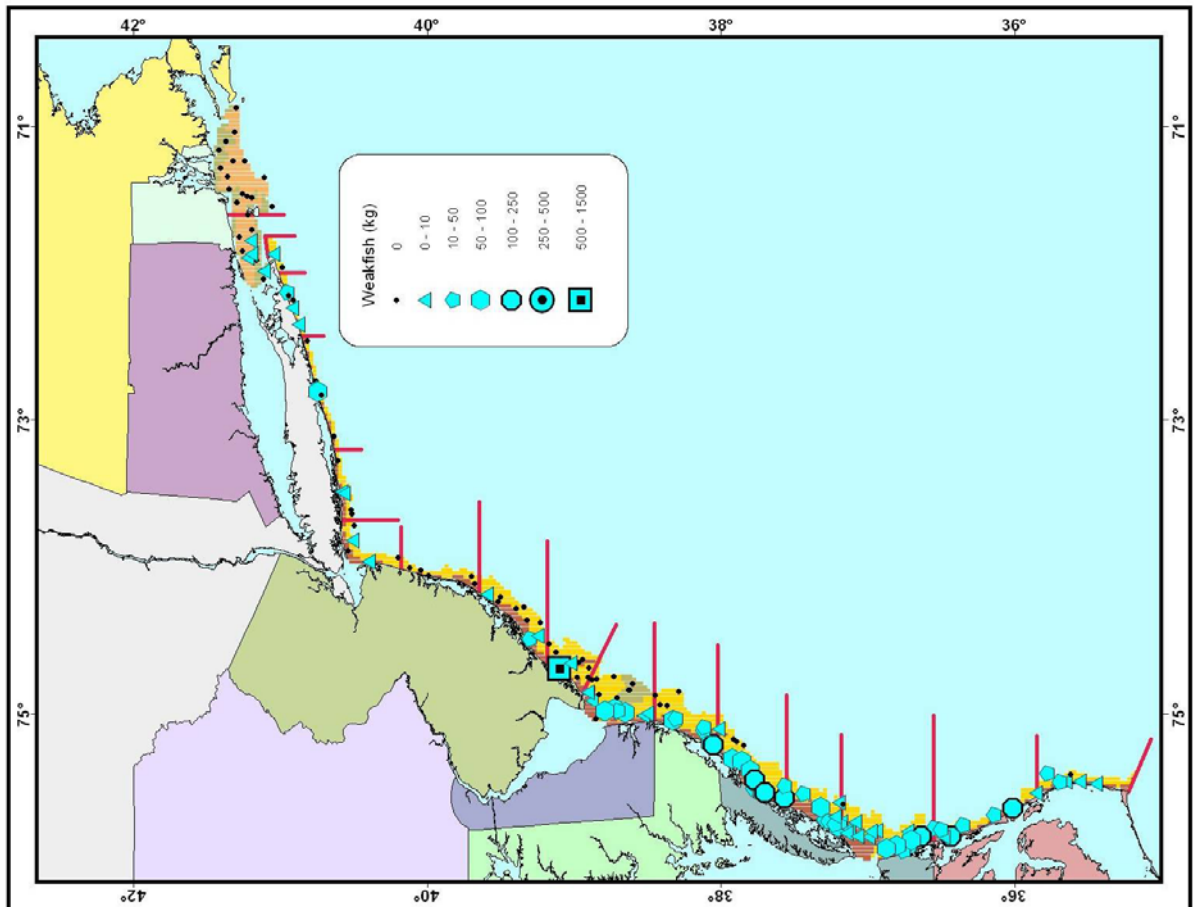


Figure 155. Preliminary indices of abundance, in terms of number and biomass, of weakfish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

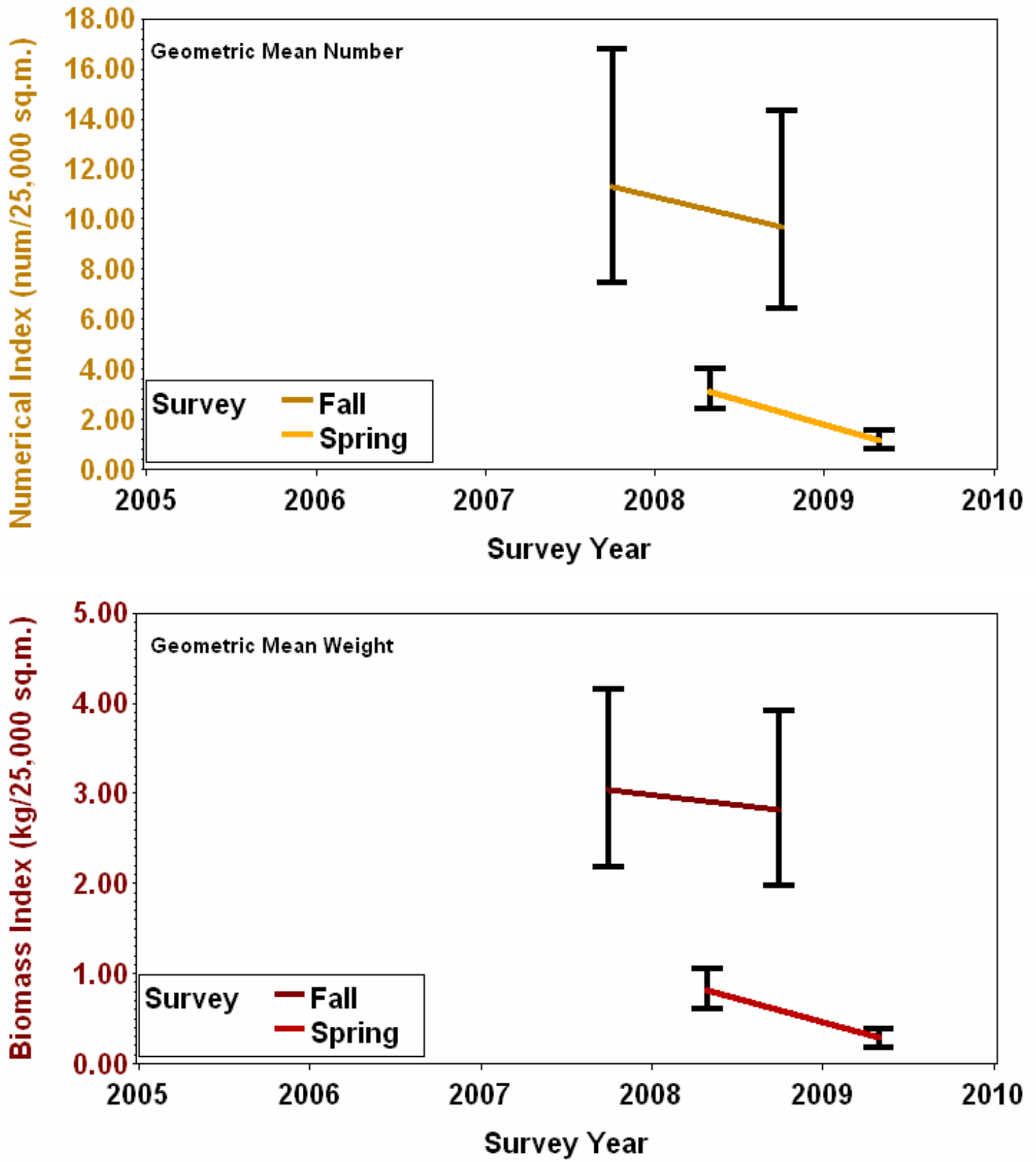


Figure 156. Length-frequency distributions, by cruise, for weakfish. Numbers taken for full processing, by length, are represented by the orange bars.

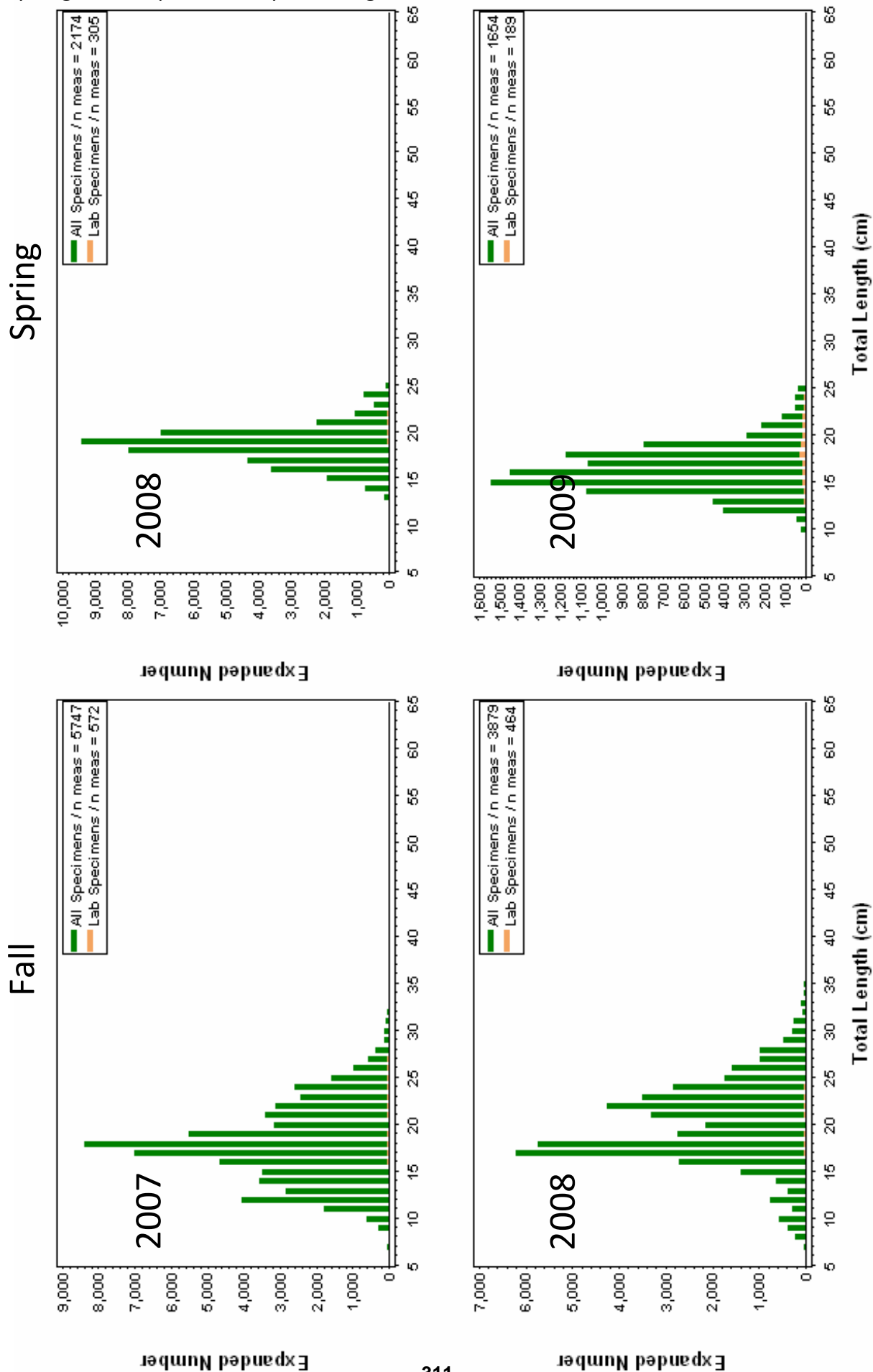




Figure 157. Sex ratio, by length group, for weakfish collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

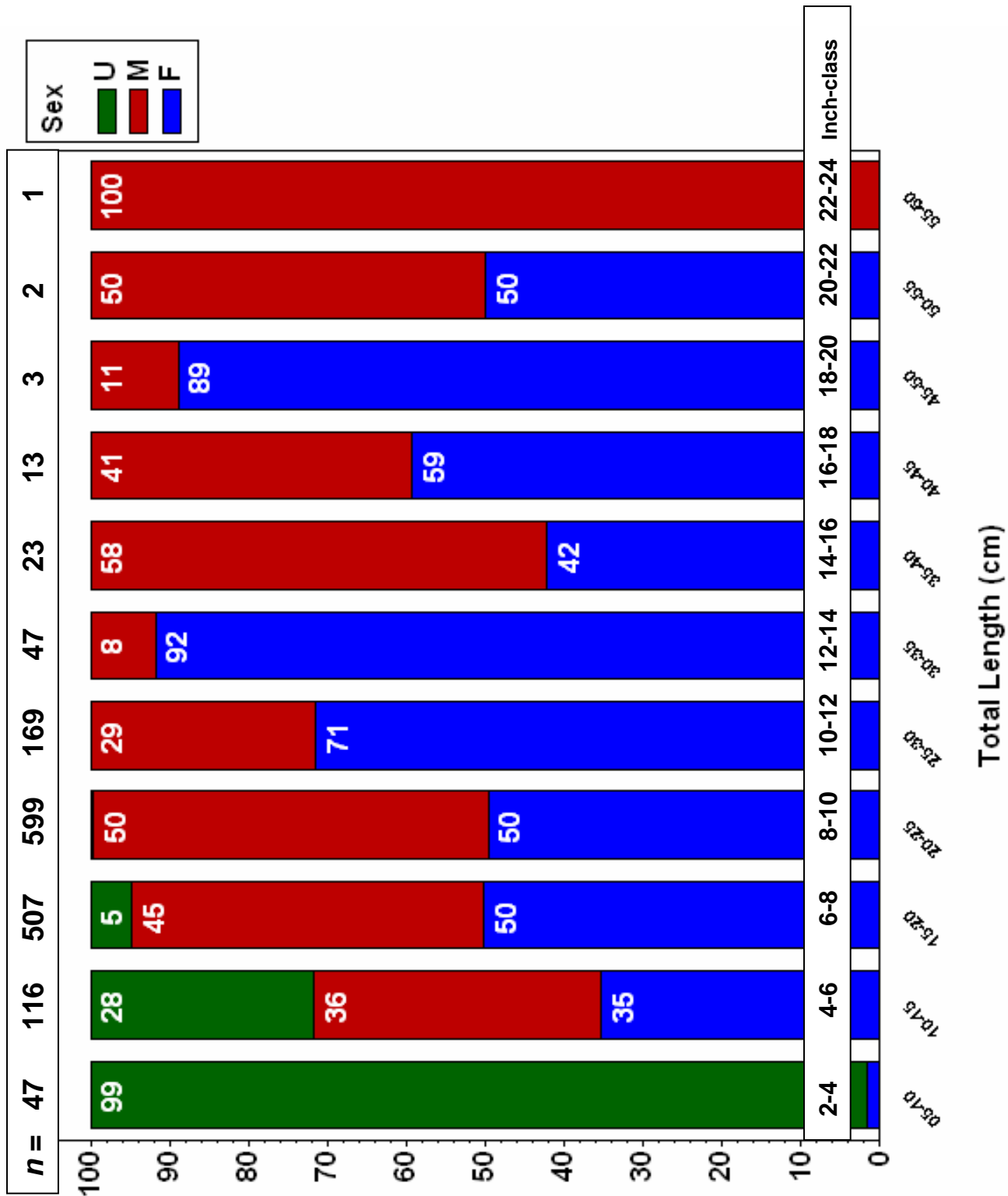


Figure 158. Age-frequency distribution, by cruise, for weakfish. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.

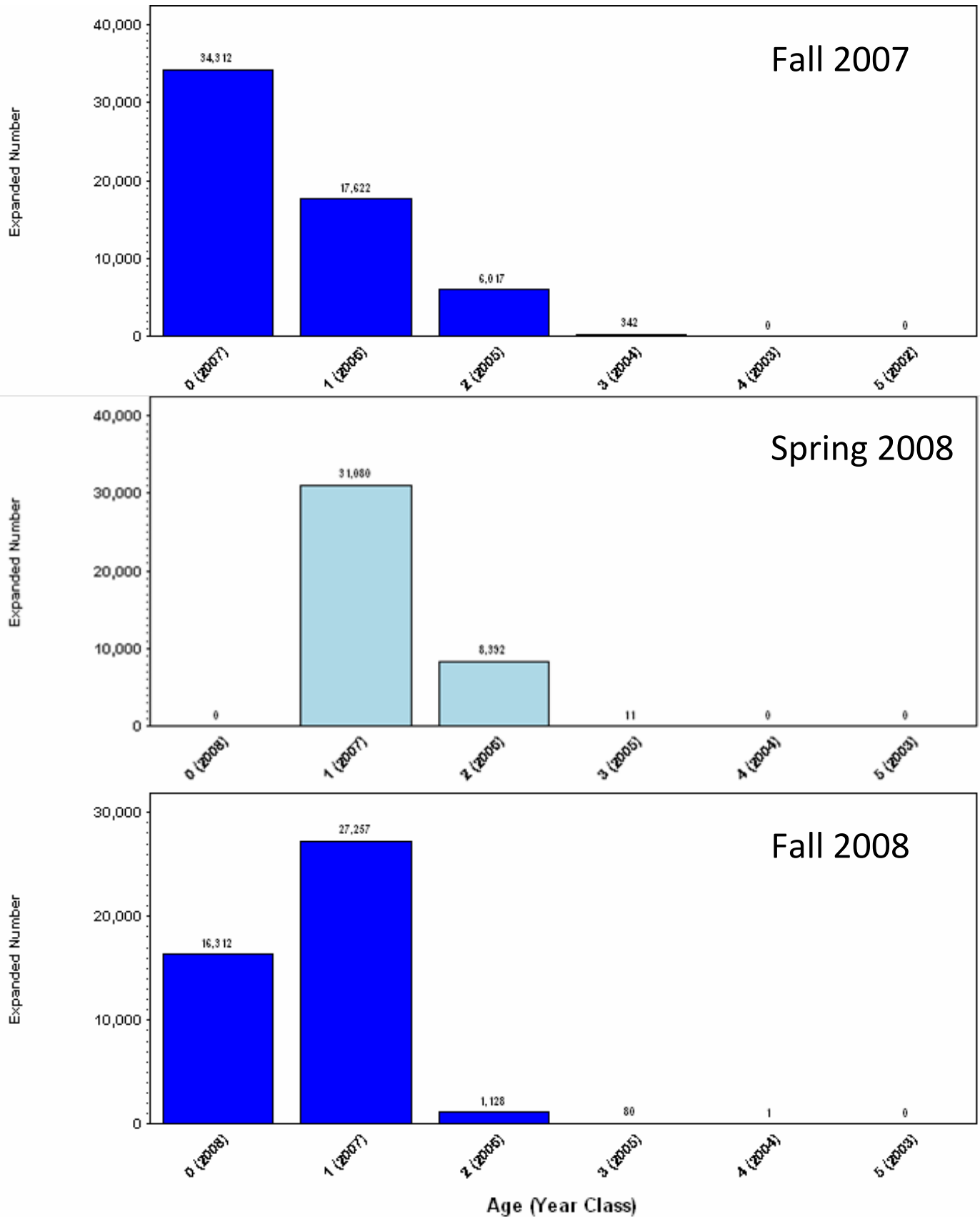
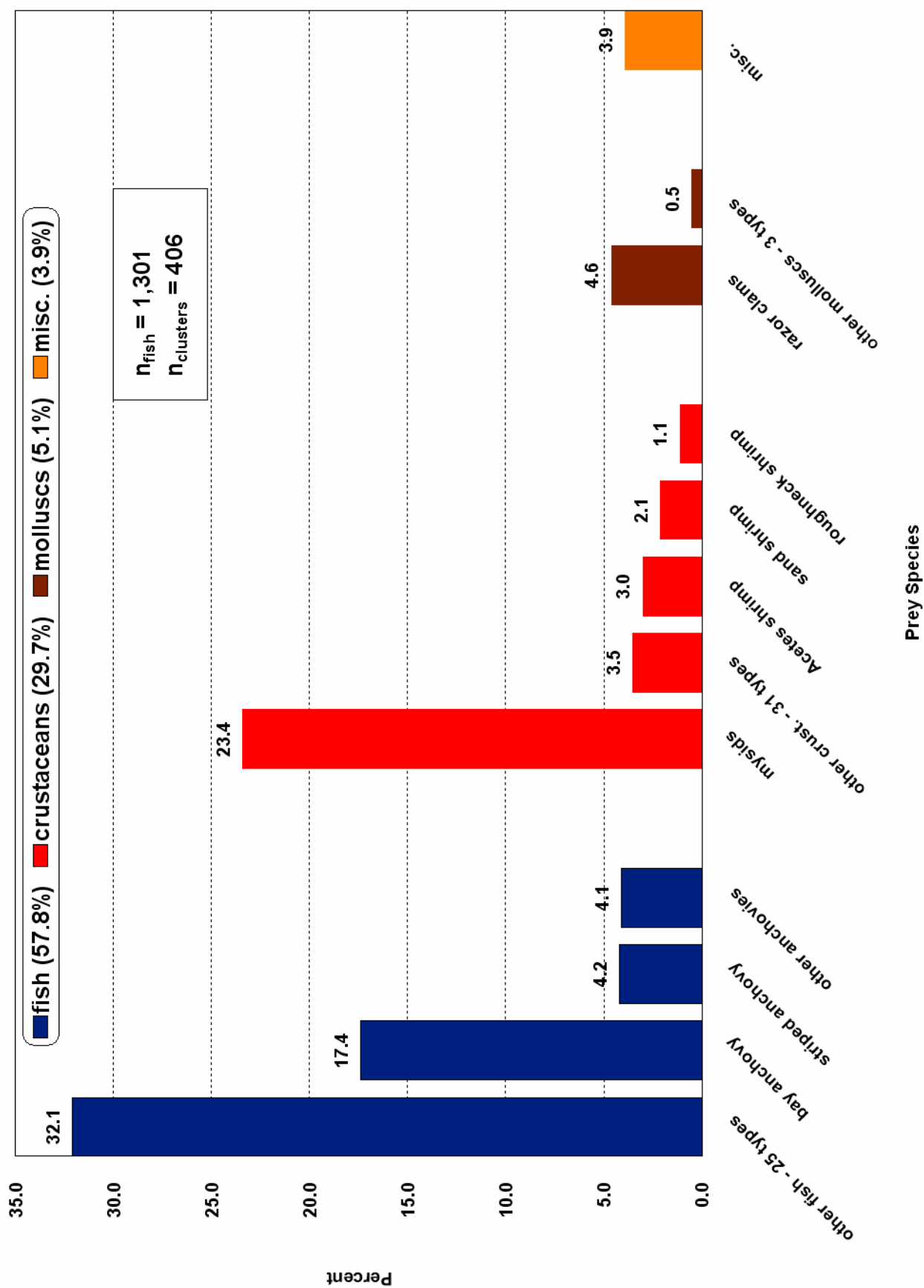


Figure 159. Diet composition, expressed using the percent weight index, of weakfish collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of weakfish sampled.



# White Shrimp (Priority E)

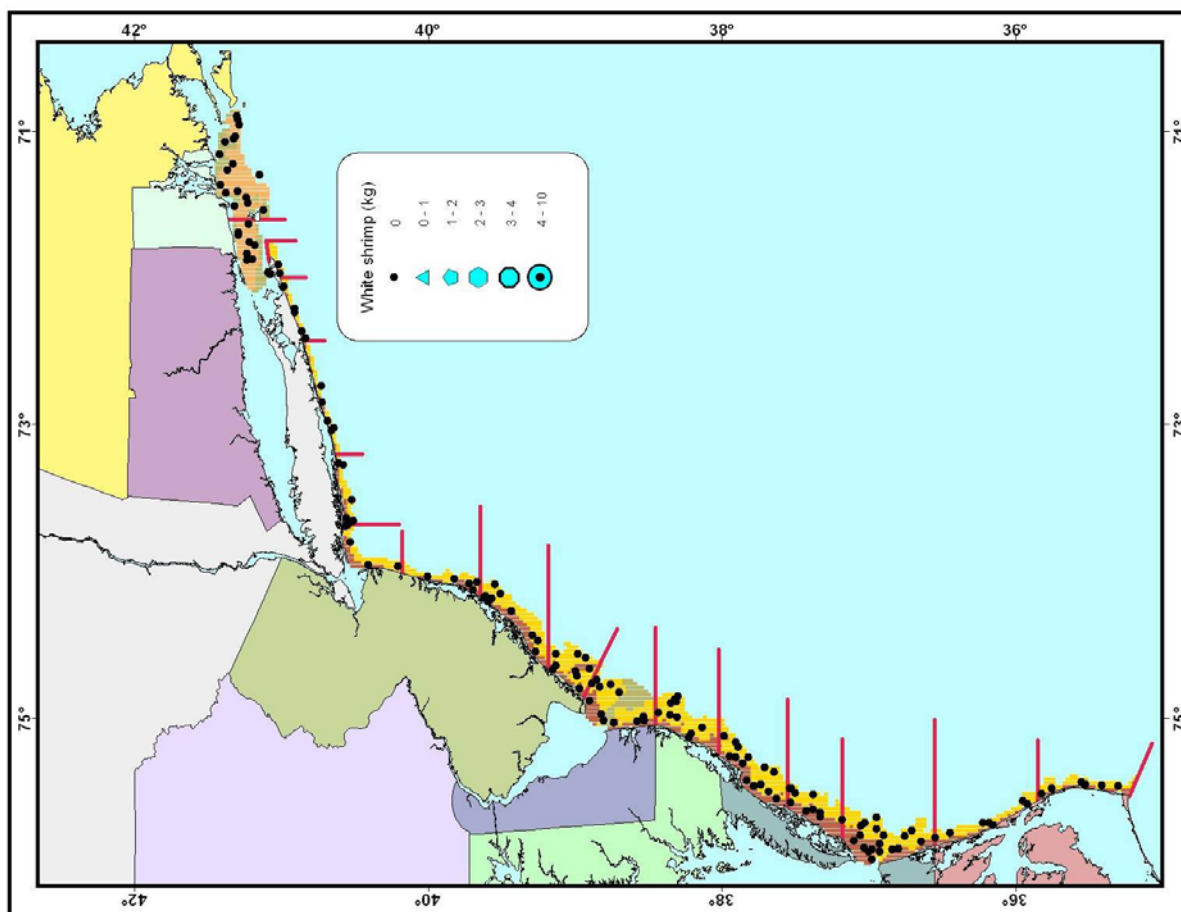


Table 44. Sampling rates and abundance indices of white shrimp for four NEAMAP cruises.

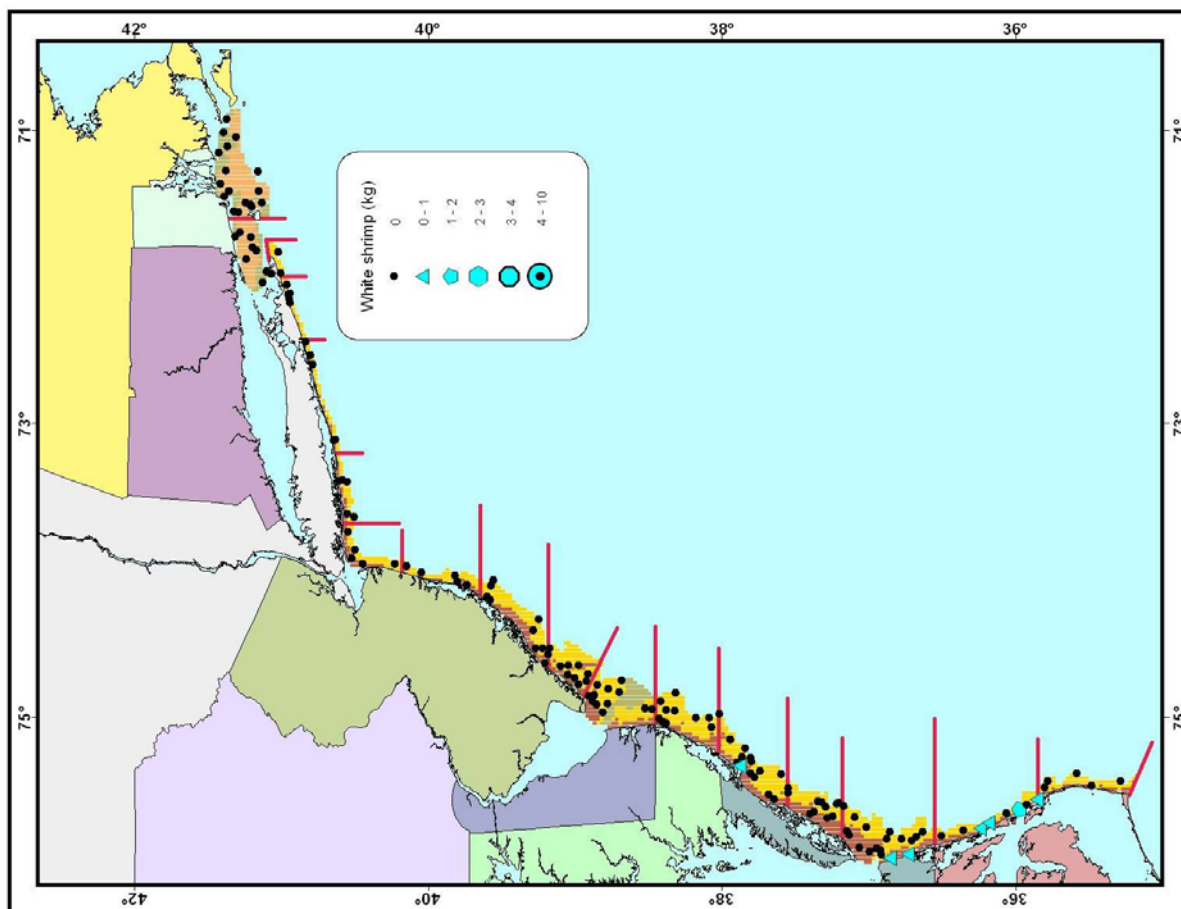
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	48	1.8	20	0		0		0.07	0.01
2008	Spring	0	0.0	0					0.00	0.00
	Fall	753	19.7	267	0		0		0.30	0.06
2009	Spring	23	0.7	23	0		0		0.02	0.00

Figure 160. Biomass (kg) of white shrimp collected at each sampling site for four NEAMAP cruises.

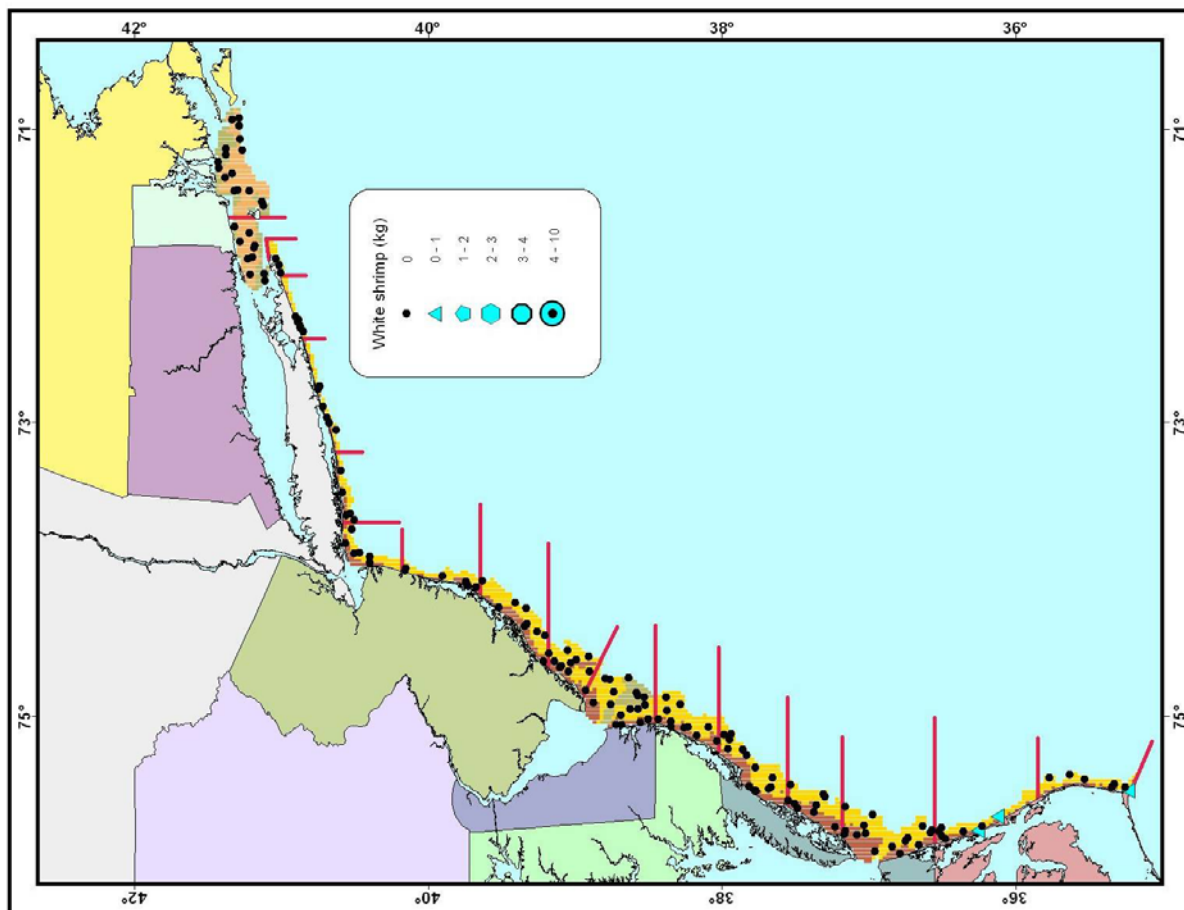
Spring 2008



Fall 2007



Spring 2009



Fall 2008

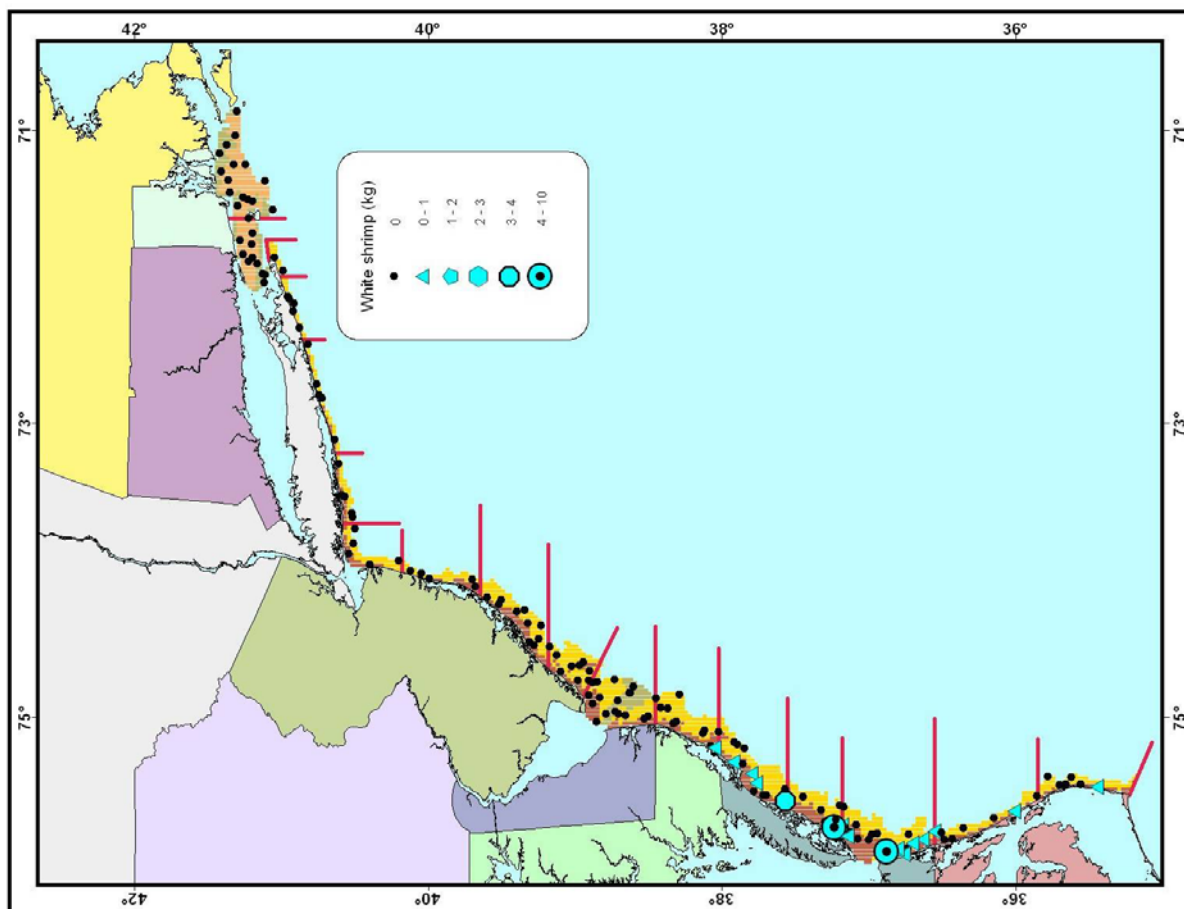


Figure 161. Preliminary indices of abundance, in terms of number and biomass, of white shrimp for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

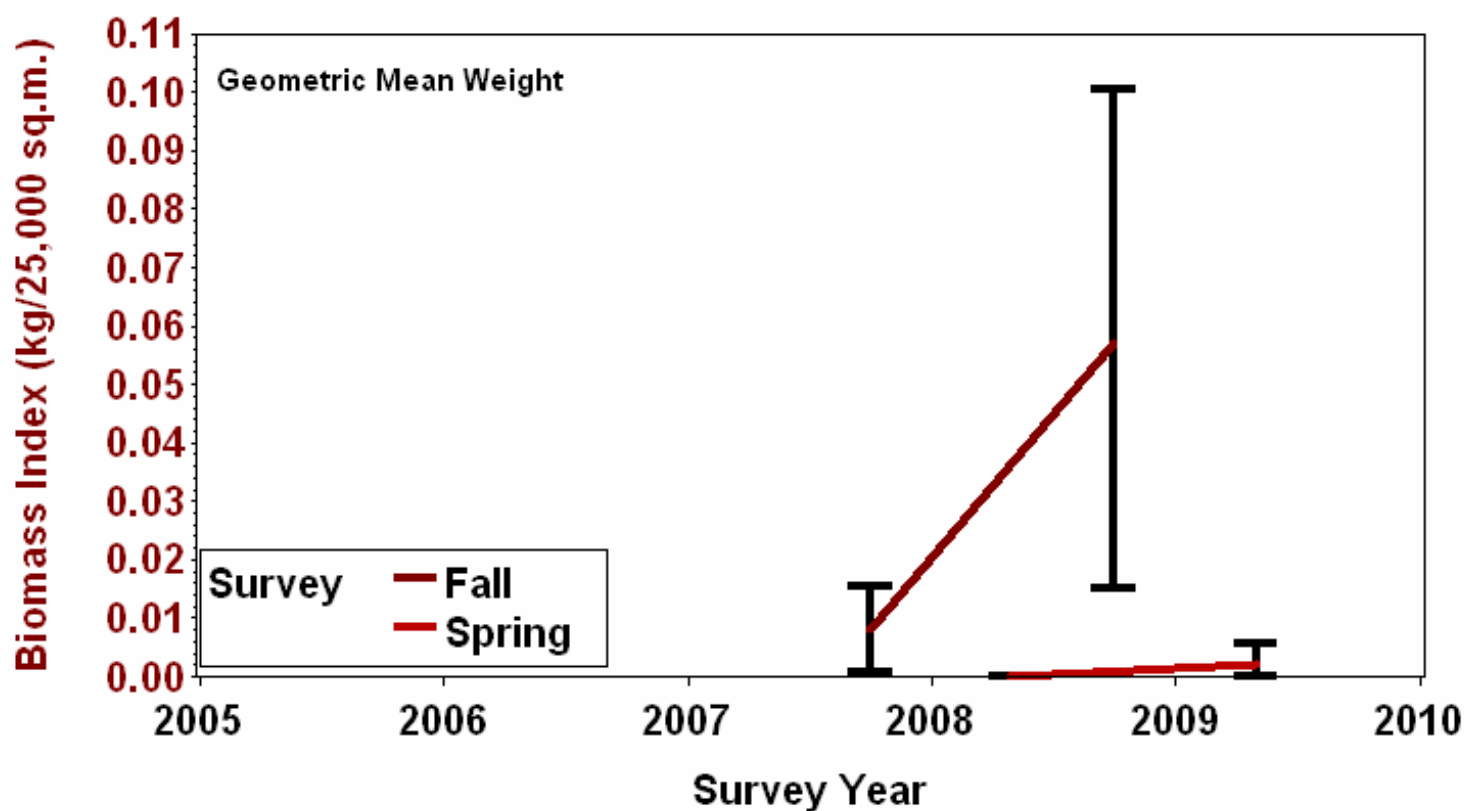
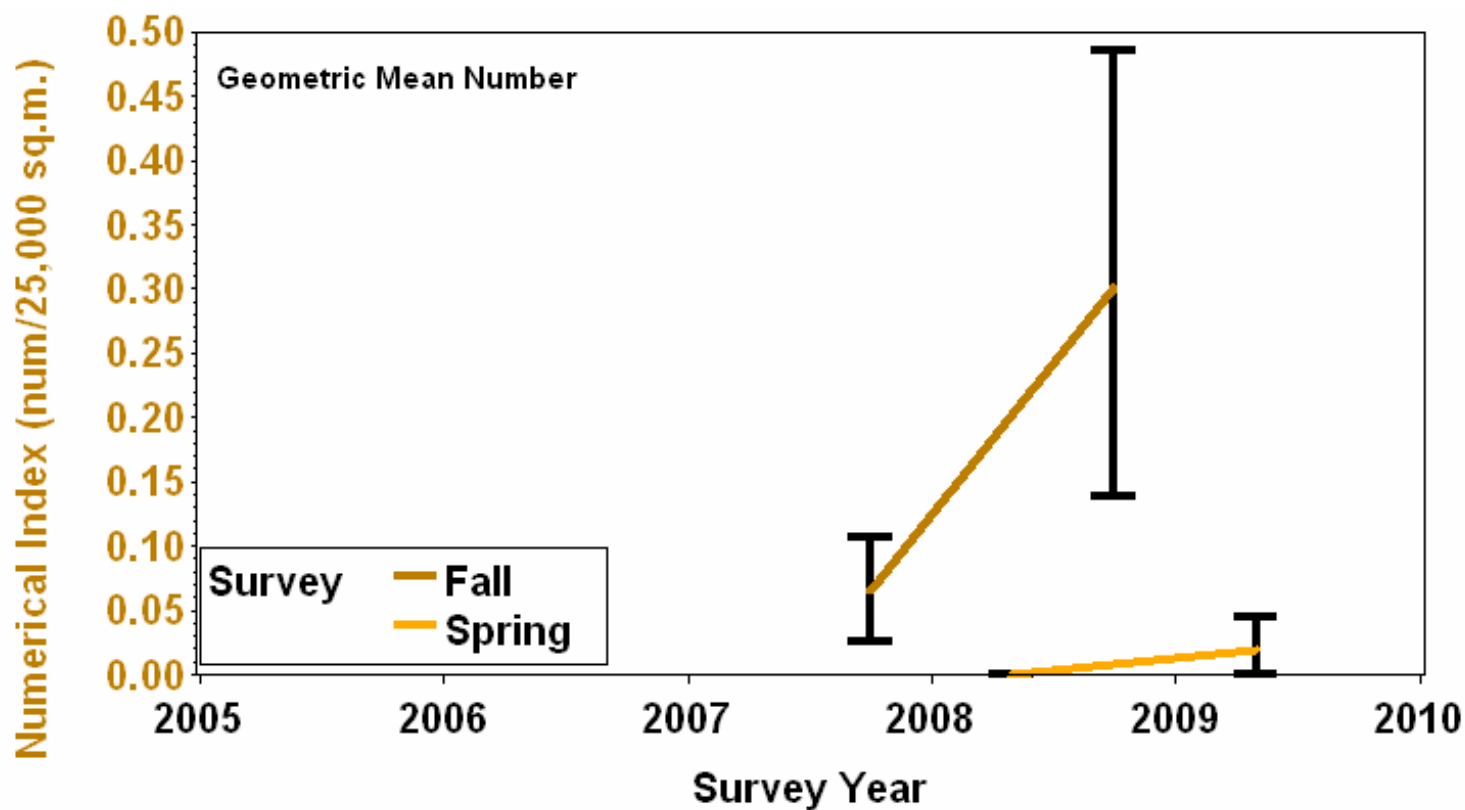
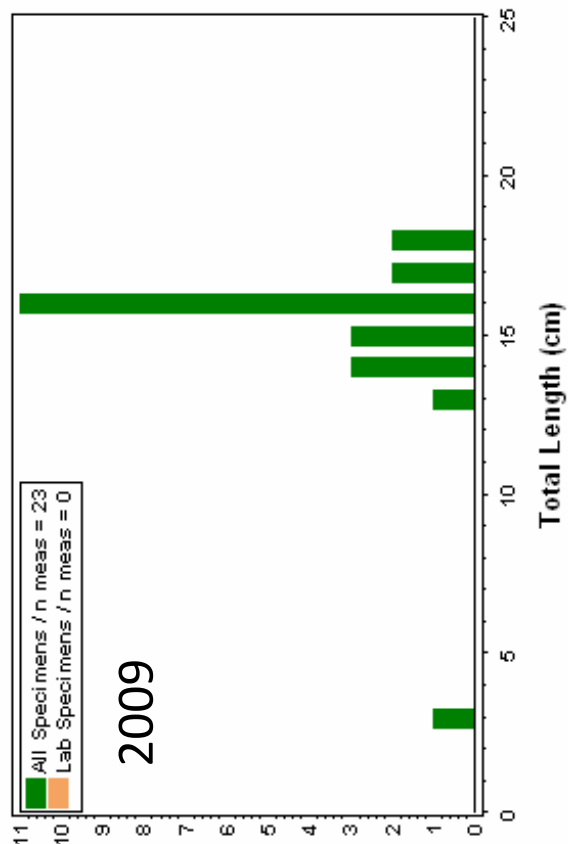
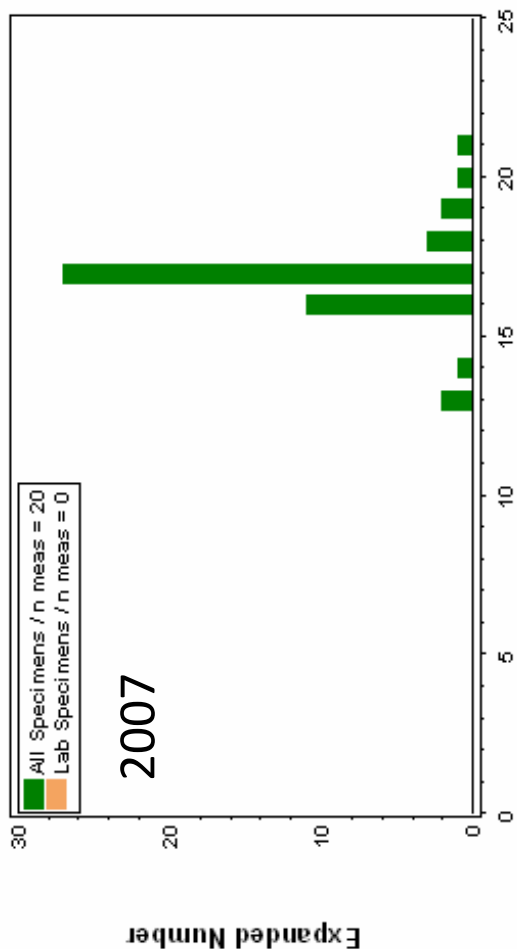


Figure 162. Length-frequency distributions, by cruise, for white shrimp. This species was absent from collections during the Spring 2008 survey.

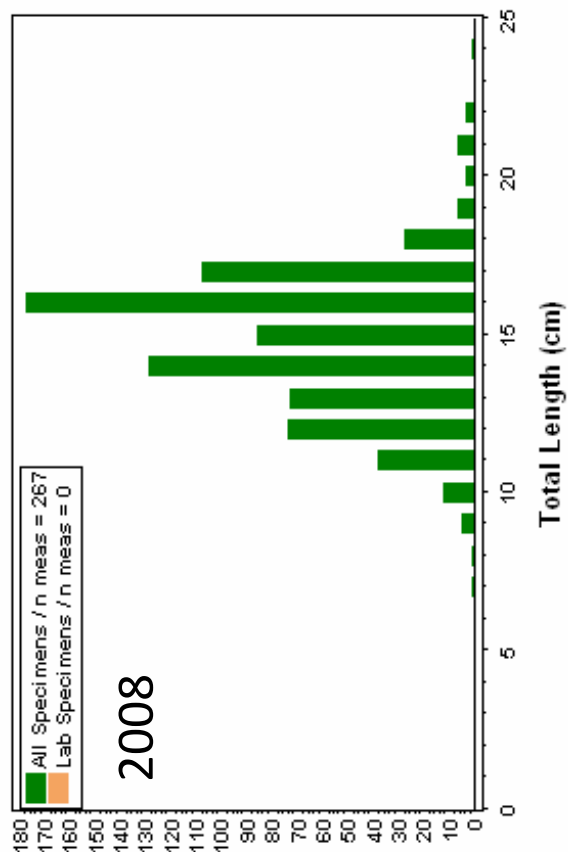
Spring



Fall



Expanded Number



Expanded Number





# Windowpane Flounder (Priority D)

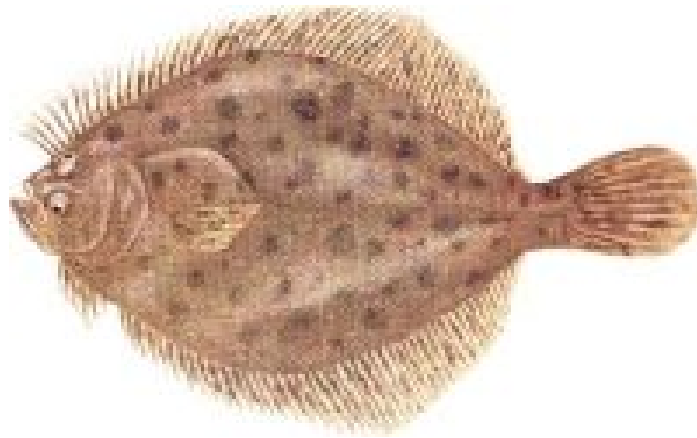
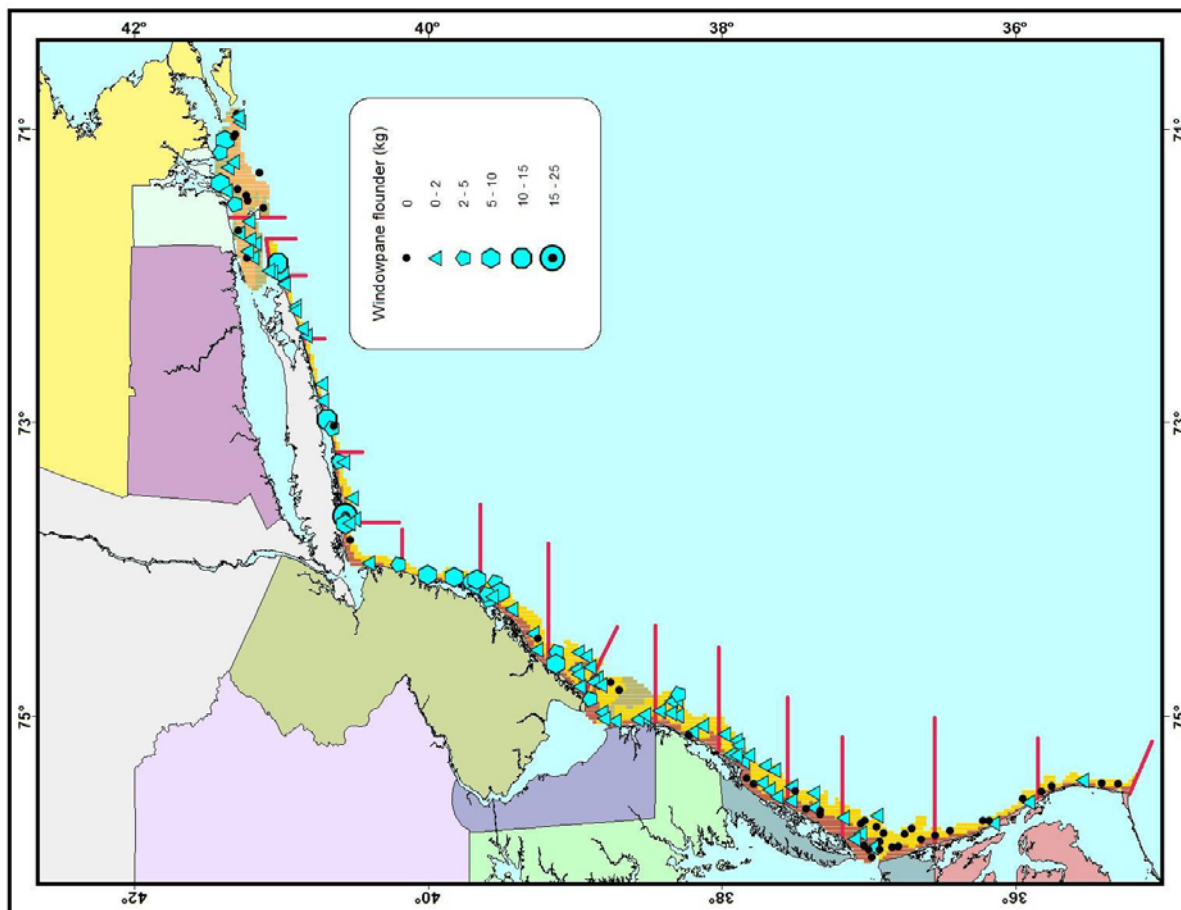


Table 45. Sampling rates and abundance indices of windowpane flounder for four NEAMAP cruises.

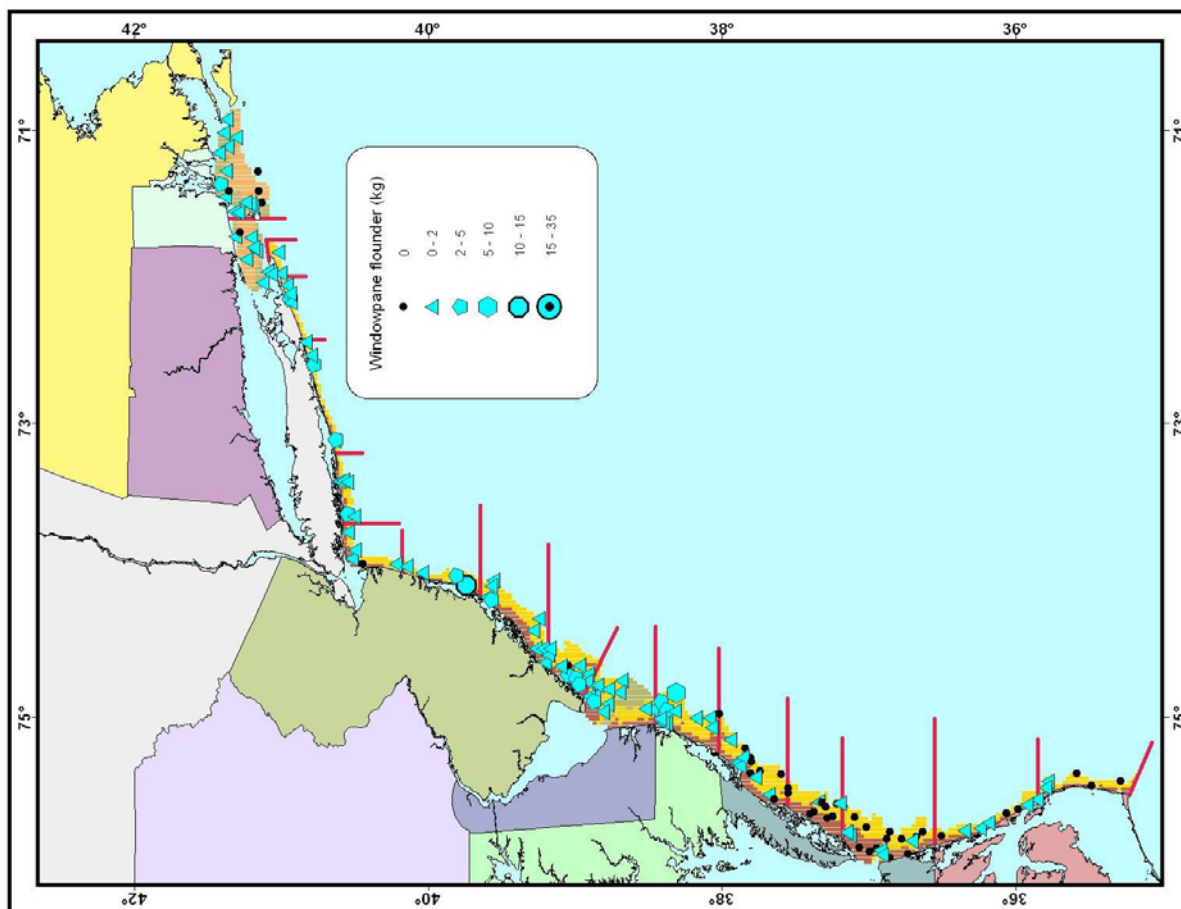
Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	744	114.0	694	0		0		2.21	0.49
2008	Spring	756	191.0	697	0		0		2.12	0.68
	Fall	475	79.4	410	0		0		1.08	0.27
2009	Spring	1,067	268.2	868	0		0		1.79	0.58

Figure 163. Biomass (kg) of windowpane flounder collected at each sampling site for four NEAMAP cruises.

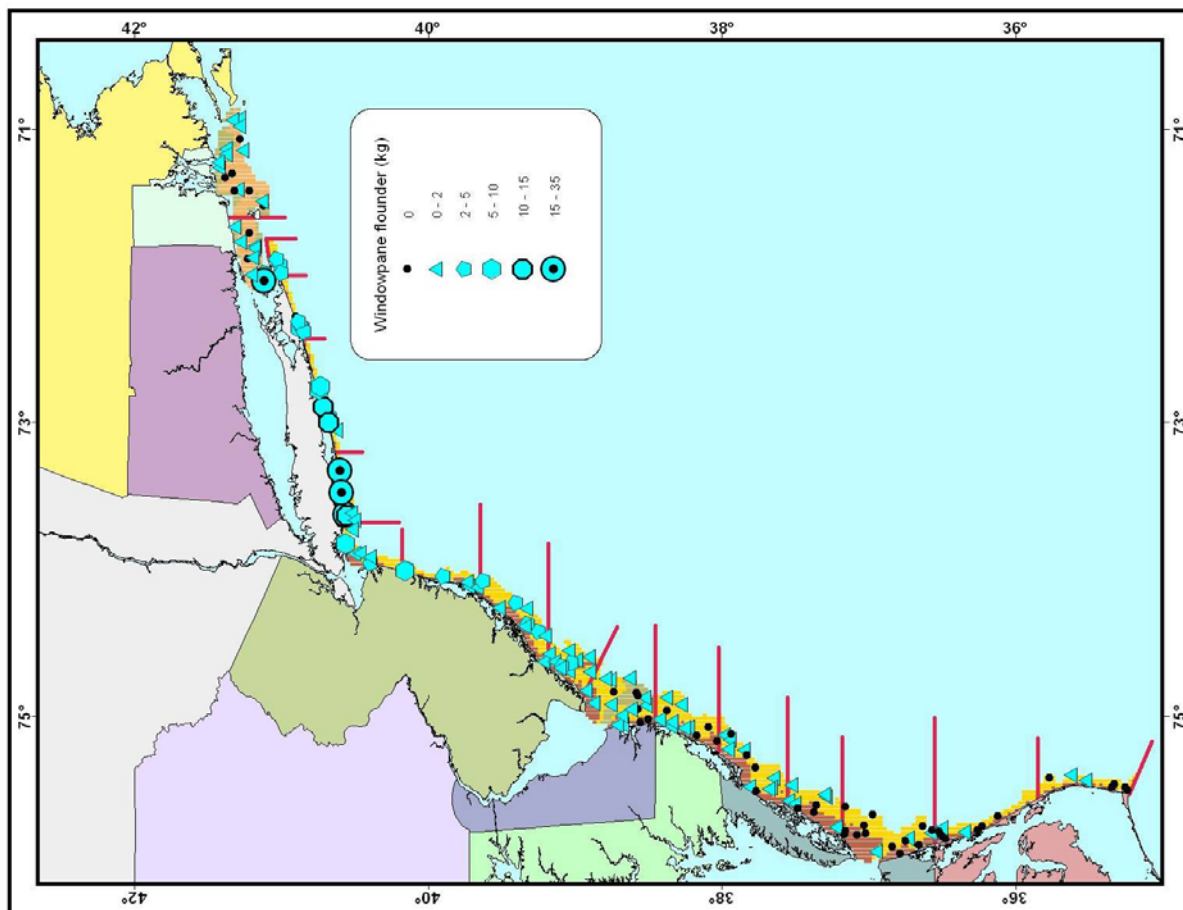
Spring 2008



Fall 2007



Spring 2009



Fall 2008

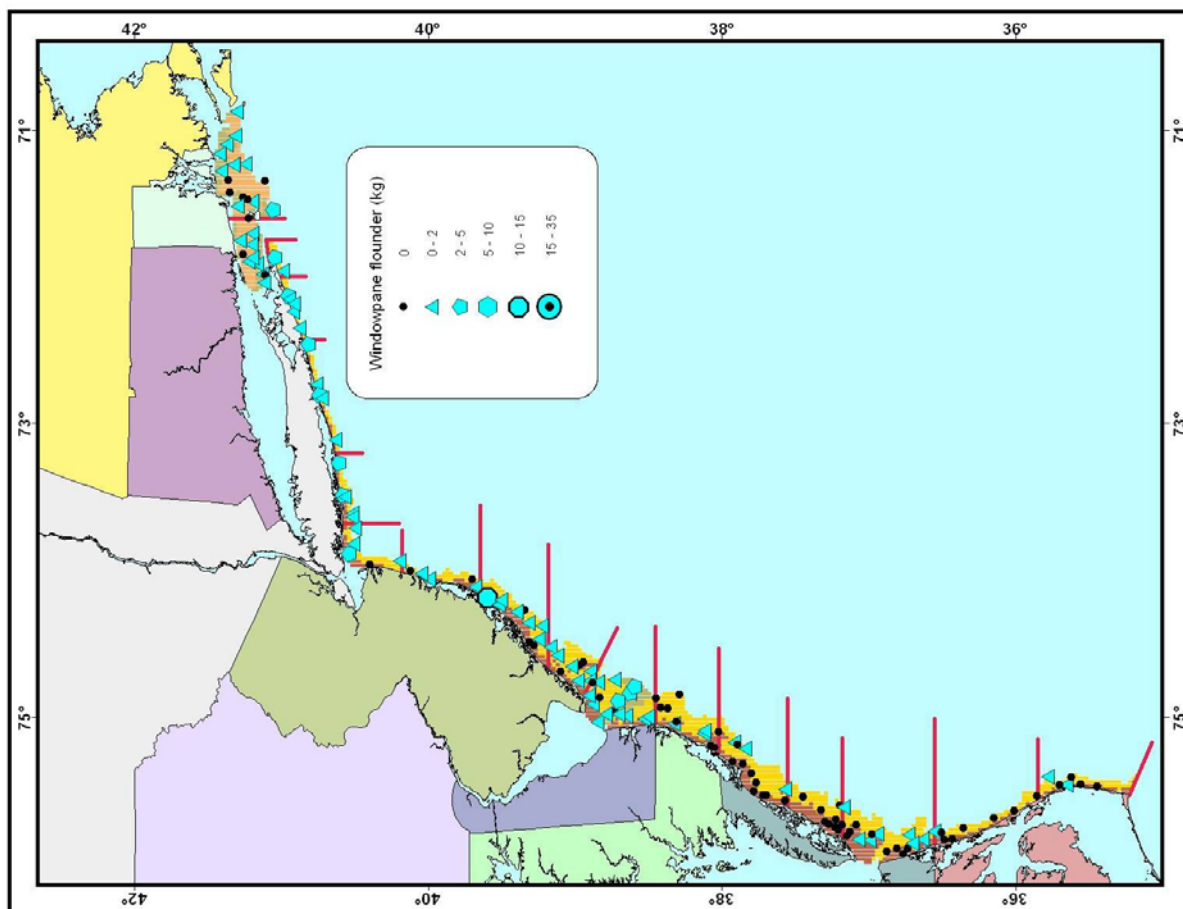


Figure 164. Preliminary indices of abundance, in terms of number and biomass, of windowpane flounder for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

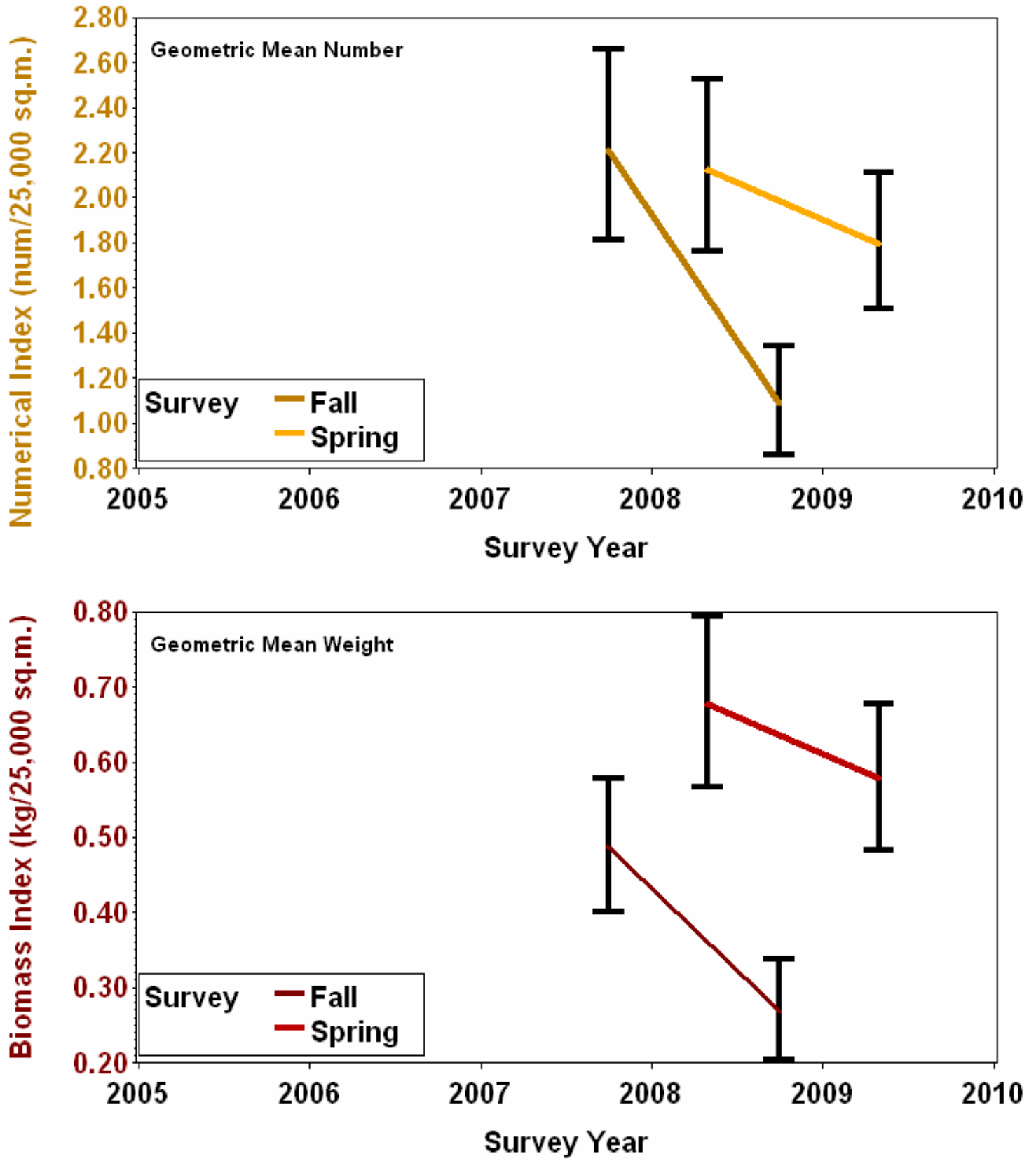
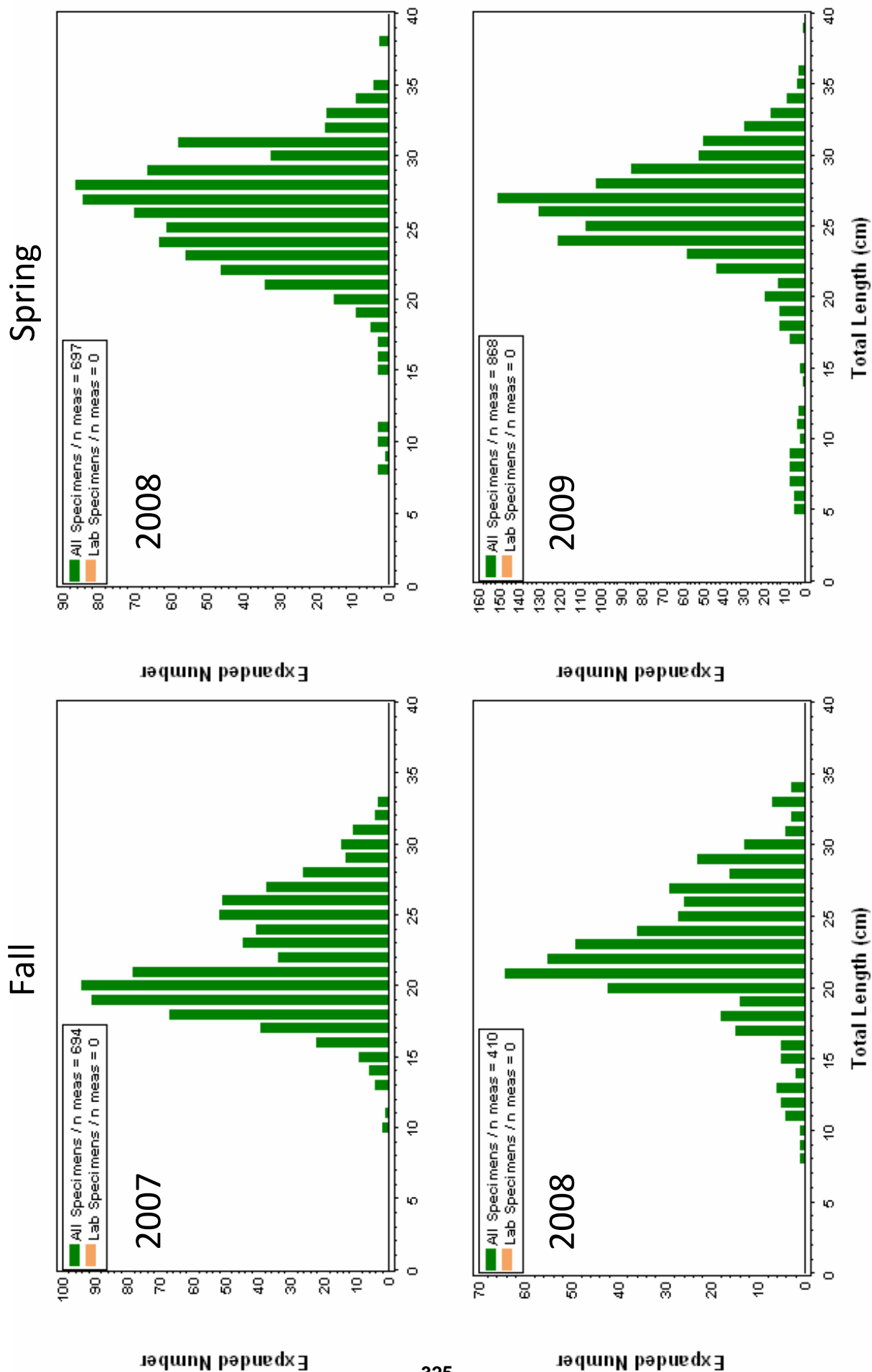


Figure 165. Length-frequency distributions, by cruise, for windowpane flounder.





# Winter Flounder (Priority A)

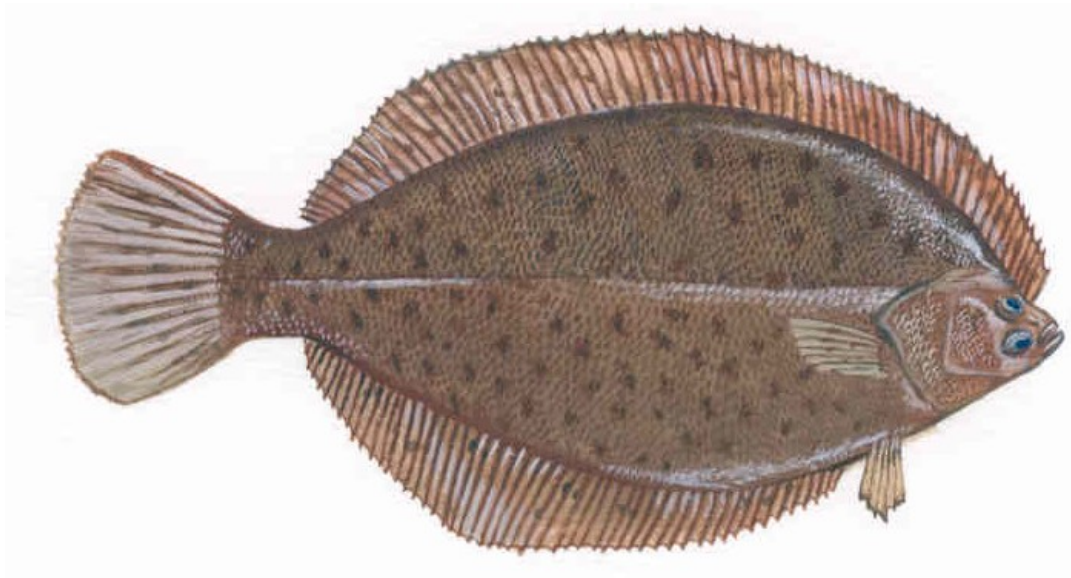


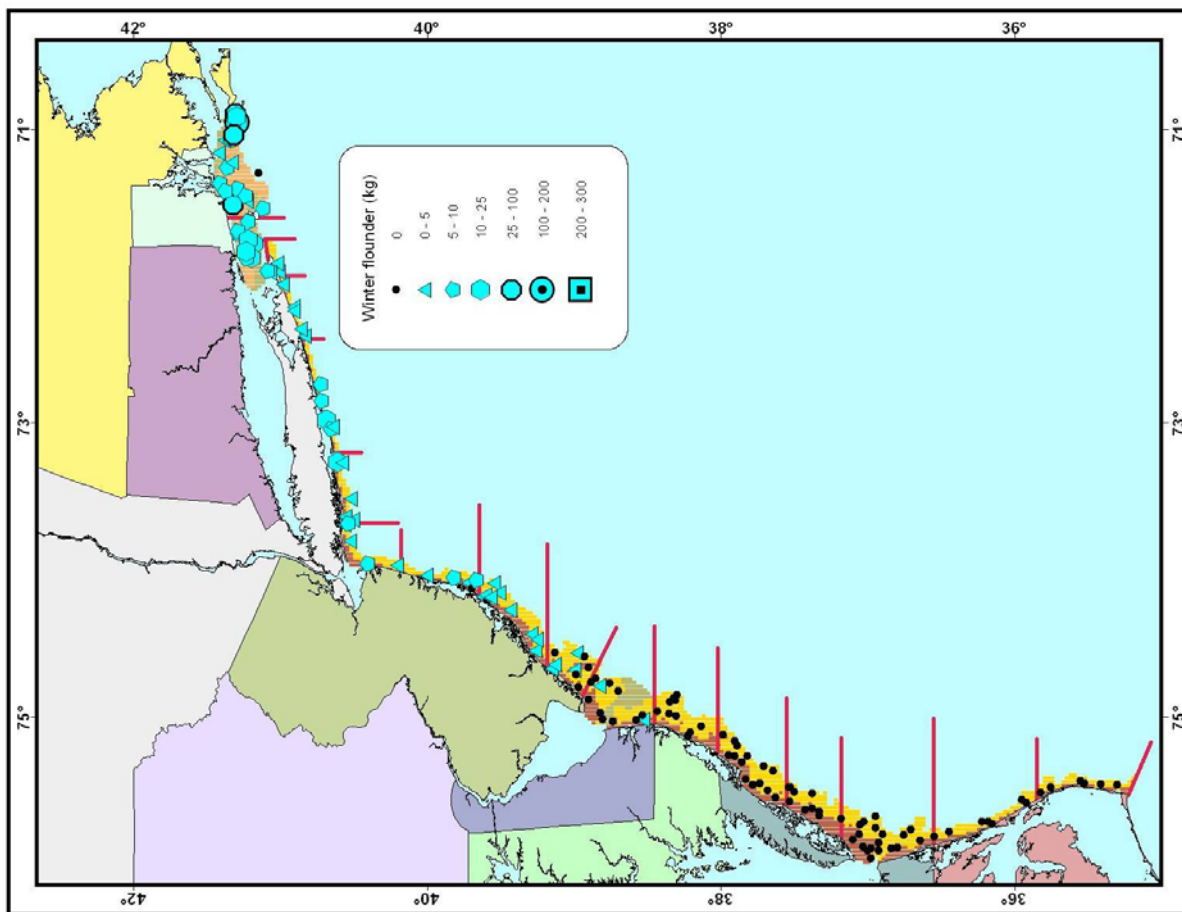
Table 46. Sampling rates and abundance indices of winter flounder for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	391	98.7	391	118	118	114	112	0.39	0.21
2008	Spring	1,863	554.1	1,525	466	466	450	442	1.96	0.99
	Fall	670	142.0	522	137	137	132	109	0.61	0.30
2009	Spring	1,954	628.2	1,746	543	0	526	478	1.96	1.06

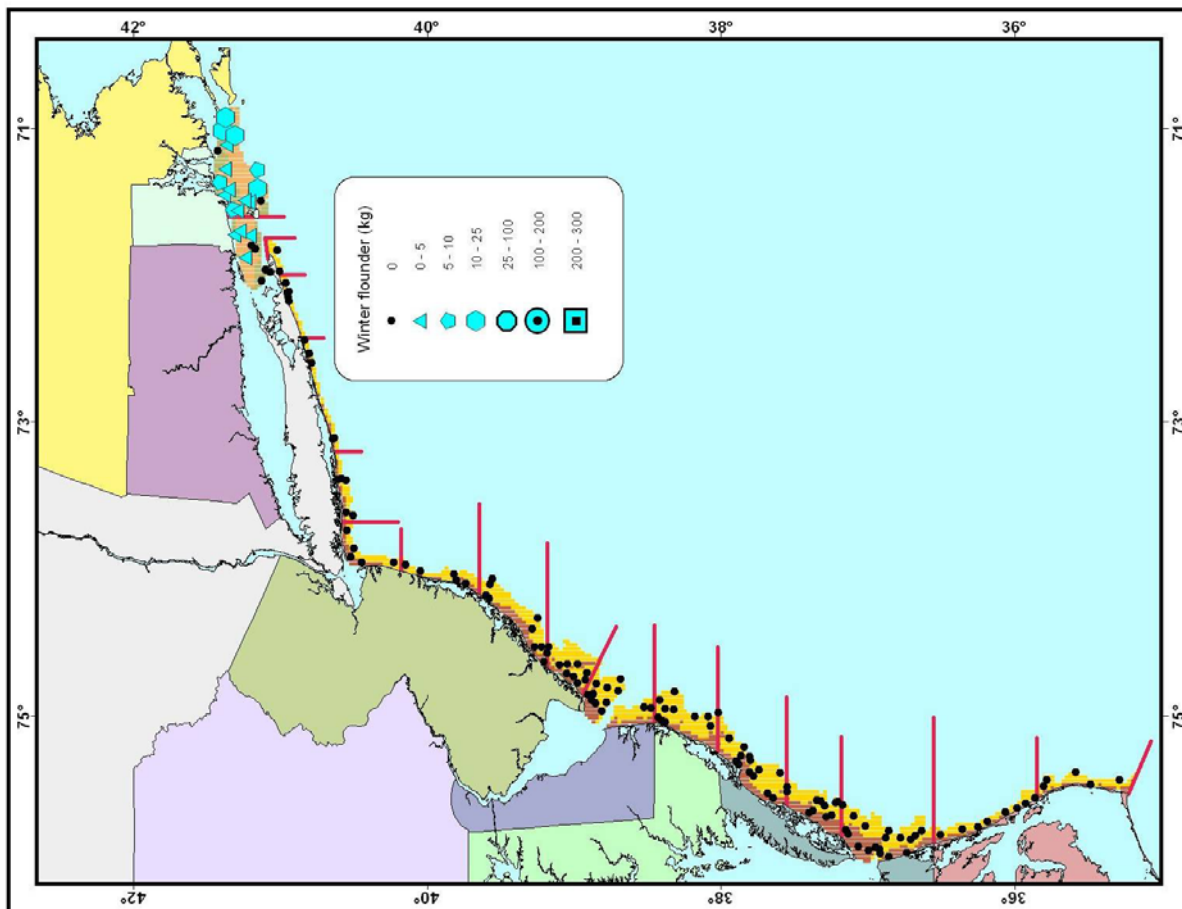


Figure 166. Biomass (kg) of winter flounder collected at each sampling site for four NEAMAP cruises.

