Northeast Area Monitoring and Assessment Program

Final Report
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NEAMAP
NORTHEAST AREA MONITORING & ASSESSMENT PROGRAM

MID-ATLANTIC FISHERY MANAGEMENT COUNCIL
BUILDING SUSTAINABLE FISHERIES

VIMS
Virginia Institute of Marine Science

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Northeast Area Monitoring and Assessment Program (NEAMAP)

Data collection and analysis in support of single and multispecies stock assessments in the Mid-Atlantic: Northeast Area Monitoring and Assessment Program Near Shore Trawl Survey

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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 program modeled after the Southeast Area Monitoring and Assessment Program (SEAMAP), which has 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 for areas where current sampling is either inadequate or absent 2) coordinating data collection among 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 that would operate in the coastal zone (i.e., between the 6.1 m and 27.4 m depth contours) of the Mid-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 had been sampling from Cape Hatteras to the U.S. / Canadian border in waters less than 460 m since 1963, few sites were sampled inshore of the 27.4 m contour due to the sizes of the sampling area and research vessels (NEFSC 1988, R. Brown, NMFS, pers. comm). In addition, of the states in the MAB, only New Jersey conducts a fishery-independent trawl survey in its coastal zone (Byrne 2004). The NEAMAP Near Shore Trawl Survey was therefore developed to address this gap in fishery-independent survey coverage, which is consistent with the program goals. The main objectives of this new survey were defined to include the estimation of abundance, biomass, length frequency distribution, age-structure, diet composition, and various other assessment-related parameters for fishes and select invertebrates inhabiting the survey area.

In early 2005, the ASMFC received $250,000 through the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) and made these funds available for pilot work 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 full pilot survey in 2006 (Bonzek et al. 2007).

Following a favorable review of the pilot sampling, the ASMFC bundled funds from a combination of sources in an effort to provide the resources necessary to support the initiation of full-scale sampling operations for NEAMAP. The ASMFC awarded VIMS this new contract in the late spring of 2007, and the first full NEAMAP cruise was scheduled for fall 2007.

Two significant changes to the NEAMAP survey area were implemented prior to this first full-scale cruise:

- In 2007, the NEFSC took delivery of the *FSV Henry B. Bigelow*, began preliminary sampling operations with this new vessel, and determined that this boat could safely operate in waters as shallow as 18.3 m. NEFSC personnel then determined that future surveys would likely extend inshore to that depth contour (R. Brown, NMFS, pers. comm.). The NEAMAP Operations Committee subsequently decided that the offshore boundary of the NEAMAP survey between Montauk and Cape Hatteras should be realigned to coincide with the inshore boundary of the NEFSC survey, and that NEAMAP should discontinue sampling between the 18.3 m and 27.4 m contours in these waters.

- The NEFSC contributed an appreciable amount of funding toward NEAMAP full implementation with the provision that Block Island Sound (BIS) and Rhode Island Sound (RIS), regions that were under-sampled at the time, be added to the NEAMAP sampling area. These waters are deeper than those sampled along the coast by NEAMAP; however, the offshore extent of sampling in these sounds (with respect to distance from shore) is consistent with that along the coast. The NEAMAP Survey has sampled BIS and RIS since the fall of 2007 and intends to continue to do so.

VIMS acquired funding for full sampling (i.e., two cruises, one in the spring and one in the fall, each covering the entire survey range) in 2008 from two sources, ASMFC "Plus-up" funds and Research Set-Aside (RSA) quota provided by the Mid-Atlantic Fishery Management Council and the National Oceanographic and Atmospheric Administration (NOAA). ASMFC "Plus-up" was used for the spring survey, while the proceeds derived from the auction of RSA quota supported the fall cruise. All sampling in 2009 was funded through the Mid-Atlantic RSA Program; this report therefore summarizes the results of the both the spring and fall 2009 survey cruises.

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 are selected for each cruise of the NEAMAP Near Shore Trawl Survey using a stratified random design. During the planning stages of the 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 Survey, 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.

An 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 and representing a potential sampling site.

One of the main goals of the NEAMAP trawl survey is to increase fishery-independent sampling intensity in the near shore zone of the MAB and SNE. When designing the survey, it was decided that the target sampling intensity would be approximately 1 station per 30 nm^2, a moderately high intensity when compared with other fishery-independent trawl surveys operating along the US East Coast. This intensity, when applied to the NEAMAP survey area, results in the sampling of 150 sites per cruise. The number of cells (sites) to be sampled in each of the strata during each survey cruise was 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).

Prior to each survey, a SAS program is used to randomly select the cells to be sampled in each region / depth stratum during that cruise (SAS, 2002). Again, the number of cells selected in a particular stratum is proportional to the surface area of that stratum. Once these 150 ‘primary’ sampling sites (i.e., those to be sampled during the upcoming cruise) are generated, the program is run a second time to produce 244 ‘alternate’ sites. In instances where sampling a primary site is not possible due to fixed gear, bad bottom, vessel traffic, etc., one of these alternate sites is selected in its stead. If an alternate is sampled in the place of an untowable primary, the alternate is required to occupy the same region / depth stratum as the aberrant primary. Usually, the alternate chosen is the closest towable alternate to that primary. In an effort to illustrate a typical station layout for a survey cruise, the locations of the primary and alternate sites selected for the fall 2009 survey are provided (Figures 2a.-f.). Station locations for the spring 2009 cruise were similar, but varied somewhat due to the random selection of sampling sites.

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^2) and sampling intensity (nm^2 per Station) are also given.

Region	State*	Stations Sampled								Totals			nm^2 per Station
		6.1m-12.2m		12.2m – 18.3m		18.3m – 27.4m		27.4m –36.6m					
		Stations sampled	Num. cells	Stations sampled	Num. cells	Stations sampled	Num. cells	Stations sampled	Num. cells	Stations sampled	Num. cells	nm^2**	
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

* Note that region boundaries are not perfectly aligned with all state boundaries:

- Some stations in RI Sound may occur in MA
- Some stations in BI Sound may occur in NY
- Region 5 spans the NY-NJ Harbor area
- Some stations in Region 9 may occur in NJ

** Calculation does not account for decreases in distance per minute of longitude as latitude increases.

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 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, one additional sampling site was randomly selected and added to each of these small strata for both of the 2009 cruises. Analyses of the survey data with and without the information collected from these additional stations will occur in 2010, and decisions will be made as to whether a re-stratification of the NEAMAP survey area is warranted. The results of these analyses and stratification decisions will be available in future annual reports.

As a result of adding a third site to each region/depth stratum where only two stations had been allocated previously, a total of 160 sites were sampled during both the spring and fall 2009 surveys. Besides supporting efforts to address potential over-stratification of the NEAMAP sampling area, these additional 10 stations will enable an evaluation of the sampling intensity chosen for this survey. Specifically, simulations will be run using the 2009 data 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). Again, these analyses are expected to occur in 2010, and the results will be included in the next annual report.

Species Priority Lists

During the survey design phase, the NEAMAP Operations Committee developed a set of species priority lists intended to guide catch processing and sample collection. Species of management interest in the MAB and SNE were to be of top priority and taken for full processing (see *Procedures at Each Sampling Site* below) at each sampling site in which they were collected (Table 2). Initially, this list was subdivided into Priority ‘A’, ‘B’, and ‘C’ so that if time and/or resources became limited, species could be eliminated from full processing in a manner that would preserve the most important species (i.e., Priority ‘A’) at the expense of those of lesser interest (‘B’ and ‘C’ species). In practice, because survey personnel work quickly and efficiently, time constraints are not an issue and it has never been necessary to eliminate any of the Priority ‘B’ or ‘C’ species from full processing. Because the species on each of these lists have been and will continue to be treated as though they are all ‘A’ species, the ‘B’ and ‘C’ designations were eliminated and all of these species were included as ‘A’ list. For all other fishes (here called Priority ‘D’), aggregate weights and individual length measurements, at a minimum, are recorded. A third category (‘E’) includes species which require special handling, such as sharks (other than dogfish) and sturgeon, which are measured, weighed, tagged, and released. Select invertebrates of management interest are also Priority ‘E’ species; individual length, weight, and sex are recorded, at a minimum, from these.

Table 2. Species priority list (A list only – includes all species from the A-C categories presented in previous reports).

A LIST	
Alewife	*Alosa pseudoharengus*
All skate species	
American shad	*Alosa sapidissima*
Atlantic cod	*Gadus morhua*
Atlantic croaker	*Micropogonias undulatus*
Atlantic herring	*Clupea harengus*
Atlantic mackerel	*Scomber scombrus*
Atlantic menhaden	*Brevoortia tyrannus*
Black drum	*Pogonias cromis*
Black sea bass	*Centropristis striata*
Blueback herring	*Alosa aestivalis*
Bluefish	*Pomatomus saltatrix*
Butterfish	*Peprilus triacanthus*

Haddock	*Melanogrammus aeglefinus*
Monkfish	*Lophius americanus*
Pollock	*Pollachius virens*
Red drum	*Sciaenops ocellatus*
Scup	*Stenotomus chrysops*
Silver hake	*Merluccius bilinearis*
Smooth dogfish	*Mustelus canis*
Spanish mackerel	*Scomberomorus maculatus*
Speckled trout	*Cynoscion nebulosus*
Spiny dogfish	*Squalus acanthias*
Spot	*Leiostomus xanthurus*
Striped bass	*Morone saxatilis*
Summer flounder	*Paralichthys dentatus*
Tautog	*Tautoga onitis*
Weakfish	*Cynoscion regalis*
Winter founder	*Pseudopleuronectes americanus*
Yellowtail flounder	*Limanda ferruginea*

Gear Performance

The NEAMAP Survey uses the 400 x 12 cm, three-bridle four-seam bottom trawl designed by the Mid-Atlantic / New England Fishery Management Council Trawl Survey Advisory Panel as its sampling gear. This net is paired with a set of Thyboron, Type IV 66" doors. Wingspread, doorspread, and headrope height were monitored during each tow of the spring and fall 2009 cruises using a digital Netmind® Trawl Monitoring System. Bottom contact of the footgear was also evaluated during the fall survey using Netmind. Wingspread sensors were positioned on the middle 'jib' of the net, which is consistent with NEFSC procedures for this gear, and doorspread sensors were mounted in the trawl doors according to manufacturer specifications. The headrope sensor was affixed to the center of the headline. The bottom contact sensor, which is effectively an inclinometer, was attached to the center of the footrope and used to evaluate the timing of the initial bottom contact of the footgear at the beginning of a tow, liftoff of the footgear during haulback, and the behavior of the gear throughout each tow. The inclusion of this bottom contact sensor was based on the recommendations of the NEAMAP peer review panel. A catch sensor was mounted in the cod-end, and set to signal when the catch reached approximately 2,200 kg. GPS coordinates and vessel speed were recorded every 2 seconds during each tow. These data were used to plot tow tracks for each station.

It is important to note that, while the performance of the survey gear had been recorded on all previous cruises, NEAMAP began to use these data to assess tow validity in 2009. The peer review panel recommended that acceptable ranges be defined for headrope height and wingspread such that if the average value of either or both of the parameters for a given tow fell outside of these ranges, the tow be considered invalid, the catch discarded, and a re-tow of the sampling site be initiated. Doorspread was not included since doorspread and wingspread are typically highly correlated (Gómez and Jiménez 1994). Such a procedure is intended to promote consistency in the performance of the survey gear and resulting catch data. The review panel and VIMS personnel agreed that 4.7 m to 5.8 m would be an appropriate range for headrope height while 12.3 m to 14.7 m would be acceptable for wingspread. These values were generated by adding to the optimal ranges of each parameter (defined by the Trawl Survey Advisory Panel), 5% of the midpoint of each range. This use of trawl performance to assess tow validity was successfully implemented for both the spring and fall 2009 survey cruises.

Procedures at Each Sampling Site

The *F/V Darana R* served as the sampling platform for all field operations in 2009 as well as for all previous surveys (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.

All fishing operations were conducted during daylight hours. Standard tows were 20 minutes in duration with a target tow speed of 3.1 kts. One tow was truncated at 17 minutes and another at 15 minutes due to known hangs in the tow path. The triggering of the catch sensor led to the early termination of three tows, one at 18 minutes and two at 15 minutes.

At each station, several standard variables were recorded. These included:

- *Station identification parameters* - date, station number, stratum.
- *Tow parameters* - beginning & ending tow location, vessel speed & direction, engine RPMs, duration of tow, water depth, current direction.
- *Gear identification and operational parameters* - net type code & net number, door type code & door numbers, tow warp length, trawl door spread, wing spread, headline height & bottom contact of the footgear.
- *Atmospheric and weather data* - air temperature, wind speed & direction, barometric pressure, relative humidity, general weather state, sea state.
- *Hydrographic data* - water temperature, salinity, dissolved oxygen, pH.

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 in duration) could be executed while remaining within the boundaries of the defined cell.

Vessel crew were responsible for all of the fishing-related aspects of the survey (gear handling, maintenance, repair, etc.). 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). One scientist was present in the wheelhouse during deployment and retrieval of the trawl. For the set-out, the Captain would signal when the winch breaks were engaged; this marked the beginning time of the tow. At this point, the scientist would activate the Netmind software, the tow track recording software, and the digital countdown timer clock (used to record tow time).

Table 3. Relationship between water depth and warp length 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 zero time, haul-back commenced, and the Netmind and tow track programs were stopped. Average headrope height and wingspread were then calculated to assess tow validity. Assuming that gear performance was acceptable, vessel crew dumped the catch into one of two sorting pens (depending on the size of the catch) for processing. Otherwise, a re-tow of the sampling site was initiated.

Hydrographic data were recorded at the end of each tow while the vessel was stationary and the fishing crew emptied the catch. This protocol was developed as a time-saving mechanism; these data were collected prior to setting the gear in earlier cruises, resulting in a pause in net streaming (and therefore survey operations) while instruments were deployed and these data were recorded. Measurements were taken at 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 (kg) and individual length measurements were recorded for each species-size group combination of the Priority 'D' species. For Priority 'A' fishes, a subsample of five individuals from each size group was selected for full processing (see next paragraph). For some very common Priority 'A' species including spot (*Leiostomus xanthurus*), butterfish (*Peprilus triacanthus*), skates, and dogfishes, only three individuals per size group were sampled for full processing.

Data collected from each of these subsampled specimens included individual length (mm fork length where appropriate, mm total length for species lacking a forked caudal fin, mm pre-caudal length for dogfishes, mm disk width for skates), individual whole and eviscerated weights (measured in grams, accuracy depended upon the balance on which individuals were measured), and macroscopic sex and maturity stage (immature, mature-resting, mature-ripe, mature-spent) determination. Stomachs were removed (except for spot and butterfish; 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 subsequent examination. Otoliths or other appropriate ageing structures were removed from each subsampled specimen for later age determination. For the Priority 'A' species, all specimens not selected for the full processing were weighed (aggregate weight), 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 occurred during both of the 2009 survey cruises, 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, the appropriate corresponding 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 2009 survey cruises, including improved mixing, the formation of multiple subsamples from which to randomly 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

Otoliths and other appropriate ageing structures were (and are in the process of being) prepared according to methodology established by the NEFSC, Old Dominion University, and VIMS. For otoliths (the most common of the structures used by NEAMAP for ageing), typically one 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, perpendicular to the sulcal groove, 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 smaller, fragile otoliths were read whole. Both sectioned and whole otoliths were most commonly viewed using transmitted light under a dissecting microscope. Other structures such as vertebrae, opercles, and spines were processed and read using the standardized and accepted methodologies for each. For all hard parts, ages were assigned as the mode of three independent readings, one by each of three readers, and were adjusted as necessary to account for the timing of sample collection and mark formation.

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

Analytical Methods

<u>Abundance Indices</u>: 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 therefore presented in this report, and are provided for each species by survey cruise.

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

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

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 $\hat{\hat{N}}_s$ 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:

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

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^2 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.

<u>Length-Frequency</u>: 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' species presented in this report, as well as for some of 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 five full-scale surveys conducted to date, 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 is possible to produce these ratios overall, by sub-area, by year, by cruise, etc.

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):

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

where

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

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' 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 five 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.

Age-Structure: Age-frequency histograms were generated by cruise for each of the Priority 'A' 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.

Results

General Cruise Information / Station Sampling

The spring 2009 survey began on 21 April and ended on 15 May, while the fall cruise spanned from 24 September to 31 October. All 160 sites were sampled during each of these surveys. The number of primary and alternate stations sampled during each cruise 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 10% to 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 for both 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 survey 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, however, as NEAMAP continues to accumulate information on known towable and untowable locations in these waters through both survey experience and cooperation with local fishing industry representatives.

Outside of the sounds, the rate of alternate sampling tended to be relatively low and variable. The sampling of alternates in the more northern portion of the survey range (i.e., off of New York and New Jersey) was mainly due to rocky bottom and the presence of wrecks, while issues related to water depth (specifically, the lack of), were the most common cause of alternate substitution off of Virginia and North Carolina.

Table 4. Number of sites sampled in each region and overall during the spring and fall 2009 NEAMAP cruises. The numbers of primary and alternate sites sampled in each region and overall are given in parenthesis below the totals

Region	Spring 2009 Total* (*Prim. / Alt.*)	Fall 2009 Total* (*Prim. / Alt.*)
RI Sound	16 (*10 / 6*)	16 (*8 / 8*)
BI Sound	10 (*7 / 3*)	10 (*7 / 3*)
1	3 (*0 / 3*)	3 (*3 / 0*)
2	6 (*6 / 0*)	6 (*6 / 0*)
3	6 (*6 / 0*)	6 (*5 / 1*)
4	6 (*5 / 1*)	6 (*5 / 1*)
5	6 (*3 / 3*)	6 (6 / *0*)
6	6 (*6 / 0*)	6 (*5 / 1*)
7	10 (*10 / 0*)	10 (*9 / 1*)
8	10 (*10 / 0*)	10 (*10 / 0*)
9	17 (*17 / 0*)	17 (*16 / 1*)
10	11 (*11 / 0*)	11 (*10 / 1*)
11	13 (*13 / 0*)	13 (*13 / 0*)
12	9 (*9 / 0*)	9 (8 / *1*)
13	16 (*16 / 0*)	16 (*15 / 1*)
14	8 (*8 / 0*)	8 (*8 / 0*)
15	7 (*7 / 0*)	7 (*7 / 0*)
Total	160 (*144 / 16*)	160 (*141 / 19*)

* one additional sampling site was added to each 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 of these nets was torn in half off of the coast of New Jersey during the 107th tow of the spring 2009 survey. This trawl was replaced by a second net which was used throughout the remainder of the spring cruise and for the entire fall survey. Although this net did not sustain any appreciable damage, the bottom bellies will be replaced, due to normal wear-and-tear, prior to the 2010 survey cruises. The former net was returned to the manufacturer and rebuilt according to the original specifications. 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 and all previous full-scale surveys, the NEAMAP survey gear performed consistently and, for the most part, within expected ranges during the spring and fall 2009 cruises (Figures 3). The cruise averages for door spread (33.3 m), wing spread (13.8 m), and headline height (5.4 m) were within optimal ranges for the spring 2009 survey. Average towing speed was 3.0 kts. Relative to the spring survey, average door spread (32.5 m), wingspread (13.6 m), and headrope height (5.3 m) were slightly lower for the fall, but still well within the optimal ranges for this gear; the average towing speed for this survey was unchanged relative to the spring. For both cruises, the overwhelming majority of the station averages for each of these parameters fell within the optimal ranges. Also, as noted above, the spring and fall 2009 surveys were 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 an effort to illustrate the behavior of the survey trawl within a tow, raw data collected from two sites sampled off of southern New Jersey during the autumn cruise are provided (Figure 4). For each tow, nearly all readings fall within the optimal ranges of the respective parameters, again attesting to the ability of this gear to achieve and maintain its ideal configuration. Bottom contact data are also provided in these figures (0 = on bottom; 1 = off bottom) and suggest that this gear package tends bottom well throughout survey tows. Although the gear apparently remains on the bottom for an appreciable amount of time following the initiation of haul-back, vessel speed is minimal and it is likely that the net is no longer fishing during this period.

Catch Summary

Over 1,526,000 individual specimens (fishes and invertebrates) weighing approximately 93,000 kg and representing 110 species, including boreal, temperate, and tropical fishes, were collected during the two surveys conducted in 2009 (Table 5a & b). 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 182,548 animals. Lab processing is proceeding on the 9,418 stomach samples and 13,019 ageing structures (otoliths, vertebrae, spines, opercles) collected in the field. As of the date of this report, 6,625 of these stomachs have been examined and quantified. Ages have yet to be assigned to any of the specimens sampled for age determination in 2009, due both to the relatively short amount of time between the end of the fall survey and the preparation of this report and the NEAMAP protocol of processing all age structures collected from a given species in a given year at one time (i.e., spring and fall samples processed together after the fall survey). The aforementioned protocol is in place to facilitate ‘blind reading’ of these samples. Much of the 2009 age data should be available by late summer 2010.

Table 5a. For each species collected during the NEAMAP spring 2009 cruise, the total number and biomass of specimens caught, number measured for individual length, number sampled for ageing, and number of stomachs collected that contained prey are given. Species are grouped by priority level.

Priority 'A' Species					
Species	**Total Number Collected**	**Total Species Weight (kg)**	**Number Measured**	**Number for Ageing**	**Number of Stomachs**
Alewife	2,955	233.0	1,225	235	235
American shad	1,141	33.2	859	260	260
Atlantic cod	2	2.3	2	2	1
Atlantic croaker	17,040	1,004.3	1,225	80	66
Atlantic herring	3,610	196.5	830	86	85
Atlantic mackerel	49	4.6	49	8	8
Atlantic menhaden	24,566	786.0	2,146	78	78
Black sea bass	237	67.6	237	168	163
Blueback herring	5,603	160.3	2,808	315	315
Bluefish	1,580	91.2	274	35	14
Butterfish	35,588	816.5	16,089	1,045	0
Clearnose skate	2,429	3,382.1	1,431	205	188
Little skate	23,391	12,463.6	5,115	397	383
Monkfish	18	71.0	18	18	10
Scup	16,884	2,827.3	7,043	740	708
Silver hake	5,153	105.7	1,789	406	402
Smooth dogfish	947	2,741.4	725	236	221
Spiny dogfish	1,271	3,562.7	1,137	359	261
Spot	29,643	824.9	3,454	59	0
Striped bass	162	388.9	162	78	48
Summer flounder	974	518.3	977	623	362
Tautog	16	31.0	16	15	15
Weakfish	8,785	339.3	1,654	189	143
Winter flounder	1,954	628.2	1,746	543	526
Winter skate	3,595	6,843.0	1,778	374	345
Yellowtail flounder	52	21.3	52	19	19
Priority 'D' Species					
Species	**Total Number Collected**	**Total Species Weight (kg)**	**Number Measured**	**Number for Ageing**	**Number of Stomachs**
American sand lance	2	0.1	2	0	0
Atlantic cutlassfish	44	0.9	44	0	0
Atlantic thread herring	3	0.1	3	0	0
Banded drum	305	3.1	254	0	0
Banded gunnel	9	0.1	9	0	0
Bay anchovy	62,807	145.9	7,112	0	0
Blackcheek tonguefish	32	1.5	32	0	0

Priority 'D' Species (cont)					
Species	**Total Number Collected**	**Total Species Weight (kg)**	**Number Measured**	**Number for Ageing**	**Number of Stomachs**
Bluntnose stingray	85	490.8	85	0	0
Bullnose ray	5	42.5	5	0	0
Cownose ray	4	11.4	4	0	0
Cunner	55	4.5	55	0	0
Etropus spp.	7	0.3	7	0	0
Fawn cusk-eel	3	0.2	3	0	0
Fourspot flounder	89	23.3	89	0	0
Gulf Stream flounder	4	0.1	4	0	0
Harvestfish	24	1.1	24	0	0
Hickory shad	4	0.2	4	0	0
Hogchoker	58	5.3	58	0	0
Kingfishes	1,742	207.8	483	0	0
Little & winter skates	3,138	594.4	861	0	0
Longhorn sculpin	92	23.5	92	0	0
Northern puffer	172	16.7	172	0	0
Northern searobin	116	13.4	116	0	0
Northern stargazer	3	6.8	3	0	0
Ocean pout	70	59.8	70	0	0
Pigfish	58	2.4	58	0	0
Pinfish	8	0.2	8	0	0
Red hake	301	27.7	301	0	0
Round herring	19	0.6	19	0	0
Sea raven	13	9.8	13	0	0
Silver perch	1,657	41.1	218	0	0
Smallmouth flounder	4	0.1	4	0	0
Smooth butterfly ray	2	4.5	2	0	0
Southern stingray	1	2.5	1	0	0
Spotted hake	7,648	116.7	4,599	0	0
Striped anchovy	104	1.5	104	0	0
Striped searobin	865	332.0	383	0	0
Windowpane	1,067	268.2	868	0	0

Priority 'E' Species					
Species	**Total Number Collected**	**Total Species Weight (kg)**	**Number Measured**	**Number for Ageing**	**Number of Stomachs**
American lobster	290	89.9	248	0	0
Atlantic brief squid	11	0.1	11	0	0
Brown shrimp	7	0.1	7	0	0
Horseshoe crab	2,388	2,702.1	1,673	0	0
Illex squid	18	0.6	18	0	0
Loligo squid	12,451	501.6	5,710	0	0
Sea scallop	63	5.0	63	0	0

White shrimp	23	0.7	23	0	0
SPRING 2009 TOTALS	**283,516**	**43,904.7**	**76,763**	**6,573**	**4,856**

Table 5b. For each species collected during the NEAMAP fall 2009 cruise, the total number and biomass of specimens caught, number measured for individual length, number sampled for ageing, and number of stomachs collected that contained prey are given. Species are grouped by priority level.