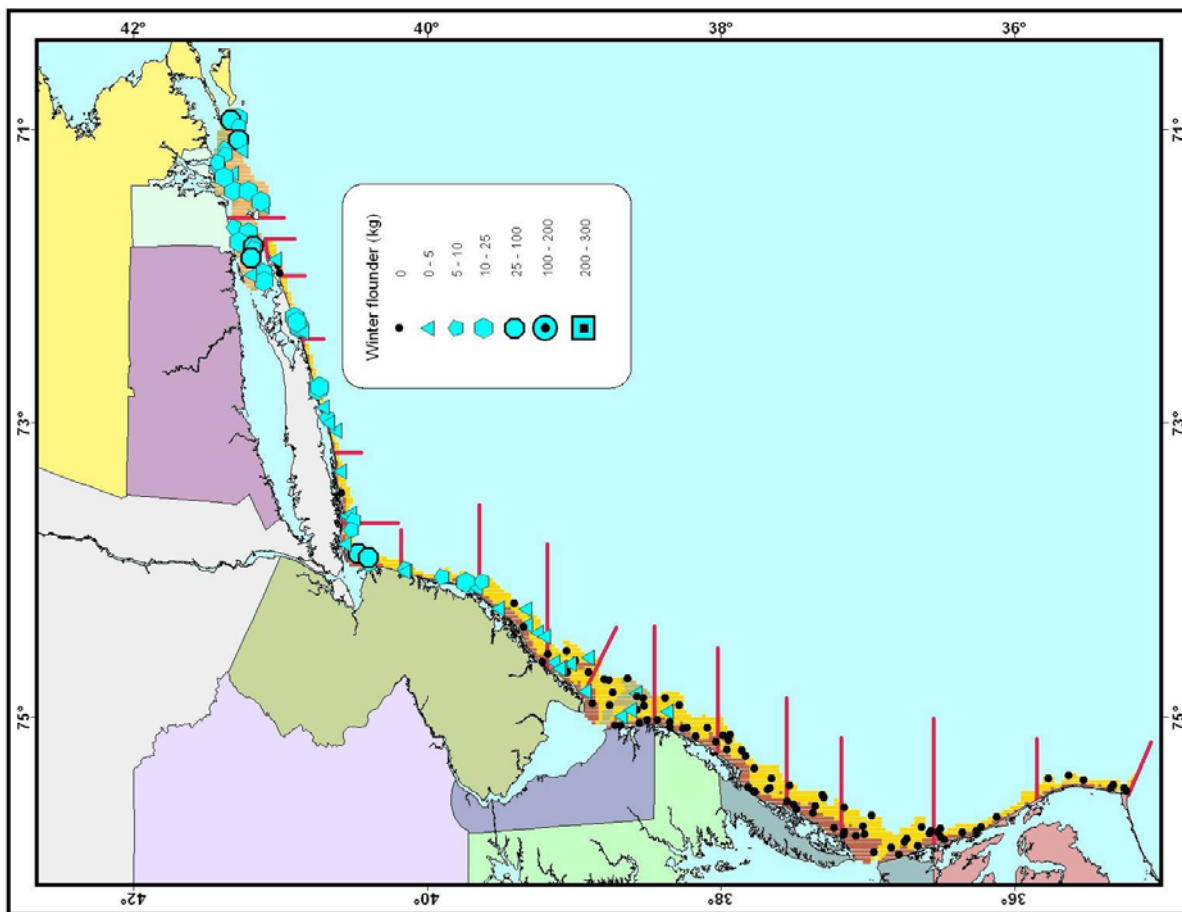
Spring 2008



Fall 2007



Spring 2009



Fall 2008

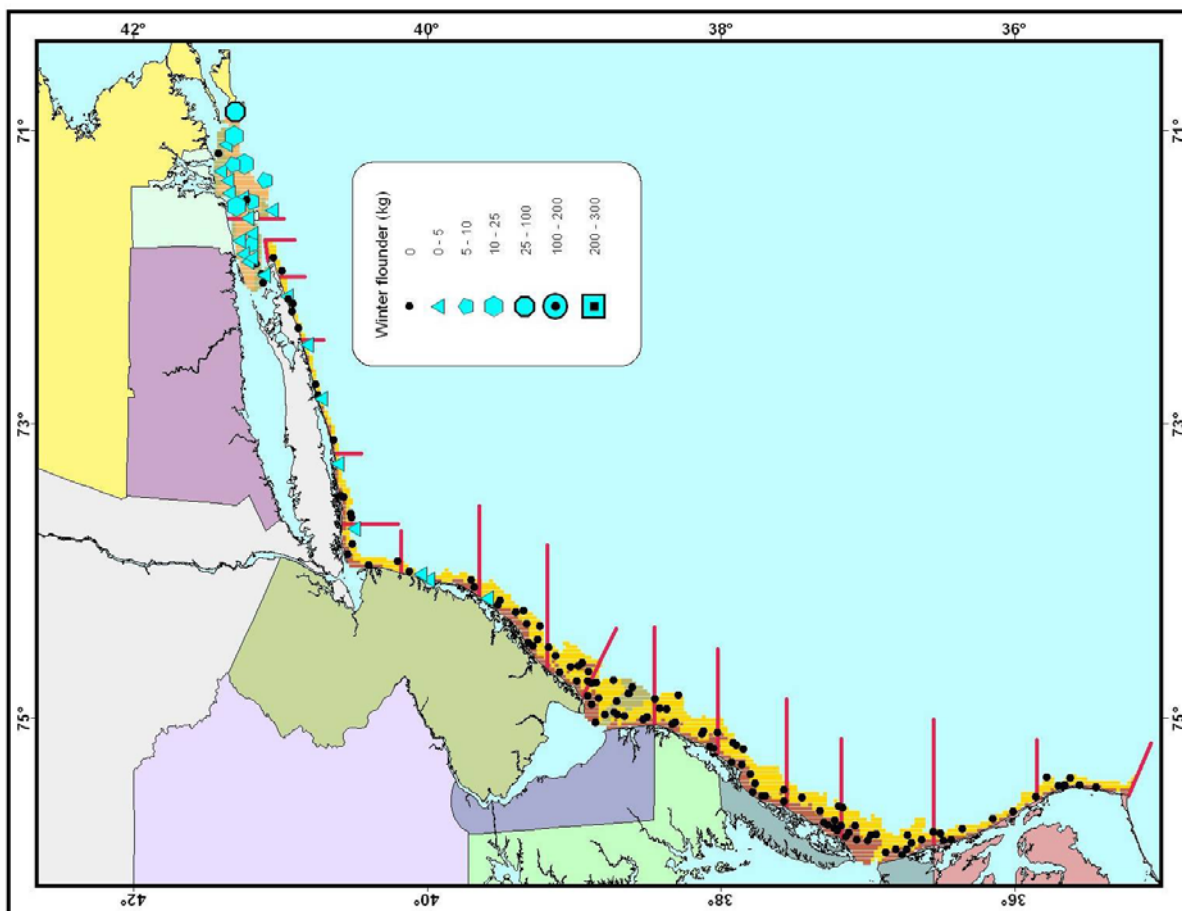


Figure 167. Preliminary indices of abundance, in terms of number and biomass, of winter flounder for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

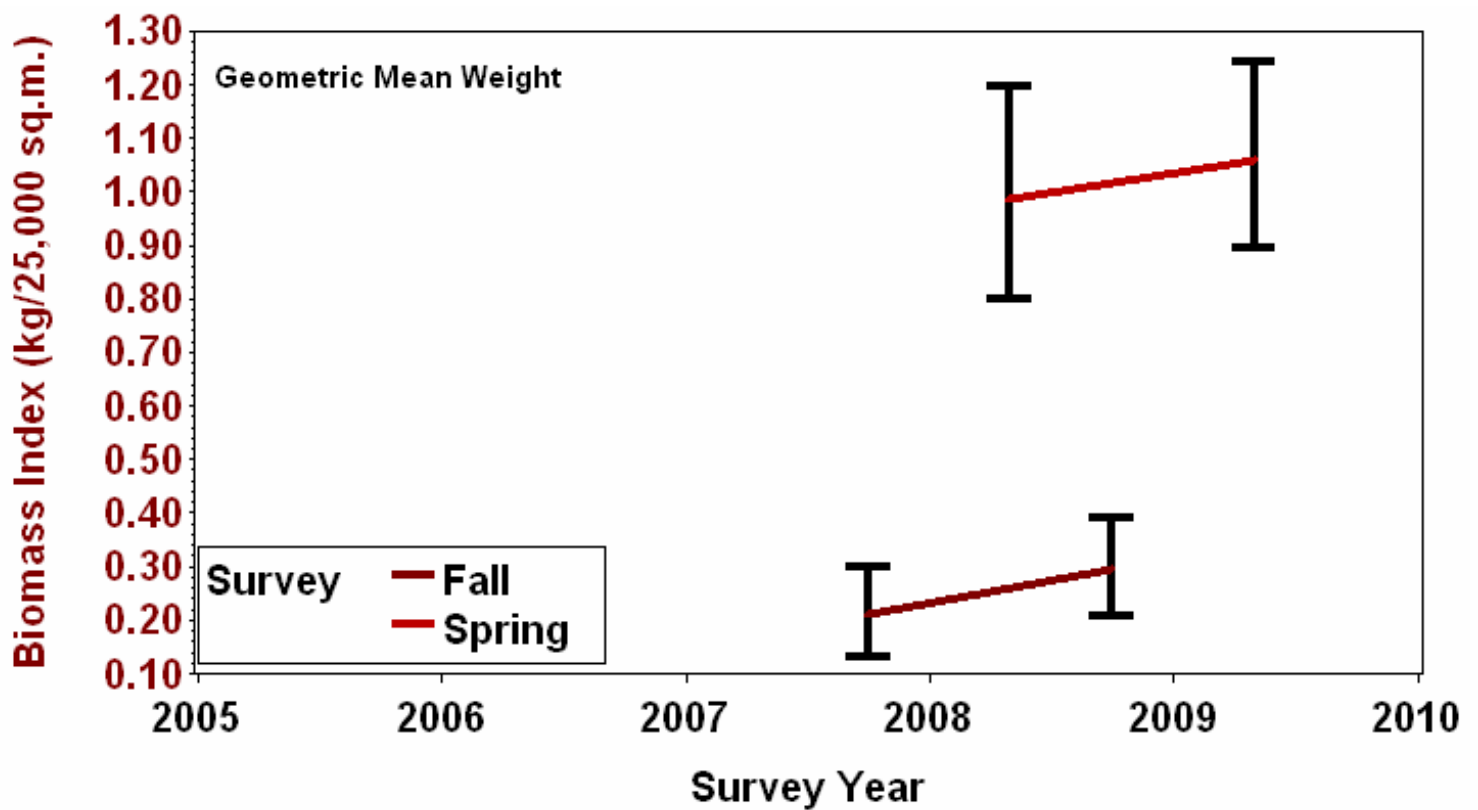
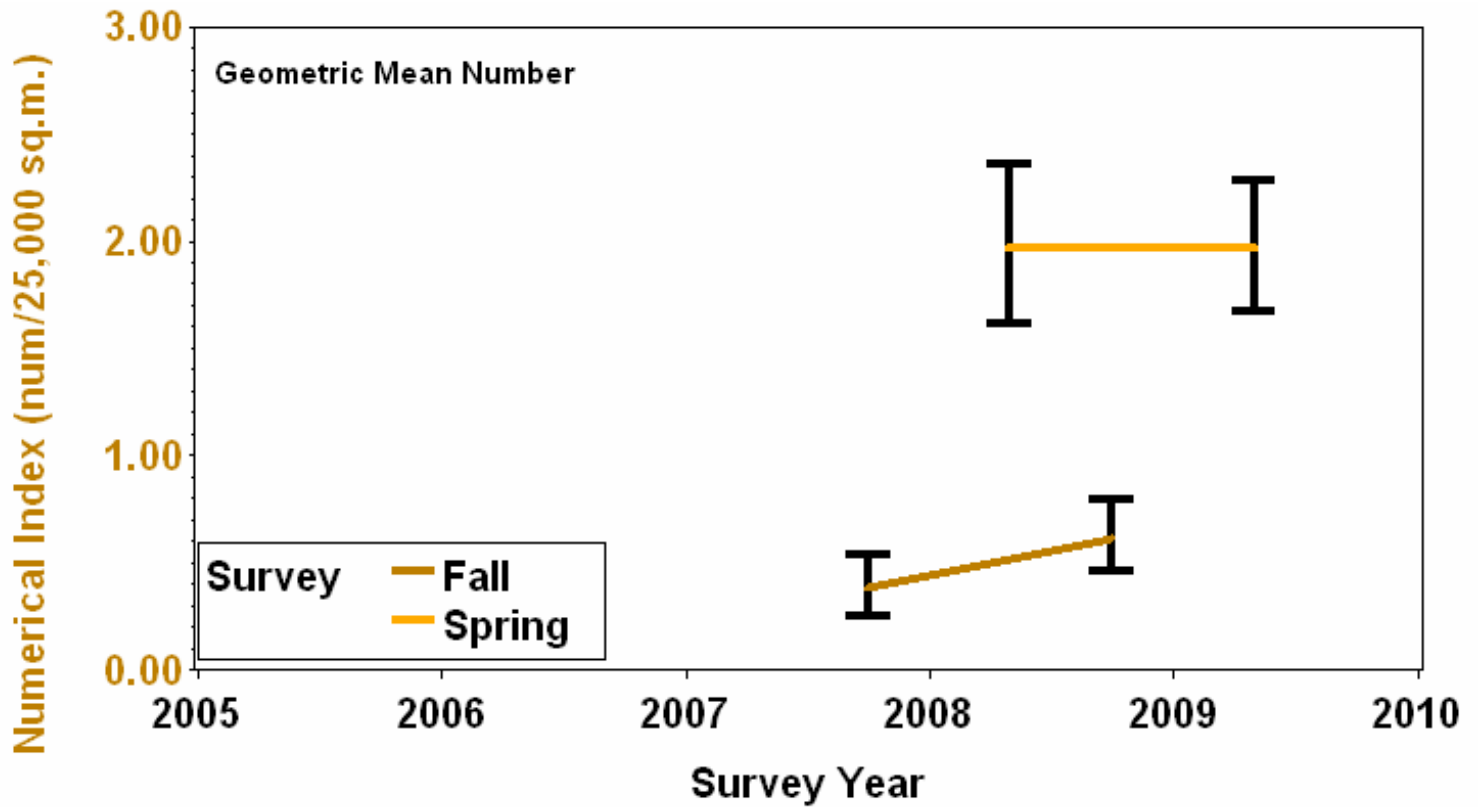


Figure 168. Length-frequency distributions, by cruise, for winter flounder. Numbers taken for full processing, by length, are represented by the orange bars.

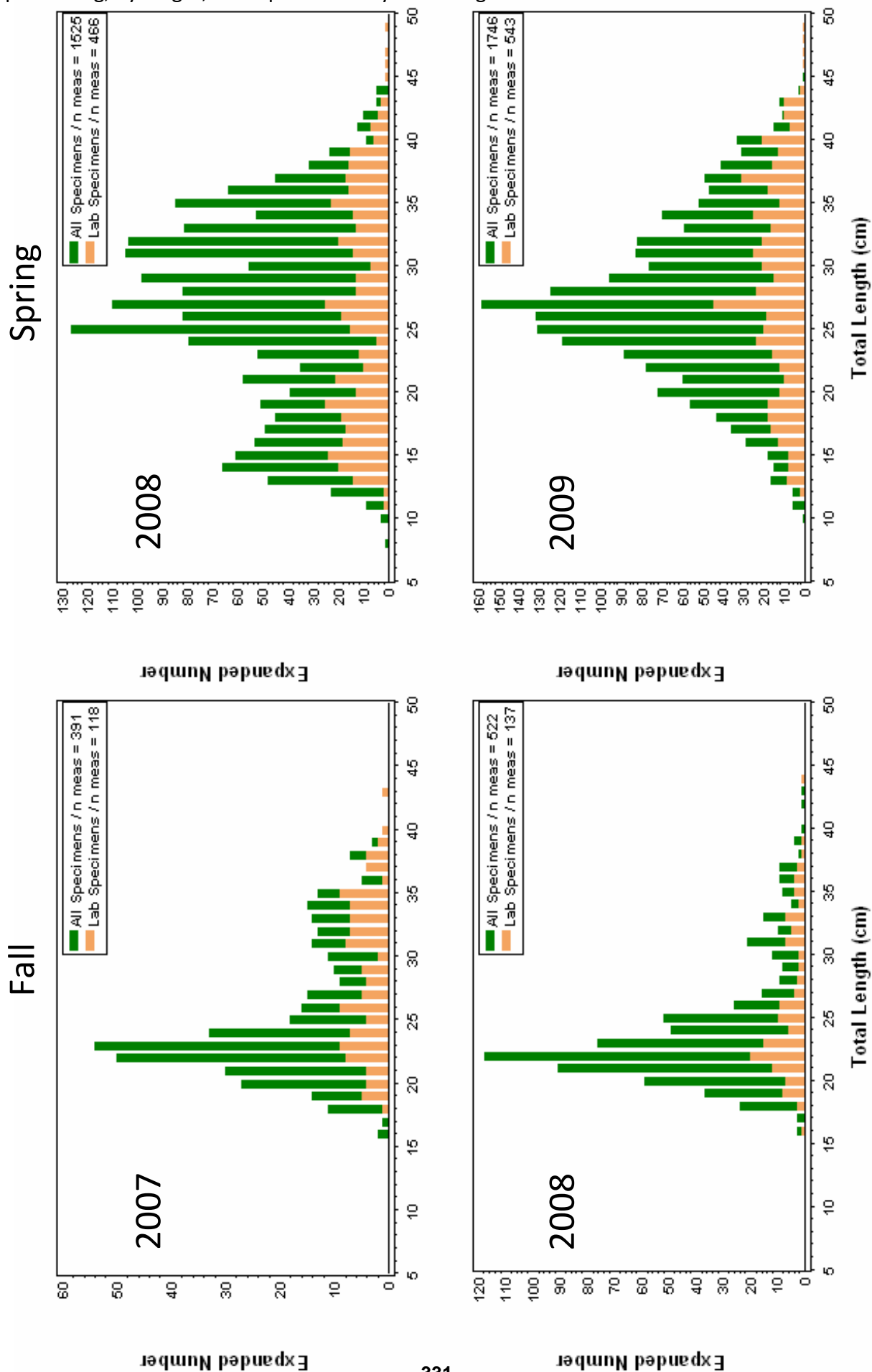


Figure 169. Sex ratio, by length group, for winter flounder collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

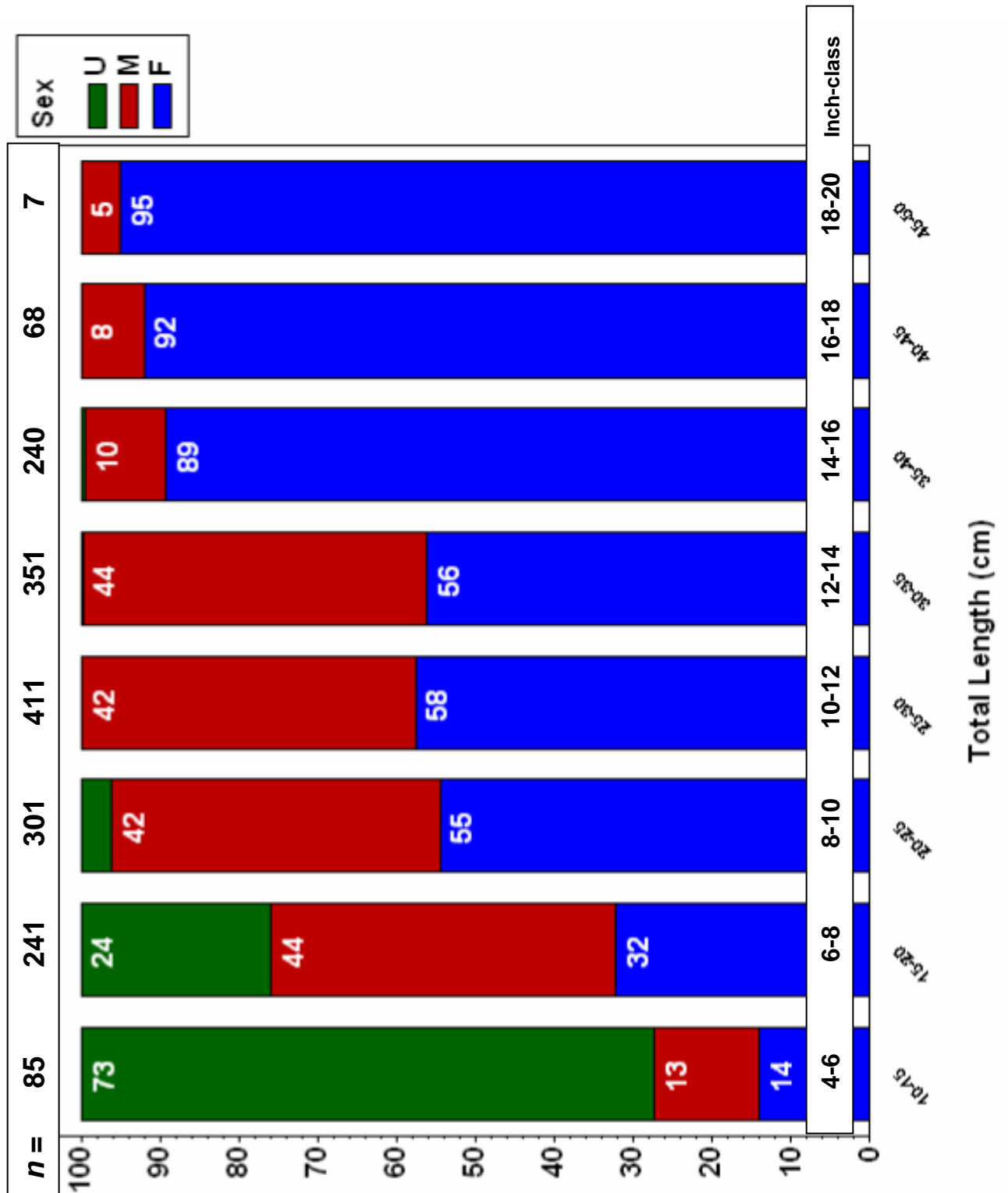


Figure 170. Age-frequency distribution, by cruise, for winter flounder. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.

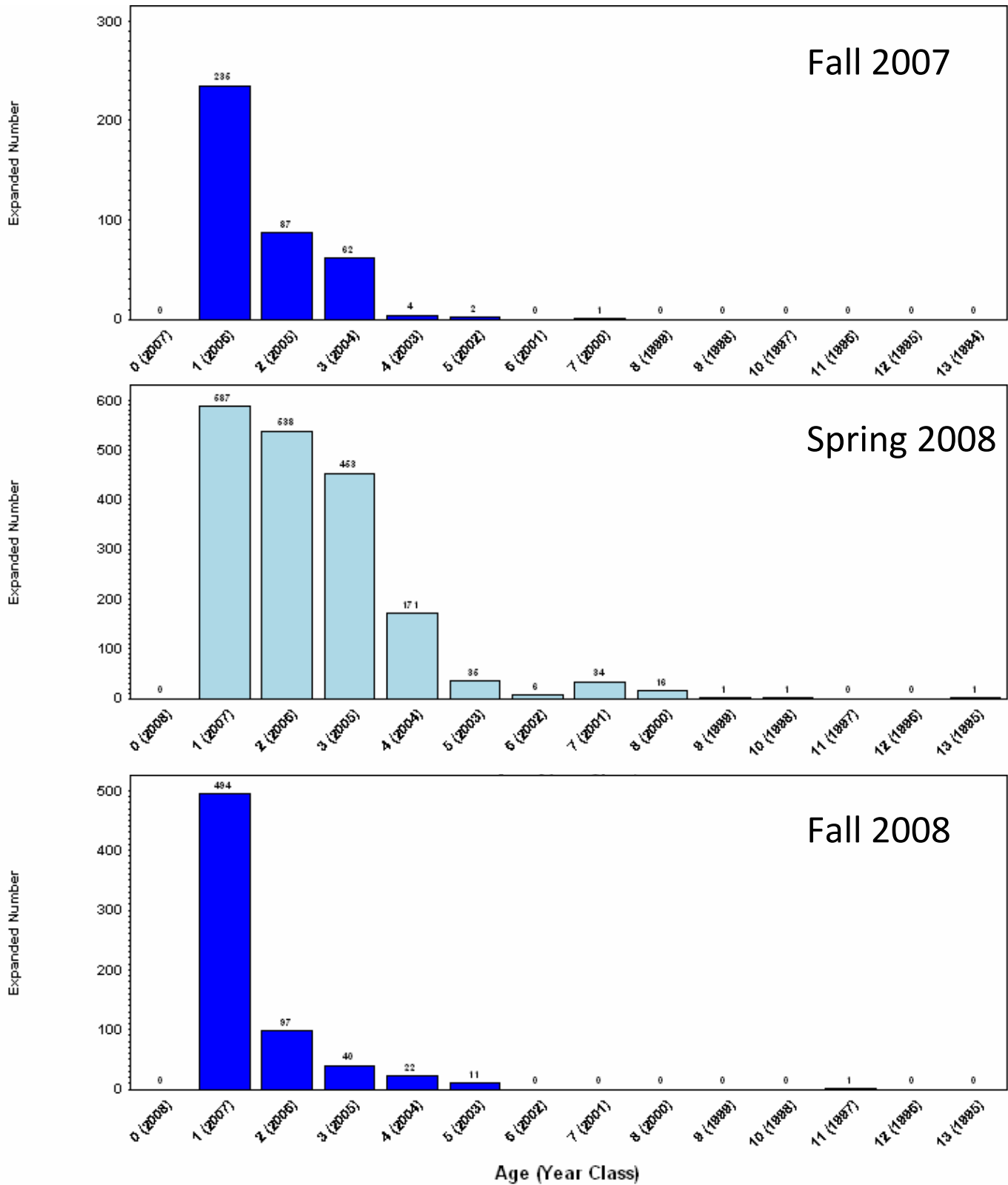
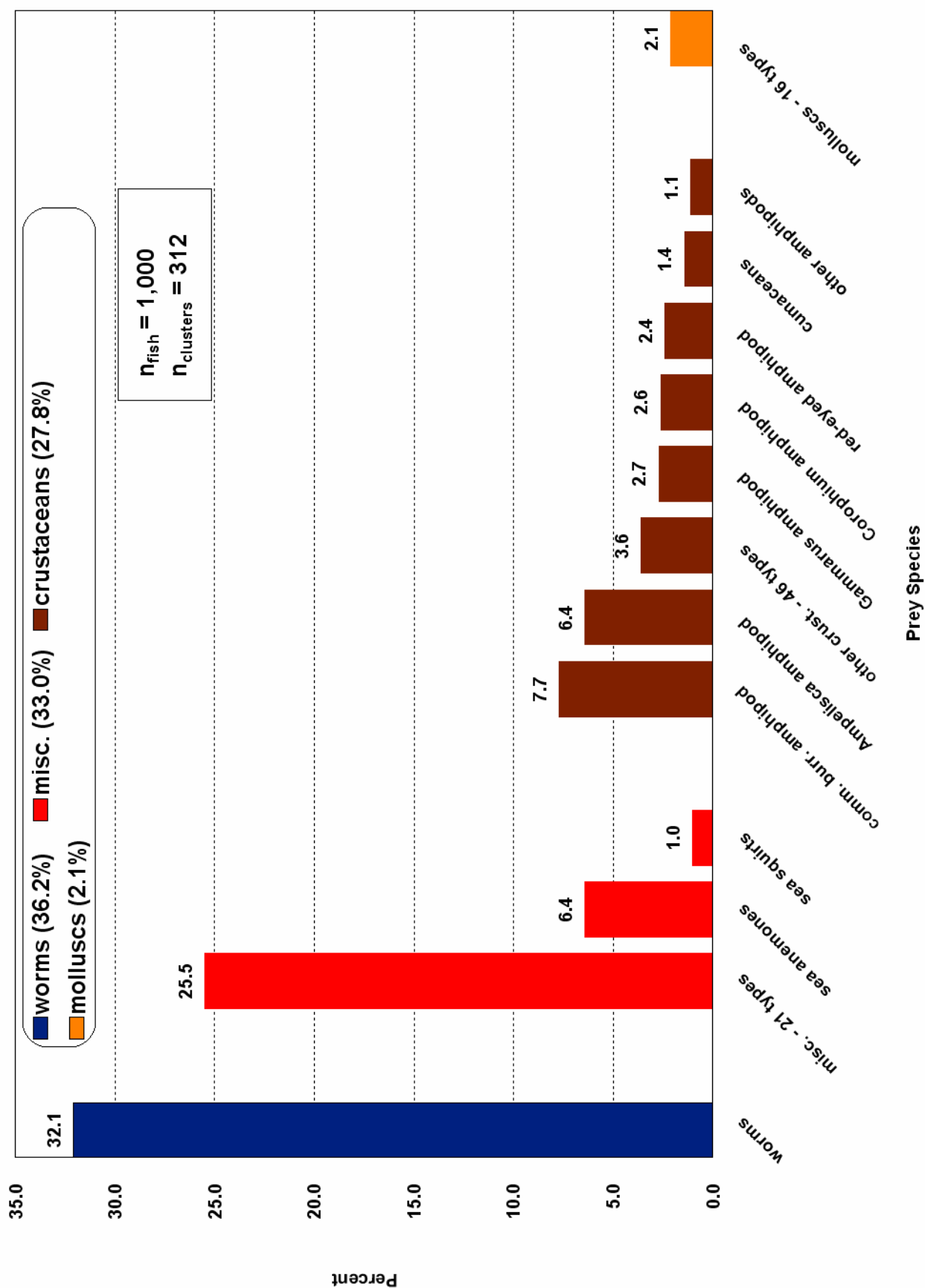


Figure 171. Diet composition, expressed using the percent weight index, of winter flounder collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of winter flounder sampled.



# Winter Skate (Priority B)

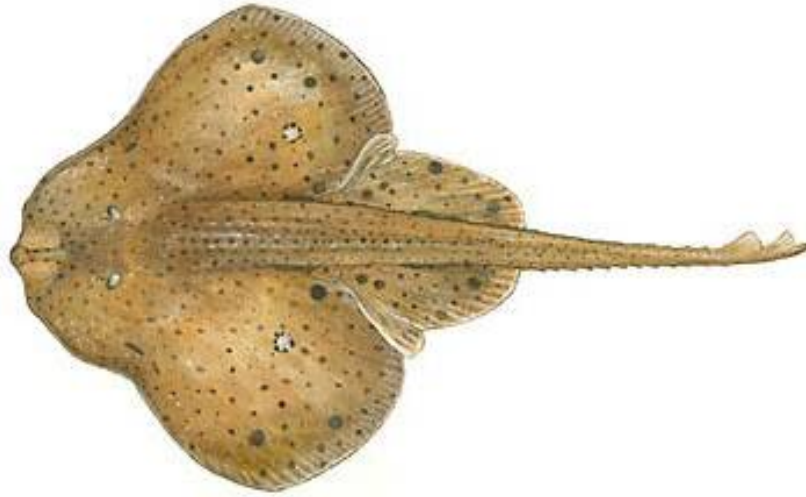


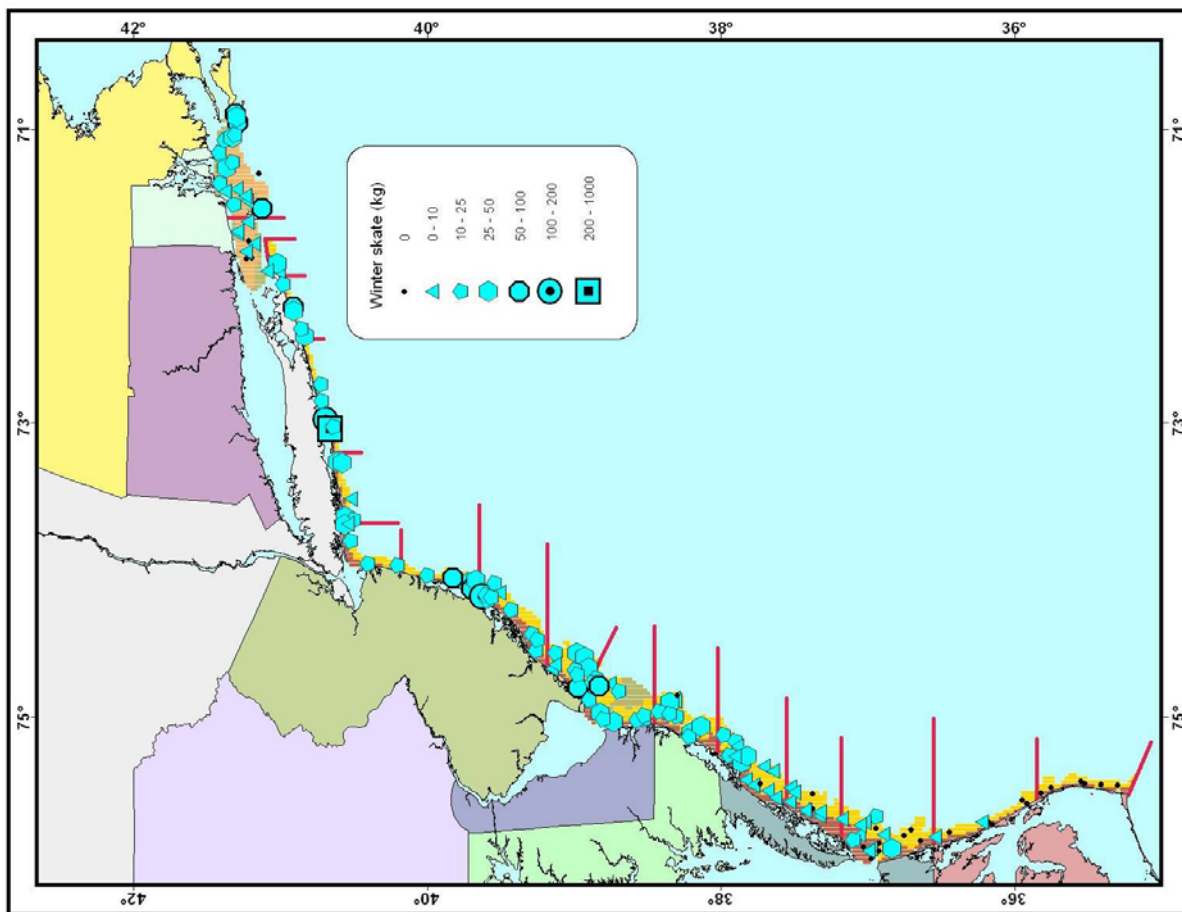
Table 47. Sampling rates and abundance indices of winter skate for four NEAMAP cruises.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Index (Number)	Index (Biomass)
2007	Fall	951	925.3	735	171	0	160	159	0.83	0.87
2008	Spring	1,713	3,168.3	1,214	317	0	299	297	4.99	8.18
	Fall	619	921.0	399	120	0	115	114	0.75	0.94
2009	Spring	3,595	6,843.0	1,778	374	0	345	6	5.28	10.48

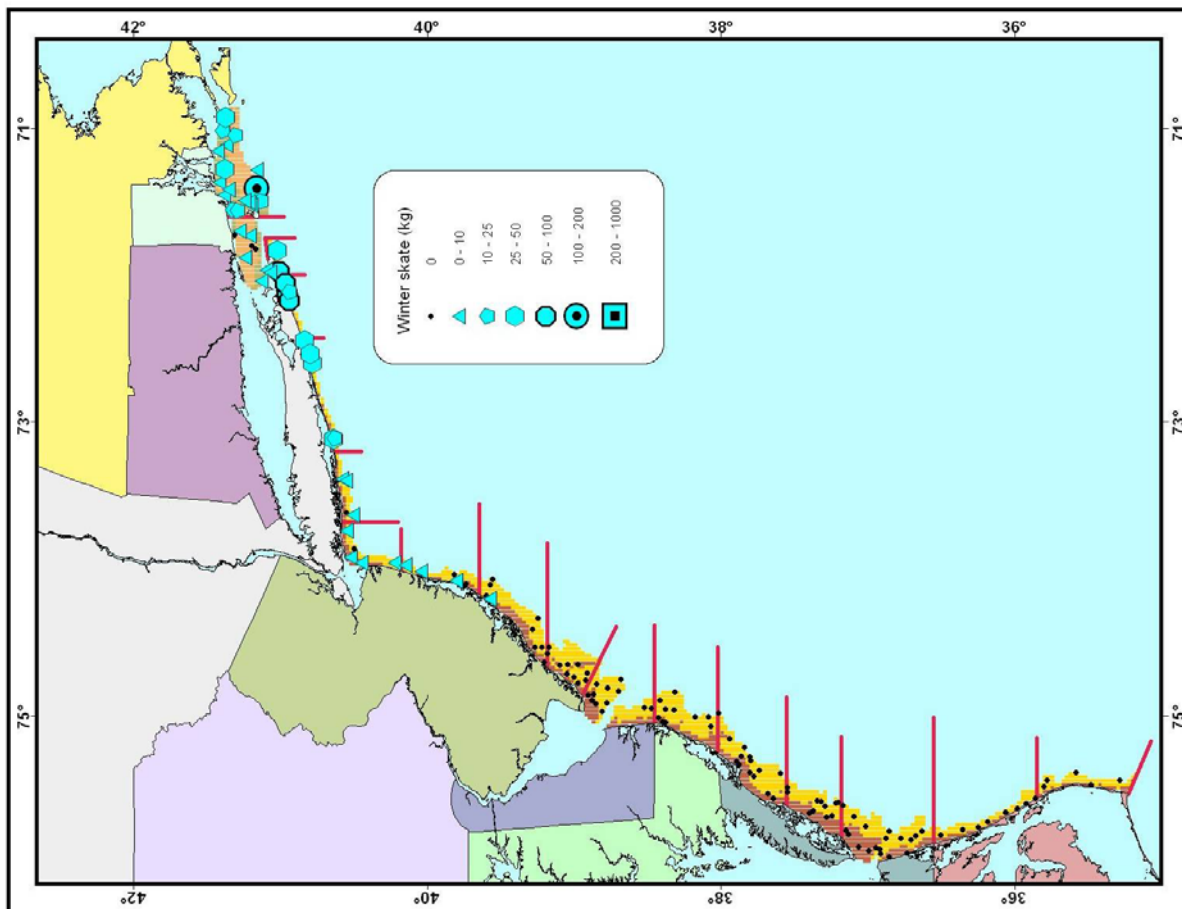


Figure 172. Biomass (kg) of winter skate collected at each sampling site for four NEAMAP cruises.

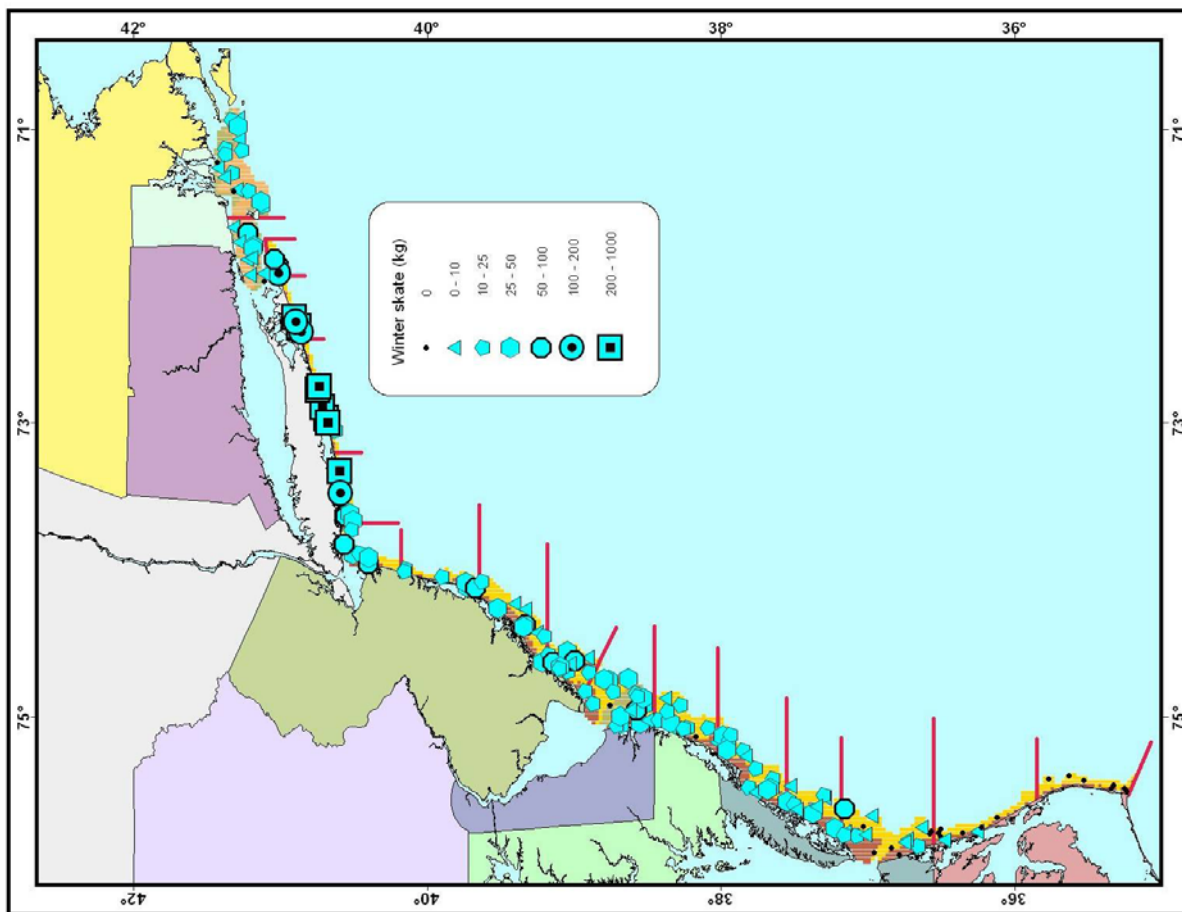
Spring 2008



Fall 2007



Spring 2009



Fall 2008

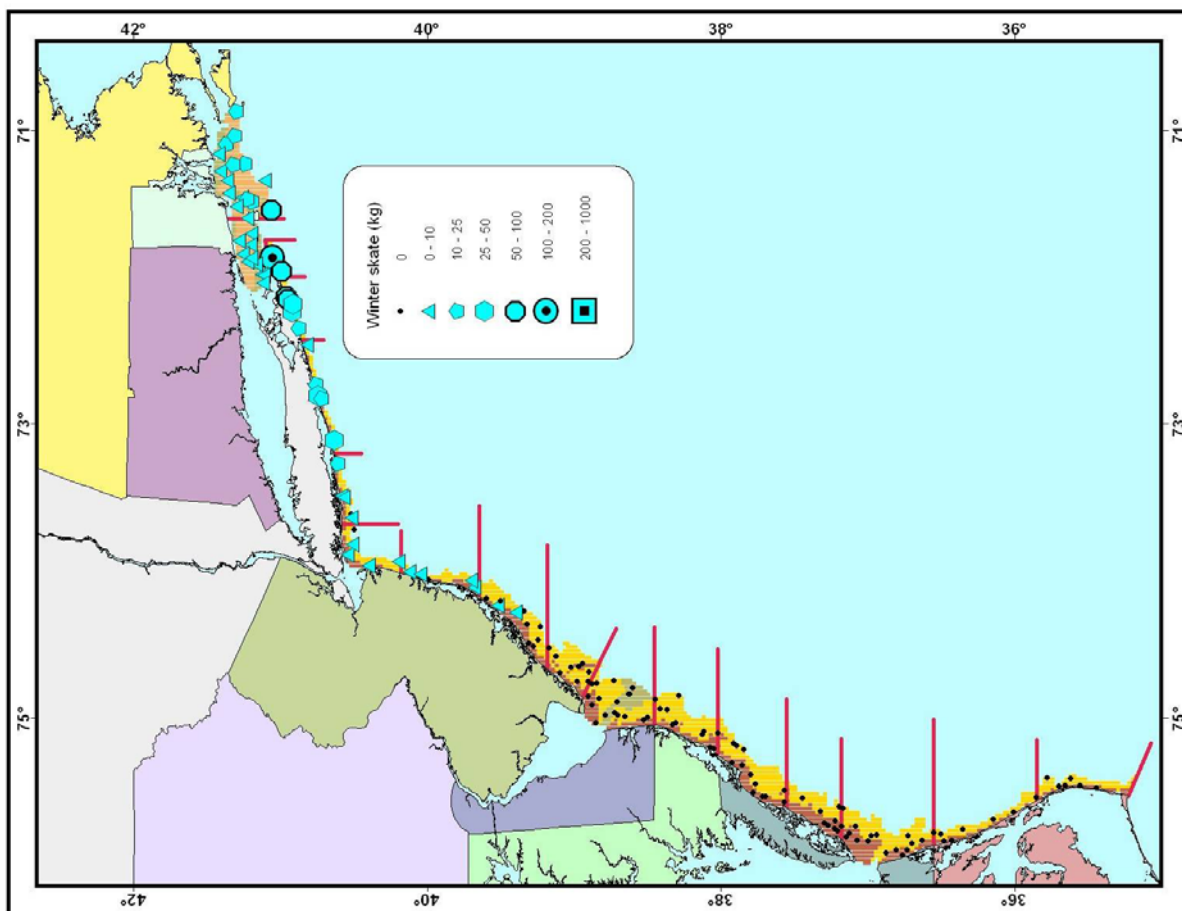


Figure 173. Preliminary indices of abundance, in terms of number and biomass, of winter skate for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

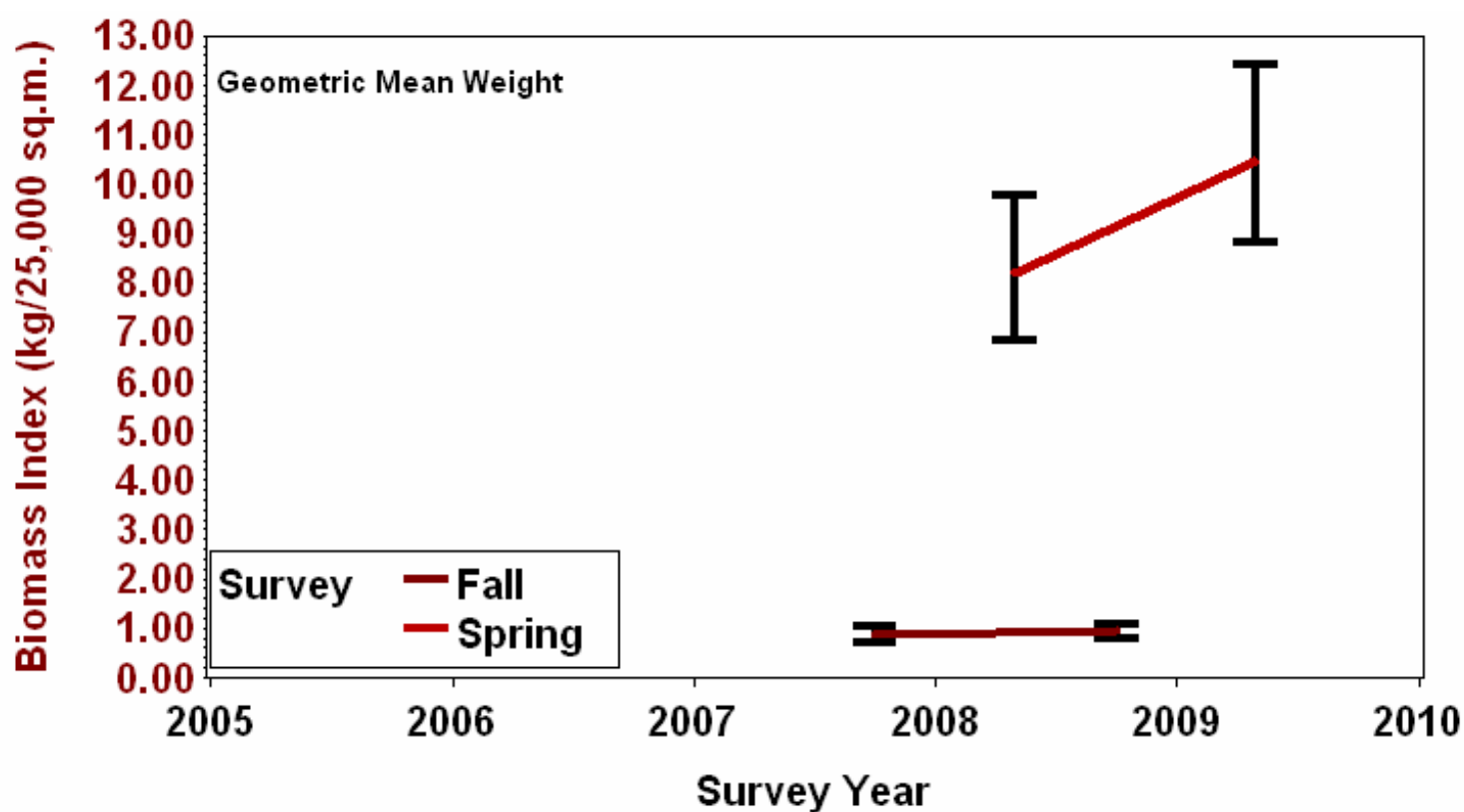
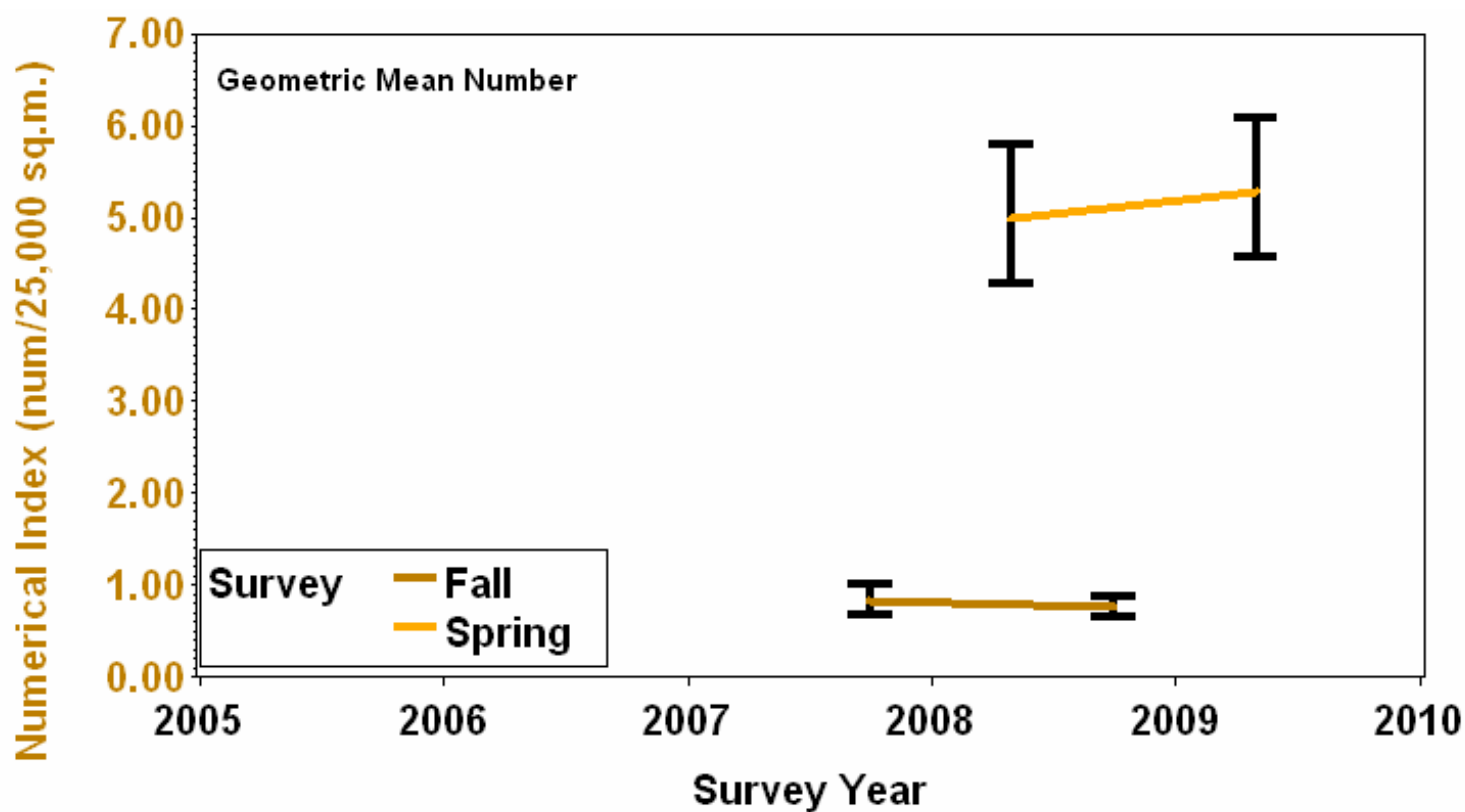


Figure 174. Length-frequency distributions, by cruise, for winter skate. Numbers taken for full processing, by length, are represented by the orange bars.

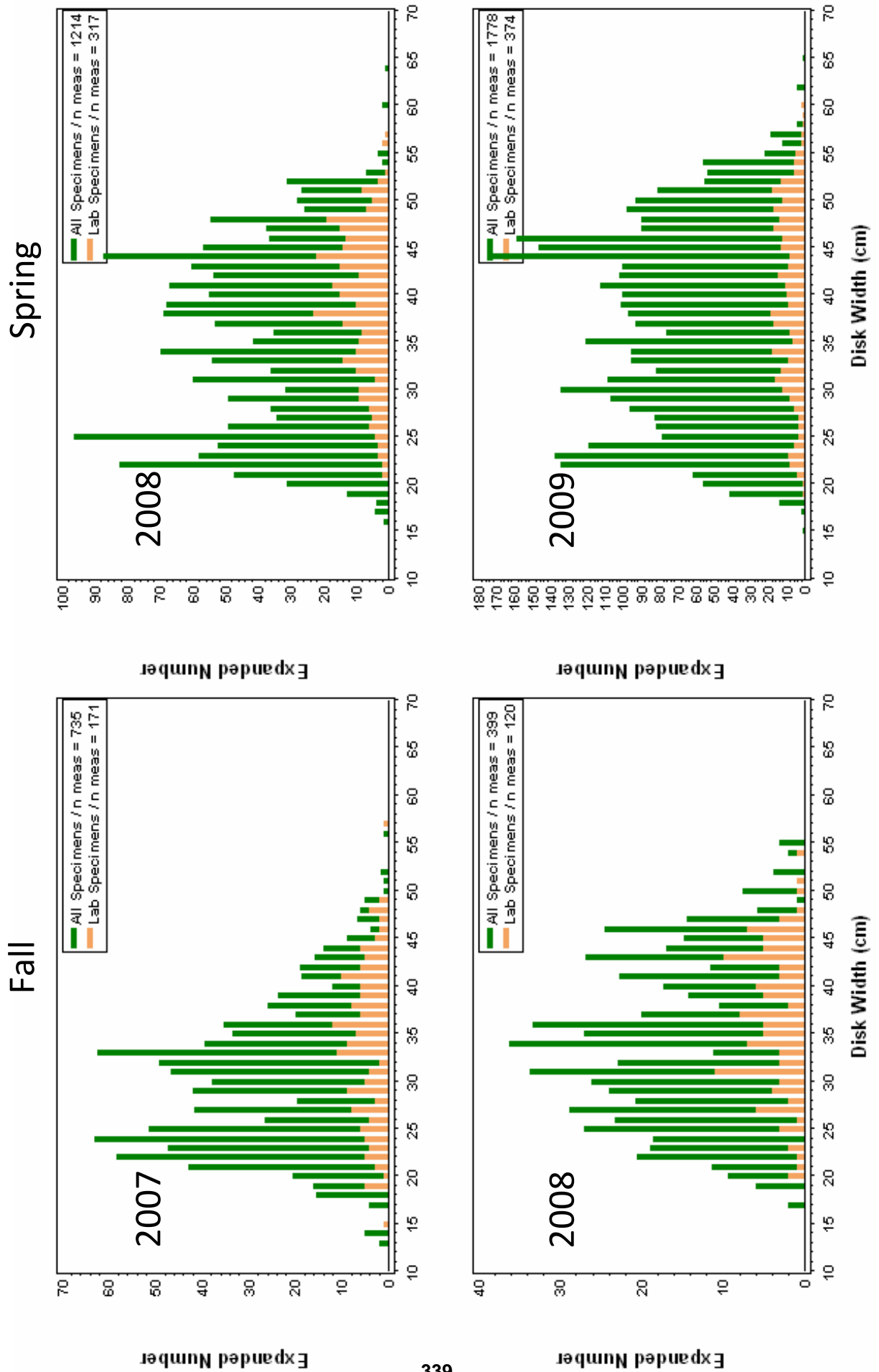


Figure 175. Sex ratio, by length group, for winter skate collected on the four full-scale NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

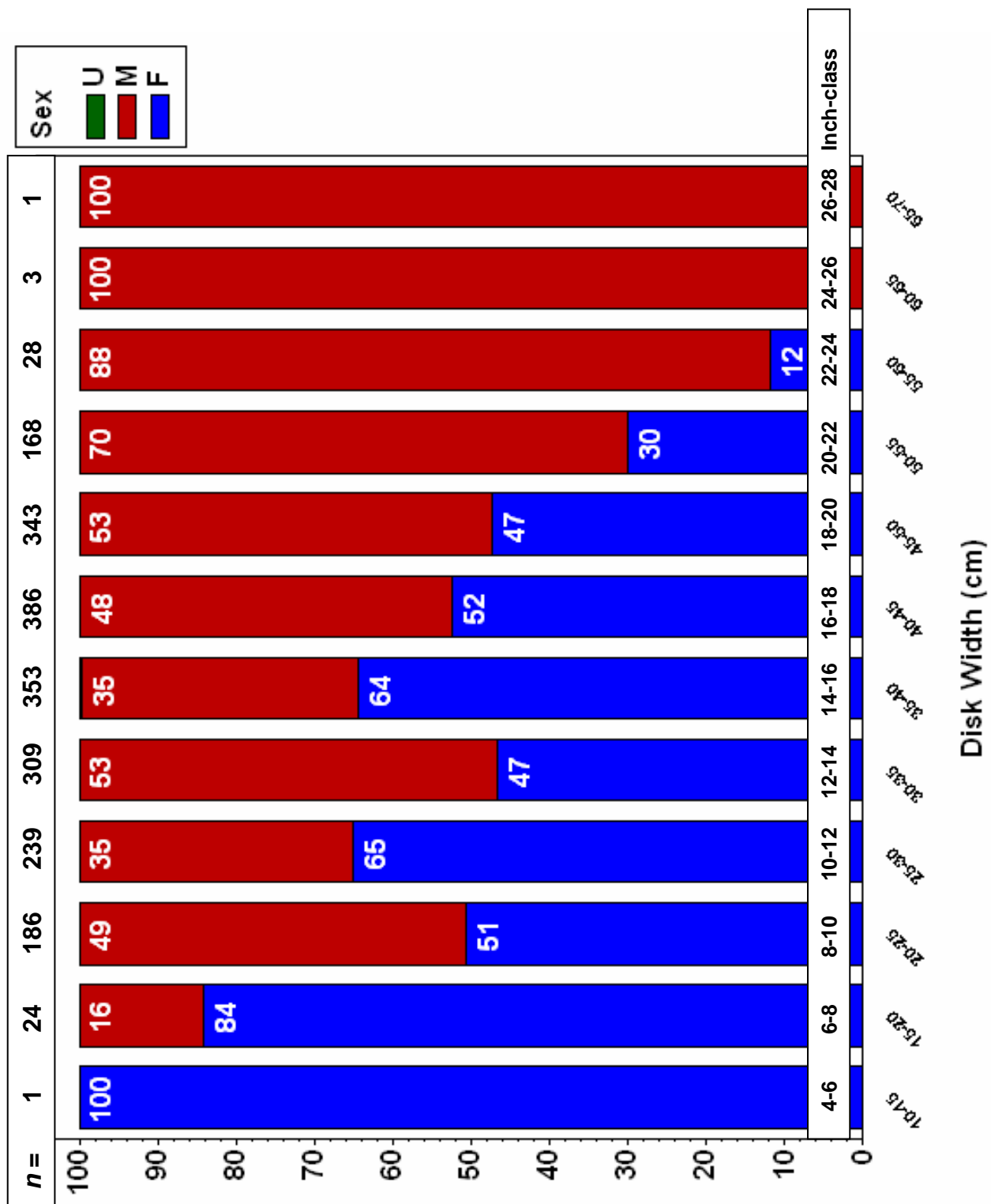
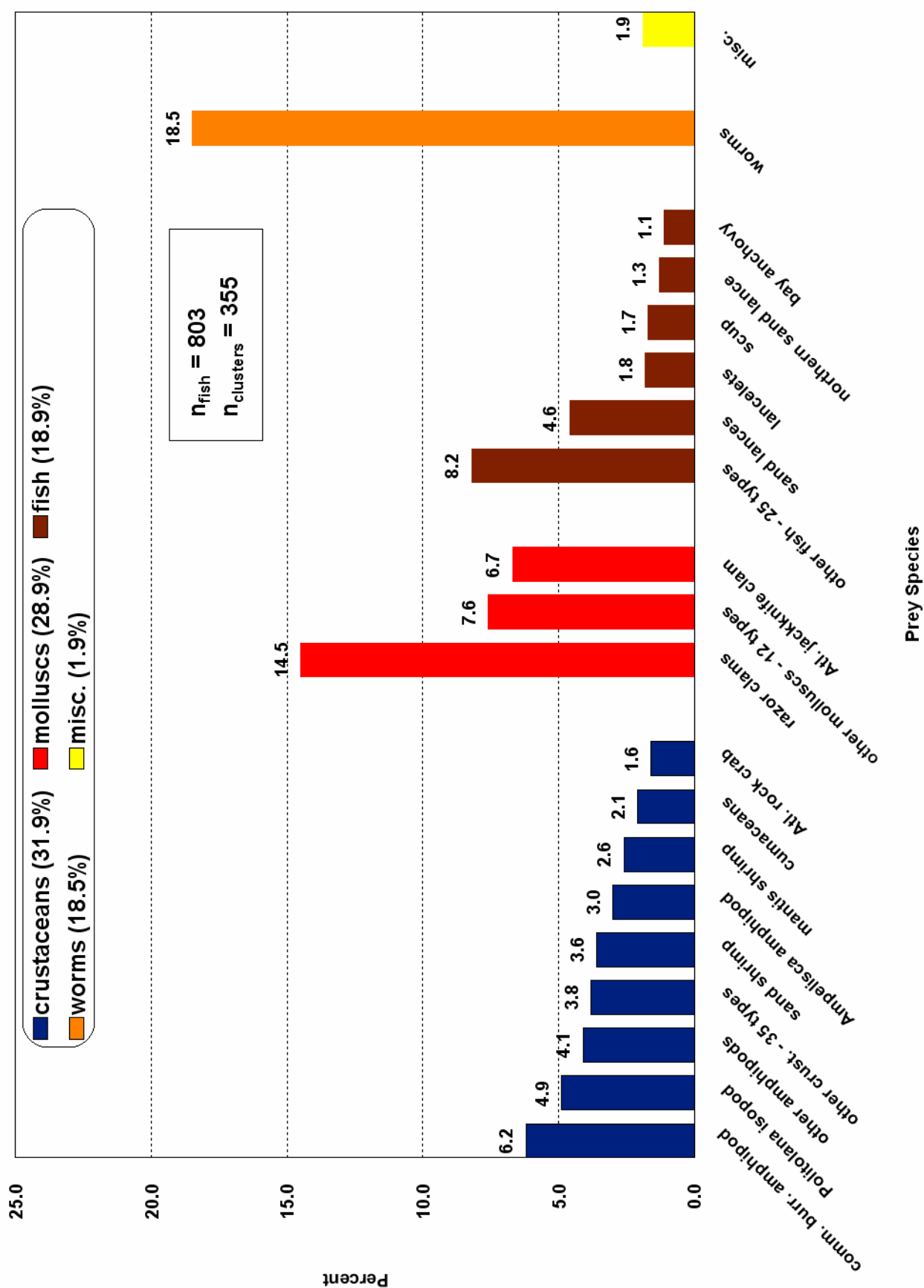


Figure 176. Diet composition, expressed using the percent weight index, of winter skate collected during four NEAMAP survey cruises. The number of fish sampled for diet is given by  $n_{fish}$ , while  $n_{clusters}$  indicates the number of clusters of skate sampled.





# Appendix I

Northeast Area Monitoring and Assessment Program (NEAMAP)

Mid-Atlantic Nearshore Trawl Program

Pilot Survey Completion Report



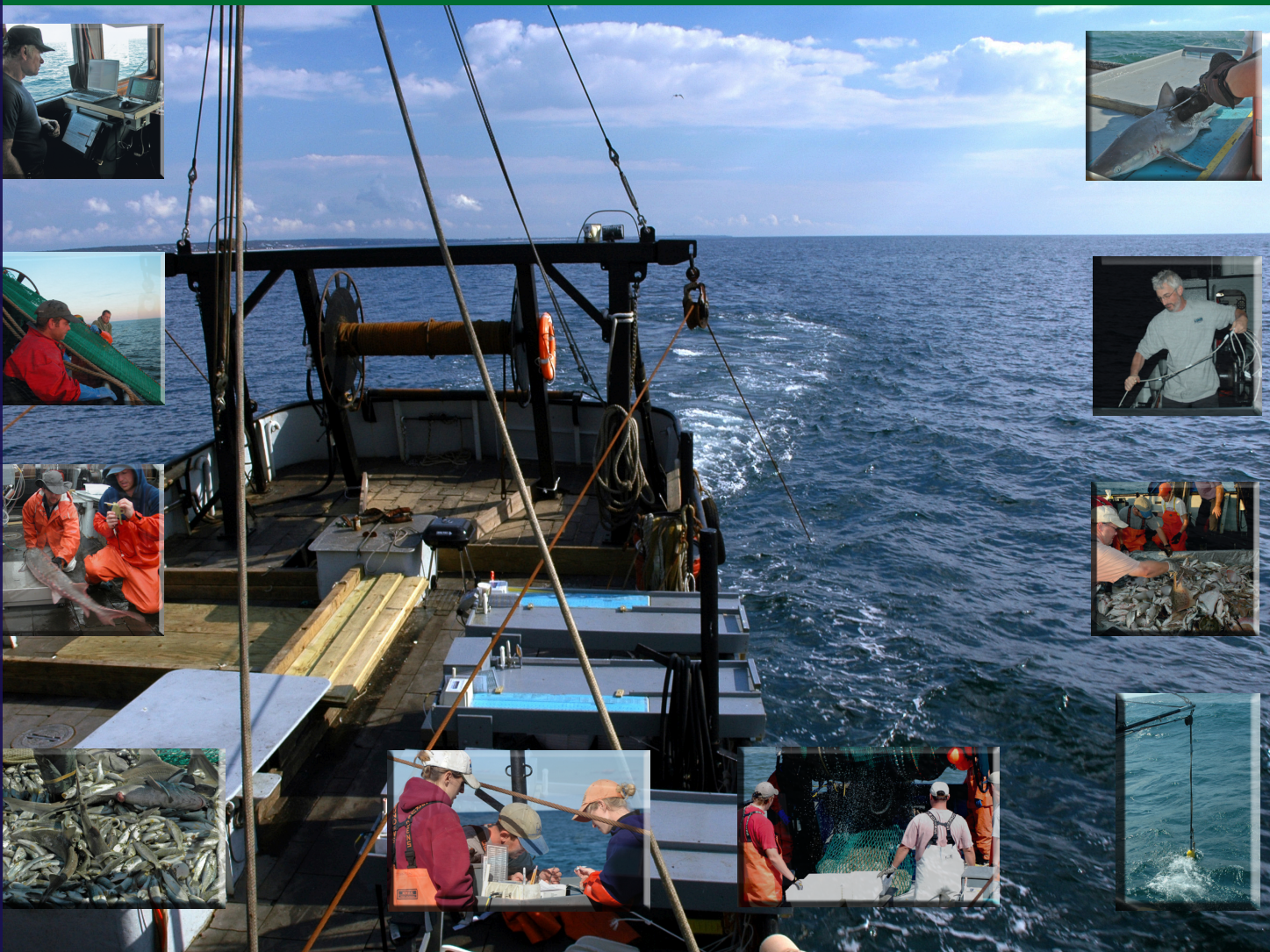




# NEAMAP Pilot Survey Final Report

March 2007

Christopher F. Bonzek, James Gartland, Robert J. Latour



## NEAMAP ASMFC Progress Report

- I. **Project Title:** Data collection and analysis in support of multispecies stock assessments in the mid-Atlantic: Northeast Area Monitoring and Assessment Program Nearshore Trawl Program.
- II. **Grantee State and Contact Name:** Virginia/Virginia Institute of Marine Science – Christopher F. Bonzek, James Gartland, Robert J. Latour
- III. **Project Period:** 1 August 2005 – 31 December 2006  
**Reporting Period:** 31 July 2006 – 31 January 2007
- IV. **Project Description:** This is a pilot study for a new fisheries-independent bottom trawl survey operating in the near coastal ocean waters of the Mid-Atlantic region. The survey is an element of the ASMFC Northeast Area Monitoring and Assessment Program (NEAMAP) and is designed to sample fishes and invertebrates from coastal waters (approximately 20-90 feet) between Montauk, New York and Cape Hatteras, North Carolina using a bottom trawl. The main objective of the survey is the estimation of biomass, length and age structures, and diet compositions of finfishes and select invertebrates inhabiting the area.
- V. **Project Summary/Accomplishments:** The pilot survey was successfully completed during a research cruise between the dates of 25 September through 15 October 2006. A total of 98 stations were sampled, compared to the anticipated number of 100. About 432,000 individual fish weighing almost 19,000kg and representing 114 species (including selected invertebrates which were processed similarly to fishes). Almost 63,000 specimens were individually measured. Lab processing is proceeding on the 3,630 otoliths and 2,903 stomach samples which were saved (622 otoliths and 971 stomachs have been fully processed as of the date of this report). A full report is attached to this standard project summary.
- VI. **Challenges/Changes:** Beyond completion of laboratory samples, no significant challenges remain for this contract segment.
- VII. **Participants:** Program personnel remain unchanged.
- VIII. **Quality Assurance:** Previous progress reports provided brief descriptions of quality assurance procedures in selecting fishing gear, conducting fishing operations, and processing the catch. These are interwoven into the attached report as well. Data collected during the survey have been processed through several data quality checks which were previously developed for other survey work and new checks developed specifically for NEAMAP.
- IX. **Funding Status:** A small balance (~\$5,000) remains in this project account. Those funds will be used in continued processing of samples prior to the project completion date.

**X. Future Activities:** The future of this program is dependent upon continued funding. We are awaiting instruction from ASMFC before we finalize plans for the next project segment.

**XI. Presentations/Public Outreach:** Since completion of field sampling on 15 October, presentations of survey results have been (or will be) made as follows:

- November 2006: NEAMAP Board
- December 2006: NMFS NEFSC Trawl Advisory Panel
- January 2007: NEAMAP Operations Committee
- January 2007: ASMFC Policy Board
- February 2007: New England Fishery Management Council
- February 2007: Mid-Atlantic Fishery Management Council

Northeast Area Monitoring and Assessment Program (NEAMAP)

Mid-Atlantic Nearshore Trawl Program

Pilot Survey Completion Report

31 January 2007

Submitted to:

Atlantic States Marine Fisheries Commission  
Washington, DC

By:

Christopher F. Bonzek  
James Gartland  
Robert J. Latour, Ph.D.

Department of Fisheries Science  
Virginia Institute of Marine Science  
College of William and Mary  
Gloucester Point, VA



## Introduction

Concerns regarding the status of fishery-independent data collection from the continental shelf waters between Cape Hatteras, North Carolina and the U.S. / Canadian border led the Atlantic States Marine Fisheries Commission's (ASMFC) Management and Science Committee (MSC) to draft a resolution in 1997 calling for the formation the Northeast Area Monitoring and Assessment Program (NEAMAP) (ASMFC 2002). NEAMAP is a cooperative state-federal program modeled after the Southeast Area Monitoring and Assessment Program (SEAMAP), which had been coordinating fishery-independent data collection south of Cape Hatteras since the mid-1980s (Rester 2001). The four main goals of this new program directly address the deficiencies noted by the MSC for this region and include 1) developing fishery-independent surveys where current sampling is either inadequate or absent 2) coordinating data collection amongst existing surveys as well as any new surveys 3) providing for efficient management and dissemination of data and 4) establishing outreach programs (ASMFC 2002). The NEAMAP Memorandum of Understanding was signed by all partner agencies by July 2004.

One of the first major efforts of the NEAMAP was to design a trawl survey intended to operate in the coastal zone of the Middle Atlantic Bight (MAB - i.e., Montauk, New York to Cape Hatteras, North Carolina). While the National Marine Fisheries Service (NMFS) Northeast Fisheries Science Center's (NEFSC) bottom trawl survey has been sampling from Cape Hatteras to the U.S. / Canadian border in waters less than 91.4m since 1963, few stations are sampled in waters less than 27.4m due to the size of the sampling area and vessels (NEFSC 1988, R. Brown, NMFS, pers. comm). Further, NMFS plans to take delivery on a new, larger vessel in 2007, meaning that sampling intensity in these coastal waters will decline further, while waters less than 18.3m may no longer be sampled (R. Brown, NMFS, pers. comm.). In addition, of the six coastal states in the MAB, only New Jersey conducts a fishery-independent trawl survey in its coastal zone (Byrne 2004). This new NEAMAP Inshore Trawl Survey is intended to fill the aforementioned gap in fishery-independent survey coverage, which is consistent with the program goals.

In early 2005, the ASMFC made \$250,000 of "plus-up" funds that it had received from the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) available for some small-scale pilot work in an effort to assess the viability of the NEAMAP Inshore Trawl Survey. The Virginia Institute of Marine Science provided the sole response to the Commission's request for proposals and was awarded the funding in August 2005. This document summarizes the results of the 2006 NEAMAP Inshore Trawl Survey pilot work conducted by VIMS.

## Methods

### *Gear Performance – Pre-Pilot Cruise*

On 9-10 May 2006, a pre-pilot cruise was completed aboard the *F/V Darana R* using the 4-seam 3-bridle bottom trawl developed by the NMFS Trawl Advisory Panel (hereafter called the NEAMAP net) and size 66 Type IV Thyboron trawl doors. Prior to this cruise, this combination of net and doors had yet to be tested in the field. Previously, NMFS had tested several door types, all of which tended to overspread the net (compared to design specifications and to

parameters determined to be ideal during previous flume tank testing). This short pre-pilot cruise was considered necessary for several reasons:

- To provide an opportunity for the vessel crew and scientific crew to begin operating as a cooperative single unit.
- To assure that the various electronics could be deployed correctly and would operate satisfactorily.
- To assure that the net-door-vessel combination produced satisfactory gear performance.
- To test the reaction of the gear to changes in settings and fishing conditions (e.g. varying speeds, scopes, depths, and tow directions) to establish parameter standards for the full pilot cruise.
- To allow the vessel crew to become familiar with deployment and retrieval of the gear.
- To provide the scientific crew with estimates of average catch rates which would aid in preparing for the full pilot cruise.
- To provide the science crew the opportunity to practice workup procedures and to test the layout of workstations.

#### *Gear Performance – NMFS-NEAMAP Joint Cruise*

Subsequent to the Pre-Pilot cruise it was determined that the choice of size 66 Thyboron Type IV trawl doors was appropriate for the NEAMAP net in the inshore zone of the Middle Atlantic Bight. However, it was uncertain whether the desired net parameters achieved during the cruise could have resulted from measurement difference between *Netmind* net measurement gear used by VIMS and the *Scanmar* equipment employed by NMFS in previous cruises.

A second two-day cruise was arranged during which both Netmind and Scanmar gear would measure gear performance. This cruise occurred on 29-30 June 2006 and representatives from both VIMS and the NEFSC participated. NMFS net monitoring apparatus measured door spread in addition to wingspread and headrope height. For several tows, Netmind and Scanmar gear was interchanged and the net was fished under similar conditions. Eventually, it was determined that the two systems did not interfere with one another so both sets of equipment were mounted simultaneously. For the final several tows both systems were employed, however, equipment malfunctions and computer crashes resulted in a small amount of data loss from one system or the other on some tows.

#### *Gear Performance – Pilot Cruise*

Wingspread and headrope height were measured on each tow during the pilot cruise using the VIMS Netmind system. Wingspread sensors were positioned on the middle net ‘jib’ in accordance with NFMS procedures. The headrope sensor was mounted at the midpoint of the headrope. A catch sensor was mounted in the cod-end, set to signal when the catch reached roughly 2,000lbs. Along with recording the net parameters every 10 to 20 seconds (with the various sensors reporting at different times) the Netmind software records GPS coordinates and vessel speed at the reporting rate of the GPS unit (every two seconds in the present case) which gives the ability to later plot tow tracks for each station. The same computer used to record Netmind readings was also employed to plot station locations (and the corners of each sampling cell) and to run the countdown clock for each tow.

### *Station Selection*

Primary consideration in regards to survey stratification was consistency with the NMFS bottom trawl surveys. However, those surveys will be redesigned and restratified for 2008 and so restratification for the inshore NEAMAP areas was open for consideration as well.

Examination of existing strata revealed that the major divisions among survey areas (latitudinal divisions from New Jersey to the south, longitudinal divisions off Long Island) generally corresponded well with major estuarine outflow areas. Therefore these boundary definitions, with minor modifications so that regional boundaries would more closely correspond to state borders, were used for the NEAMAP pilot survey. However, examination of the current NMFS depth stratum definitions reveals that in some areas (primarily off the southern states) current stratum boundaries do not correspond well to actual depth contours. Depth stratum assignments were redrawn using depth sounding data from the National Ocean Service using depth strata 20ft.-40ft., 40ft.-60ft., and 60ft.-90ft. Finally, each stratum was subdivided into a grid pattern of potential sampling locations, with each cell measuring 1.5 x 1.5 minutes.

The number of stations (cells) selected for each region was assigned by proportional sampling according to surface area within a region. Within each region, the number of stations selected in each depth stratum was equal. This method assured that shallow areas, where there was little surface area, would be sufficiently sampled.

### *Species Priority Lists*

During preparations for the survey, the NEAMAP Operations Committee developed a set of species priority lists. Priority 'A' species were to be subjected to full processing (see *Procedures at Each Station* below) at every station. Priority 'B' species were to be fully processed as time allowed. Priority 'C' species would only be fully processed if handling of A and B species would not be affected. These three categories might be summarized as 'must have' 'great to have' and 'nice to have.' All other species (here called Priority 'D') were to have gross weights recorded and all or a significant subsample to be measured. A fifth category ('E') was later defined, including species which required special handling. This category included sharks (other than dogfish) turtles, and sturgeon, which were measured, tagged, and released; and selected invertebrates which were processed similarly to Priority D fish species. Species included categories A-C are presented below (Table 1).



Table 1. Species priority lists (categories A-C only).

A LIST	
Black Sea Bass	<i>Centropristis striata</i>
Scup	<i>Stenotomus chrysops</i>
Bluefish	<i>Pomatomus saltatrix</i>
Striped Bass	<i>Morone americana</i>
Weakfish	<i>Cynoscion regalis</i>
Summer Flounder	<i>Paralichthys dentatus</i>
Winter Flounder	<i>Pleuronectes americanus</i>
B LIST	
American Shad	<i>Alosa sapidissima</i>
Atlantic Menhaden	<i>Brevoortia tyrannus</i>
Atlantic Croaker	<i>Micropogonias undulatus</i>
Spot	<i>Leiostomus xanthurus</i>
Monkfish	<i>Lophius americanus</i>
Yellowtail Flounder	<i>Limanda ferruginea</i>
Smooth Dogfish	<i>Mustelus canis</i>
Spiny Dogfish	<i>Squalus acanthias</i>
Skate and Ray Species	
C LIST	
Alewife	<i>Alosa pseudoharengus</i>
Atlantic Herring	<i>Clupea harengus</i>
Blueback Herring	<i>Alosa aestivalis</i>
Atlantic Mackerel	<i>Scomber scombrus</i>
Black Drum	<i>Pogonias cromis</i>
Red Drum	<i>Sciaenops ocellatus</i>
Speckled Trout	<i>Cynoscion nebulosus</i>
Tautog	<i>Tautoga onitis</i>

### *Procedures at Each Station*

All fishing operations were conducted during daylight hours. Each tow was 20 minutes in duration with a target tow speed of between 2.9 and 3.3 knots. No tows were truncated due to known hangs in the tow path, surface traffic etc.

At each station several standard parameters were recorded. These included:

- All necessary station identification parameters (date, station number, stratum, depth).
- All necessary vessel operation parameters (beginning and ending GPS position, beginning and ending tow times, compass course, engine RPMs).
- All necessary gear identification and operational parameters (net type code and net number, door type code and door numbers, amount of cable deployed).
- Atmospheric and weather data (air temperature, wind speed, wind direction, general weather state, sea state, barometric pressure).
- Hydrographic data at the surface and at the bottom (water temperature, salinity, and dissolved oxygen).

Upon arrival near a sampling cell, the Captain and Chief Scientist jointly determined the desired starting point and tow path. Flexibility was allowed with regard to these parameters such that a clear tow could be accomplished while staying within the cell boundaries and the defined cell depth stratum.

Hydrographic data were taken prior to the beginning of each tow, except rarely when taking these readings would have delayed the tow until after sunset; in these cases hydrographic data were recorded at the completion of the tow.

Vessel crew was responsible for all aspects of deployment and retrieval of the fishing gear. Due to the relatively shallow waters, 50fm. of warp was set out at all stations. One scientist was present in the wheelhouse during deployment and retrieval. The Captain signaled when the gear was fully set, at which time the Netmind software and the countdown clock were both activated. At the conclusion of each tow, the scientist signaled the Captain when the clock reached zero, at which time retrieval commenced and the Netmind recording software was stopped. Vessel crew dumped the catch into one of two enclosed locations on deck.

The catch was sorted by species and modal size group. Biomass (kg) was measured for each species-size group combination. For priority A species, and often for priority B species, a subsample from each group was selected for complete processing. At first, a species-size subsample of ten individuals per species-size class group per tow was implemented. After several stations, this number was reduced to five specimens with full stomachs, and later still for extremely common species, to three. Previous experience showed that these sampling rates would likely result in an adequate number of specimens overall, especially in consideration of the fact that in such survey work, the sampling unit is the station, not the individual specimen, and sampling large numbers of individuals at each station is not informative. These changes allowed full processing to occur for several priority B species.

Data collected from each subsampled specimen included length (to the nearest millimeter), total and eviscerated weight (measured in grams, accuracy depended upon the balance on which individuals were measured), and macroscopic sex and maturity stage (mature, immature, unknown) determination. Stomachs were removed and those containing prey items were preserved for subsequent examination. Otoliths or other appropriate ageing structures were removed from each subsampled specimen for age determination. All specimens not selected for the complete processing were enumerated, and either all or a large proportion will be measured for length, in accordance with approved subsampling procedures when necessary.

#### *Laboratory Methods*

Otoliths (or, depending upon the species, other appropriate ageing structures) were (and are being) prepared according to methodology established for other VIMS surveys. One otolith was selected and mounted on a piece of 100 weight paper with a thin layer of *Crystal Bond*. A thin transverse section was cut through the nucleus of the otolith using two *Buehler* diamond wafering blades and a low speed *Isomet* saw. The section was then mounted on a glass slide and covered with *Crystal Bond*. If necessary, the section was wet-sanded to an appropriate thickness before being covered with *Crystal Bond*. Some smaller, fragile otoliths were read whole. Both

sectioned and whole otoliths were most commonly read using transmitted light under a dissecting microscope. Age was determined as the mode of the three readings.

Stomach samples were (and are being) analyzed according to standard procedures (Hyslop 1980). Prey were identified to the lowest possible taxon. Experienced laboratory personnel are able to process, on average, approximately 30 to 40 stomachs per person per day.

#### *Analytical Methods (Abundance)*

Estimates of abundance are expressed in terms of minimum trawlable number or biomass according to the formula:

$$N = \frac{cA}{a}, \quad (2)$$

where N is the smallest number (or biomass) of fish present within the sampling area that are susceptible to the sampling gear, c is the mean number (or weight) of fish captured per tow, a is the area swept by one trawl tow, and A is the total survey area. These estimates represent the smallest number (or biomass) of fish present within the sampling area that are susceptible to the sampling gear.

This method produces estimates of abundance for each stratum, which are totaled to produce estimates for the entire survey area. As regional stratum boundaries were drawn to generally correspond with state borders, estimates of abundance (and certain other stock parameters) can be produced on a state-specific basis. While usually not biologically meaningful, for some parameters it was considered worthwhile to present results in this way due to the potential usefulness for fishery managers.

#### *Analytical Methods (Sex Ratios)*

Sex ratios were determined by summation of data from fully processed specimens. For this and several other stock parameters, data from fully processed specimens are expanded to the entire sample for parameter estimation. That is because workup procedures result in differential subsampling rates among size groups and failure to account for such factors would bias resulting stock parameter estimates. In the NEAMAP database each specimen has a calculated expansion factor associated with it which represents the number of fish that the specimen represents in the total sample for that station.

#### *Analytical Methods (Length Frequency)*

Length frequency histograms were designed using 10mm bins and the expansion factors as previously described. Length bins were identified using the bin midpoint (e.g. the 250mm bin represents individuals between 245mm and 254mm).

#### *Analytical Methods (Length-Weight Regressions)*

Power regressions for length-weight relationships were calculated and plotted for sexes combined and separately. No tests for differences in growth by sex were performed. No expansion factors were used in these calculations as they do not depend on subsampling rates.

#### *Analytical Methods (Maturity Regressions)*

Logistic regressions were calculated and plotted separately for males and females. No expansion factors were used in these calculations as they do not depend on subsampling rates.

#### *Analytical Methods (Diets)*

Diets for each species were determined by estimating the mean proportional contribution of prey type ( $k$ ) to predator ( $x$ ) by weight or number ( $W_{k,x}$ ) using the following equation:

$$W_{k,x} = \frac{\sum_{i=1}^n M_{i,x} q_{i,k,x}}{\sum_{i=1}^n M_{i,x}}, \quad (1)$$

where

$$q_{i,k,x} = \frac{w_{i,k,x}}{w_{i,x}}, \quad (2)$$

where  $M_{i,x}$  is the number of predator  $x$  captured at station  $i$ ,  $w_{i,k,x}$  is the total weight (or number) of prey type  $k$  encountered in the stomachs of predator  $x$  collected at station  $i$ , and  $w_{i,x}$  is the total weight (or number) of all prey items encountered in these stomachs (Buckel et al. 1999). This cluster sampling estimator was used since trawl collections yield a cluster of each predator at each station.

## **Results**

#### *Gear Performance – Pre-Pilot Cruise*

The pre-pilot cruise was successful in all respects. A total of 11 tows were completed under a variety of fishing conditions and the net performed to design specifications. Vessel speeds of 3.0-3.3 knots and relatively short scope ratios were determined to be the target parameters (Figure 1), though the shallow waters in which the NEAMAP survey is prosecuted virtually assure that the net will be ‘over-scoped’ compared to the 2.5:1-3:1 standard.

Further, it was determined that catch rates for a 20-minute tow were within the expected range and should provide the science crew with adequate numbers of specimens while allowing time to sample at 5-8 stations per day.

#### *Gear Performance – NMFS-NEAMAP Joint Cruise*

Simultaneous measurement of net opening by both Netmind and Scanmar monitoring gear resulted in similar dimension reports by both systems (Figure 2). The Scanmar equipment generally gave slightly smaller readings, but probably not significantly so. As a result of the two

pre-pilot cruises, NMFS determined that the Thyboron doors were an appropriate choice for initial trials aboard the *FSV Bigelow*.

#### *Gear Performance – Pilot Cruise*

Due to lessons learned during the pre-pilot cruises and during prior use on other surveys, the gear performed flawlessly and measurements were obtained for every tow. Further, due to the expertise of the Captain and crew, not a single mesh was broken during the entire cruise.

A sample wheelhouse computer ‘screenshot’ with the Netmind software (with no actual Netmind data plotted), charting software (with a sampling cell boundaries) and countdown clock is shown (Figure 3).

Within-tow tow-tracks and Netmind data for a straight tow (Figure 4) and a tow with a hard turn (Figure 5) are presented. Under both circumstances the gear is seen to consistently maintain the desired net openings of approximately 13m width and 5m height (random odd readings seen in both plots are edited out before calculation of average measurements for each tow).

Net opening and vessel speed averages for each tow were consistent (Figure 6A). As stations were generally both numbered and occupied from north-to-south, the order presented (x-axis) by and large is the order in which stations were completed. A slight increasing, and unexplained, trend is apparent in net width measurements. To test net performance and catch rate, one station (number 202) was executed at 3.8kt for 30 minutes (the current NMFS standard tow parameters). Both the net opening and the magnitude of catch were still within acceptable bounds.

As vessel speed during each tow was generally consistent and tow direction in relation to the current was random, tow distance and area swept were both relatively constant (Figure 6B). Notably, both parameters were nearly doubled during the tow fished at current NMFS standard speed and duration.

#### *Stations Sampled*

Compared to the goal of occupying 100 stations during the pilot cruise, 98 stations were actually sampled. This represented an average of about 6 stations per day-at-sea, though several whole or partial days were spent in transit. On days which were spent mostly or entirely conducting fishing operations, an average of a little fewer than 8 stations per day were sampled. Day-by-day vessel activities and work schedules are presented (Table 2).

Several stations in Regions 2-5 (Long Island and New York Harbor areas) in the shallow strata could not be sampled due to numerous underwater obstructions. As there were very few of these stations available in the sampling frame, no suitable alternate locations could be sampled. This may affect plans for sampling in those strata in future NEAMAP cruises. Maps comparing selected and actual stations are shown (Figure 7).

#### *Magnitude of Catch*

A major concern prior to the pilot cruise was whether the large and efficient net, coupled with a relatively small crew, would overwhelm the ability to process the catch quickly enough to accomplish the expected number of stations per day. While catches were large compared to the

previous experience of the VIMS crew, they were within the range for which the group was prepared (Figure 8). A large majority (75%) of tows caught less than 225kg and 85% of tows captured 6,000 or fewer individual fish.

Because a large portion of the time at each station is spent separating specimens by species and size group, the species-size diversity of each tow is as important as the simple magnitude of the catch. Between 1 and 46 (median 21) species and 1 and 52 (median 21) species-size classes were captured at each station (Figure 9). Due to the relatively small number of priority species defined by the NEAMAP Operations Committee for full processing (see below) this level of diversity was within acceptable bounds. For each species, the total number and biomass, the number of specimens measured, and the number of otoliths and stomachs saved for processing are shown (Table 3).

### *Species Data Summaries*

Several graphical data summaries are shown for each species (Figures 10-108). Species are organized alphabetically within priority group.

For priority A species, most or all of the following figures are presented:

- Distribution maps showing catch ranges by number and biomass for all stations.
- Bar graphs showing the minimum trawlable number (MTN) and biomass (MTB) by state, annotated with estimates of the overall MTN and MTB and percent standard error for each.
- Histograms of sex ratio by state, annotated with the number of specimens examined.
- Length-frequency histograms annotated with the total number of specimens captured and measured and the number of otoliths removed for processing.
- Age distribution graphs shown with the total number of specimens by age if all specimens had been aged. Note that when this figure is present, the number of otoliths read is presented here rather than in the length-frequency figure. Note as well that only weakfish ageing has been completed as of the date of this report. Future updates will include age distribution figures for other species.
- Length-weight power regressions for sexes combined and separately.
- Logistic regressions for maturity, by sex, annotated with sizes at 50% and 99% maturity.
- Diet compositions by weight and number, with prey types separated into broad taxonomic groups, annotated with the number of stomachs analyzed.

These data summaries are numbered as follows:

- Black seabass – Figures 10-19.
- Bluefish – Figures 20-29.
- Scup – Figures 30-37.
- Striped bass – Figures 38-43.
- Summer flounder – Figures 44-53.
- Weakfish – Figures 54-64.
- Winter flounder – Figures 65-70.

For priority A species, at the time of report preparation, all stomachs have been analyzed and data summaries provided except for scup. As noted previously, ageing only for weakfish has been completed.

For priority B species, some or all of the following data summaries are presented:

- Distribution maps showing catch ranges by number and biomass for all stations.
- Bar graphs showing the MTN and MTB by state, annotated with estimates of the overall MTN and MTB and percent standard error for each.
- Histograms of sex ratio by state, annotated with the number of specimens examined.
- Length-frequency histograms annotated with the total number of specimens captured and measured and the number of otoliths (or vertebrae for elasmobranchs) removed for processing.
- Length-weight power regressions for sexes combined and separately.
- Logistic regressions for maturity, by sex, annotated with sizes at 50% and 99% maturity.

These data summaries are numbered as follows:

- Atlantic croaker – Figures 71-78.
- Bullnose ray – Figures 79-86.
- Clearnose skate – Figures 87-94.
- Smooth dogfish – Figures 95-100.

Several other species were captured in significant numbers as well. Data summaries for these species that are shown are:

- Distribution maps showing catch ranges by number and biomass for all stations.
- Bar graphs showing the MTN and MTB by state, annotated with estimates of the overall MTN and MTB and percent standard error for each.
- Length-frequency histograms annotated with the total number of specimens captured and measured.

These data summaries are numbered as follows:

- Butterfish – Figures 101-103.
- Silver perch – Figures 104-106.
- Southern kingfish – Figures 107-109.
- Striped anchovy – Figures 110-112.

Finally, three invertebrate species (or species groups) were captured in large enough numbers to be of note. Data summaries for these species that are shown are:

- Distribution maps showing catch ranges by number and biomass for all stations.
- Bar graphs showing the MTN and MTB by state, annotated with estimates of the overall MTN and MTB and percent standard error for each.
- Histograms of sex ratio by state, annotated with the number of specimens examined (horseshoe crab only).
- Length-frequency histograms annotated with the total number of specimens captured and measured.
- Length-weight power regressions for sexes combined and separately (horseshoe crab only).

These data summaries are numbered as follows:

- Horseshoe crab – Figures 113-118.
- Squid (all species combined) – Figures 119-121.
- Penaeid shrimp (all species combined) – Figures 122-124.

## Literature Cited

- Atlantic States Marine Fisheries Commission (ASMFC). 2002. Development of a Cooperative State/Federal Fisheries Independent Sampling Program. ASMFC Document, Washington, DC.
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<<http://www.state.nj.us/dep/fgw/artoceancount.htm>>
- Hyslop, E. J. 1980. Stomach contents analysis – a review of methods and their application. *Journal of Fish Biology* 17:411-429.
- NEFC. 1988. An evaluation of the bottom trawl survey program of the Northeast Fisheries Center. *NOAA Tech. Memo.* NMFS-F/NEC-52, p. 83.
- Rester, J.K. 2001. Annual report to the Technical Coordinating Committee Gulf States Marine Fisheries Commission. Report of the Southeast Area Monitoring and Assessment Program (SEAMAP) to the Gulf States Marine Fisheries Commission, Ocean Springs, Mississippi.



Table 2. Summary of activities conducted during each day at sea during the NEAMAP pilot cruise.

Hours worked and stations sampled each day.																								
Date	Time of Day																							
	12:00 AM						6:00 AM							12:00 PM									6:00 PM	
25-Sep	Steaming Day - Hampton-Montauk																							0 Stations
26-Sep	Steaming Day - Hampton-Montauk																							0 Stations
27-Sep																								6 Stations
28-Sep																								9 Stations
29-Sep																								8 Stations
30-Sep																								9 Stations
1-Oct	Crew Change Day																							Cape May, NJ
2-Oct	Refuel/Rewater/Steam to Station																							4 Stations
3-Oct	One Station After Dark																							8 Stations
4-Oct																								8 Stations
5-Oct																								8 Stations
6-Oct																								2 Stations
7-Oct	High Winds																							
8-Oct	High Winds																							
9-Oct	High Winds																							
10-Oct	Steam to Stations																							3 Stations
11-Oct																								7 Stations
12-Oct																								8 Stations
13-Oct	No Fishing																							
14-Oct																								7 Stations
15-Oct																								6 Stations

Table 3. Number of specimens captured and measured and number of otoliths and stomachs sampled, by species priority level.

Priority A Species					
Species	Total Number Caught	Total Species Weight (kg)	Number Measured	Number of Otoliths	Number of Stomachs
black seabass	48	10	48	40	32
bluefish	6,206	282	2,143	562	383
scup	55,889	1,417	7,635	668	578
striped bass	17	55	17	17	14
summer flounder	494	203	389	278	141
weakfish	30,826	2,328	4,783	494	366
winter flounder	22	9	22	17	7
Priority B Species					
Species	Total Number Caught	Total Species Weight (kg)	Number Measured	Number of Otoliths	Number of Stomachs
Atlantic croaker	26,426	2,206	2,891	275	240
Atlantic menhaden	55	11	55	27	27
Atlantic stingray	9	4	9	4	4
bluntnose stingray	72	224	72	57	50
bullnose ray	430	1,133	313	126	120
clearnose skate	708	802	708	297	286
cownose ray	60	119	60	33	23
little skate	1,815	1,106	1,690	165	160
rosette skate	5	3	5		
rougtail stingray	35	199	35	31	29
smooth butterfly ray	147	164	147	70	51
smooth dogfish	653	495	653	182	179
southern stingray	1	14	1	1	1
spiny butterfly ray	38	436	38	23	20
spot	19,829	1,354	2,345	228	158
winter skate	82	50	82	9	8
Priority C Species					
Species	Total Number Caught	Total Species Weight (kg)	Number Measured	Number of Otoliths	Number of Stomachs
alewife	6	0	6		
Atlantic herring	10	0	10	4	4
black drum	11	11	11	1	1
blueback herring	23	1	23	1	1
red drum	5	66	5		
spotted seatrout	6	1	6		
tautog	78	75	78	20	20

continued

Table 3. cont..

Species	Total Number Caught	Total Species Weight (kg)	Number Measured	Number of Otoliths	Number of Stomachs
Atlantic cutlassfish	377	11	375		
Atlantic moonfish	3,766	29	1,211		
Atlantic spadefish	86	3	86		
Atlantic sturgeon	2	23	2		
Atlantic thread herring	187	9	186		
Atlantic threadfin	2	0	2		
banded drum	1,154	25	574		
barrelfish	1	0	1		
bay anchovy	33,503	79	3,700		
bigeye scad	36	1	36		
blackcheek tonguefish	21	1	21		
blue runner	82	5	82		
bluespotted cornetfish	1	0	1		
butterfish	114,532	2,248	10,433		
cobia	2	0	2		
crevalle jack	19	2	19		
cunner	3	0	3		
dwarf goatfish	7	0	7		
Etropus sp.	8	0	8		
Florida pompano	3	1	3		
fourspot flounder	1	0	1		
gag	2	0	2		
guaguanche	1	0	1		
gulf kingfish	3	1	3		
harvestfish	765	42	210		
hickory shad	13	3	13		
hogchoker	77	7	77		
inshore lizardfish	149	15	149		
jellyfish spp		150			
king mackerel	2	0	2		
kingfish spp	628	110	150		
lined seahorse	25	0	5		
lookdown	2	0	2		
mackerel scad	1	0	1		
mantis shrimp	6	0	6		
northern kingfish	405	75	405		
northern pipefish	1	0	1		
northern puffer	73	4	72		
northern searobin	470	59	469		
northern sennet	65	4	65		
northern stargazer	14	12	14		

continued

Table 3. cont.

Priority D Species (continued)					
Species	Total Number Caught	Total Species Weight (kg)	Number Measured	Number of Otoliths	Number of Stomachs
pigfish	944	39	466		
pinfish	21	1	21		
planehead filefish	3	0	3		
red hake	2	0	2		
rock seabass	1	0	1		
rough scad	317	7	291		
round herring	120	3	110		
round scad	91	1	86		
sea bass spp	1	0	1		
sheepshead	10	39	10		
short bigeye	4	0	4		
silver anchovy	541	3	224		
silver hake (whiting)	228	1	188		
silver jenny	4	0	4		
silver perch	9,060	349	1,932		
silver seatrout	2	0	2		
smallmouth flounder	12	0	12		
southern kingfish	1,778	252	961		
Spanish mackerel	22	4	22		
Spanish sardine	14	1	14		
spotfin mojarra	4	0	4		
spotted hake	366	49	360		
star drum	1	0	1		
striped anchovy	47,714	582	3,983		
striped burrfish	42	14	42		
striped cusk-eel	21	1	21		
striped searobin	347	77	347		
white hake	1	0	1		
windowpane	590	92	541		

continued

Table 3. cont.

Priority E Species					
Species	Total Number Caught	Total Species Weight (kg)	Number Measured	Number of Otoliths	Number of Stomachs
American lobster	11	4	11		
Atlantic angel shark	4	22	4		
Atlantic sharpnose shark	20	83	20		
blue crab, adult female	12	1	12		
brief squid	208	2	188		
brown shrimp	757	17	569		
green turtle	1		1		
horseshoe crab	380	546	361		
loggerhead turtle	2		2		
pink shrimp	56	1	56		
sand tiger shark	4	139	4		
sandbar shark	22	75	22		
squid spp	68,135	816	9,048		
thresher shark	2	49	2		
white shrimp	408	11	299		
<b>Total</b>	<b>432,784</b>	<b>18,981</b>	<b>62,933</b>	<b>3,630</b>	<b>2,903</b>

Figure 1. Sample within-tow variability of net height and width at varying speeds as measured during the pre-pilot cruise.

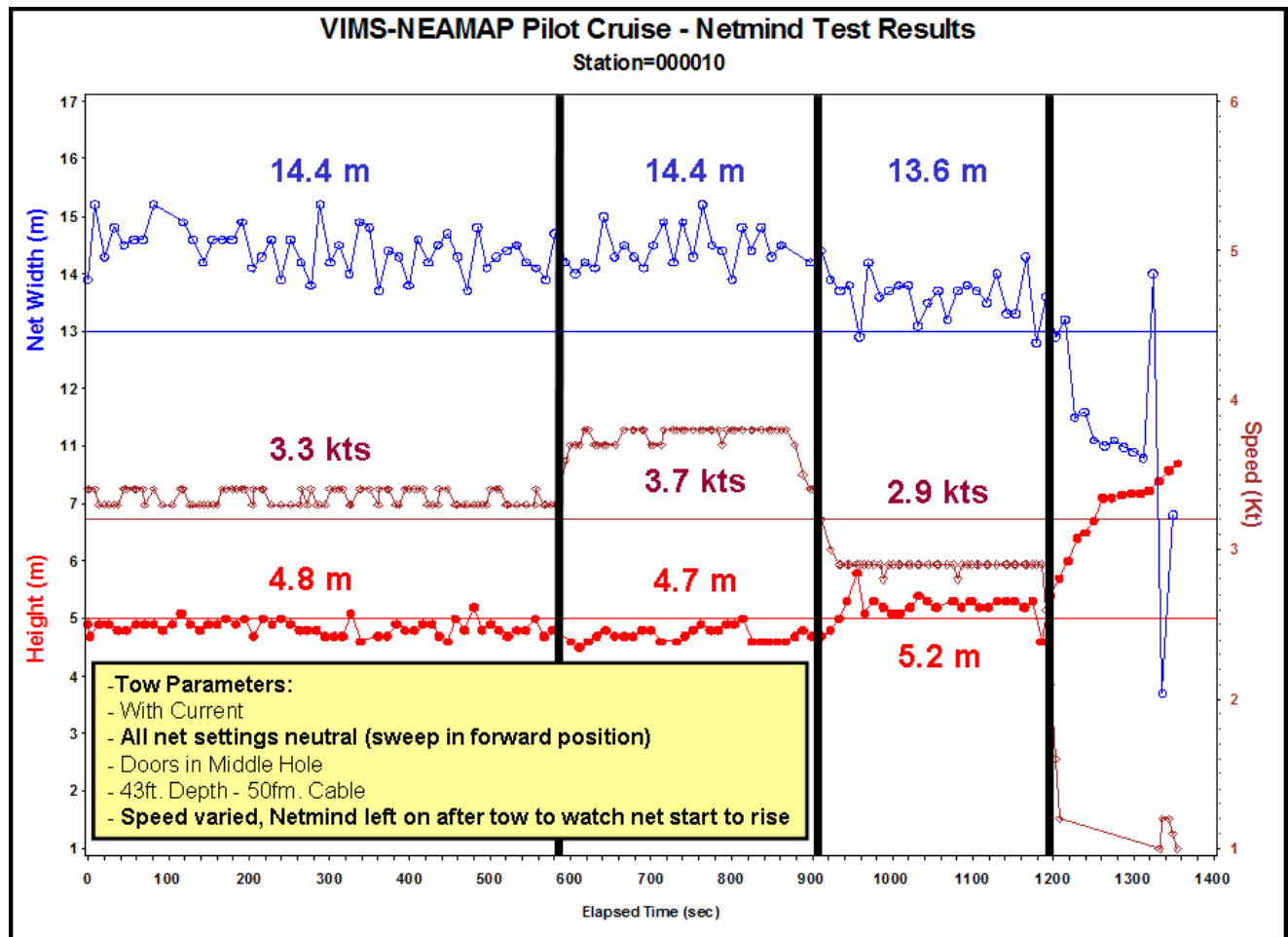
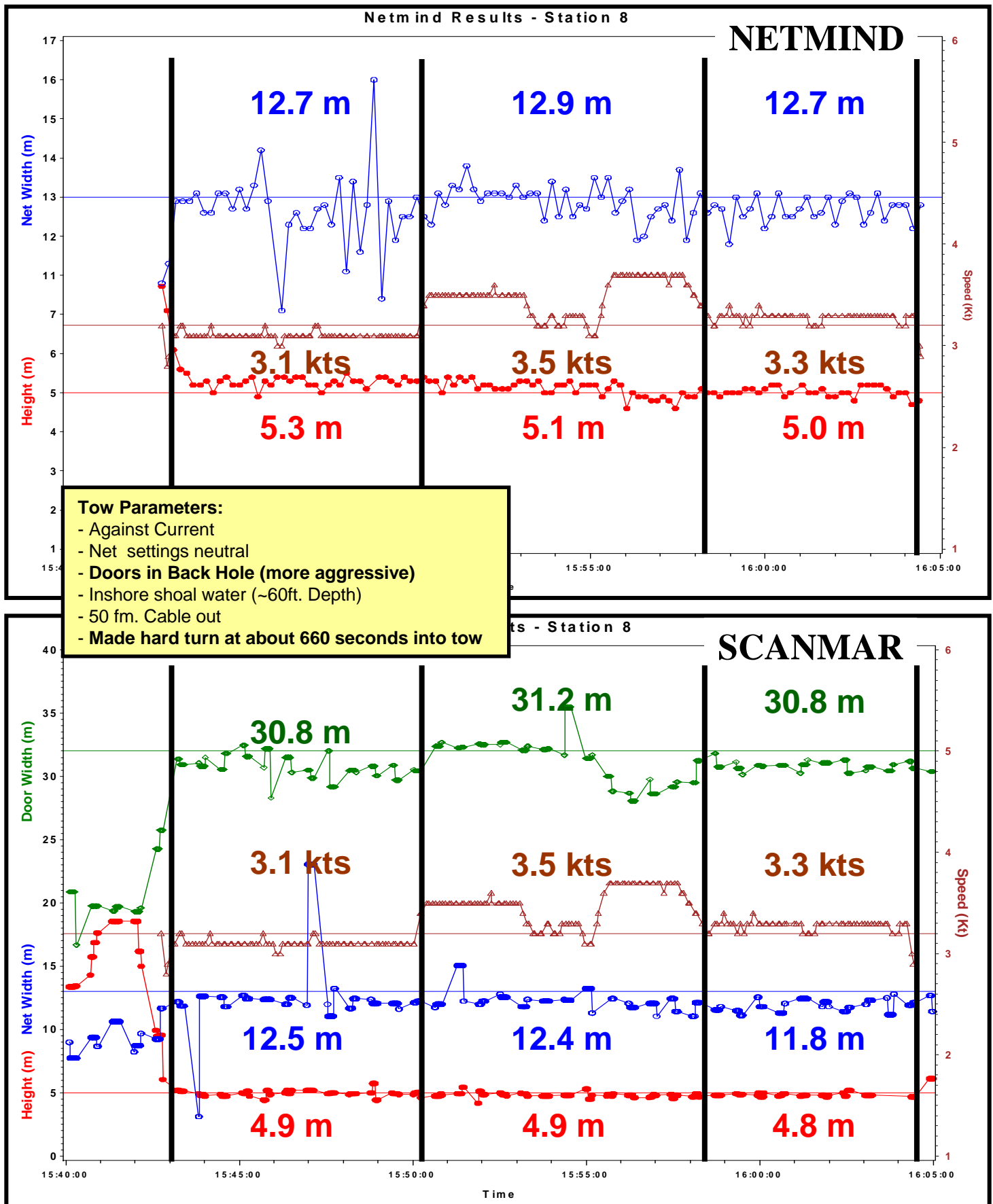


Figure 2. Sample within-tow variability of net height and width at varying speeds as measured during the NEAMAP-NMFS joint cruise.



Note: Vessel speed data taken with Netmind gear but plotted with Scanmar data for ease of interpretation.

Figure 3. Sample wheelhouse computer screenshot with Netmind software (no actual data shown), charting software with a sampling cell (blue diamonds) and countdown clock.

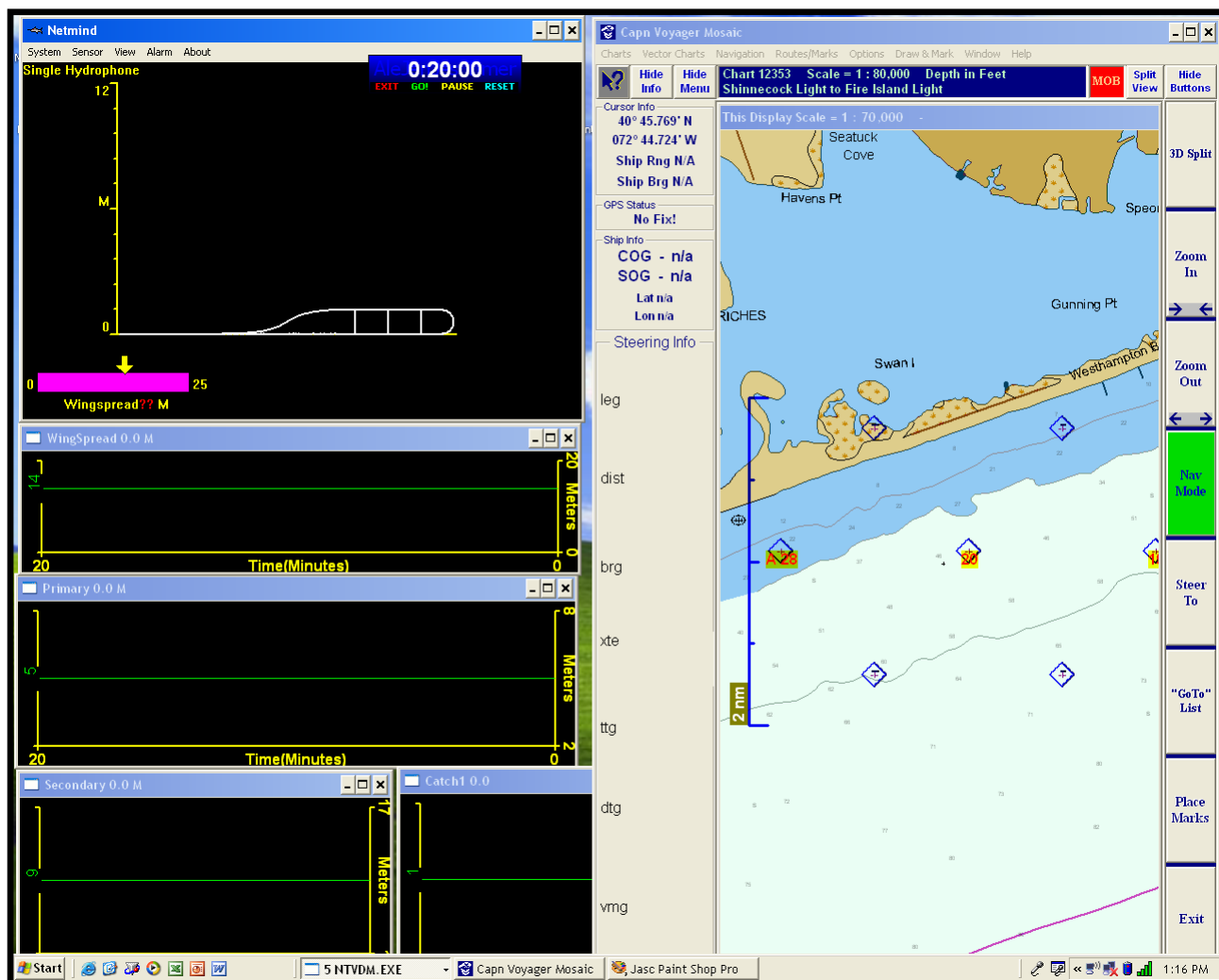
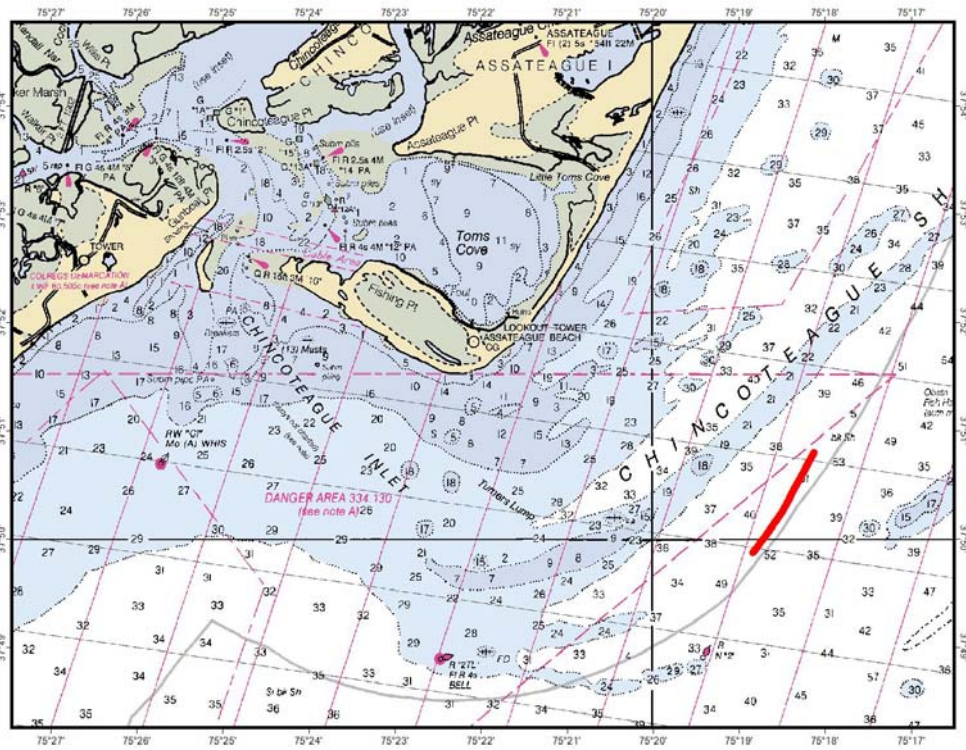




Figure 4. Sample within-tow tow-track (A) and trawl gear width, height, and vessel speed (B) during a straight tow (station 120).

A.



B.

Netmind Results - Station 120

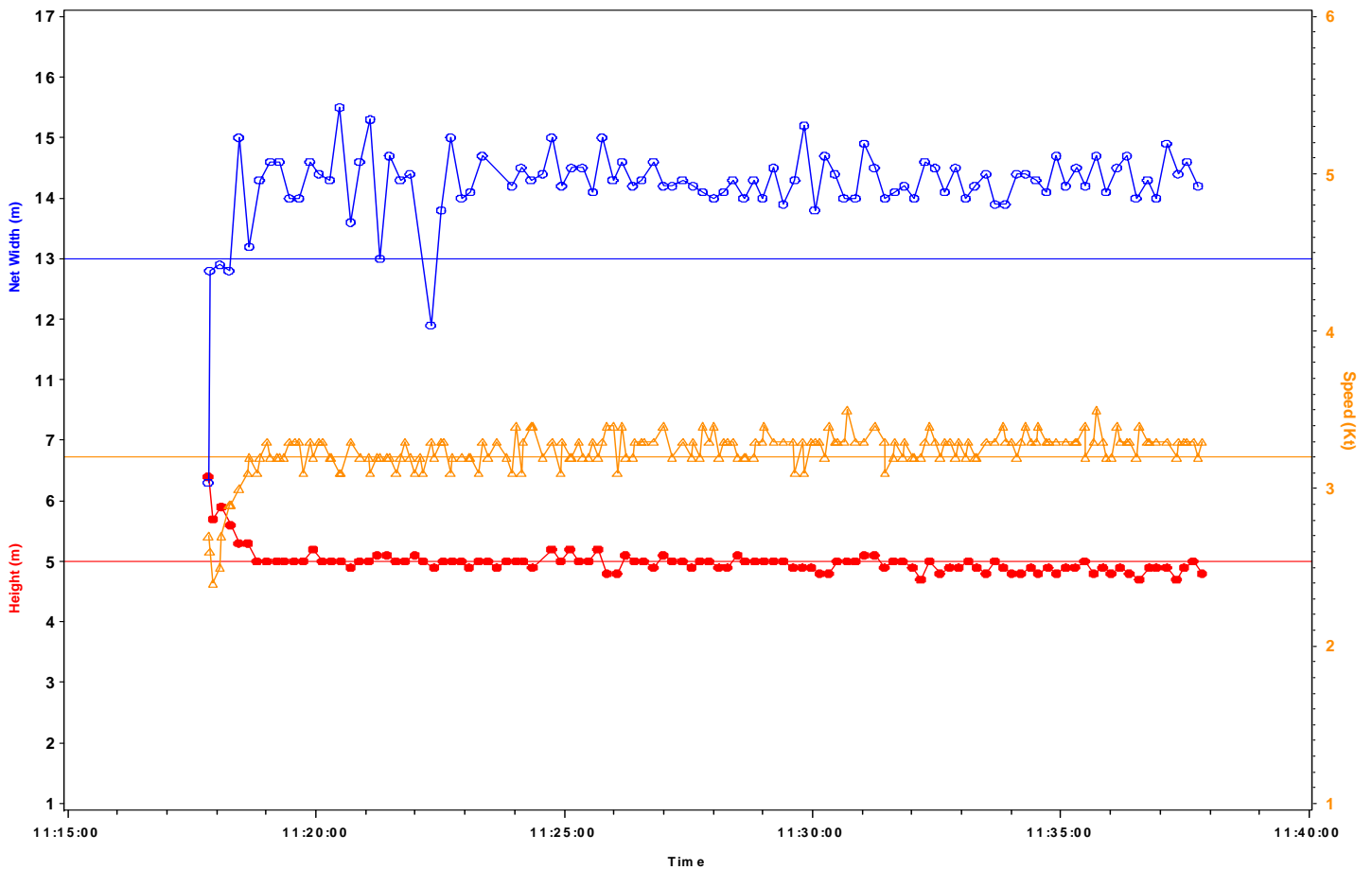
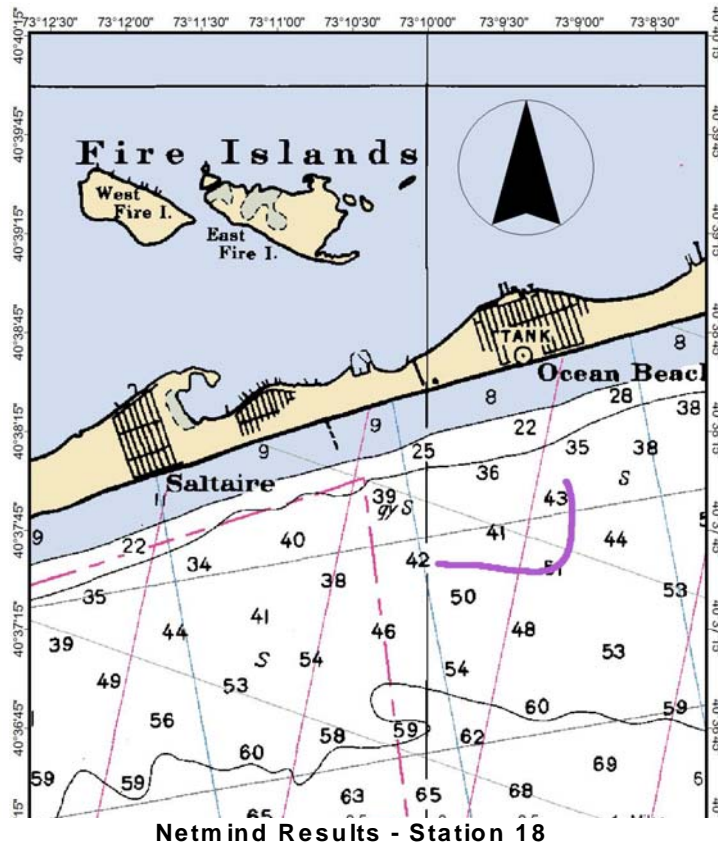


Figure 5. Sample within-tow tow-track (A) and trawl gear width, height, and vessel speed (B) during a non-straight tow (station 18).

A.



B.

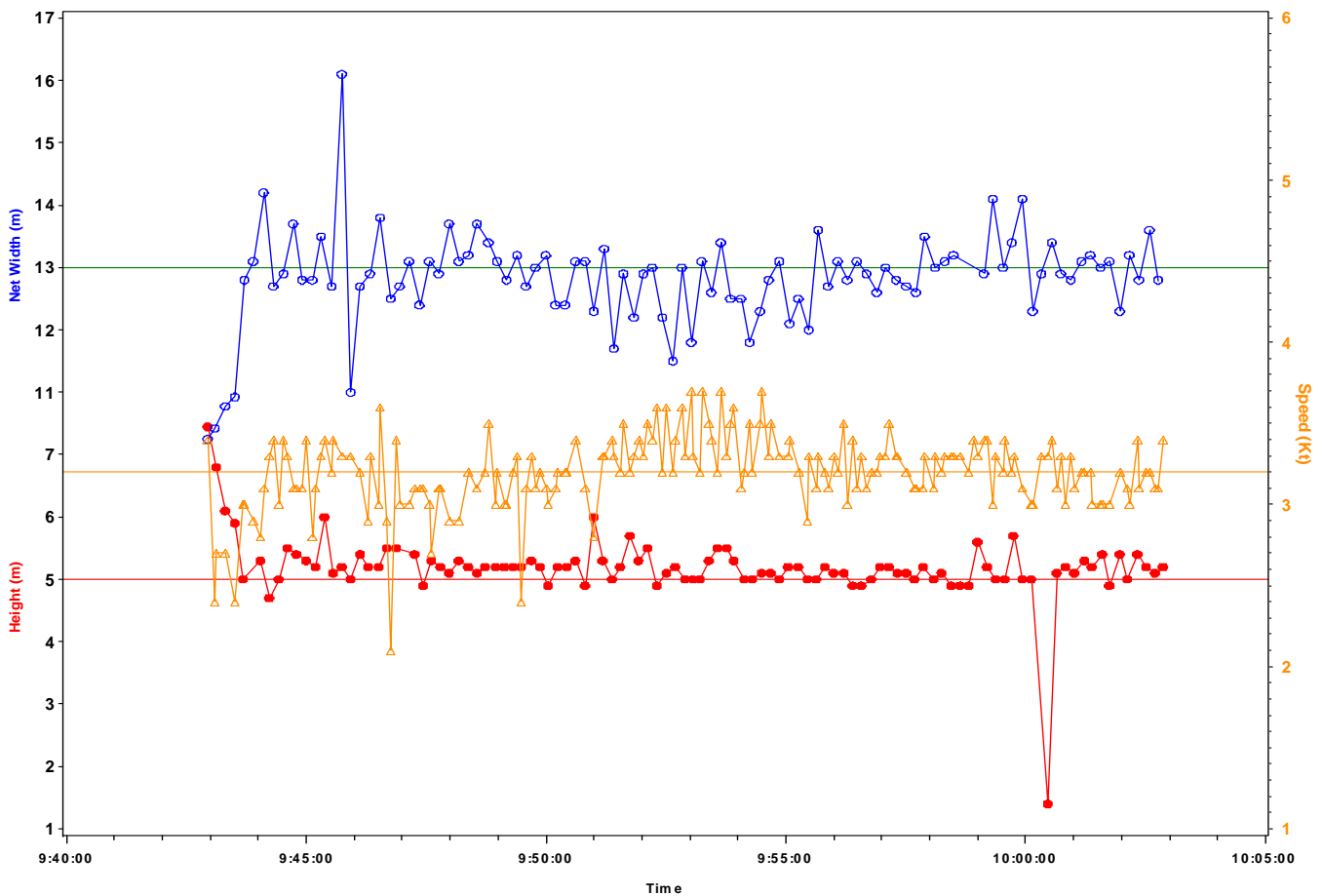
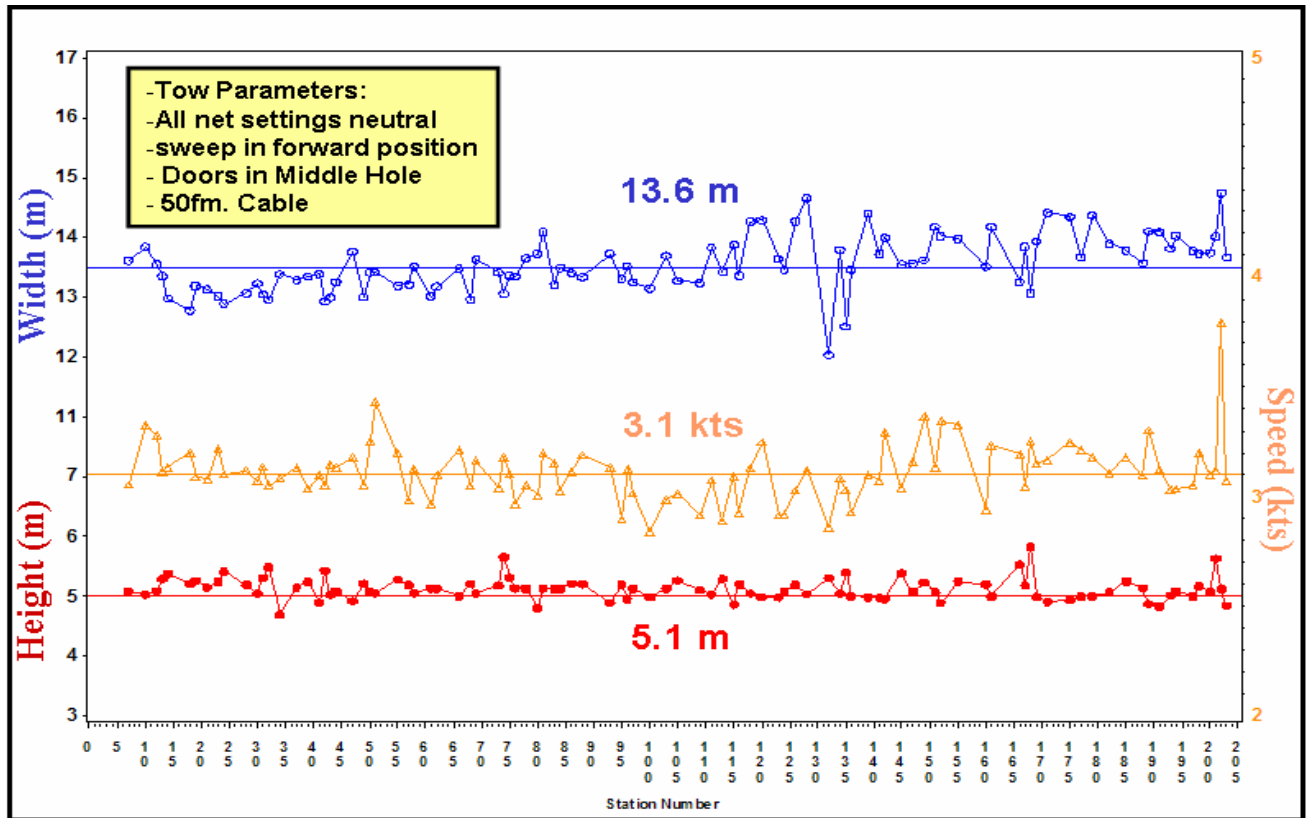


Figure 6. Tow-by-tow trawl gear width, height, and vessel speed (A), and tow distance and area swept (B), all stations.

A.



B.

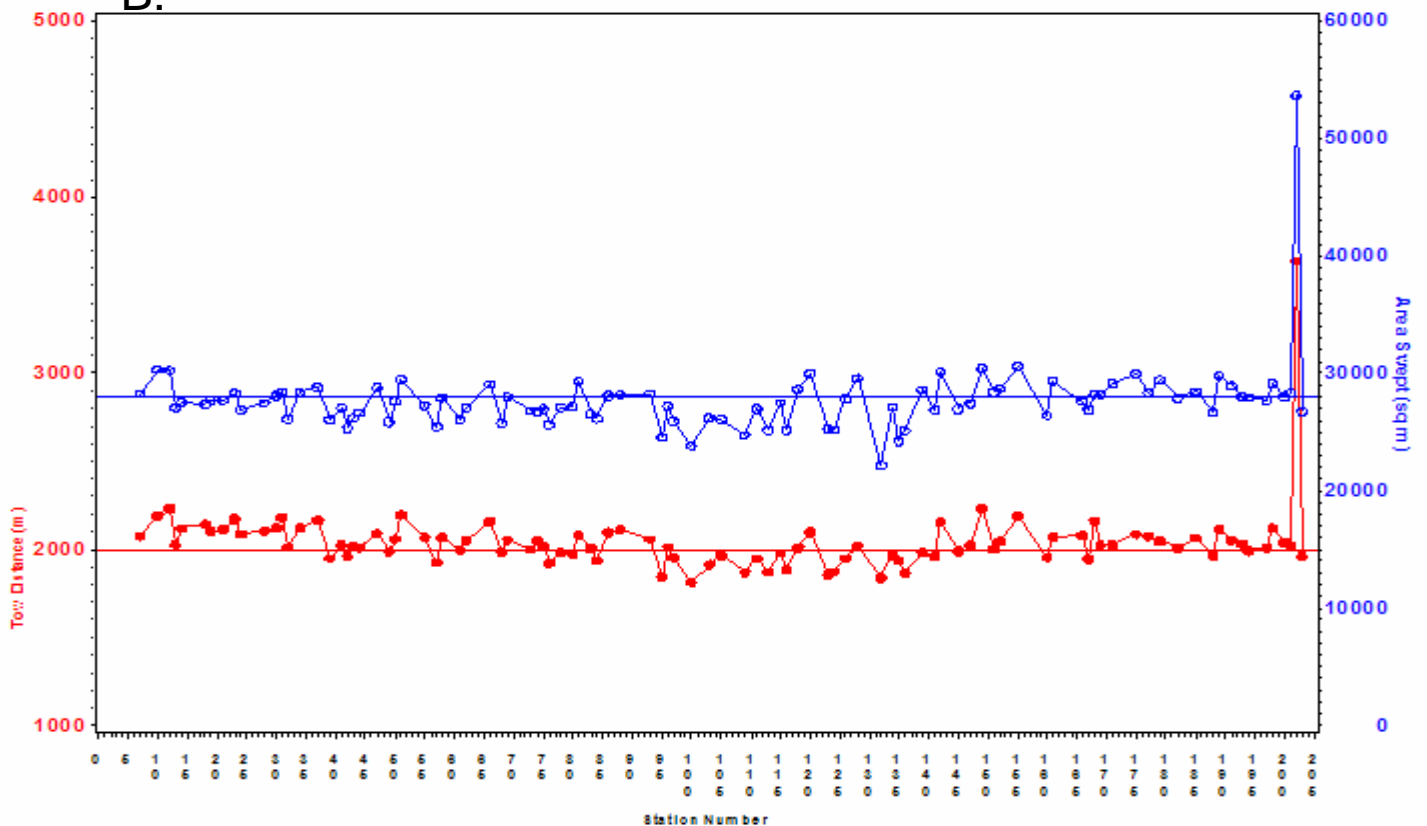


Figure 7. Comparison of stations selected for sampling and those actually occupied.

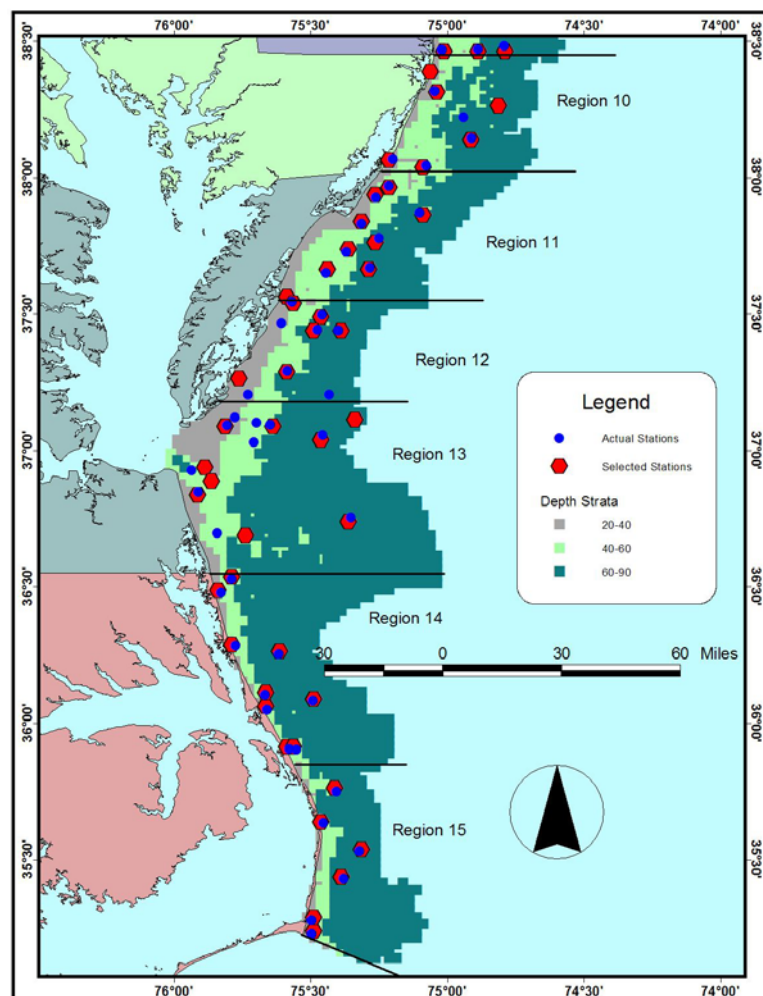
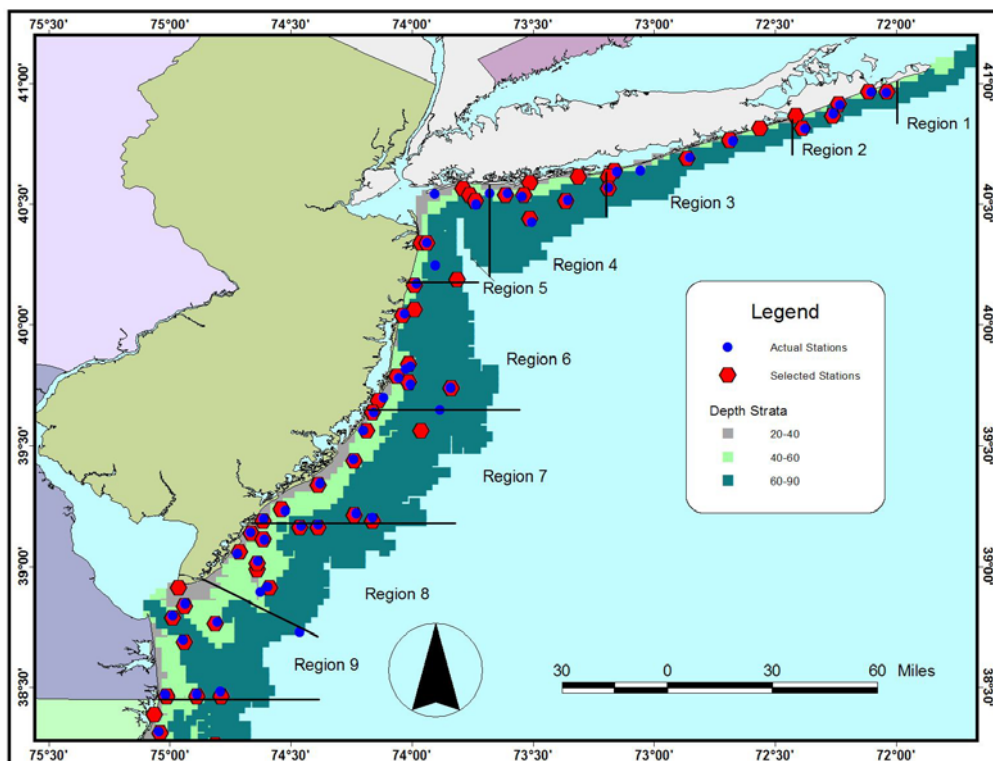


Figure 8. Frequency distributions of number (A) and biomass (B) of fish per tow.

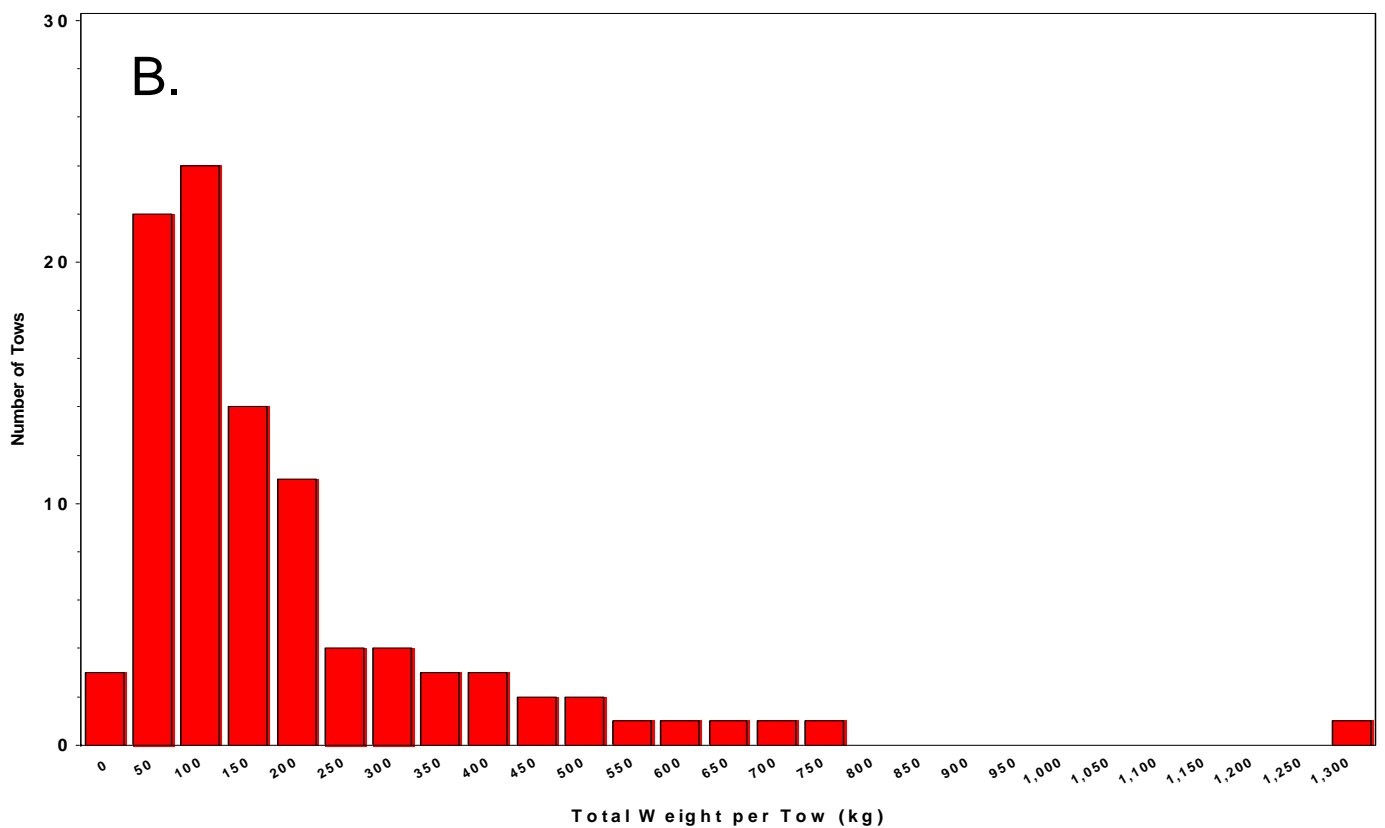
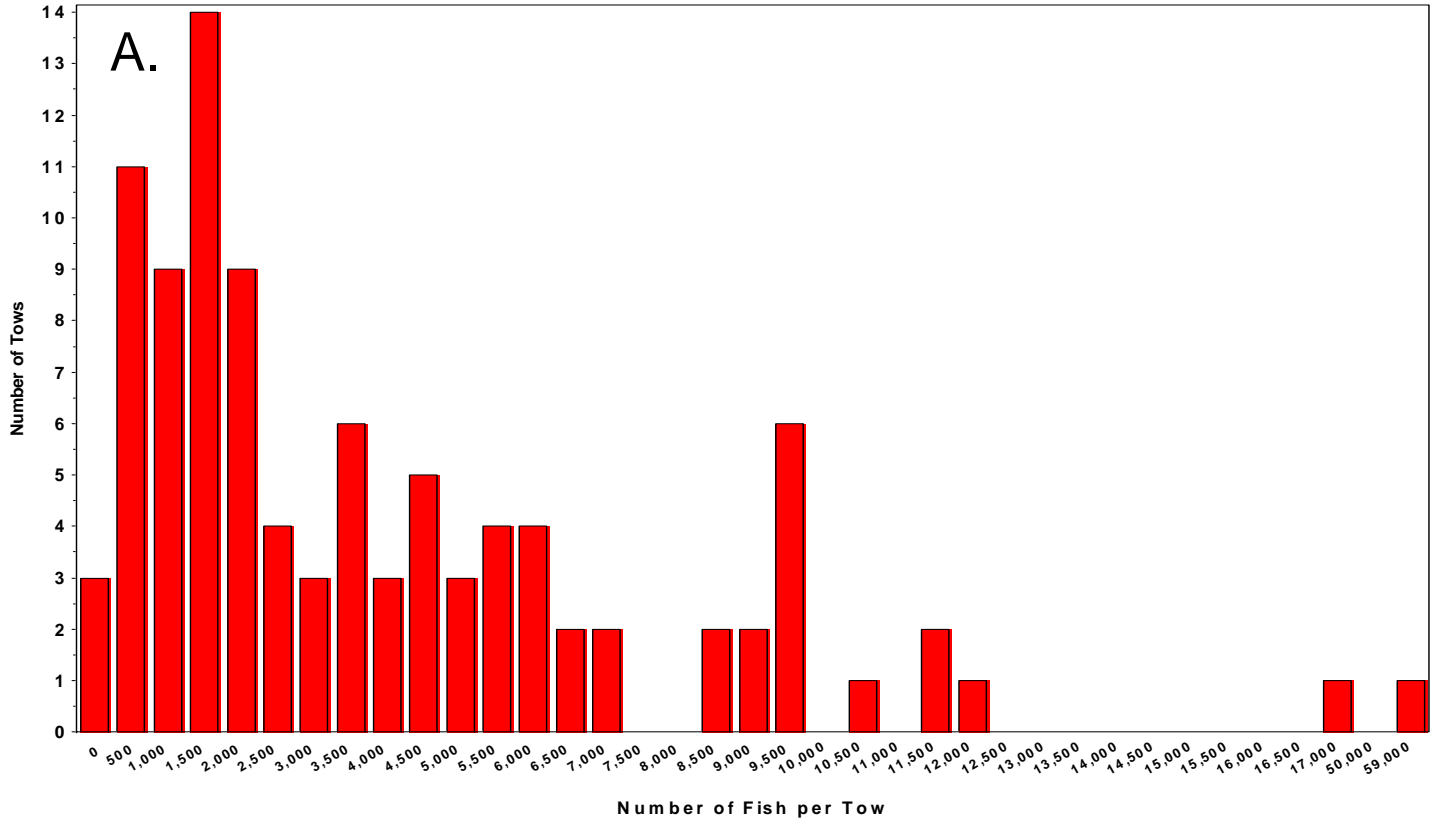
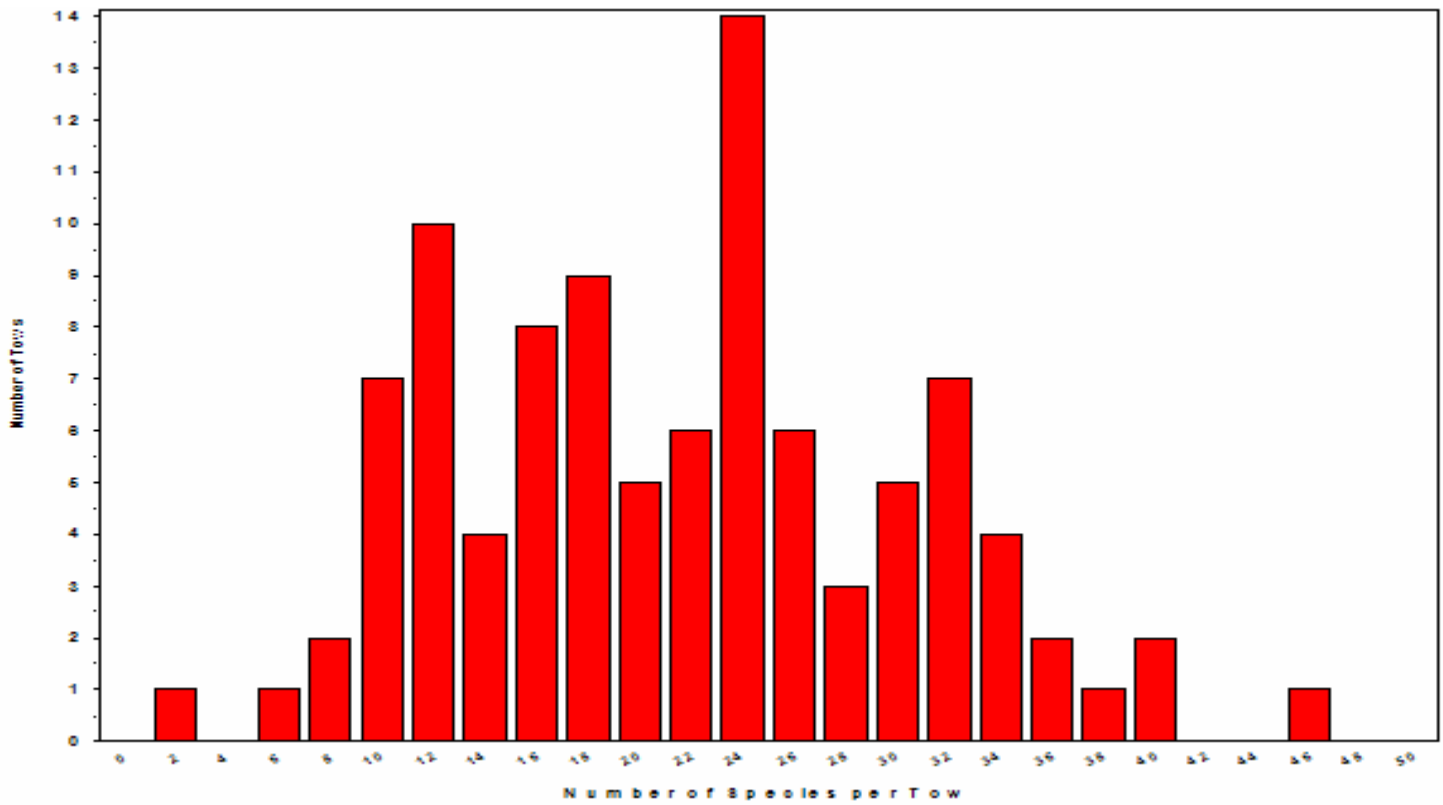
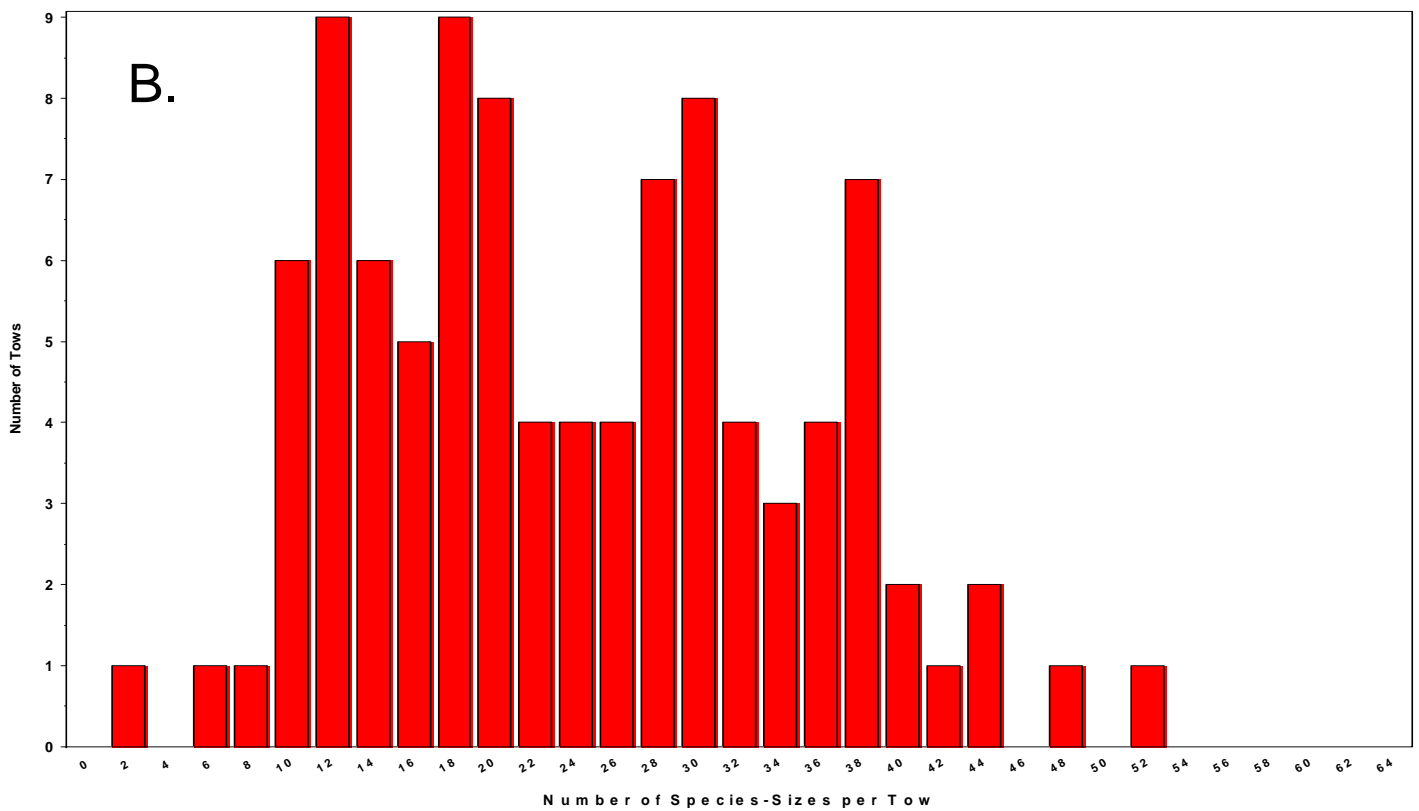


Figure 9. Frequency distributions of number of species (A) and species-size class combinations (B) per tow.

A.



B.





# Black Seabass

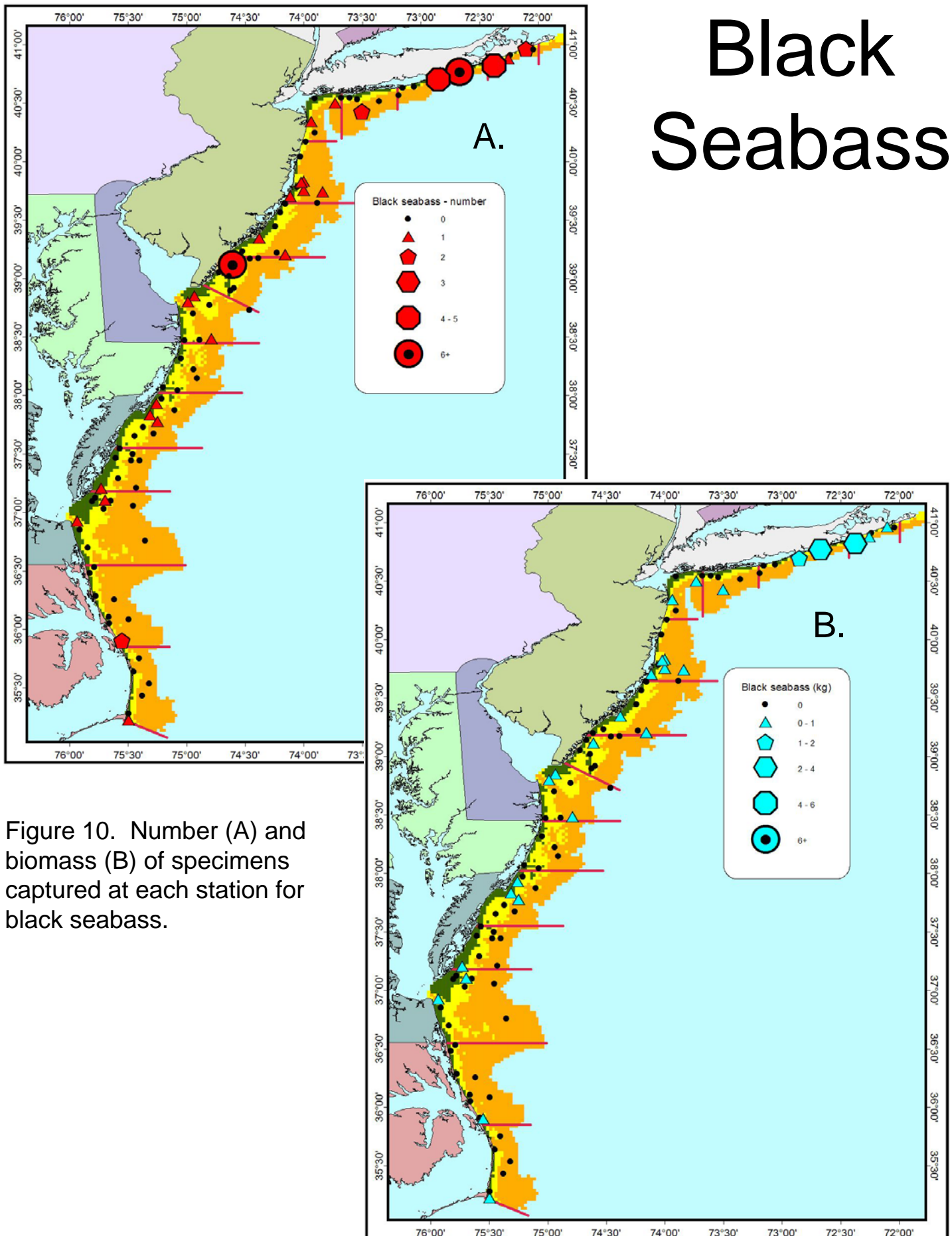


Figure 10. Number (A) and biomass (B) of specimens captured at each station for black seabass.

Figure 11. Minimum trawlable number and biomass by state for black seabass.

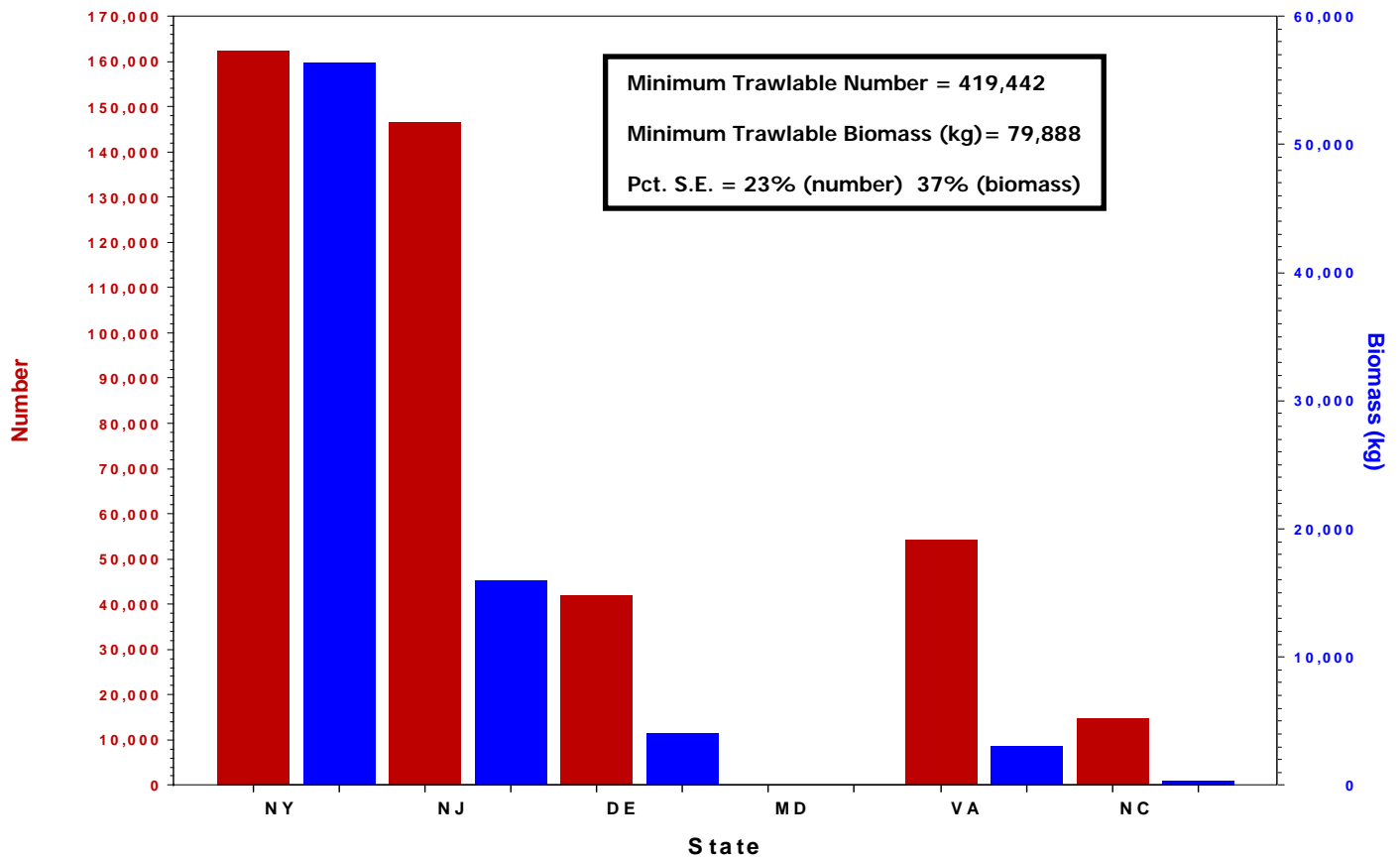


Figure 12. Sex ratios by state for black seabass.

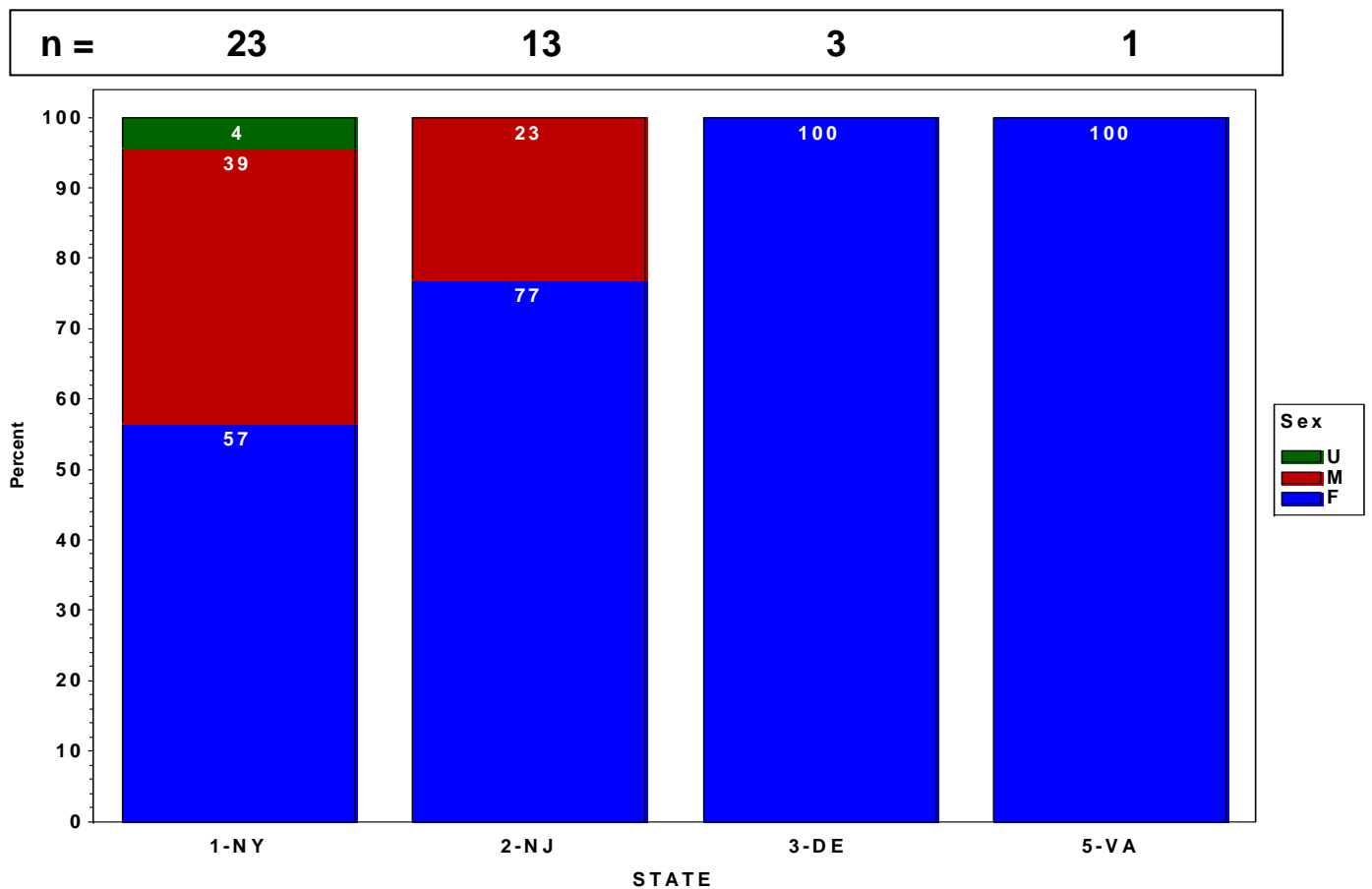




Figure 13. Length frequency for black seabass.

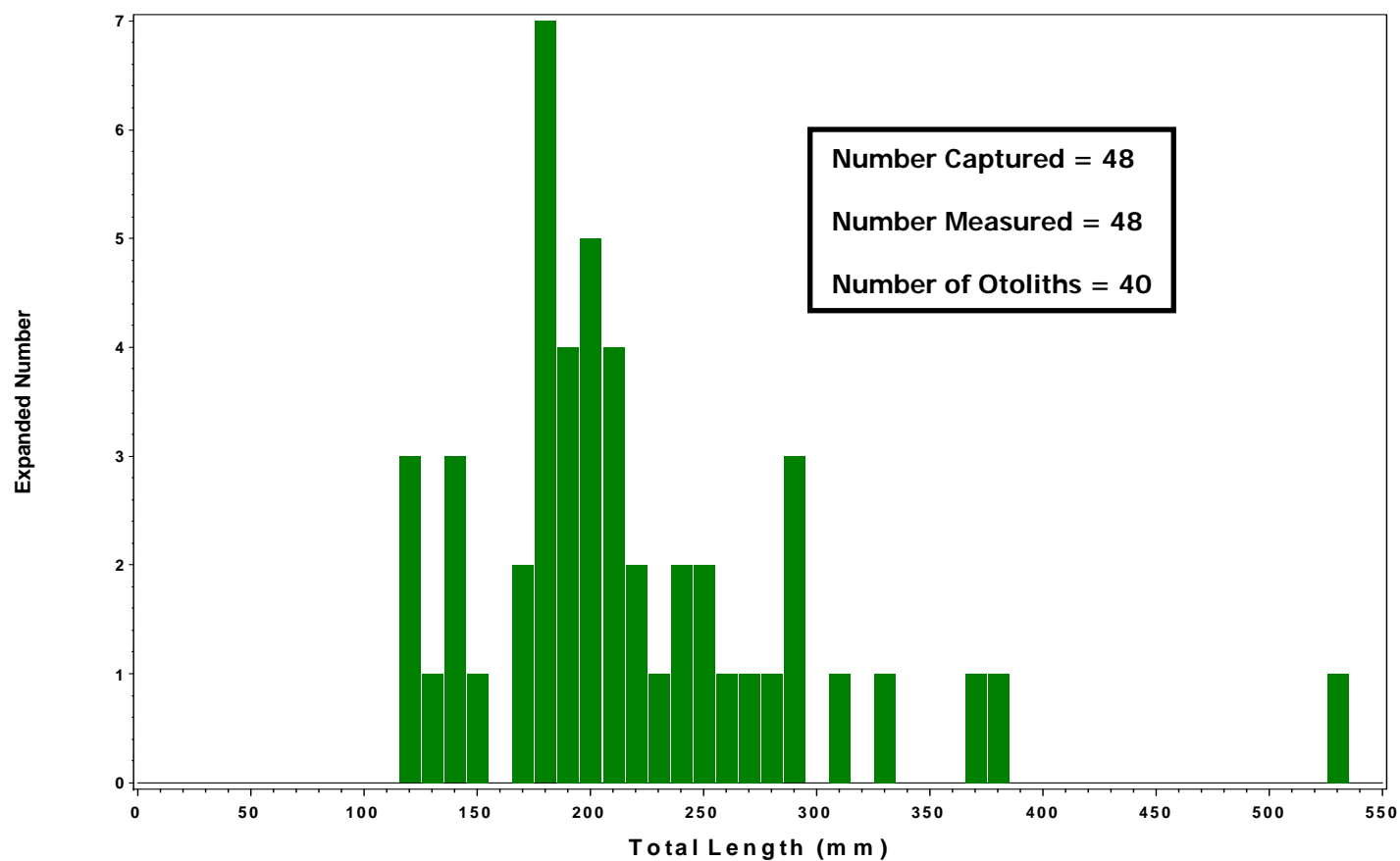


Figure 14. Length-weight regression for black seabass, sexes combined.

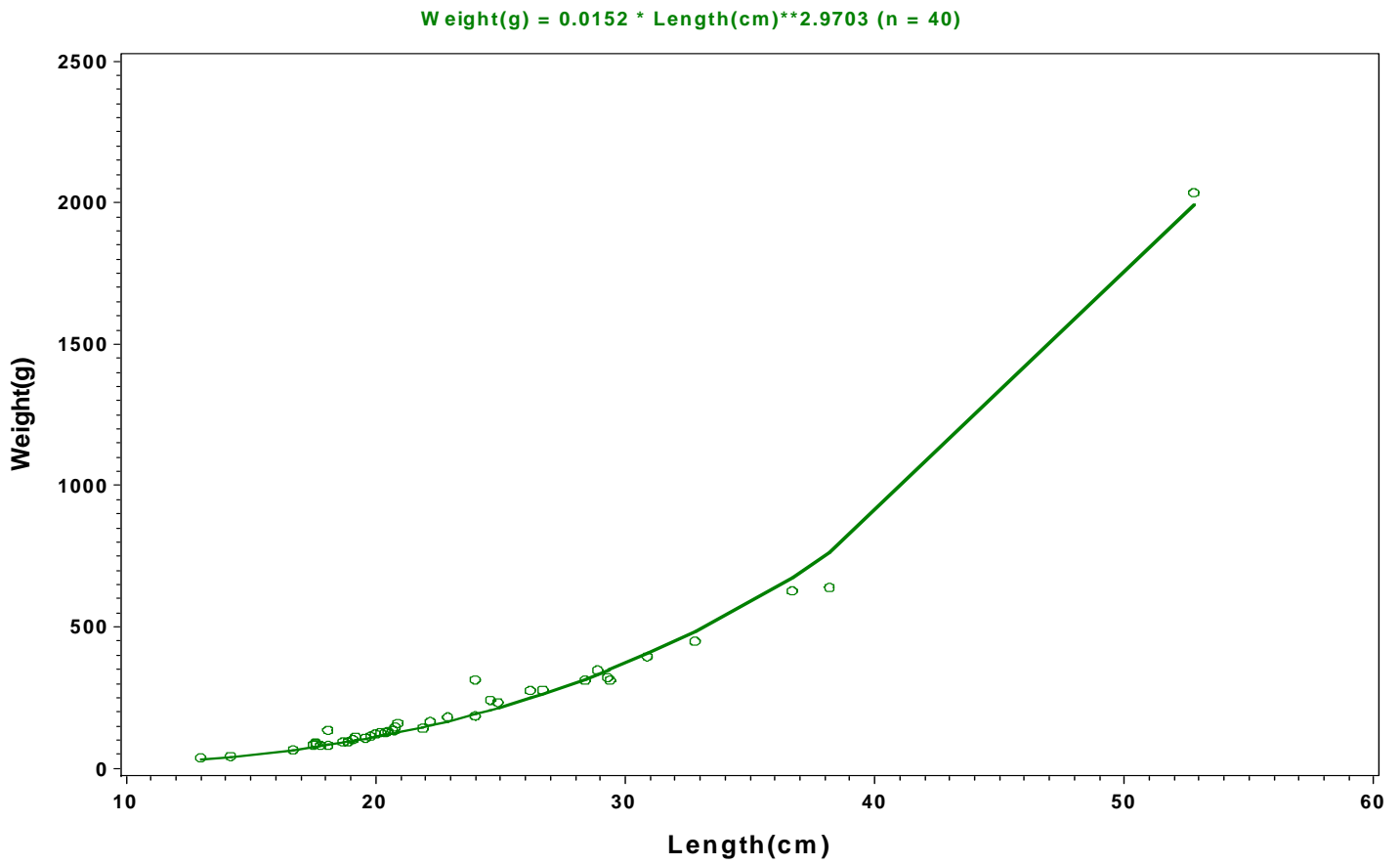


Figure 15. Length-weight regression for black seabass, by sex.

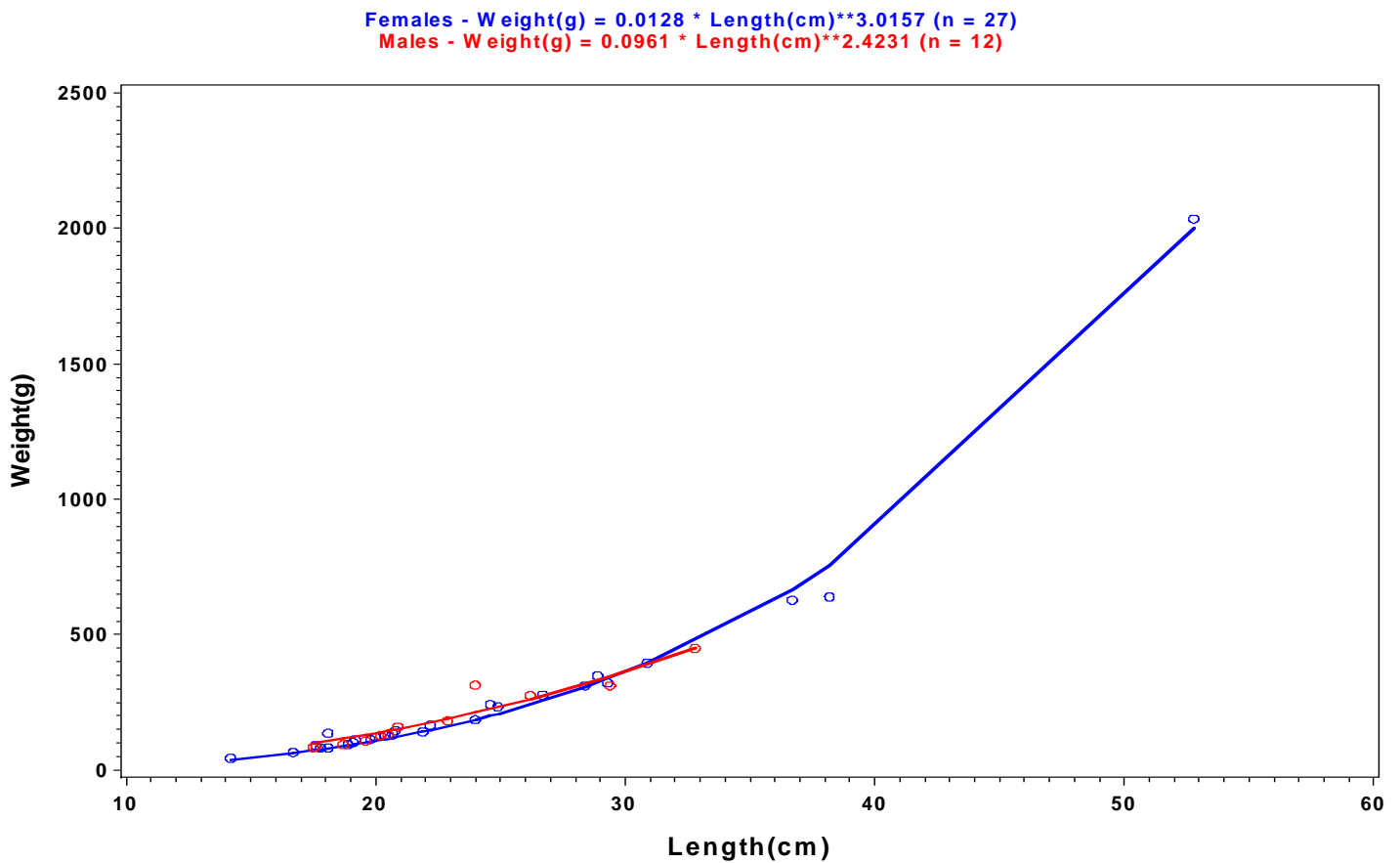


Figure 16. Maturity logistic regression for black seabass, females.