Priority 'A' Species					
Species	**Total Number Collected**	**Total Species Weight (kg)**	**Number Measured**	**Number for Ageing**	**Number of Stomachs**
Alewife	87	3.9	87	17	16
American shad	28	3.1	28	10	10
Atlantic croaker	45,730	5,685.3	5,277	415	335
Atlantic herring	919	12.4	176	44	44
Atlantic mackerel	4	0.3	4	4	4
Atlantic menhaden	146	11.9	146	59	58
Black drum	66	8.5	66	63	28
Black sea bass	470	94.5	375	148	138
Blueback herring	15	0.6	15	6	6
Bluefish	18,075	910.7	4,016	632	428
Butterfish	544,718	8,677.5	20,670	774	0
Clearnose skate	1,107	1,352.1	1,007	335	306
Little skate	8,441	4,964.4	4,370	303	283
Monkfish	3	0.6	3	3	3
Red drum	6	73.5	6	6	5
Scup	158,567	2,577.8	12,792	897	887
Silver hake	1,470	17.3	499	125	118
Smooth dogfish	1,156	843.5	1,156	333	329
Spanish mackerel	31	3.9	31	12	10
Spiny dogfish	795	1,750.0	483	52	45
Spot	8,428	593.0	2,699	169	0
Spotted seatrout	36	3.3	36	32	7
Striped bass	352	1,523.7	127	32	22
Summer flounder	1,117	545.8	1,117	745	533
Tautog	39	43.0	39	20	19
Weakfish	96,394	5,557.0	13,012	872	644
Winter flounder	558	127.4	558	214	177
Winter skate	1,787	4,040.3	623	123	106
Yellowtail flounder	1	0.2	1	1	1
Priority 'D' Species					
Species	**Total Number Collected**	**Total Species Weight (kg)**	**Number Measured**	**Number for Ageing**	**Number of Stomachs**
African pompano	3	1.0	3	0	0
American eel	5	0.5	5	0	0
American sand lance	8	0.1	8	0	0
Atlantic cutlassfish	1,052	20.0	635	0	0
Atlantic moonfish	6,882	33.0	1,200	0	0

Priority 'D' Species (cont)					
Species	Total Number Collected	Total Species Weight (kg)	Number Measured	Number for Ageing	Number of Stomachs
Atlantic spadefish	8	0.2	8	0	0
Atlantic stingray	6	1.7	6	0	0
Atlantic thread herring	133	0.6	133	0	0
Atlantic threadfin	8	0.1	8	0	0
Atlantic torpedo	5	123.9	5	0	0
Banded drum	387	5.1	358	0	0
Banded rudderfish	2	0.6	2	0	0
Bay anchovy	50,033	194.3	4,647	0	0
Bigeye scad	55	1.6	55	0	0
Blackcheek tonguefish	168	7.3	168	0	0
Blue runner	28	1.3	28	0	0
Bluespotted cornetfish	8	0.1	8	0	0
Bluntnose stingray	5	3.1	5	0	0
Bullnose ray	116	78.5	116	0	0
Cownose ray	35	66.5	35	0	0
Crevalle jack	3	0.2	3	0	0
Etropus spp.	17	0.3	17	0	0
Fawn cusk-eel	21	1.0	21	0	0
Fourspot flounder	87	15.2	87	0	0
Gray triggerfish	7	4.9	7	0	0
Gulf Stream flounder	51	0.8	51	0	0
Harvestfish	1,894	34.8	846	0	0
Hogchoker	517	51.5	223	0	0
Inshore lizardfish	43	4.1	43	0	0
Kingfishes	7,969	888.9	3,303	0	0
Lookdown	34	0.3	34	0	0
Northern puffer	265	22.8	265	0	0
Northern searobin	206	28.5	206	0	0
Northern sennet	211	10.9	211	0	0
Northern stargazer	15	19.7	15	0	0
Pigfish	780	30.8	300	0	0
Pinfish	3	0.1	3	0	0
Planehead filefish	1	0.1	1	0	0
Red goatfish	1	0.1	1	0	0
Red hake	87	7.7	87	0	0
Rough scad	271	9.2	271	0	0
Roughtail stingray	104	57.9	104	0	0
Round herring	43	0.8	43	0	0
Round scad	341	6.1	223	0	0
Sea raven	5	3.3	5	0	0
Sheepshead	3	10.7	3	0	0
Short bigeye	5	0.1	5	0	0
Silver anchovy	24	0.1	24	0	0
Silver perch	19,477	542.2	3,635	0	0

Priority 'D' Species (cont)					
Species	**Total Number Collected**	**Total Species Weight (kg)**	**Number Measured**	**Number for Ageing**	**Number of Stomachs**
Silver seatrout	1	0.1	1	0	0
Smallmouth flounder	26	0.5	26	0	0
Smooth butterfly ray	61	132.2	61	0	0
Southern stingray	2	9.1	2	0	0
Spanish sardine	16	0.2	16	0	0
Spiny butterfly ray	33	414.3	33	0	0
Spotfin butterflyfish	1	0.1	1	0	0
Spotted hake	2,576	343.5	1,782	0	0
Striped anchovy	8,605	113.4	2,171	0	0
Striped burrfish	33	8.2	33	0	0
Striped cusk-eel	4	0.2	4	0	0
Striped searobin	1,108	243.6	812	0	0
White mullet	1	0.1	1	0	0
Windowpane	1,155	211.2	1,155	0	0
Priority 'E' Species					
Species	**Total Number Collected**	**Total Species Weight (kg)**	**Number Measured**	**Number for Ageing**	**Number of Stomachs**
American lobster	89	29.1	89	0	0
Atlantic angel shark	3	11.5	3	0	0
Atlantic brief squid	1,317	10.1	1,012	0	0
Horseshoe crab	1,931	2,164.4	1,092	0	0
Loligo squid	242,495	3,406.4	10,005	0	0
Sand tiger shark	1	12.4	1	0	0
Sandbar shark	1	1.9	1	0	0
Sea scallop	629	30.1	143	0	0
Thresher shark	1	11.2	1	0	0
White shrimp	451	6.6	451	0	0
FALL 2009 TOTALS	**1,242,518**	**48,878.0**	**105,785**	**6,446**	**4,562**

Species Data Summaries

The data summaries presented in this report focus on species that are of management interest to the Mid-Atlantic Fishery Management Council. Some that are of interest to the New England Fishery Management Council, the ASMFC, 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 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.

Although this report focuses on the data collected during 2009, some information from previous years is included in these species summaries to both place the 2009 data in context as well as to increase sample sizes. 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’ species only) are also given for each by cruise. Catch distribution plots are presented for the 2009 surveys only, while length-frequency distributions are provided for these species for each cruise completed to date. Sex ratios by size are given for all Priority ‘A’ species as well as for some of the invertebrates, and were generated by combining data across all cruises. Diet compositions (overall) and age-frequency distributions (by cruise) are also included for the Priority ‘A’ 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 of the 2009 cruises.
- 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’ species and select invertebrates). These histograms were generated by combining data across all cruises.

- Bar plot of diet composition, generated using data from all cruises combined. The number of stomachs examined and the number of ‘clusters’ sampled (i.e., effective sample size) are provided. Diet is presented for Priority ‘A’ species only, when available.
- Age-frequency histograms for each cruise, indicating the number caught at each age and the year-class associated with each age group (Priority ‘A’ 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 managed by the Mid-Atlantic Council). Text associated with these tables and figures is provided following this list. Detailed descriptions of these data and analyses are included for species managed by the Mid-Atlantic Council, while a listing of the contents of the tables and figures is given for all others.

Species list

Alewife (*Alosa pseudoharengus*)

Table 6. Sampling rates and abundance indices of alewife for each NEAMAP cruise.

Figure 5. Biomass (kg) of alewife collected at each sampling site for each 2009 NEAMAP cruise.

Figure 6. Preliminary indices of abundance, in terms of number and biomass, of alewife for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 7. Length-frequency distributions, by cruise, for alewife. Numbers taken for full processing, by length, are represented by the orange bars.

Figure 8. Sex ratio, by length group, for alewife collected on all 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 (*Homarus americanus*)

Table 7. Sampling rates and abundance indices of American lobster for each NEAMAP cruise.

Figure 9. Biomass (kg) of American lobster collected at each sampling site for each 2009 NEAMAP cruise.

Figure 10. Preliminary indices of abundance, in terms of number and biomass, of American lobster for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 11. Length-frequency distributions, by cruise, for American lobster.

Figure 12. Sex ratio, by length group, for American lobster collected on all 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 (*Alosa sapidissima*)

Table 8. Sampling rates and abundance indices of American shad for each NEAMAP cruise.

Figure 13. Biomass (kg) of American shad collected at each sampling site for each 2009 NEAMAP cruise.

Figure 14. Preliminary indices of abundance, in terms of number and biomass, of American shad for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 15. Length-frequency distributions, by cruise, for American shad. Numbers taken for full processing, by length, are represented by the orange bars.

Figure 16. Sex ratio, by length group, for American shad collected on all 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 (*Micropogonias undulatus*)

Table 9. Sampling rates and abundance indices of Atlantic croaker for each NEAMAP cruise.

Figure 17. Biomass (kg) of Atlantic croaker collected at each sampling site for each 2009 NEAMAP cruise.

Figure 18. Preliminary indices of abundance, in terms of number and biomass, of Atlantic croaker for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 19. Length-frequency distributions, by cruise, for Atlantic croaker. Numbers taken for full processing, by length, are represented by the orange bars (difficult to see due to scale of the y-axis).

Figure 20. Sex ratio, by length group, for Atlantic croaker collected on all 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 21. Diet composition, expressed using the percent weight index, of Atlantic croaker collected during five 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.

Figure 22. 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.

Atlantic Menhaden (*Brevoortia tyrannus*)

Table 10. Sampling rates and abundance indices of Atlantic menhaden for each NEAMAP cruise.

Figure 23. Biomass (kg) of Atlantic menhaden collected at each sampling site for each 2009 NEAMAP cruise.

Figure 24. Preliminary indices of abundance, in terms of number and biomass, of Atlantic menhaden for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 25. Length-frequency distributions, by cruise, for Atlantic menhaden. Numbers taken for full processing, by length, are represented by the orange bars (difficult to see in some cases due to the scale of the y-axis)

Figure 26. Sex ratio, by length group, for Atlantic menhaden collected on all 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.

Bay Anchovy (*Anchoa mitchilli*)

Table 11. Sampling rates and abundance indices of bay anchovy for each NEAMAP cruise.

Figure 27. Biomass (kg) of bay anchovy collected at each sampling site for each 2009 NEAMAP cruise.

Figure 28. 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 29. 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, although it appeared that catches may be greater in the fall (Table 12). The largest number of sea bass was collected during the fall 2009 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 of this species in the spring of 2009 were spotty, and survey tows in the southern portion of the sampling area produced very few black sea bass (Figure 30). Specifically, only four collections of this species were made south of Delaware during the cruise. The largest samples of black sea bass occurred along the coast of Long Island and in BIS and RIS. Catches during the fall survey, while also patchy, occurred throughout the sampling area. The largest catches of sea bass during the fall 2009 cruise were located off of the coast of Delaware, Southern New Jersey, and in the sounds.

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 31). The rate of decrease was greater between the two fall cruises. The abundance of sea bass appeared to increase between fall 2008 and fall 2009, however. A broad size range of sea bass was collected during each of the surveys, and included both juvenile and adult specimens (Figure 32). The smallest fish sampled during the fall 2007 and 2008 cruises were 6 cm TL, while several 4 cm TL specimens were collected during the fall 2009 survey. The largest were 56 cm TL on the fall 2007 and fall 2009 surveys and 55 cm TL on the fall 2008 cruise. 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 larger 18 cm to 28 cm TL size-range dominated the fall 2009 catches of this species, and perhaps reflects growth of the predominant size category documented from the previous fall. 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 yielded an overall smaller average size 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 33). It is important to note that this species is incompletely metagonous, meaning that some fish are actually born as males are remain so throughout their lifetime, while some females never switch to male.

Crustaceans comprised the majority of the diet of black sea bass sampled by the NEAMAP Survey (Figure 34). 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.

The NEAMAP Trawl Survey ages black sea bass using both whole and sectioned otoliths (i.e., both preparations are read for each fish). Age data from sea bass collected in 2008 and 2009 are not yet available, however. For the fall 2007 cruise, the fish collected ranged from age-0 to age-9 (Figure 35). 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).

Blueback Herring (*Alosa aestivalis*)

Table 13. Sampling rates and abundance indices of blueback herring for each NEAMAP cruise.

Figure 36. Biomass (kg) of blueback herring collected at each sampling site for each 2009 NEAMAP cruise.

Figure 37. Preliminary indices of abundance, in terms of number and biomass, of blueback herring for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 38. Length-frequency distributions, by cruise, for blueback herring. Numbers taken for full processing, by length, are represented by the orange bars.

Figure 39. Sex ratio, by length group, for blueback herring collected on all 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 (*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 four of the five full-scale NEAMAP cruises conducted to date (Table 14). 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.

During the spring 2009 cruise, collections of bluefish were concentrated around Cape Hatteras and along the coast of Long Island (Figure 40). This species was sampled throughout the NEAMAP survey range during the subsequent fall survey. Catches were largest off of the coast of New Jersey, followed by the coast of Long Island, Delaware, and in the sounds. Relatively large collections also occurred along the Eastern Shore of Virginia during the fall 2009 cruise.

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 41). The rate of increase was greater between the fall surveys with respect to number and between the spring cruises in terms of biomass. Although a greater overall number and biomass of bluefish were collected during fall 2009 relative to the autumn survey in 2008, the numerical abundance index in 2009 remained essentially unchanged, while the biomass index decreased slightly. Although perhaps counterintuitive, the occurrence of large bluefish catches in relatively small survey strata in 2009 accounts for these results. Bluefish collected during the fall surveys generally ranged from 7 cm to 74 cm FL (Figure 42 – 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 of 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 43). 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 44). 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.

The NEAMAP Near Shore Trawl Survey ages bluefish using the sectioned otolith technique. Age data from bluefish collected in 2008 and 2009 are not yet available, but will likely be generated during the summer of 2010. For the fall 2007 cruise, the fish collected ranged from age-0 to age-5 (Figure 45). The overwhelming majority of the specimens were age-0 fish which, at the time of this survey, 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.

Brown Shrimp (*Penaeus aztecus*)

Table 15. Sampling rates and abundance indices of brown shrimp for each NEAMAP cruise.

Figure 46. Biomass (kg) of brown shrimp collected at each sampling site for each 2009 NEAMAP cruise.

Figure 47. 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 48. Length-frequency distributions, by cruise, for brown shrimp.

Butterfish (*Peprilis triacantus*)

Butterfish have consistently been one of the most abundant species in collections made by the NEAMAP Trawl Survey. Catches of this species in the fall have been greater, both in terms of number and biomass, than those in the spring with the former exceeding the latter by an order of magnitude (Table 16). The largest collections to date occurred during the fall

2009 survey cruise, where over a half of a million specimens, weighing more than 8,600 kg in all, were encountered. Given the relatively consistent and abundant catches of this species by the NEAMAP gear, it is likely that butterfish were well sampled by this survey.

This species was collected throughout the survey range on both the spring and fall 2009 cruises (Figure 49). Catches were greatest along the coast of Long Island and off of the central portion of New Jersey during the spring, but otherwise no apparent trends were evident. Fall abundances were greatest north of Barnegat Light, New Jersey. Butterfish spring indices of abundance increased between 2008 and 2009 with respect to number but decreased with respect to biomass (Figure 50). For the fall cruises, butterfish indices in terms of weight showed a continual increasing trend between 2007 and 2009. Numerical abundance indices increased between 2007 and 2008, but declined in 2009. Although the number of butterfish collected by NEAMAP during the fall 2009 cruise exceeded that of each of the previous surveys, most of the autumn 2009 catches occurred in relatively small strata, which accounts for this discrepancy.

Butterfish sampled during spring surveys ranged from 2 cm and 22 cm FL (Figure 51). Two distinct modal groups, likely representing age-classes, were observed during the spring 2008 cruise; the smaller group appeared to be less abundant in 2009. For both surveys, the majority of the specimens collected were between 8 cm and 12 cm FL. The overall size range encountered during the fall cruises was identical to that documented for the spring surveys, although the average sizes in autumn tended to be smaller. When comparing among fall cruises, distinct modal groups were apparent for the fall 2007 survey, but were less so for 2008 and 2009. No apparent trends were evident in the butterfish sex ratio by size; however it was not possible to accurately classify most of the fish smaller than 10 cm FL due to the small size of the gonads (Figure 52). As noted in the *Catch Summary* section of this report, butterfish otoliths have been collected for age determination. VIMS staff have been working in conjunction with researchers at the NEFSC to develop the appropriate protocols for processing and assigning ages to these samples, and it is anticipated that these data will be available in the near future.

Clearnose Skate (*Raja eglanteria*)

Table 17. Sampling rates and abundance indices of clearnose skate for each NEAMAP cruise.

Figure 53. Biomass (kg) of clearnose skate collected at each sampling site for each 2009 NEAMAP cruise.

Figure 54. Preliminary indices of abundance, in terms of number and biomass, of clearnose skate for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 55. Width-frequency distributions, by cruise, for clearnose skate. Numbers taken for full processing, by length, are represented by the orange bars.

Figure 56. Sex ratio, by length group, for clearnose skate collected on all 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 57. Diet composition, expressed using the percent weight index, of clearnose skate collected during five 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.

Horseshoe Crab (*Limulus polyphemus*)

Table 18. Sampling rates and abundance indices of horseshoe crab for each NEAMAP cruise.

Figure 58. Biomass (kg) of horseshoe crab collected at each sampling site for each 2009 NEAMAP cruise.

Figure 59. Preliminary indices of abundance, in terms of number and biomass, of horseshoe crab for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 60. Width-frequency distributions, by cruise, for horseshoe crab.

Figure 61. Sex ratio, by length group, for horseshoe crab collected on all 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.

Kingfishes (*Menticirrhus* spp.)

Table 19. Sampling rates and abundance indices of kingfishes for each NEAMAP cruise.

Figure 62. Biomass (kg) of kingfishes collected at each sampling site for each 2009 NEAMAP cruise.

Figure 63. Preliminary indices of abundance, in terms of number and biomass, of kingfishes for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 64. Length-frequency distributions, by cruise, for kingfishes.

Little Skate (*Leucoraja erinacea*)

Table 20. Sampling rates and abundance indices of little skate for each NEAMAP cruise.

Figure 65. Biomass (kg) of little skate collected at each sampling site for each 2009 NEAMAP cruise.

Figure 66. 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 67. Width-frequency distributions, by cruise, for little skate. Numbers taken for full processing, by length, are represented by orange bars.

Figure 68. Sex ratio, by length group, for little skate collected on all 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 69. Diet composition, expressed using the percent weight index, of little skate collected during five 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*)**

The abundances of *Loligo* squid encountered during the fall cruises have consistently been greater than those observed during spring (Table 21). When comparing within seasons, no particular trends are evident for the fall, while collections in the spring were greater in 2008 than in 2009. The greatest number and biomass of *Loligo* were collected during the fall 2009 cruise; over a quarter of a million specimens weighing more than 3,400 kg were sampled during this survey.

In 2009, *Loligo* squid were collected throughout the NEAMAP survey area in both the spring and the fall (Figure 70). The distribution of the catches was without apparent trend during the spring cruise, but collections were largest in BIS and RIS during autumn. Abundance indices for *Loligo* squid followed similar patterns in terms of both number and biomass (Figure 71). The abundance of these squid declined between the spring of 2008 and 2009. Abundance also declined between fall 2007 and fall 2008, but then increased for 2009.

With respect to the sizes of specimens collected, squid caught on the spring cruises ranged from 1 cm to 29 cm mantle length (ML) (Figure 72). Most of the *Loligo* caught in 2008 were between 3 cm and 7 cm ML, while the dominant size distribution in 2009 was much broader (i.e., 4 cm to 15 cm ML). The overall range of sizes collected in the fall was identical to that observed for spring cruises, but the relative abundance of the smaller squid was much greater in the autumn.

Scup (*Stenotomus chrysops*)

Scup have typically been one of the most abundant species collected by the NEAMAP Trawl Survey (Table 22). Over a quarter of a million specimens were sampled during the fall 2007 cruise, weighing nearly 4,000 kg. While catches on the subsequent surveys were much smaller with respect to both number and biomass, 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 north of Chesapeake Bay during the spring 2009 survey; largest catches were observed in RIS and BIS, as well as off of the coast of Long Island (Figure 73). This species was sampled throughout the survey area during the fall 2009 cruise, and was encountered consistently in all but the most southern portion of NEAMAP's range (i.e., waters off of North Carolina). BIS and RIS produced the largest catches of scup during this survey, but sizeable collections were also encountered off of Northern New Jersey, the mouth of Delaware Bay, and off of the coast of Cape Hatteras.

The abundance indices for scup showed declines between the fall of 2007 and 2008, but abundance then increased slightly in 2009 (Figure 74). The overwhelming majority of the scup collected during these fall surveys were YOY specimens (see below). The fluctuation in abundance among fall cruises may therefore be due to differences in age-0 recruitment among years. Decreases in abundance were seen between the spring of 2008 and 2009. This 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 cruises ranged from 3 cm to 41 cm FL (Figure 75 – difficult to see range due to scale of y-axis). As noted above, an overwhelming number of fish collected during the first fall survey were YOY individuals ranging in size from 5 cm to 7 cm FL. These fish were much less abundant during the second autumn sampling, but then appeared in greater numbers again during the fall 2009 cruise. Similar overall 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 76). The largest specimens collected were mainly 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.

Crustaceans accounted for more than half of the scup diet composition by weight (Figure 77). 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%.

Scup are aged by survey personnel using the sectioned otoliths technique. While the 2008 and 2009 age data are not yet available, most of the associated samples have been processed and are available for reading. It is anticipated then that the age data for both years should become available during the summer of 2010.

Silver Hake (*Merluccius bilinearis*)

Table 23. Sampling rates and abundance indices of silver hake for each NEAMAP cruise.

Figure 78. Biomass (kg) of silver hake collected at each sampling site for each 2009 NEAMAP cruise.

Figure 79. 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 80. Length-frequency distributions, by cruise, for silver hake. Numbers taken for full processing, by length, are represented by the orange bars.

Figure 81. Sex ratio, by length group, for silver hake collected all 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 82. Diet composition, expressed using the percent weight index, of silver hake collected during five 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.

Smooth Dogfish (*Mustelus canis*)

Table 24. Sampling rates and abundance indices of smooth dogfish for each NEAMAP cruise.

Figure 83. Biomass (kg) of smooth dogfish collected at each sampling site for each 2009 NEAMAP cruise.

Figure 84. 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 85. Length-frequency distributions, by cruise, for smooth dogfish. Numbers taken for full processing, by length, are represented by the orange bars.

Figure 86. Sex ratio, by length group, for smooth dogfish collected on all 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 87. Diet composition, expressed using the percent weight index, of smooth dogfish collected during five 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 maculates*)

Table 25. Sampling rates and abundance indices of Spanish mackerel for each NEAMAP cruise.

Figure 88. Biomass (kg) of Spanish mackerel collected at each sampling site for each 2009 NEAMAP cruise.

Figure 89. Preliminary indices of abundance, in terms of number and biomass, of Spanish mackerel for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 90. Length-frequency distributions, by cruise, for Spanish mackerel. Numbers taken for full processing, by length, are represented by the orange bars. This species was absent from all spring survey collections.

Spiny Dogfish *(Squalus acanthias)*

Catches of spiny dogfish by the NEAMAP Trawl Survey varied seasonally; spring collections exceeded fall catches (Table 26). 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 and third fall surveys 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 from the 2009 NEAMAP survey cruises reflected this migratory pattern (Figure 91). This species was collected throughout the entire NEAMAP survey area during the spring 2009 cruise. The mouth of the Chesapeake Bay, the coast of New Jersey, and the sounds produced the greatest catches of spiny dogfish during this survey. Large collections of these dogfish during the fall survey were restricted to the sounds and the eastern end of Long Island. Some smaller samples were encountered off of the Delmarva Peninsula, and these catches were comprised entirely of juvenile specimens.

The abundance indices for spiny dogfish, both in terms of number and biomass, showed a slight increase between spring surveys (Figure 92). For the fall cruises, abundance with respect to biomass continually increased, albeit slightly, between 2007 and 2009. Numerical abundance also exhibited increases between 2007 and 2008, but remained relatively stable between 2008 and 2009. 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 93). 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. The length distribution documented during the fall 2009 cruise was similar, however the size range of the smaller modal group was slightly larger (i.e., 29 cm to 40 cm PCL) that that observed in 2008. Dogfish collected on the spring 2008 survey ranged from 18 cm to 87 cm PCL, and two distinct modal groups were again observed. 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 offshore 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 94).

Approximately half of the spiny dogfish diet by weight was fishes (Figure 95). 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.

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.

Spot (*Leiostomus xanthurus*)

Table 27. Sampling rates and abundance indices of spot for each NEAMAP cruise.

Figure 96. Biomass (kg) of spot collected at each sampling site for each 2009 NEAMAP cruise.

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

Figure 98. 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 99. Sex ratio, by length group, for spot collected on all 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.

Striped Anchovy (*Anchoa hepsetus*)

Table 28. Sampling rates and abundance indices of striped anchovy for each NEAMAP cruise.

Figure 100. Biomass (kg) of striped anchovy collected at each sampling site for each 2009 NEAMAP cruise.

Figure 101. 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 102. Length-frequency distributions, by cruise, for striped anchovy.

Striped Bass (*Morone saxatilis*)

Table 29. Sampling rates and abundance indices of striped bass for each NEAMAP cruise.

Figure 103. Biomass (kg) of striped bass collected at each sampling site for each 2009 NEAMAP cruise.

Figure 104. Preliminary indices of abundance, in terms of number and biomass, of striped bass for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 105. Length-frequency distributions, by cruise, for striped bass. Numbers taken for full processing, by length, are represented by the orange bars.

Figure 106. Sex ratio, by length group, for striped bass collected on all 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 107. Diet composition, expressed using the percent weight index, of striped bass collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of striped bass sampled.

Figure 108. 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.

Summer Flounder (*Paralichthys dentatus*)

Catches of summer flounder by the NEAMAP Near Shore Trawl Survey were relatively consistent among survey cruises (683 – 1,117 specimens weighing 418 kg to 625 kg; Table 30). Summer flounder were collected from throughout the NEAMAP survey range on each of the 2009 cruises (Figure 109). A restriction of summer flounder to the southern portion of the survey area during spring, as was observed with other fishes such as sciaenids, was not seen for summer flounder as this species undertakes inshore-offshore, rather than north-south, migrations each spring and fall. For both of the survey cruises, summer flounder catches were greatest in the northern portion of the sampling area (i.e., off of the coast of Long Island and in BIS and RIS). Relatively large catches of summer flounder were also encountered off of the mouth of the Delaware Bay during the fall 2009 survey. In general, however, catches became patchier with decreasing latitude.

The numerical and biomass abundance indices for summer flounder exhibited declines between the 2008 and 2009 spring cruises (Figure 110). Decreases in abundance were also documented between the fall of 2007 and 2008, but abundance increased between 2008 and 2009. Summer flounder collected during the fall cruises ranged from 12 cm to 76 cm TL, and at least three distinct modal size groups were evident for each of these surveys (Figure 111). 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 112). Specifically, the proportion of females in the sample increased with increasing length. Females began to outnumber males at about 30 cm TL, and nearly all fish greater than 55 cm TL were female.

Summer flounder are known piscivores, and the diet of flounder collected by NEAMAP confirmed this classification (Figure 113). 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.

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 114). 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 age samples collected in 2009 have been processed, and age data for the spring and fall 2009 cruises will be available in the very near future.

Weakfish (*Cynoscion regalis*)

Table 31. Sampling rates and abundance indices of weakfish for each NEAMAP cruise.

Figure 115. Biomass (kg) of weakfish collected at each sampling site for each 2009 NEAMAP cruise.

Figure 116. Preliminary indices of abundance, in terms of number and biomass, of weakfish for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 117. Length-frequency distributions, by cruise, for weakfish. Numbers taken for full processing, by length, are represented by the orange bars (difficult to see due to scale of y-axis).

Figure 118. Sex ratio, by length group, for weakfish collected on all 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 119. Diet composition, expressed using the percent weight index, of weakfish collected during five 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.

Figure 120. 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.

White Shrimp (*Penaeus setiferus*)

Table 32. Sampling rates and abundance indices of white shrimp for each NEAMAP cruise.

Figure 121. Biomass (kg) of white shrimp collected at each sampling site for each 2009 NEAMAP cruise.

Figure 122. 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 123. Length-frequency distributions, by cruise, for white shrimp. This species was absent from collections during the spring 2008 survey.

Windowpane Flounder (*Scopthalmus aquosus*)

Table 33. Sampling rates and abundance indices of windowpane flounder for each NEAMAP cruise.

Figure 124. Biomass (kg) of windowpane flounder collected at each sampling site for each 2009 NEAMAP cruise.

Figure 125. 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 126. Length-frequency distributions, by cruise, for windowpane flounder.

Winter Flounder (*Pseudopleuronectes americanus*)

Table 34. Sampling rates and abundance indices of winter flounder for each NEAMAP cruise.

Figure 127. Biomass (kg) of winter flounder collected at each sampling site for each 2009 NEAMAP cruise.

Figure 128. Preliminary indices of abundance, in terms of number and biomass, of winter flounder for spring and fall NEAMAP surveys. Confidence intervals are provided for each abundance estimate.

Figure 129. Length-frequency distributions, by cruise, for winter flounder. Numbers taken for full processing, by length, are represented by the orange bars.

Figure 130. Sex ratio, by length group, for winter flounder collected on all 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 131. Diet composition, expressed using the percent weight index, of winter flounder collected during five 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.

Figure 132. 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.

Winter Skate (*Leucoraja ocellata*)

Table 35. Sampling rates and abundance indices of winter skate for each NEAMAP cruise.

Figure 133. Biomass (kg) of winter skate collected at each sampling site for each 2009 NEAMAP cruise.

Figure 134. 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 135. Length-frequency distributions, by cruise, for winter skate. Numbers taken for full processing, by length, are represented by the orange bars.

Figure 136. Sex ratio, by length group, for winter skate collected on all 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 137. Diet composition, expressed using the percent weight index, of winter skate collected during five 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.

Public Outreach

During 2009, presentations of survey activities and results were made as follows:

- March 2009: Bass Pro Shops Fishing Classic (Hampton, VA), Booth exhibit
- May 2009: Rhode Island Ocean Special Area Management Plan Team
- October 2009: ASMFC, NEAMAP Board
- October 2009: ASMFC, Management and Science Committee
- October 2009: ASMFC, Interstate Fisheries Management Program Policy Board
- November 2009: Randolph Macon College – Applied Science Lecture

Further, approximately 100 individuals including representatives of the recreational and commercial fishing communities, fishery managers, other scientists, local and national political leaders, and students observed survey operations both in port and in the field during layovers in

New Bedford, Massachusetts, Point Judith, Rhode Island, Montauk, New York, Cape May, New Jersey and Hampton, Virginia during the 2009 survey cruises. Brief news stories highlighting the NEAMAP Survey have appeared on local television in New Bedford, Massachusetts, and New York City. News articles also appeared in the *East Hampton Press* in February and May, the *Cape May County Herald* in May, and the *Press of Atlantic City* in December.

In an attempt to promote survey coordination and idea-sharing between organizations, NEAMAP staff participated in two trawl survey personnel exchanges in 2009. 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, the chief of the Ecosystems Survey Branch at the NEFSC accompanied NEAMAP during a portion of its fall 2009 cruise.

Data Utilization

While the time series of species abundance data generated by the NEAMAP Trawl Survey is still deemed insufficient to support stock assessment efforts for the MAB and SNE, the biological and life history information that this program produces has been (and is currently being) incorporated into the assessments for various species. These include:

- Atlantic croaker
- Bluefish
- Butterfish
- Black drum
- River herring
- Scup
- Sea scallop
- Summer flounder
- Spiny dogfish
- Spot
- Weakfish

It is expected that, as the time series of data collected by this survey continues to become established, the abundance data for each of these species will be incorporated into the assessment process. Furthermore, it is anticipated that the number of species for which assessment data are provided will expand as additional data become available and the assessments for some of the species not listed above are undertaken.

Beyond the stock assessment process, the data and samples collected by NEAMAP have also supported a number of collaborative efforts. These include:

- Inclusion of catch data from BIS and RIS into the Rhode Island Ocean Special Area Management Plan (SAMP) process
- Collection of scale samples to support striped bass scale/otolith ageing comparisons
- Collection of scale samples to support black sea bass scale/otolith ageing comparisons
- Sampling of monkfish tissue to facilitate a genetics-based population analysis

- Acquisition of whole specimens to support a ‘library of fishes’ in Virginia
- Recording of acoustic data to track the movement of bats off of the MAB and SNE coasts
- Collection of spleen samples of striped bass to delineate the prevalence and severity of *Mycobacterium* infection of stripers along the coast.

A number of these collaborative efforts are expected to continue into the foreseeable future, and it is very likely that additional initiatives will be undertaken as the opportunities arise.

Literature Cited

Atlantic States Marine Fisheries Commission (ASMFC). 2002. Development of a Cooperative State/Federal Fisheries Independent Sampling Program. ASMFC Document, Washington, DC.

Atlantic States Marine Fisheries Commission (ASMFC). 2009. Terms of Reference & Advisory Report of the NEAMAP Near Shore Trawl Survey Peer Review. ASMFC Report 09-01, Washington, DC.

Bogstad, B., M. Pennington, and J.H. Volstad. 1995. Cost-efficient survey designs for estimating food consumption by fish. Fisheries Research 23:37-46.

Bonzek, C.F., J. Gartland, and R.J. Latour. 2007. Northeast Area Monitoring and Assessment Program (NEAMAP) Mid-Atlantic Nearshore Trawl Program Pilot Survey Completion Report. ASMFC. 97pp.

Bonzek, C.F., J. Gartland, R.A. Johnson, and J.D. Lange, Jr. 2008. NEAMAP Near Shore Trawl Survey: Peer Review Documentation. A report to the Atlantic States Marine Fisheries Commission by the Virginia Institute of Marine Science, Gloucester Point, Virginia.

Buckel, J.A., D.O. Conover, N.D. Steinberg, and K.A. McKown. 1999. Impact of age-0 bluefish (*Pomatomus saltatrix*) predation on age-0 fishes in the Hudson River estuary: evidence for density-dependent loss of juvenile striped bass (*Morone saxatilis*). Canadian Journal of Fisheries and Aquatic Sciences 56:275-287.

Byrne, Don. 2004. Counting the fish in the ocean. Online. Internet. <http://www.state.nj.us/dep/fgw/artoceancount.htm>

Gómez, J.D. and J.R.V. Jiménez. 1994. Methods for the theoretical calculation of wing spread and door spread of bottom trawls. Journal of Northwest Atlantic Fishery Science 16:41-48.

Hyslop, E.J. 1980. Stomach contents analysis – a review of methods and their application. Journal of Fish Biology 17:411-429.

Northeast Fisheries Science Center (NEFSC). 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.

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

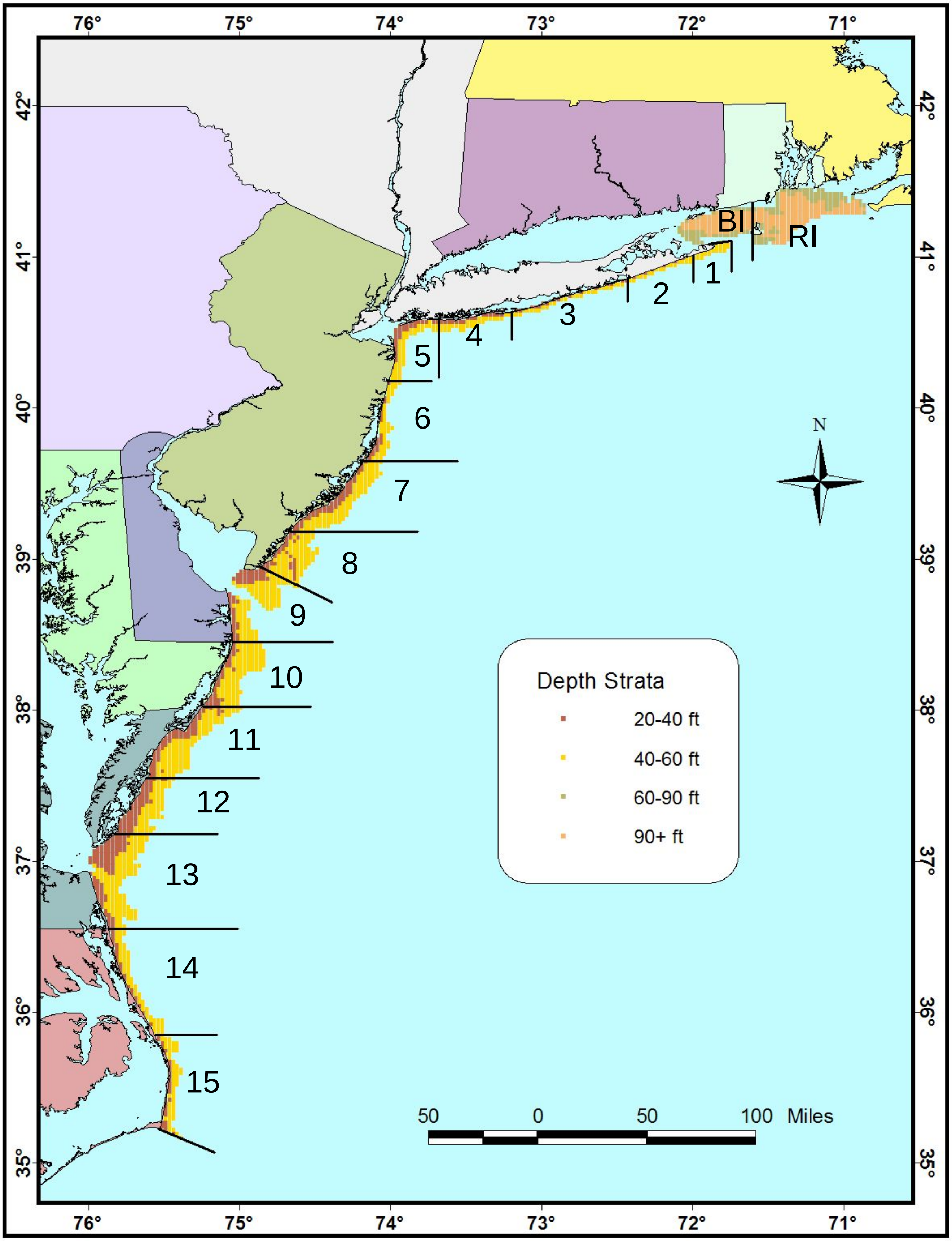


Figure 2a. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites in Rhode Island Sound and Block Island Sound for the fall 2009 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

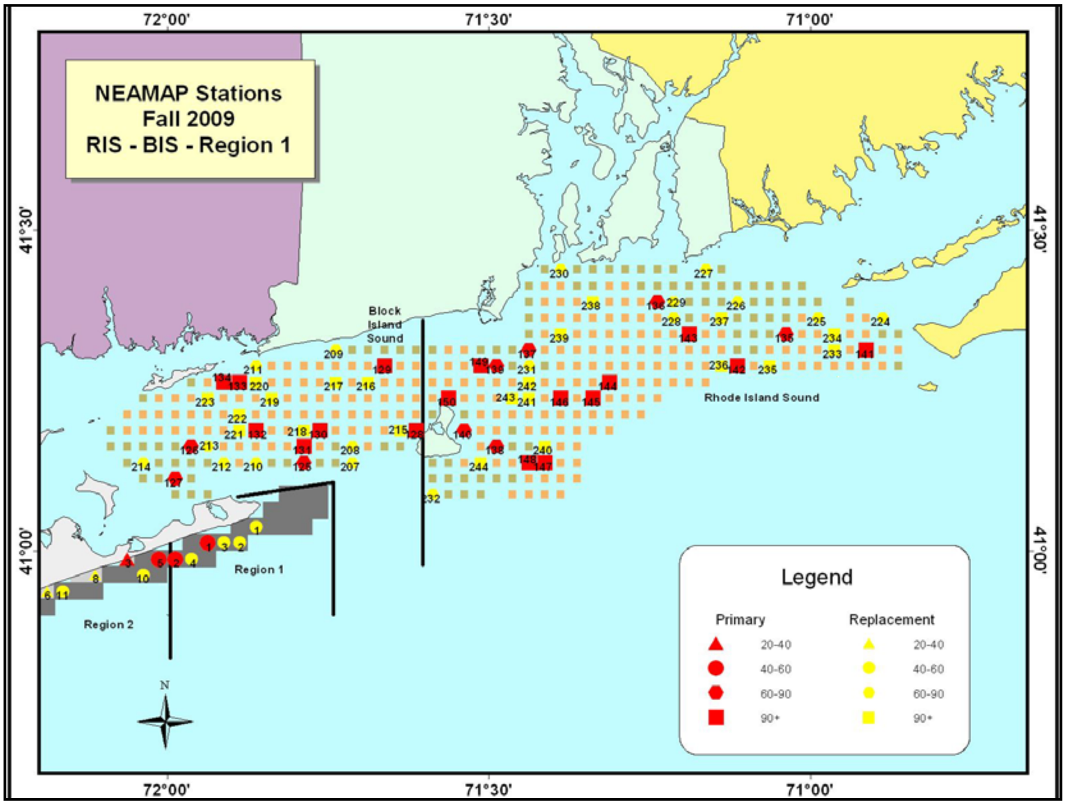


Figure 2b. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites along the coast of Long Island for the fall 2009 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

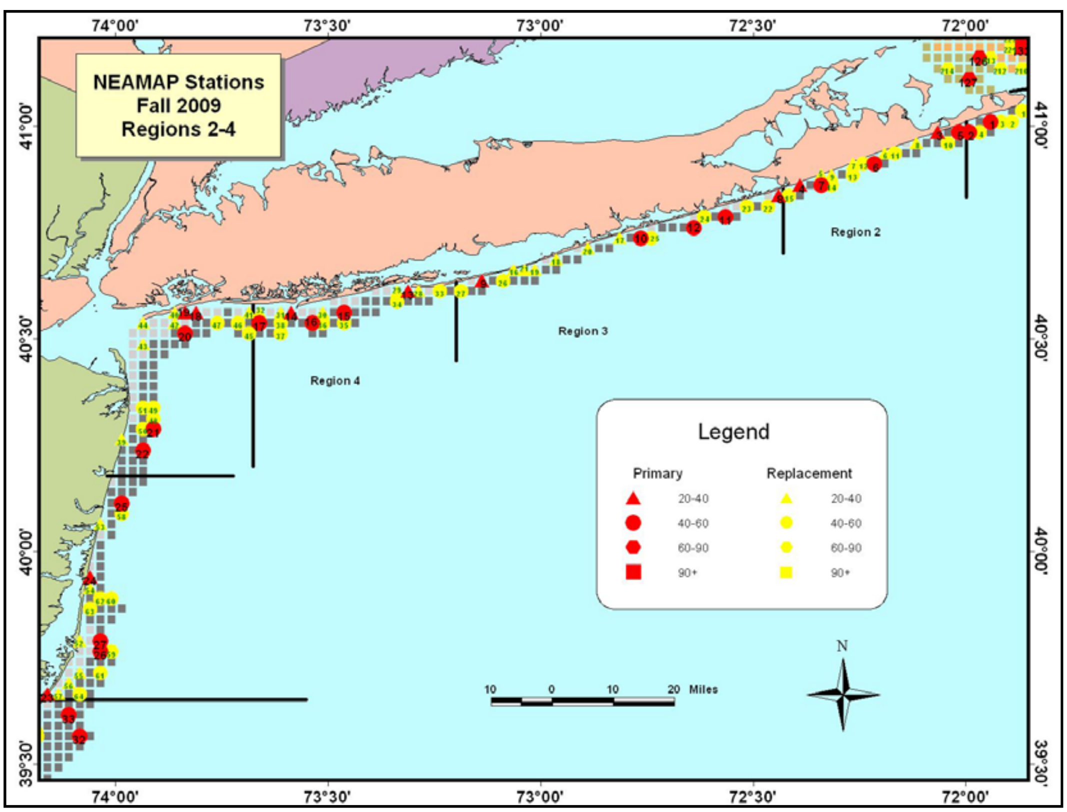


Figure 2c. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites along the coast of New Jersey for the fall 2009 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

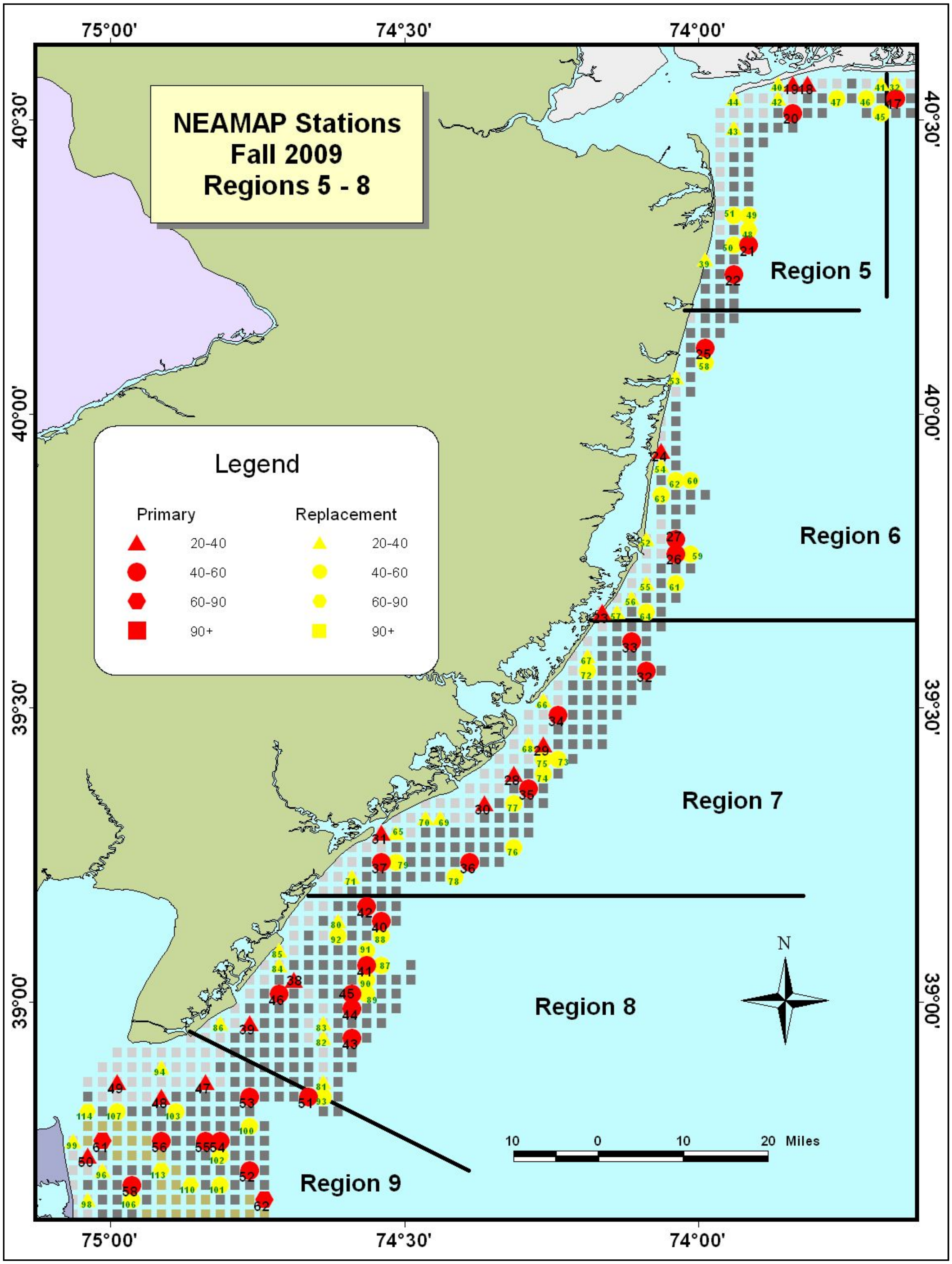


Figure 2d. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites along the coasts of Delaware, Maryland, and the northernmost portion of Virginia for the fall 2009 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