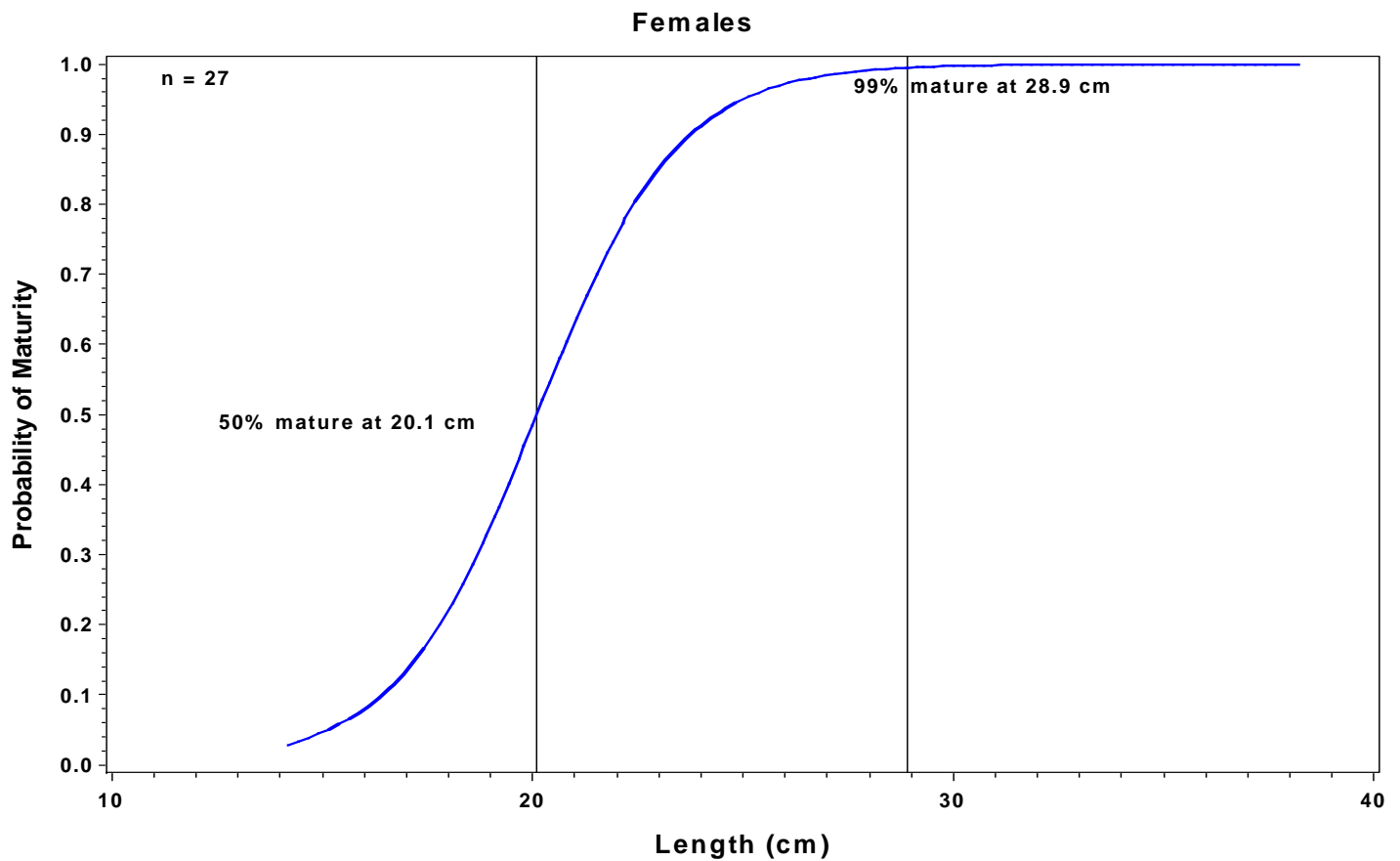


Figure 17. Maturity logistic regression for black seabass, males.

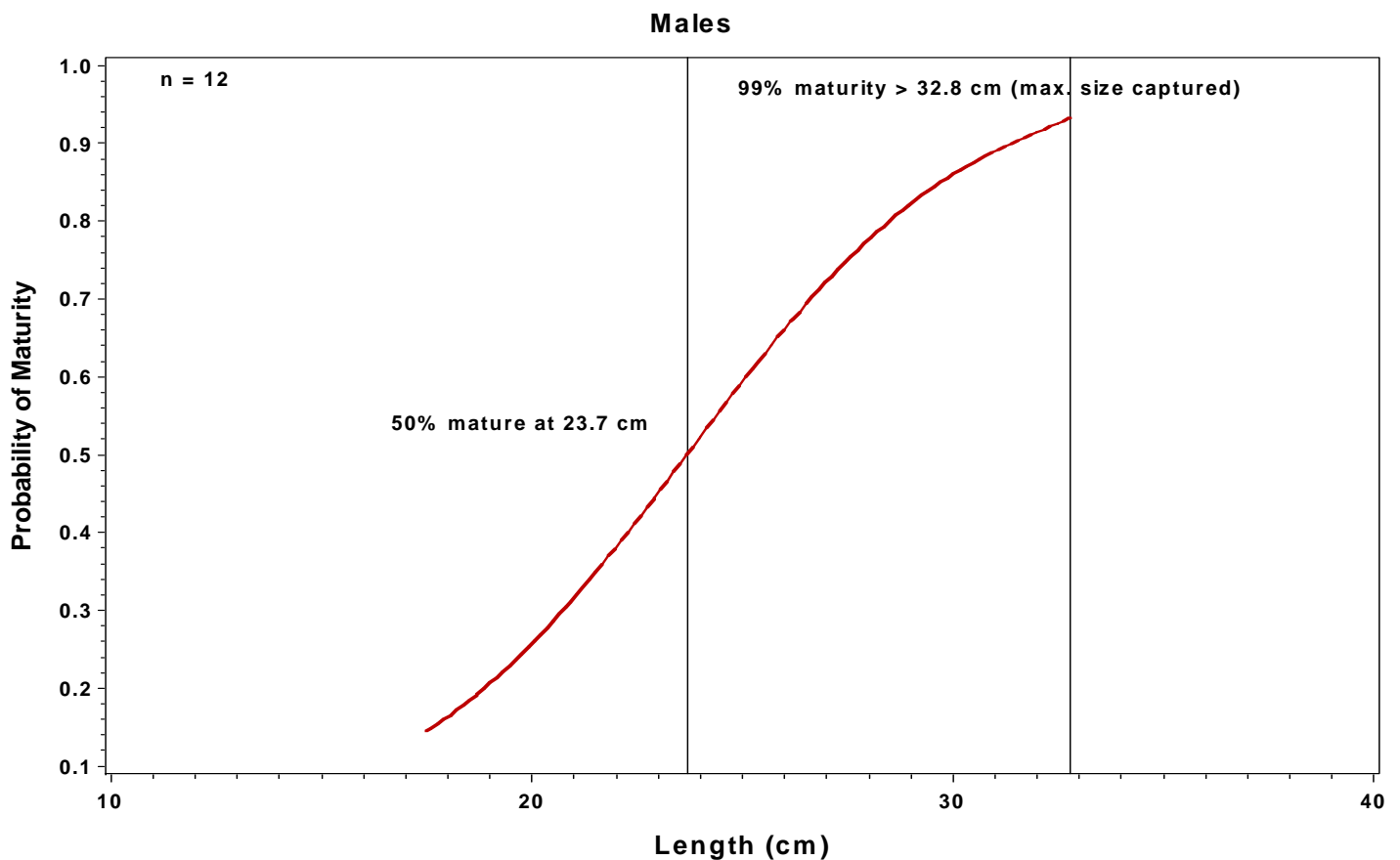


Figure 18. Diet composition by weight for black seabass.

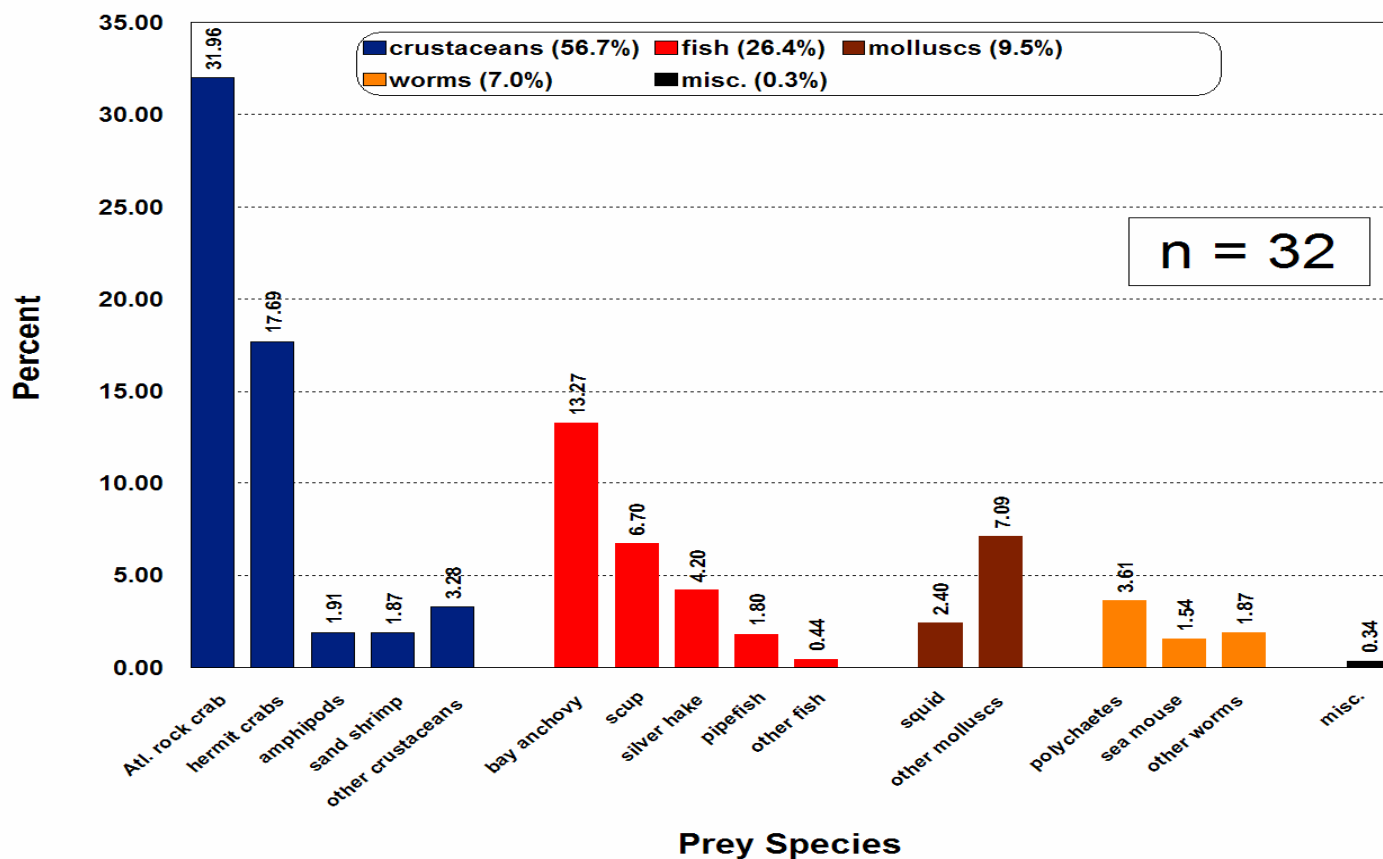
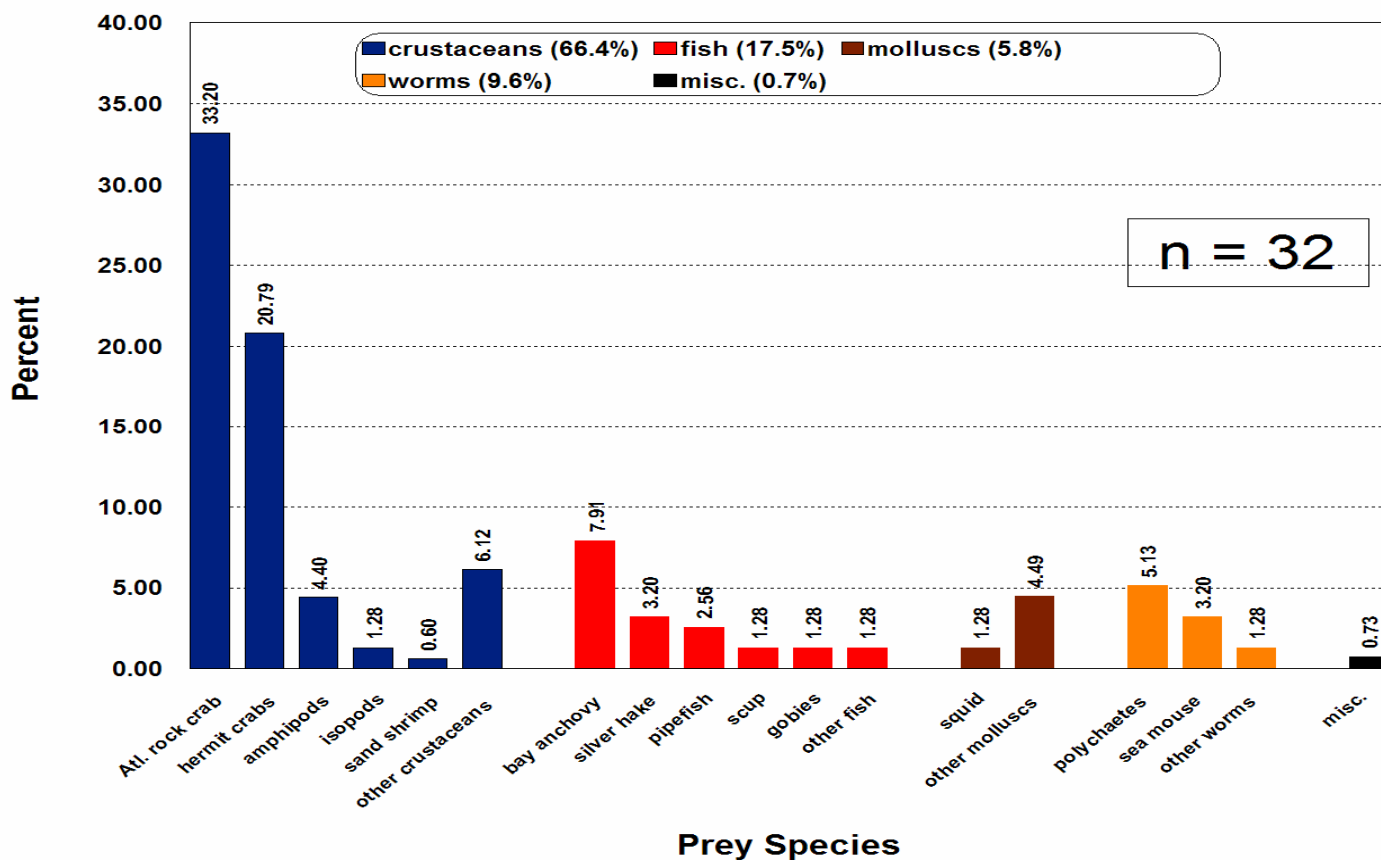


Figure 19. Diet composition by number for black seabass.



# Bluefish

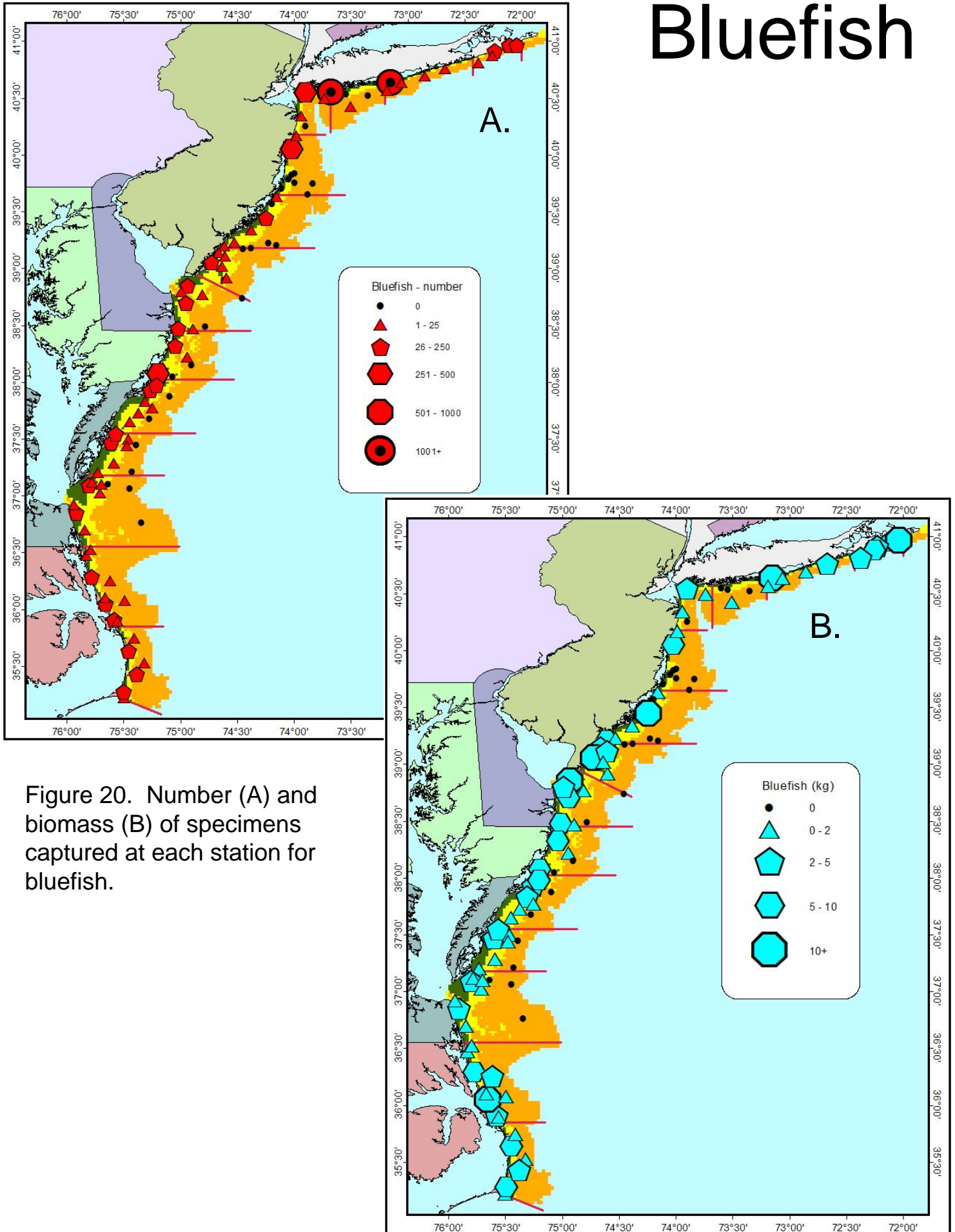


Figure 20. Number (A) and biomass (B) of specimens captured at each station for bluefish.

Figure 21. Minimum trawlable number and biomass by state for bluefish.

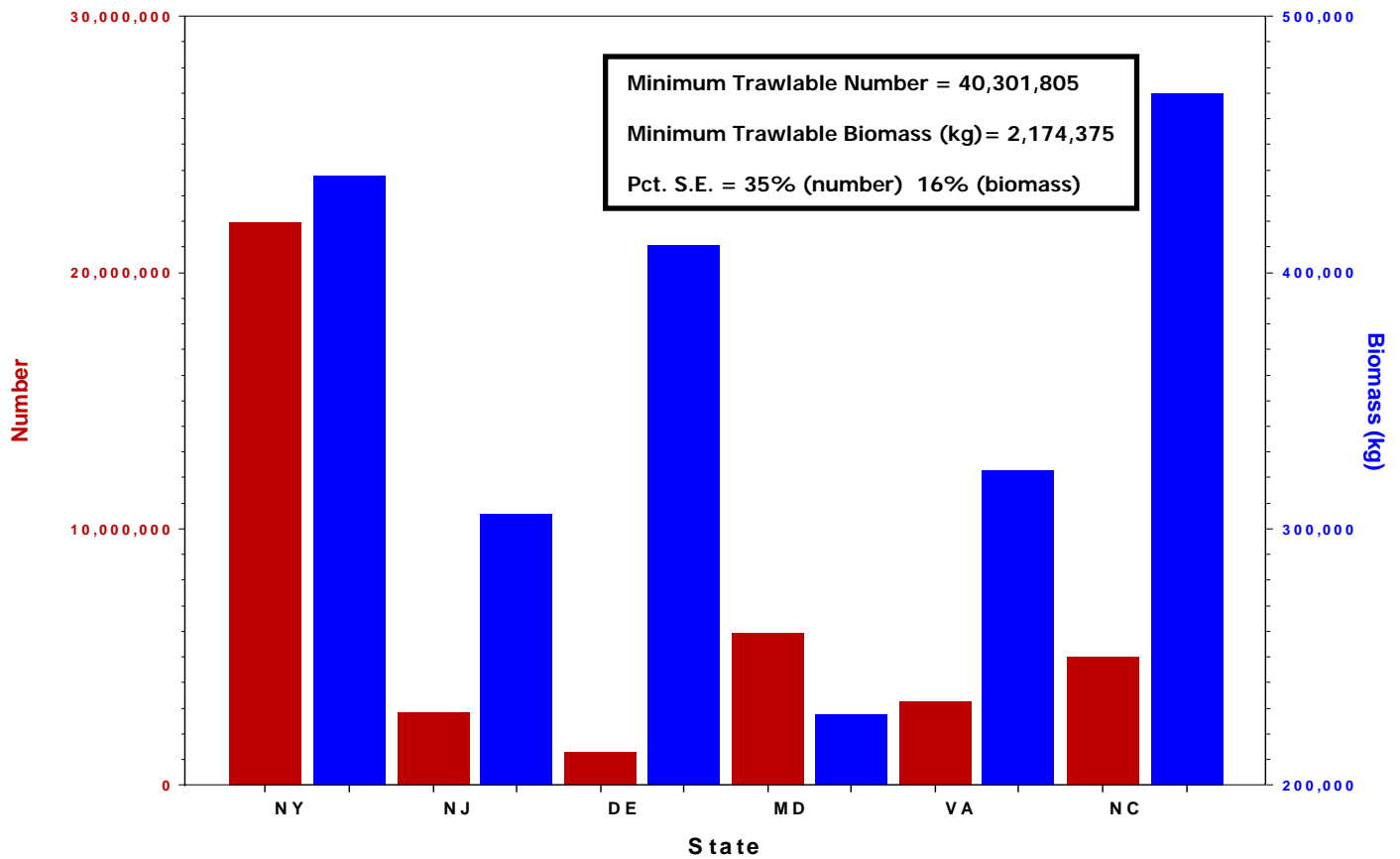


Figure 22. Sex ratios by state for bluefish.

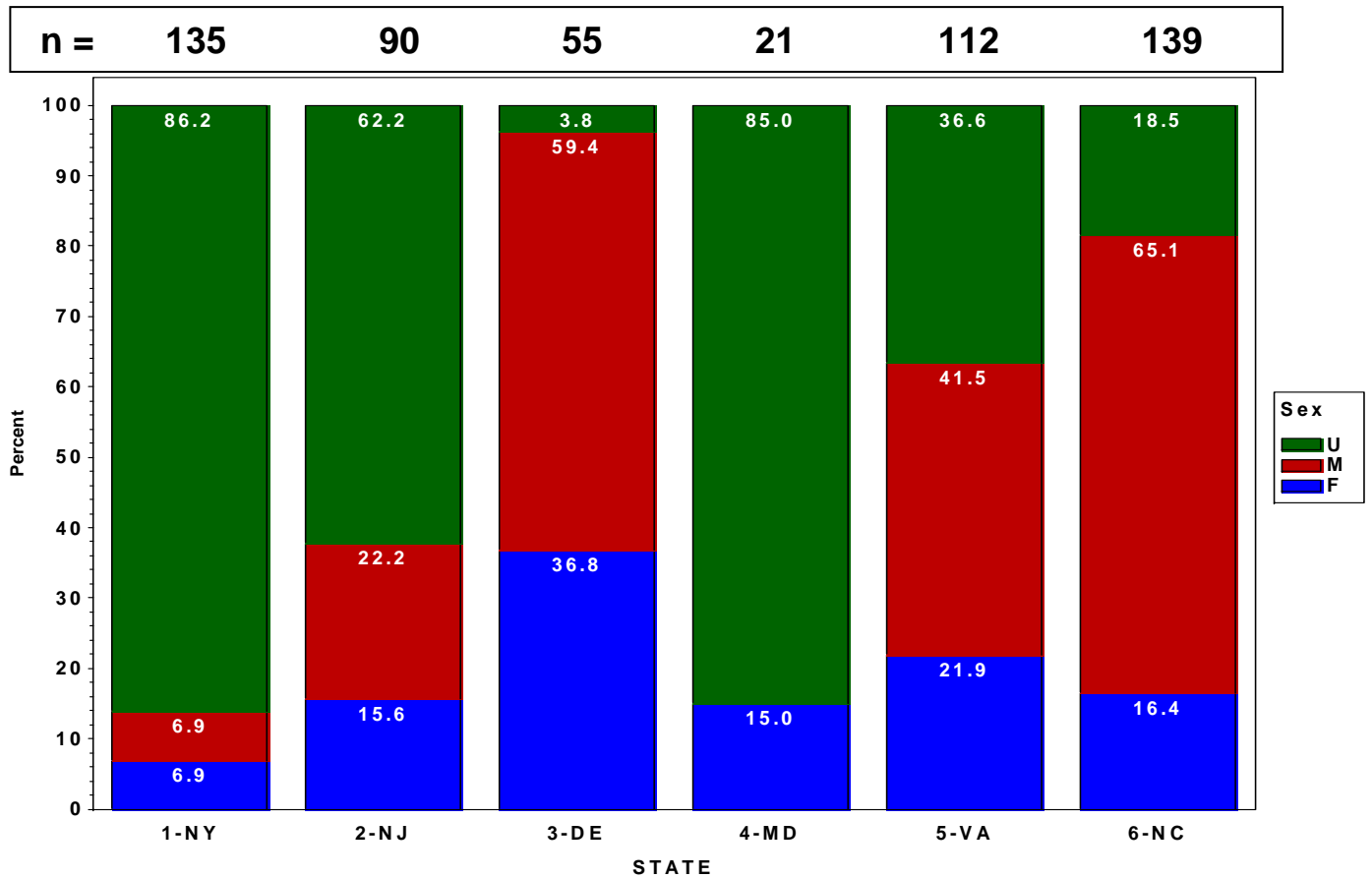


Figure 23. Length frequency for bluefish.

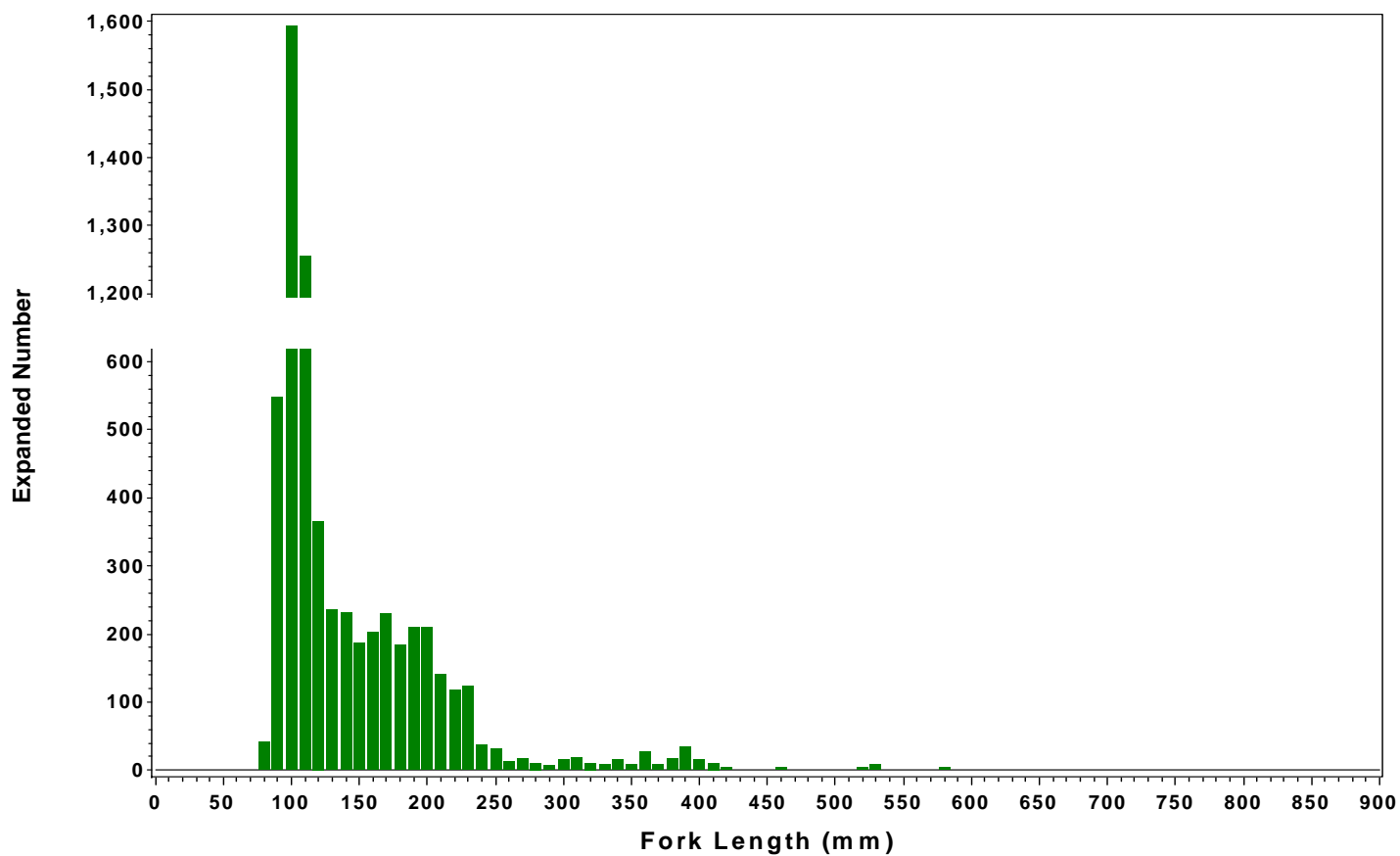


Figure 24. Length-weight regression for bluefish, sexes combined.

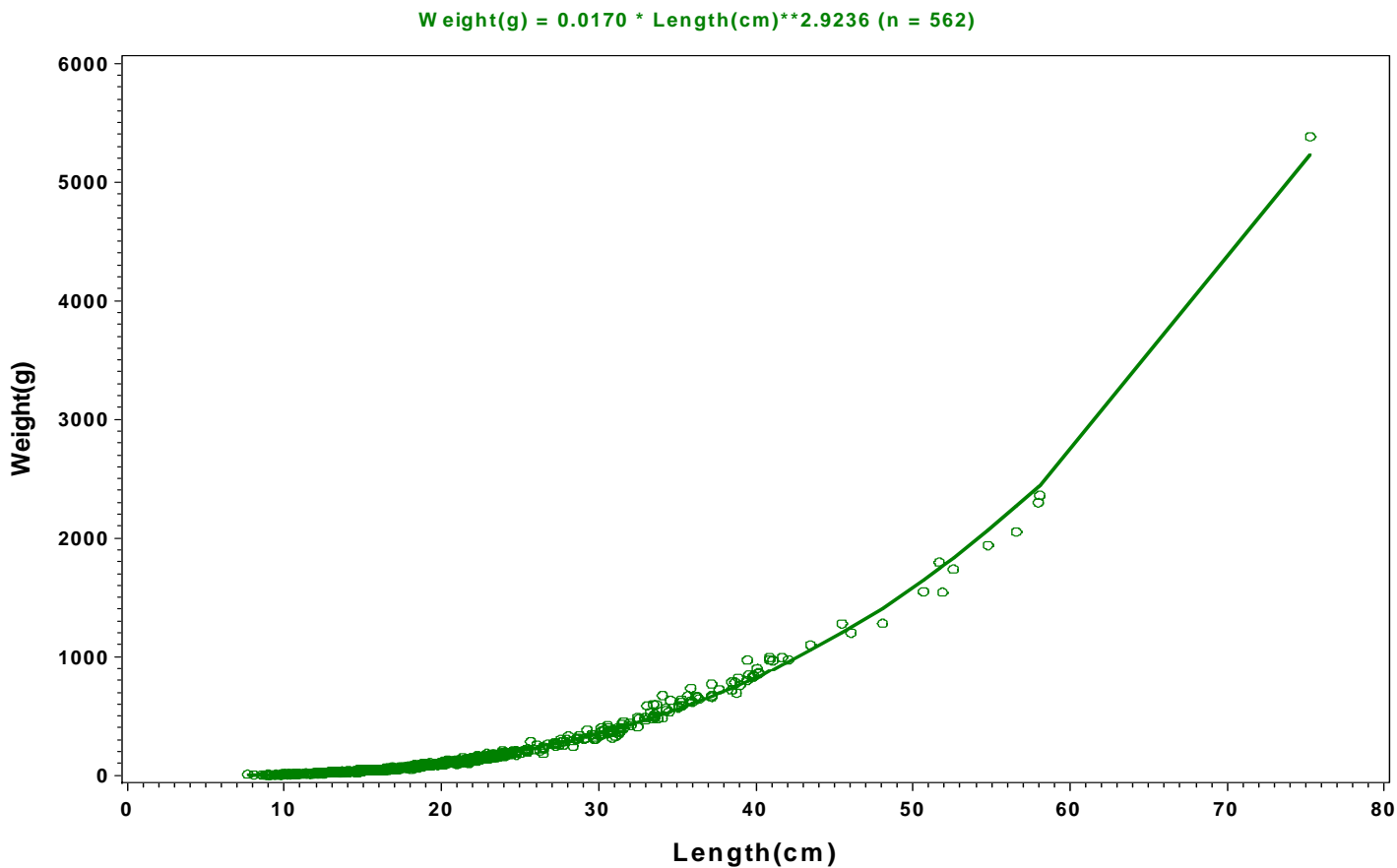


Figure 25. Length-weight regression for bluefish by sex.

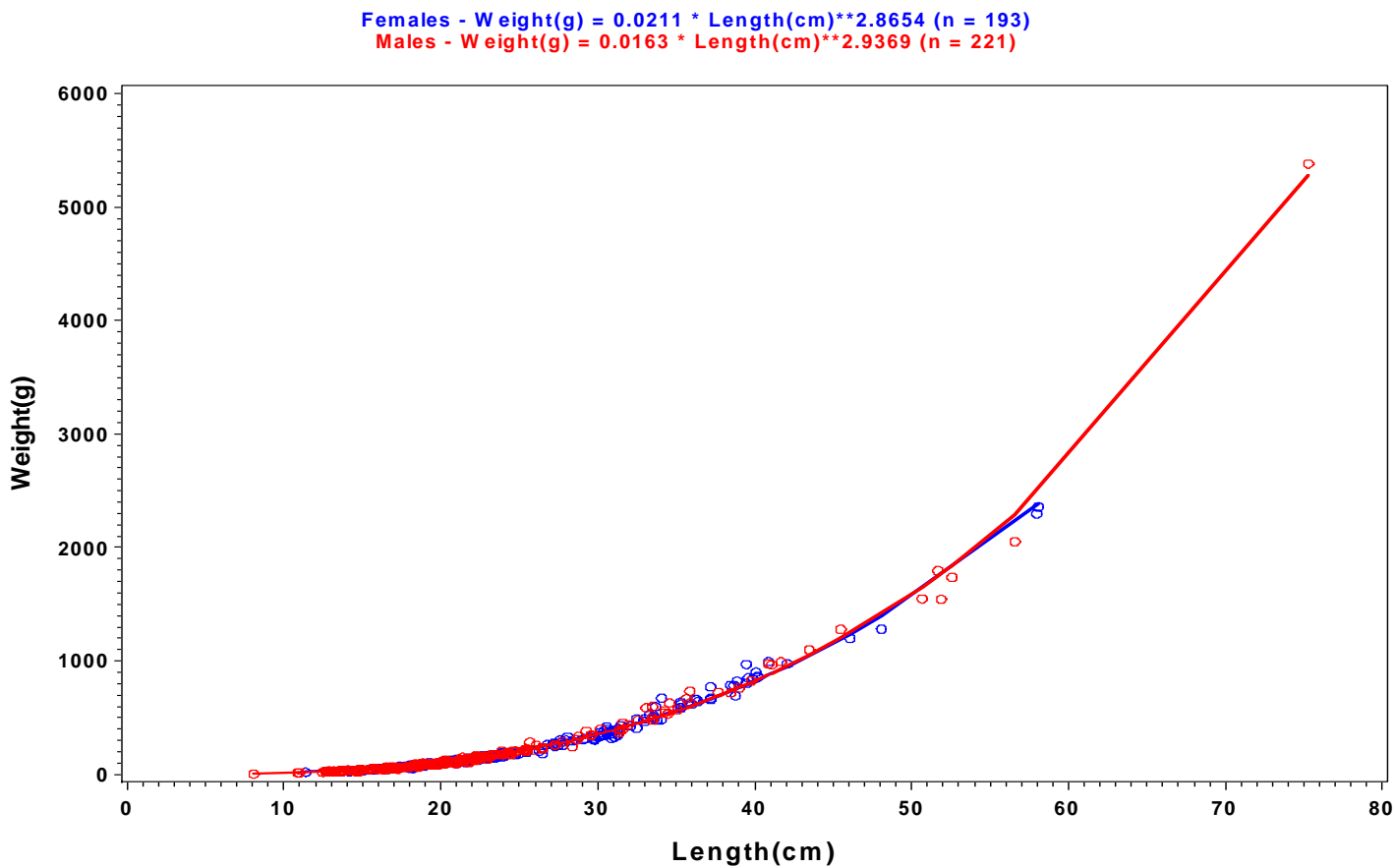




Figure 26. Maturity logistic regression for bluefish, females.

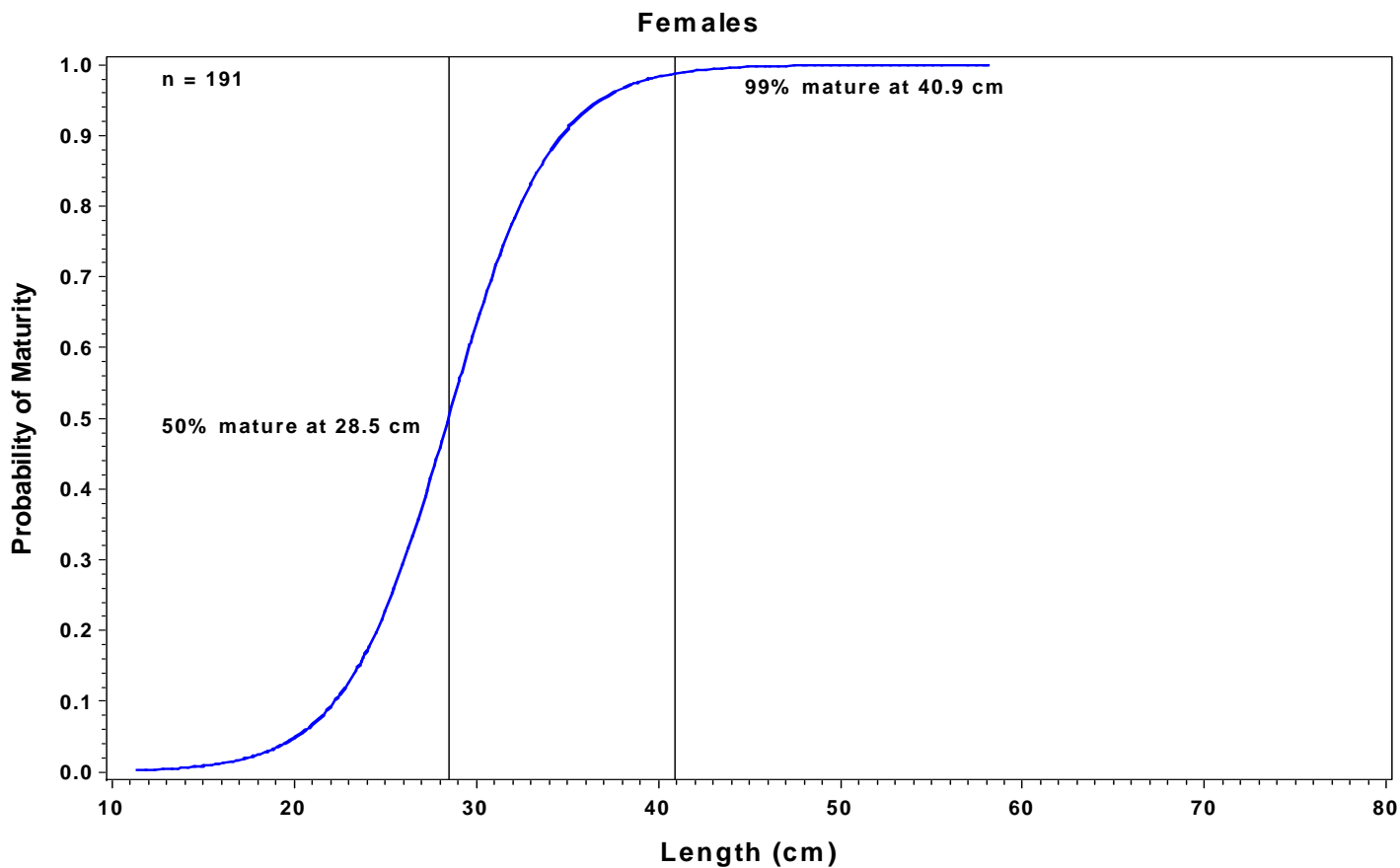


Figure 27. Maturity logistic regression for bluefish, females.

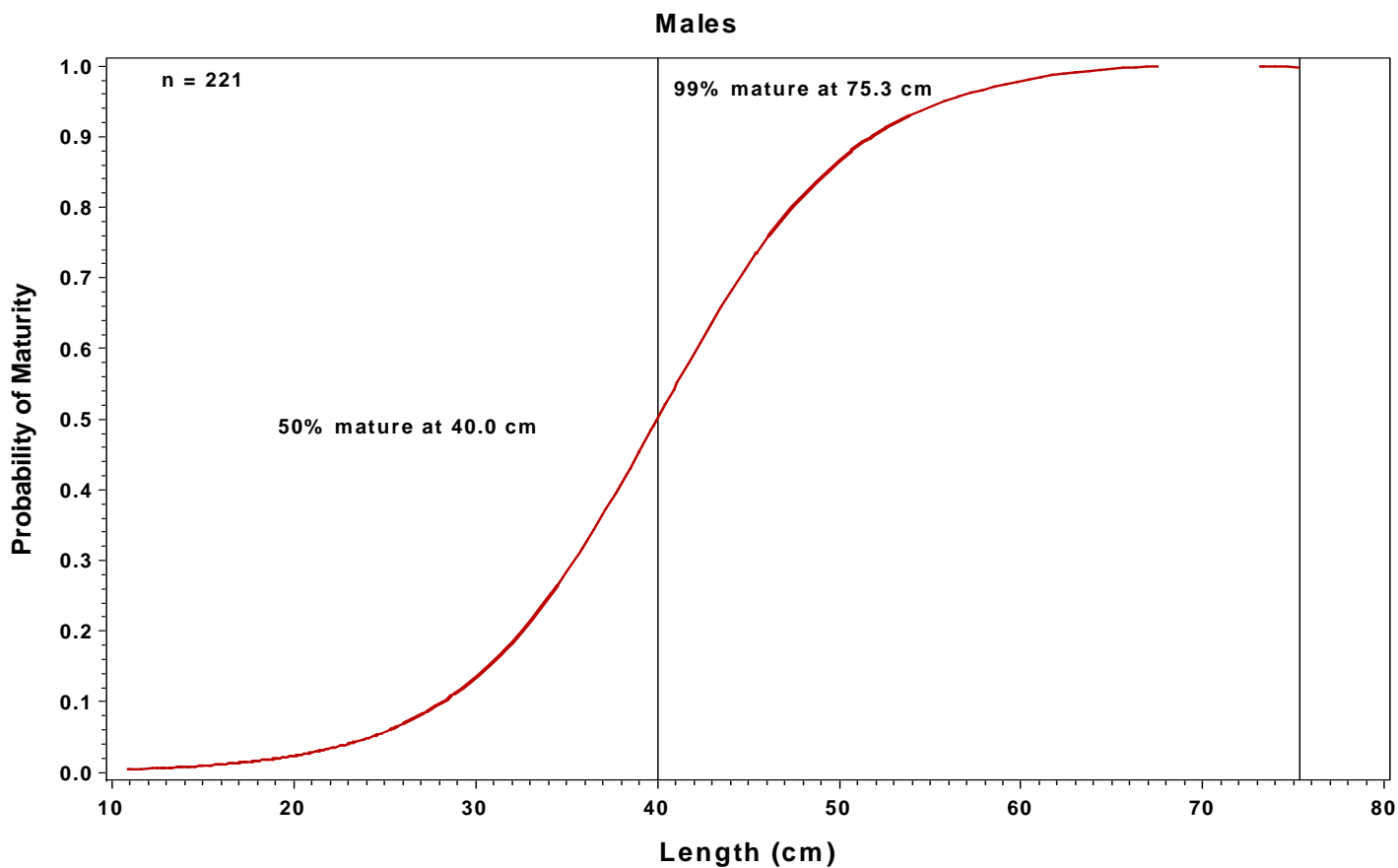


Figure 28. Diet composition by weight for bluefish.

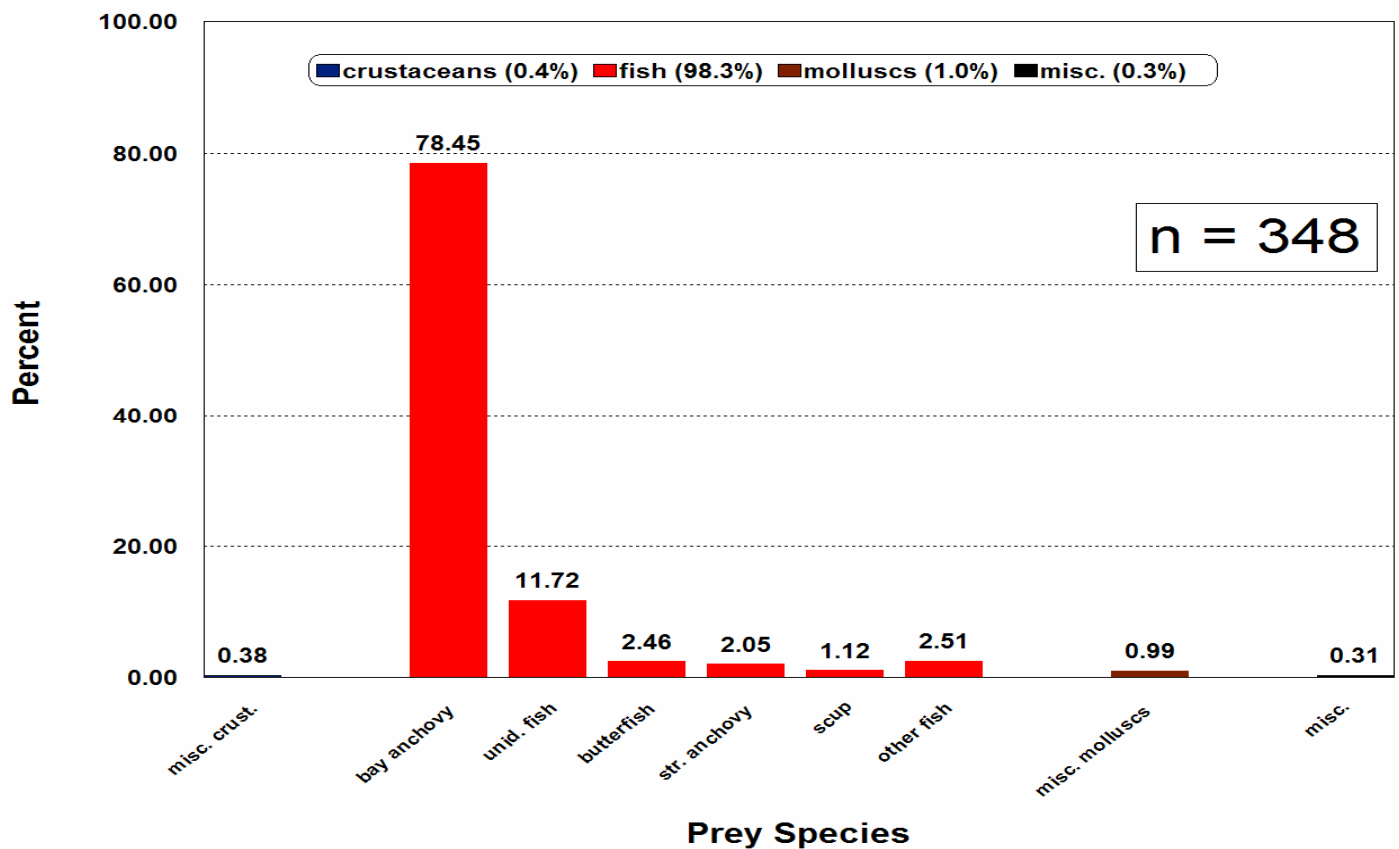
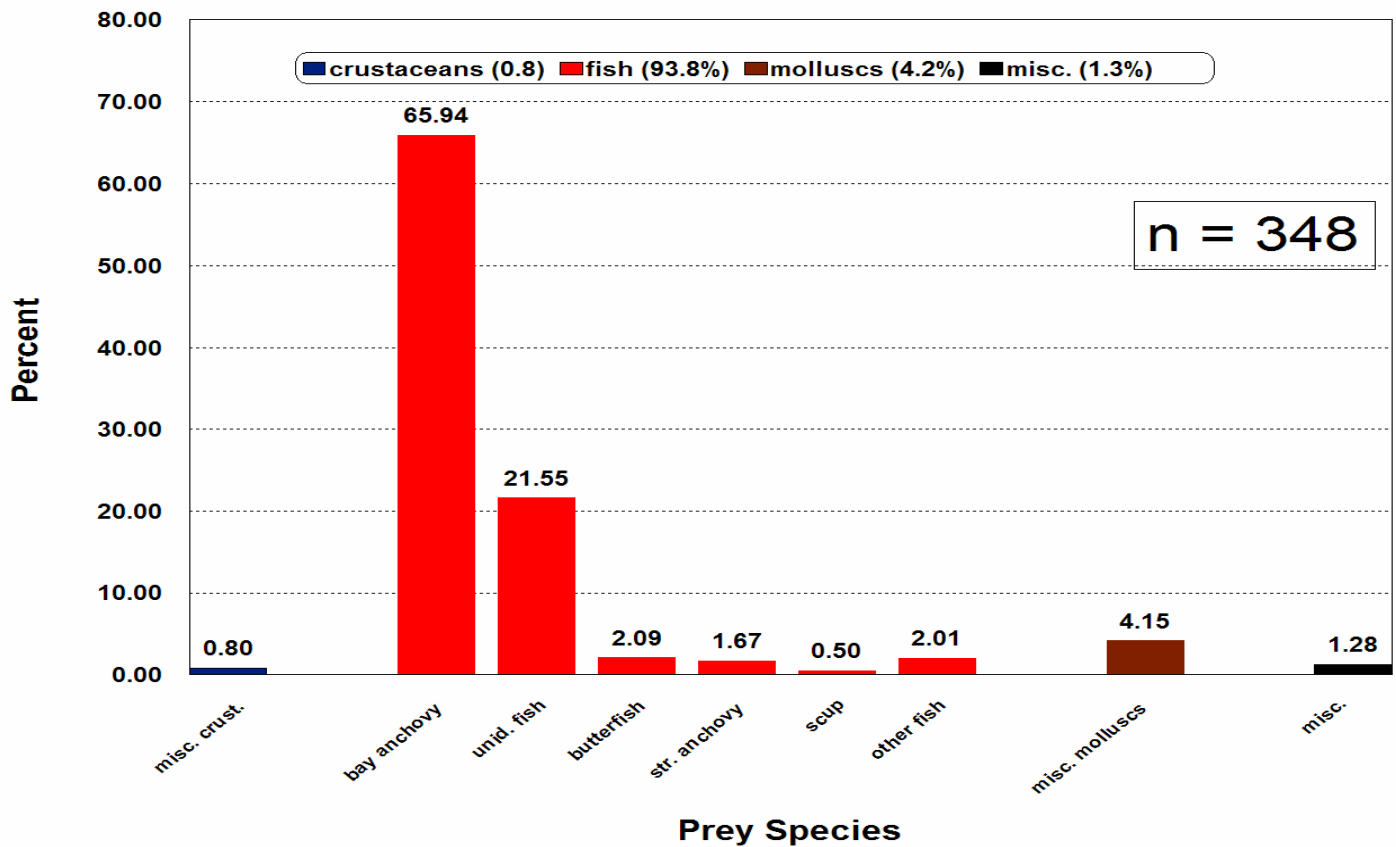


Figure 29. Diet composition by number for bluefish.



# Scup

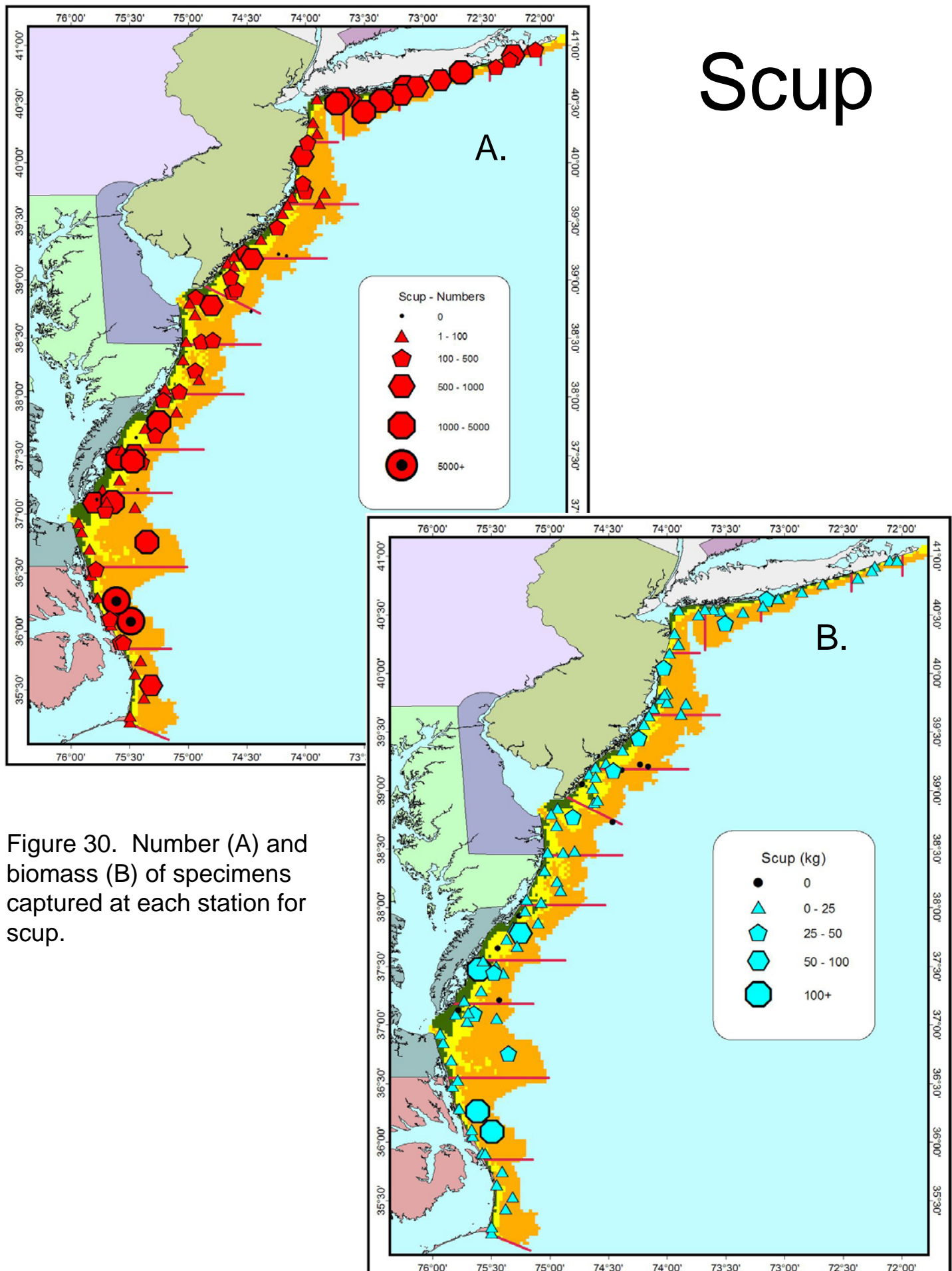


Figure 30. Number (A) and biomass (B) of specimens captured at each station for scup.

Figure 31. Minimum trawlable number and biomass by state for scup

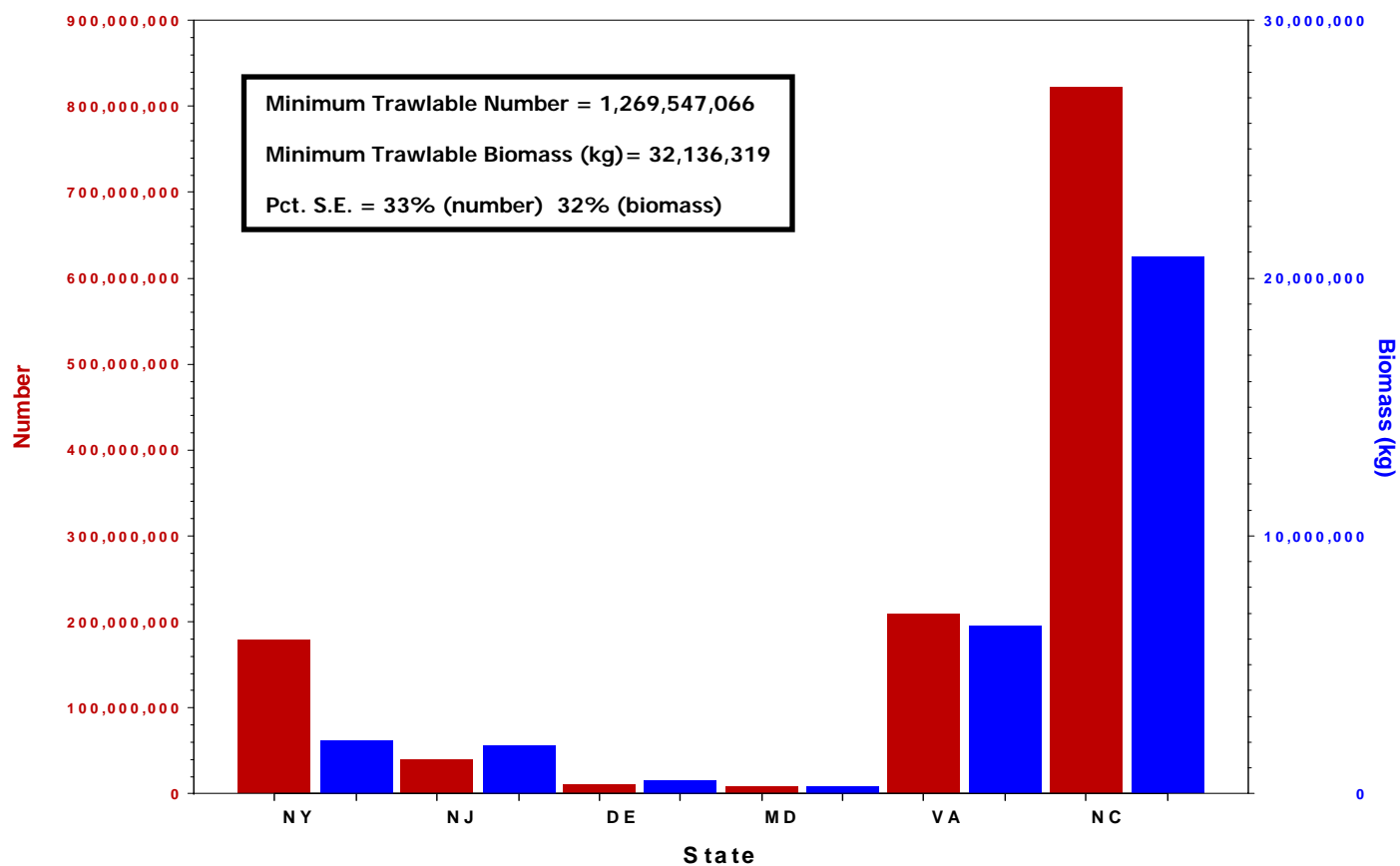


Figure 32. Sex ratios by state for scup.

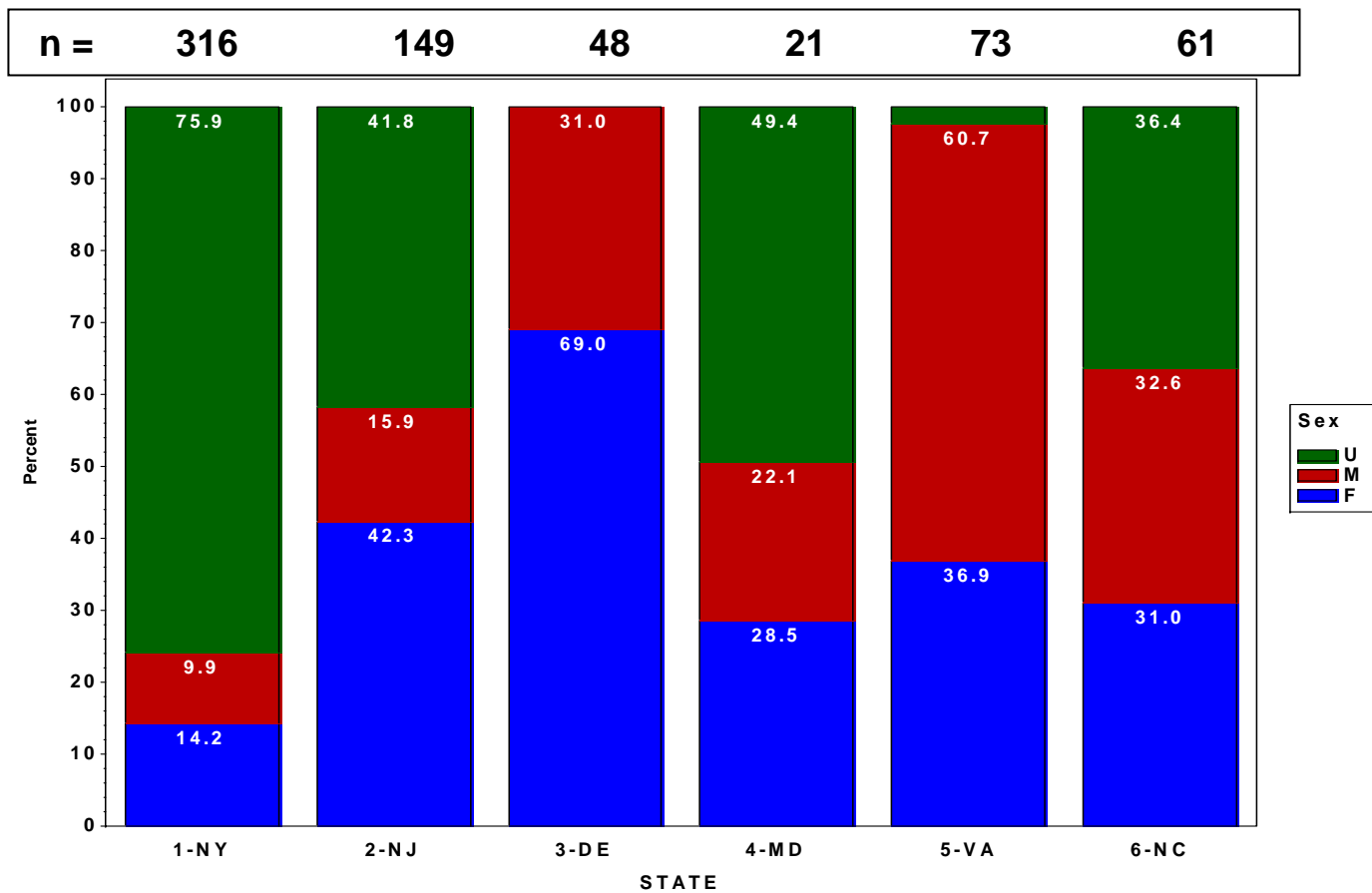


Figure 33. Length frequency for scup.

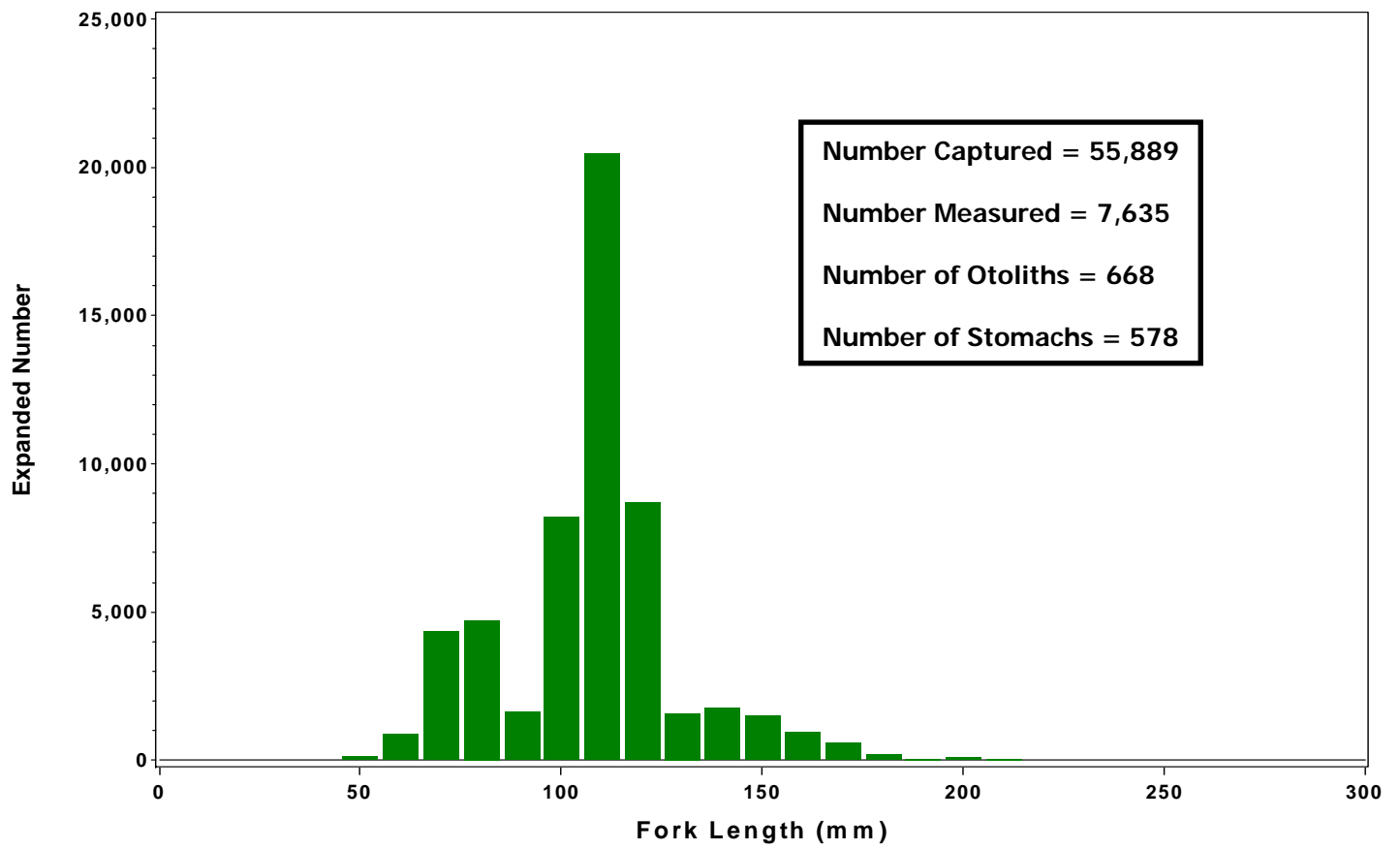


Figure 34. Length-weight regression for scup, sexes combined.

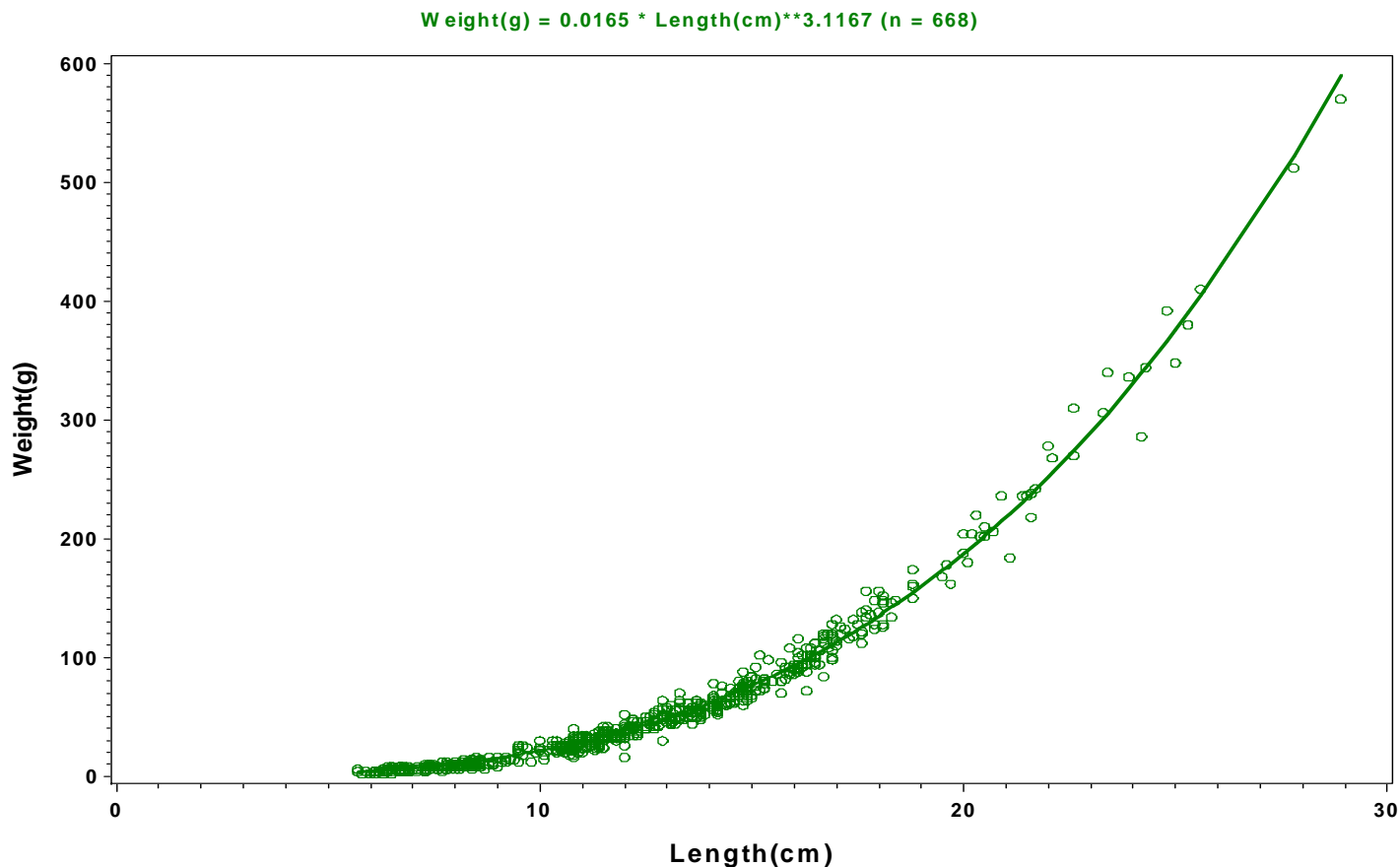


Figure 35. Length-weight regression for scup, by sex.

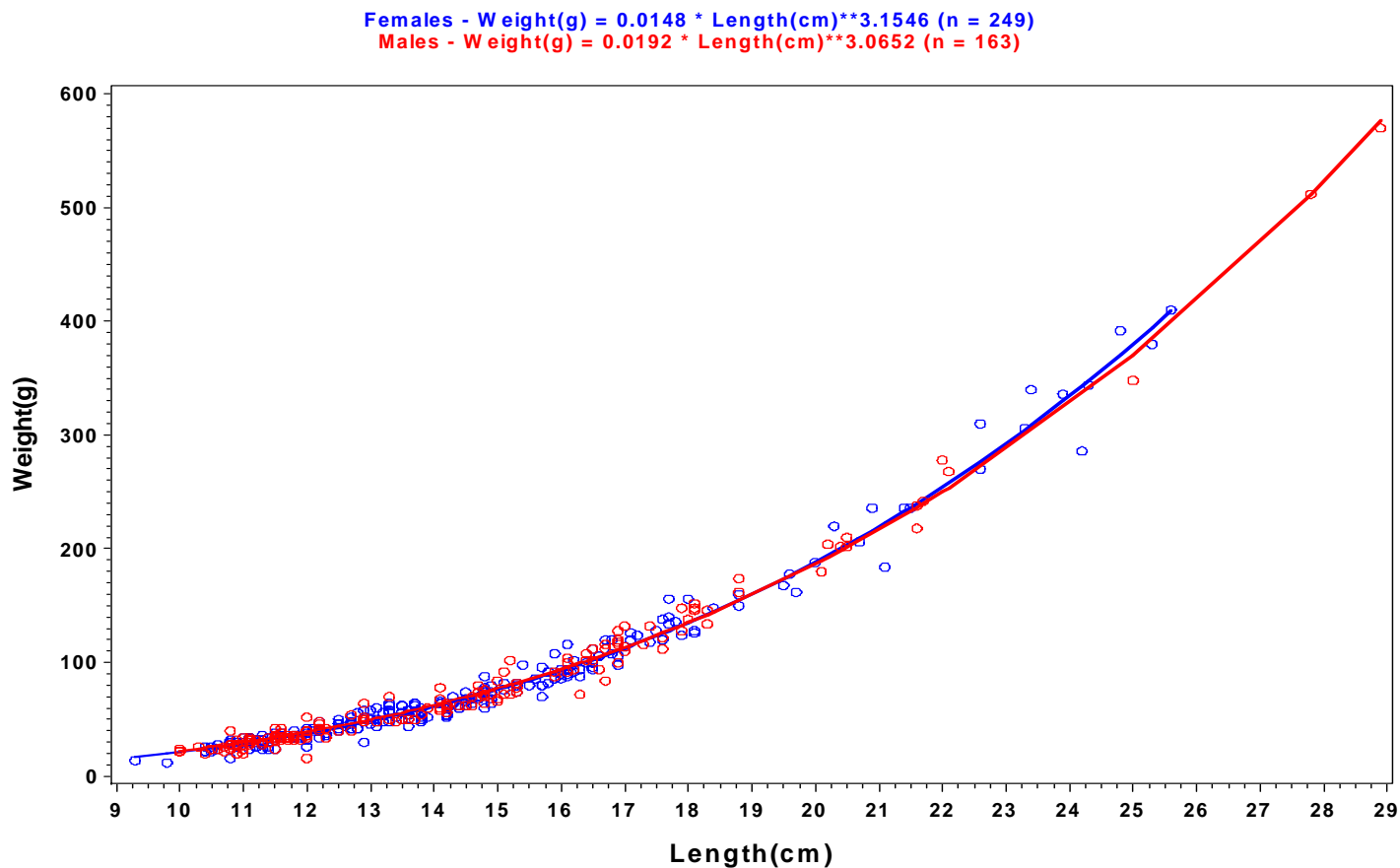


Figure 36. Maturity logistic regression for scup, females.

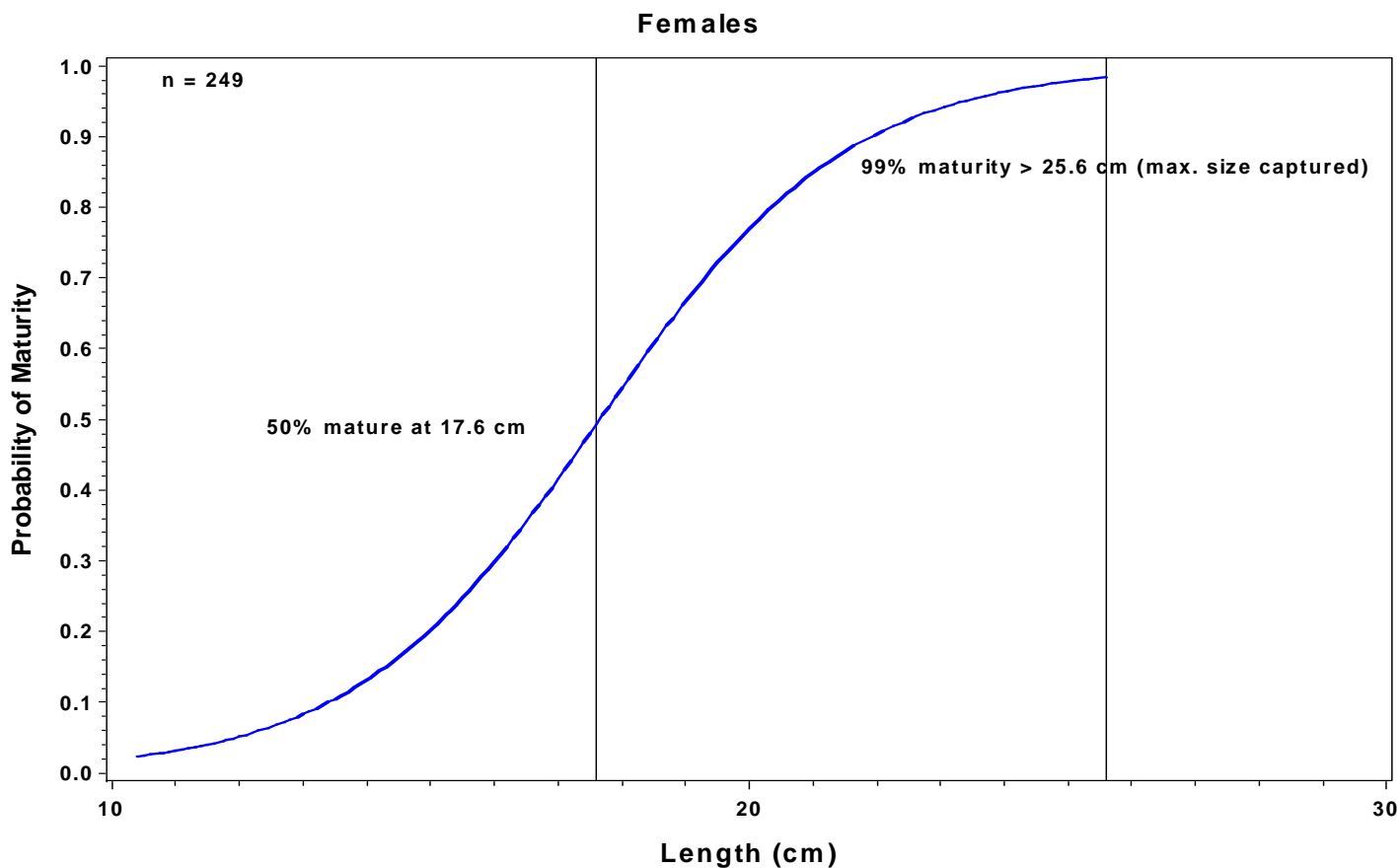
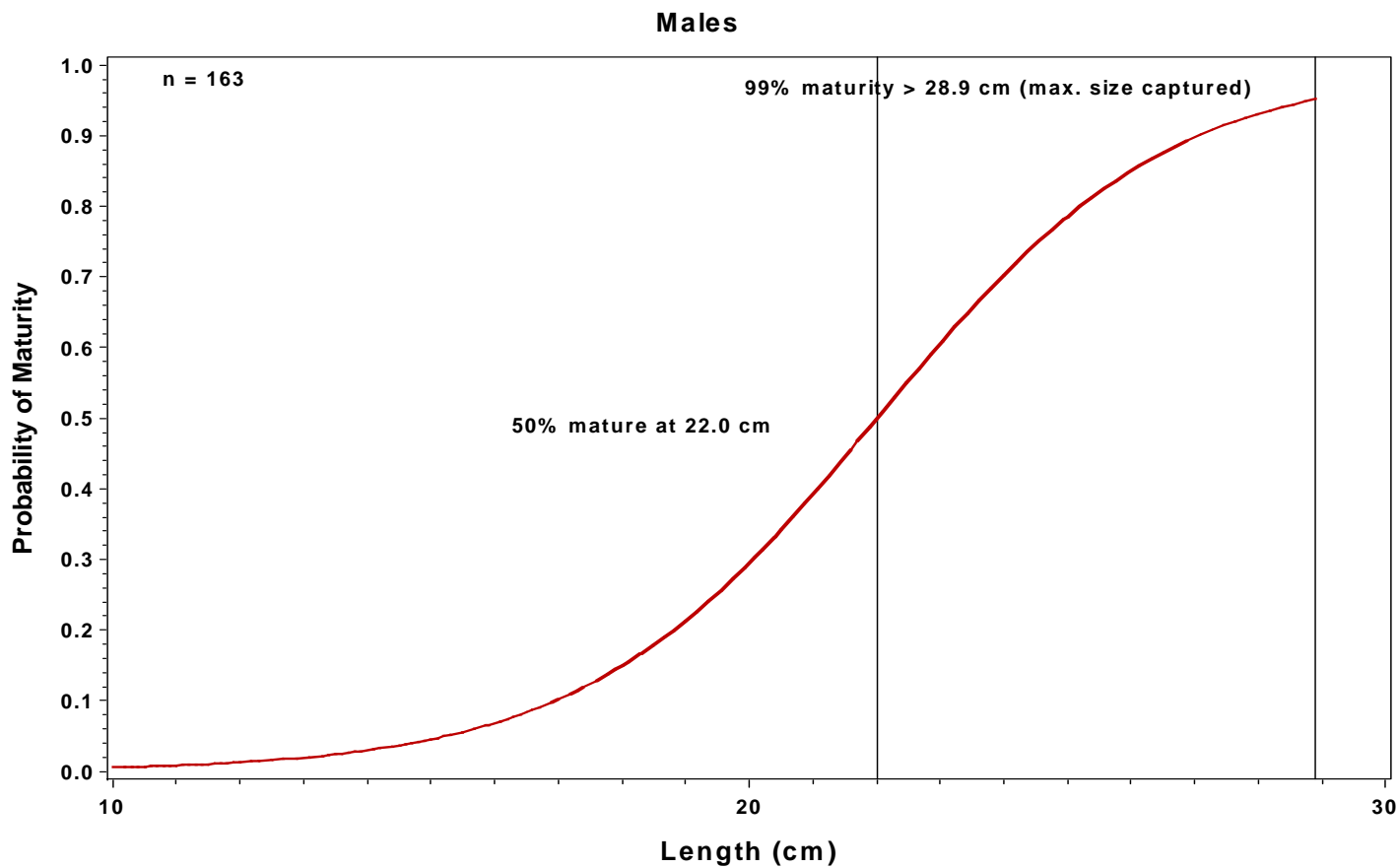


Figure 37. Maturity logistic regression for scup, males.