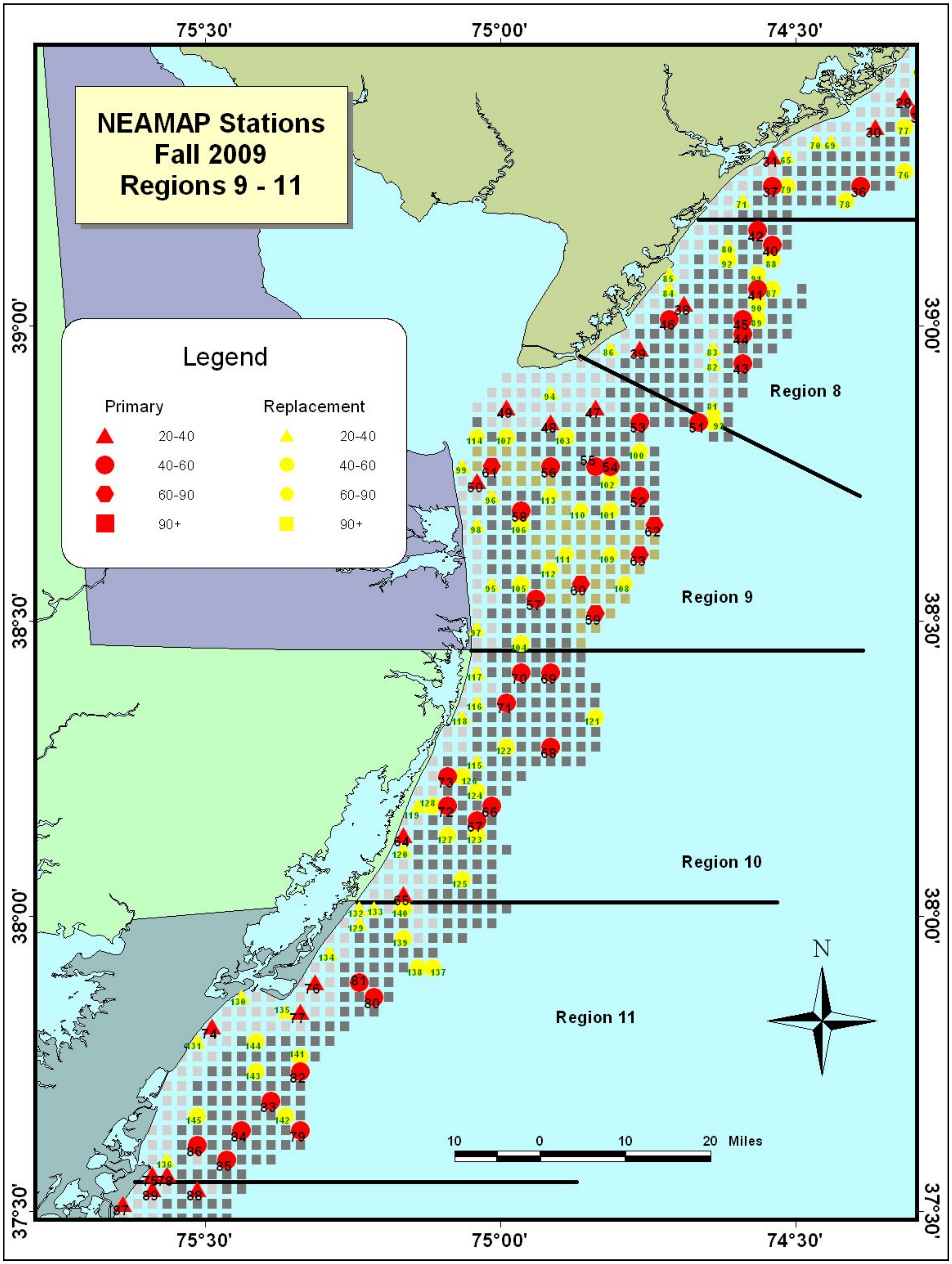


Figure 2e. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites along the coast of Virginia for the fall 2009 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

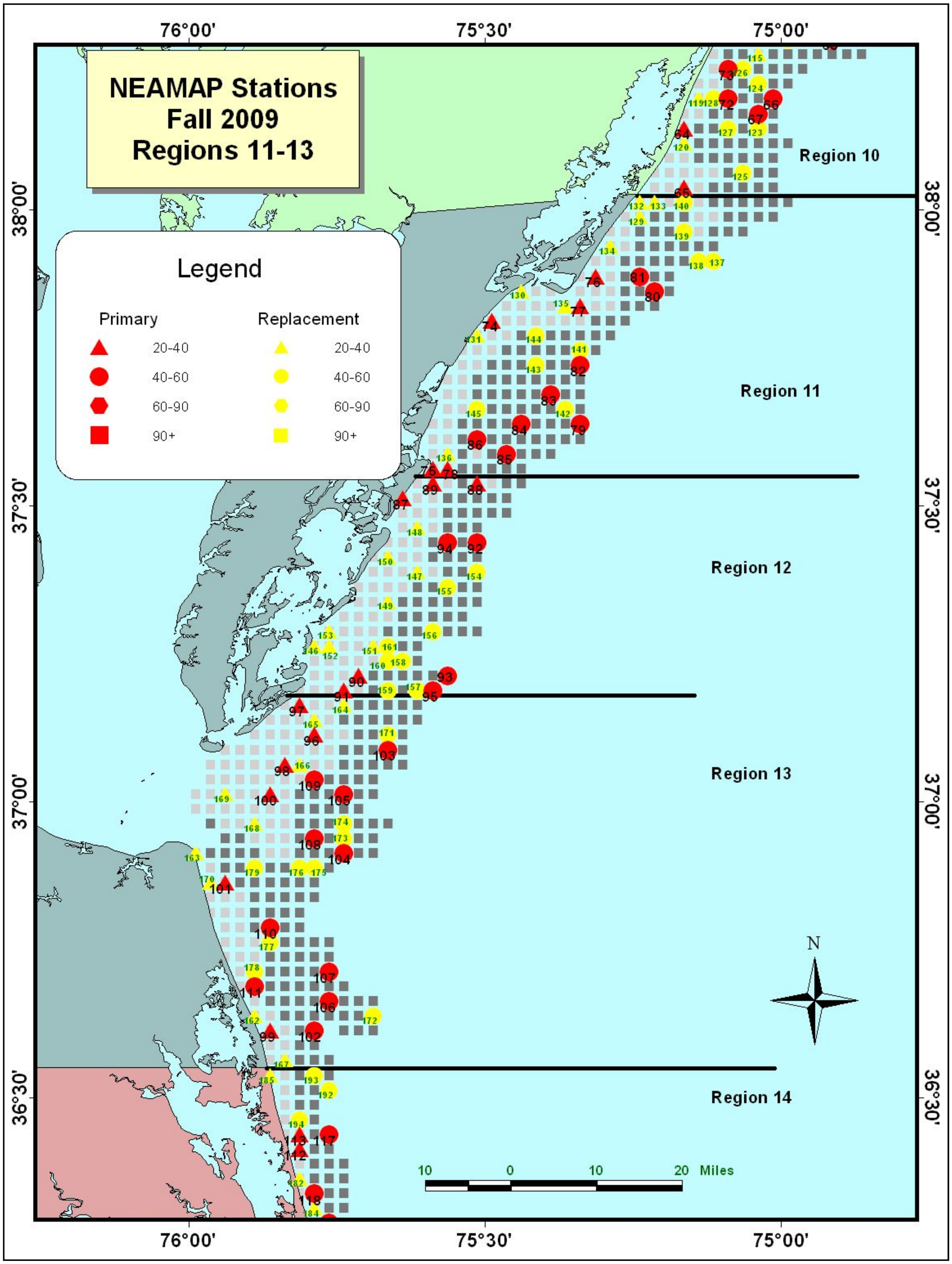


Figure 2f. NEAMAP primary (red symbols) and alternate (yellow symbols) sampling sites along the coast of North Carolina for the fall 2009 cruise. Regional strata are defined by black lines, while the shapes of the station symbols indicate the depth strata occupied by each.

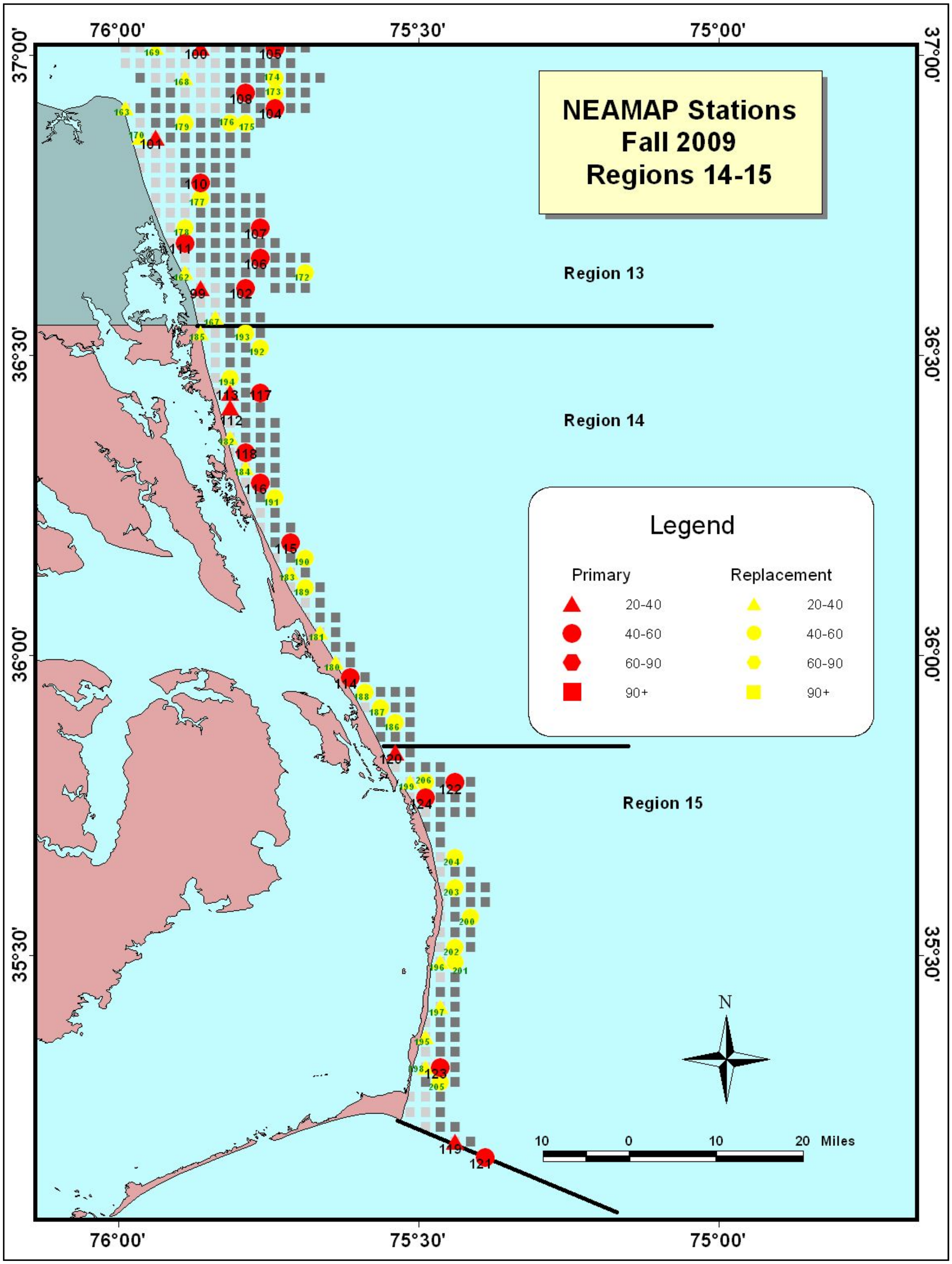


Figure 3. Performance of the NEAMAP Trawl Survey sampling gear during the spring and fall 2009 cruises. Tows are numbered chronologically along the x-axis. Points on the graph are tow averages for each of the respective parameters. Average door spreads (m) for each tow are given in green, average vessel speeds over ground (kts) in brown, average wing spreads (m) in blue, and average headline heights (m) in red. Cruise averages are given with each parameter. Optimal or acceptable ranges for each parameter are represented by the horizontal dotted lines. Optimal door spreads are 32.0 m - 34.0 m, and vessel speeds over ground are 2.9 kts - 3.3 kts. Acceptable wing spreads are 12.3 m - 14.7 m, while headline heights are 4.7 m - 5.8 m.

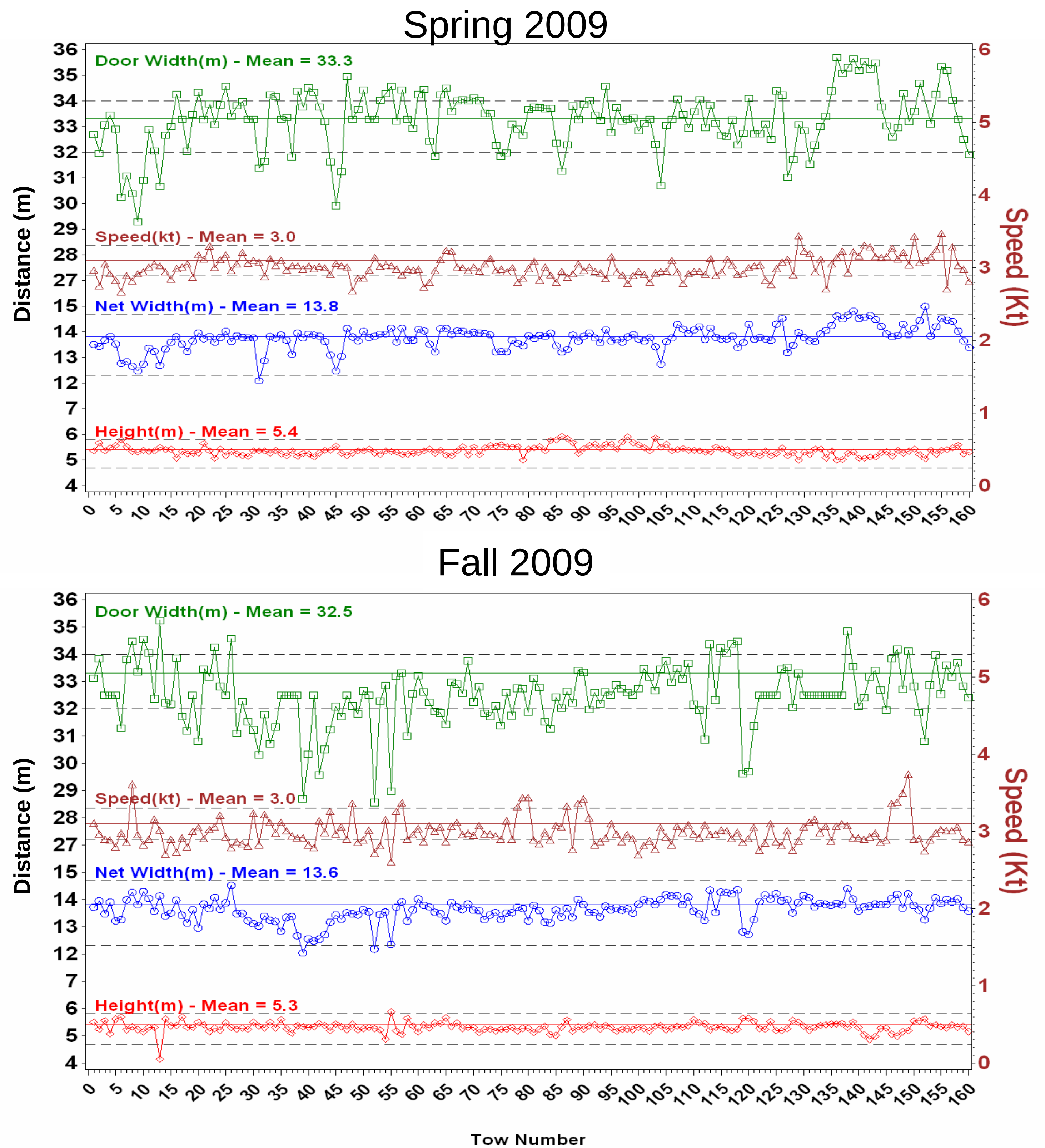
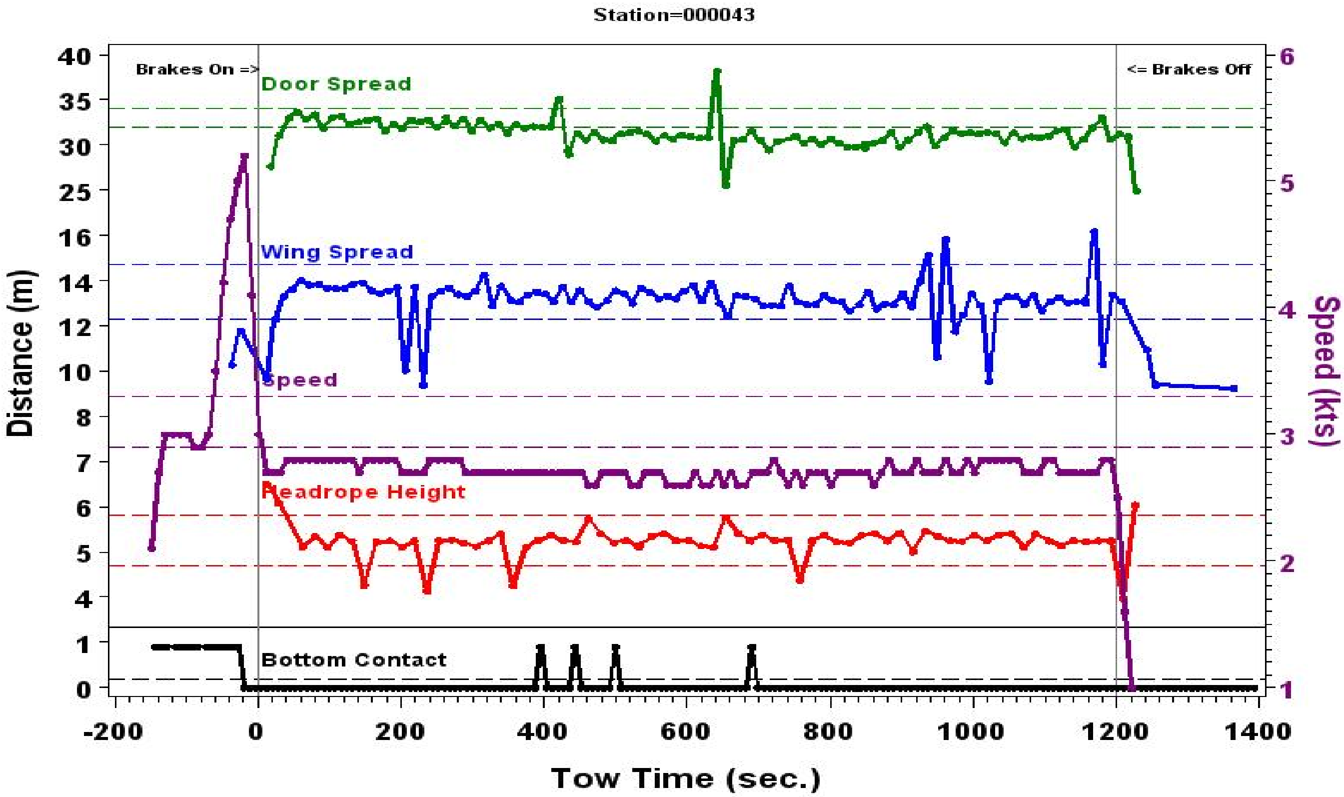
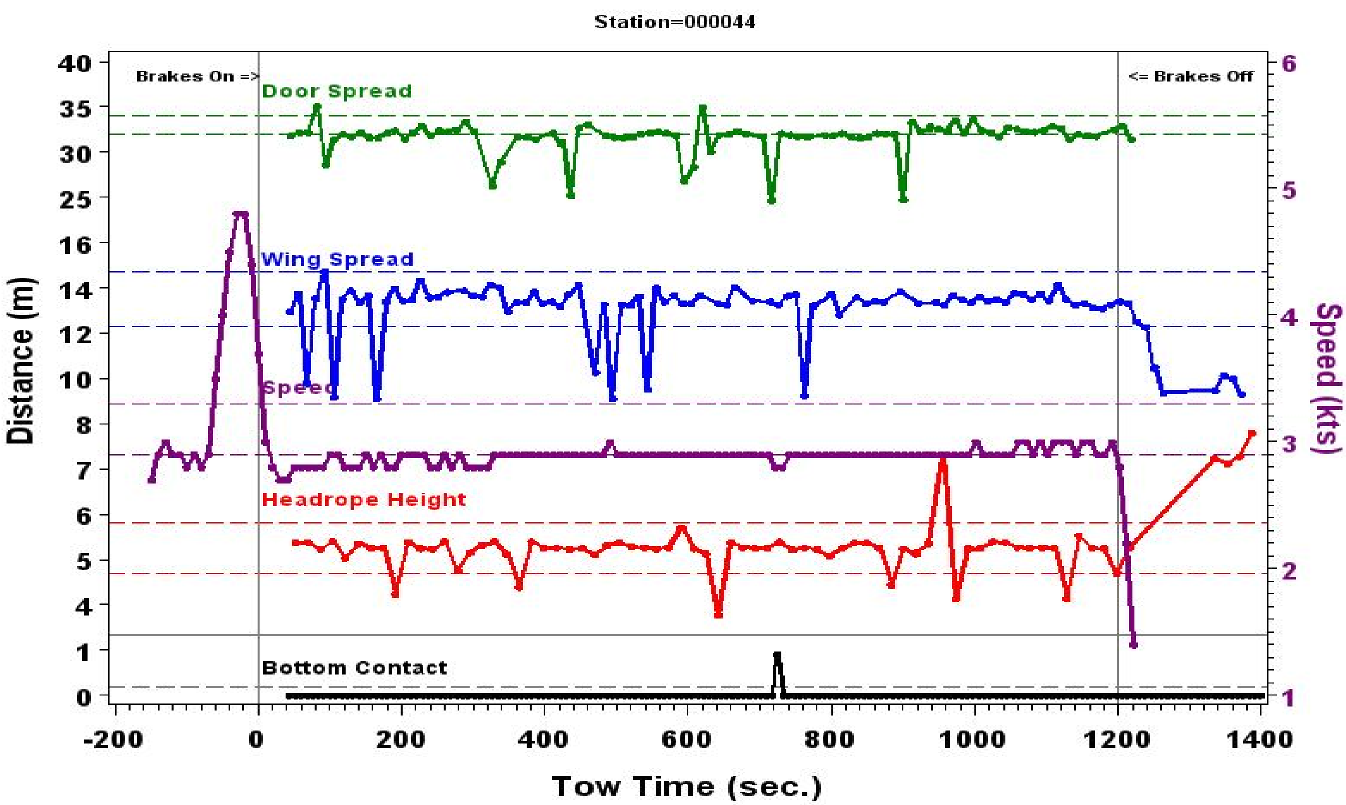


Figure 4. Within-tow performance of the NEAMAP Trawl Survey sampling gear for two select tows during the fall 2009 cruise. X-axis values represent time (in seconds) relative to the start of the tow (i.e., winch brakes set). Points on the graph are individual readings for each of the respective parameters. Door spreads (m) are given in green, vessel speeds over ground (kts) in purple, wing spreads (m) in blue, headline heights (m) in red, and bottom contact (on [0] or off [1]) in black. Optimal or acceptable ranges for each parameter are represented by the horizontal dotted lines. Optimal door spreads are 32.0 m - 34.0 m, and vessel speeds over ground are 2.9 kts - 3.3 kts. Acceptable wing spreads are 12.3 m - 14.7 m, while headline heights are 4.7 m - 5.8 m.





Alewife (Priority A)

Table 6. Sampling rates and abundance indices of alewife for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	56	3.1	56	24	0	24		0.09	36.7	0.02	54.8
2008	Spring	2,419	141.8	1,572	350	0	344	5	2.27	8.5	0.38	14.1
	Fall	5	0.3	5	5	0	5		0.02	56.5	0	59.2
2009	Spring	2,955	233.0	1,225	235	0	235		1.23	11.4	0.27	19.6
	Fall	87	3.9	87	17	0	16		0.05	68.6	0.01	91.9

Figure 5. Biomass (kg) of alewife collected at each sampling site for each 2009 NEAMAP cruise.

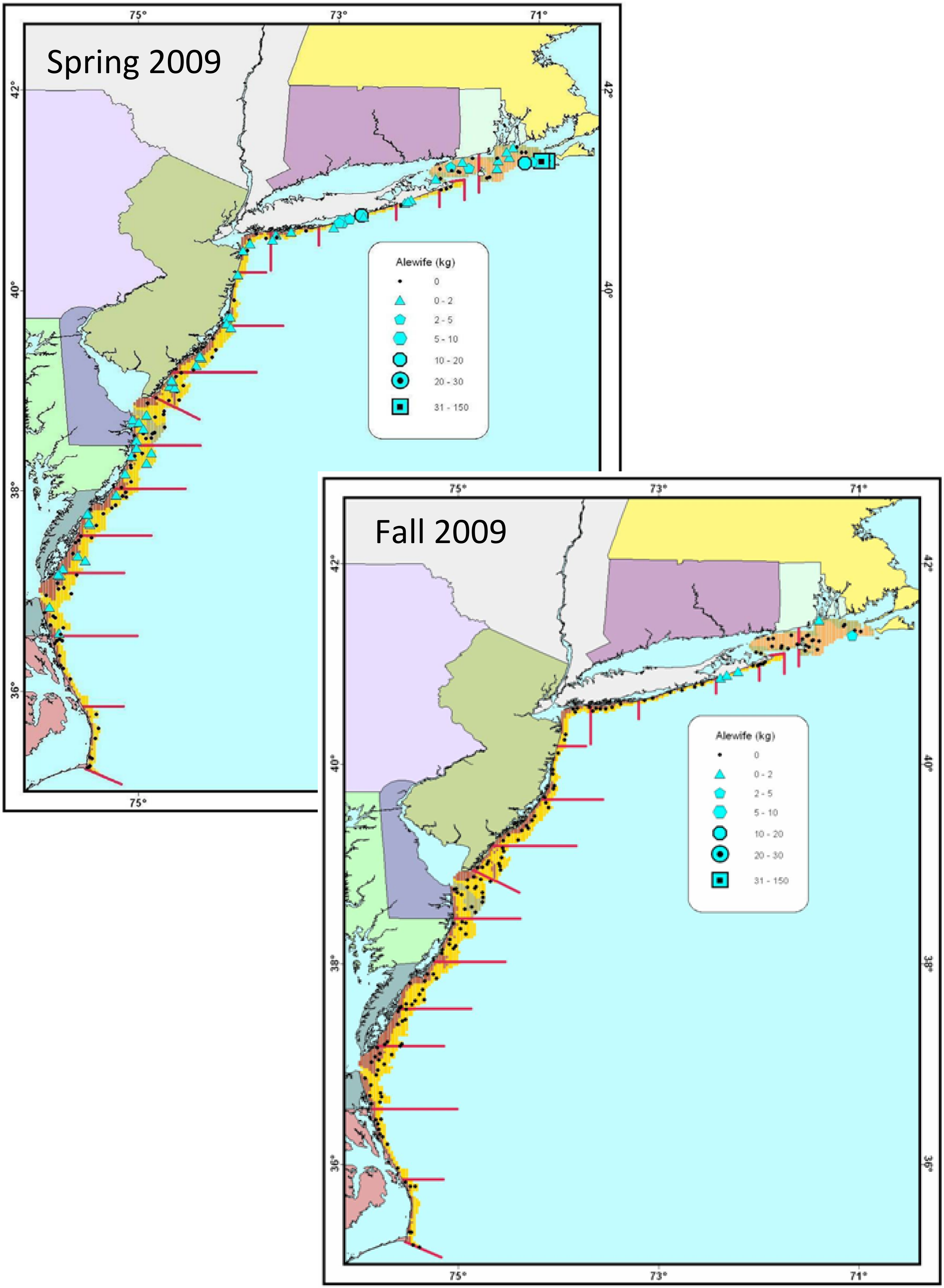


Figure 6. Preliminary indices of abundance, in terms of number and biomass, of alewife for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

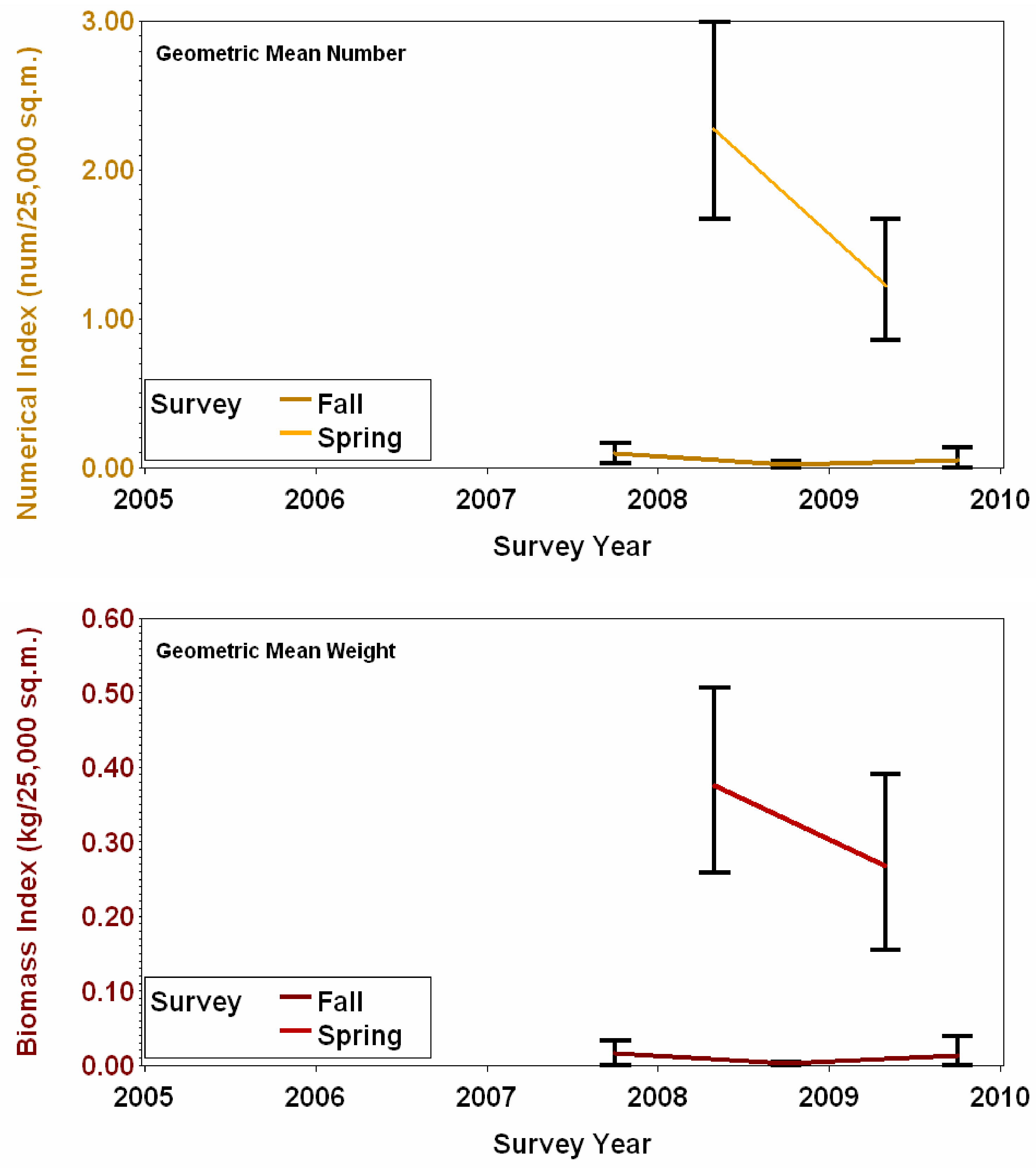


Figure 7. Length-frequency distributions, by cruise, for alewife. Numbers taken for full processing, by length, are represented by the orange bars.

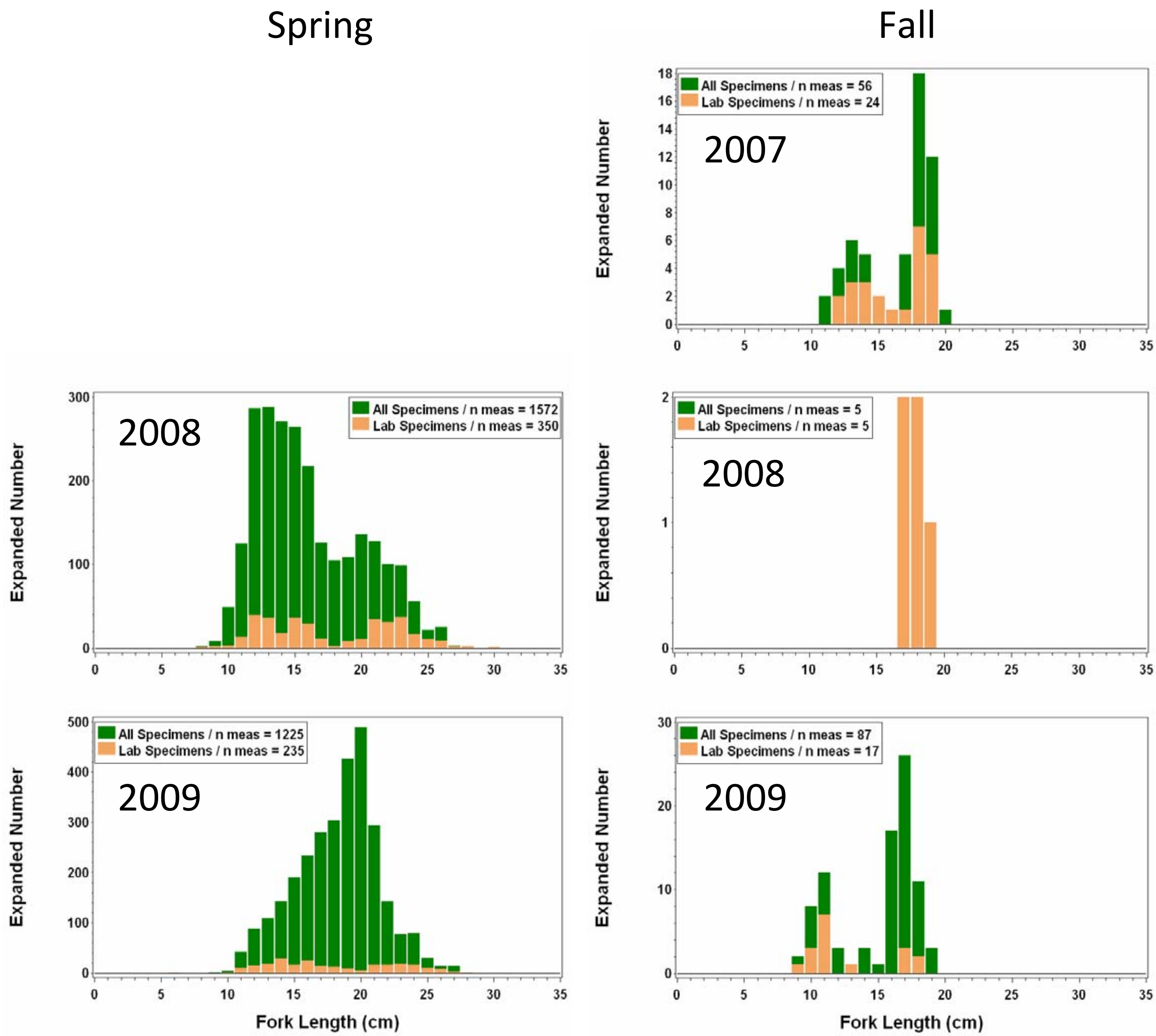
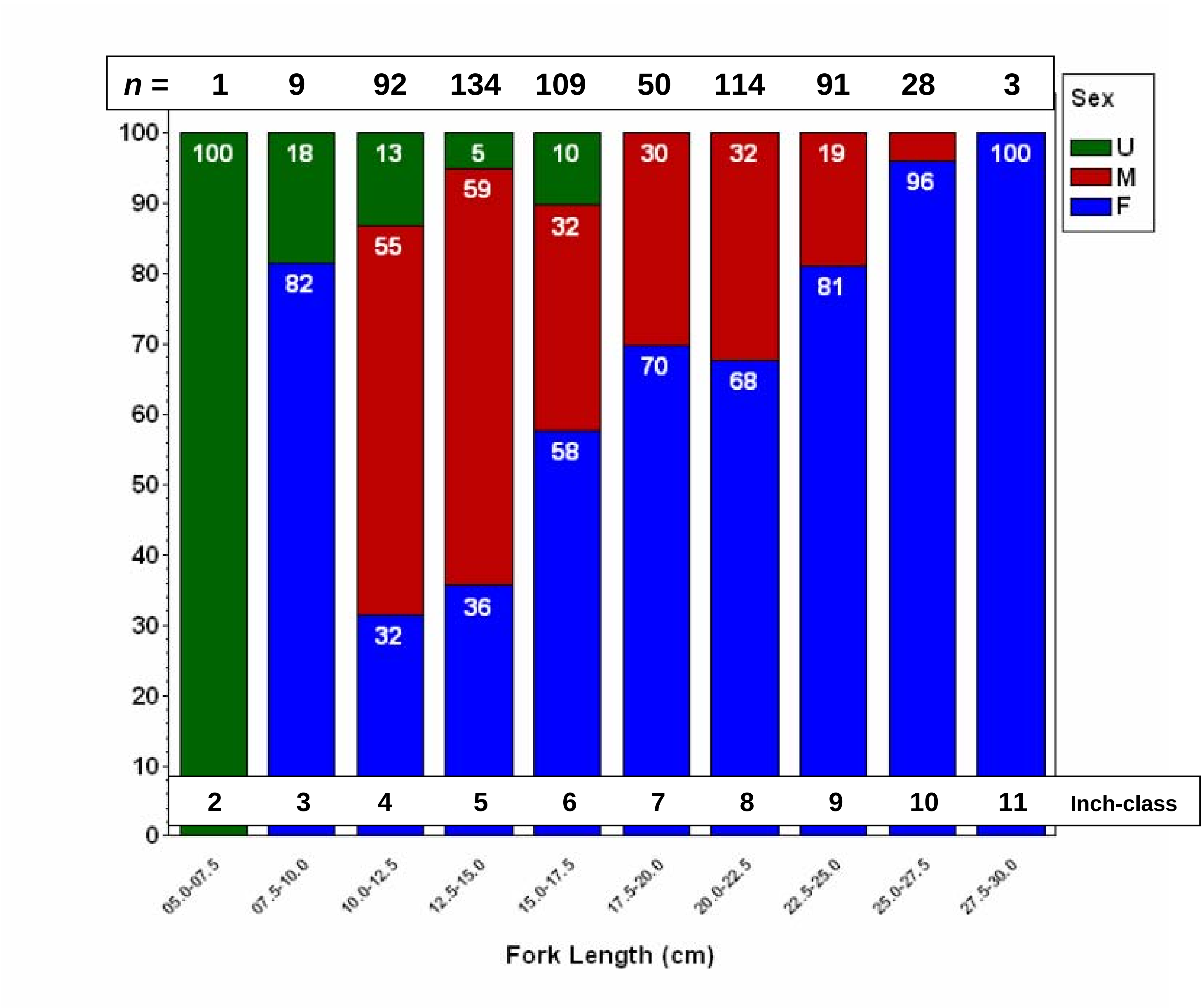


Figure 8. Sex ratio, by length group, for alewife collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



American Lobster (Priority E)

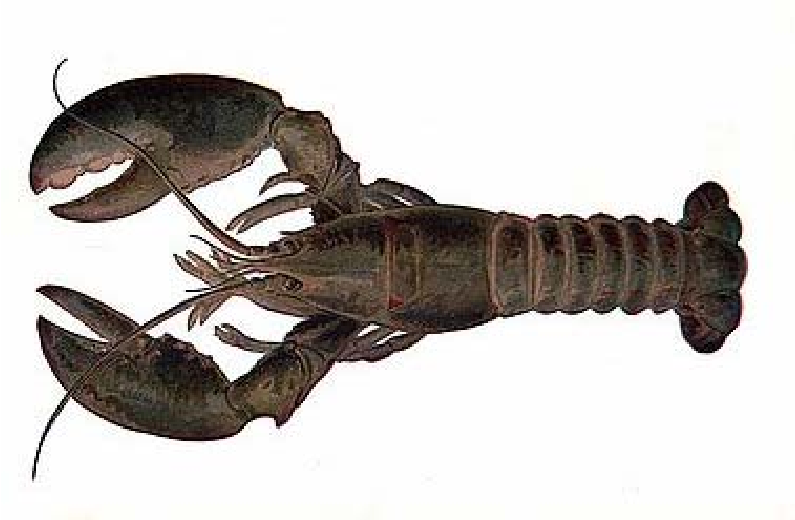


Table 7. Sampling rates and abundance indices of American lobster for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	262	59.0	262					0.30	20.8	0.14	25.5
2008	Spring	519	89.8	286					0.47	15.1	0.21	19.1
	Fall	352	80.6	178					0.36	13.9	0.16	20.2
2009	Spring	290	89.9	248					0.37	13.8	0.20	17.2
	Fall	89	29.1	89					0.24	18.7	0.11	23.1

Figure 9. Biomass (kg) of American lobster collected at each sampling site for each 2009 NEAMAP cruise.

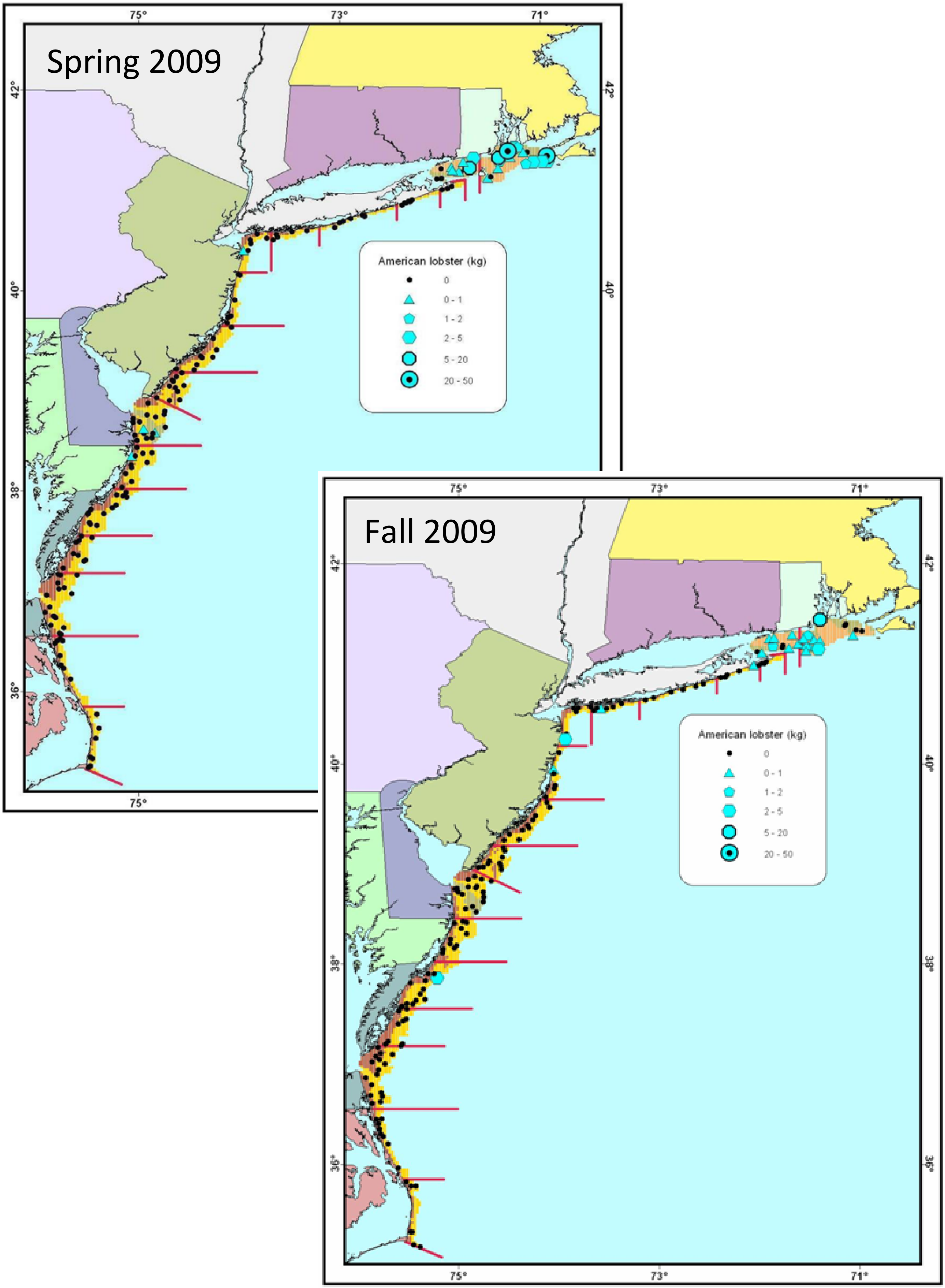
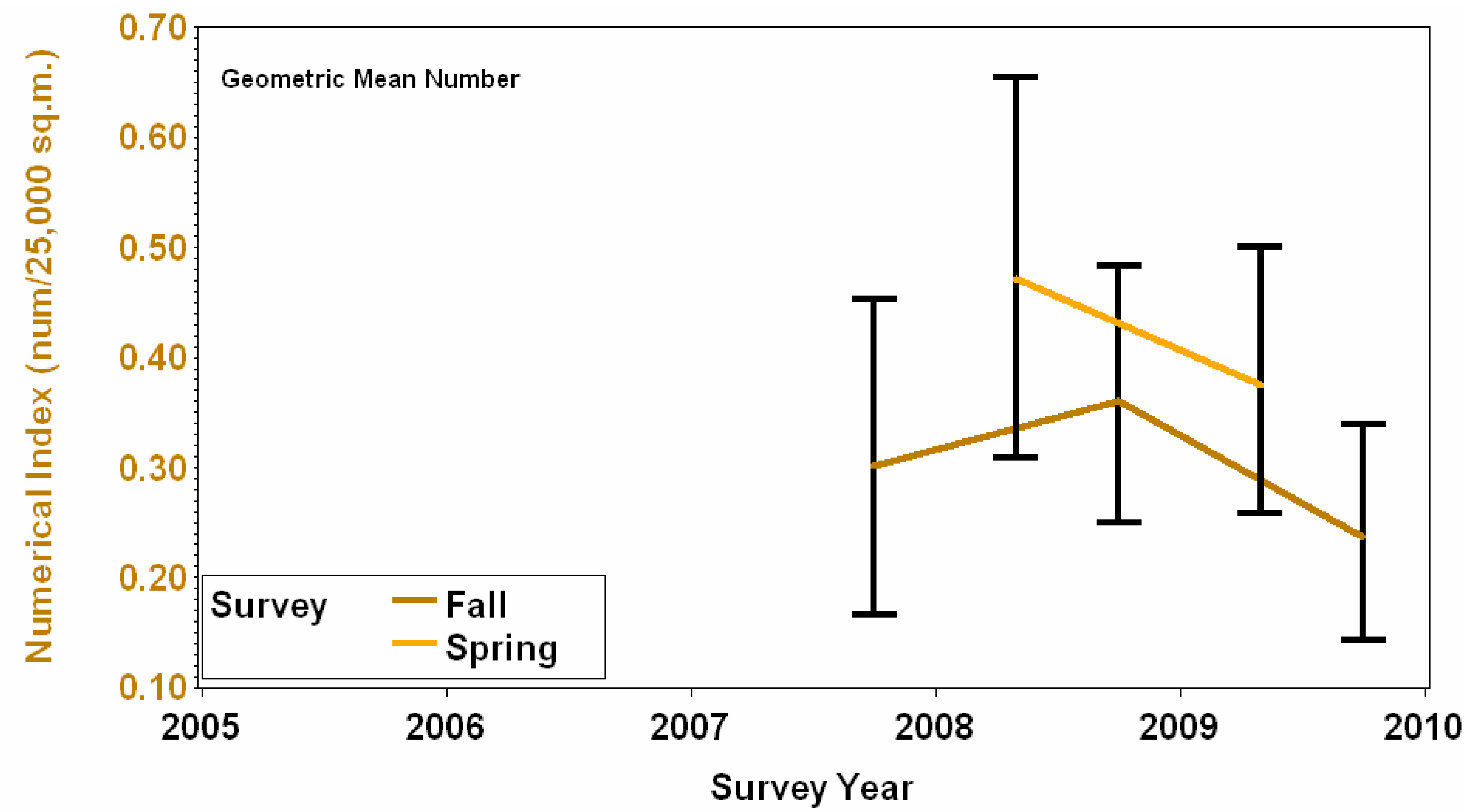