# Striped Bass

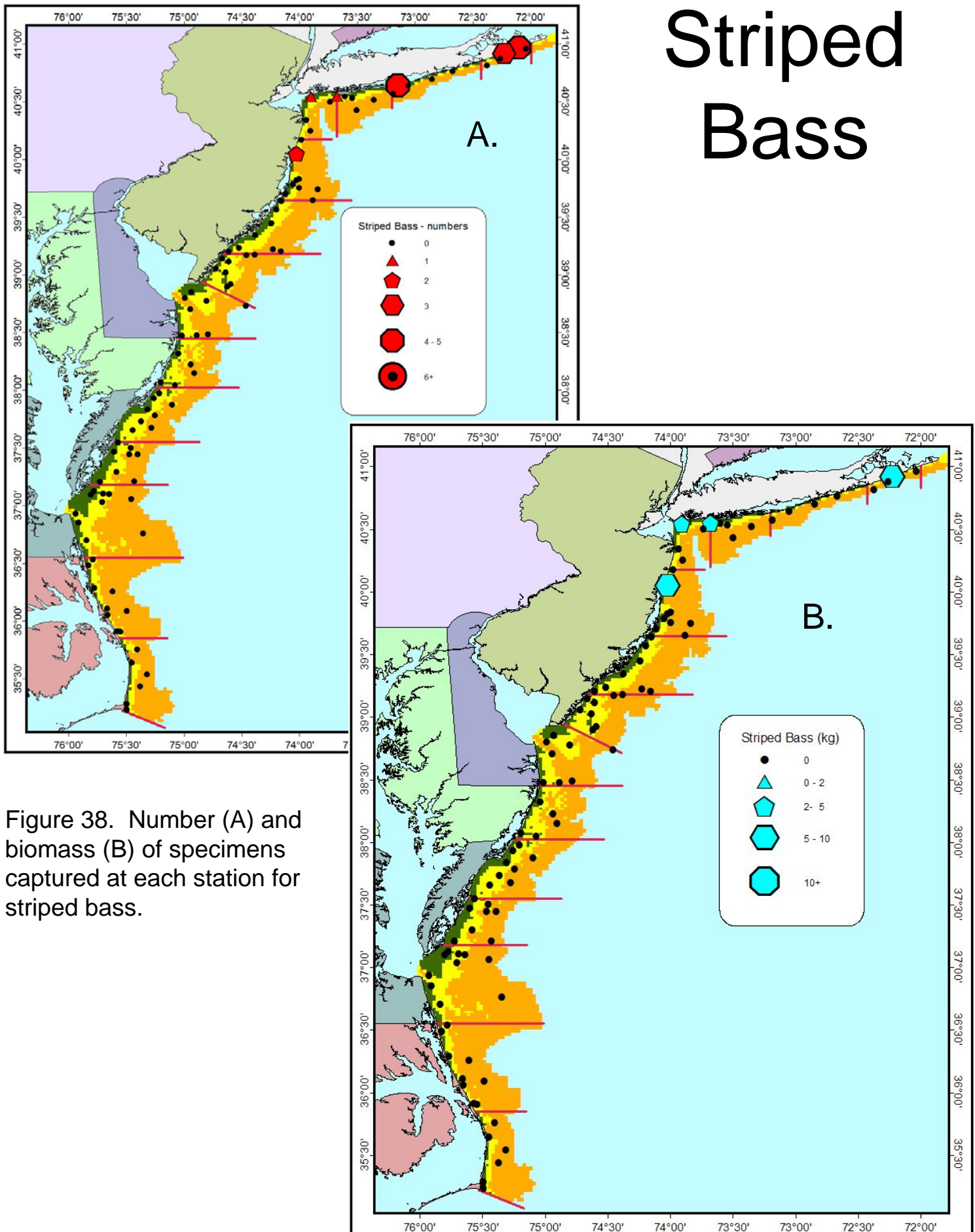


Figure 38. Number (A) and biomass (B) of specimens captured at each station for striped bass.



Figure 39. Minimum trawlable number and biomass by state for striped bass.

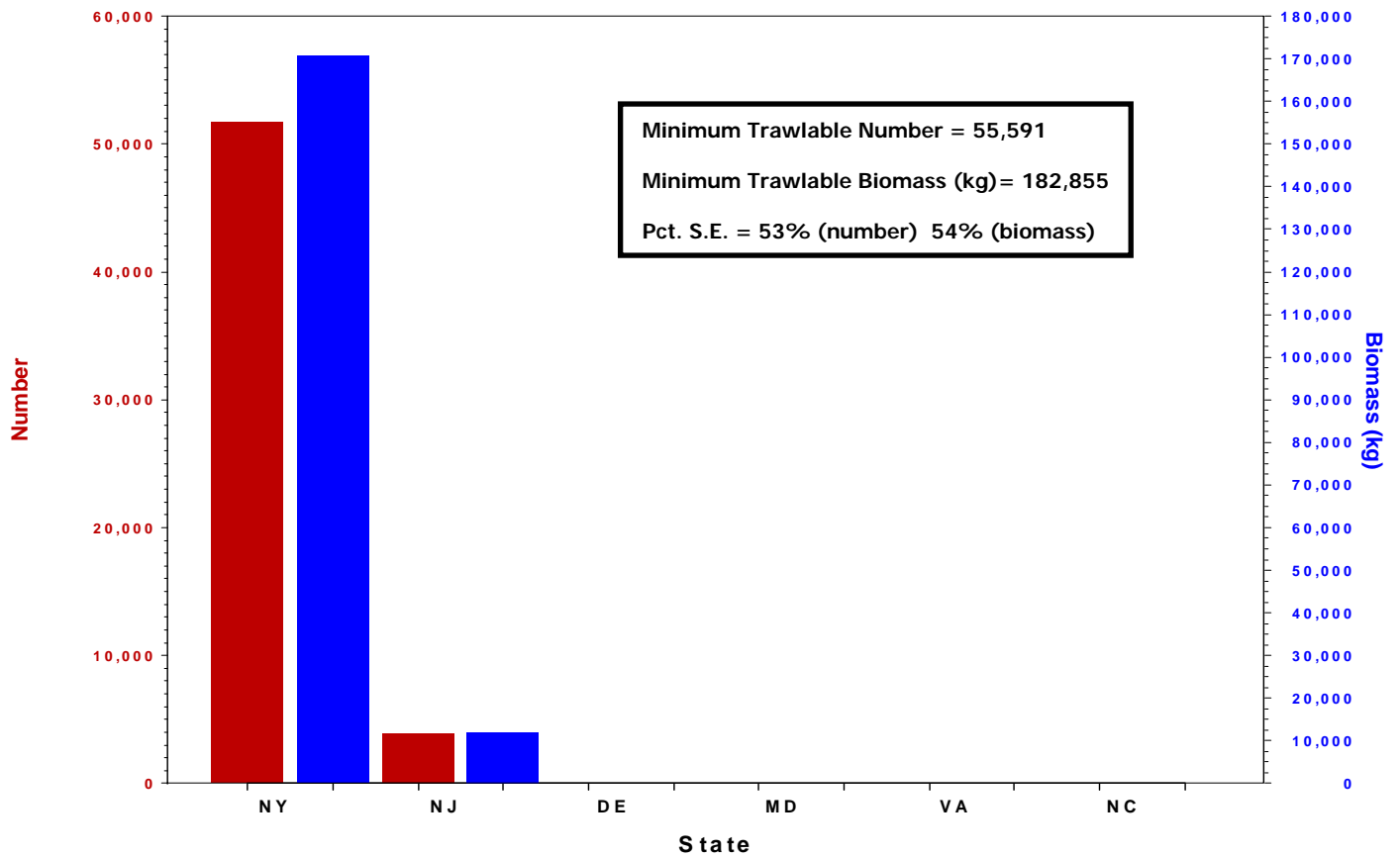


Figure 40. Sex ratios by state for striped bass.

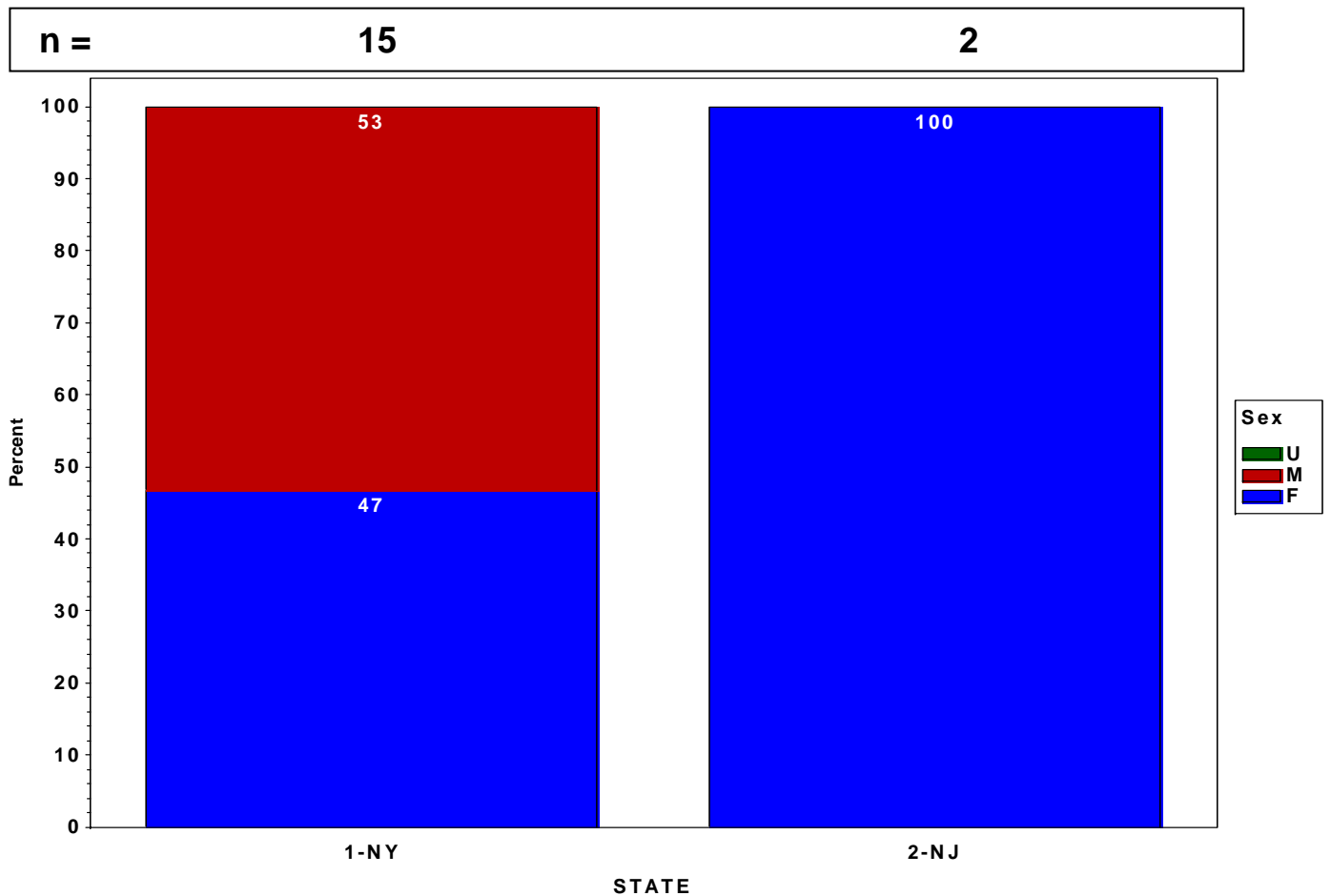


Figure 41. Length frequency for striped bass.

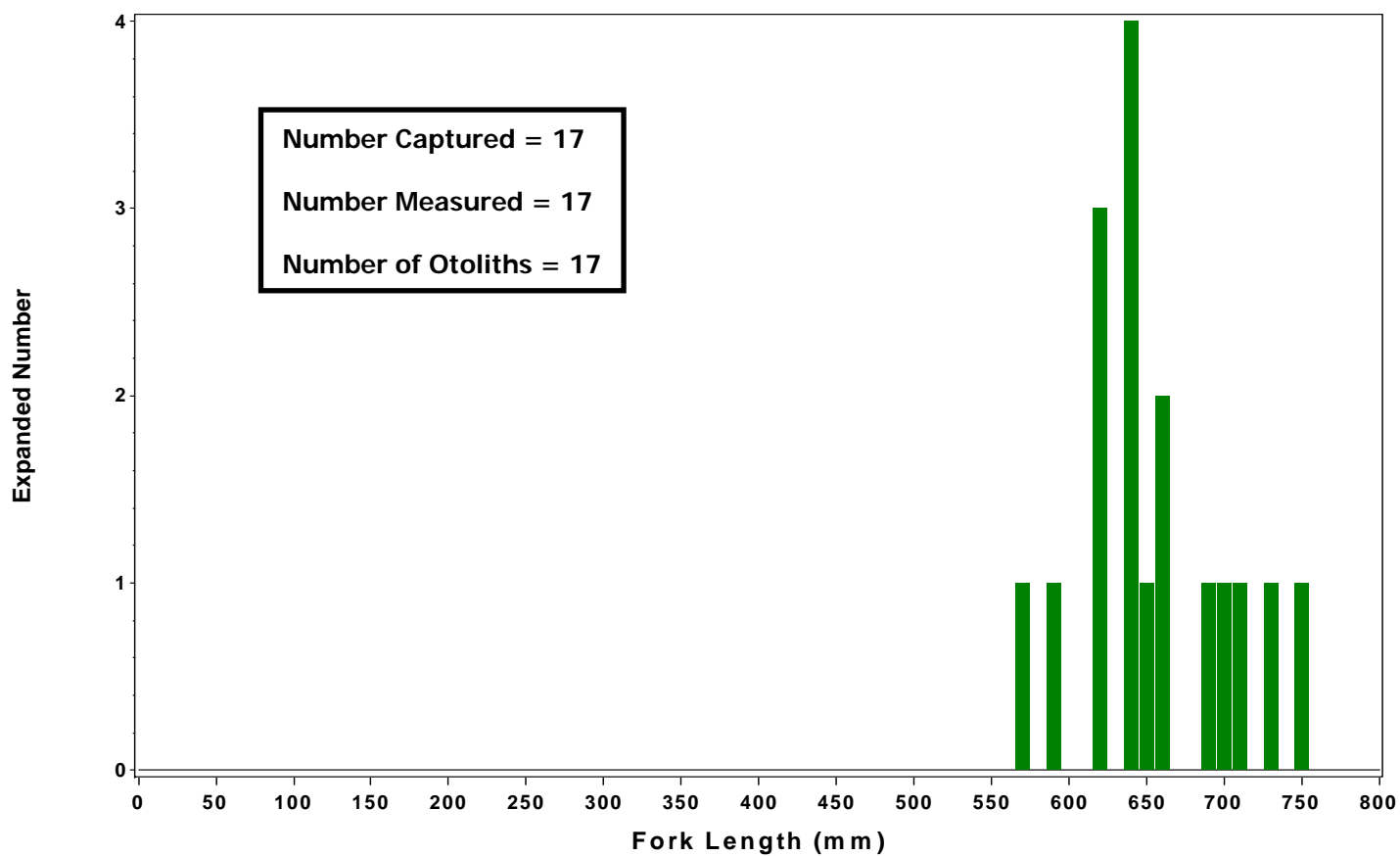


Figure 42. Diet composition by weight for striped bass.

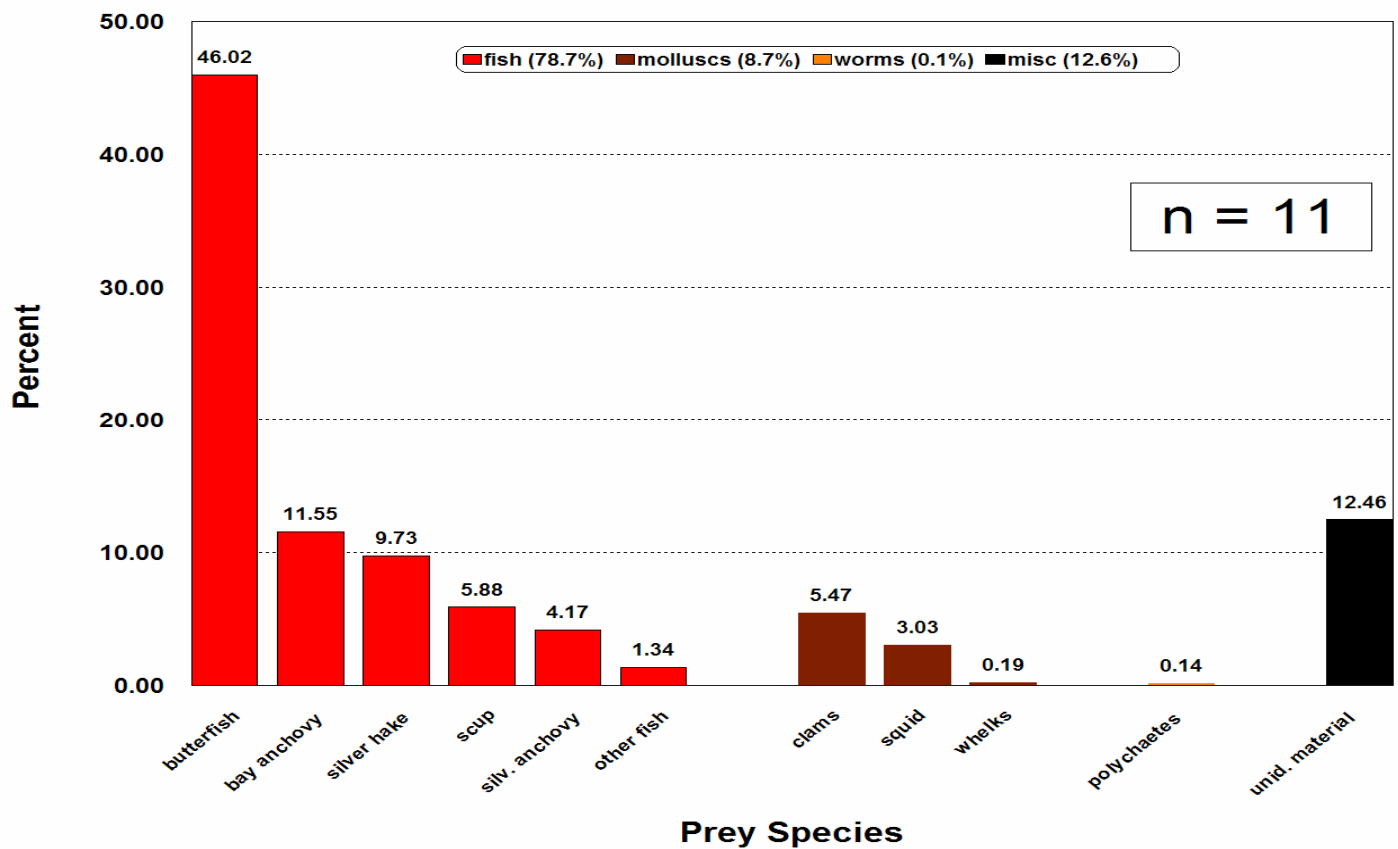
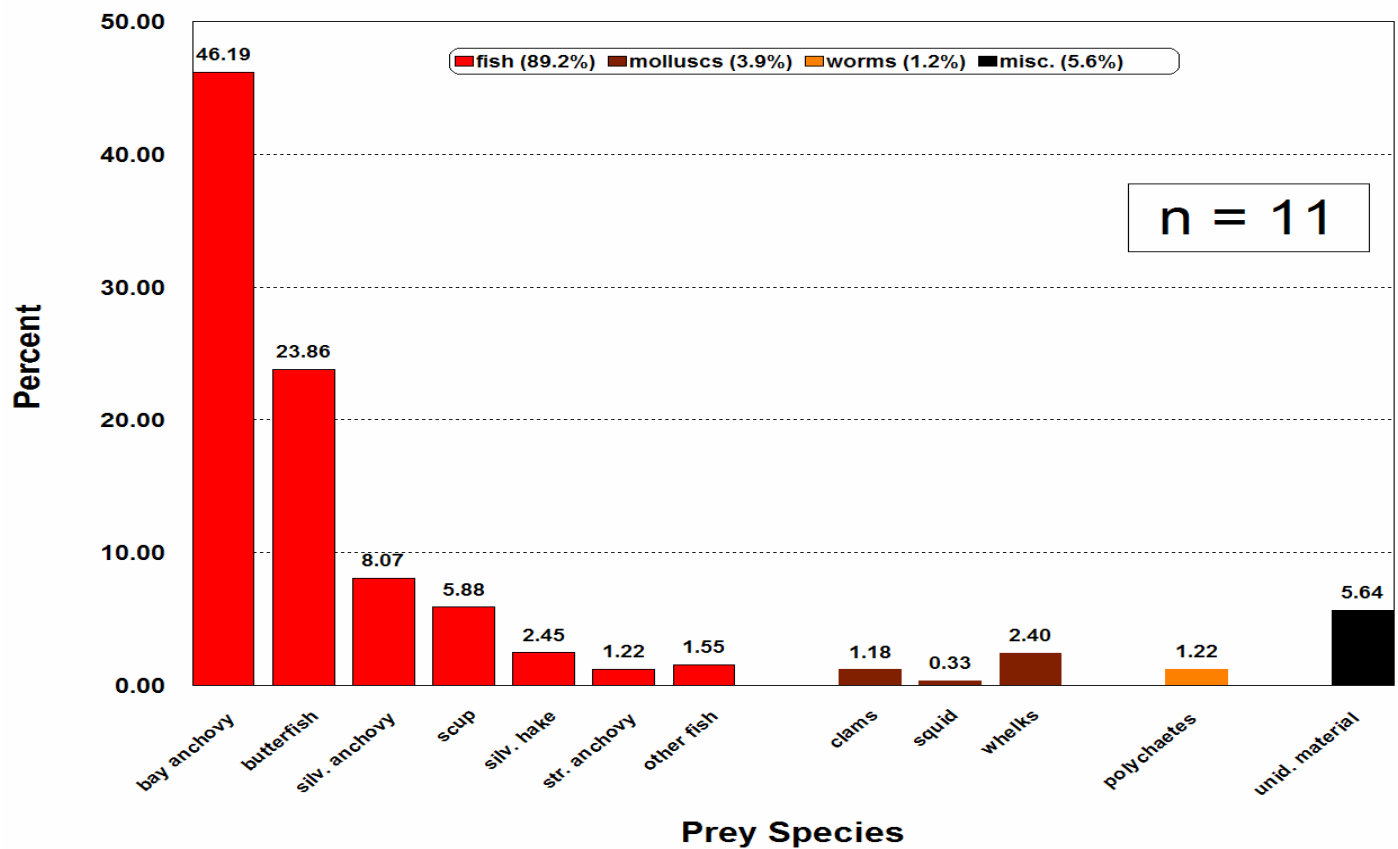


Figure 43. Diet composition by number for striped bass.



# Summer Flounder

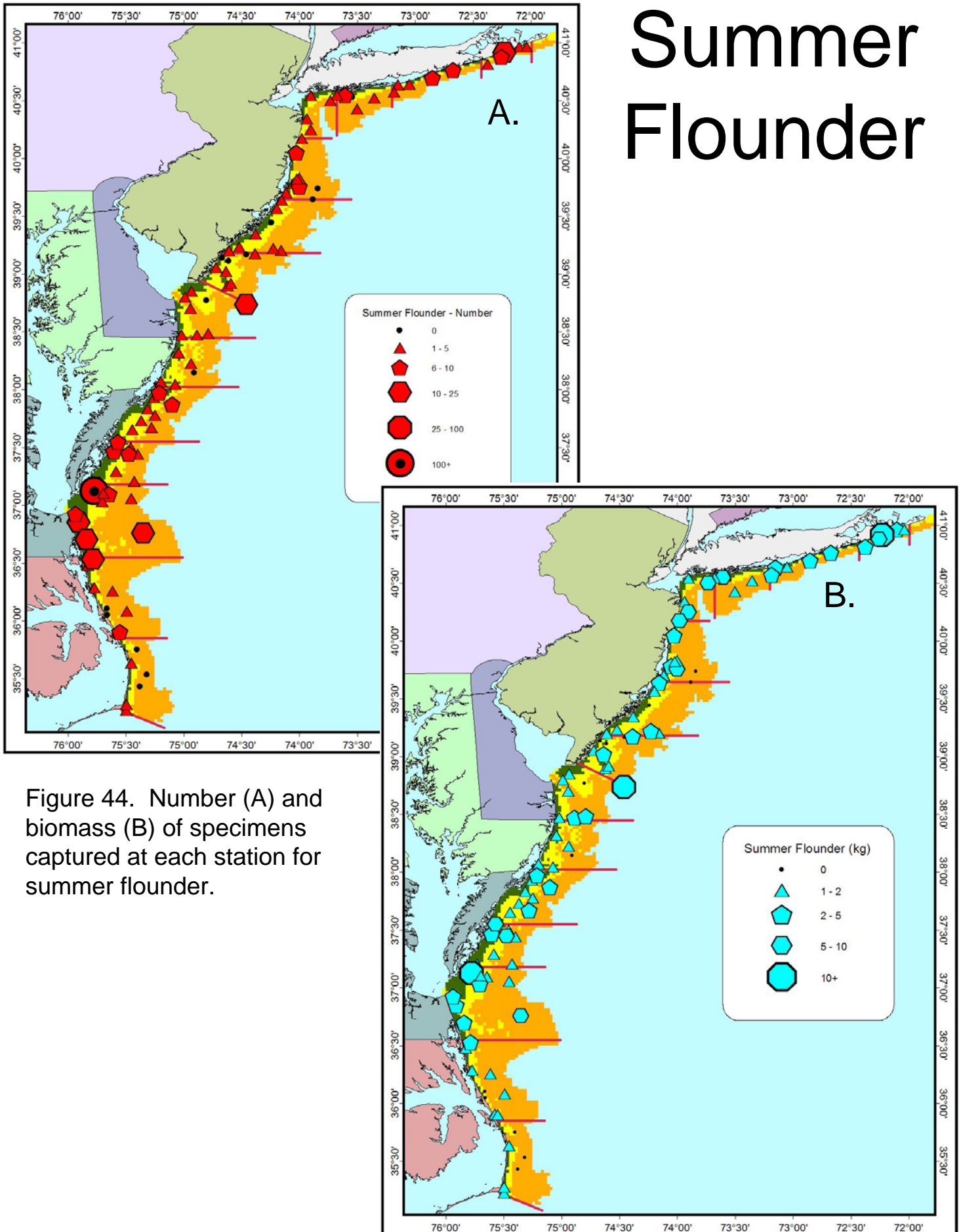


Figure 44. Number (A) and biomass (B) of specimens captured at each station for summer flounder.

Figure 45. Minimum trawlable number and biomass by state for summer flounder.

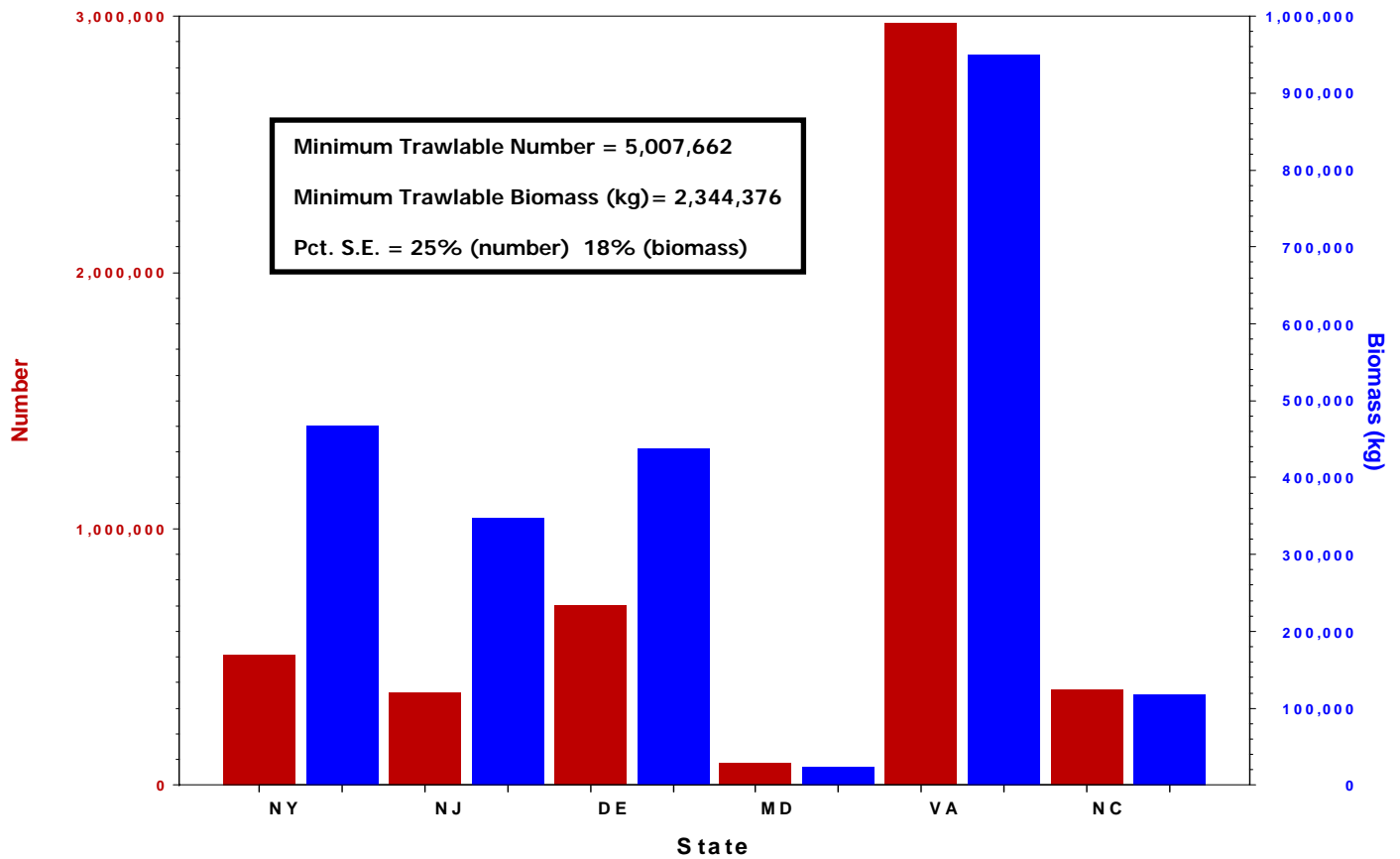


Figure 46. Sex ratios by state for summer flounder.

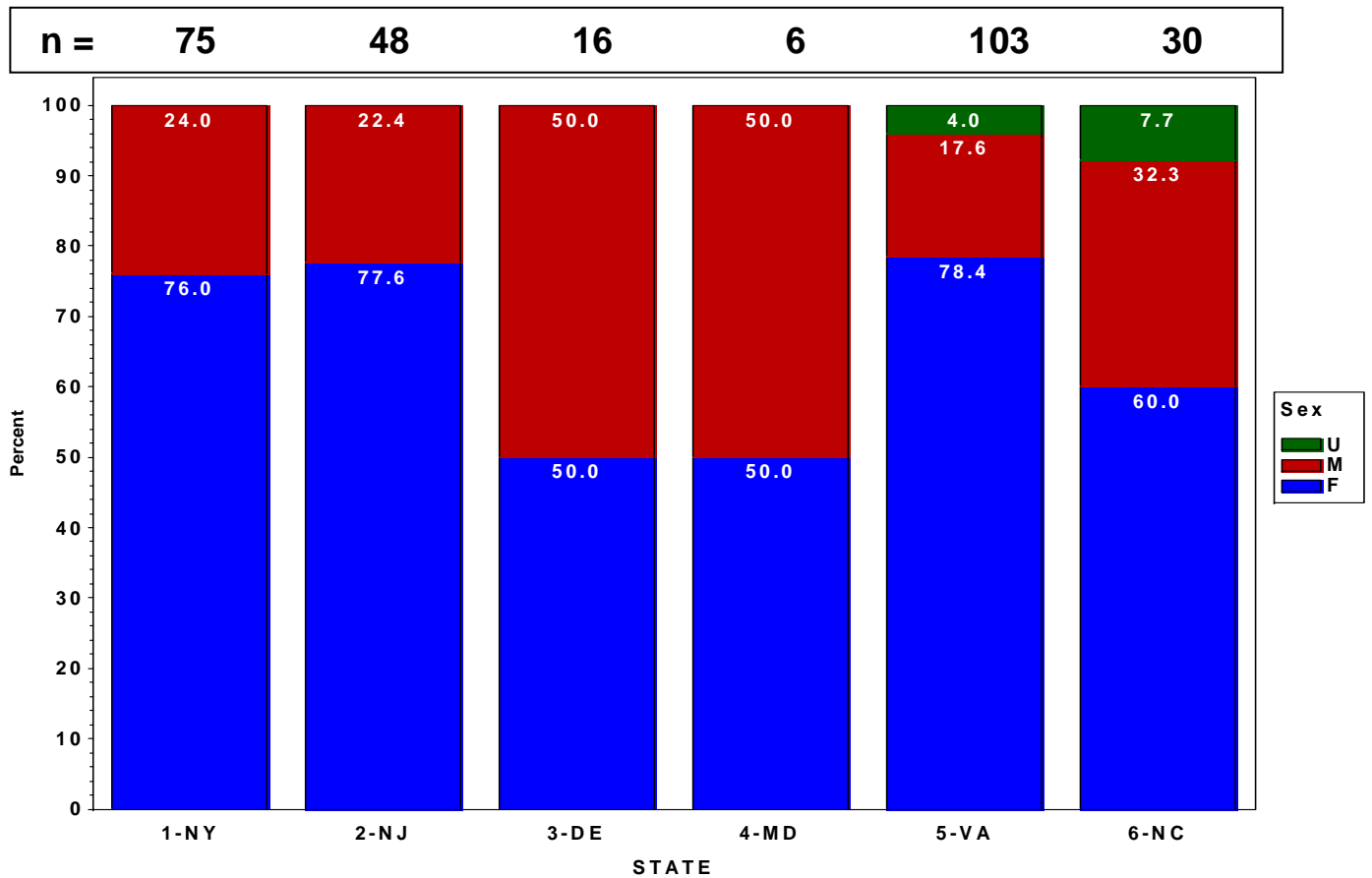


Figure 47. Length frequency for summer flounder.

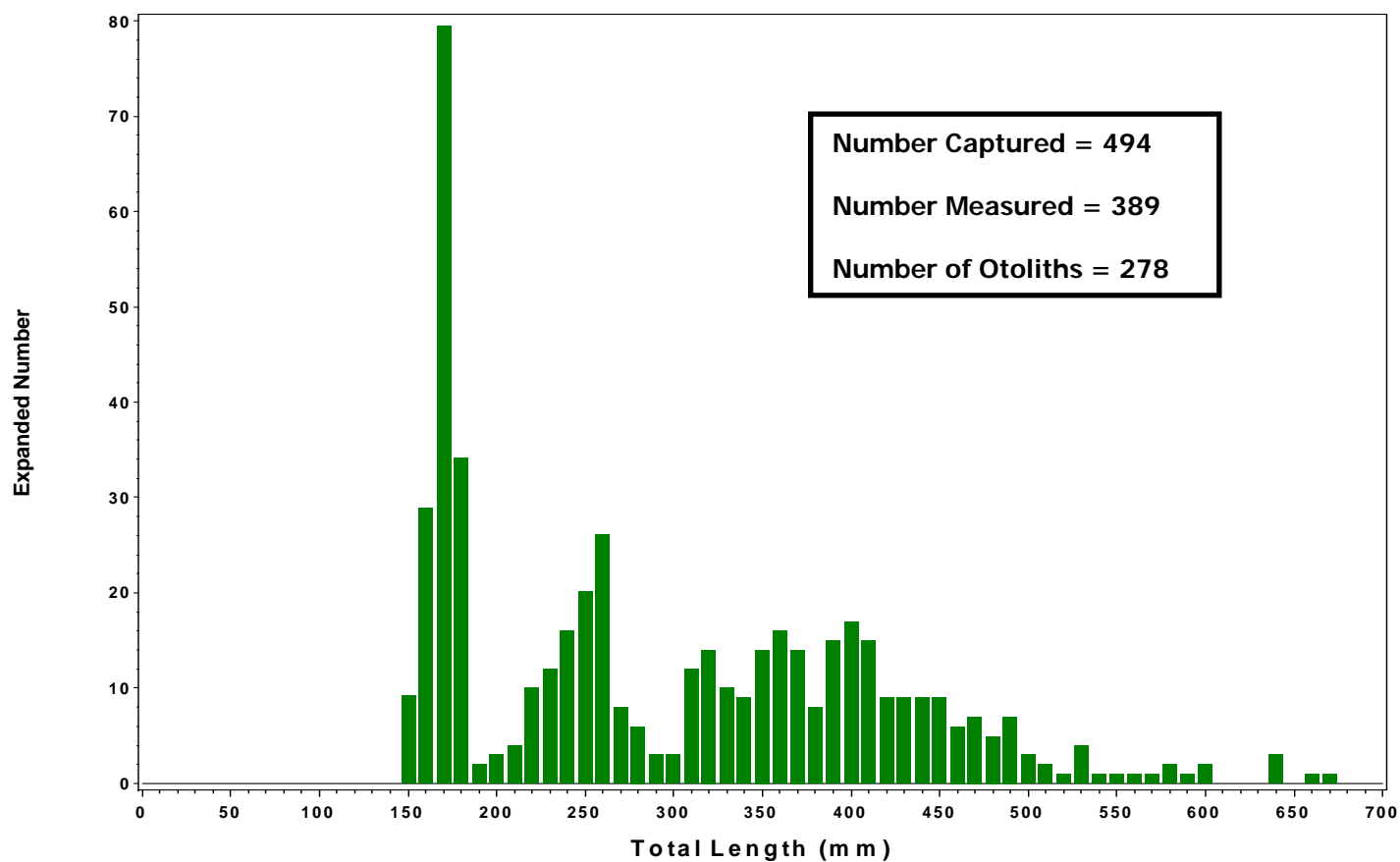


Figure 48. Length-weight regression for summer flounder, sexes combined.

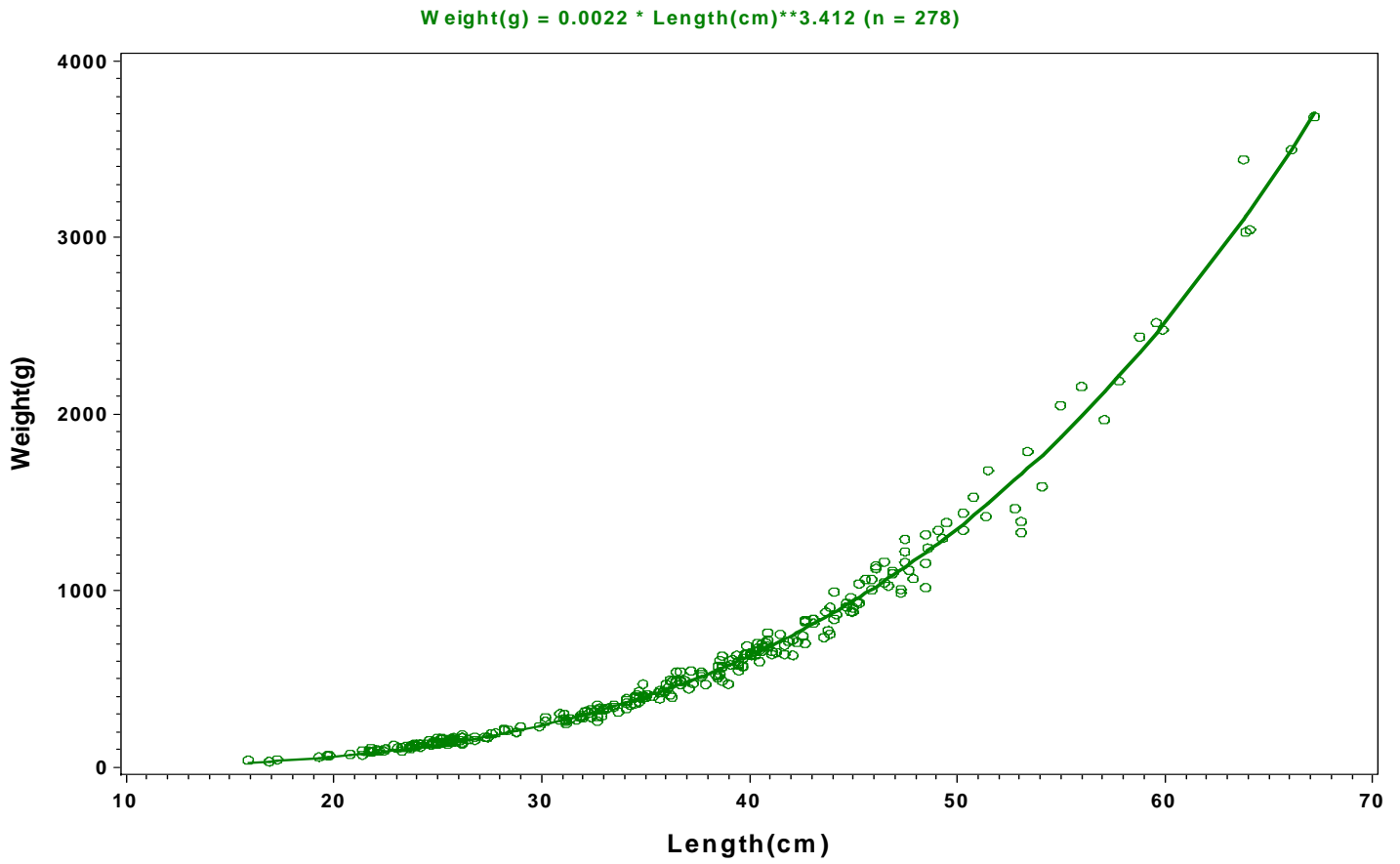


Figure 49. Length-weight regression for summer flounder, by sex.

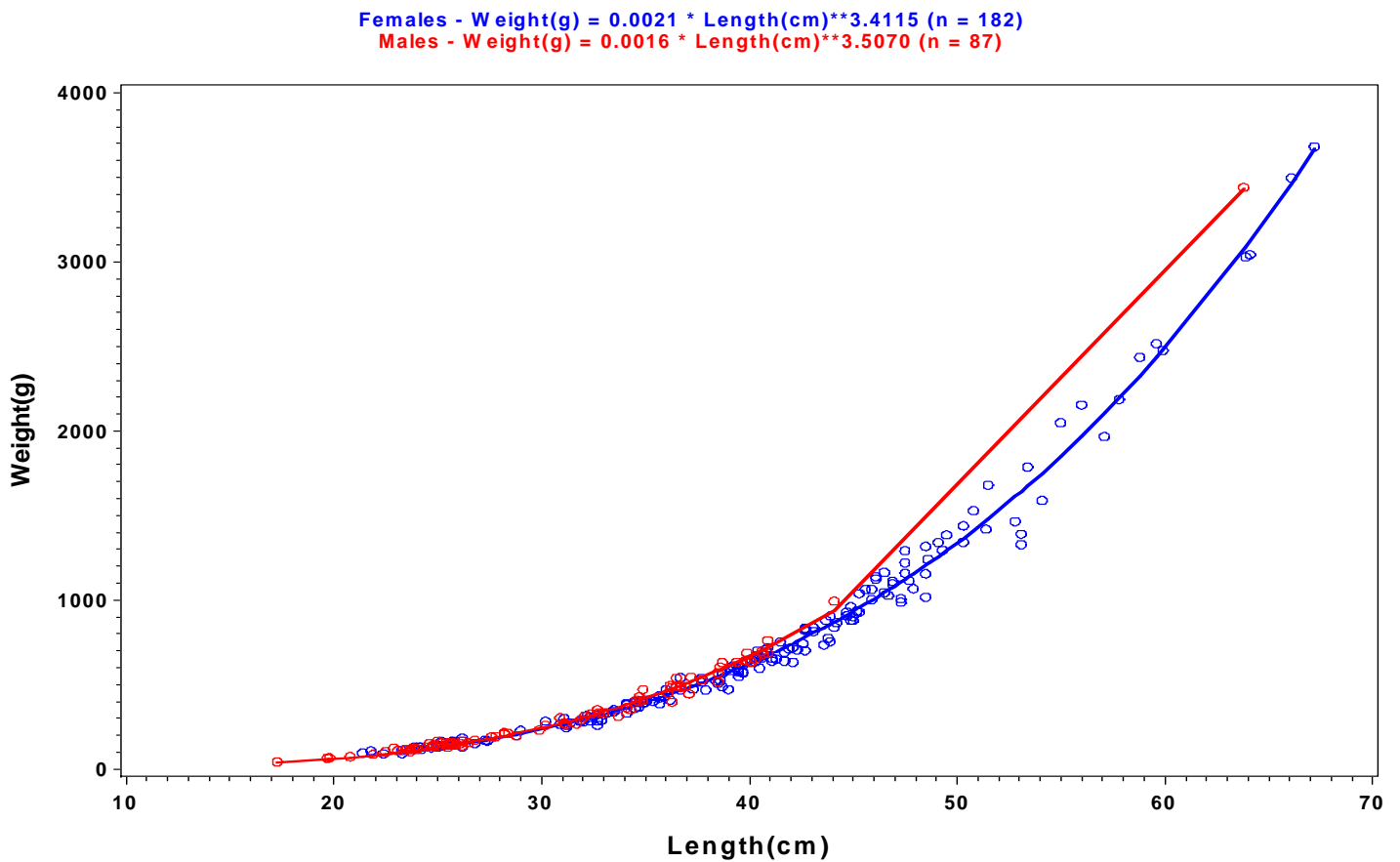


Figure 50. Maturity logistic regression for summer flounder, females.

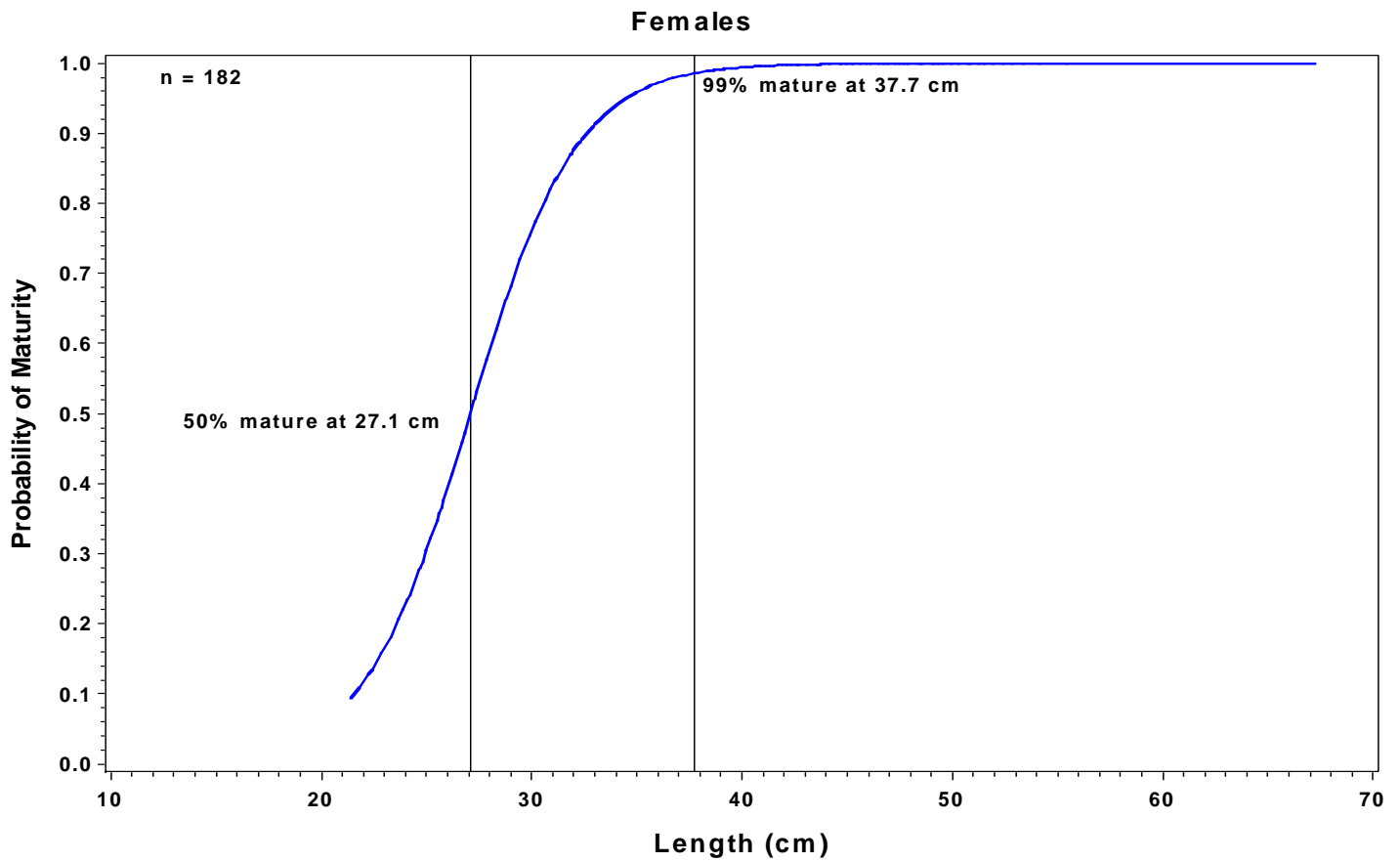


Figure 51. Maturity logistic regression for summer flounder, males.

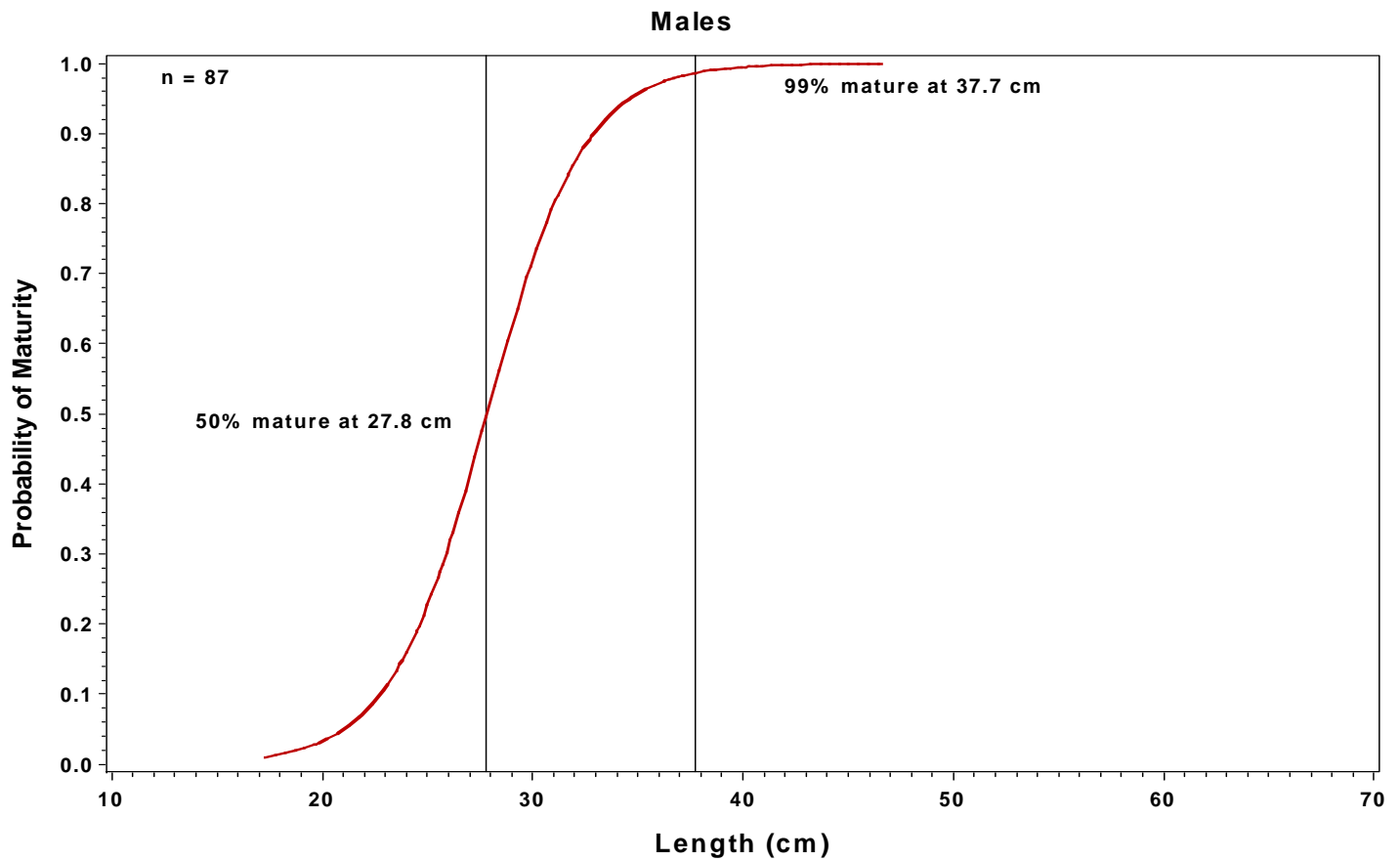




Figure 52. Diet composition by weight for summer flounder.

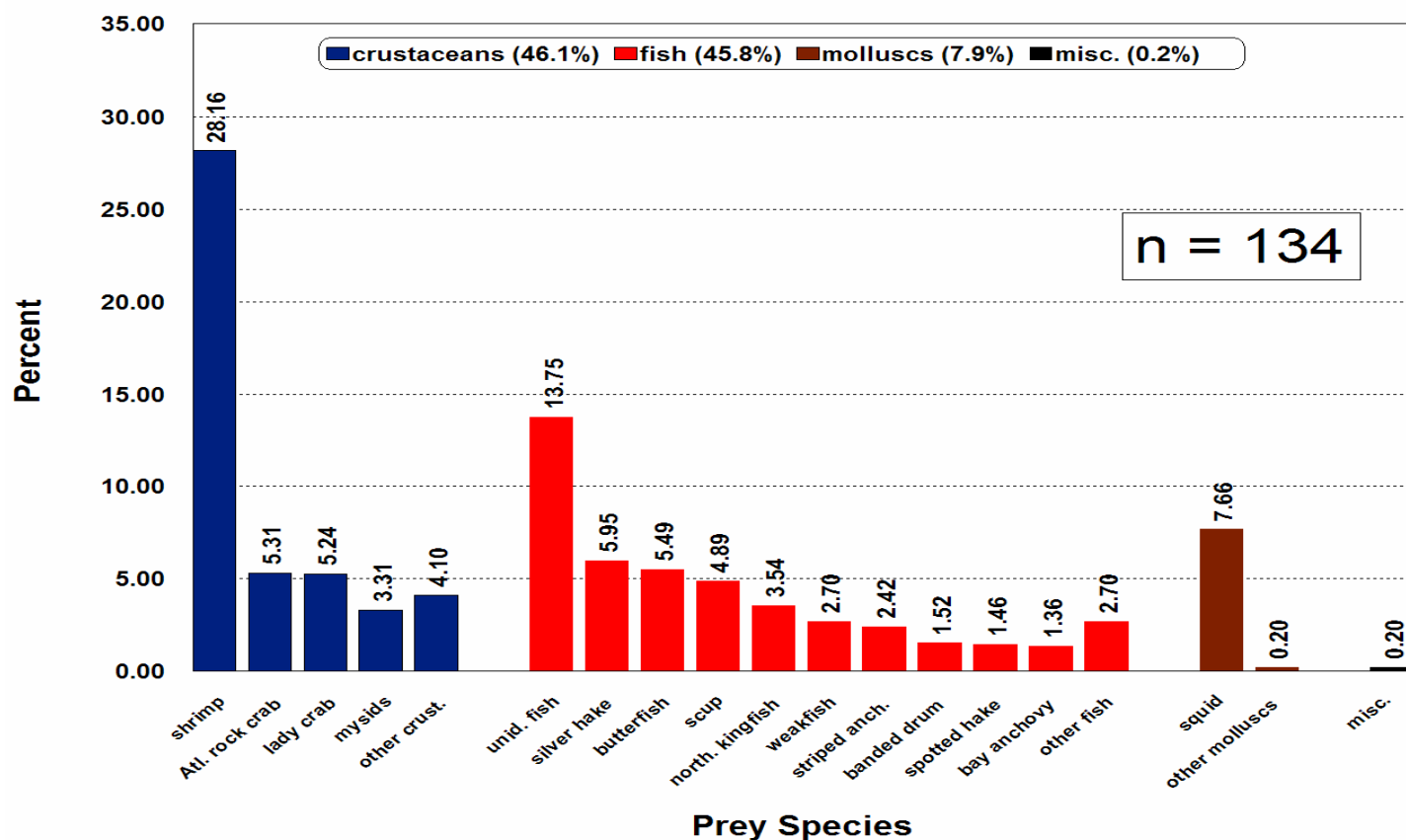
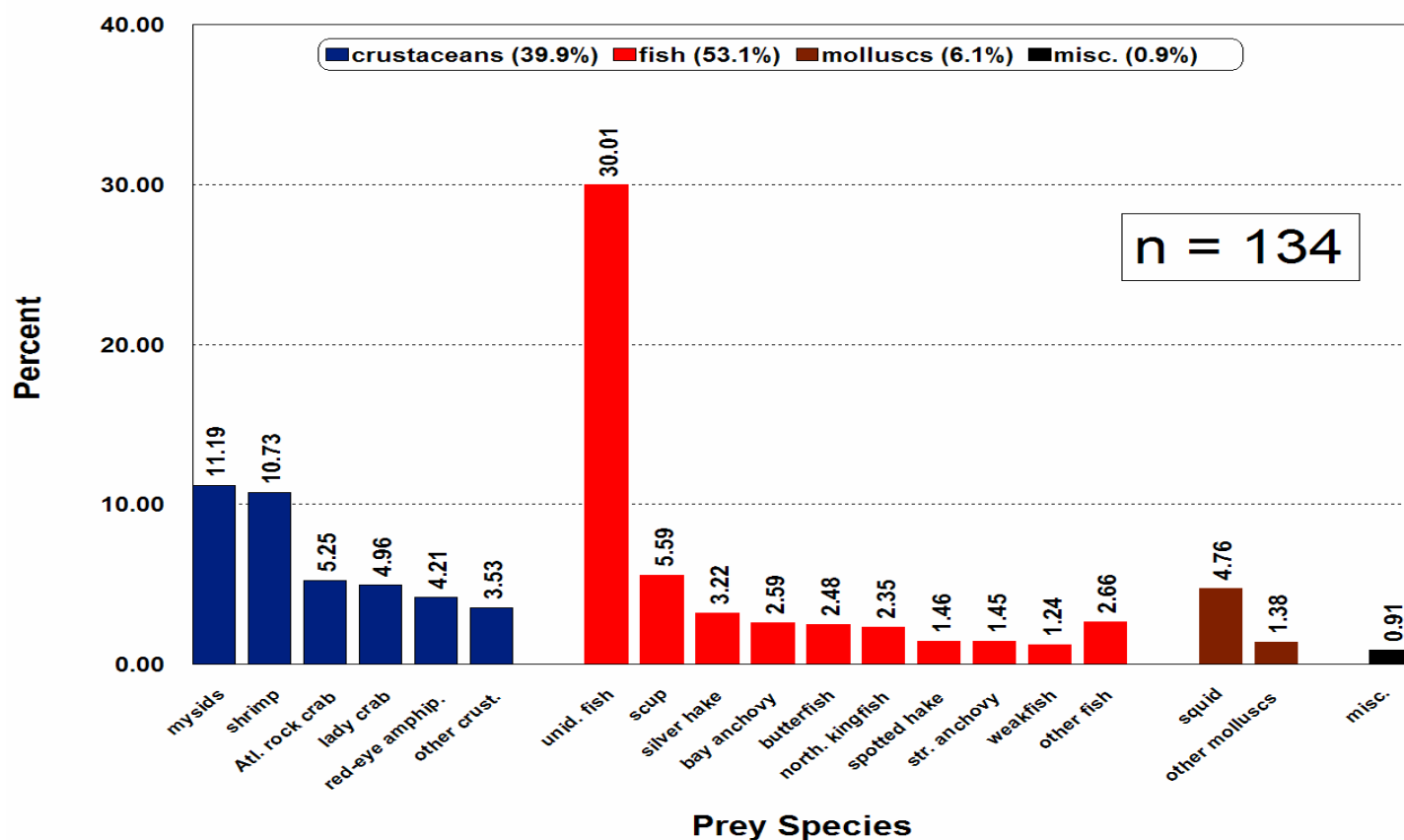


Figure 53. Diet composition by number for summer flounder.



# Weakfish

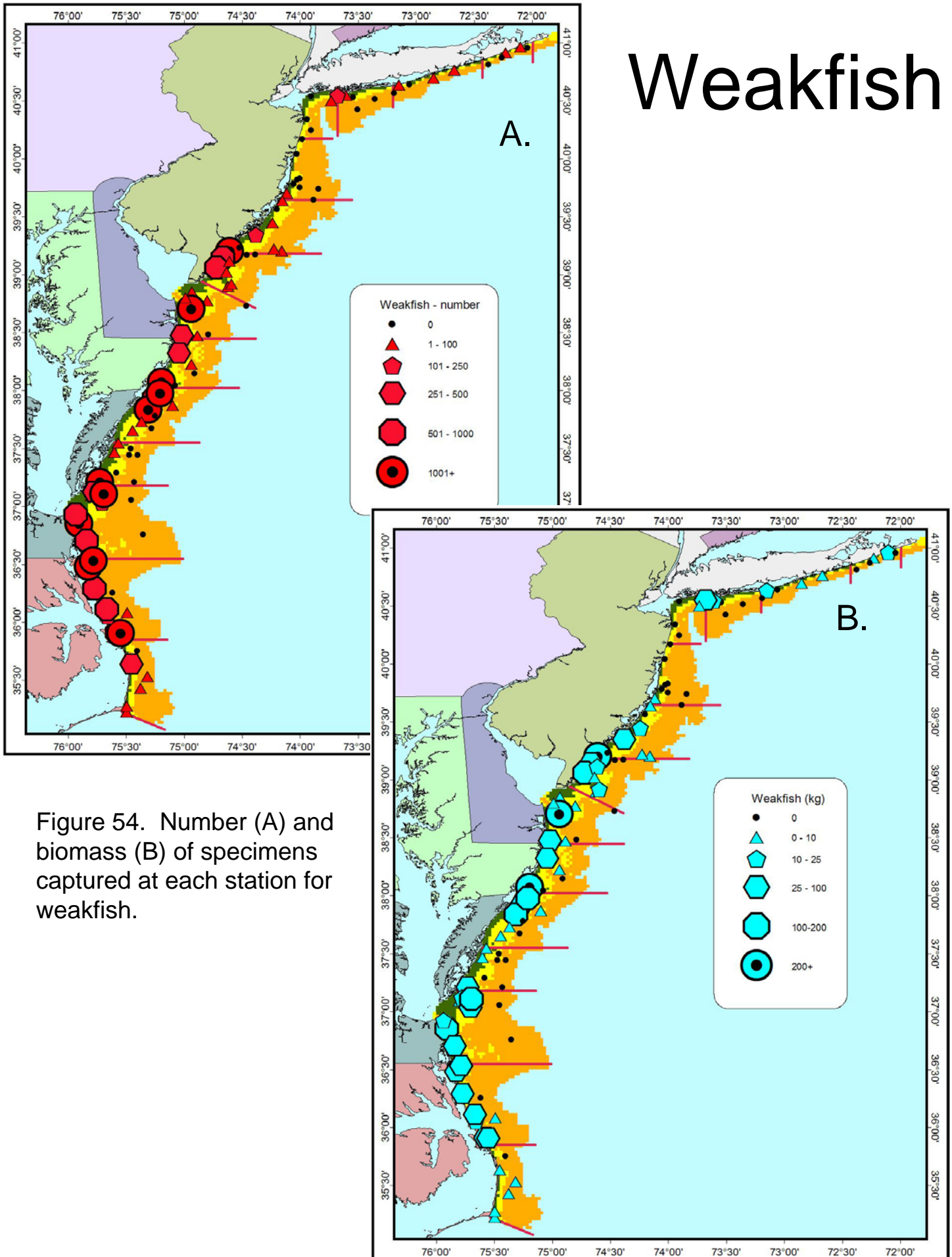


Figure 54. Number (A) and biomass (B) of specimens captured at each station for weakfish.

Figure 55. Minimum trawlable number and biomass by state for weakfish.

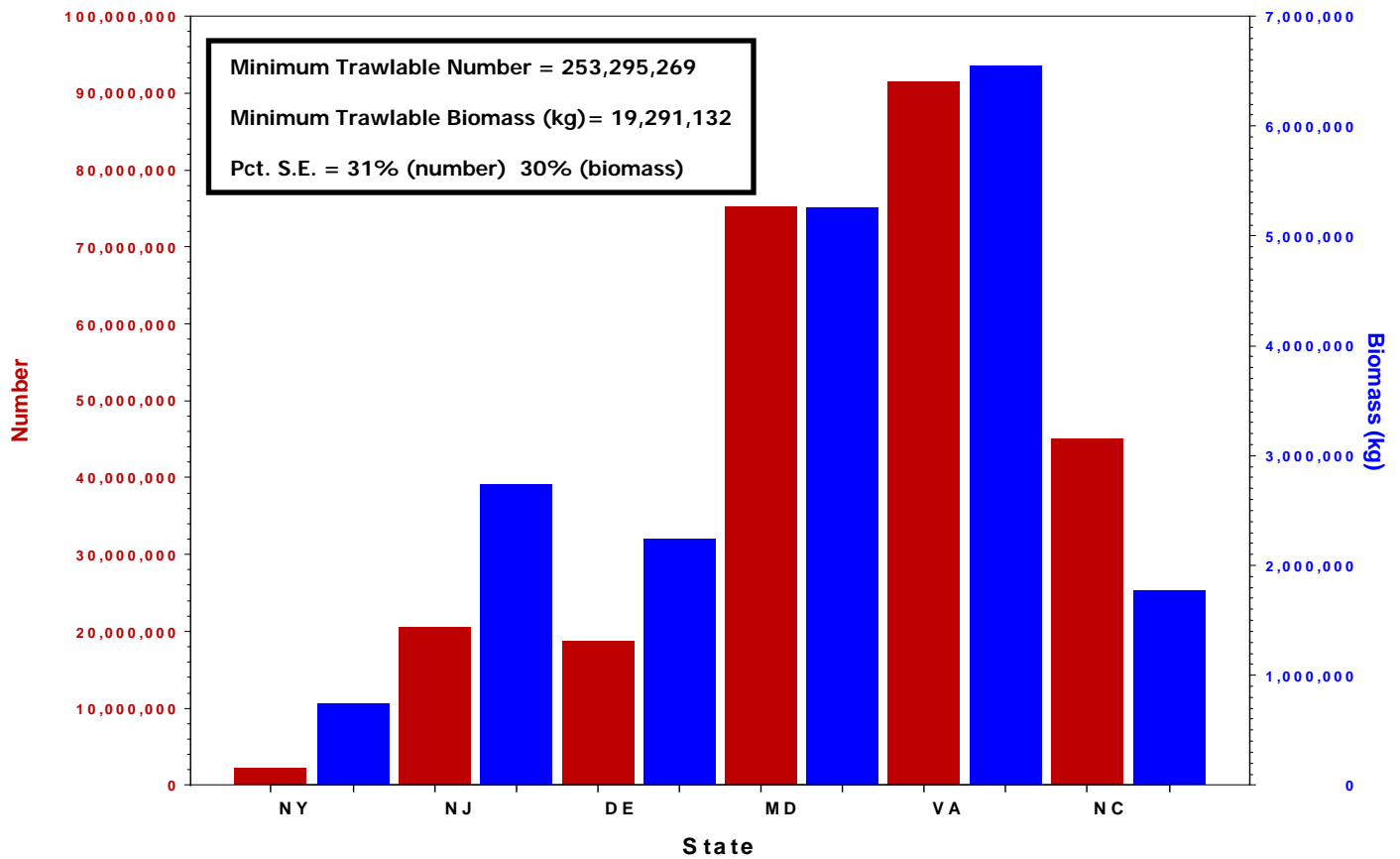


Figure 56. Sex ratios by state for weakfish.

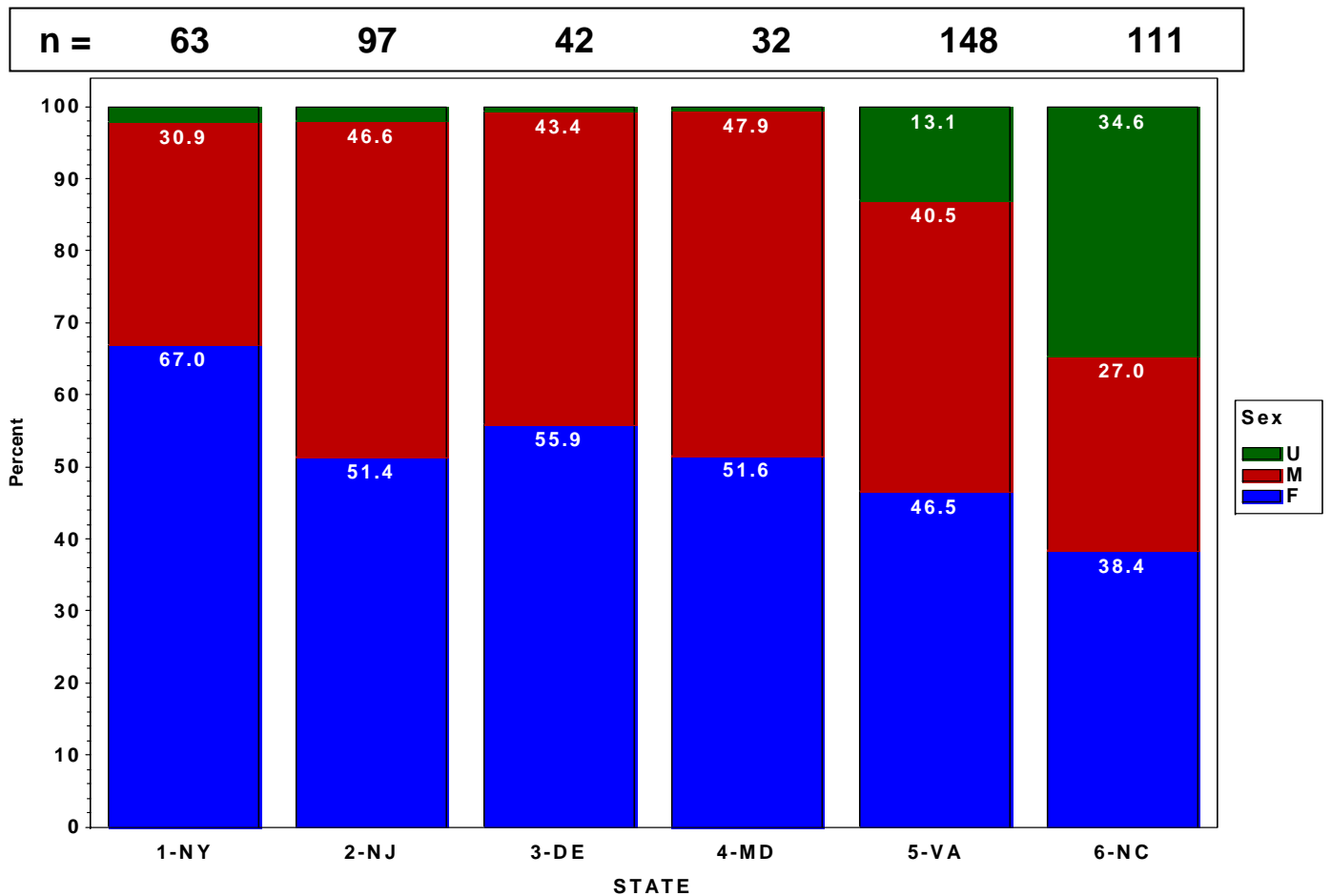


Figure 57. Length frequency for weakfish.

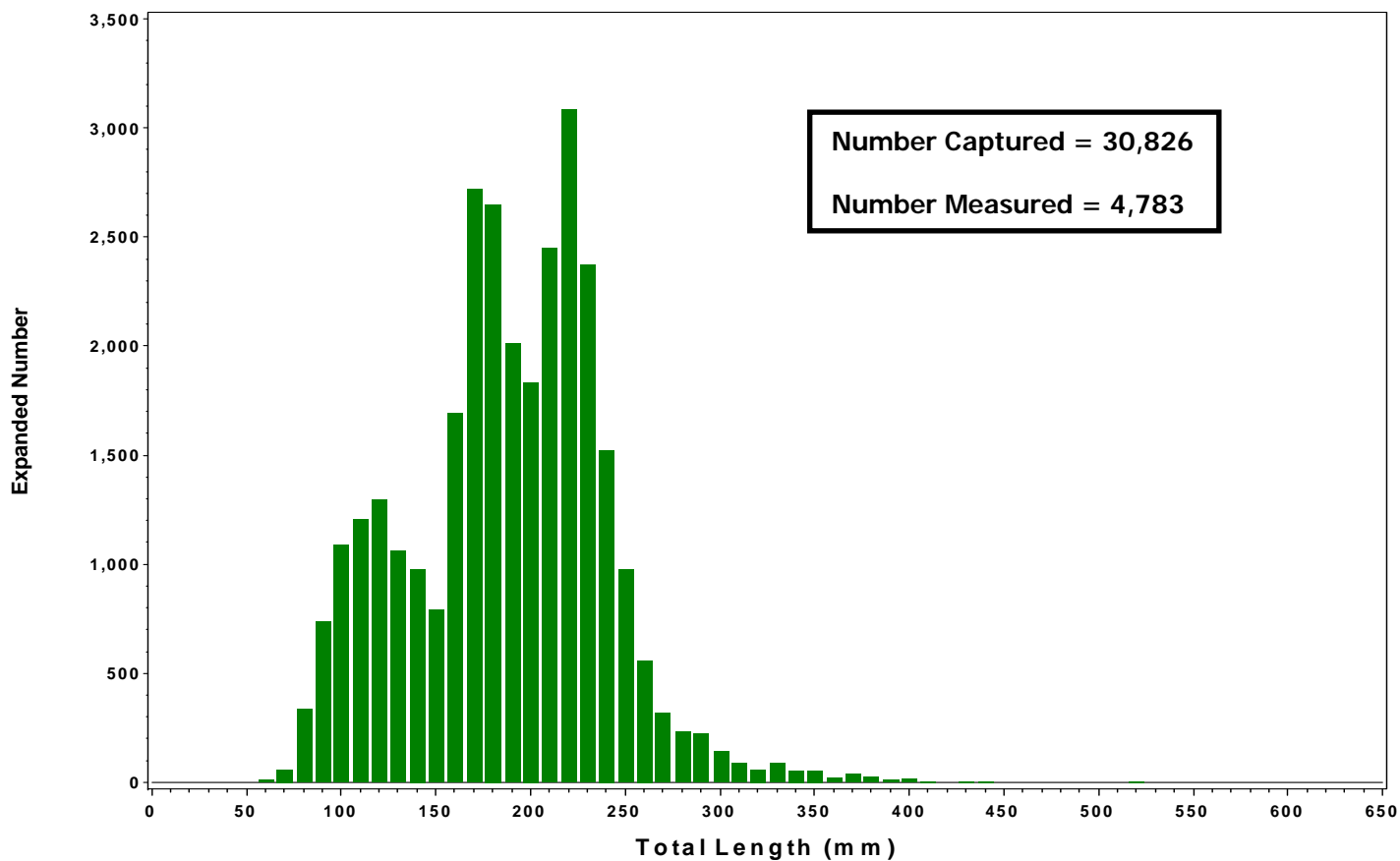


Figure 58. Age frequency for weakfish.

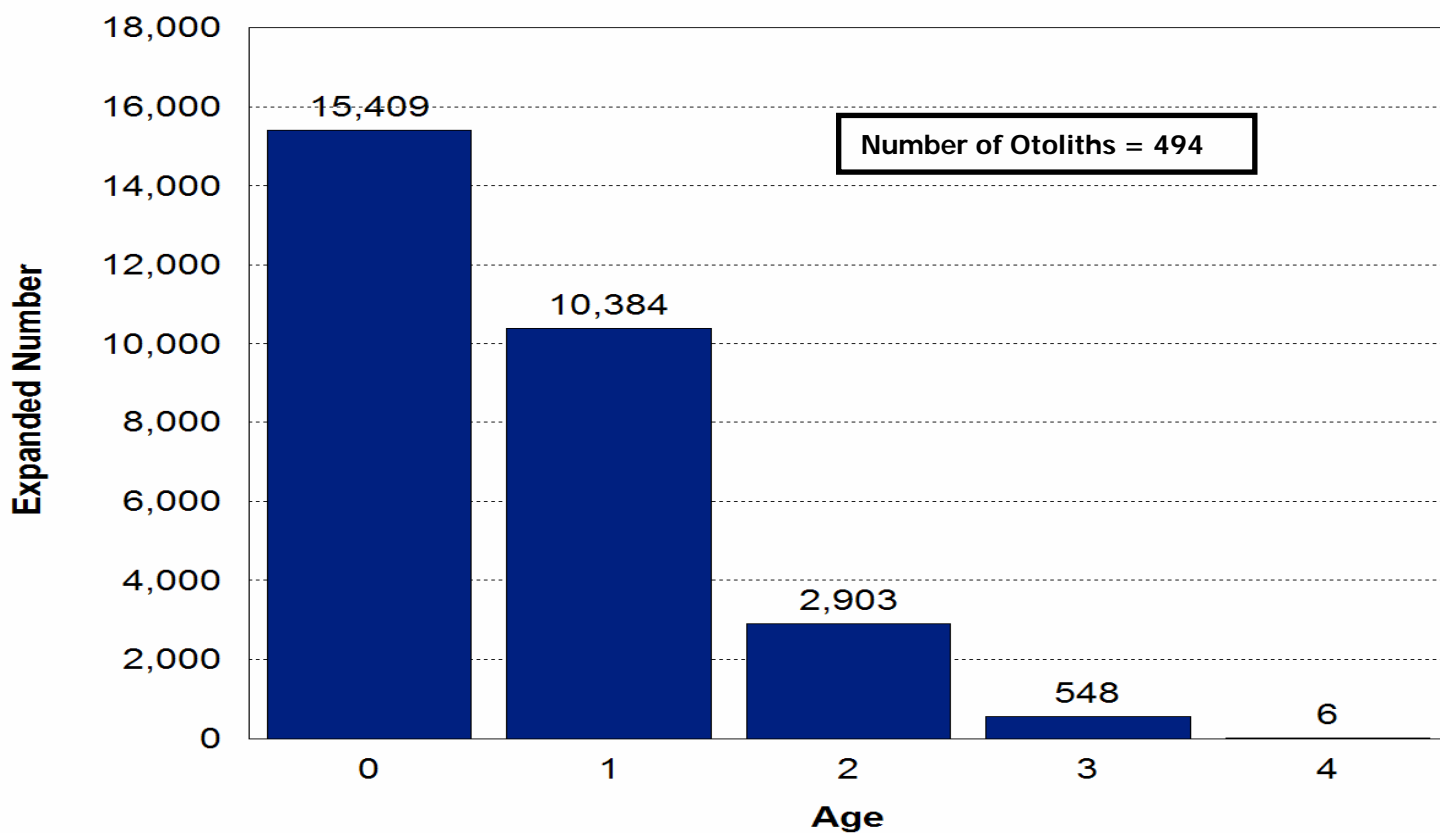


Figure 59. Length-weight regression for weakfish, sexes combined.

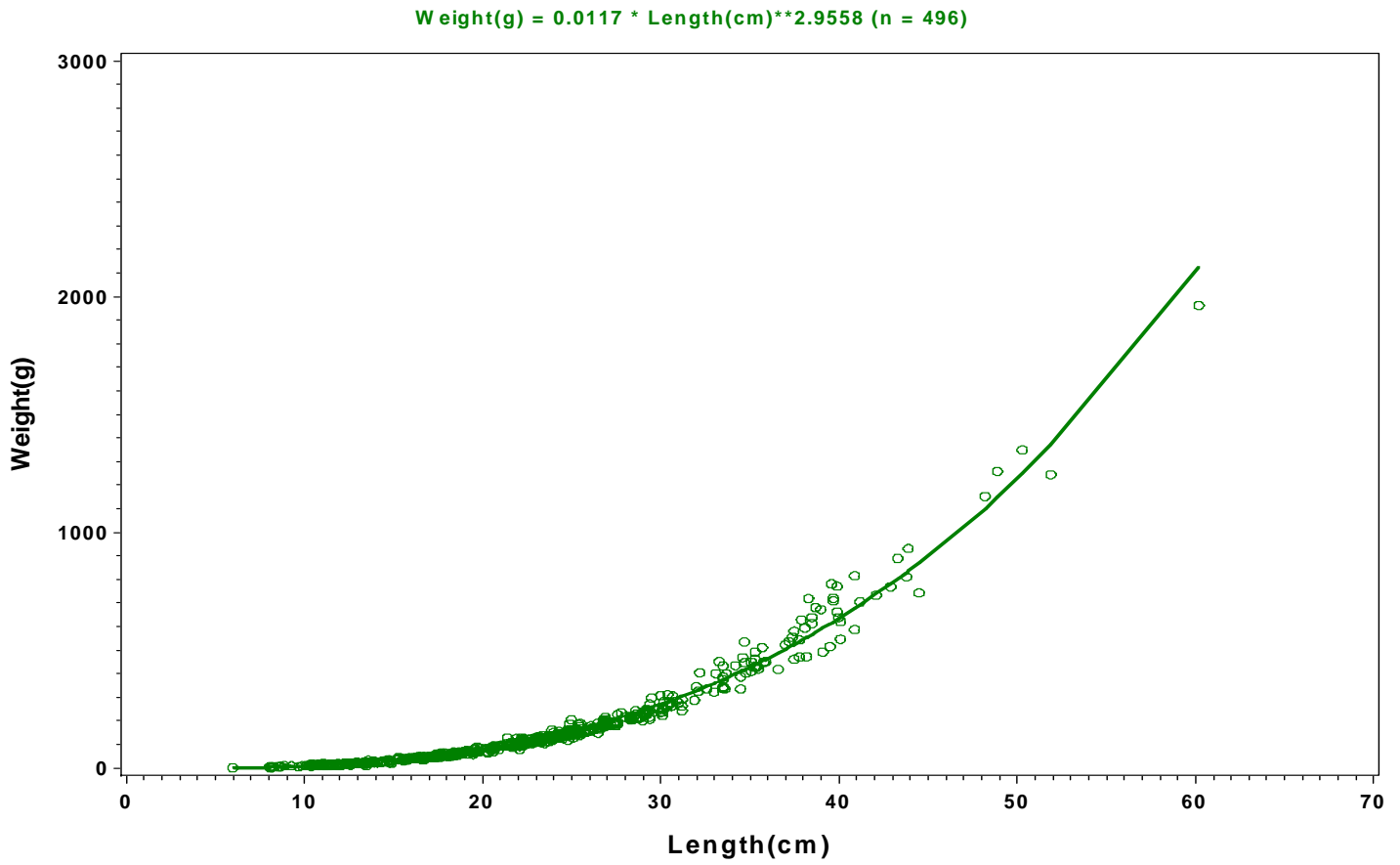


Figure 60. Length-weight regression for weakfish, by sex.

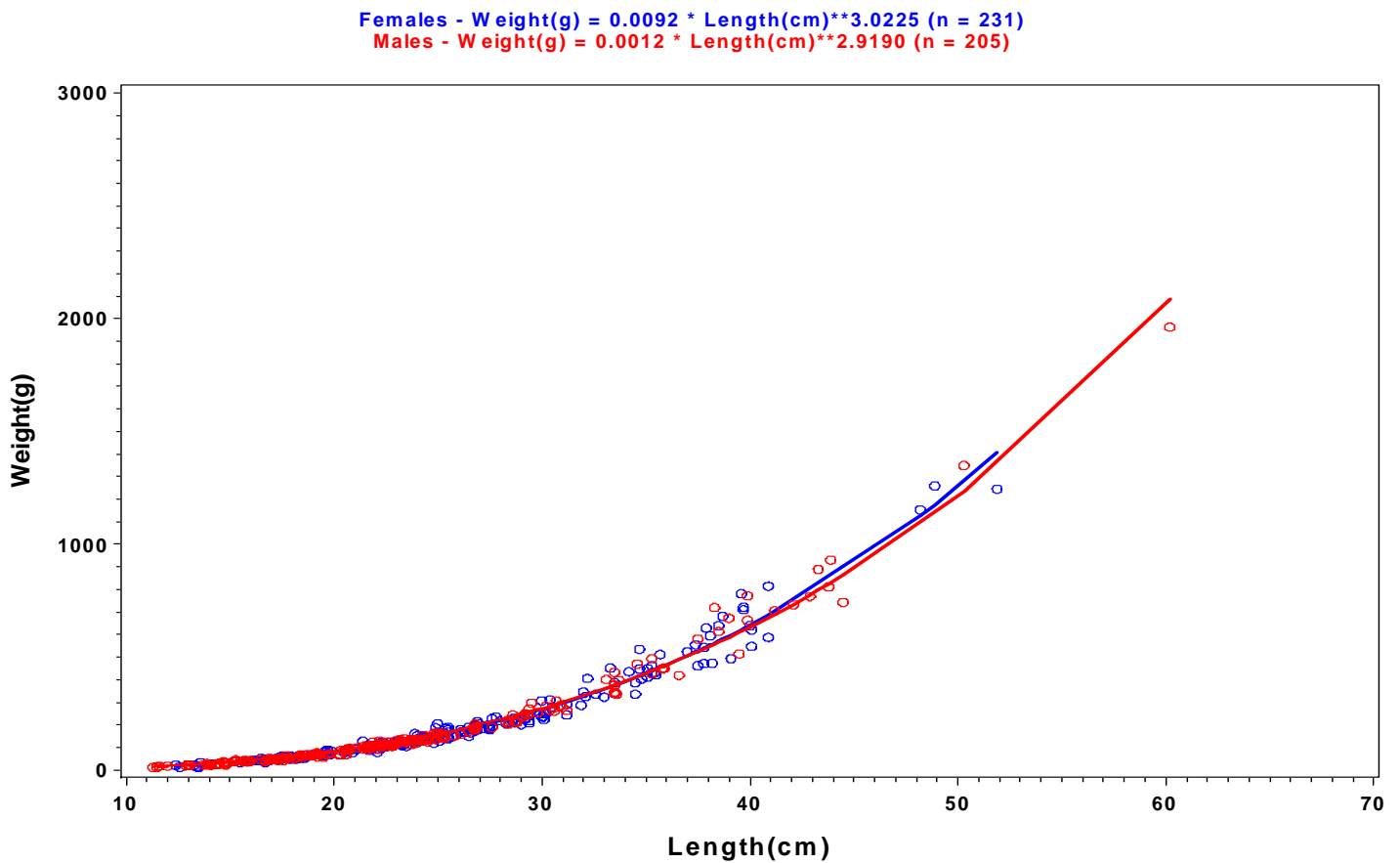


Figure 61. Maturity logistic regression for weakfish, females.