Figure 10. Preliminary indices of abundance, in terms of number and biomass, of American lobster for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



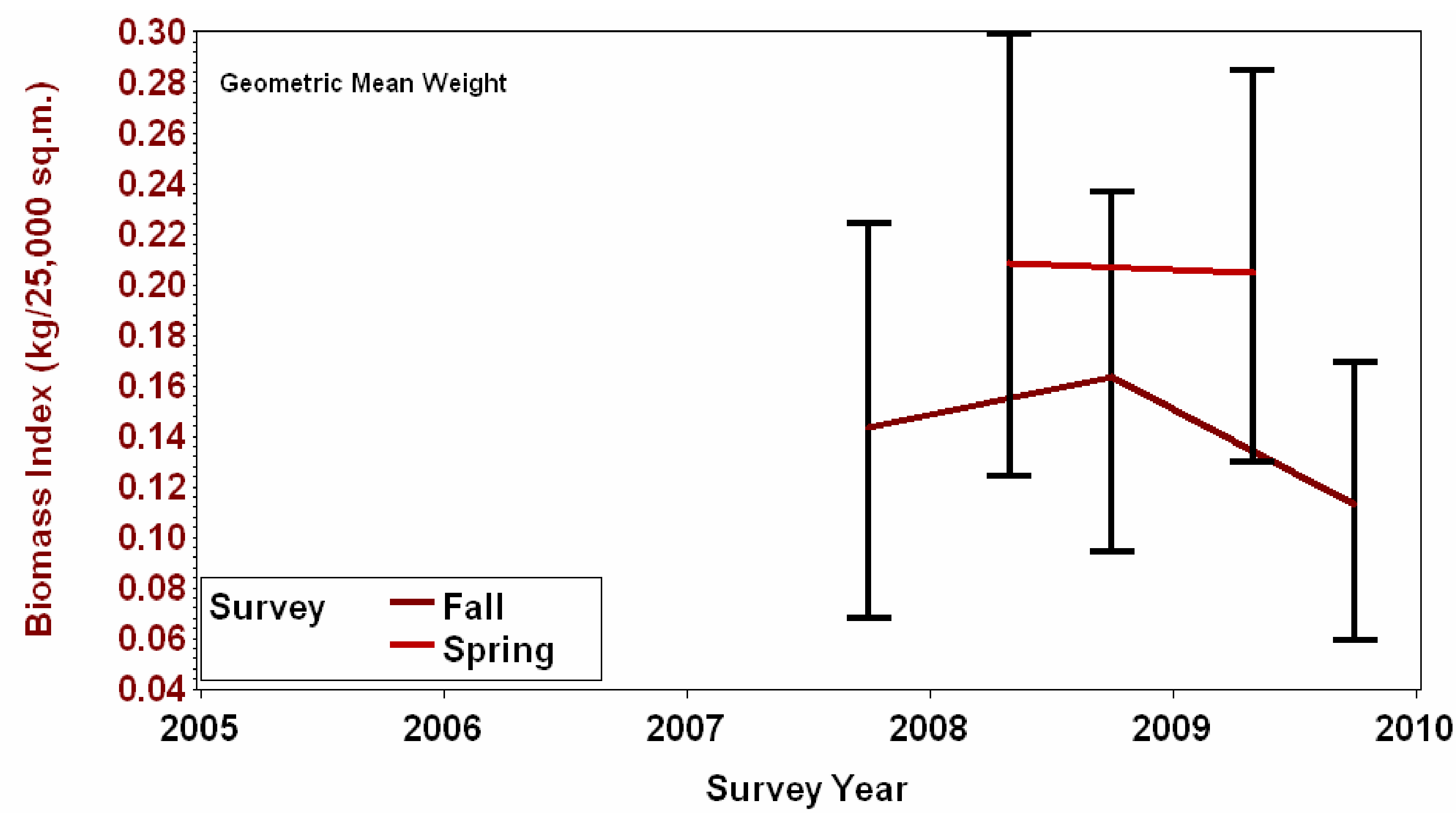


Figure 11. Length-frequency distributions, by cruise, for American lobster.

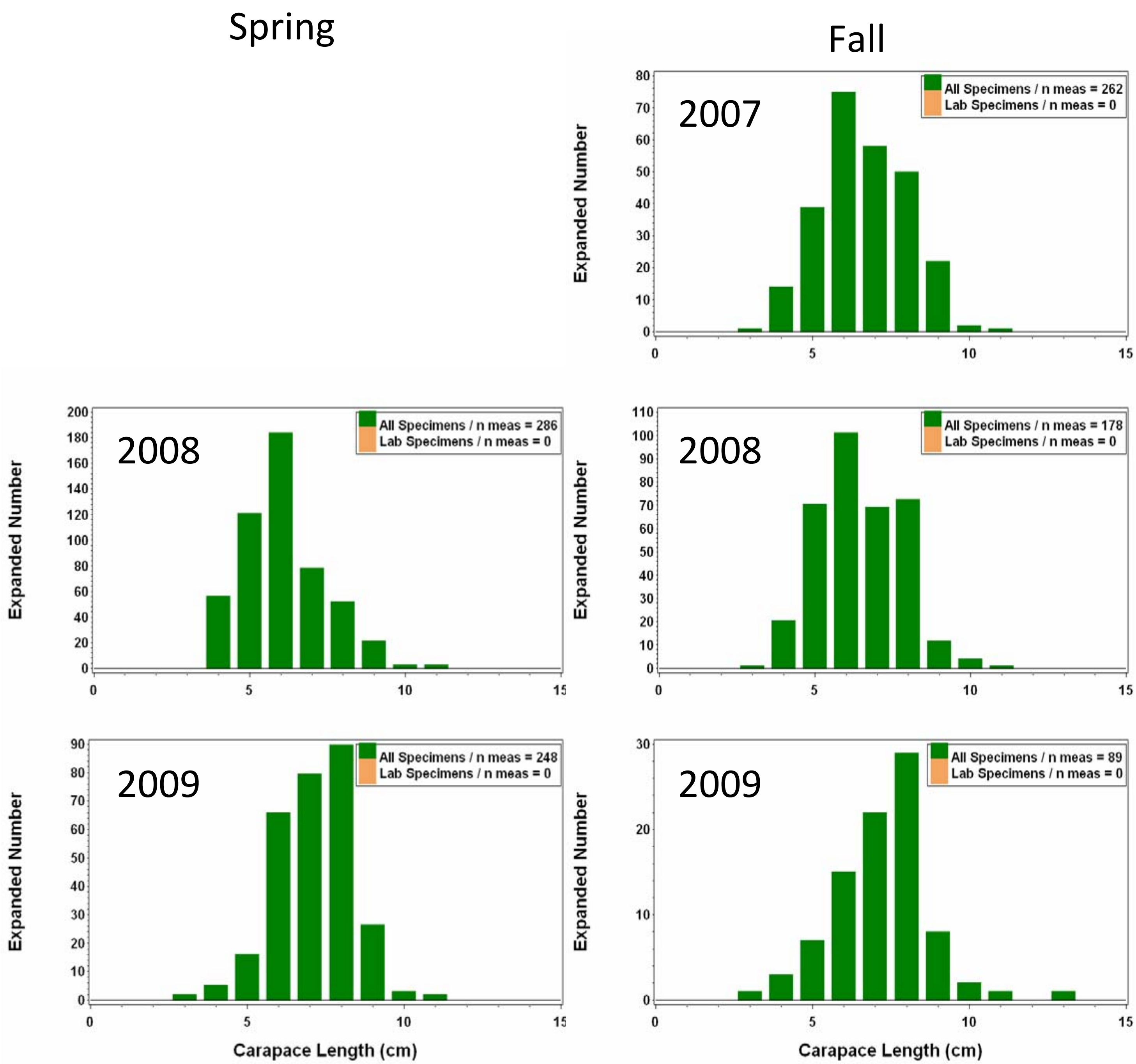
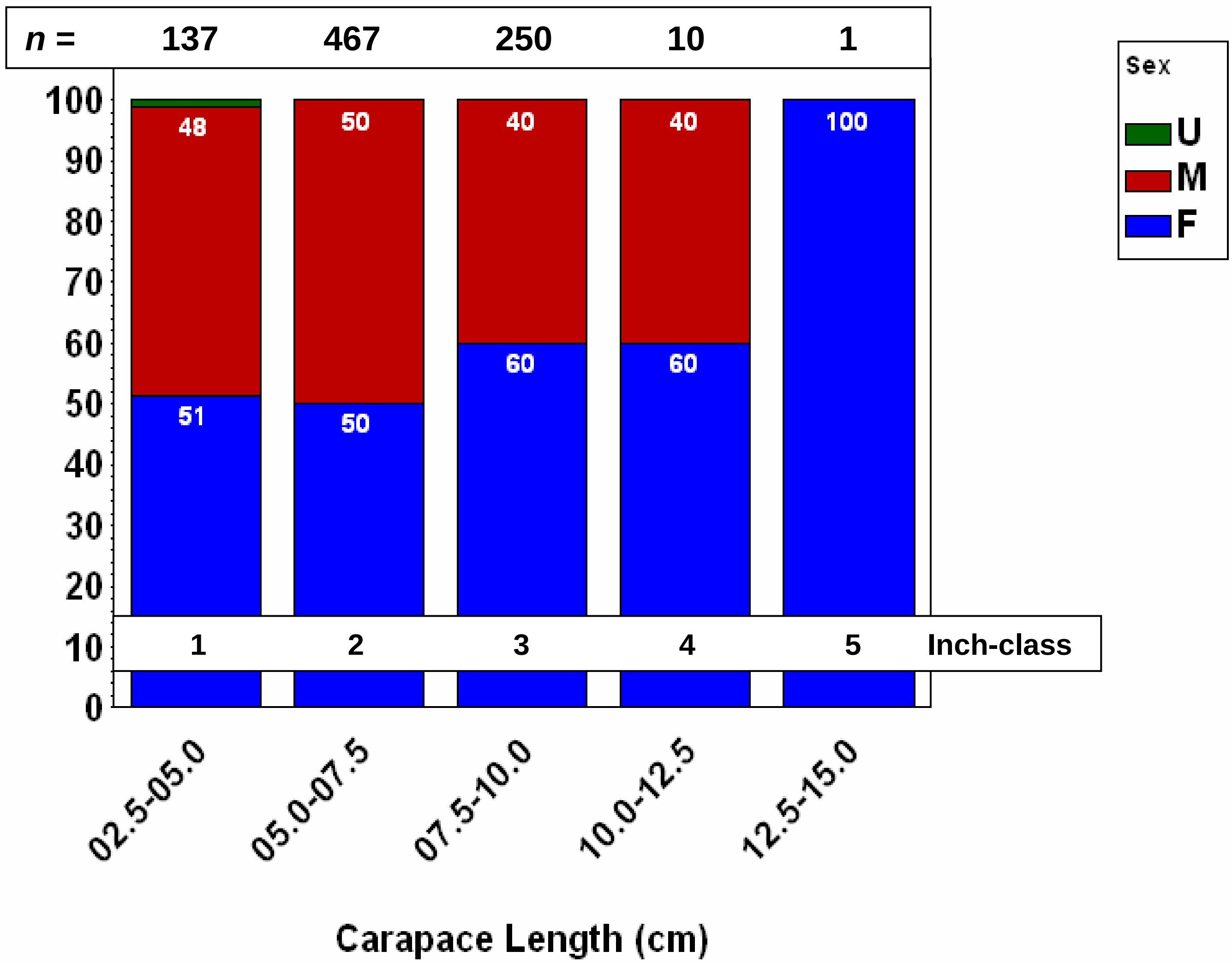


Figure 12. Sex ratio, by length group, for American lobster collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



American Shad (Priority A)

Table 8. Sampling rates and abundance indices of American shad for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	9	0.8	9	9	0	9		0.03	46.8	0.01	62.2
2008	Spring	1,205	40.8	1,205	327	0	321		2.36	7.4	0.20	10.3
	Fall	9	0.5	9	5	0	5		0.02	81.1	0.00	98.2
2009	Spring	1,141	33.2	859	260	0	260	9	1.47	9.4	0.14	16.5
	Fall	28	3.1	28	10	0	10		0.05	57.5	0.02	59.2

Figure 13. Biomass (kg) of American shad collected at each sampling site for each 2009 NEAMAP cruise.

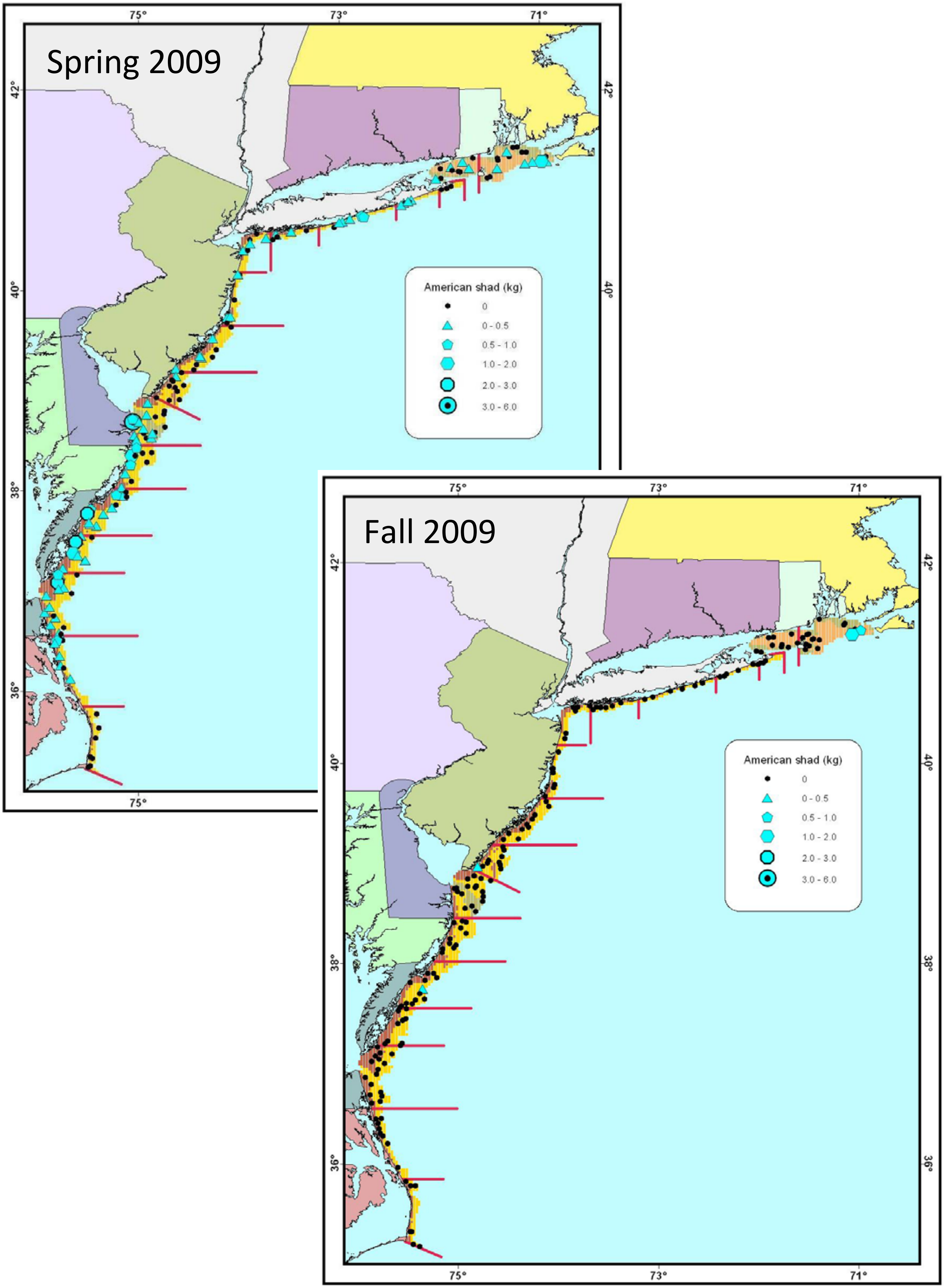
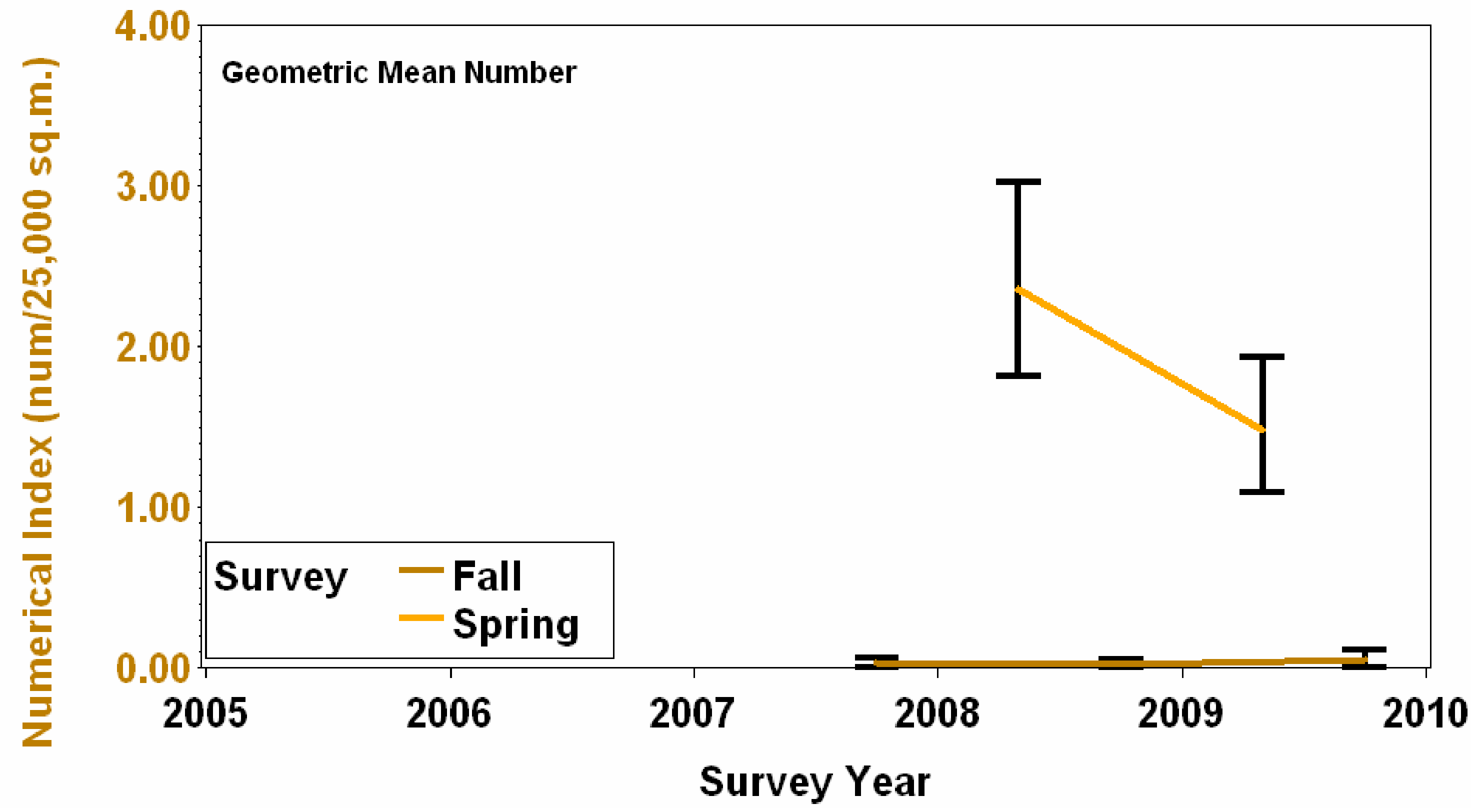


Figure 14. Preliminary indices of abundance, in terms of number and biomass, of American shad for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



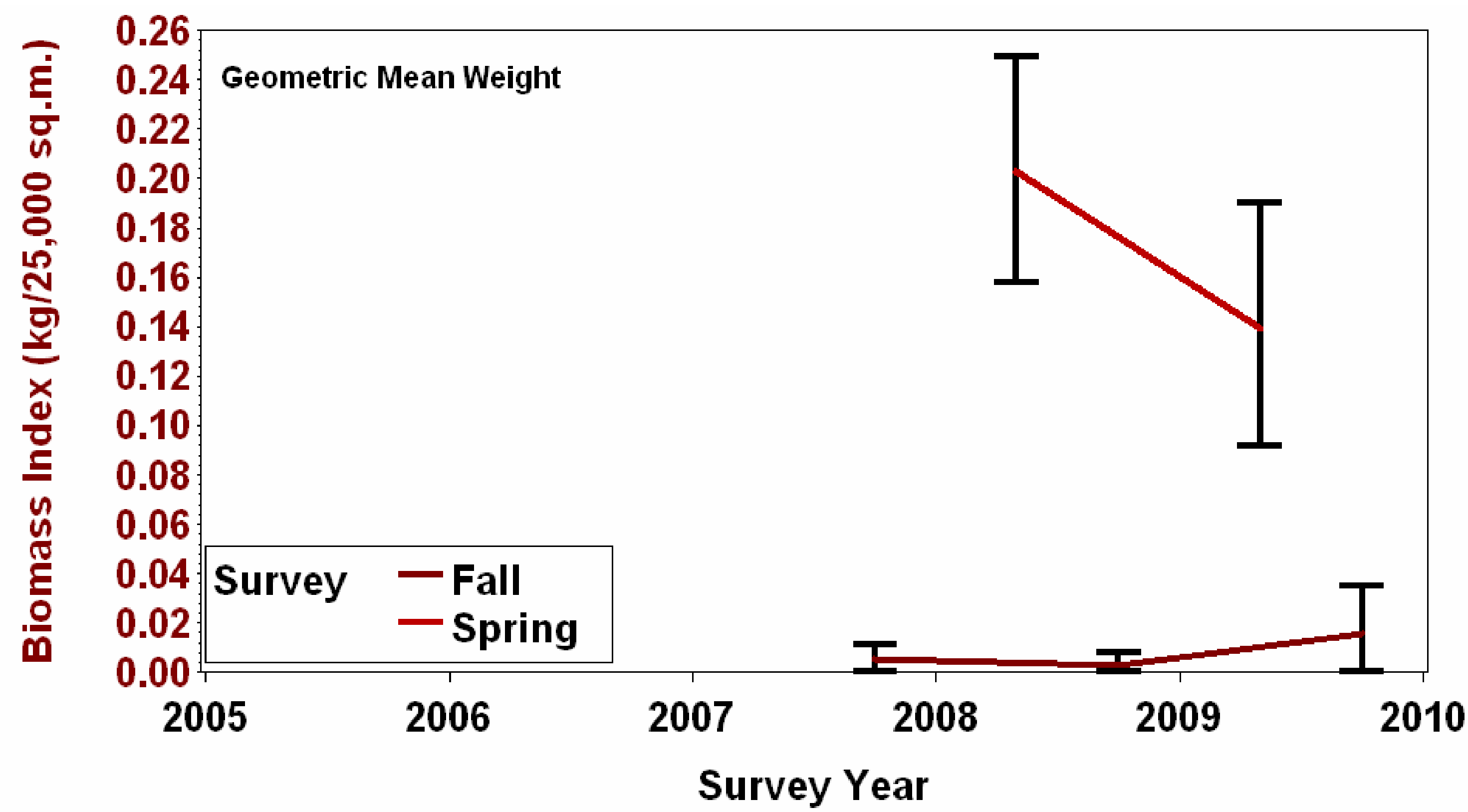


Figure 15. Length-frequency distributions, by cruise, for American shad. Numbers taken for full processing, by length, are represented by the orange bars.