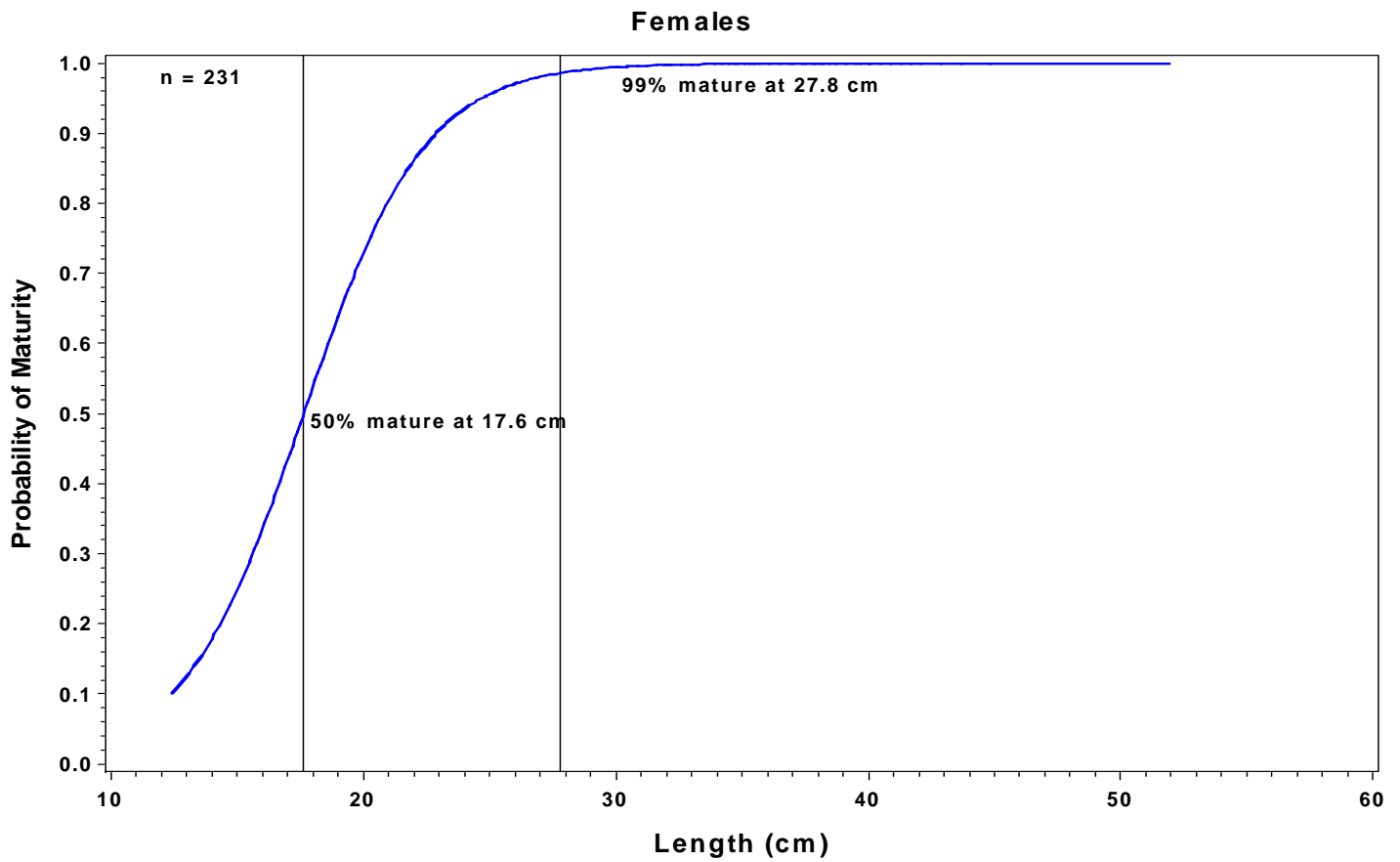


Figure 62. Maturity logistic regression for weakfish, males.

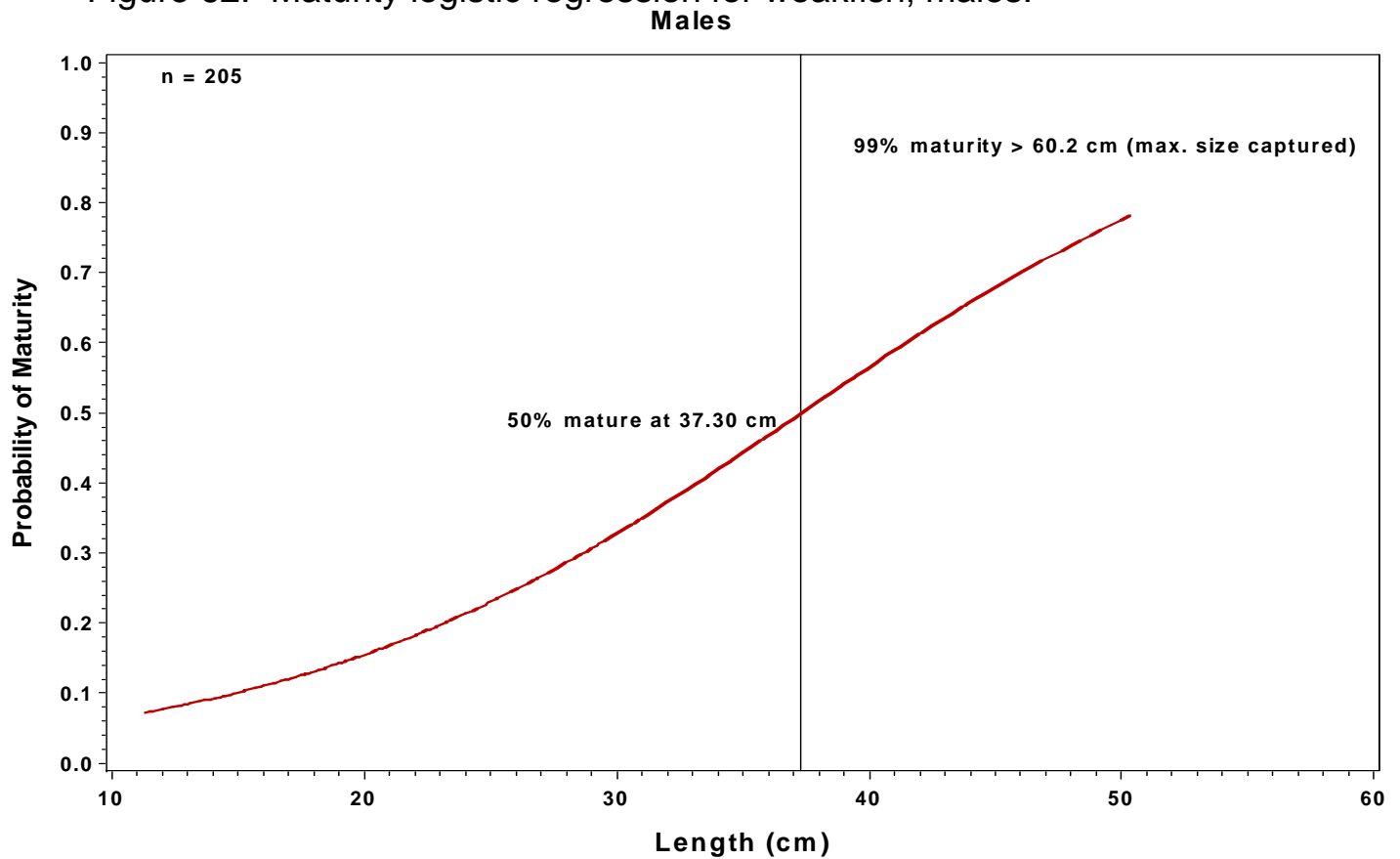


Figure 63. Diet composition by weight for weakfish.

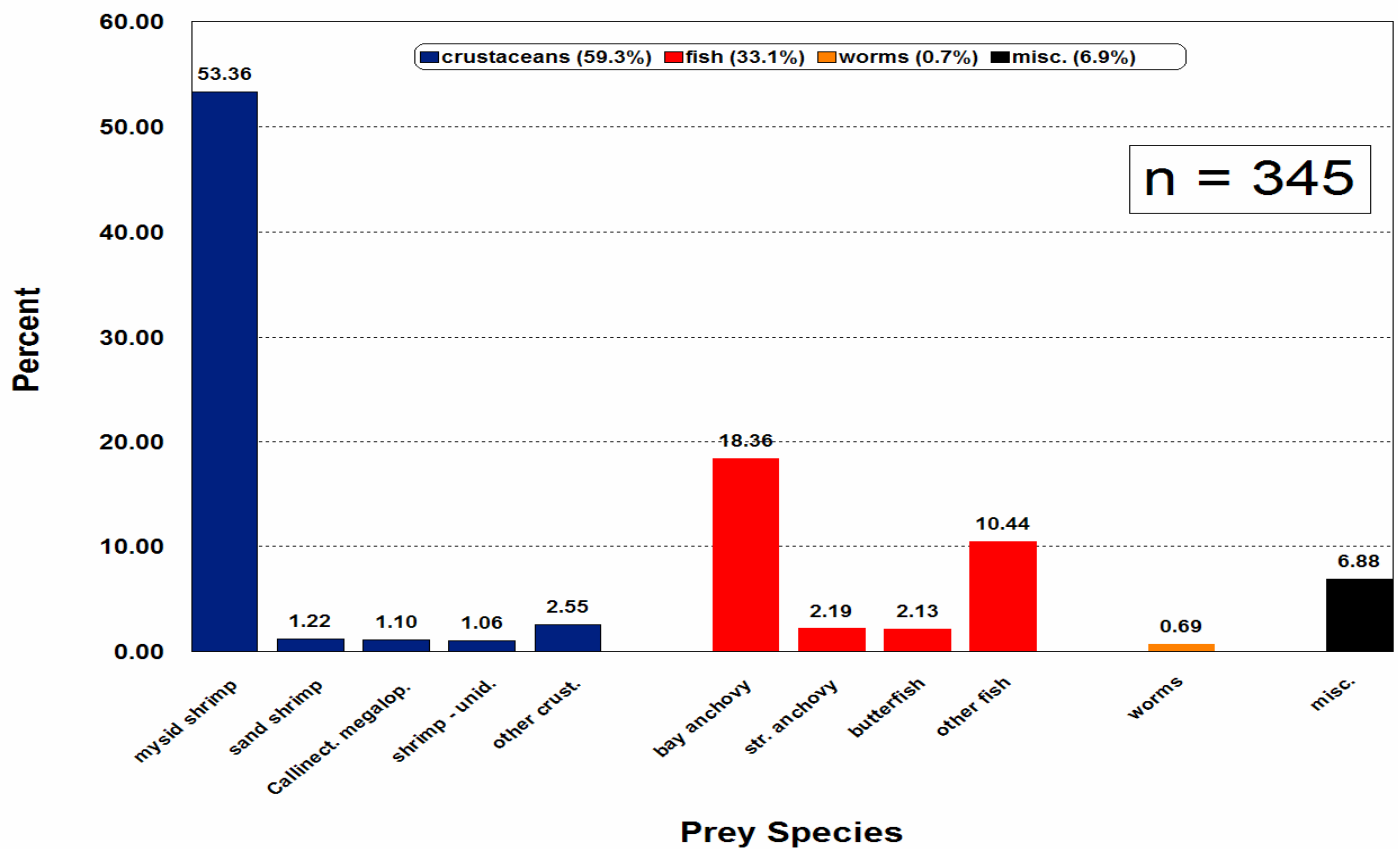
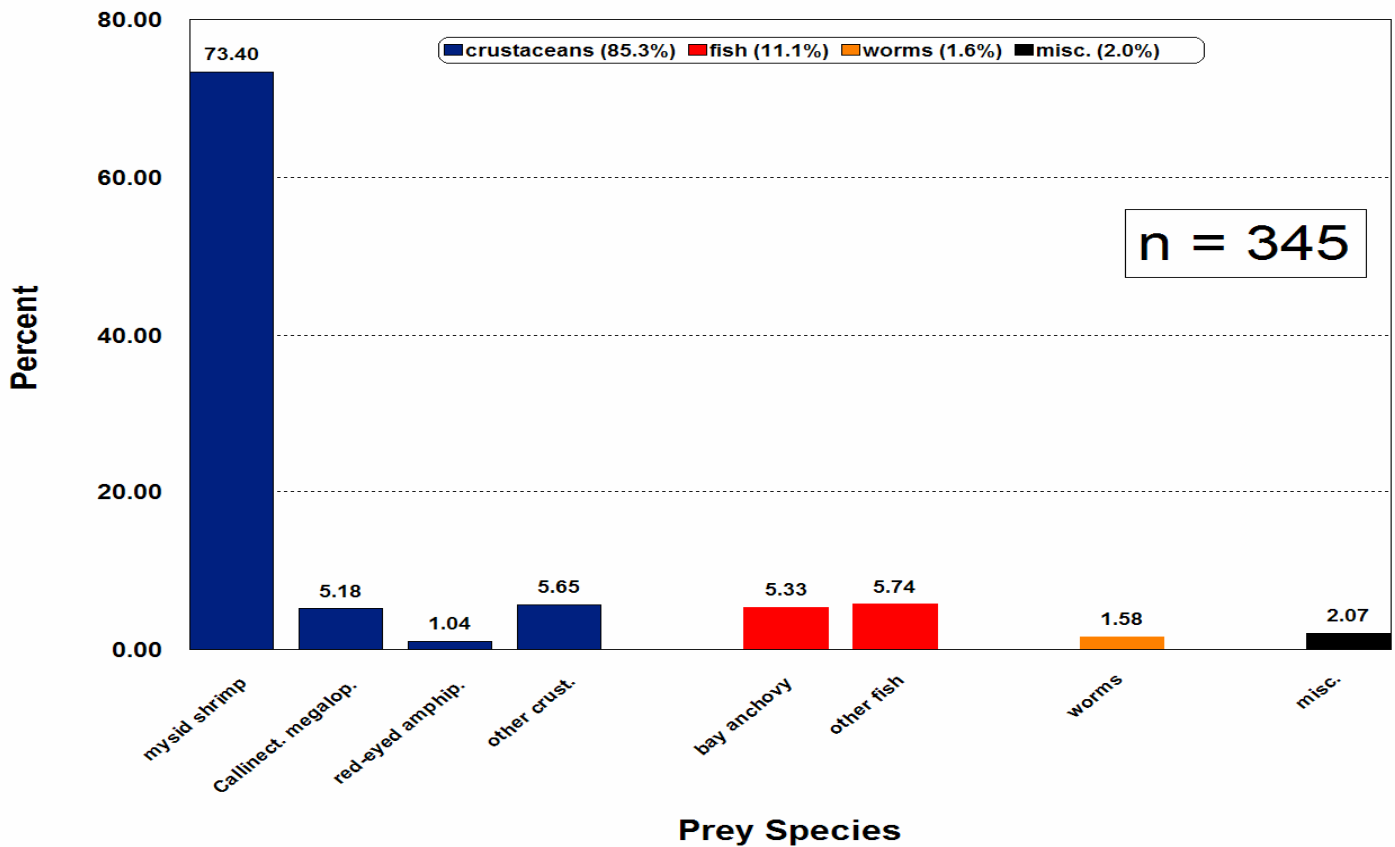


Figure 64. Diet composition by number for weakfish.



# Winter Flounder

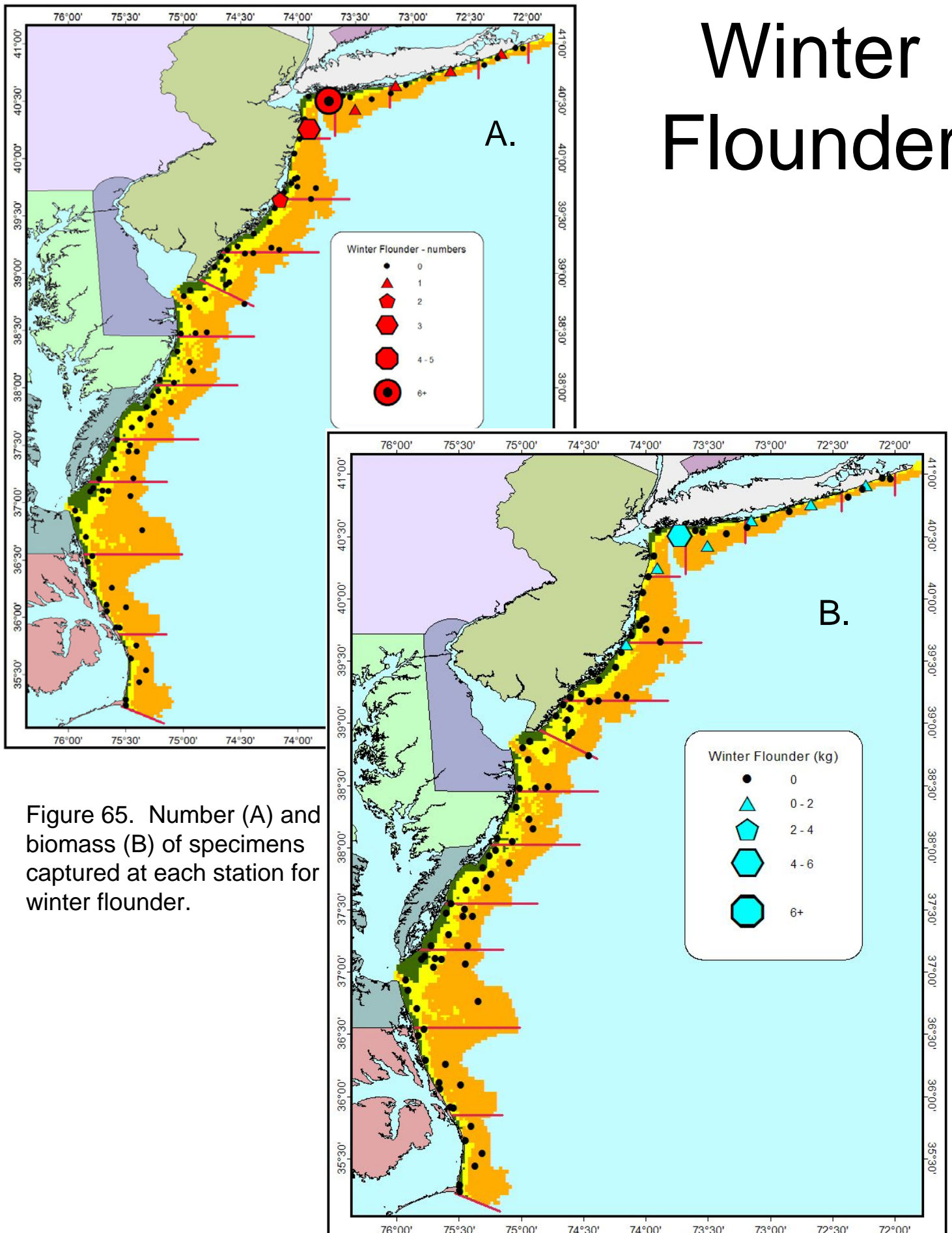




Figure 66. Minimum trawlable number and biomass by state for winter flounder.

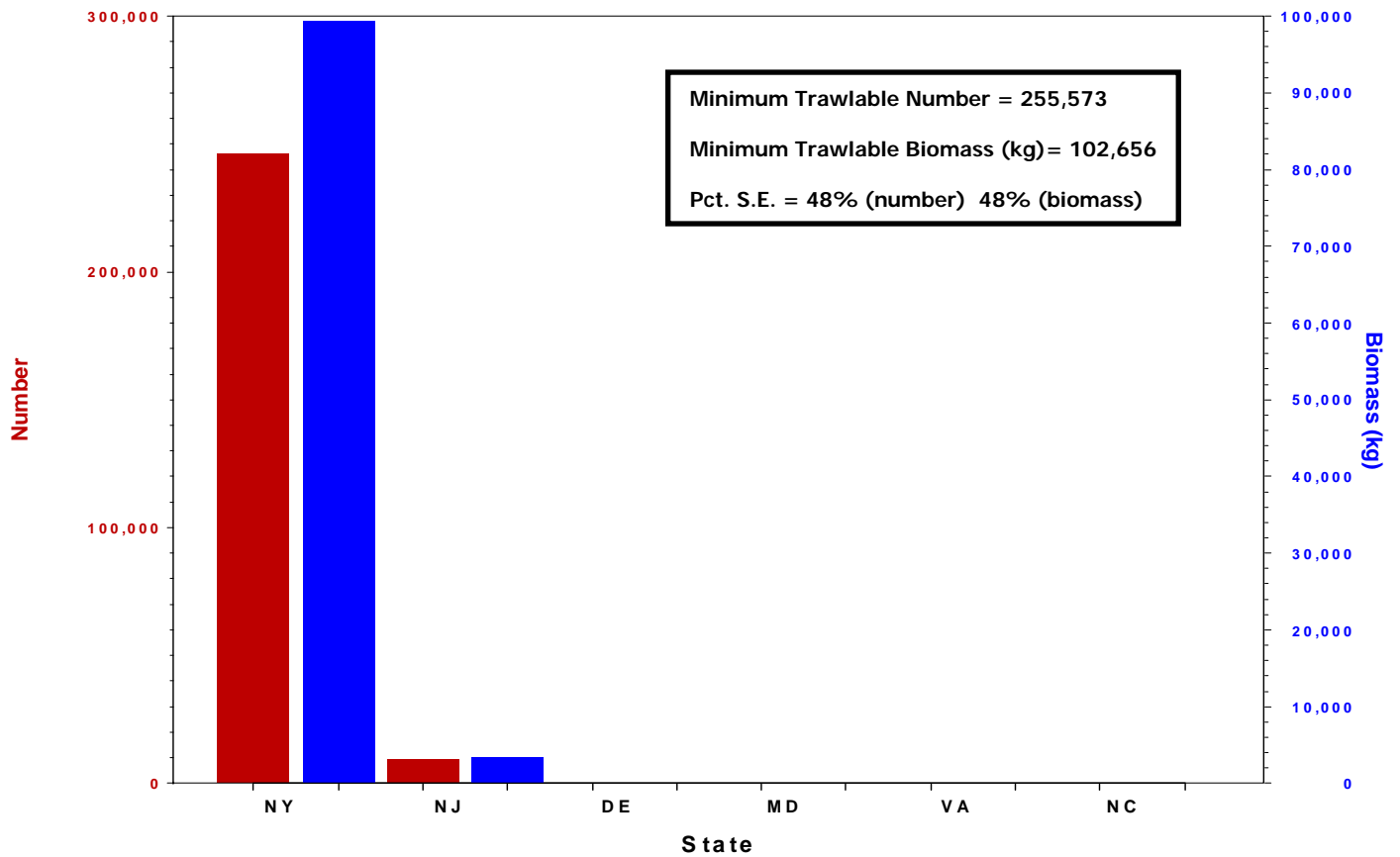


Figure 67. Sex ratios by state for winter flounder.

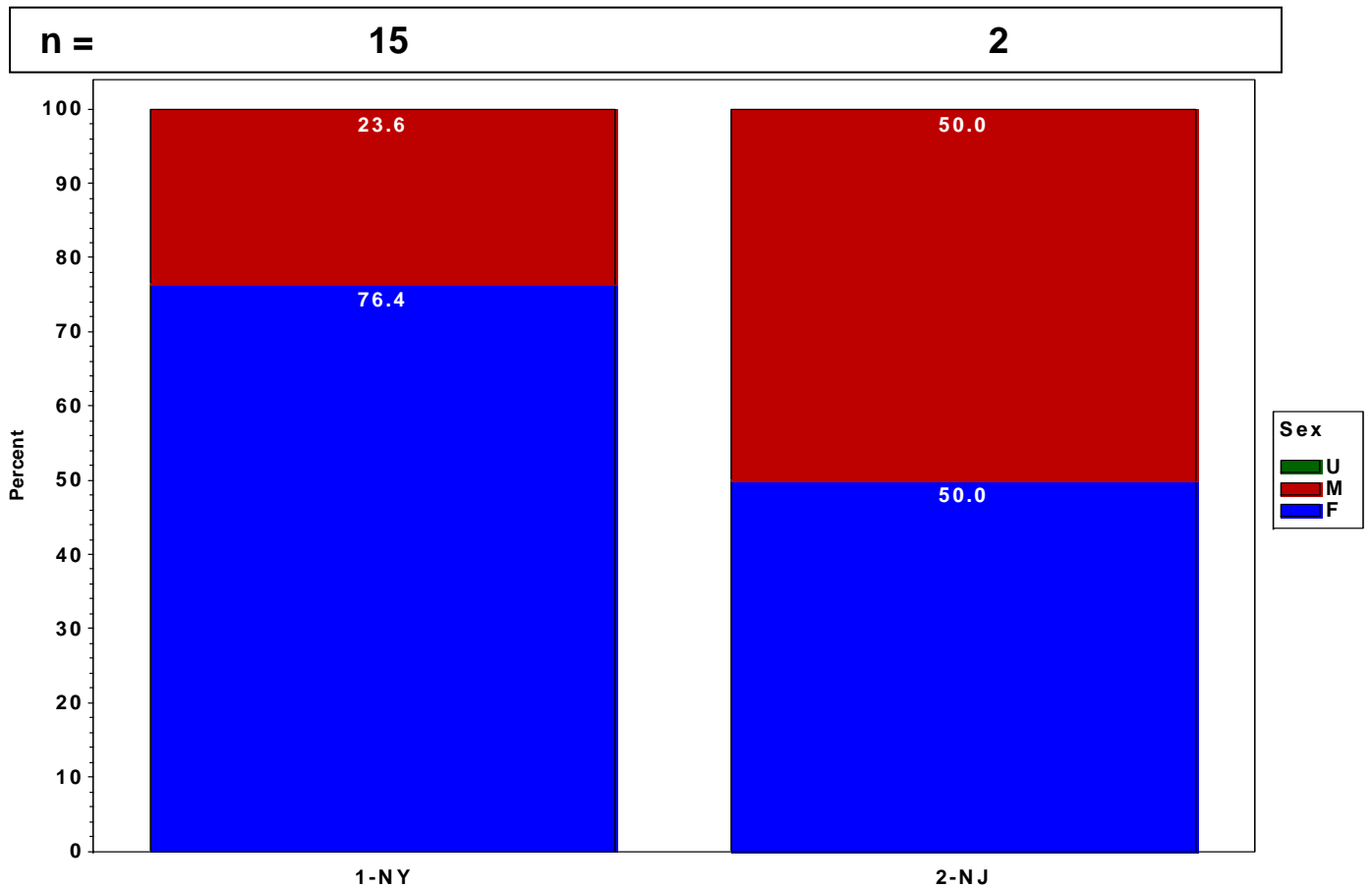


Figure 68. Length frequency for winter flounder.

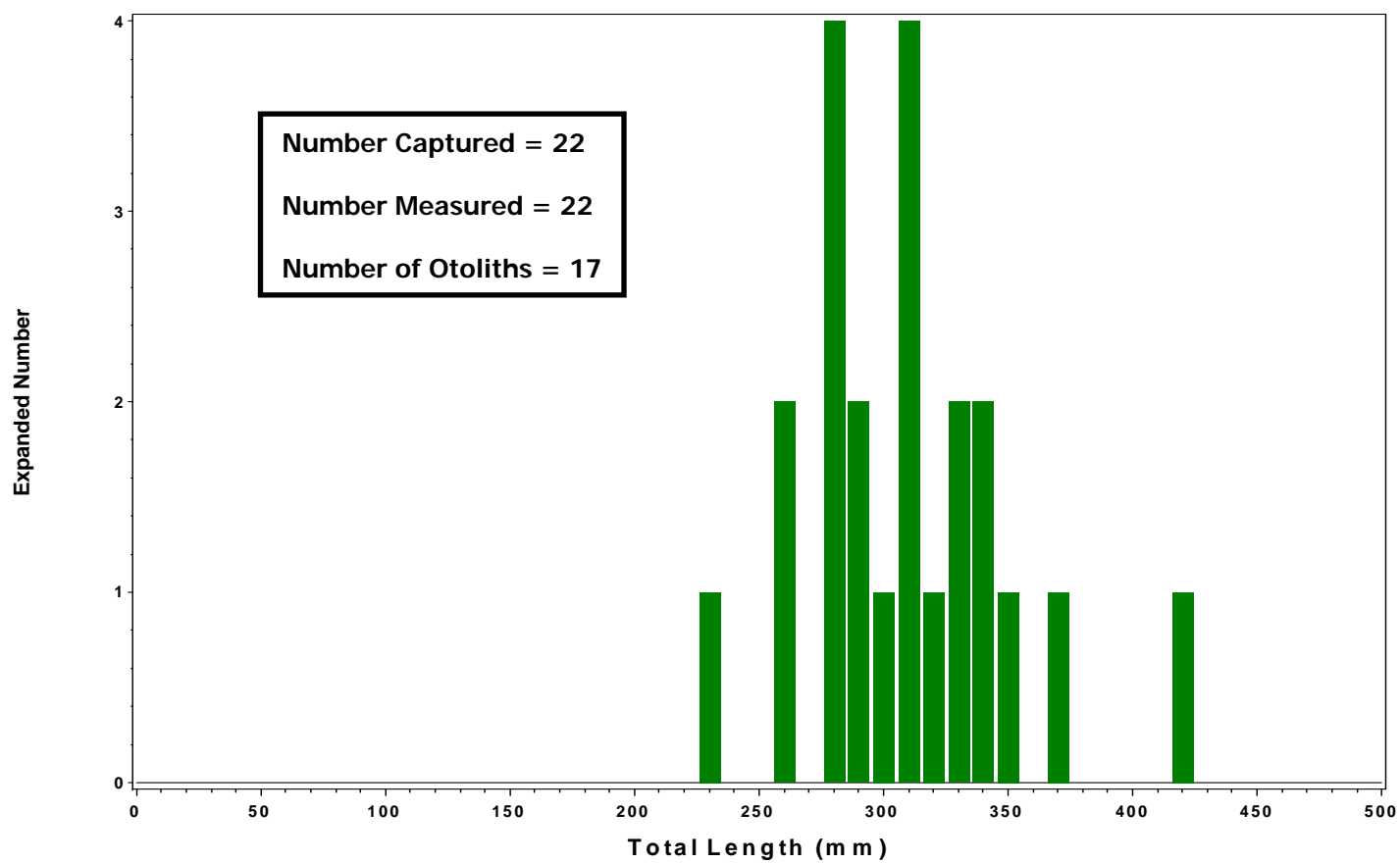


Figure 69. Diet composition by weight for winter flounder.

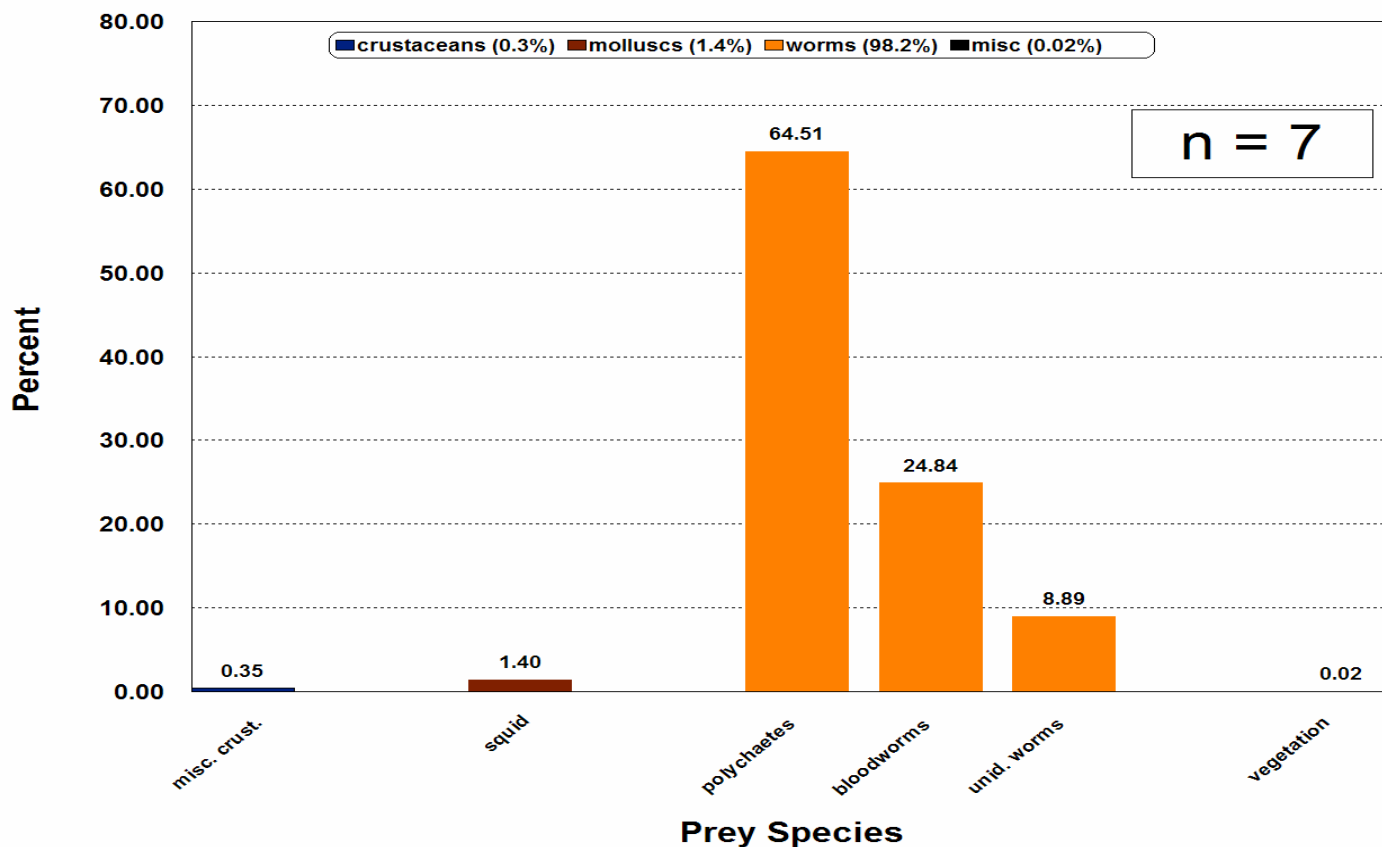
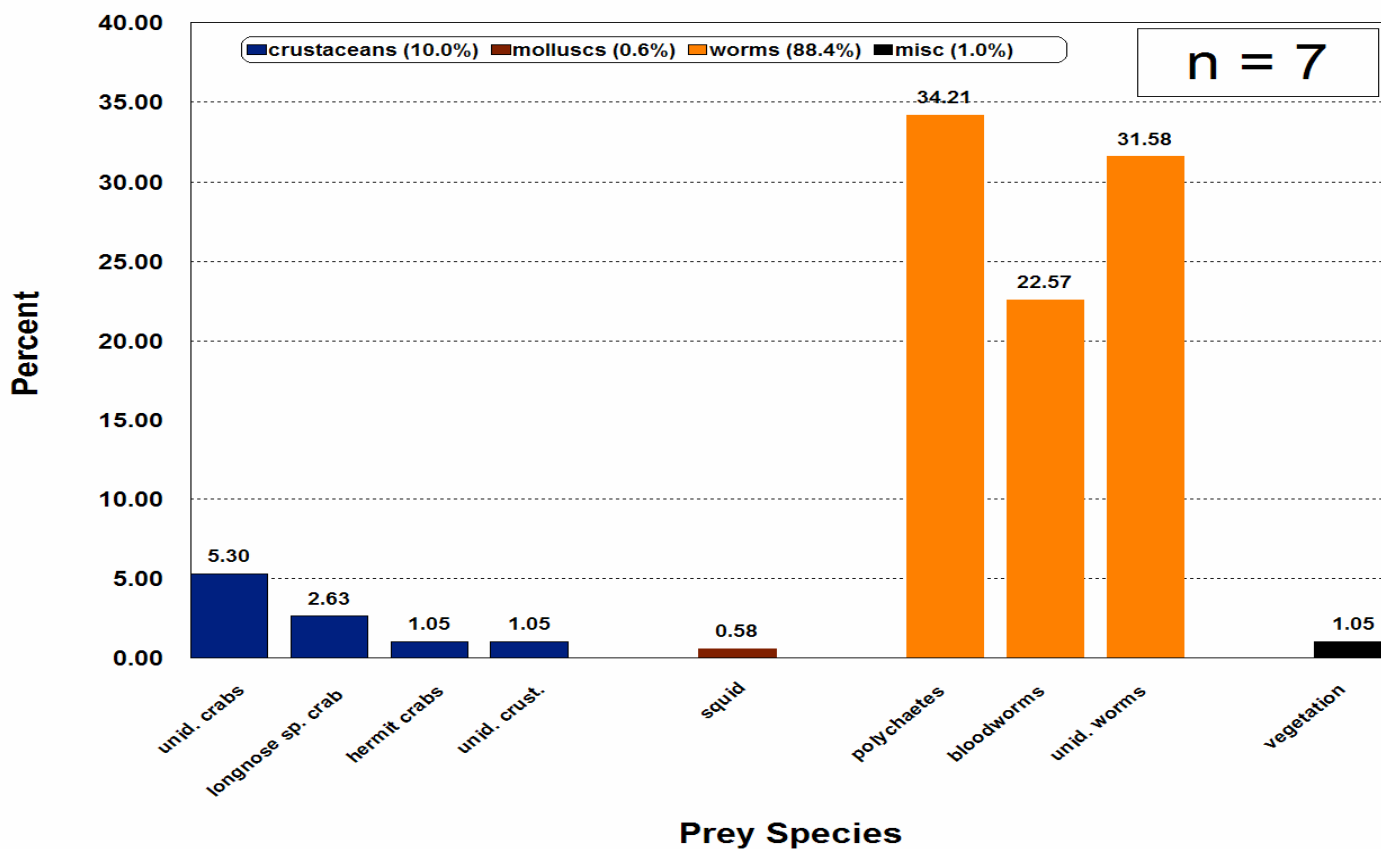


Figure 70. Diet composition by number for winter flounder.



# Atlantic Croaker

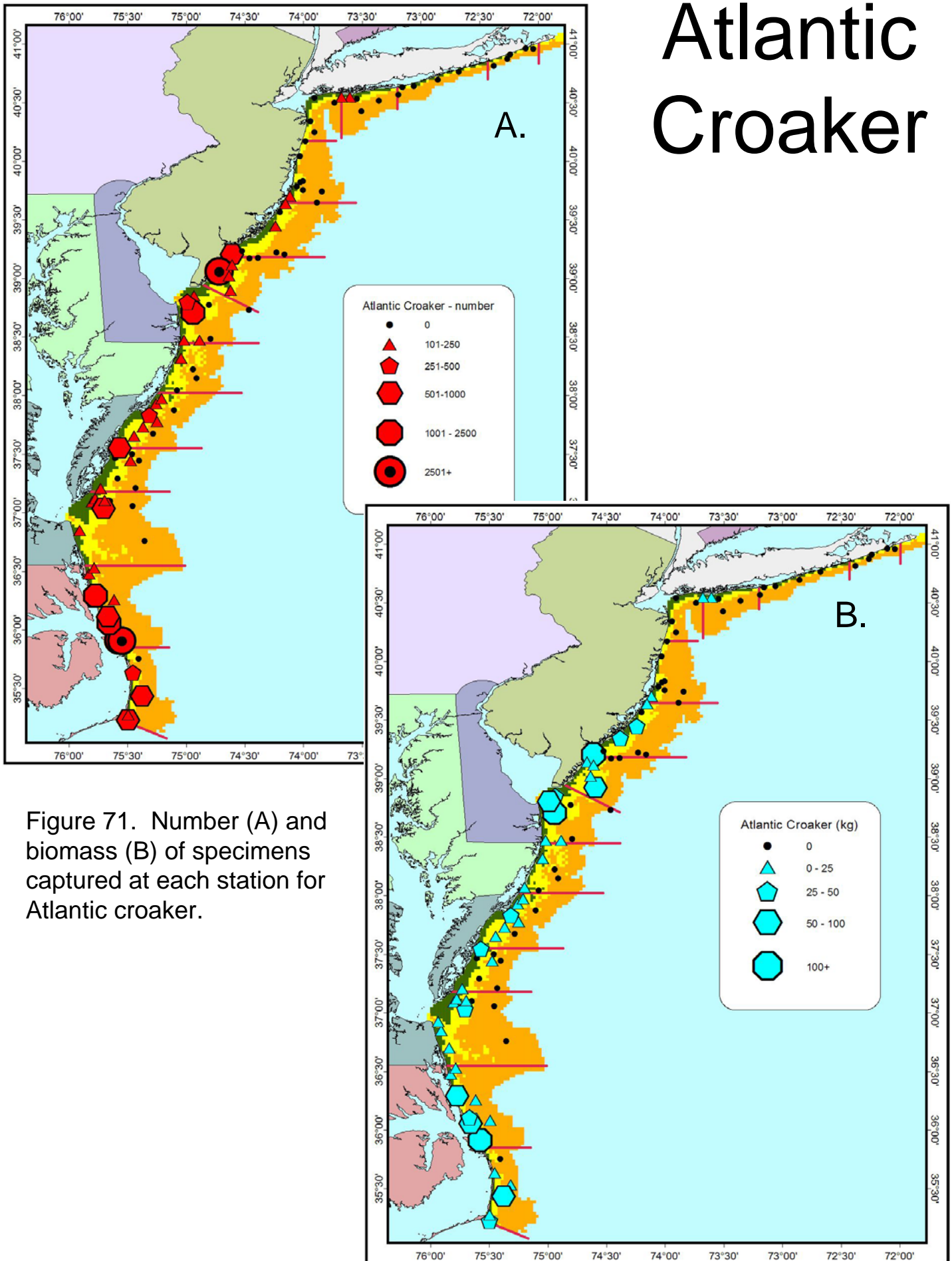


Figure 71. Number (A) and biomass (B) of specimens captured at each station for Atlantic croaker.

Figure 72. Minimum trawlable number and biomass by state for Atlantic croaker.

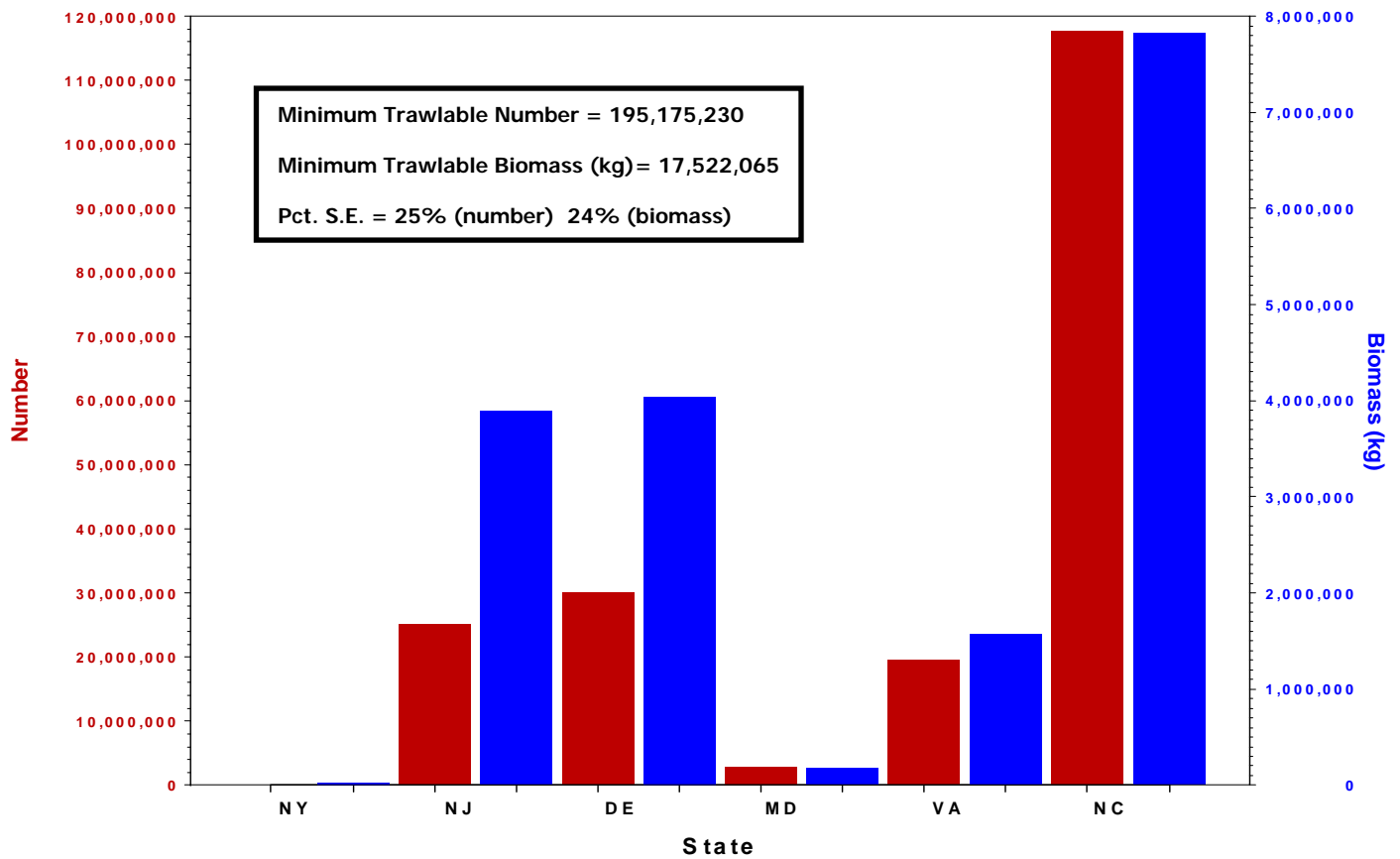


Figure 73. Sex ratios by state for Atlantic croaker.

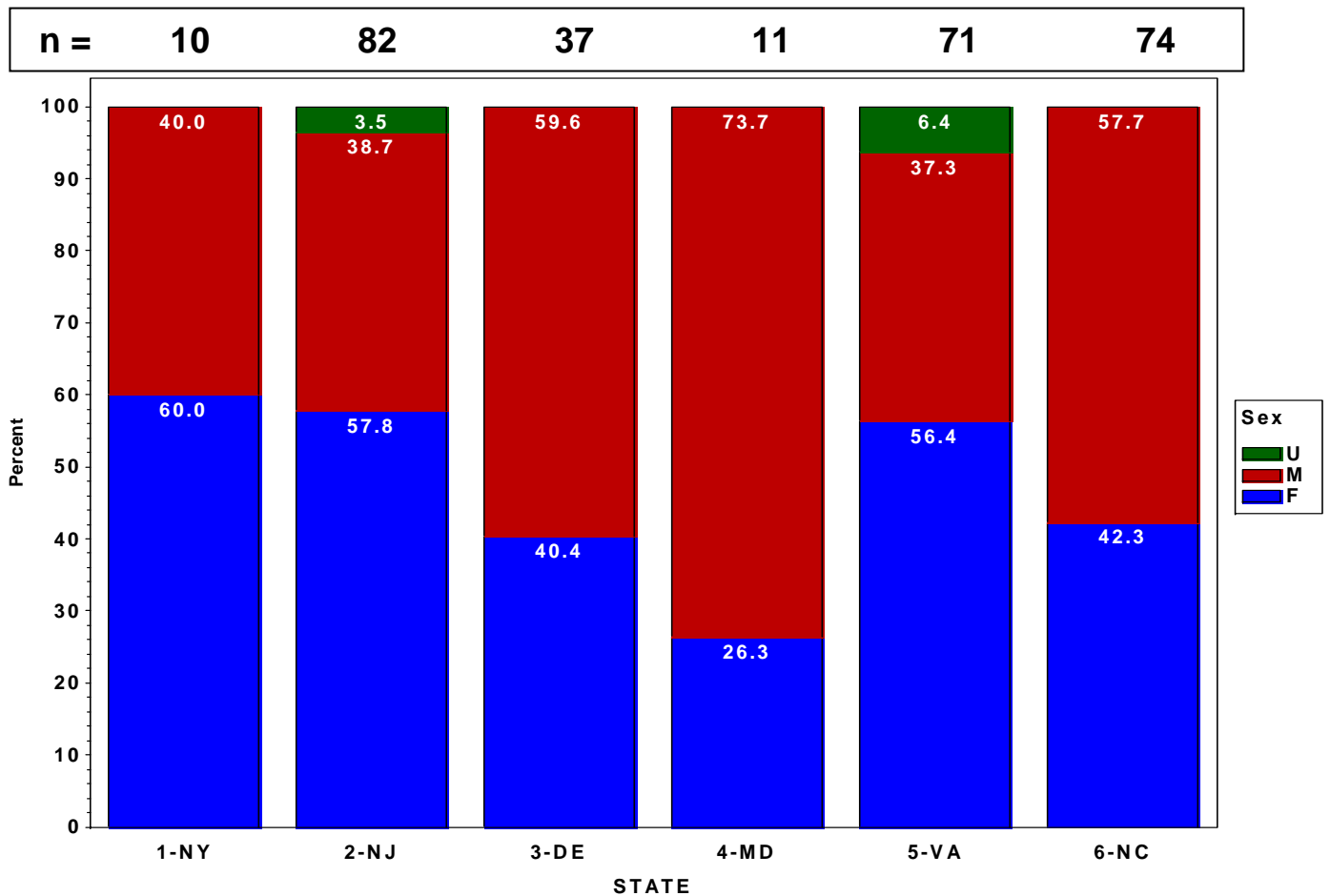


Figure 74. Length frequency for Atlantic croaker.

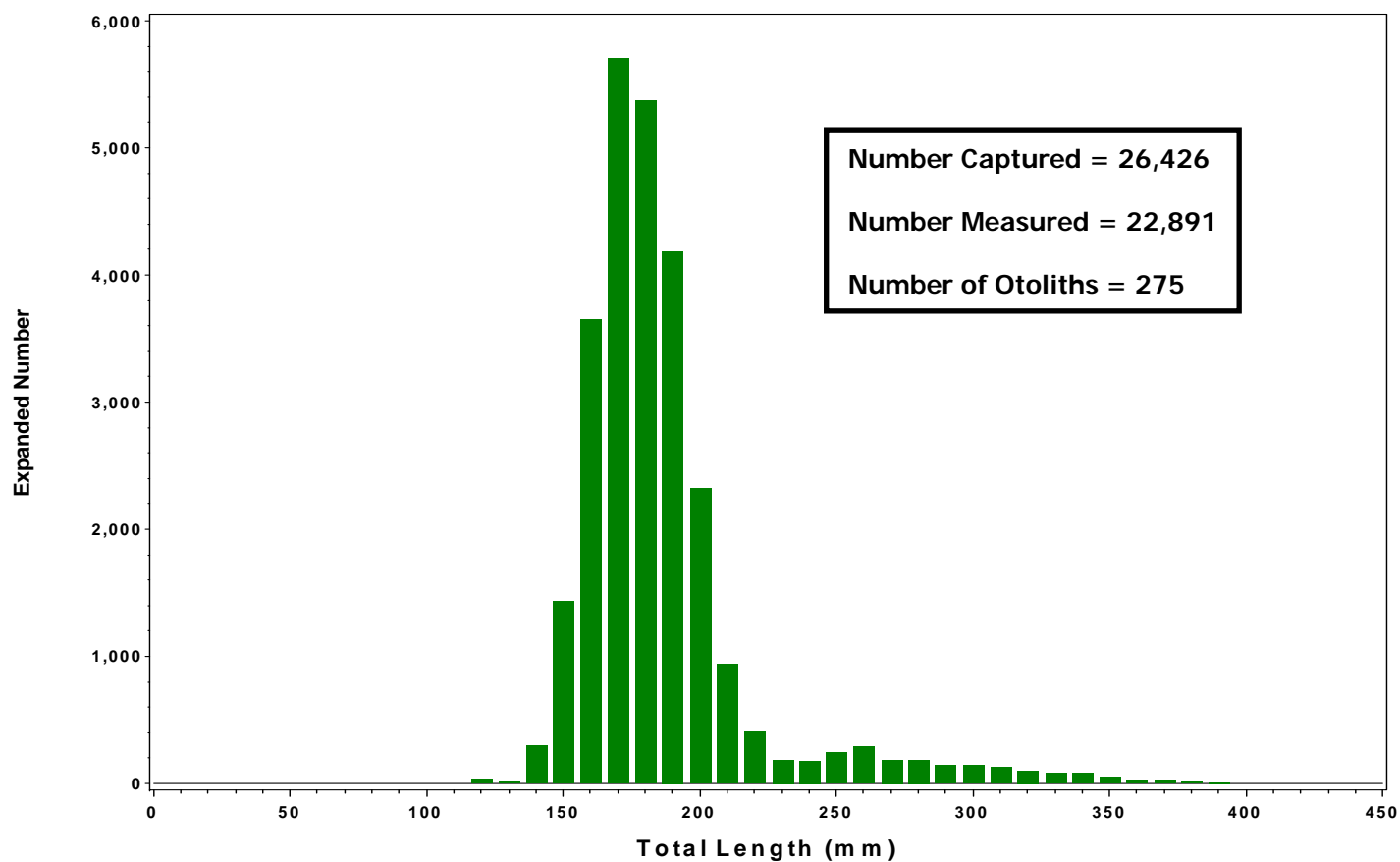


Figure 75. Length-weight regression for Atlantic croaker, sexes combined.

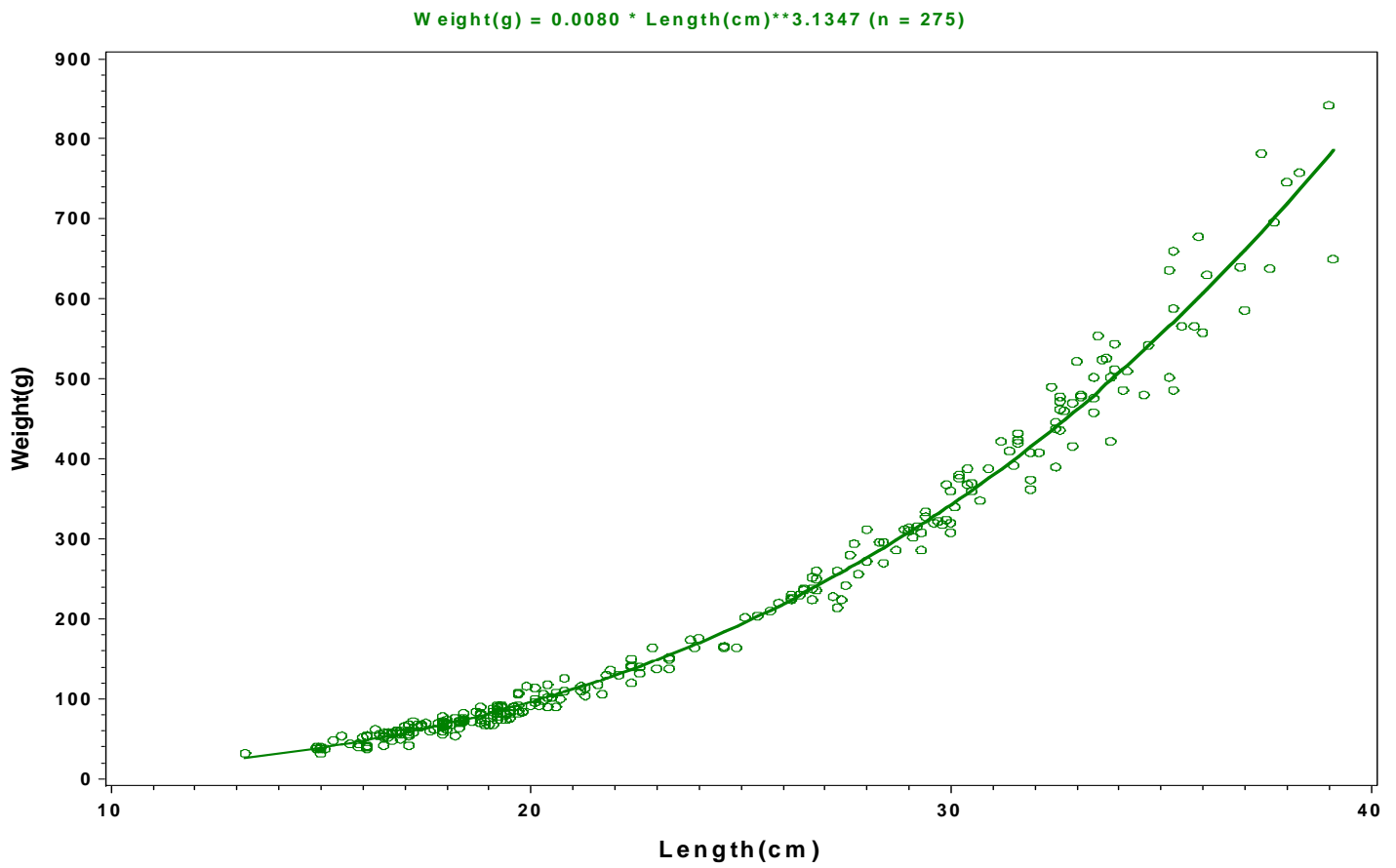


Figure 76. Length-weight regression for Atlantic croaker, by sex.

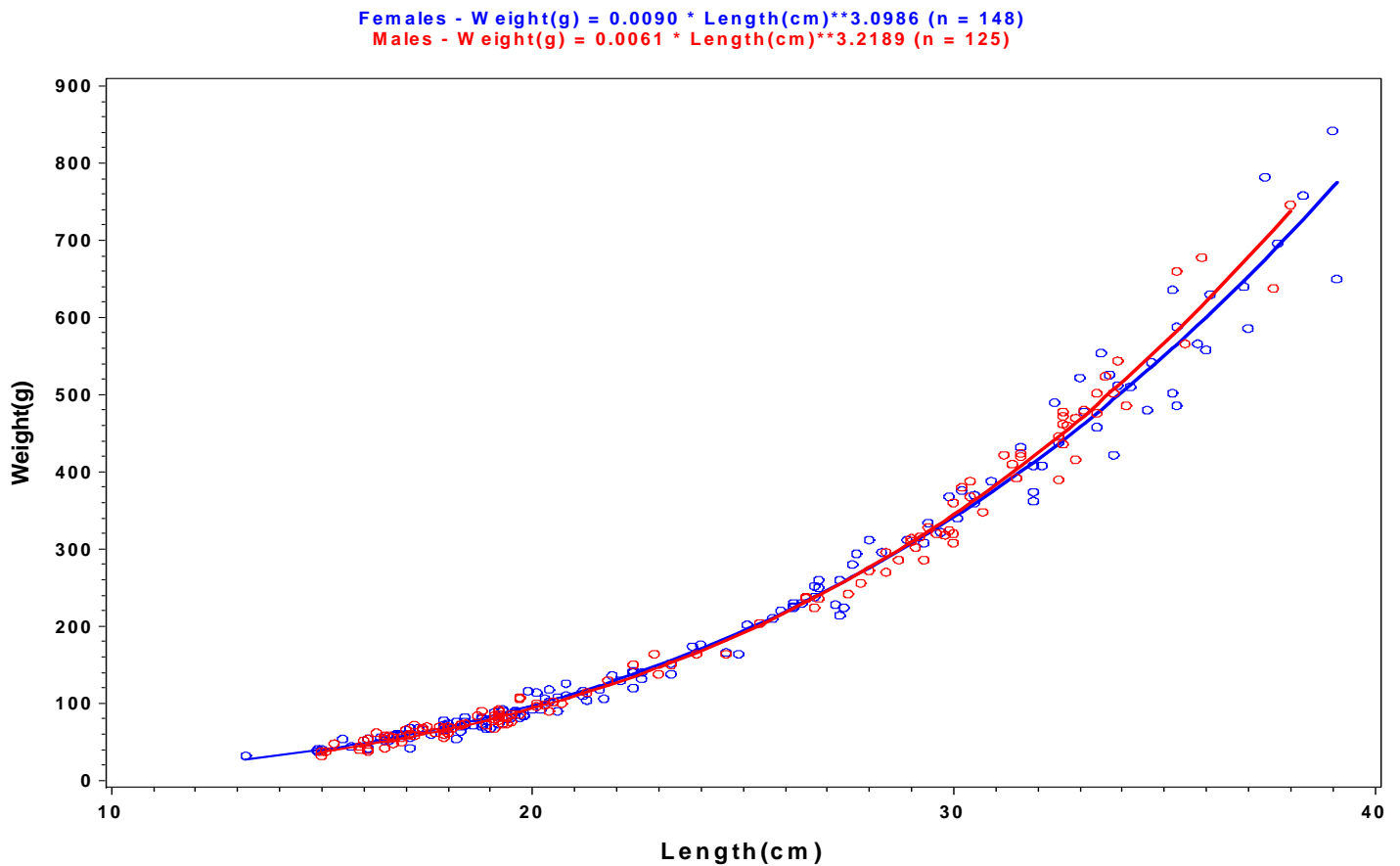


Figure 77. Maturity logistic regression for Atlantic croaker, females.

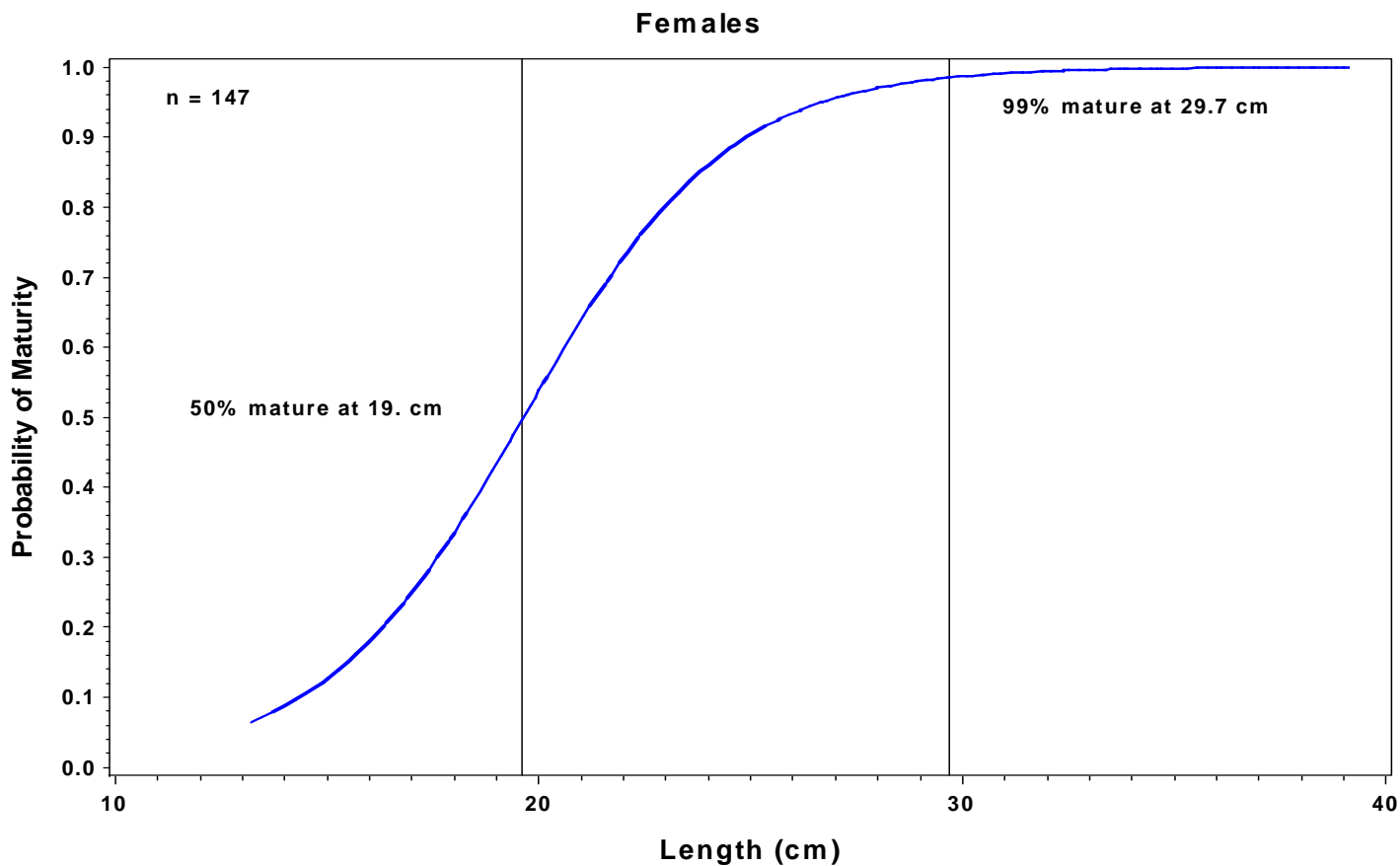
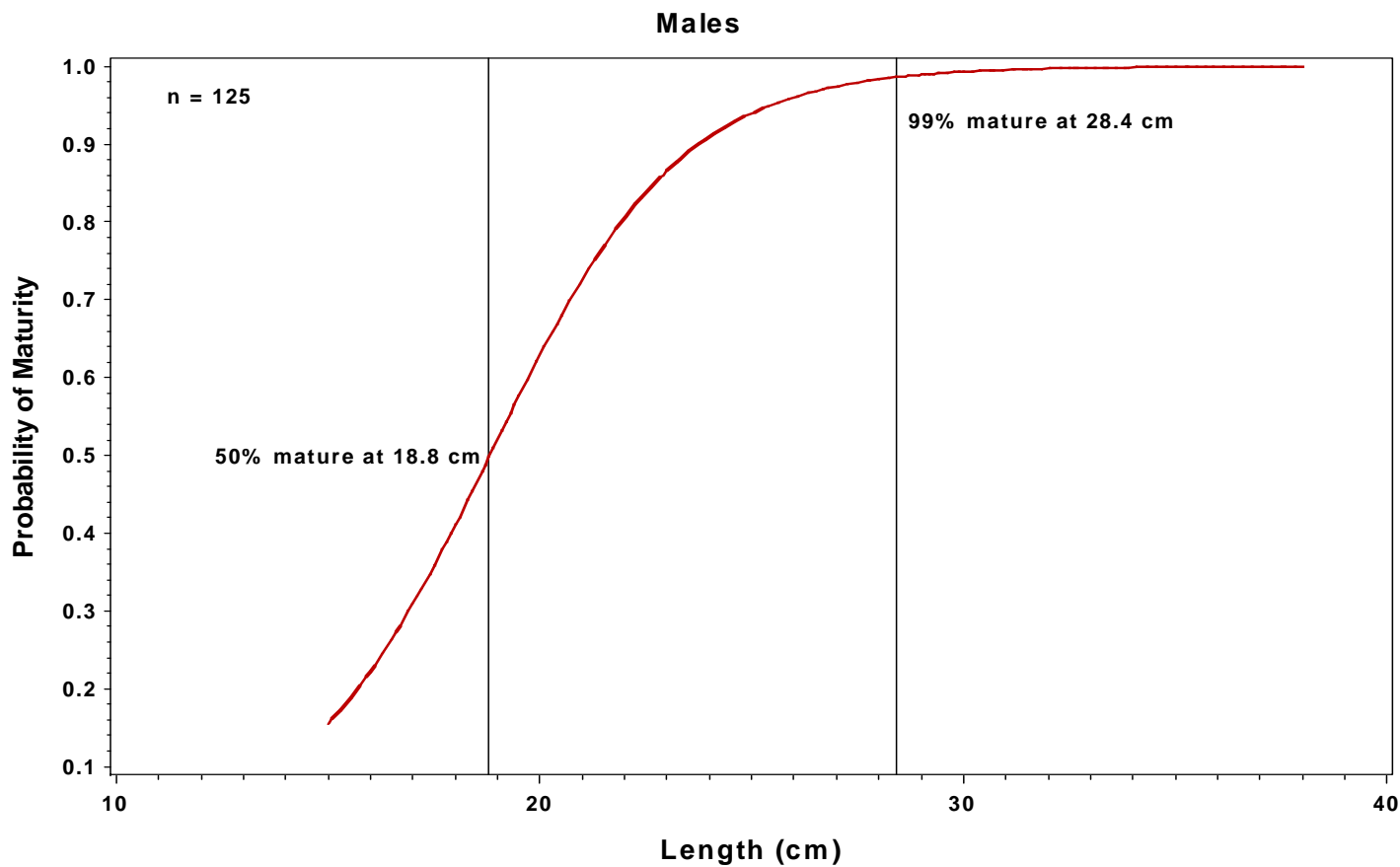


Figure 78. Maturity logistic regression for Atlantic croaker, males.





# Bullnose Ray

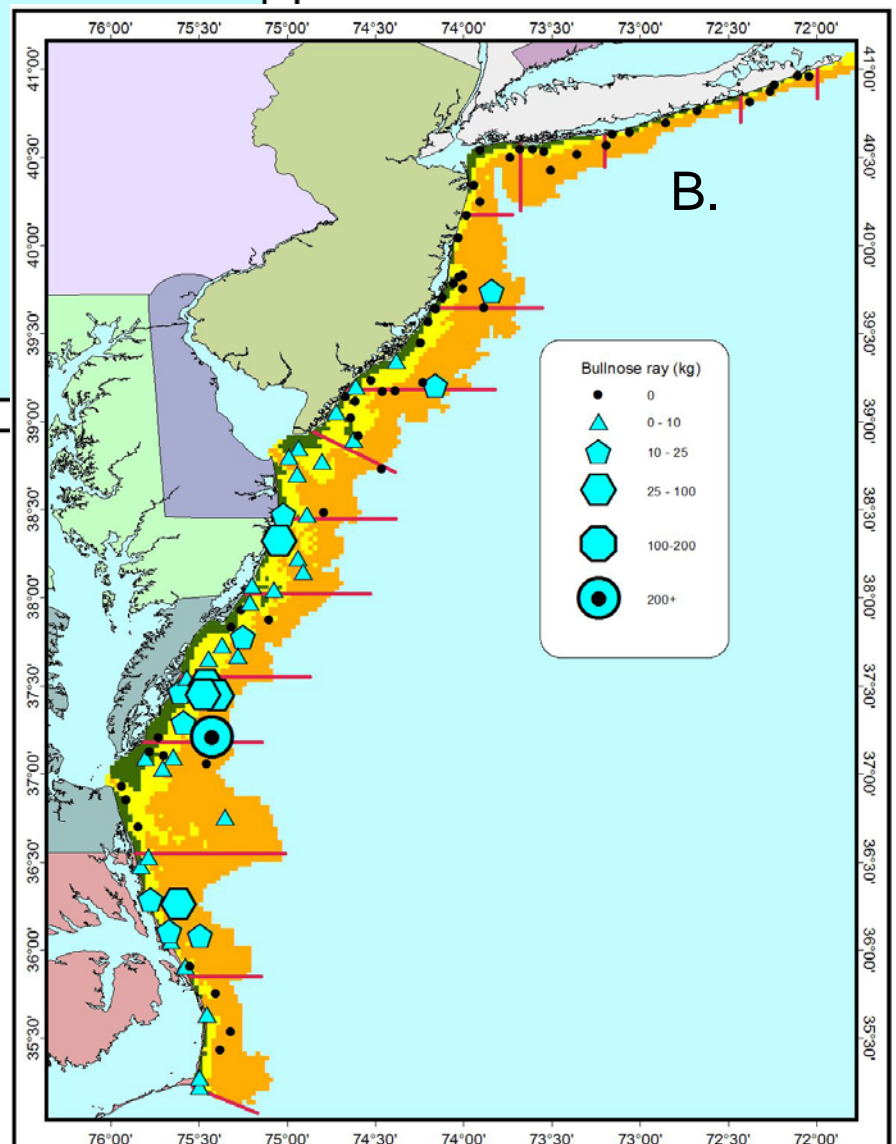
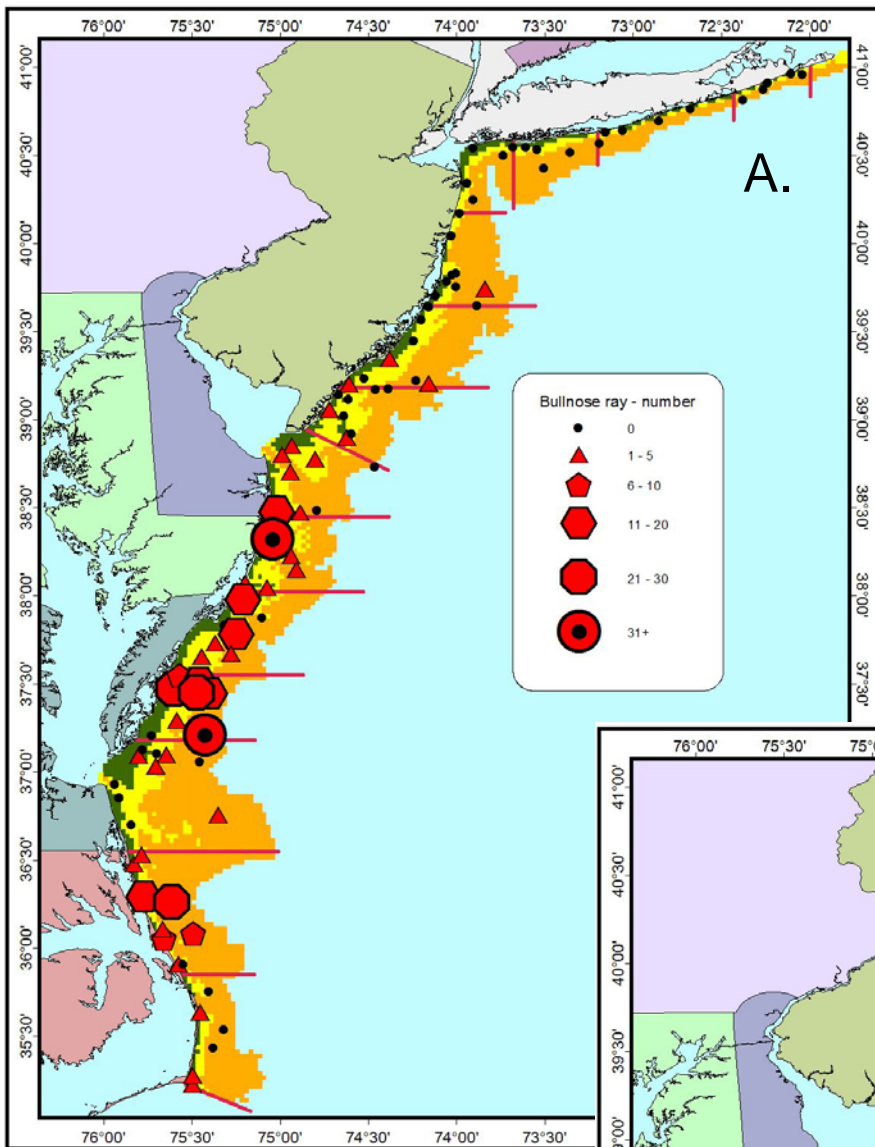


Figure 79. Number (A) and biomass (B) of specimens captured at each station for bullnose ray.

Figure 80. Minimum trawlable number and biomass by state for bullnose ray.

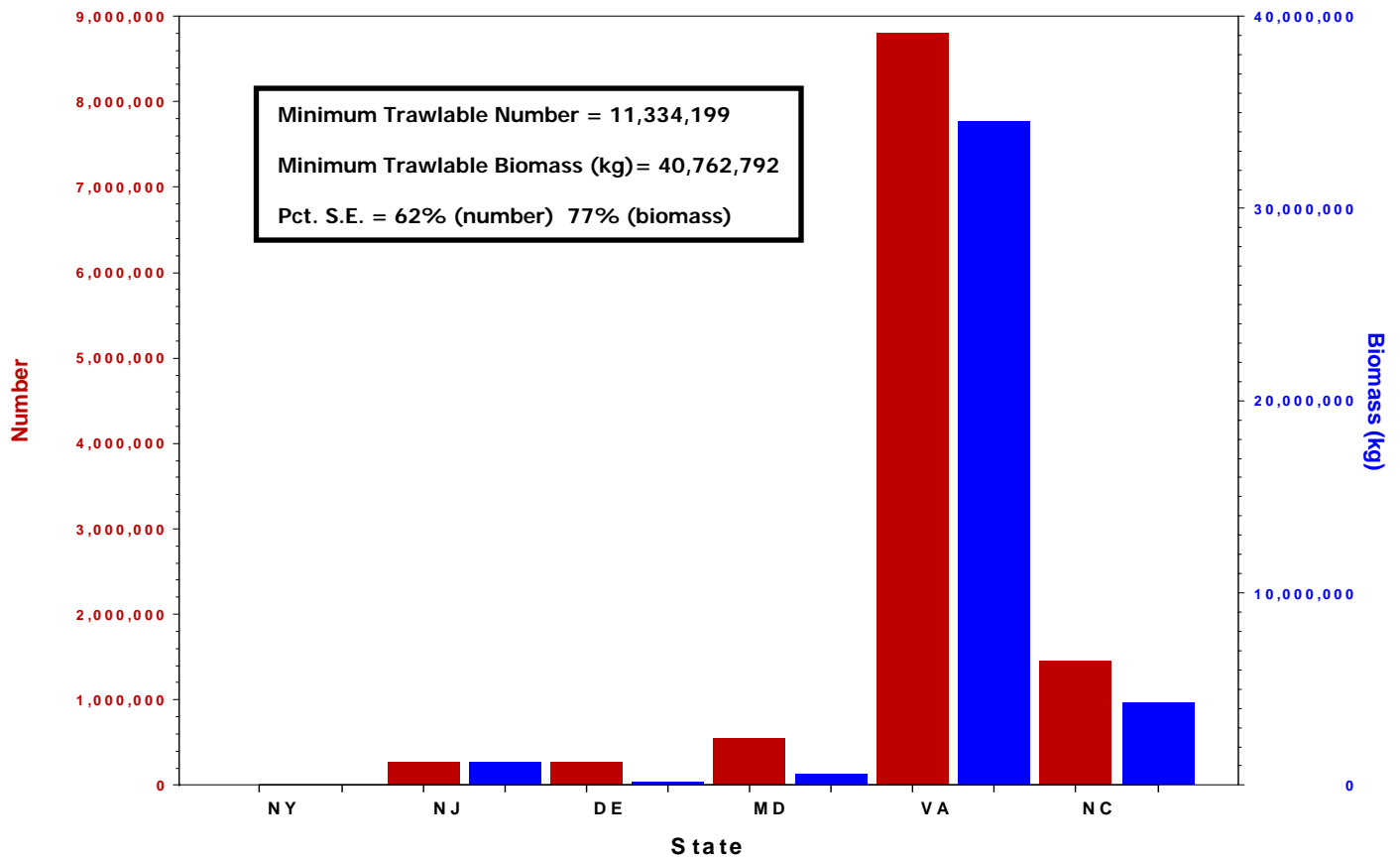


Figure 81. Sex ratios by state for bullnose ray.

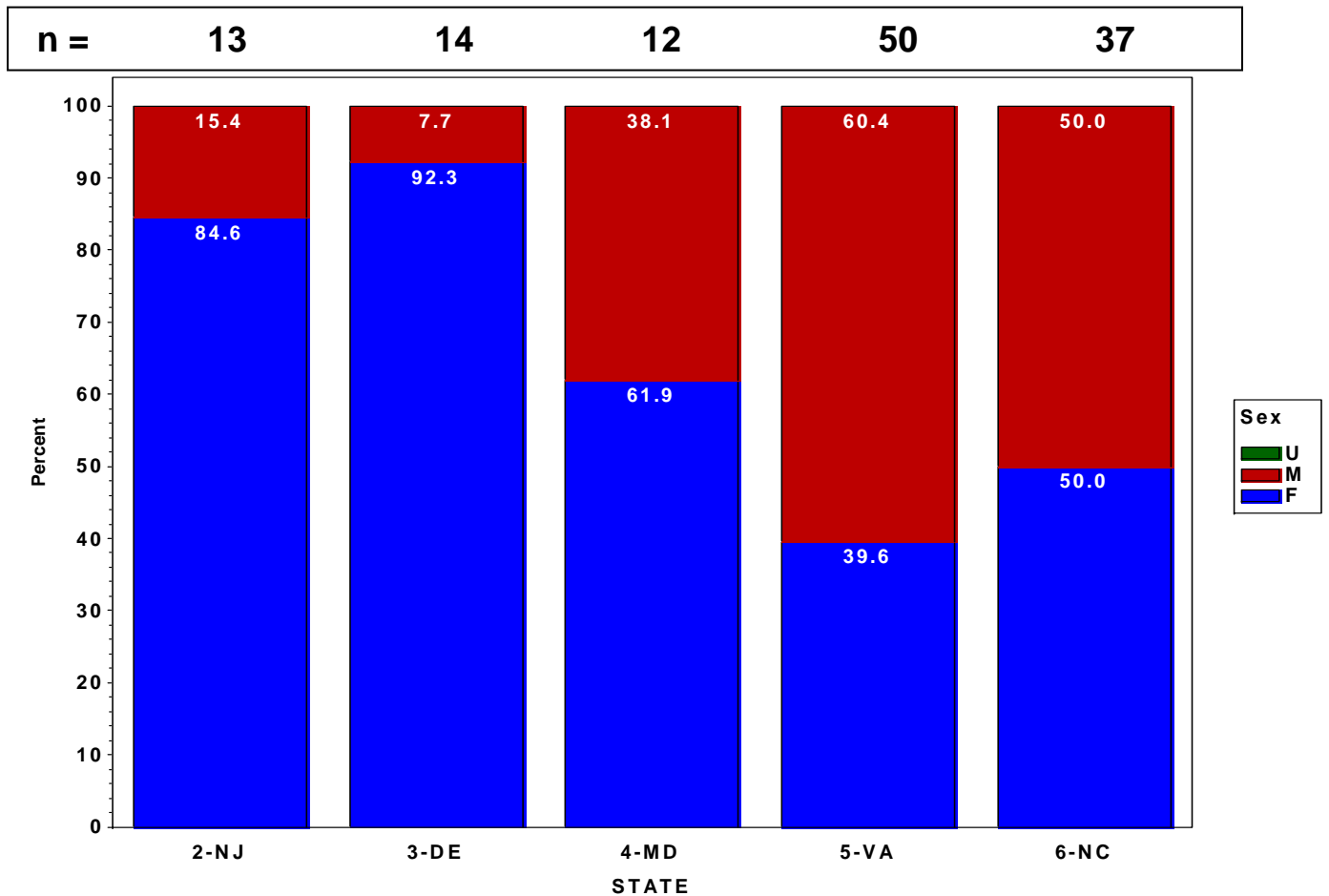


Figure 82. Length frequency for bullnose ray.

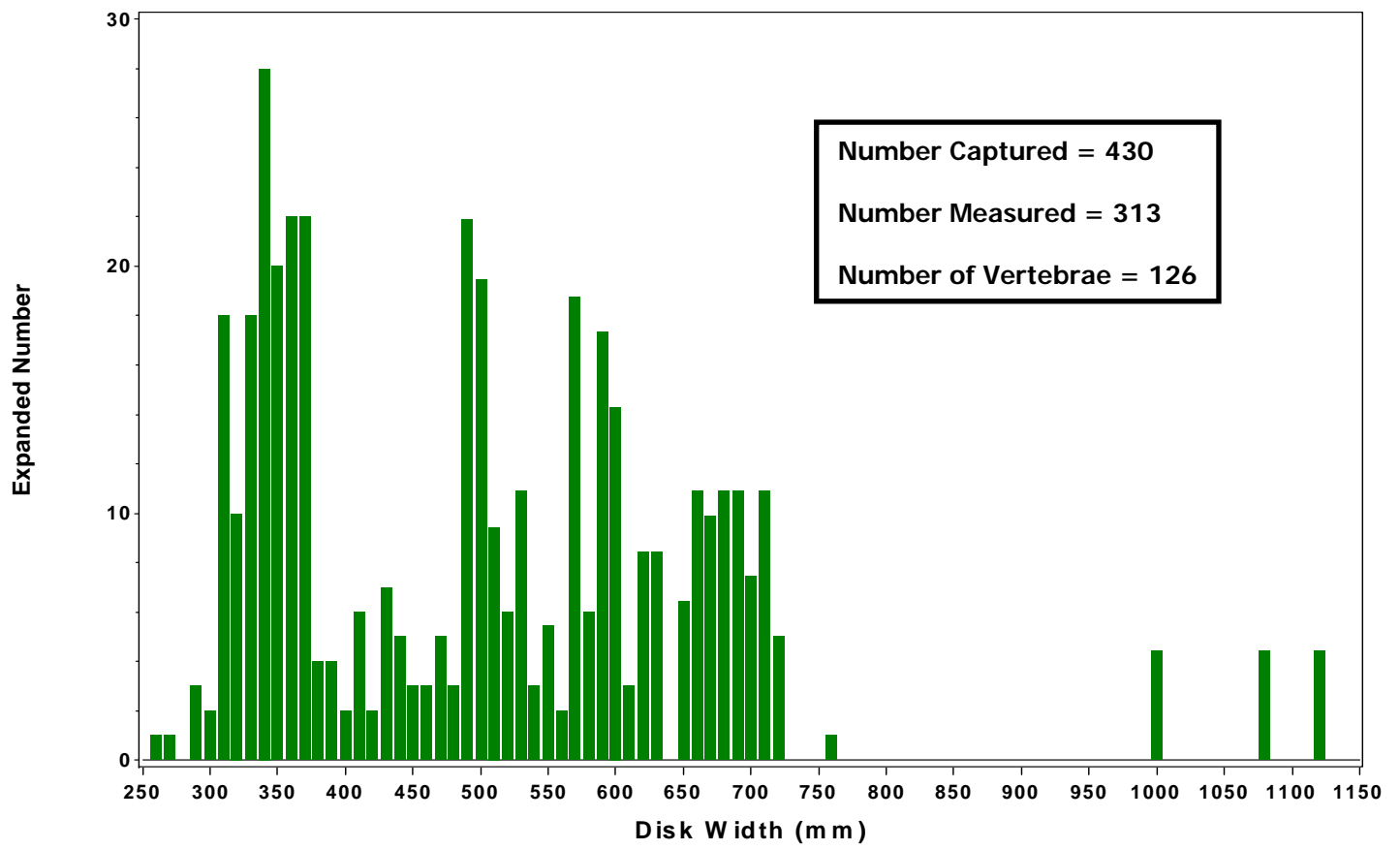


Figure 83. Length-weight regression for bullnose ray, sexes combined.