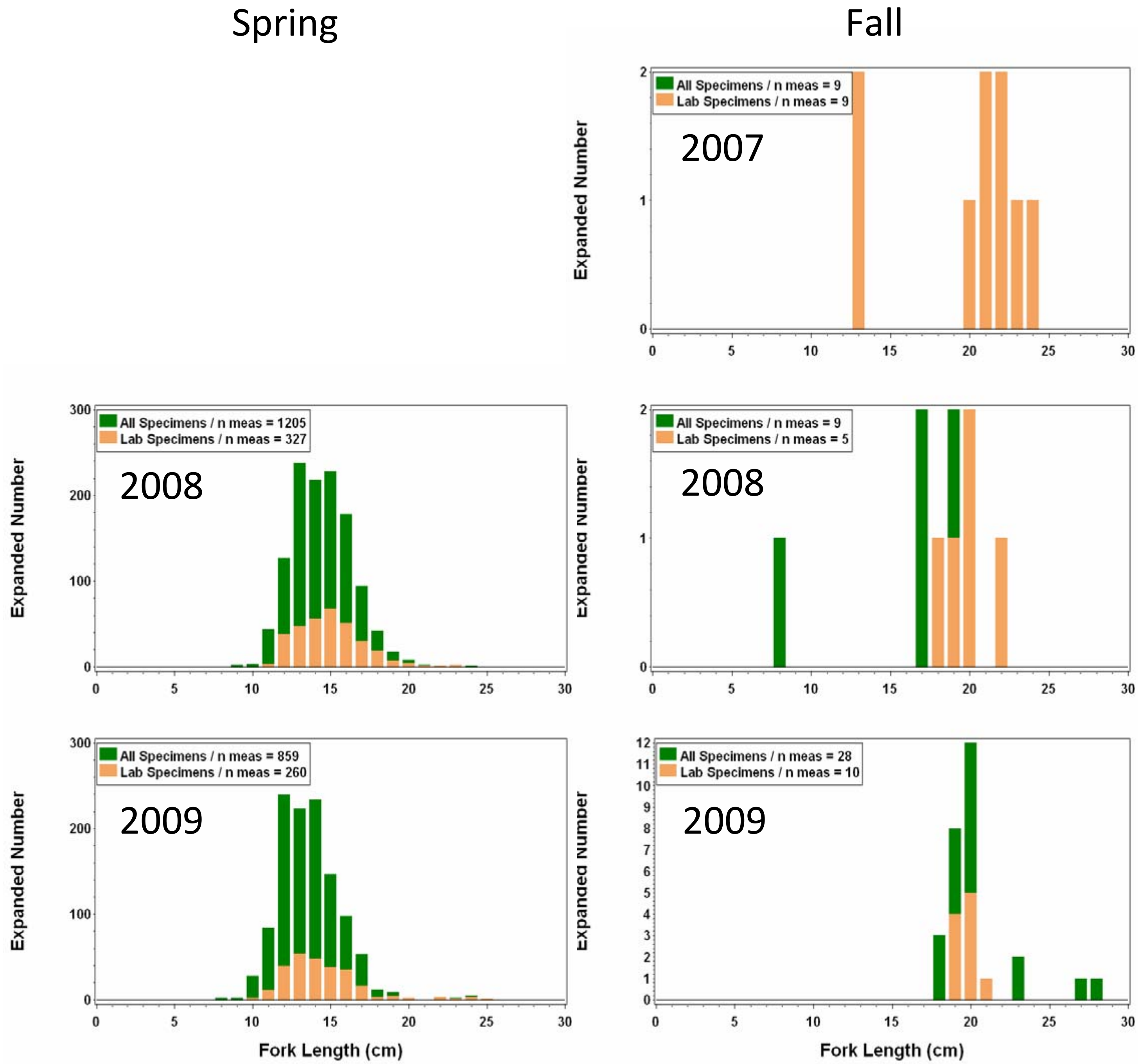
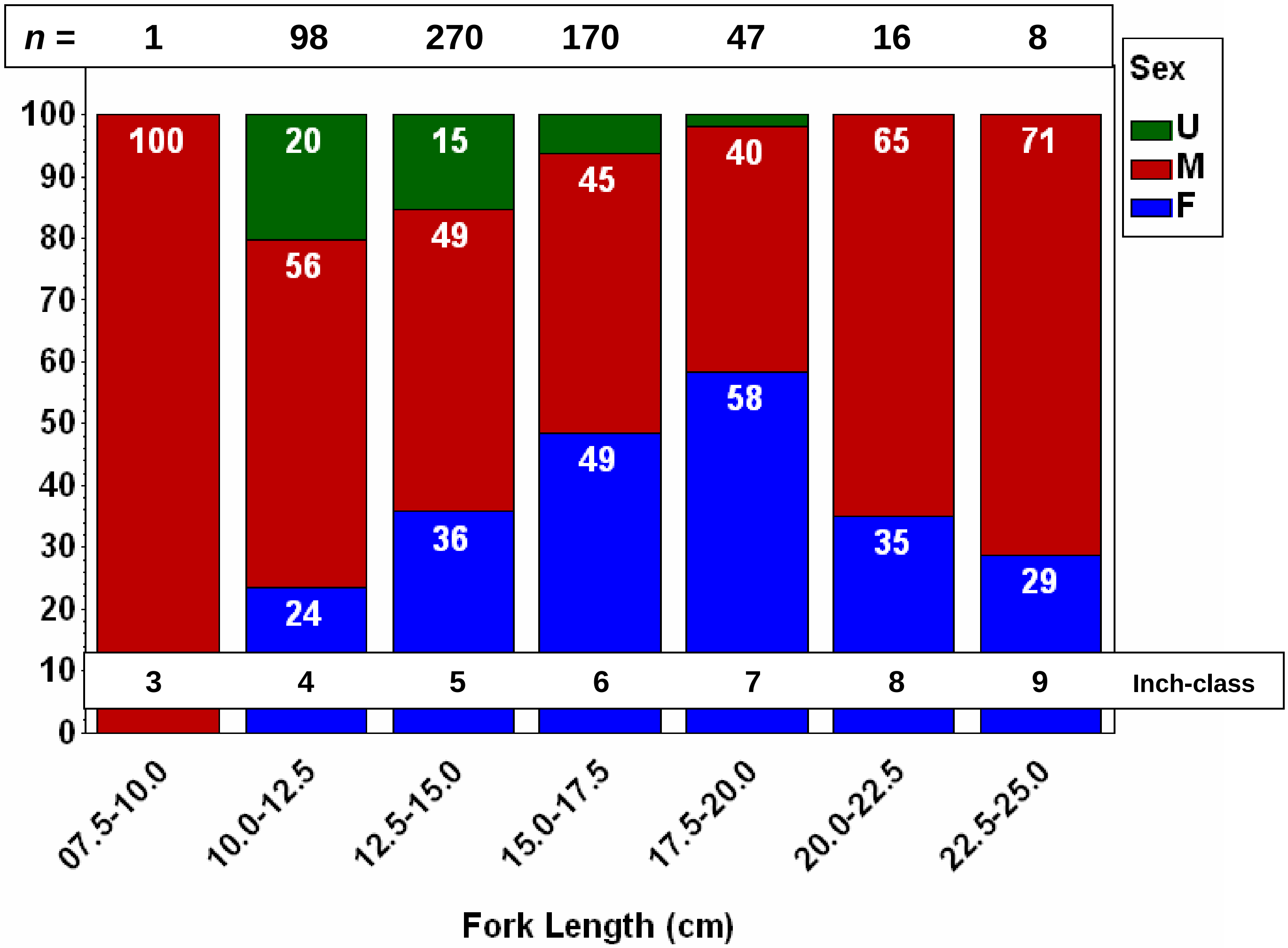


Figure 16. Sex ratio, by length group, for American shad collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



Atlantic Croaker (Priority A)

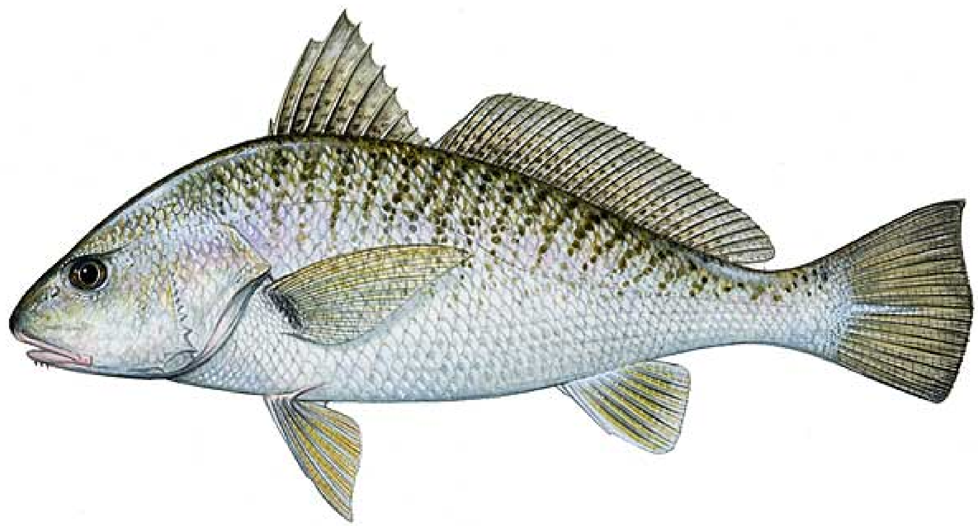


Table 9. Sampling rates and abundance indices of Atlantic croaker for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	58,763	7,616.5	2,843	211	211	194	188	7.10	8.1	3.09	9.1
2008	Spring	467	25.0	212	41	41	38	37	0.28	26.2	0.07	38
	Fall	66,823	5,123.2	3,591	307	307	283	278	4.96	10.9	1.71	13.6
2009	Spring	17,040	1,004.3	1,225	80	0	66	60	0.56	21.5	0.23	28.6
	Fall	45,730	5,685.3	5,277	415	0	335		10.15	7.5	3.46	9.1

Figure 17. Biomass (kg) of Atlantic croaker collected at each sampling site for each 2009 NEAMAP cruise.

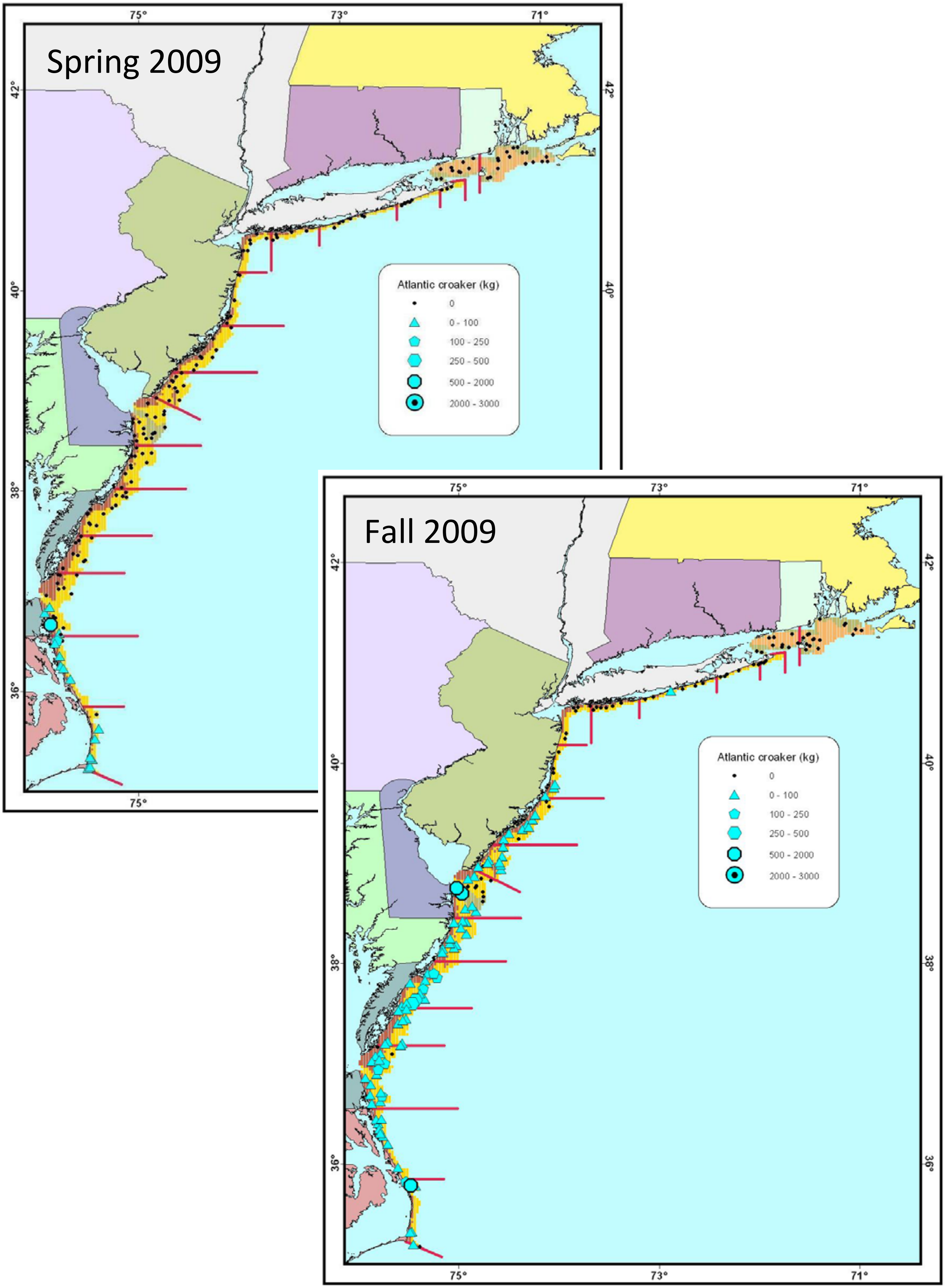
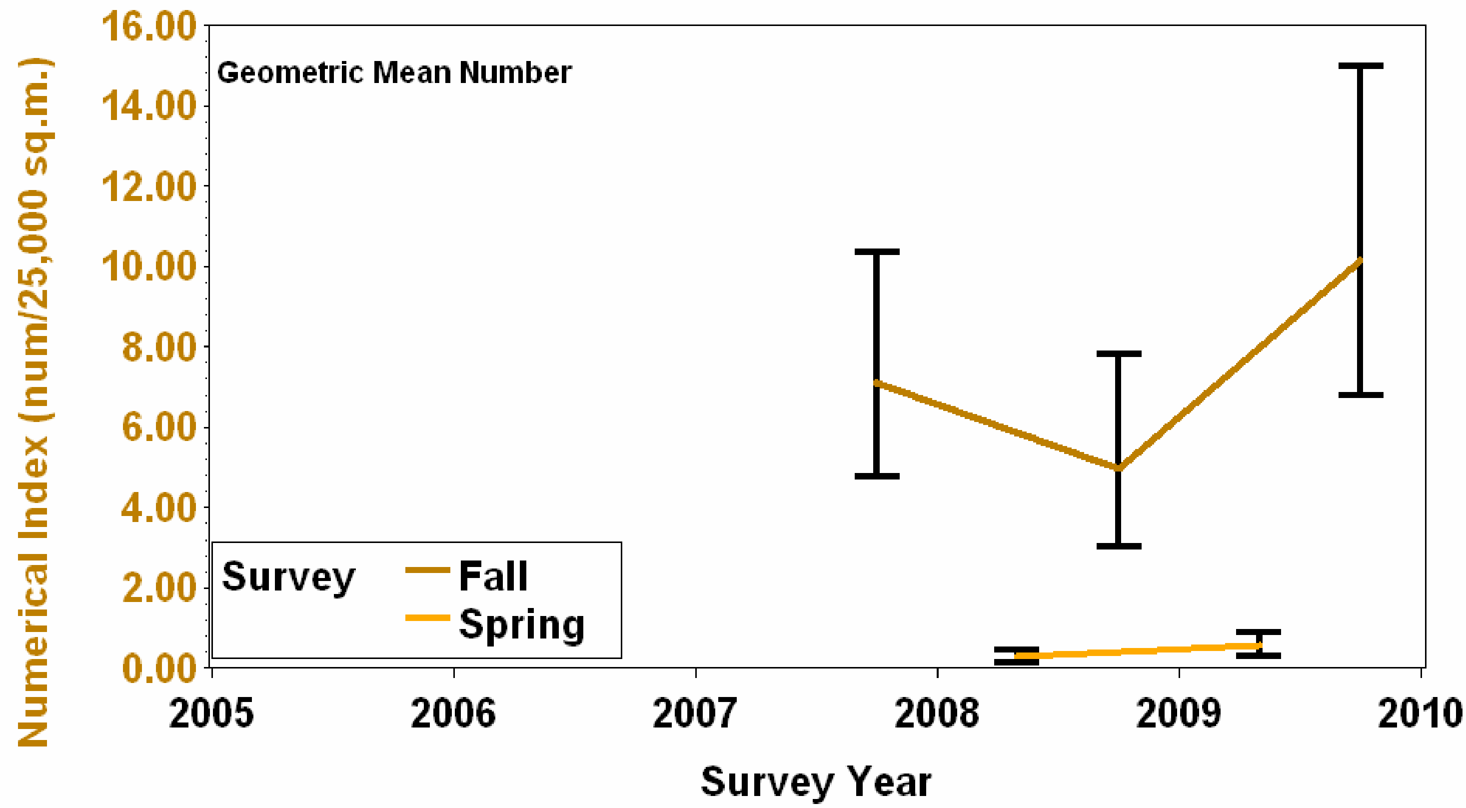


Figure 18. Preliminary indices of abundance, in terms of number and biomass, of Atlantic croaker for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



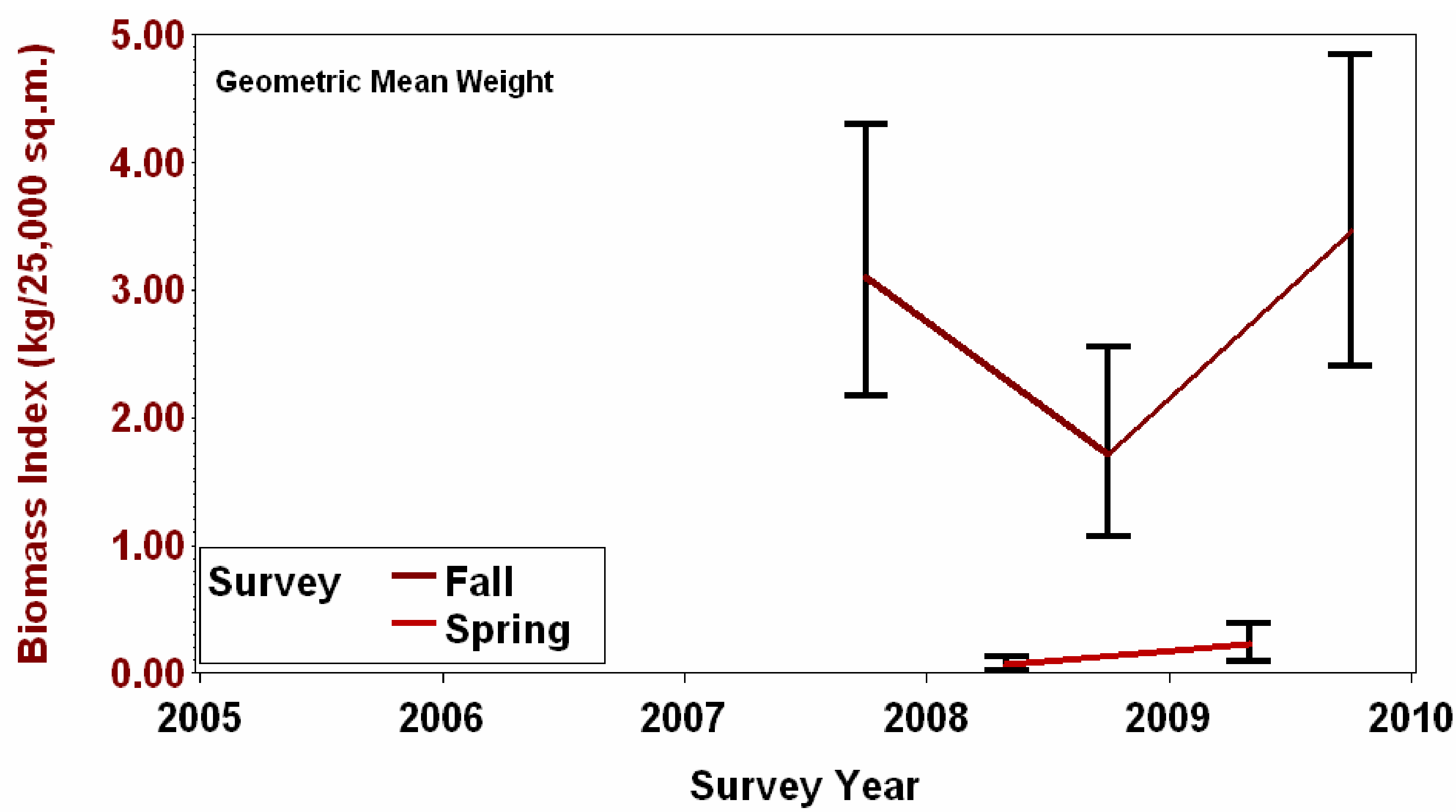


Figure 19. Length-frequency distributions, by cruise, for Atlantic croaker. Numbers taken for full processing, by length, are represented by the orange bars (difficult to see due to scale of y-axis).

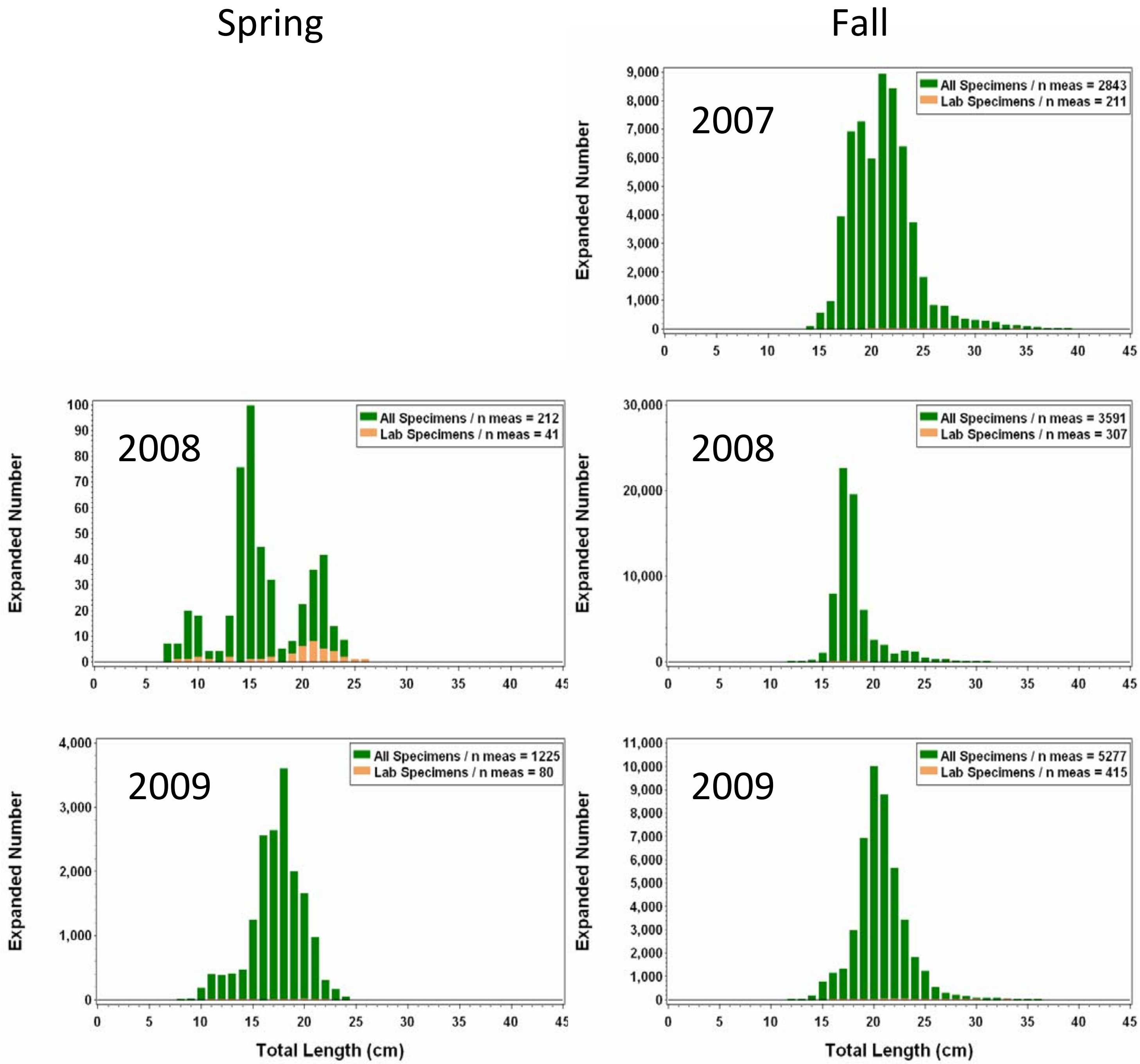


Figure 20. Sex ratio, by length group, for Atlantic croaker collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