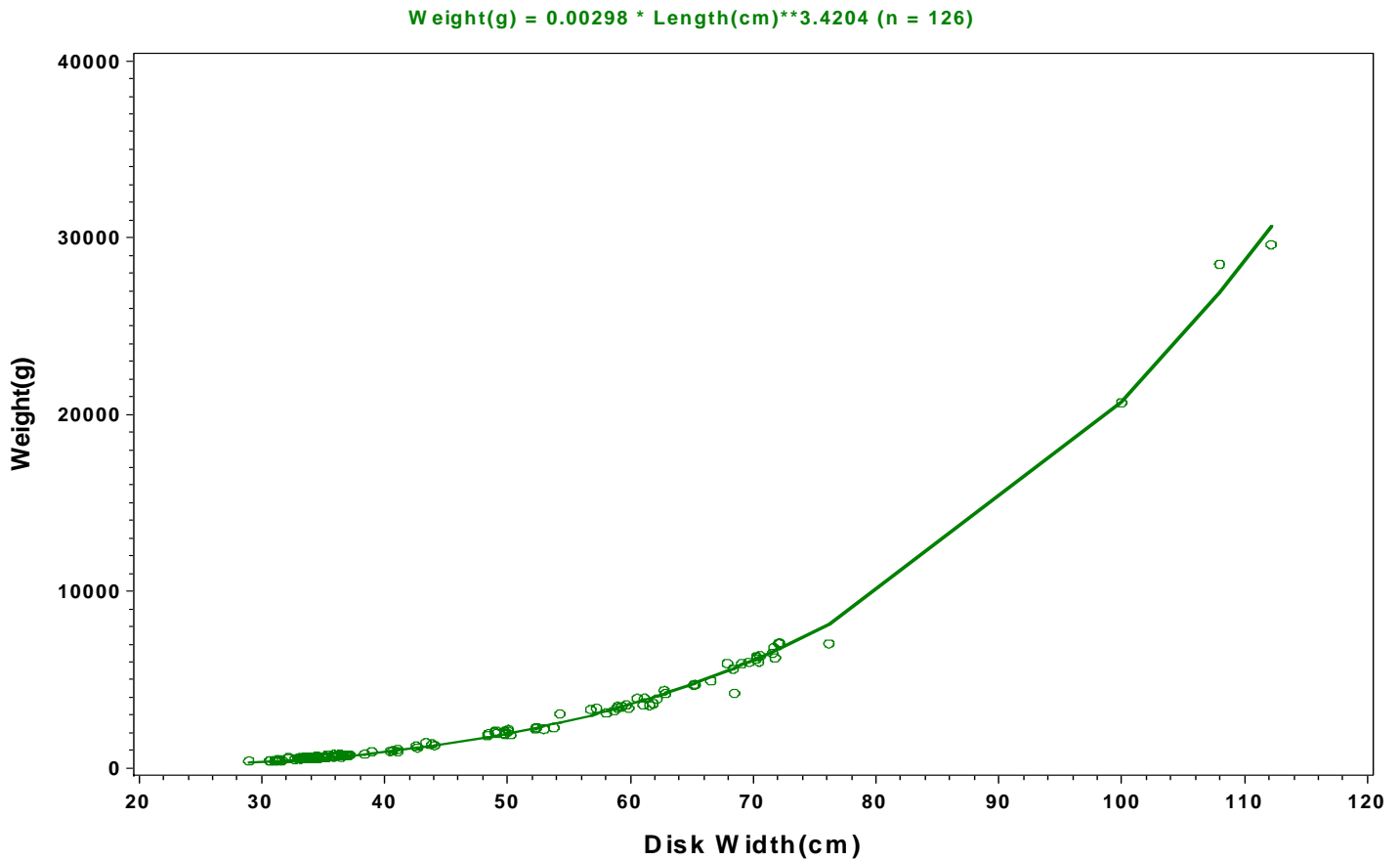


Figure 84. Length-weight regression for bullnose ray, by sex.

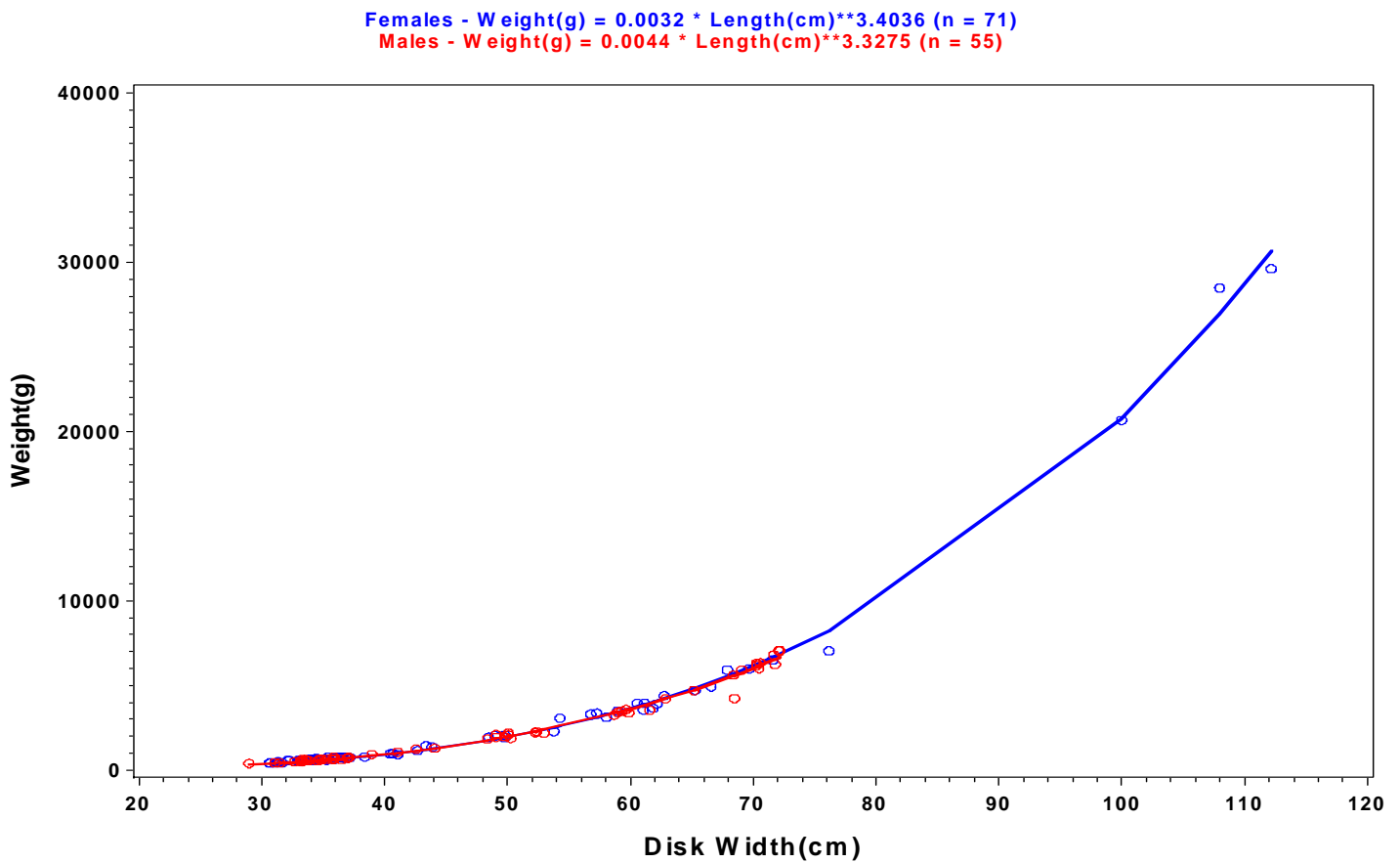


Figure 85. Maturity logistic regression for bullnose ray, females.

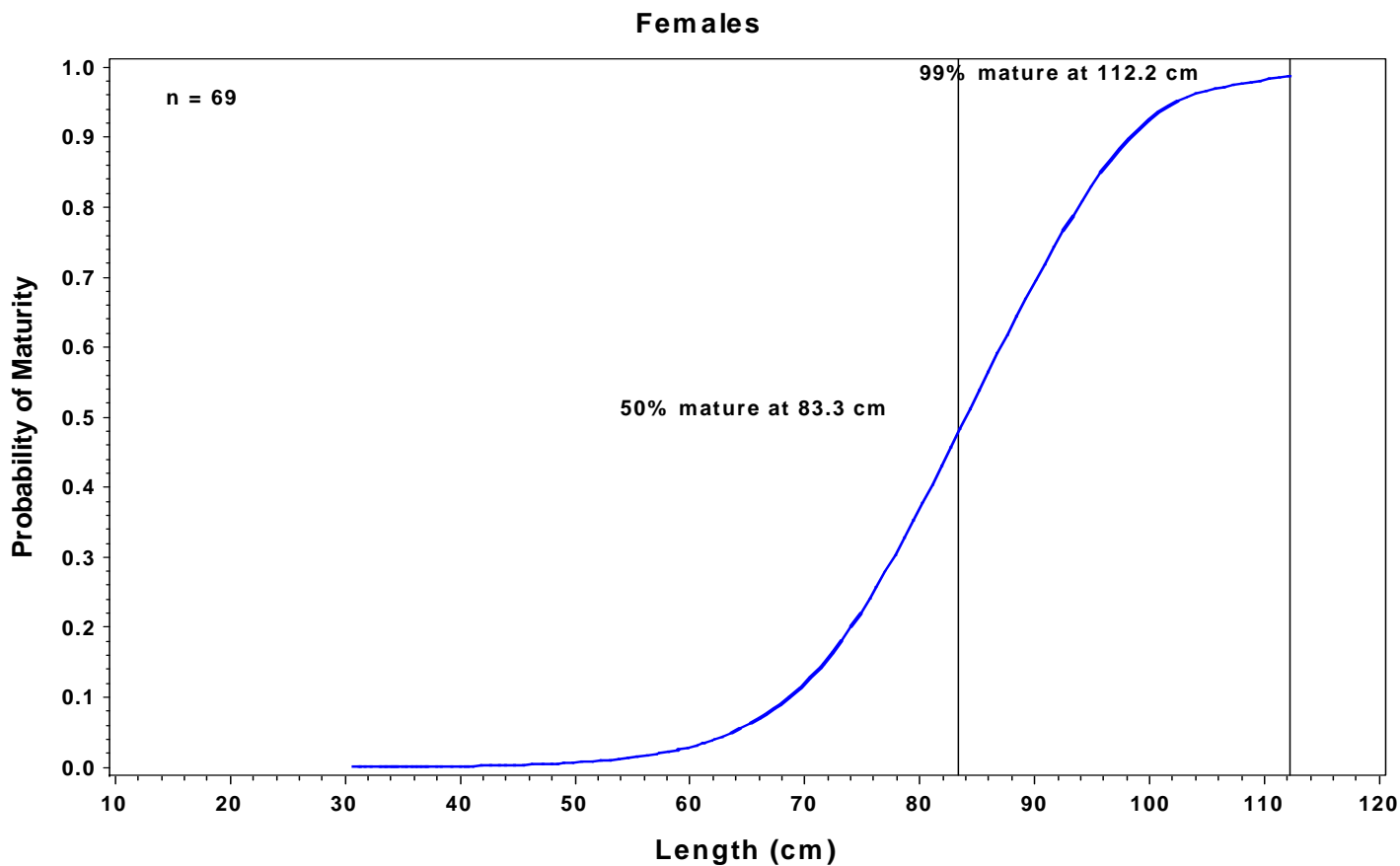
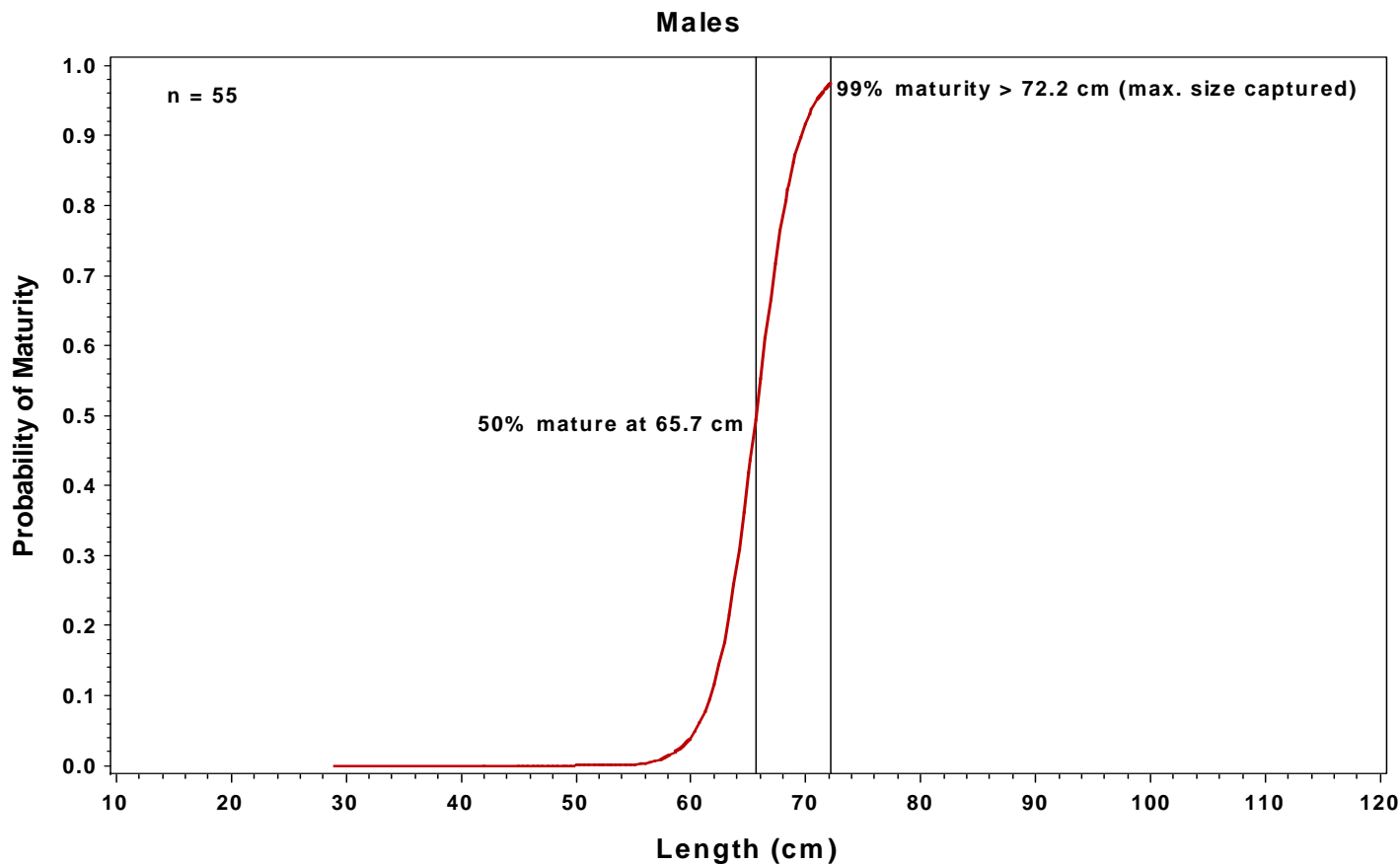


Figure 86. Maturity logistic regression for bullnose ray, males.



# Clearnose Skate

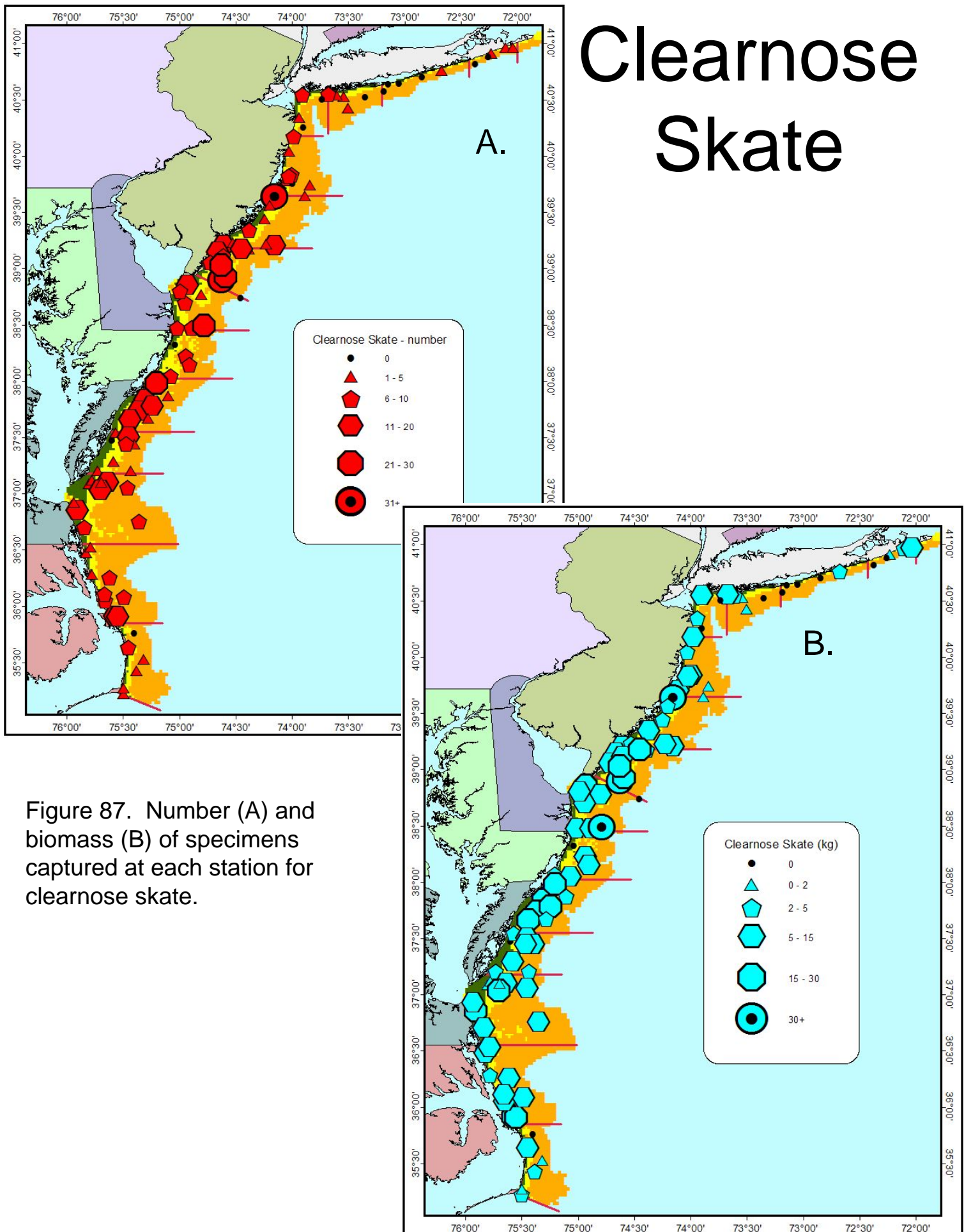


Figure 87. Number (A) and biomass (B) of specimens captured at each station for clearnose skate.

Figure 88. Minimum trawlable number and biomass by state for clearnose skate.

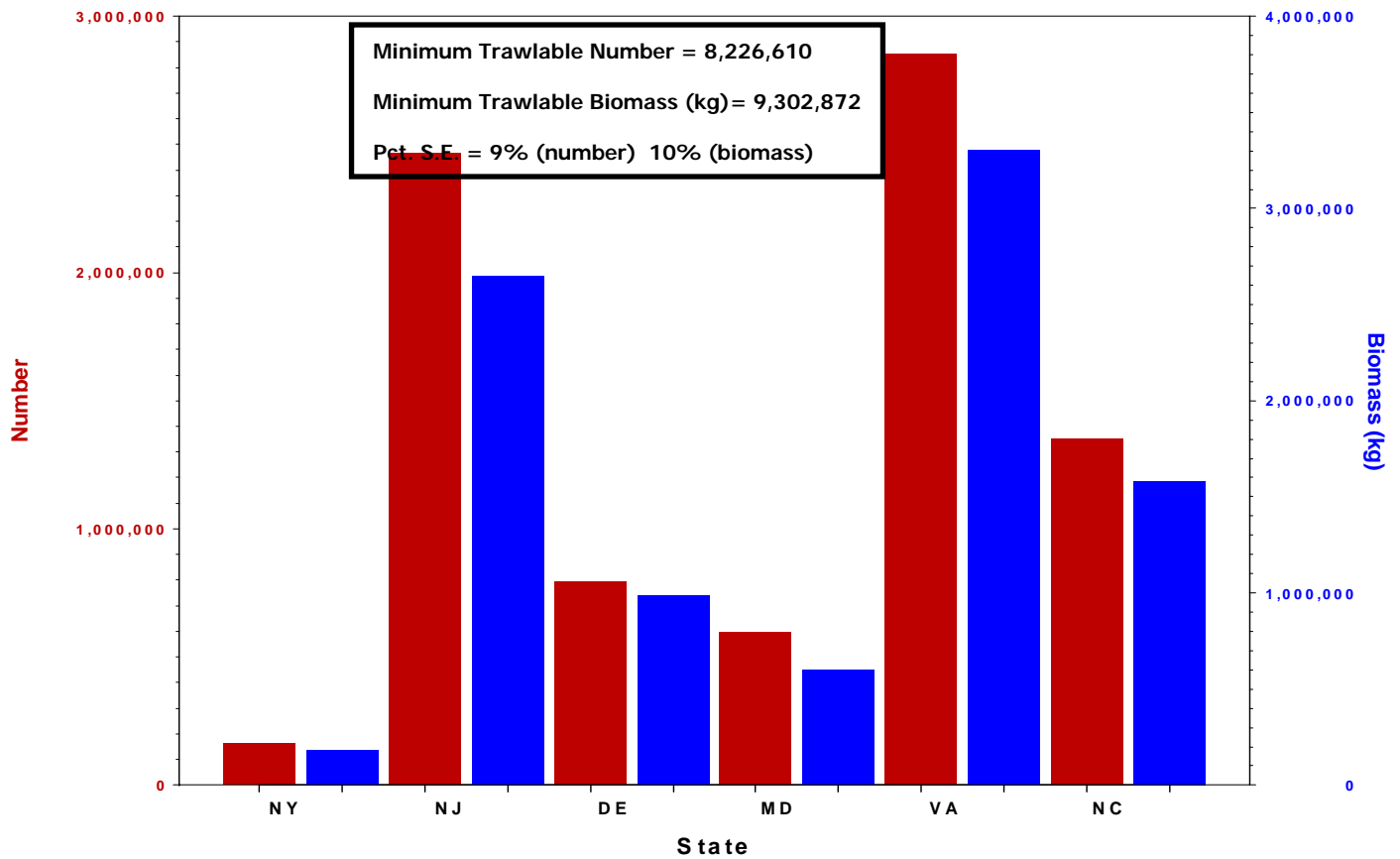


Figure 89. Sex ratios by state for clearnose skate.

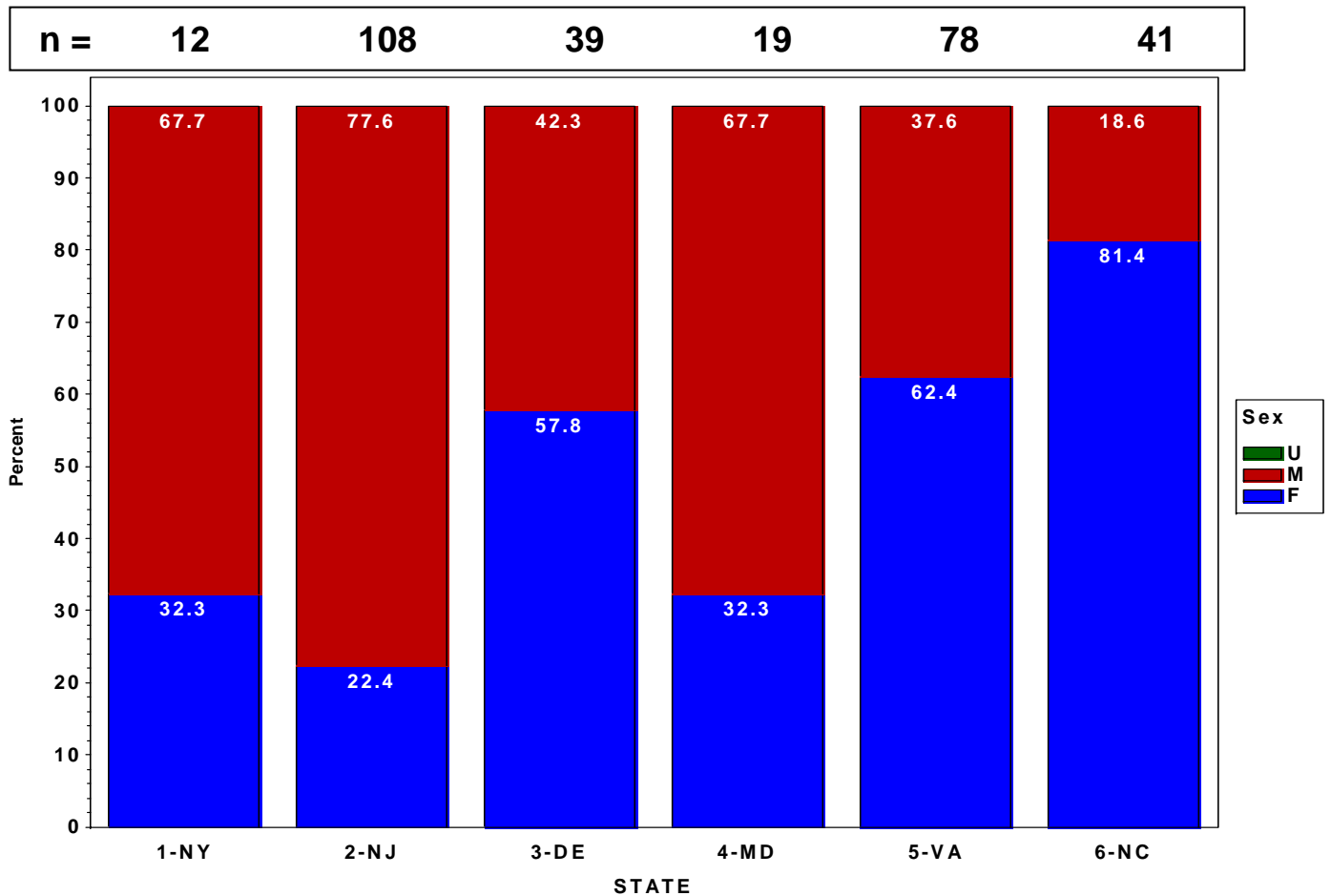


Figure 90. Length frequency for clearnose skate.

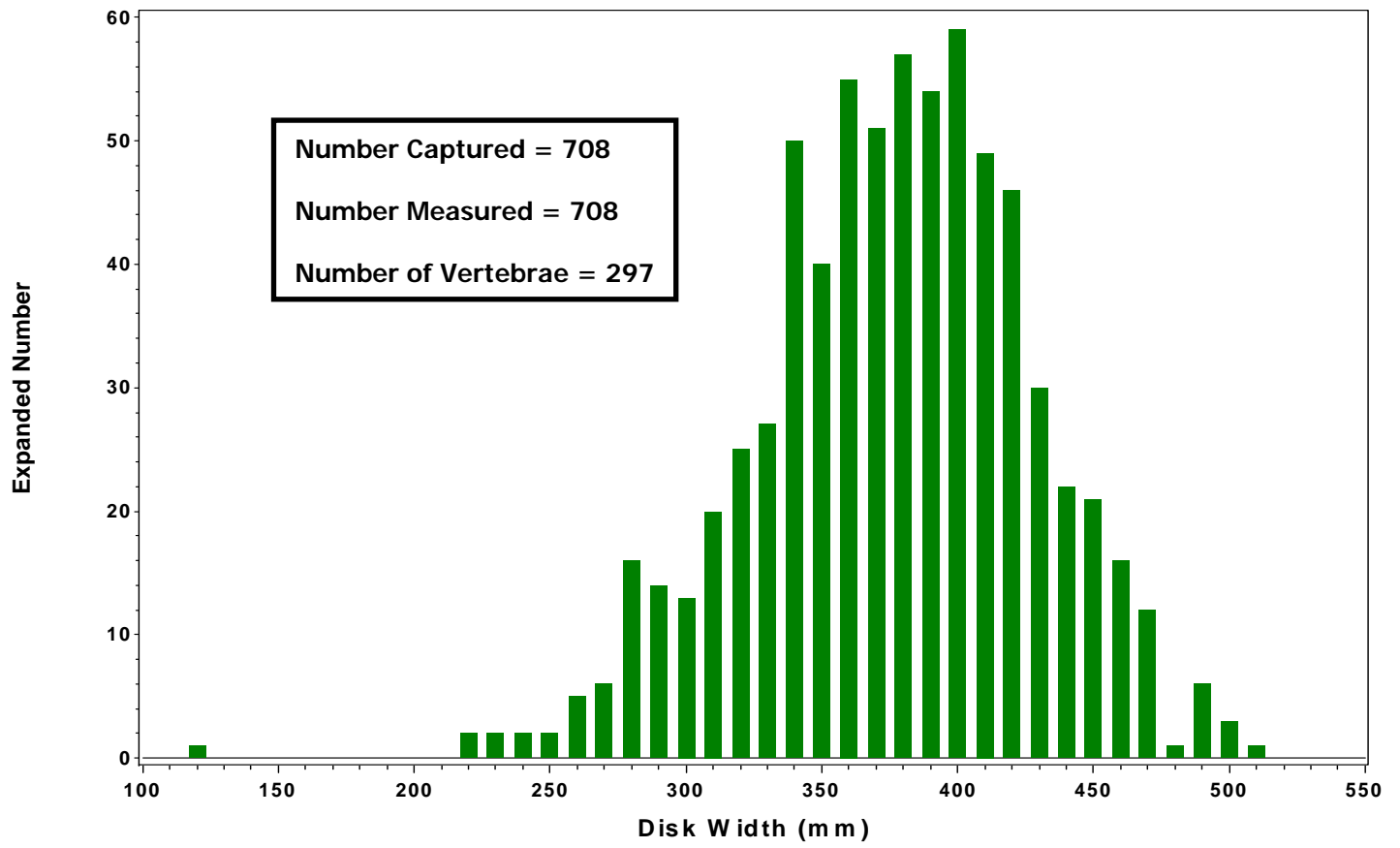




Figure 91. Length-weight regression for clearnose skate, sexes combined.

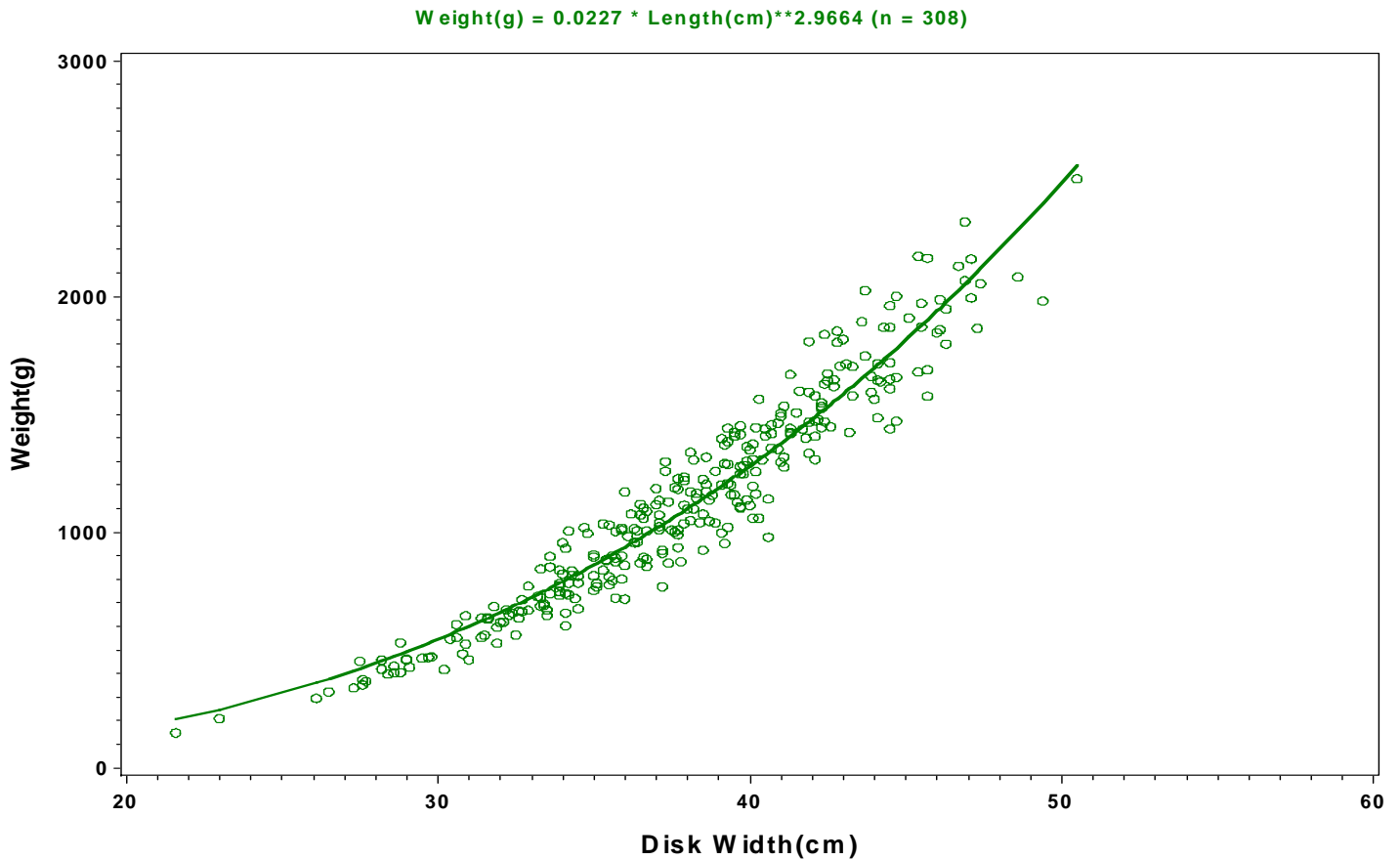


Figure 92. Length-weight regression for slearnose skate, by sex.

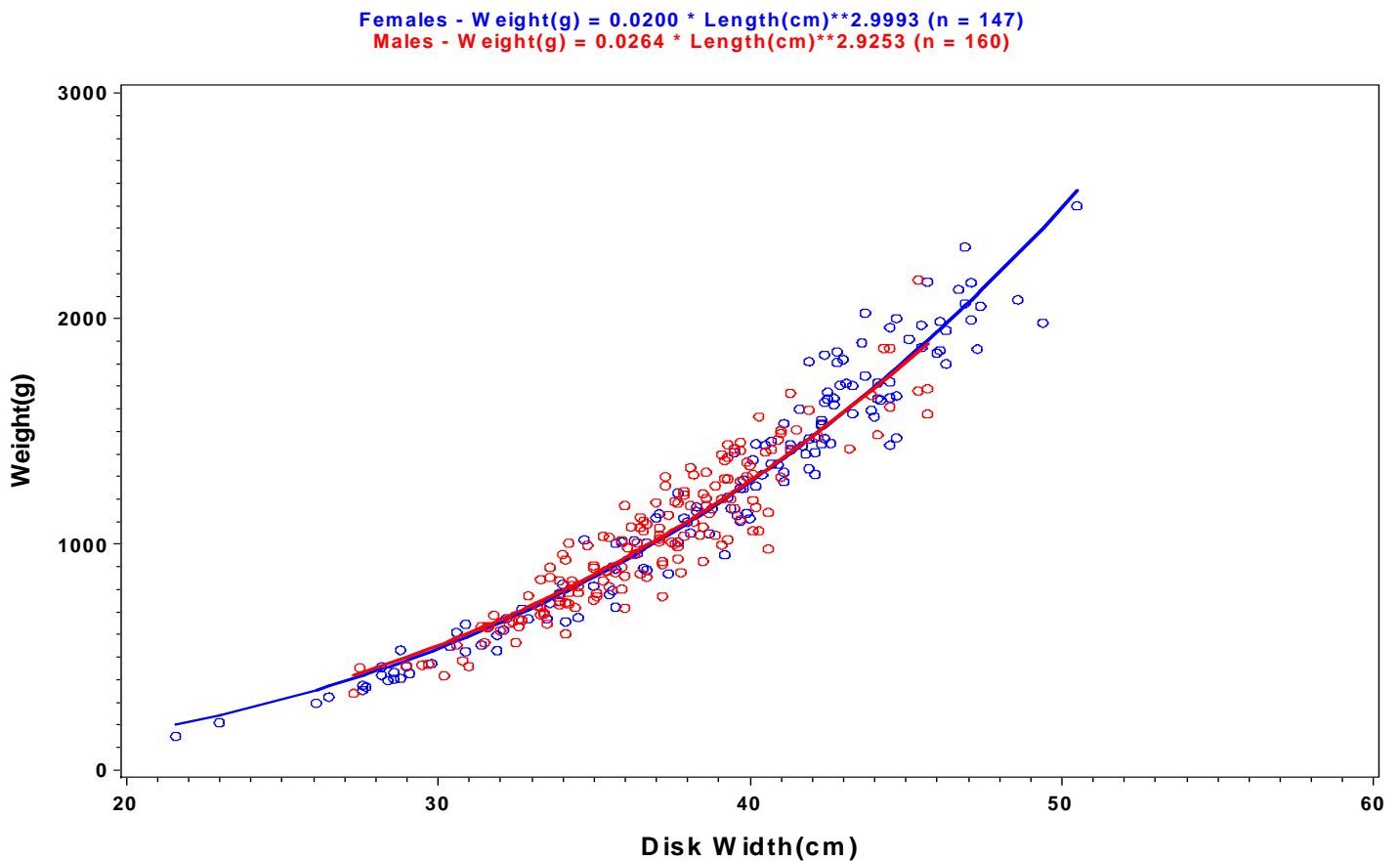


Figure 93. Maturity logistic regression for clearnose skate, females.

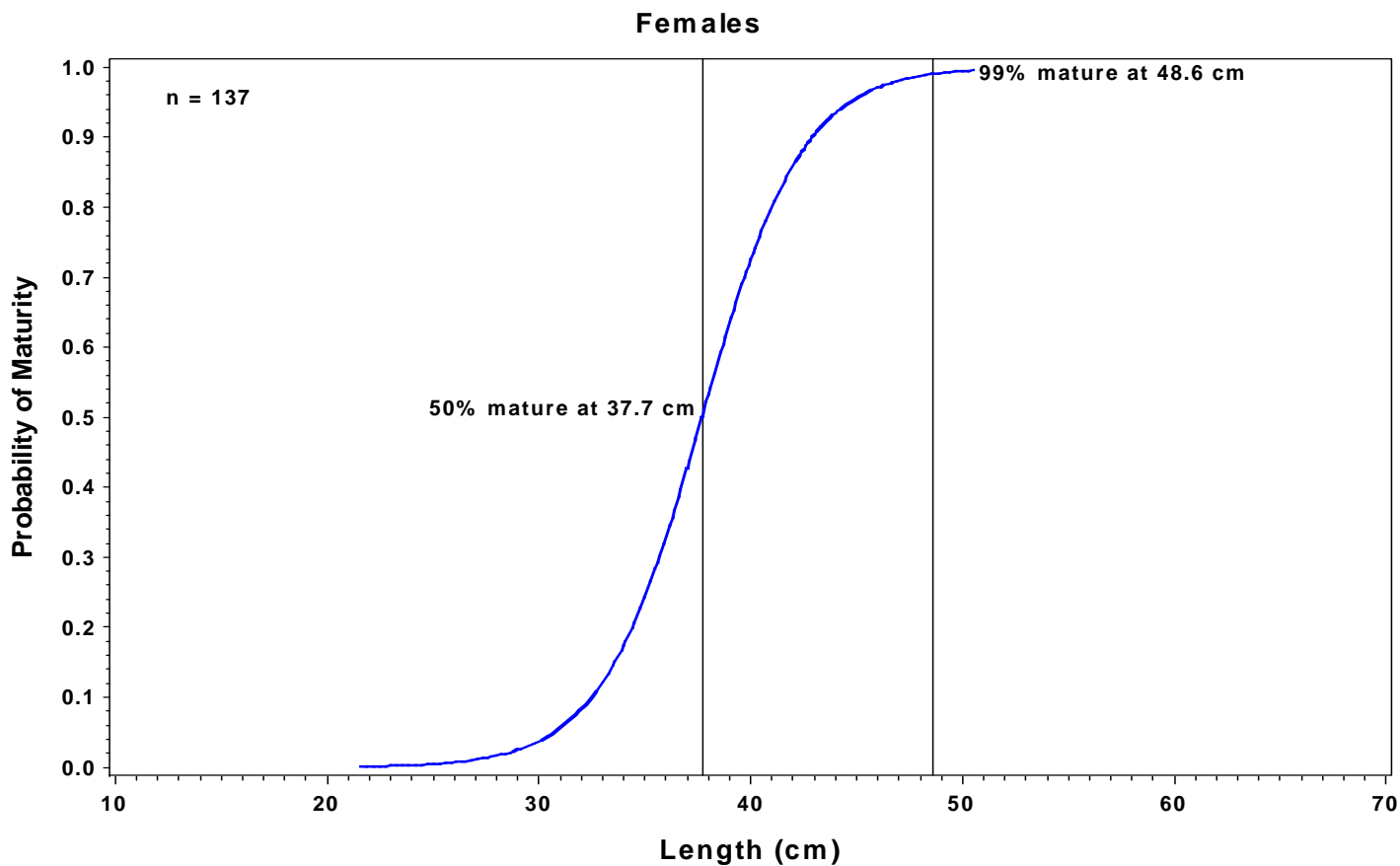
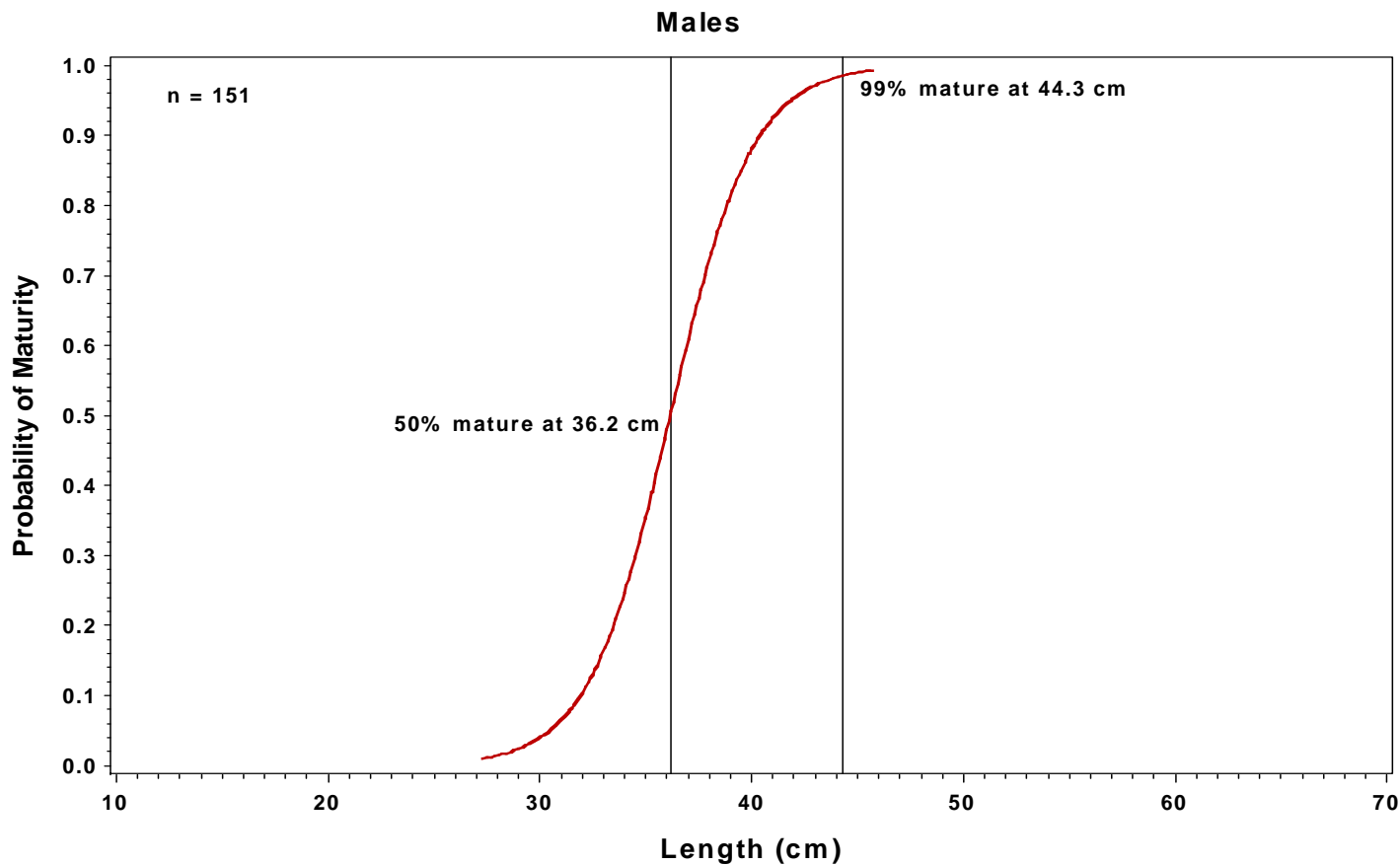


Figure 94. Maturity logistic regression for clearnose skate, males.



# Smooth Dogfish

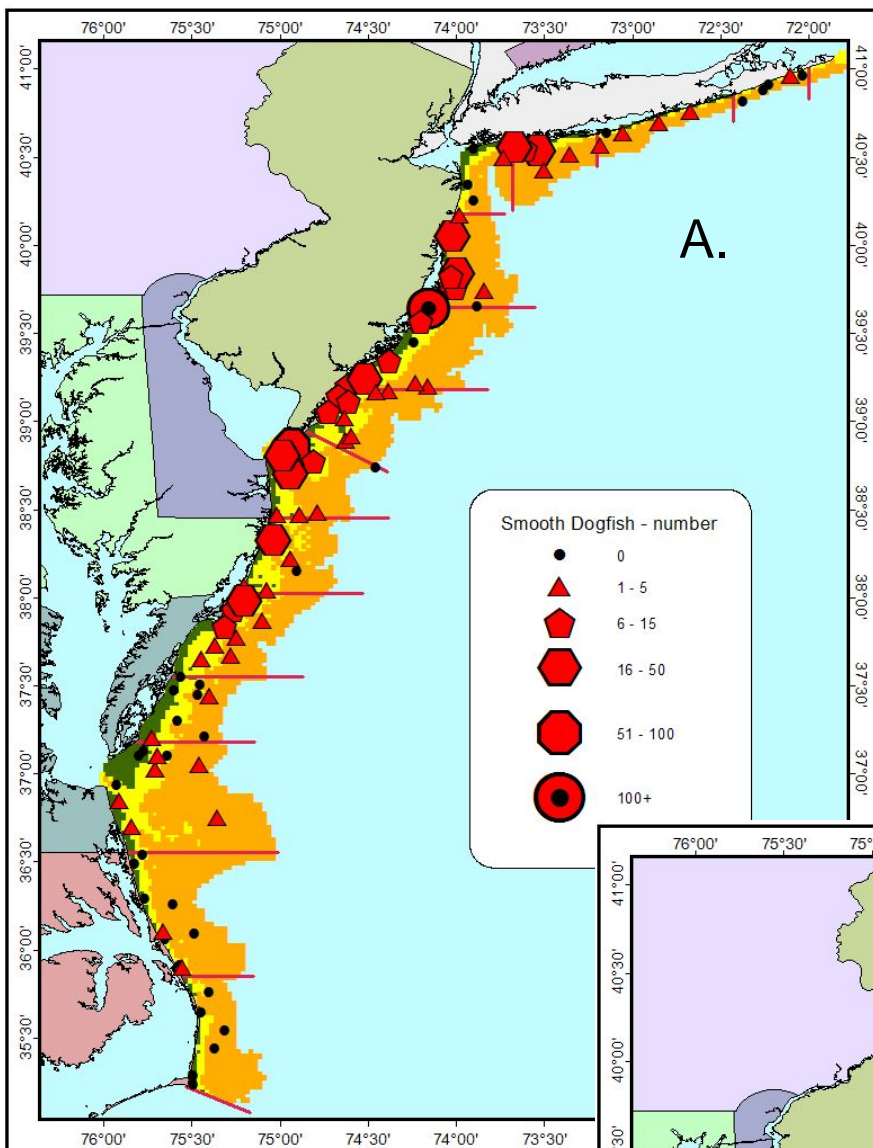


Figure 95. Number (A) and biomass (B) of specimens captured at each station for smooth dogfish.

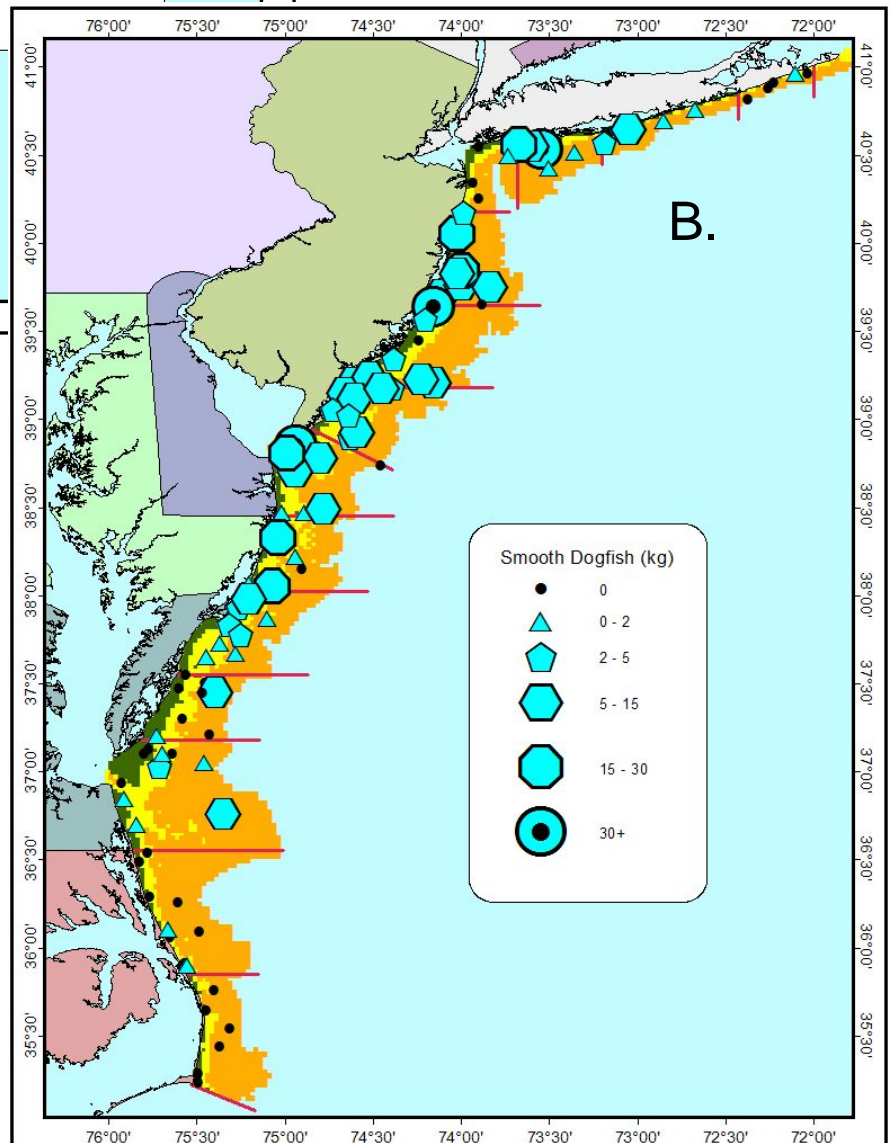


Figure 96. Minimum trawlable number and biomass by state for smooth dogfish.

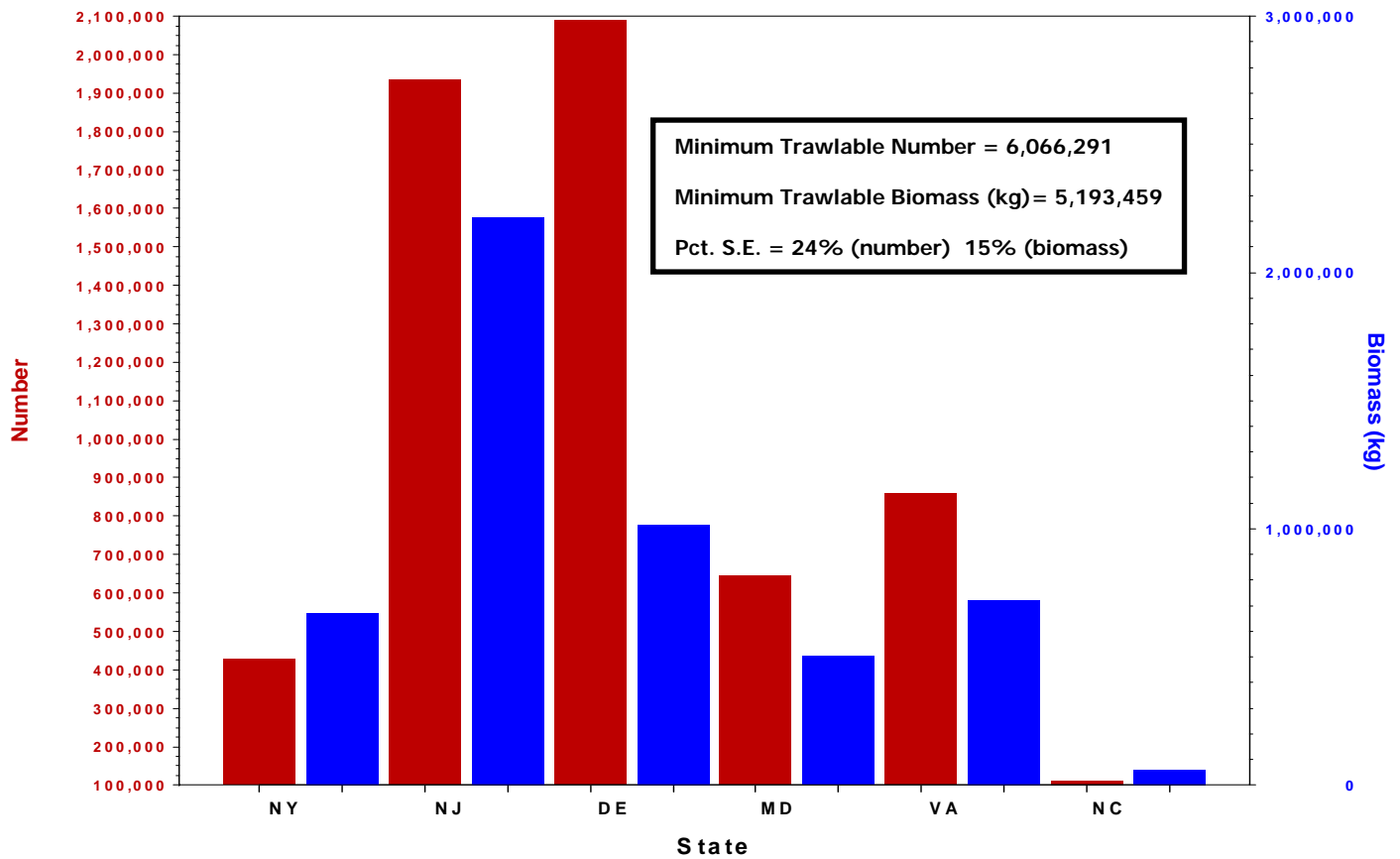


Figure 97. Sex ratios by state for smooth dogfish.

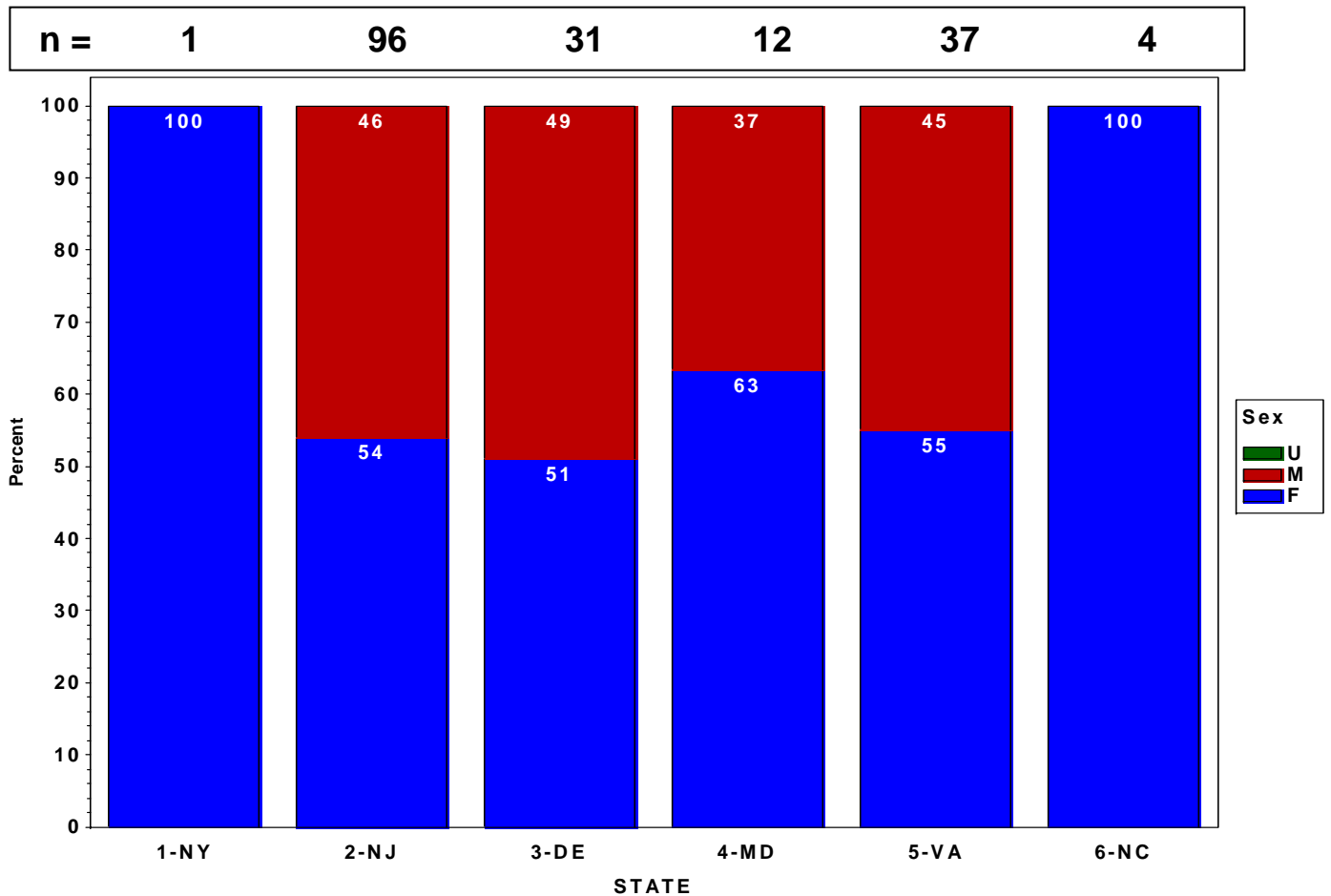


Figure 98. Length frequency for smooth dogfish.

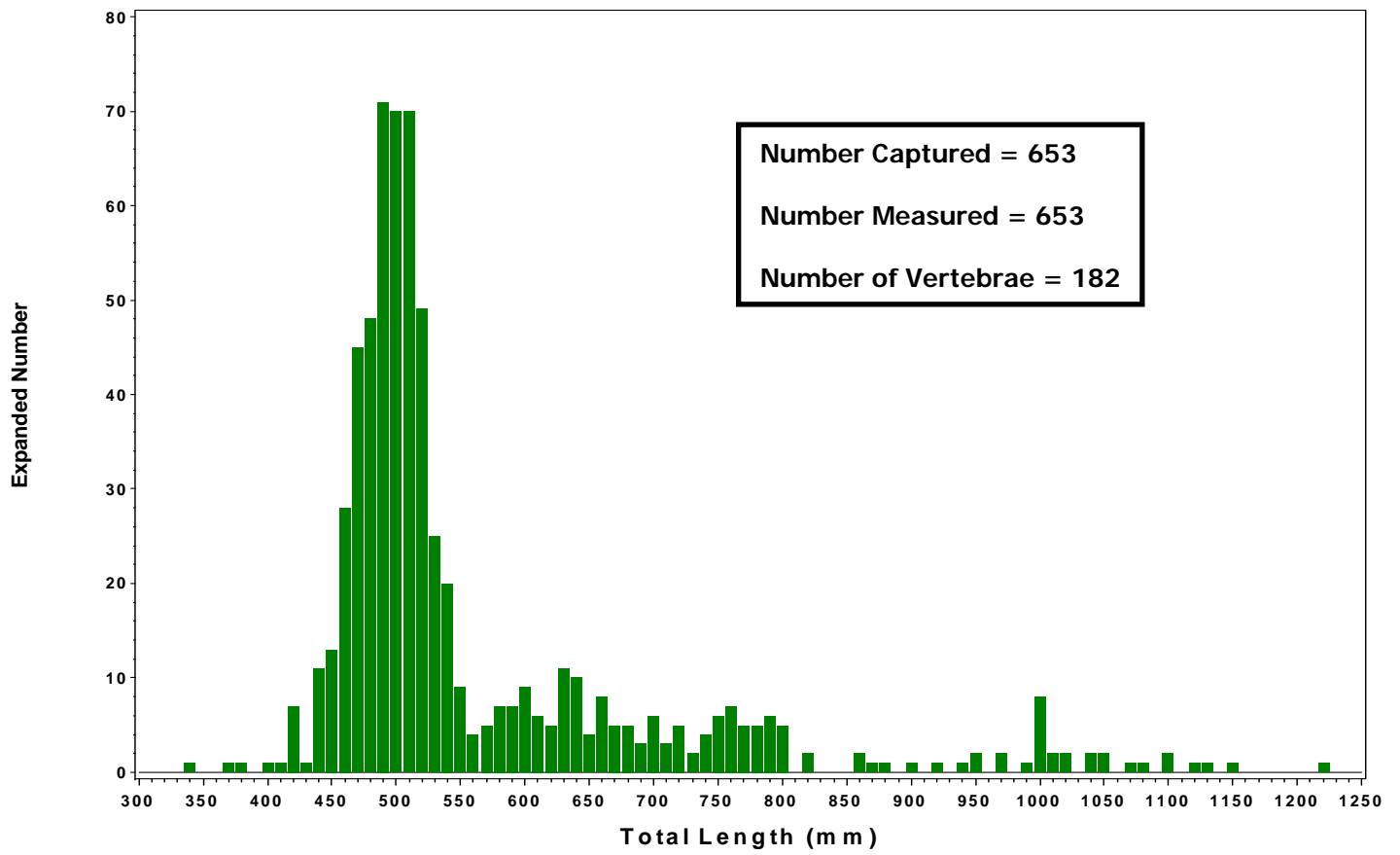


Figure 99. Length-weight regression for smooth dogfish, sexes combined.

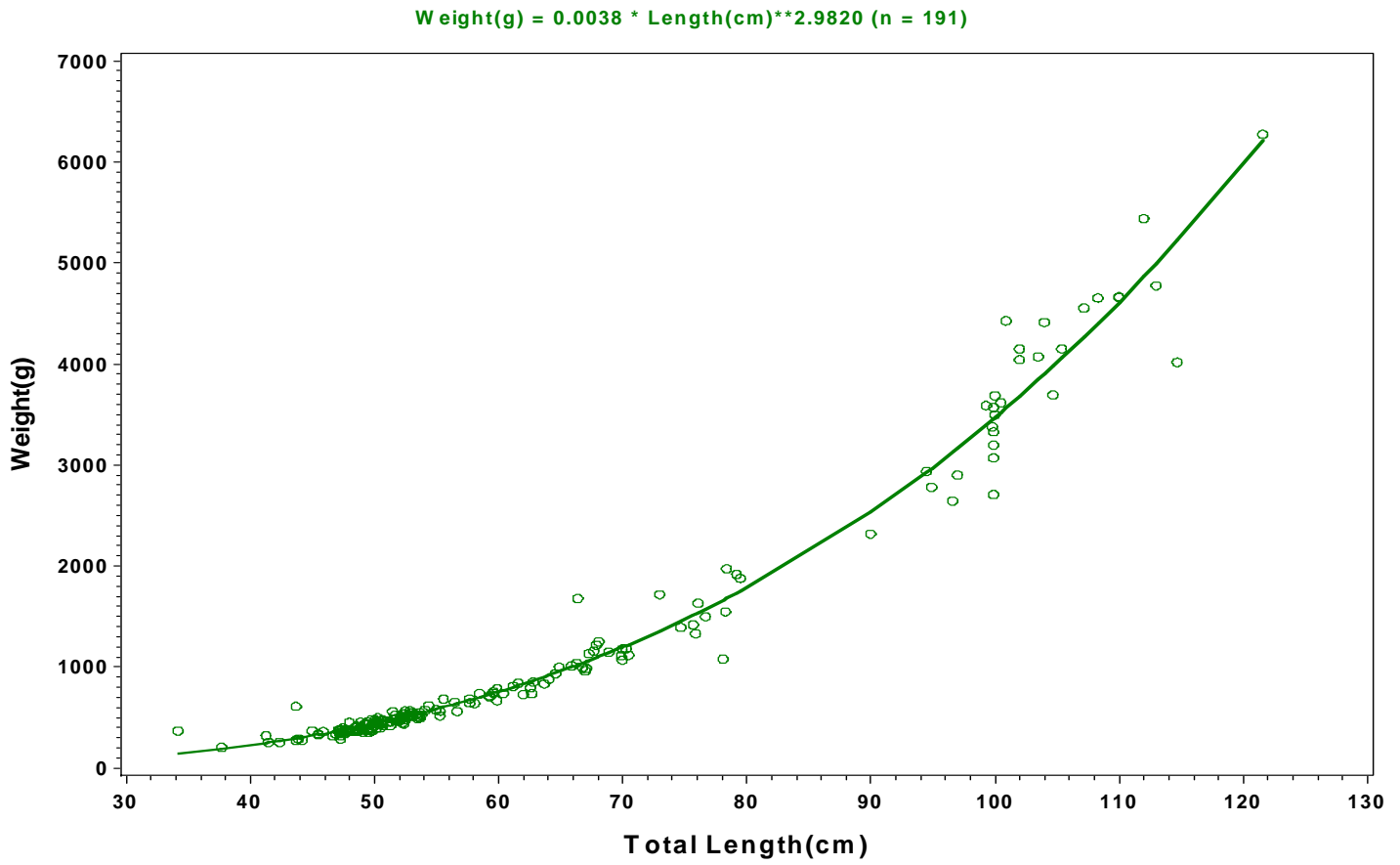
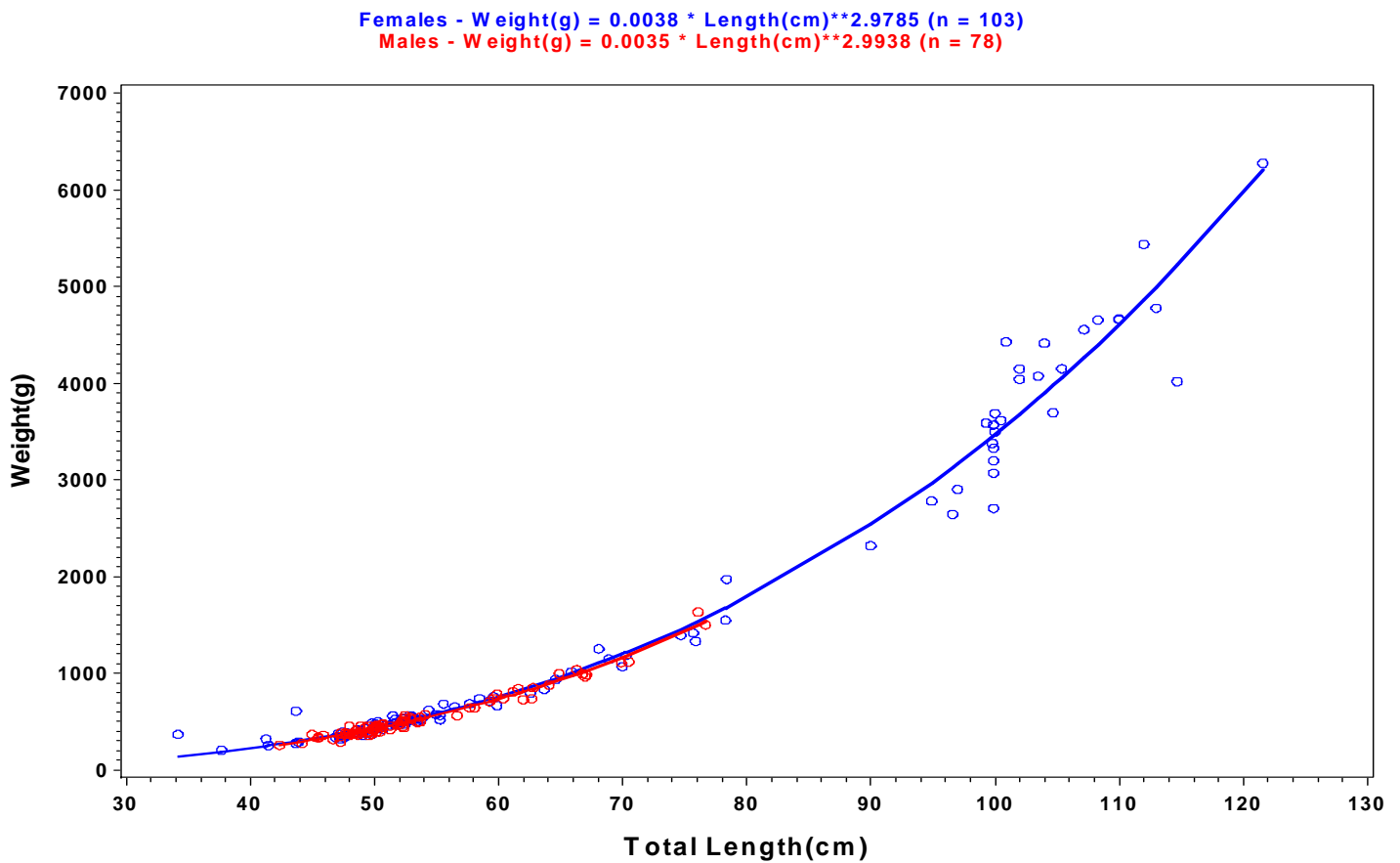


Figure 100. Length-weight regression for smooth dogfish, by sex.



# Butterfish

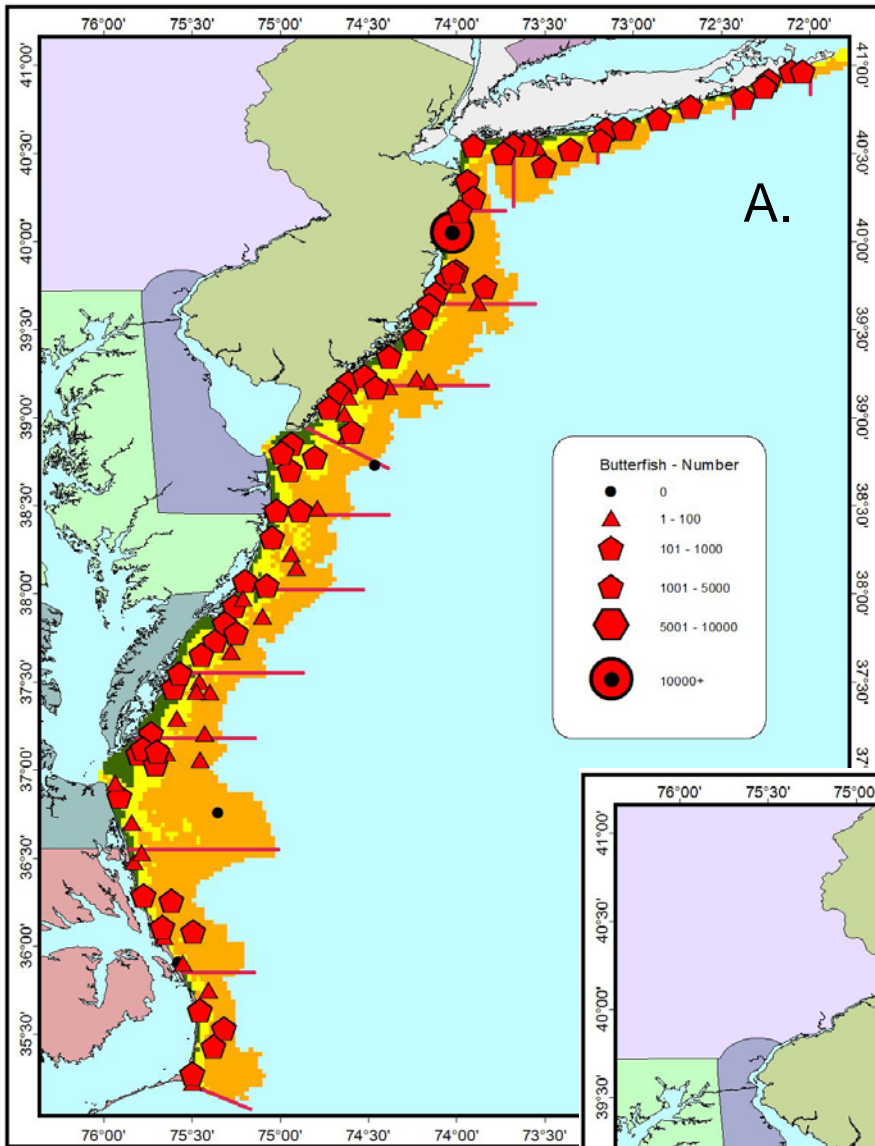


Figure 101. Number (A) and biomass (B) of specimens captured at each station for butterfish.

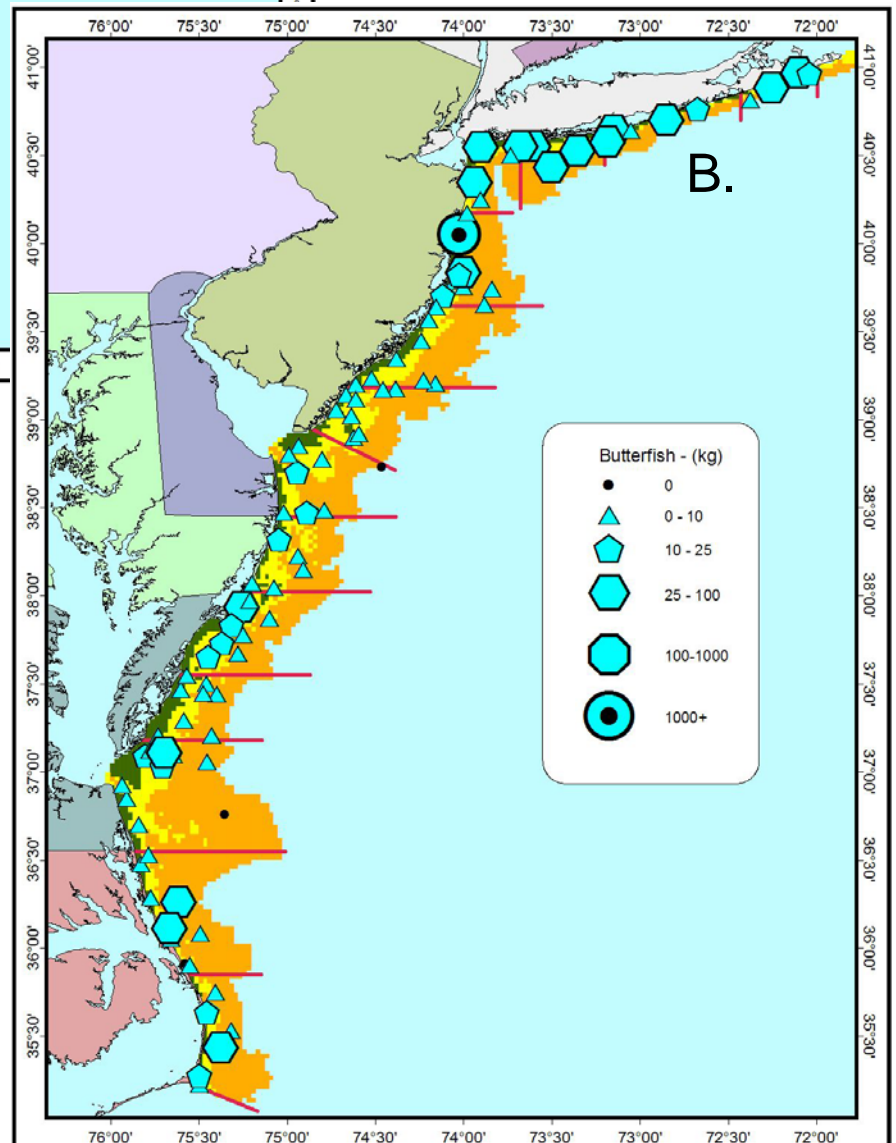


Figure 102. Minimum trawlable number and biomass by state for butterfish.

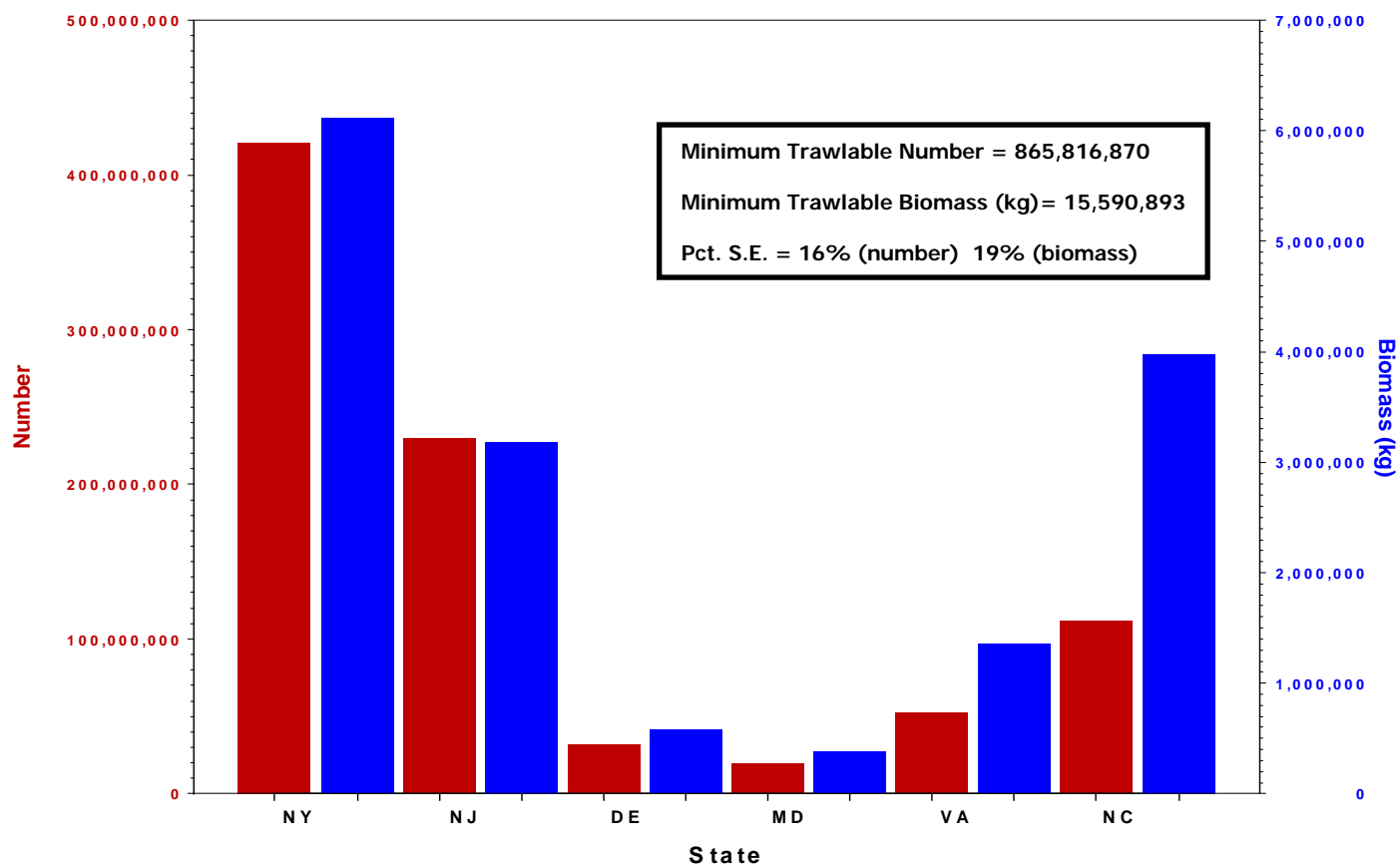
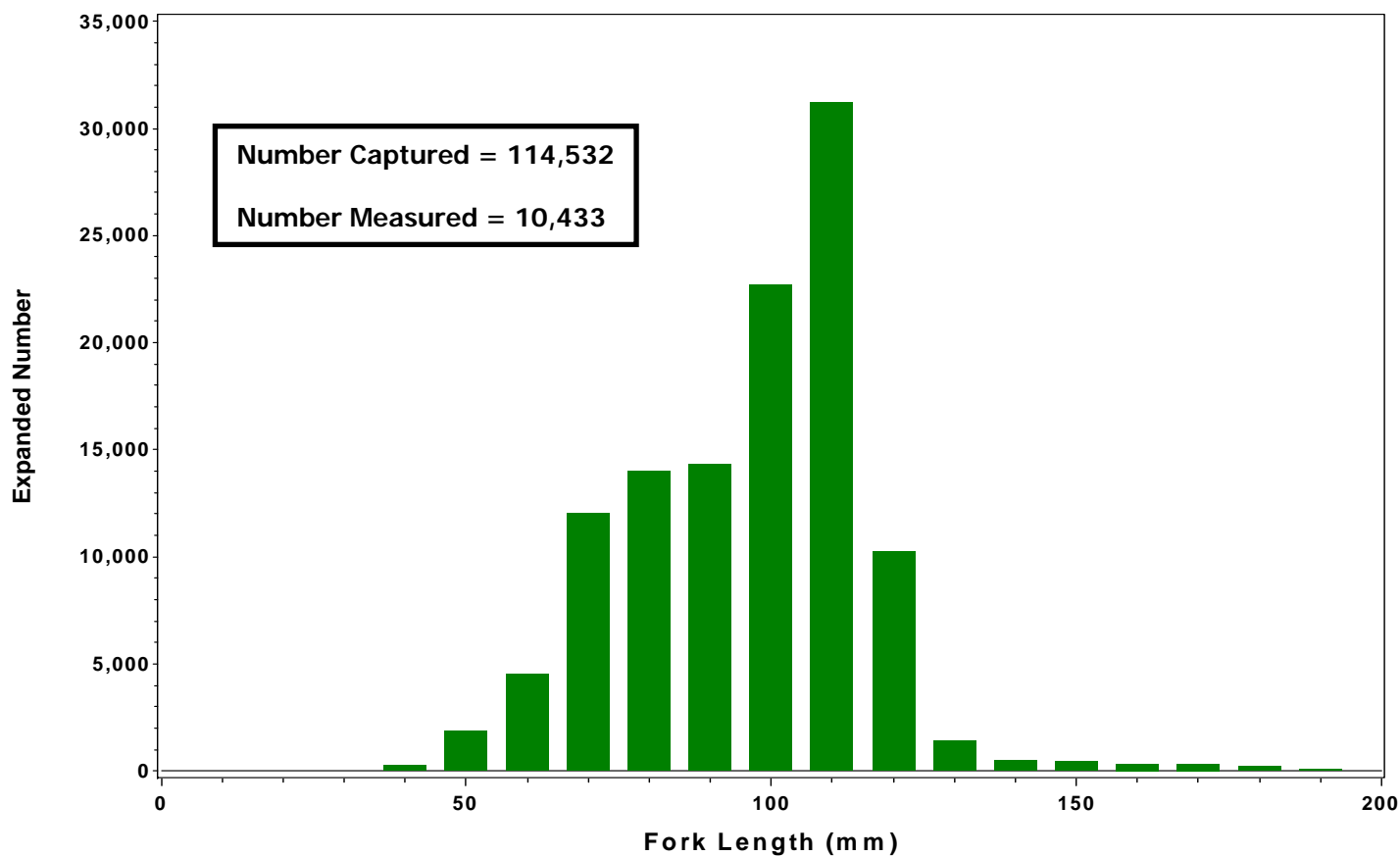


Figure 103. Length frequency for butterfish.





# Silver Perch

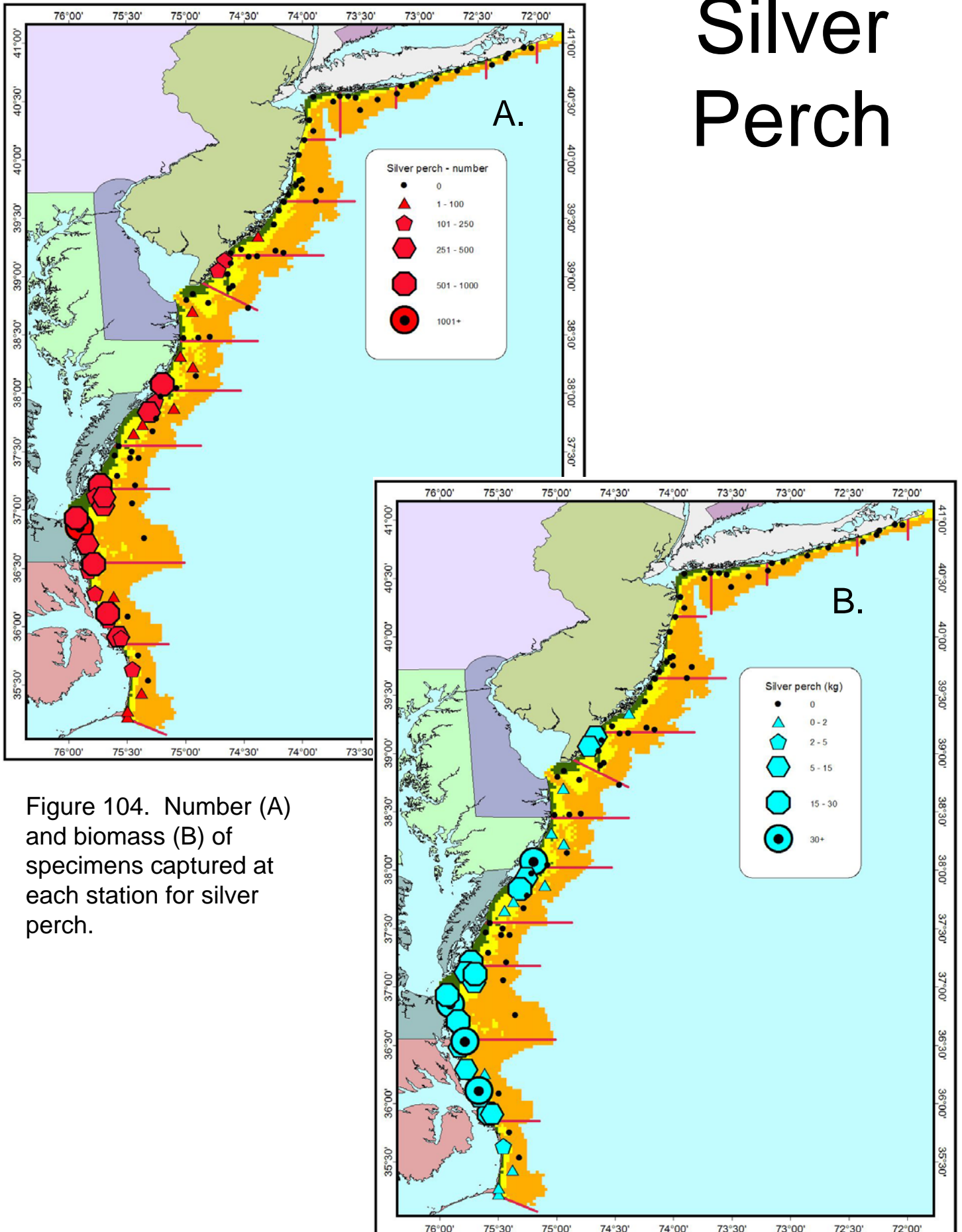


Figure 104. Number (A) and biomass (B) of specimens captured at each station for silver perch.

Figure 105. Minimum trawlable number and biomass by state for silver perch.

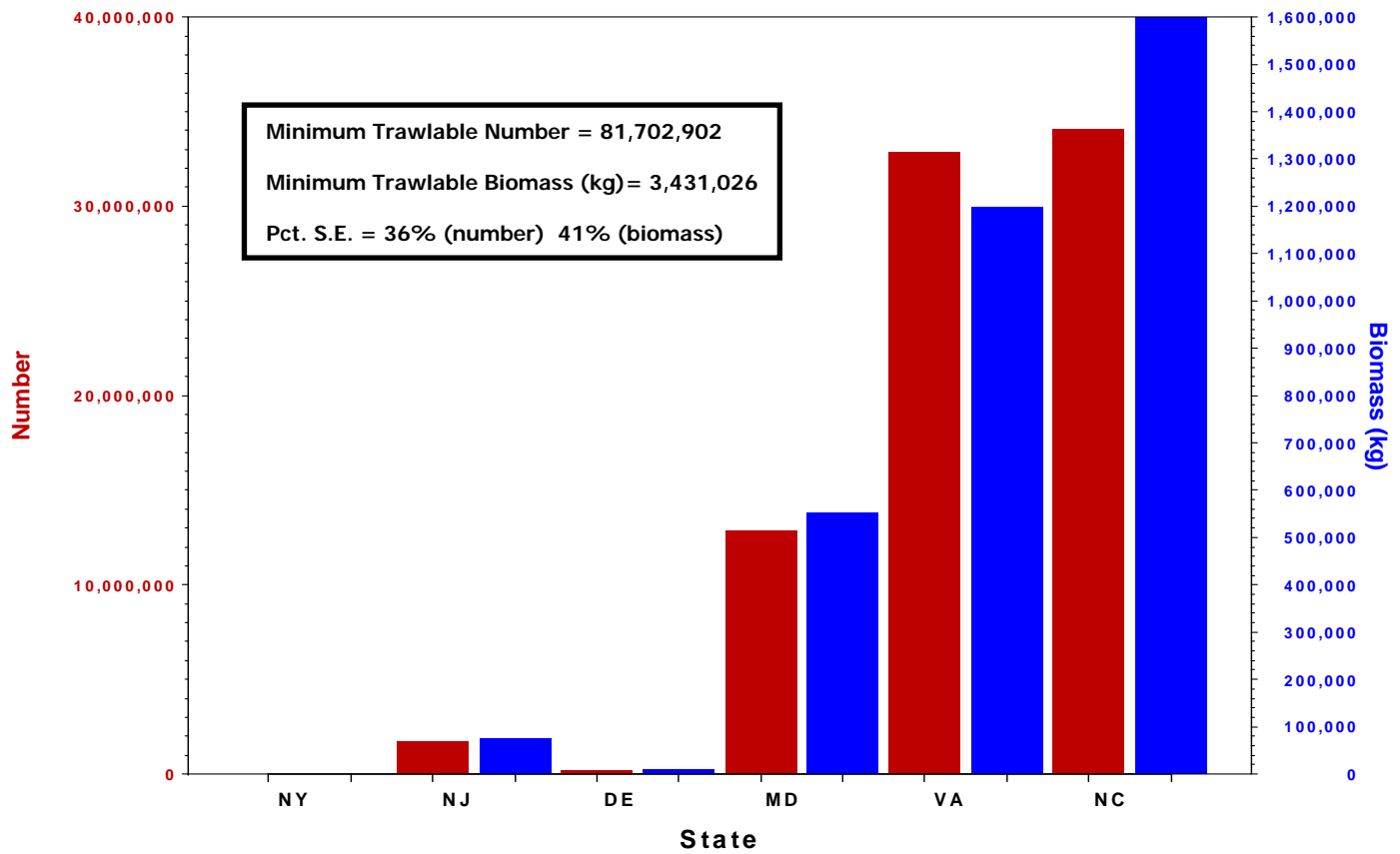
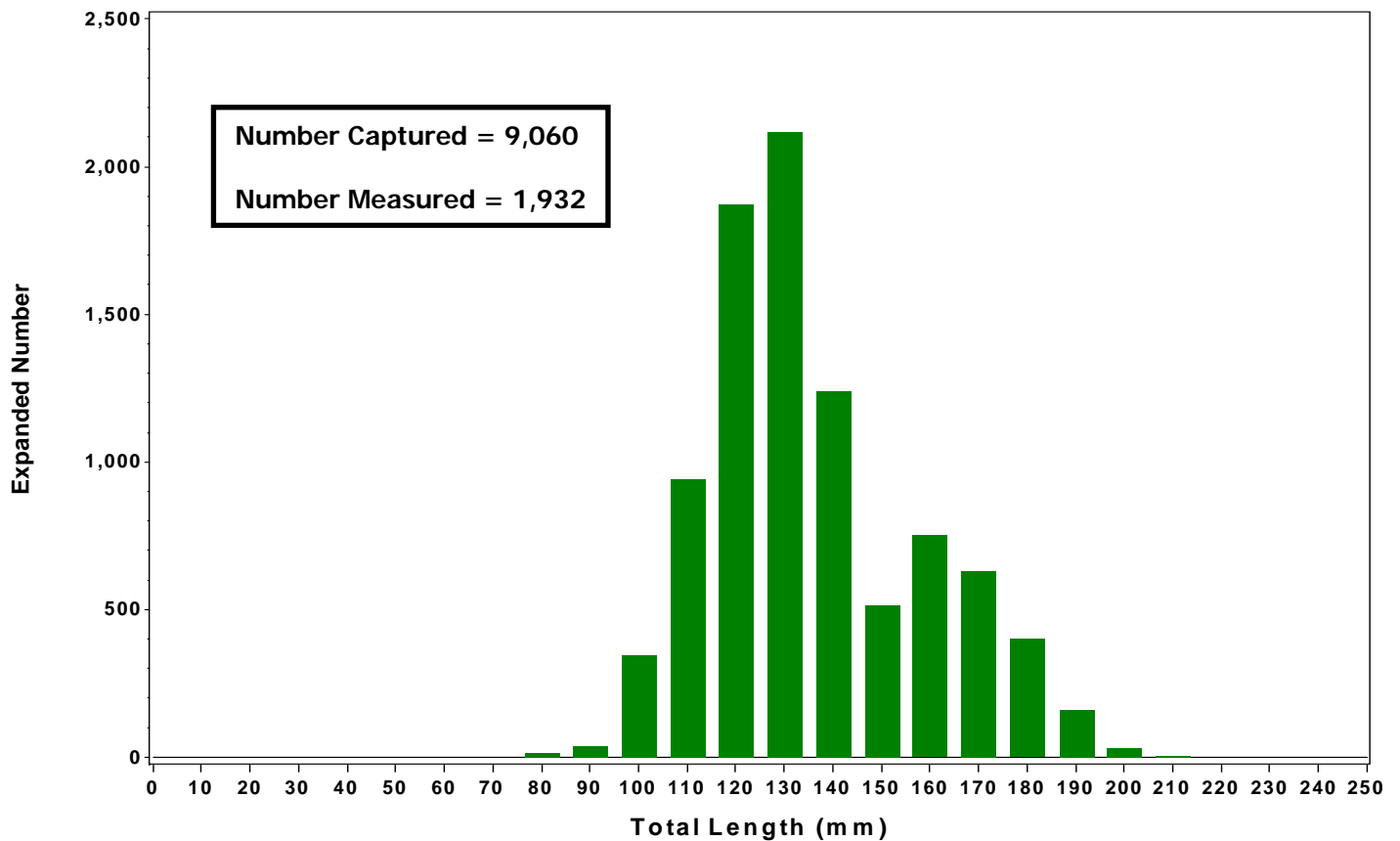


Figure 106. Length frequency for silver perch.



# Southern Kingfish

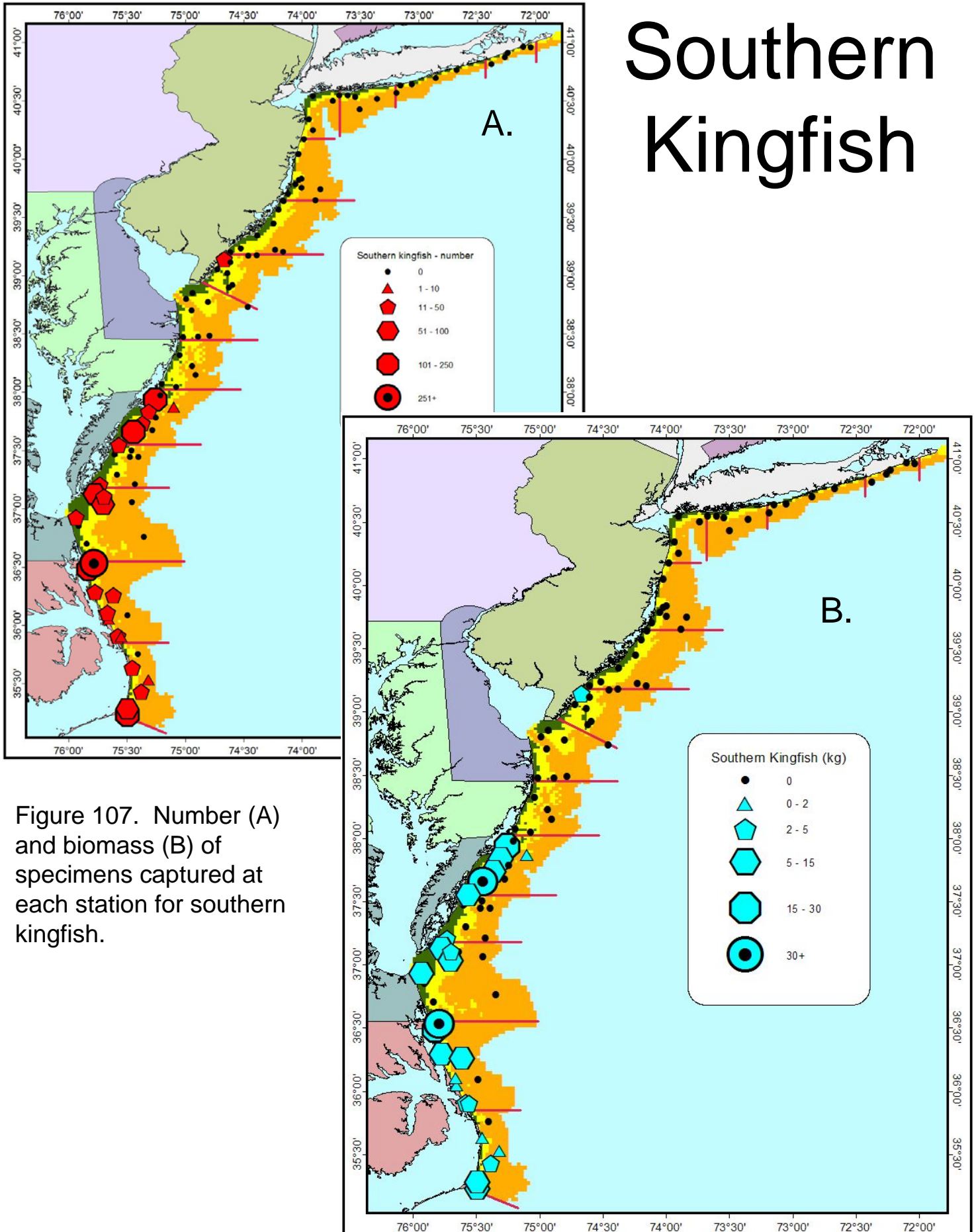


Figure 107. Number (A) and biomass (B) of specimens captured at each station for southern kingfish.

Figure 108. Minimum trawlable number and biomass by state for southern kingfish.

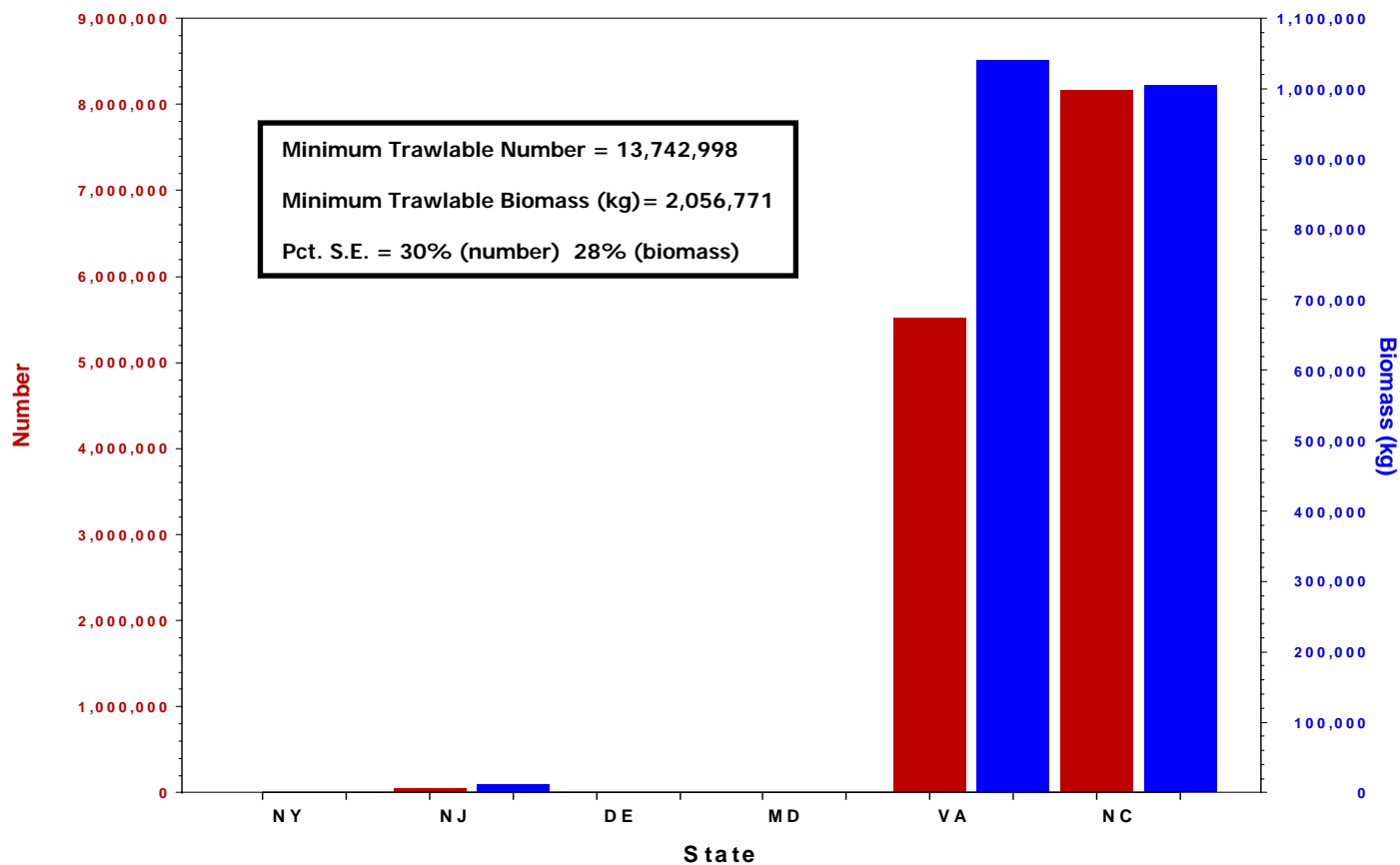
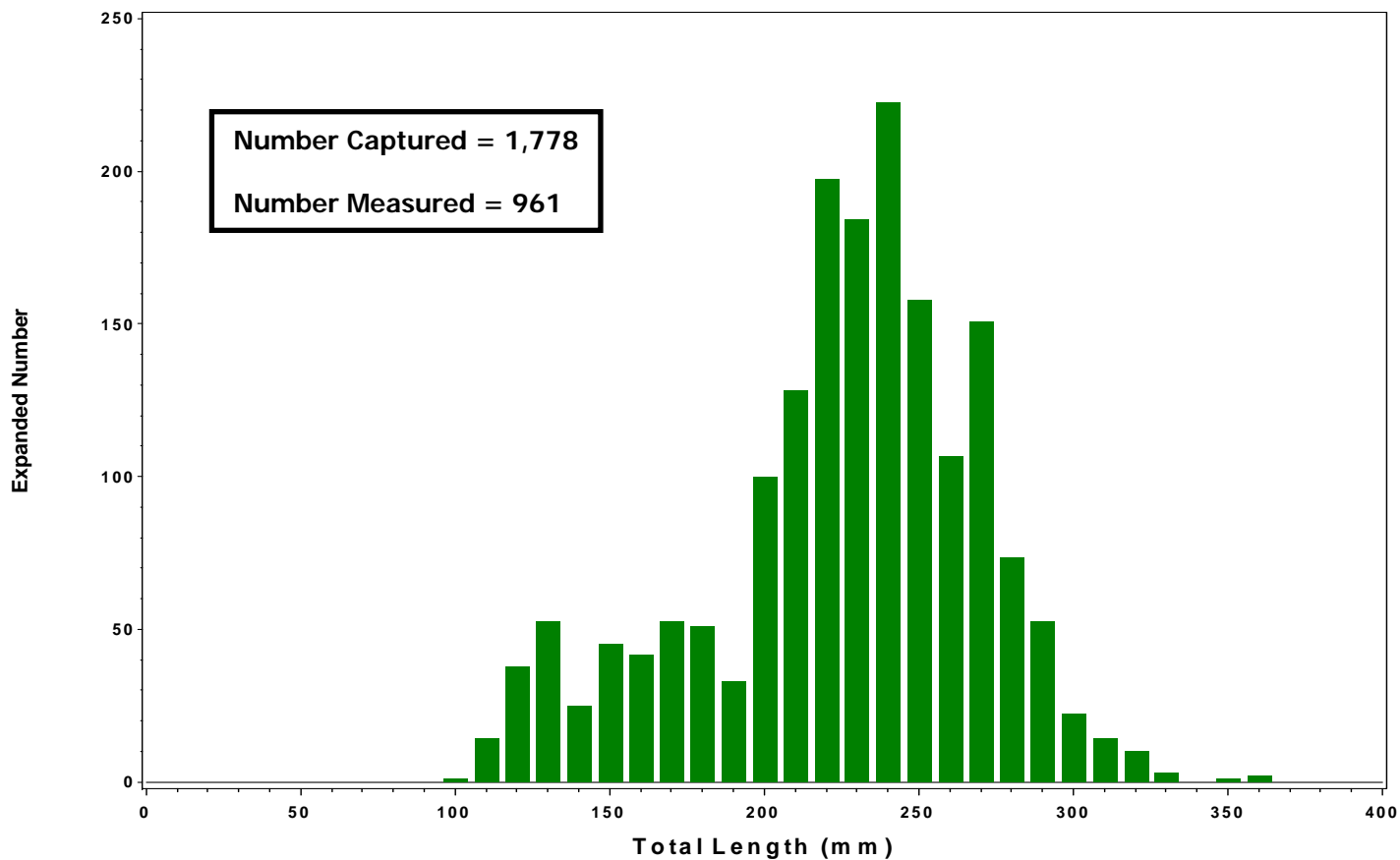


Figure 109. Length frequency for southern kingfish.



# Striped Anchovy

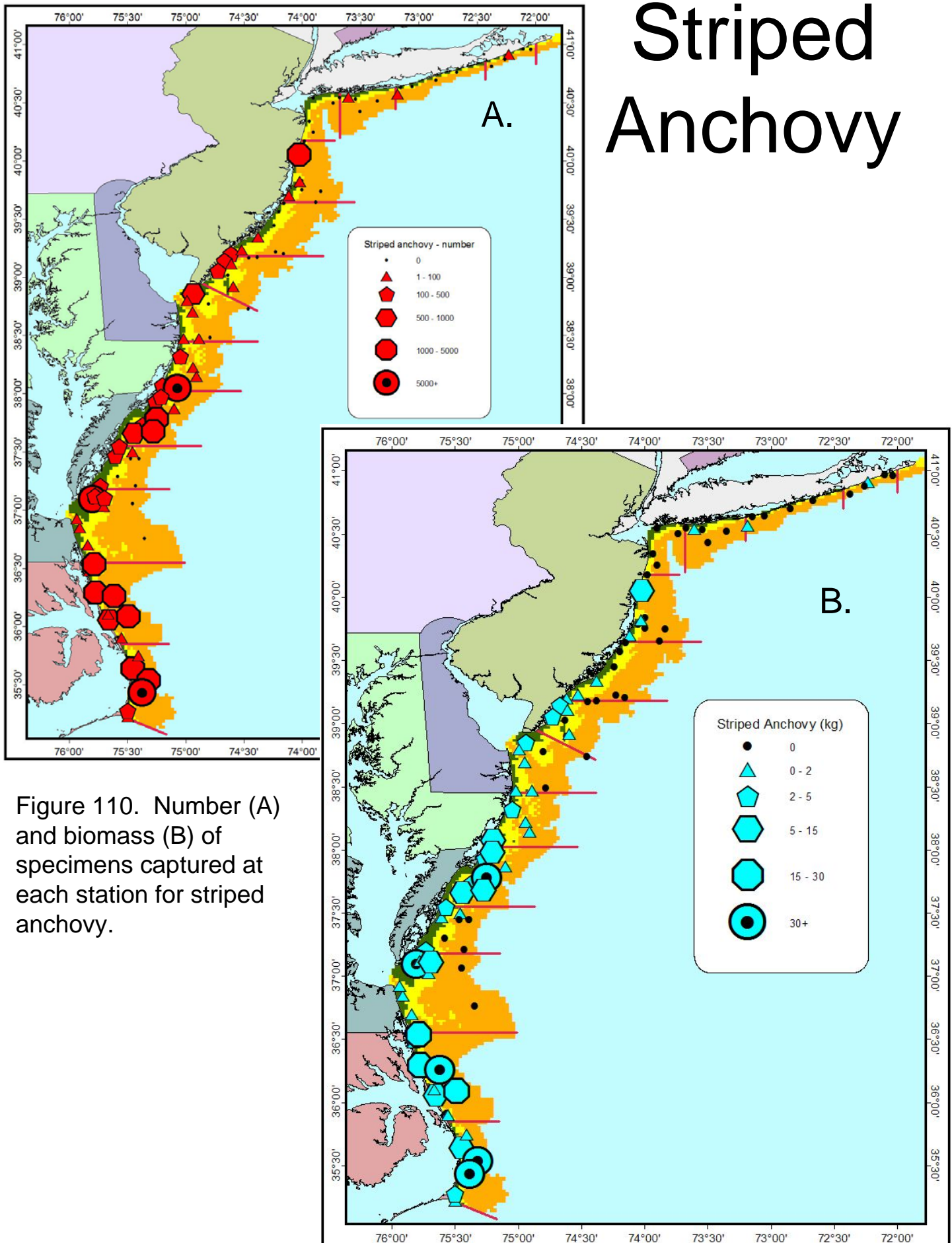




Figure 111. Minimum trawlable number and biomass by state for striped anchovy.

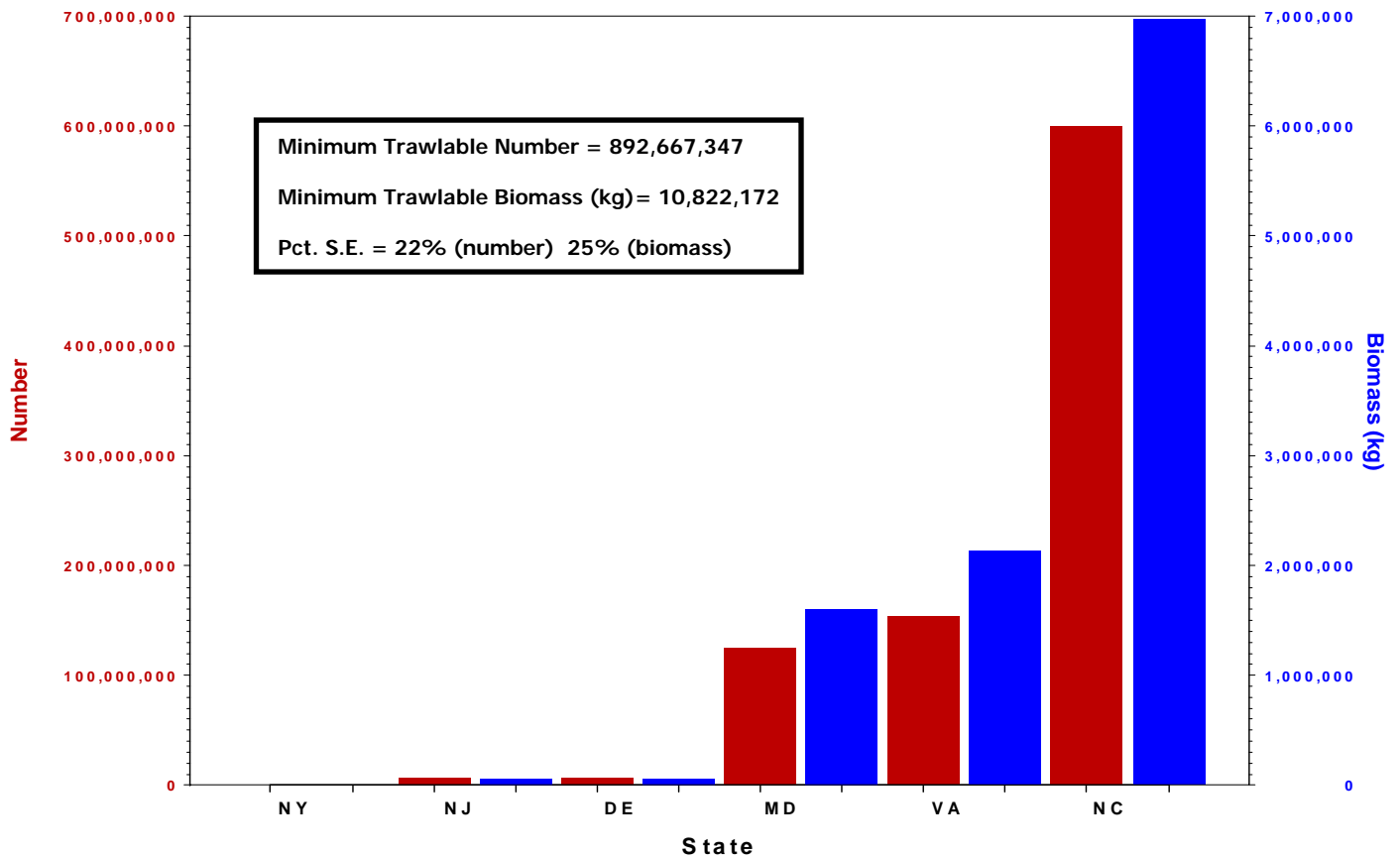
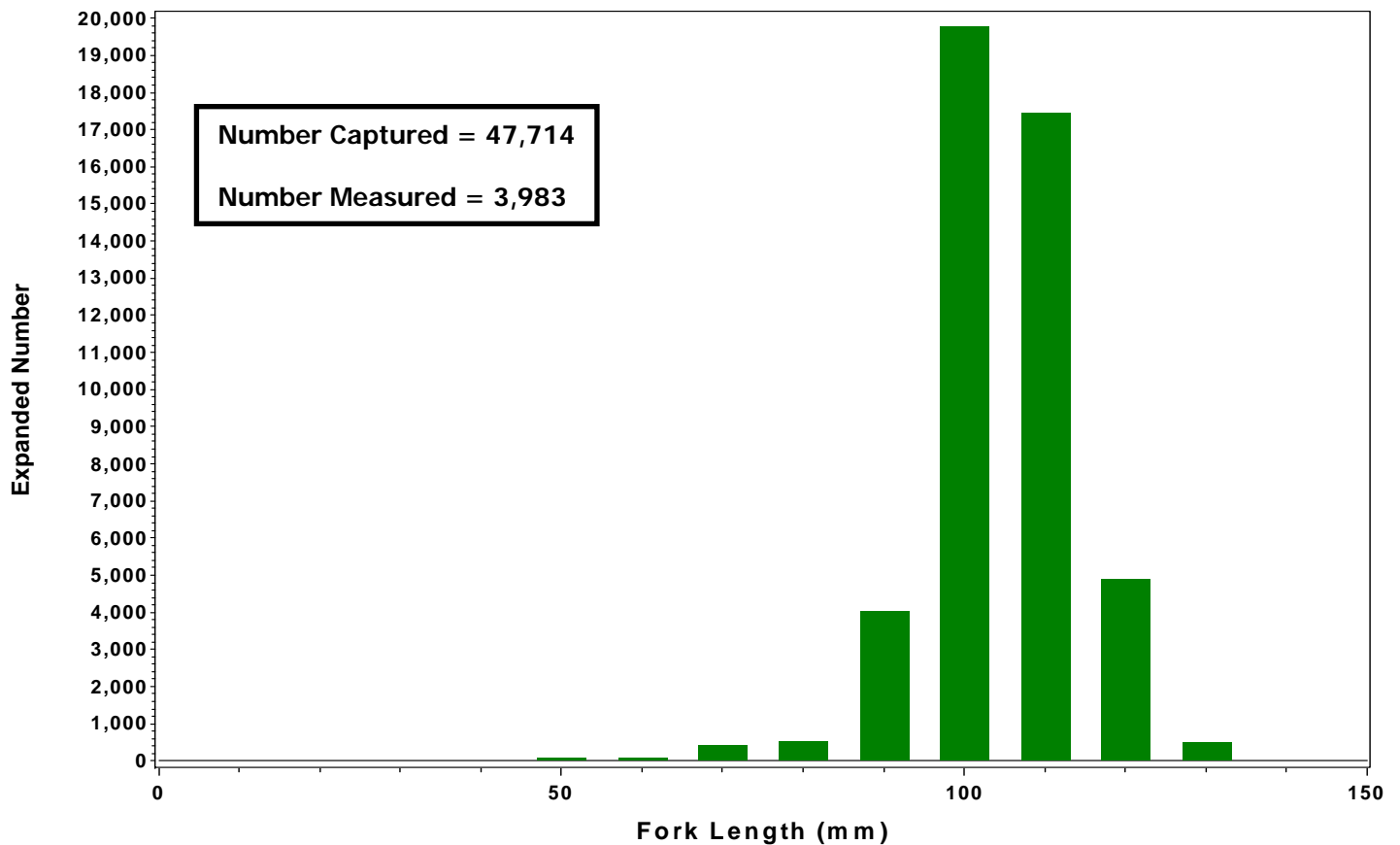


Figure 112. Length frequency for striped anchovy.



# Horseshoe Crab

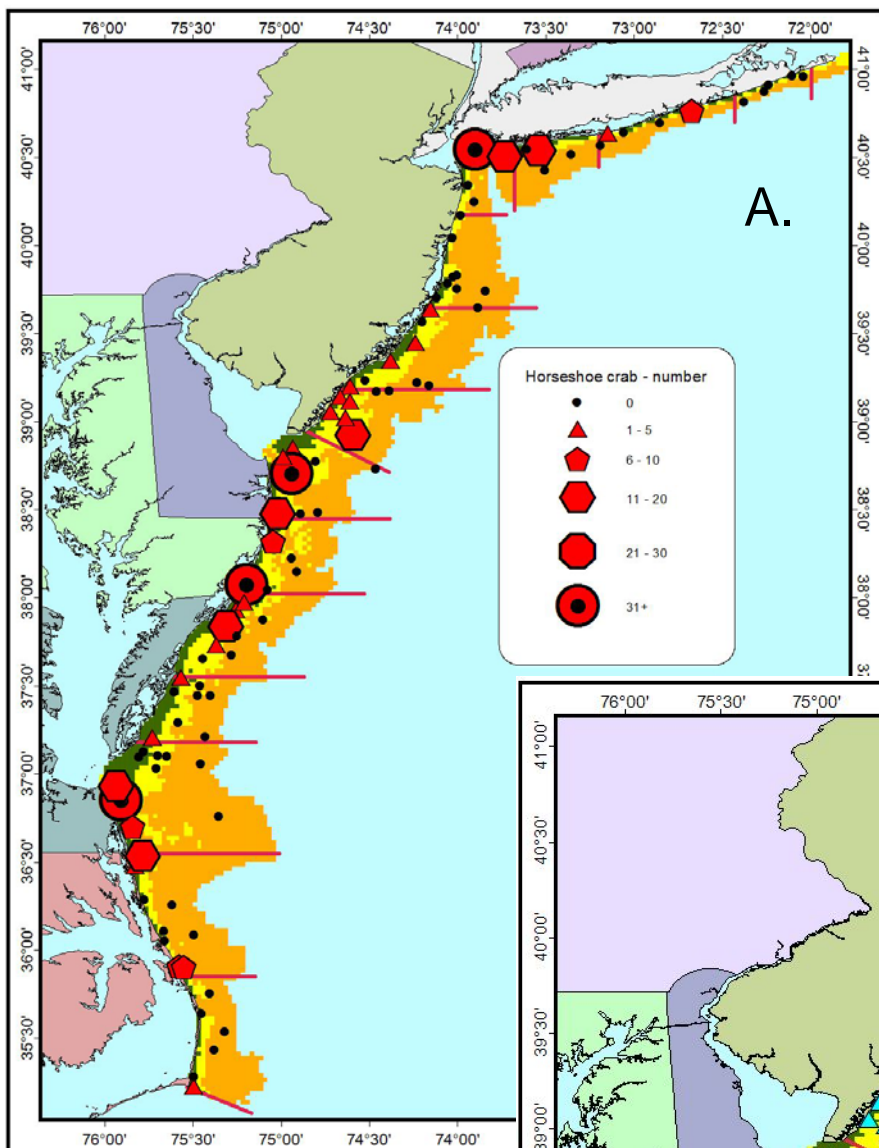


Figure 113. Number (A) and biomass (B) of specimens horseshoe crab.

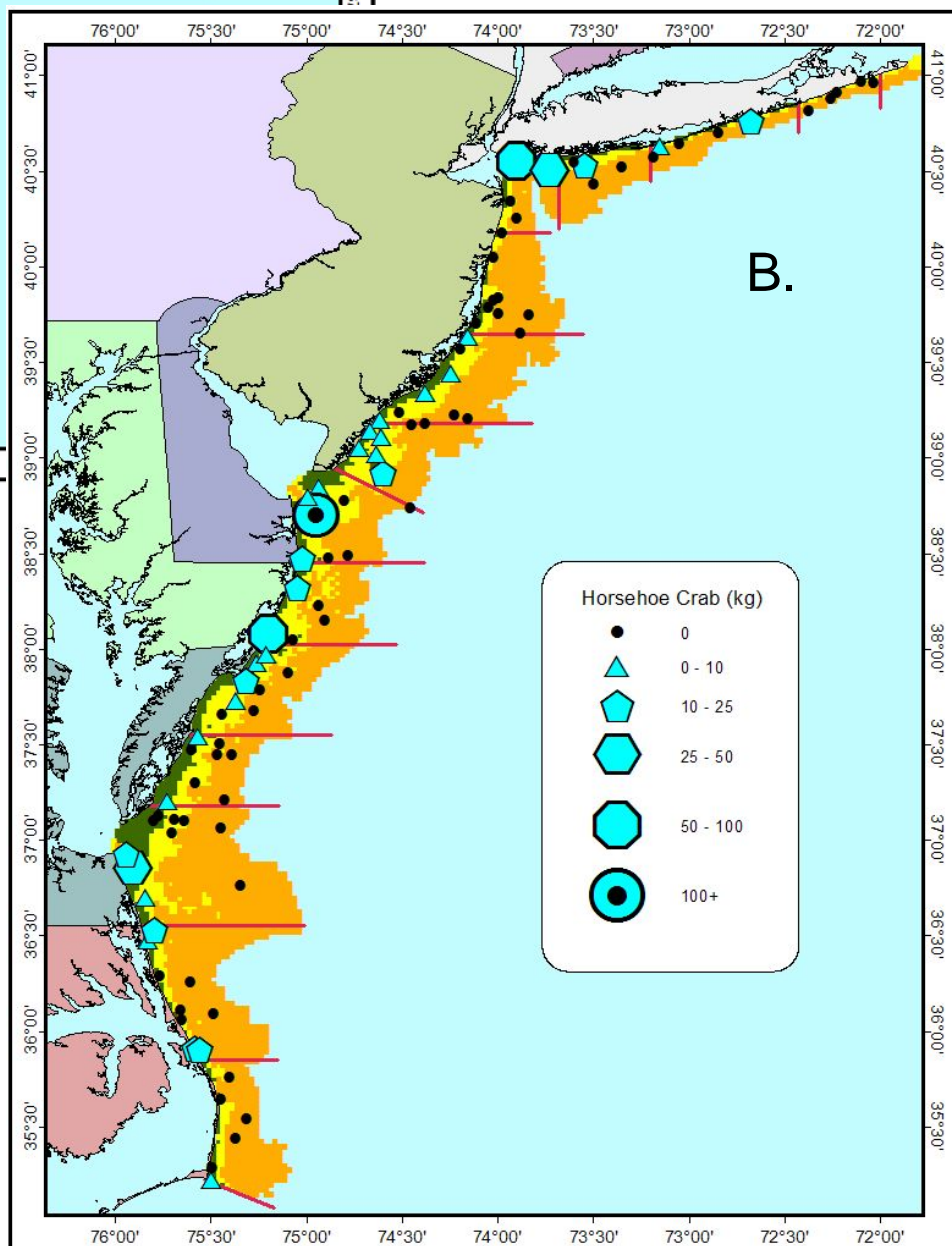


Figure 114. Minimum trawlable number and biomass by state for horseshoe crab.

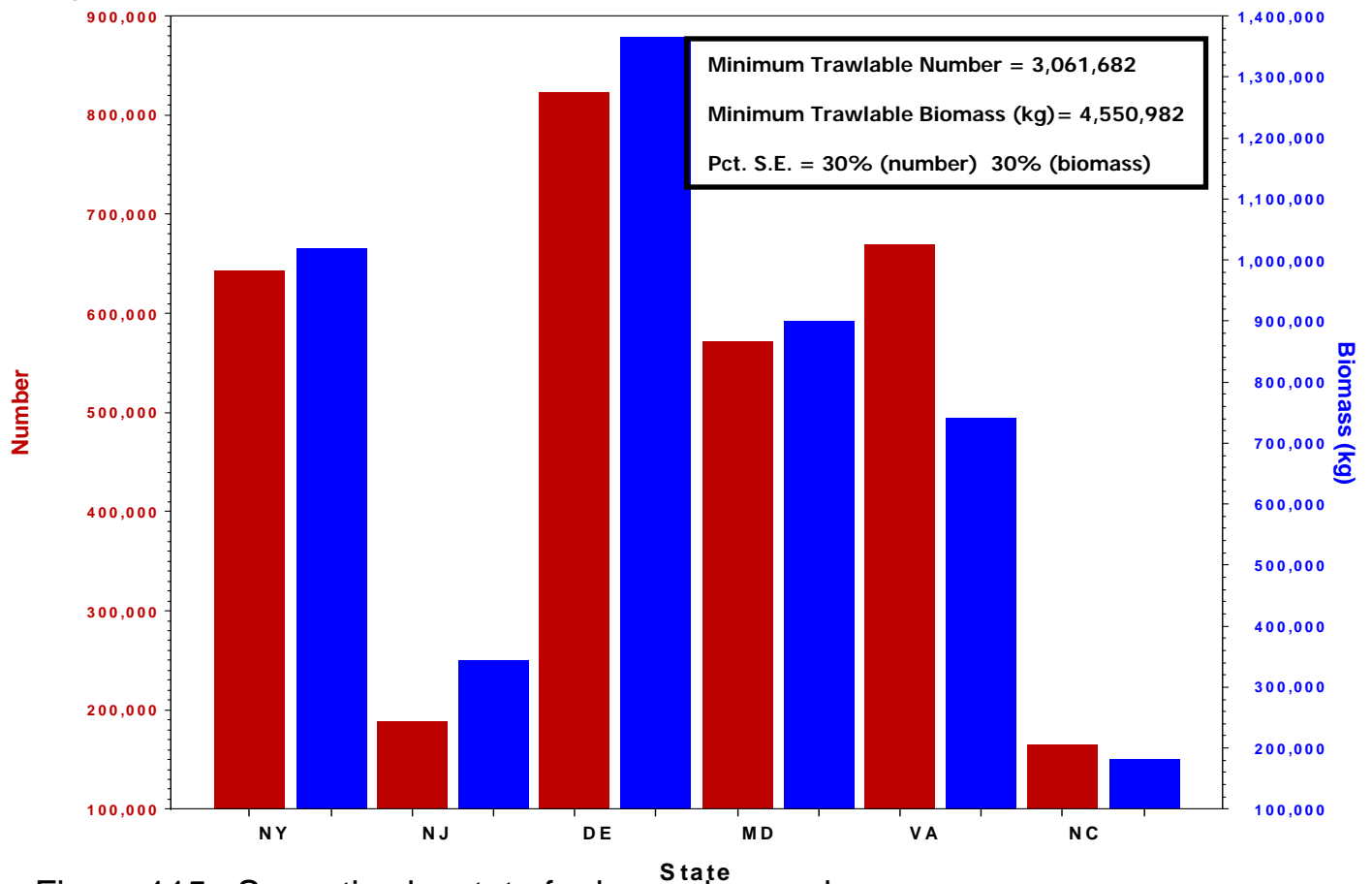


Figure 115. Sex ratios by state for horseshoe crab.

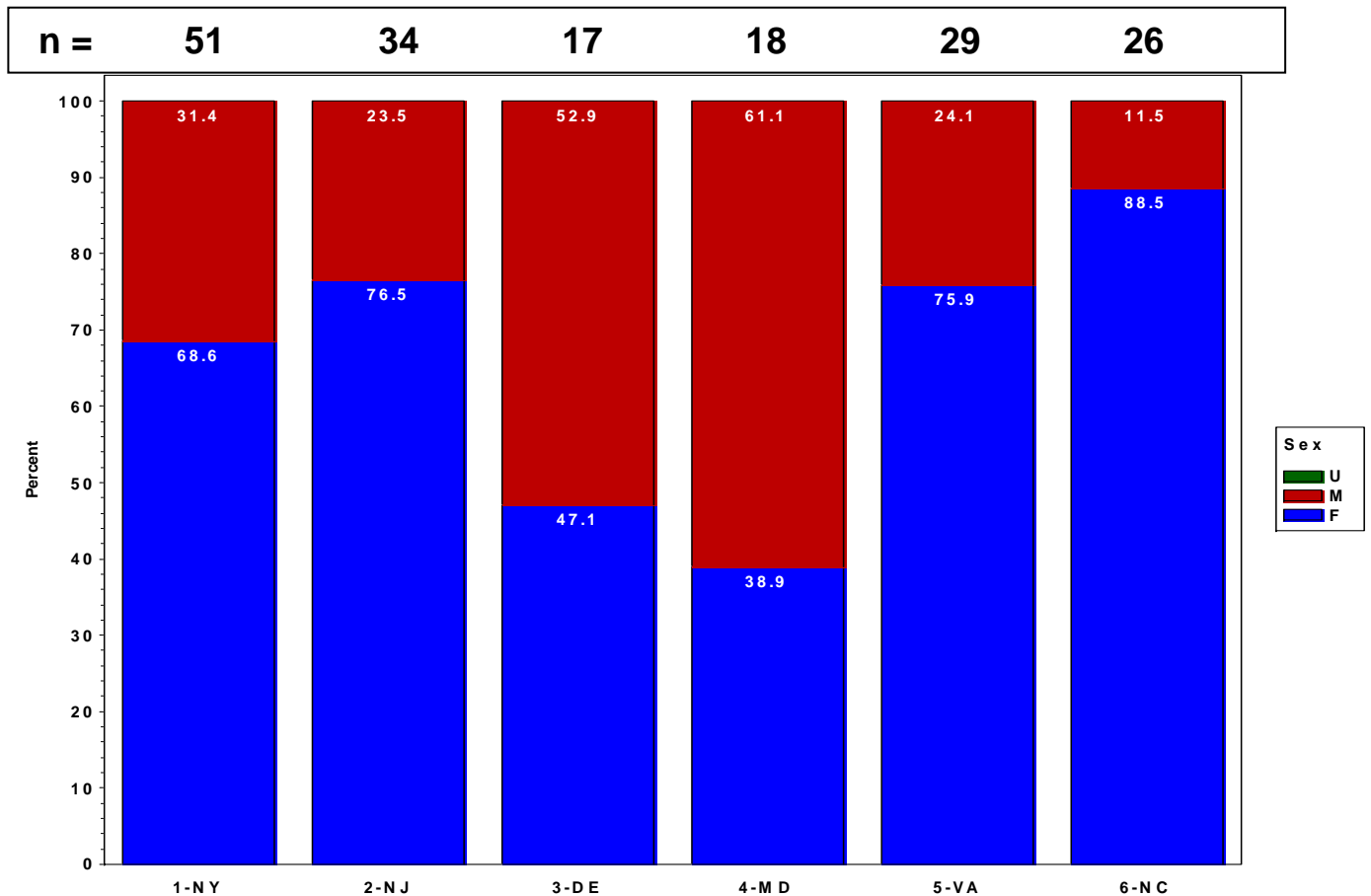




Figure 116. Width frequency for horseshoe crab.

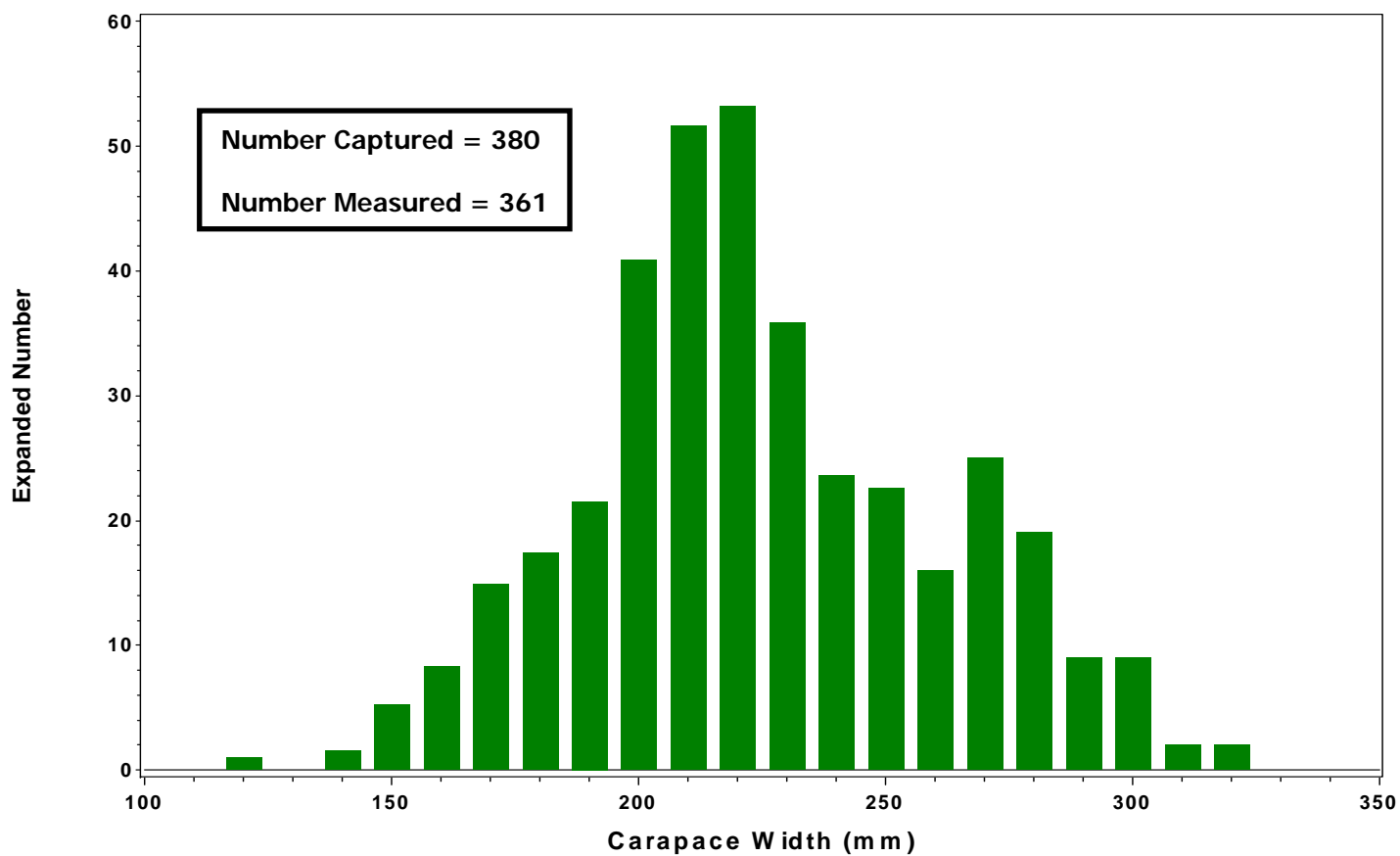


Figure 117. Length-weight regression for horseshoe crab, sexes combined.

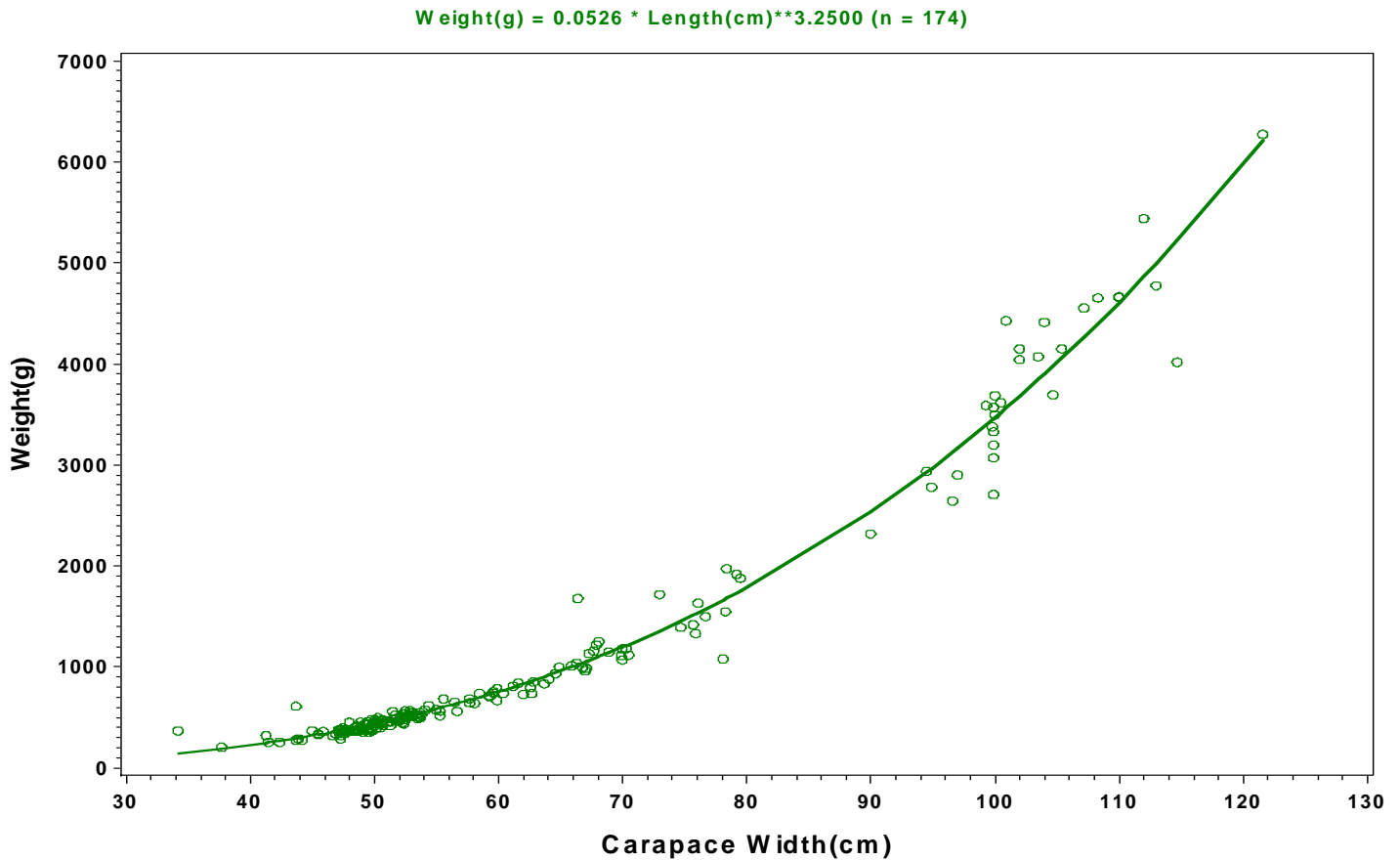
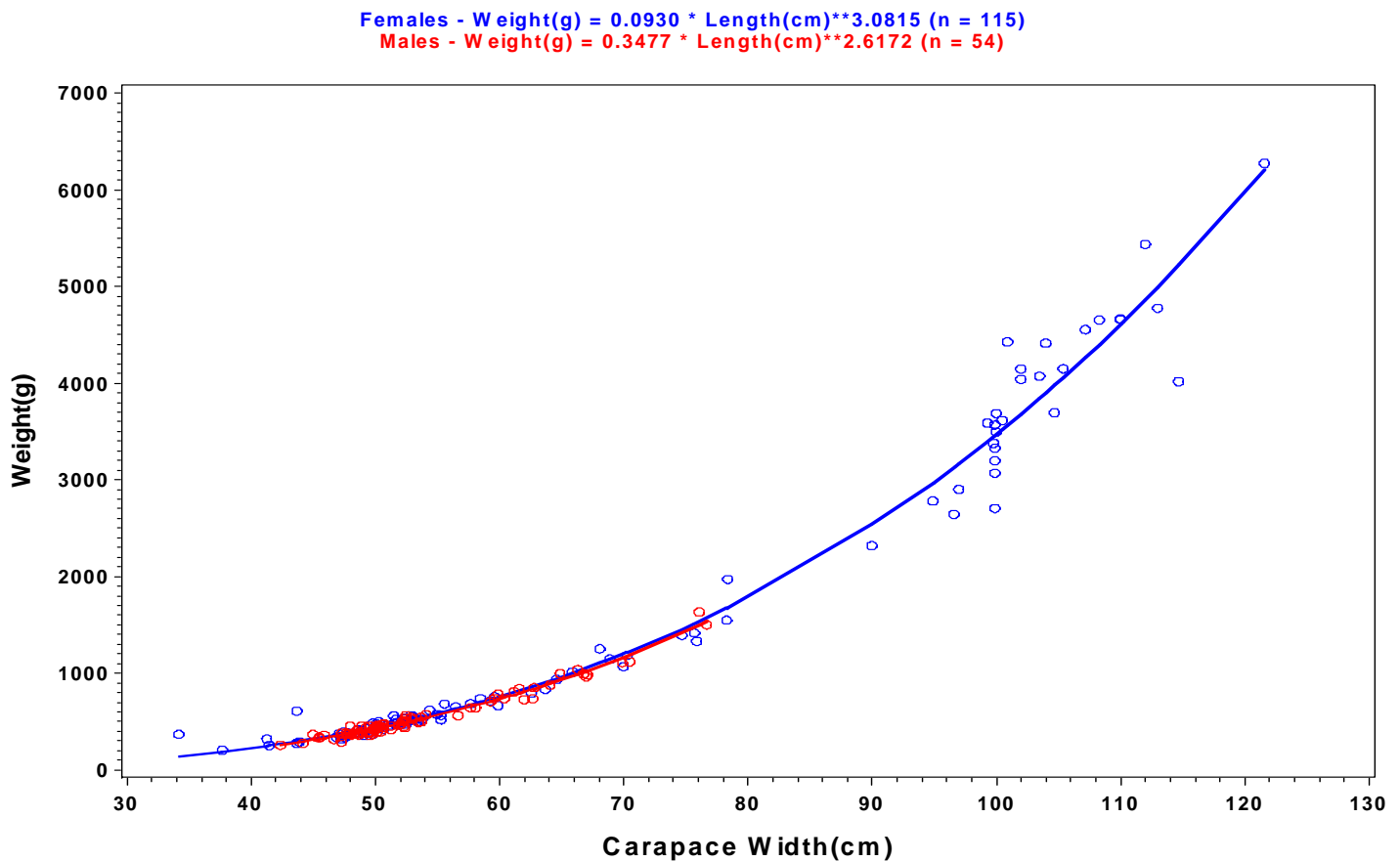


Figure 118. Length-weight regression for horseshoe crab, by sex.



# Squid (*Loligo* spp.)

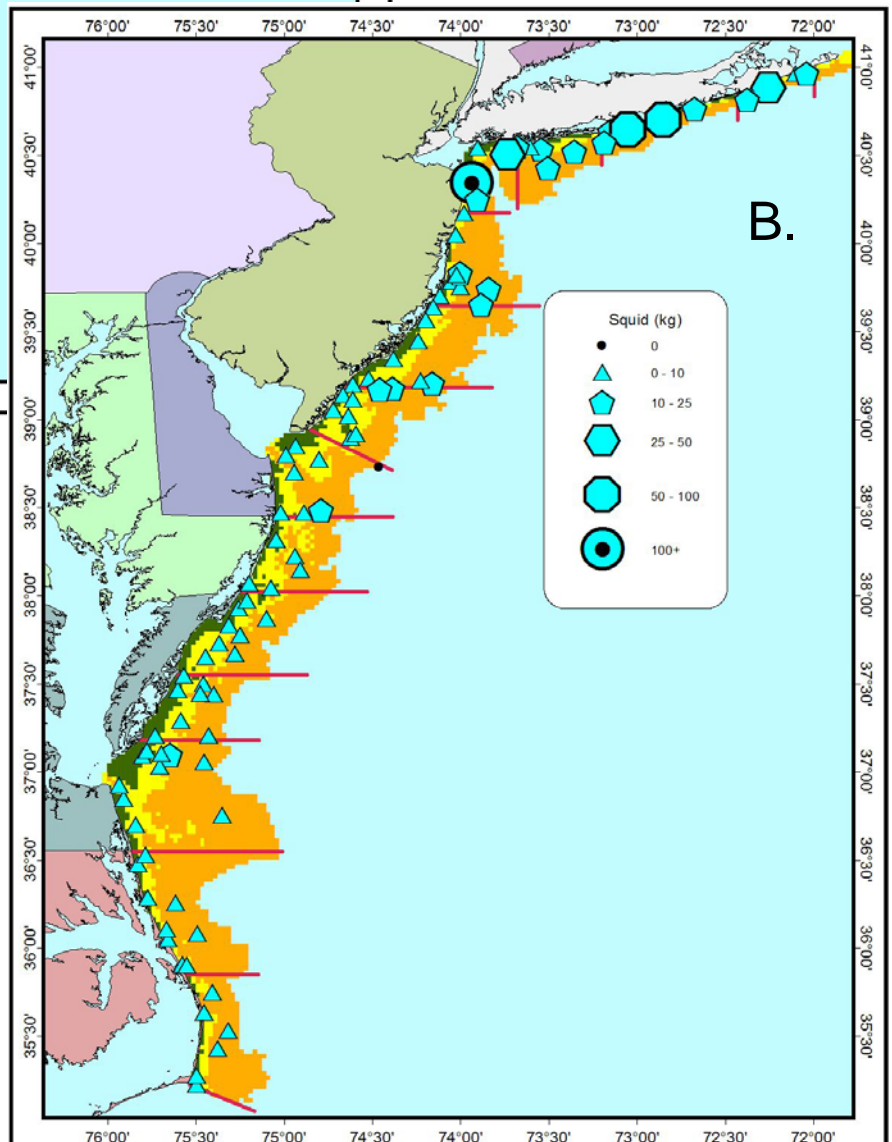
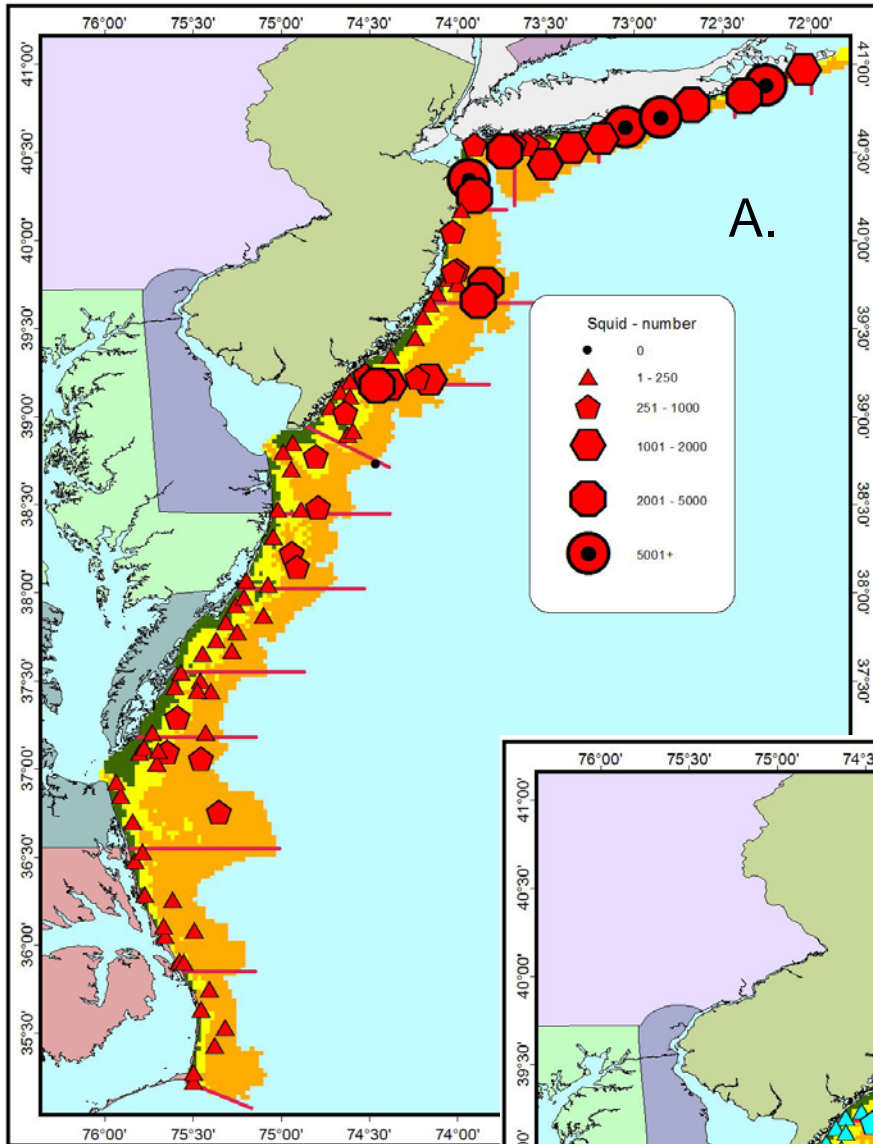


Figure 119. Number (A) and biomass (B) of specimens squid.

Figure 120. Minimum trawlable number and biomass by state for squid.

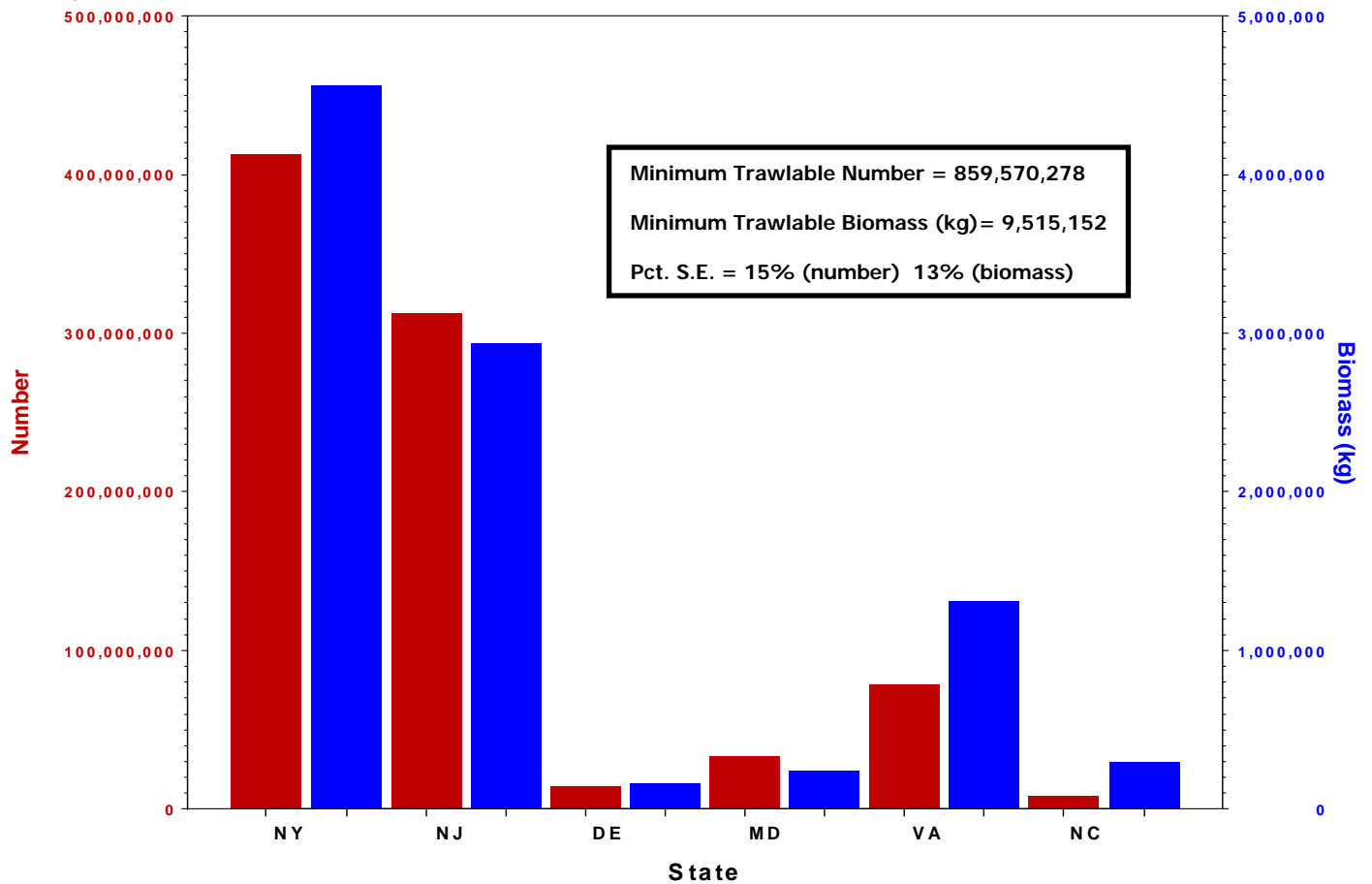
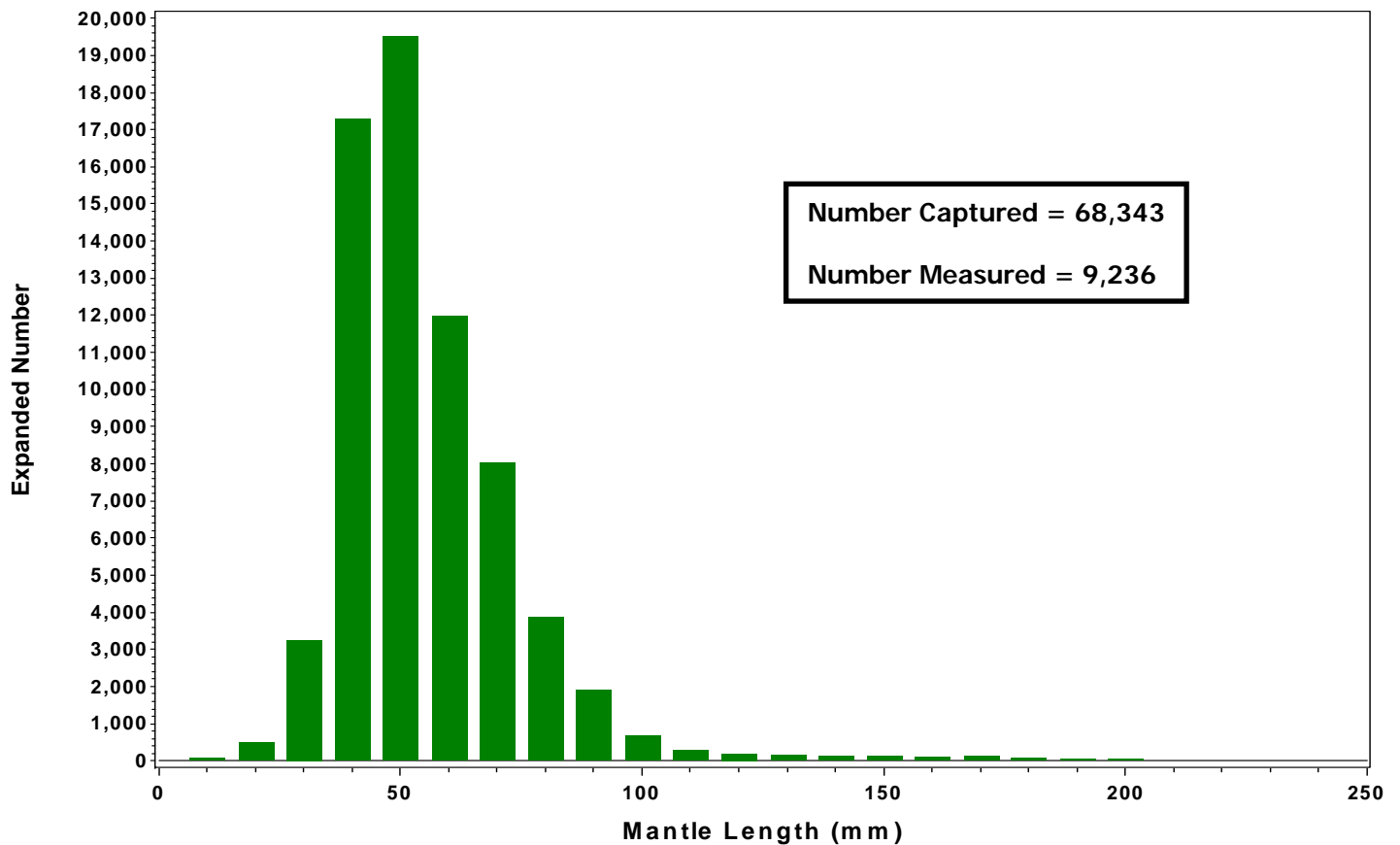


Figure 121. Length frequency for squid.



# Shrimp (Penaeid)

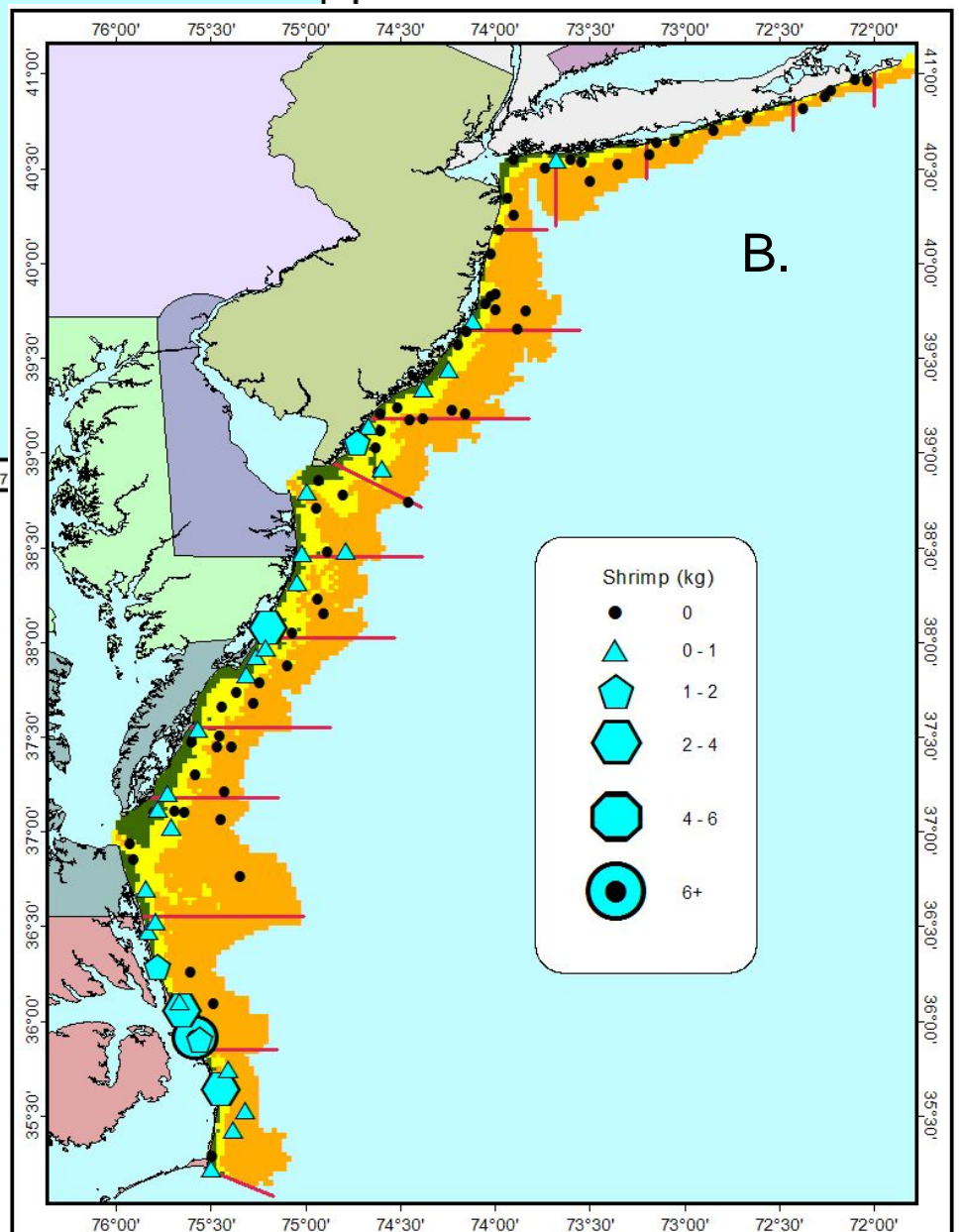
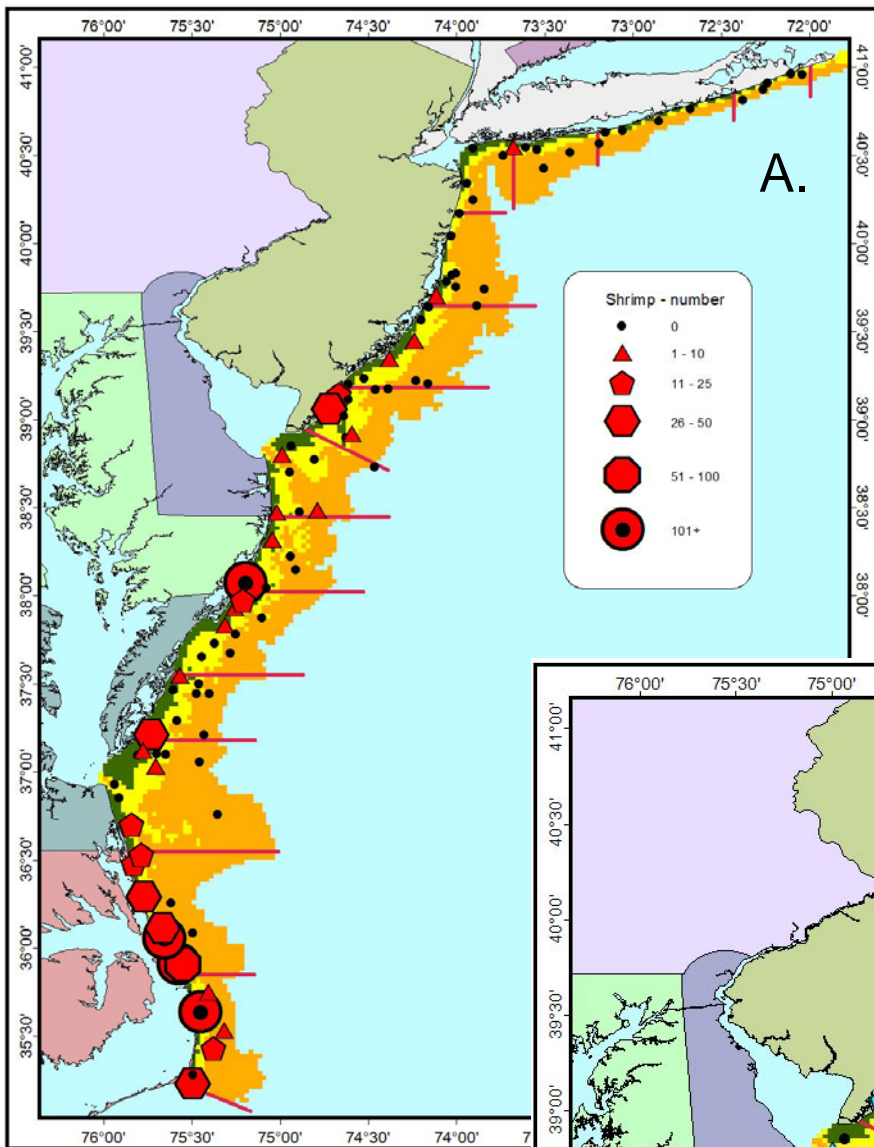


Figure 122. Number (A) and biomass (B) of specimens Penaeid shrimp (combined).

Figure 123. Minimum trawlable number and biomass by state for Penaeid shrimp.

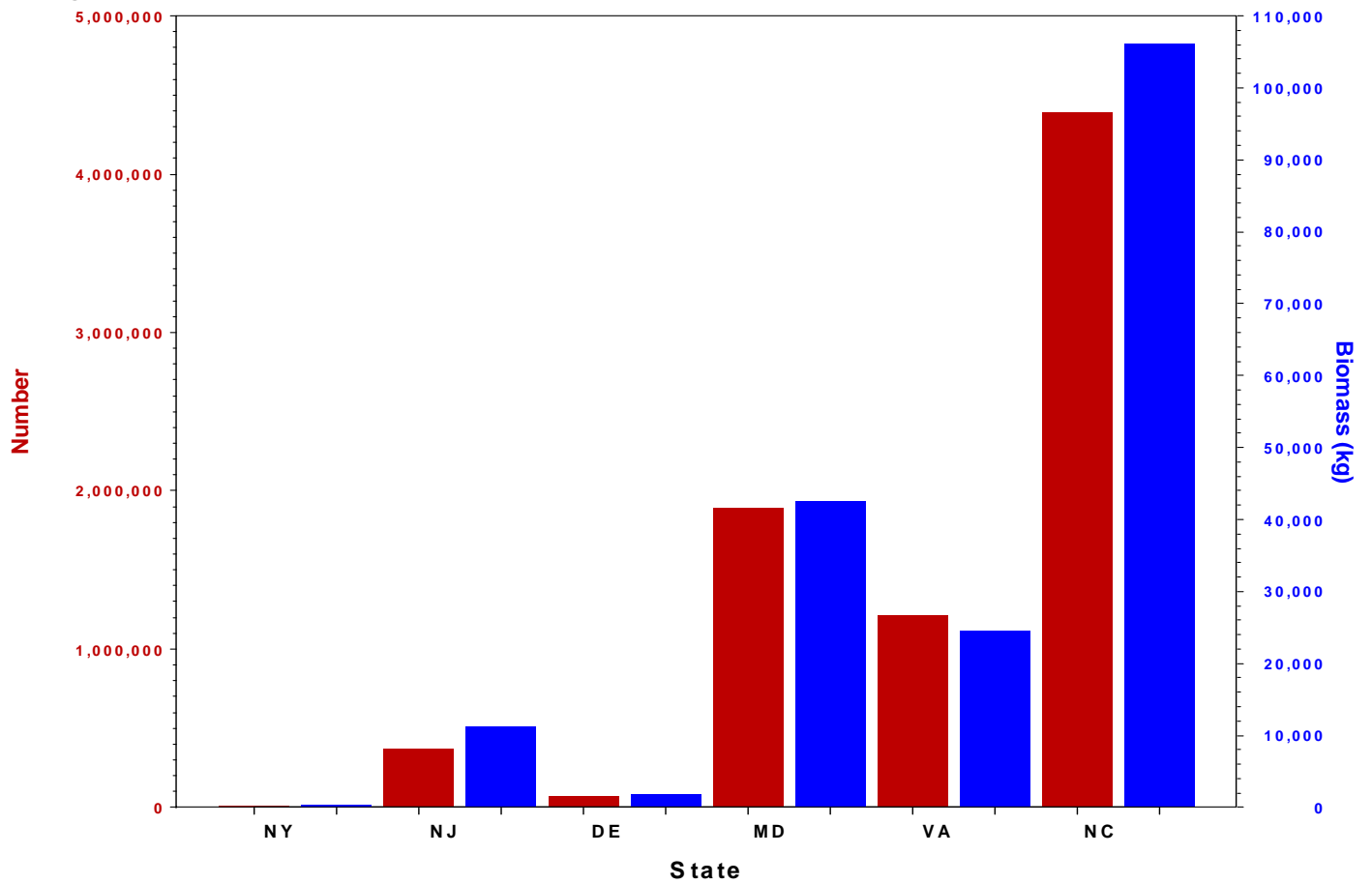


Figure 124. Length frequency for Penaeid shrimp.