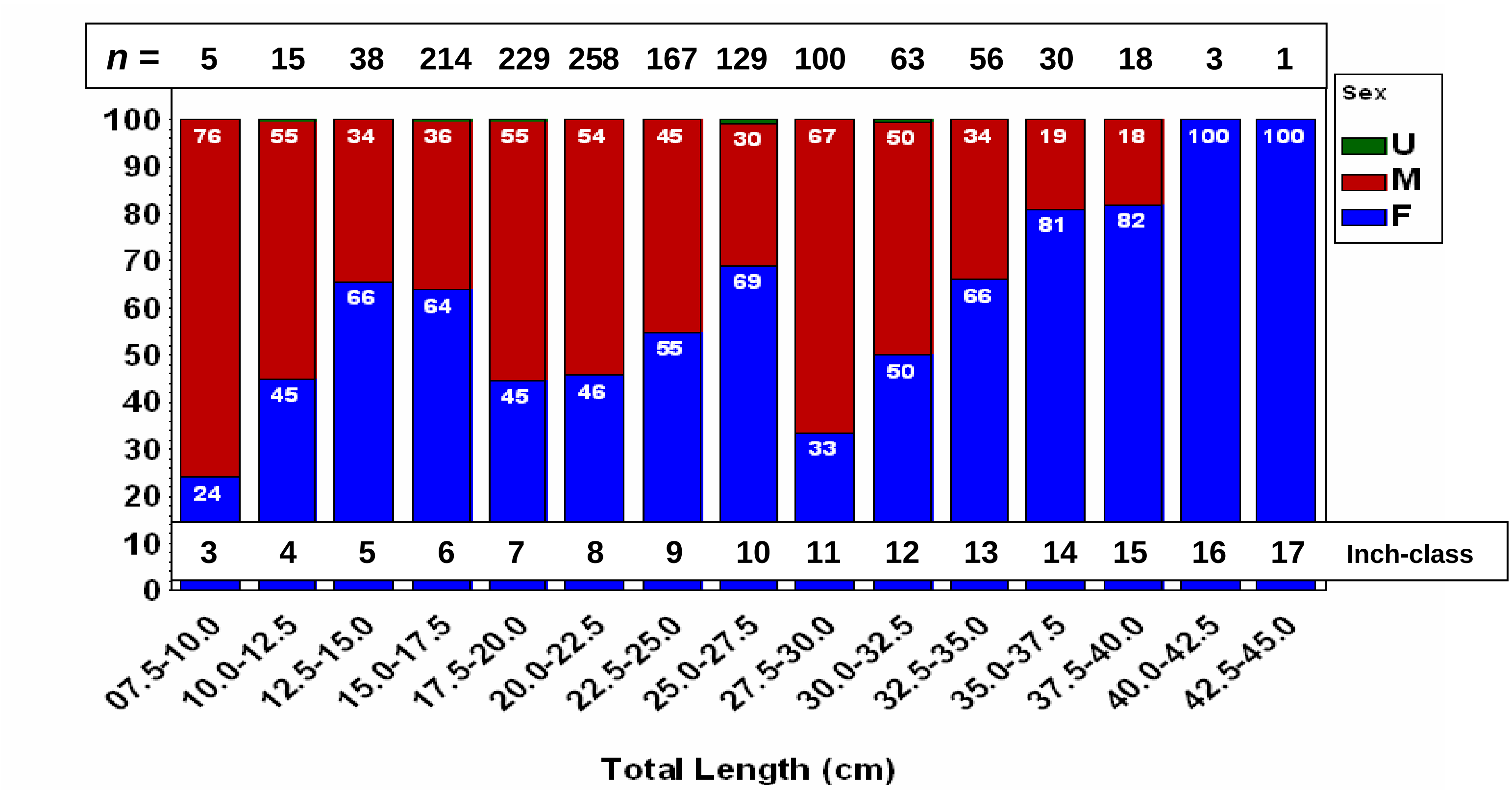


Figure 21. Diet composition, expressed using the percent weight index, of Atlantic croaker collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of croaker sampled.

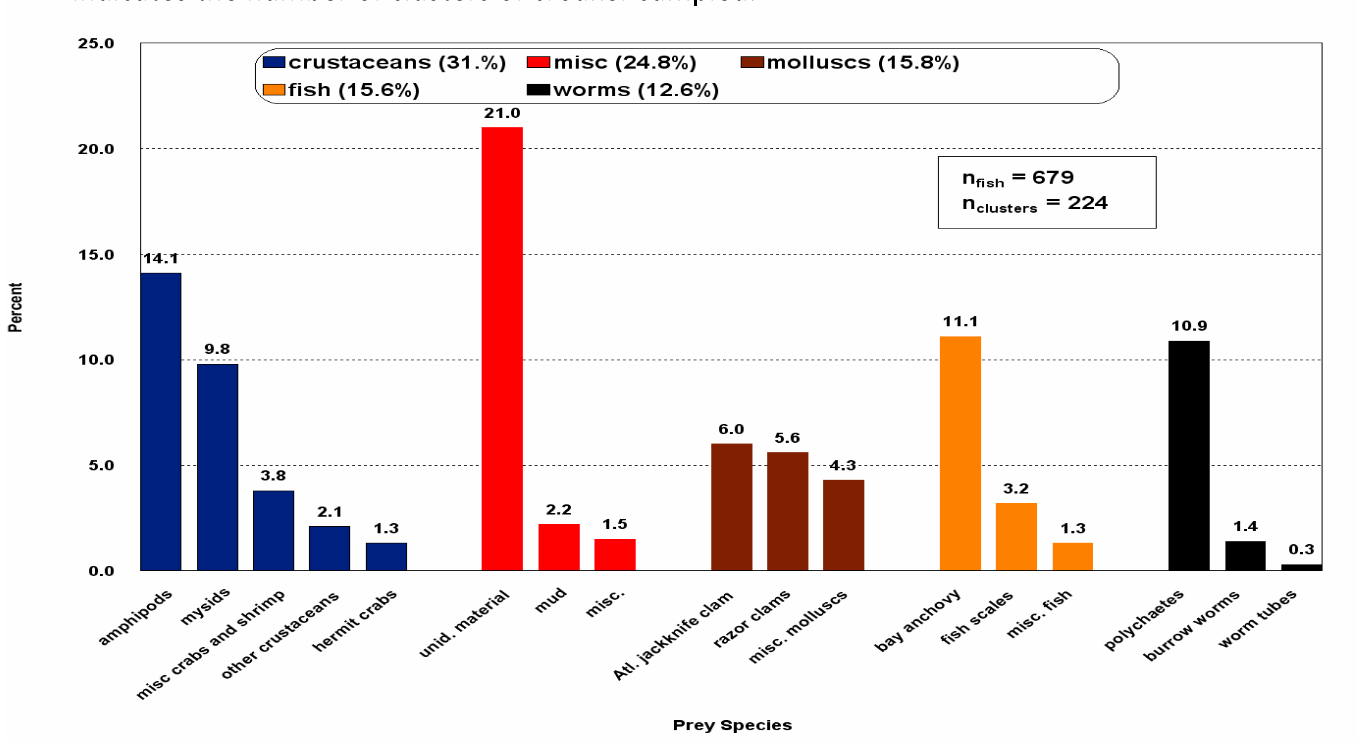
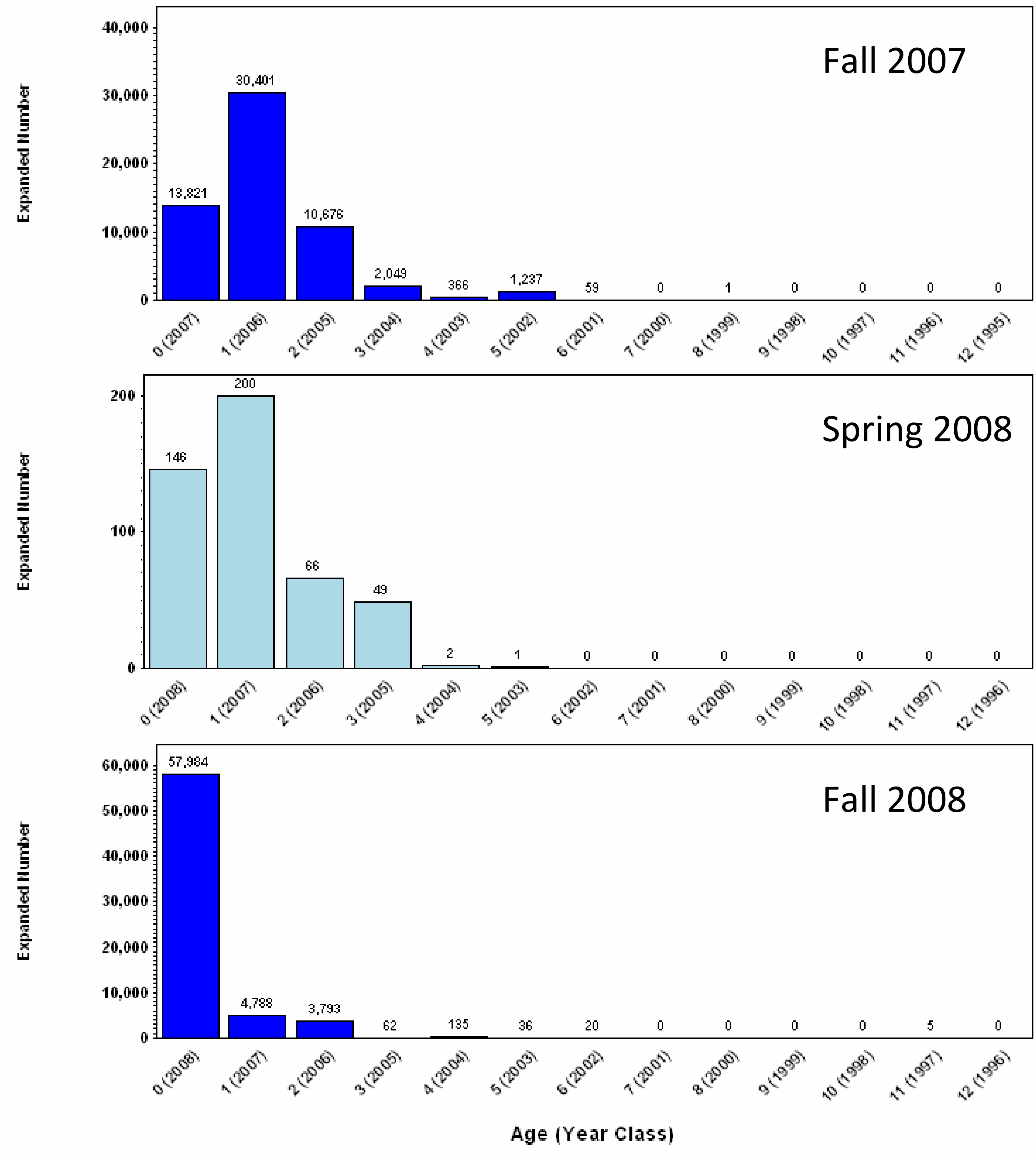


Figure 22. Age-frequency distribution, by cruise, for Atlantic croaker. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.



Atlantic Menhaden (Priority A)

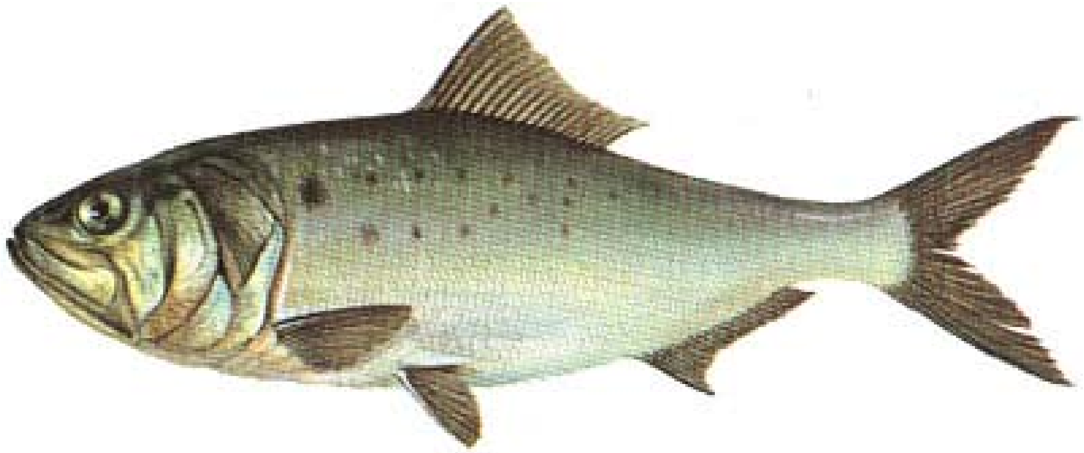


Table 10. Sampling rates and abundance indices of Atlantic menhaden for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	740	30.2	288	78	0	78	1	0.30	22	0.10	25
2008	Spring	32	2.0	32	10	0	10		0.05	58.4	0.01	66.2
	Fall	208	25.0	208	68	0	68		0.21	18.6	0.08	24.1
2009	Spring	24,566	786.0	2,146	78	0	78		0.66	20.8	0.25	26.4
	Fall	146	11.9	146	59	0	58		0.19	23.7	0.05	28

Figure 23. Biomass (kg) of Atlantic menhaden collected at each sampling site for each 2009 NEAMAP cruise.

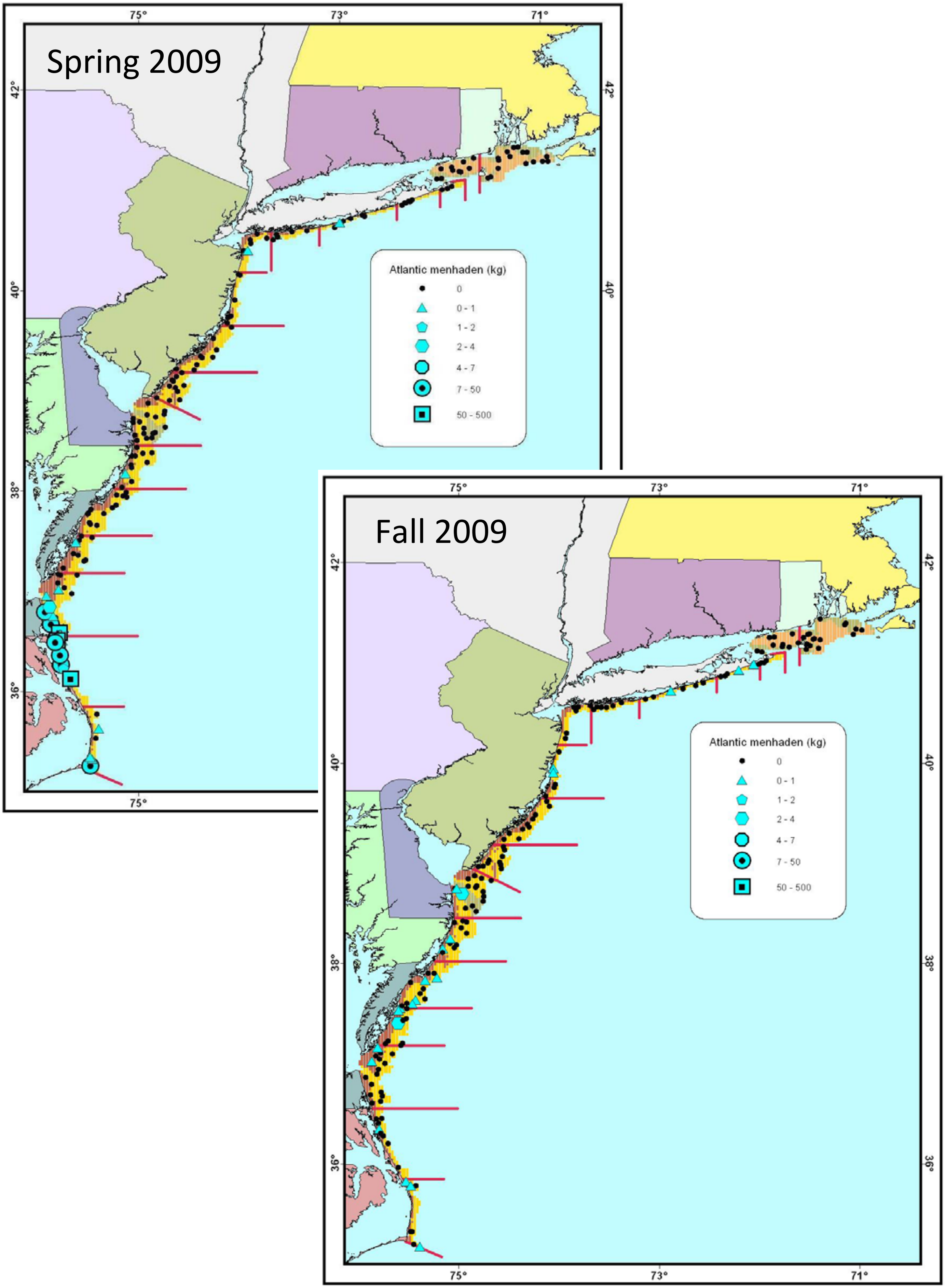
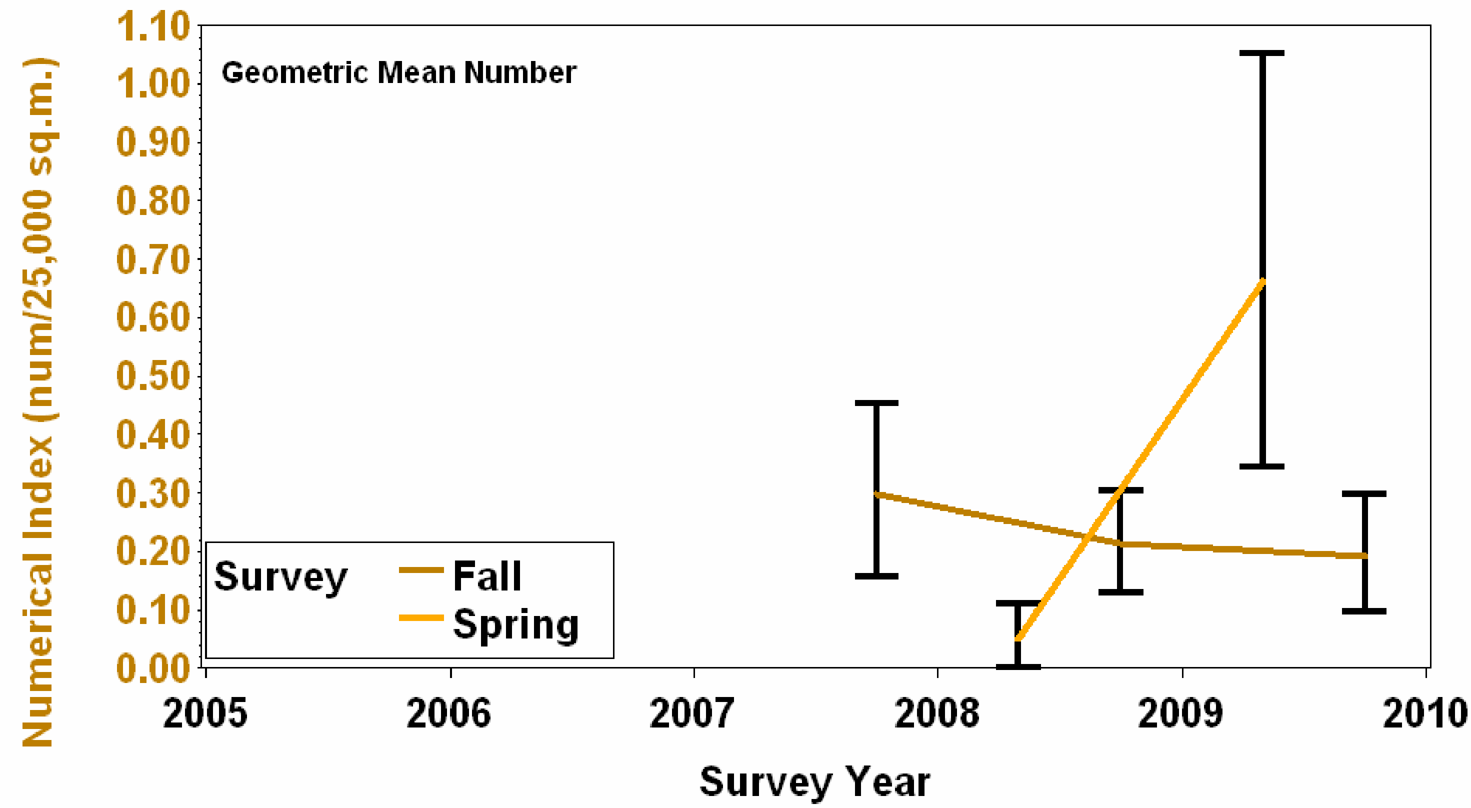


Figure 24. Preliminary indices of abundance, in terms of number and biomass, of Atlantic menhaden for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



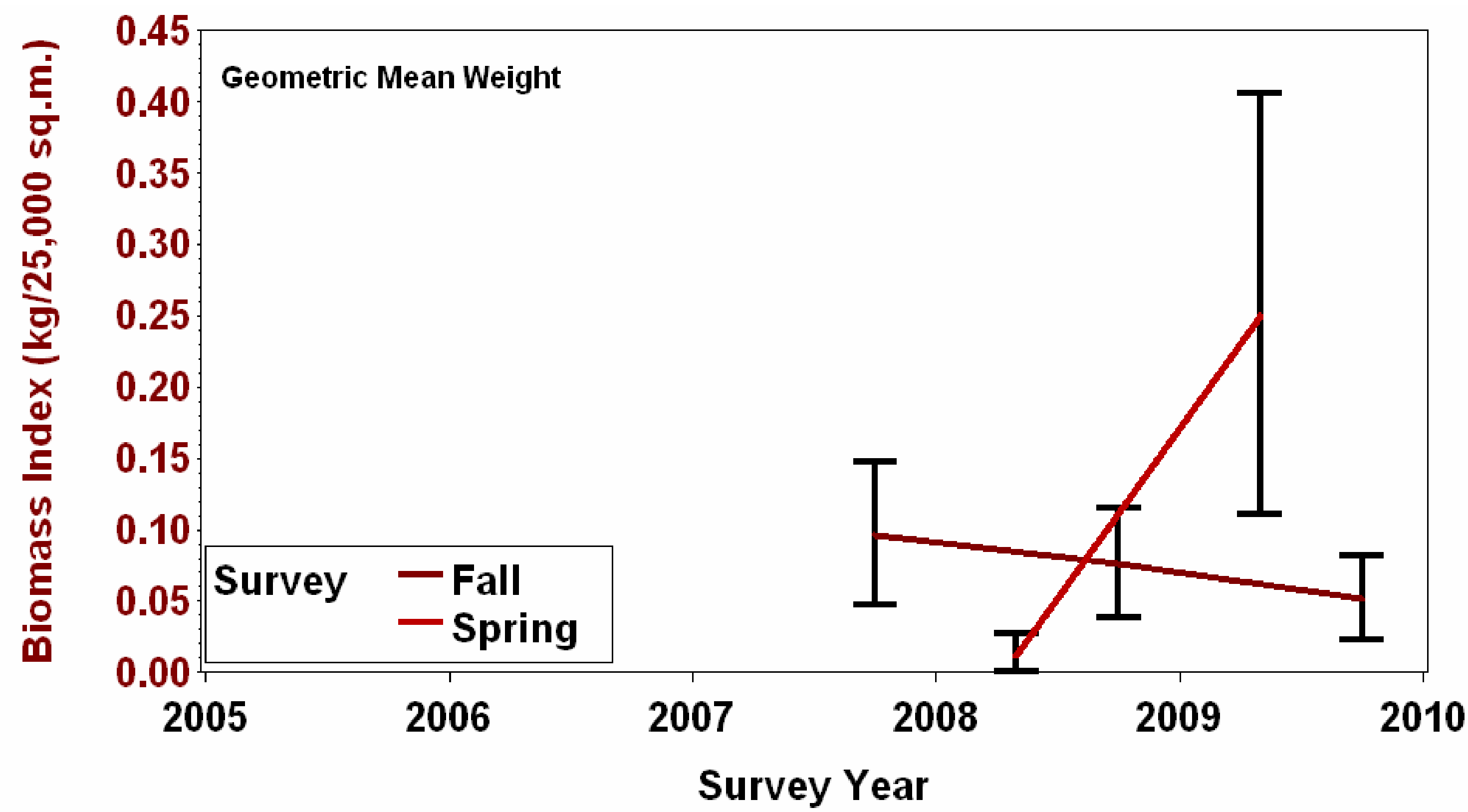


Figure 25. Length-frequency distributions, by cruise, for Atlantic menhaden. Numbers taken for full processing, by length, are represented by the orange bars (difficult to see in some cases due to the scale of the y-axis).

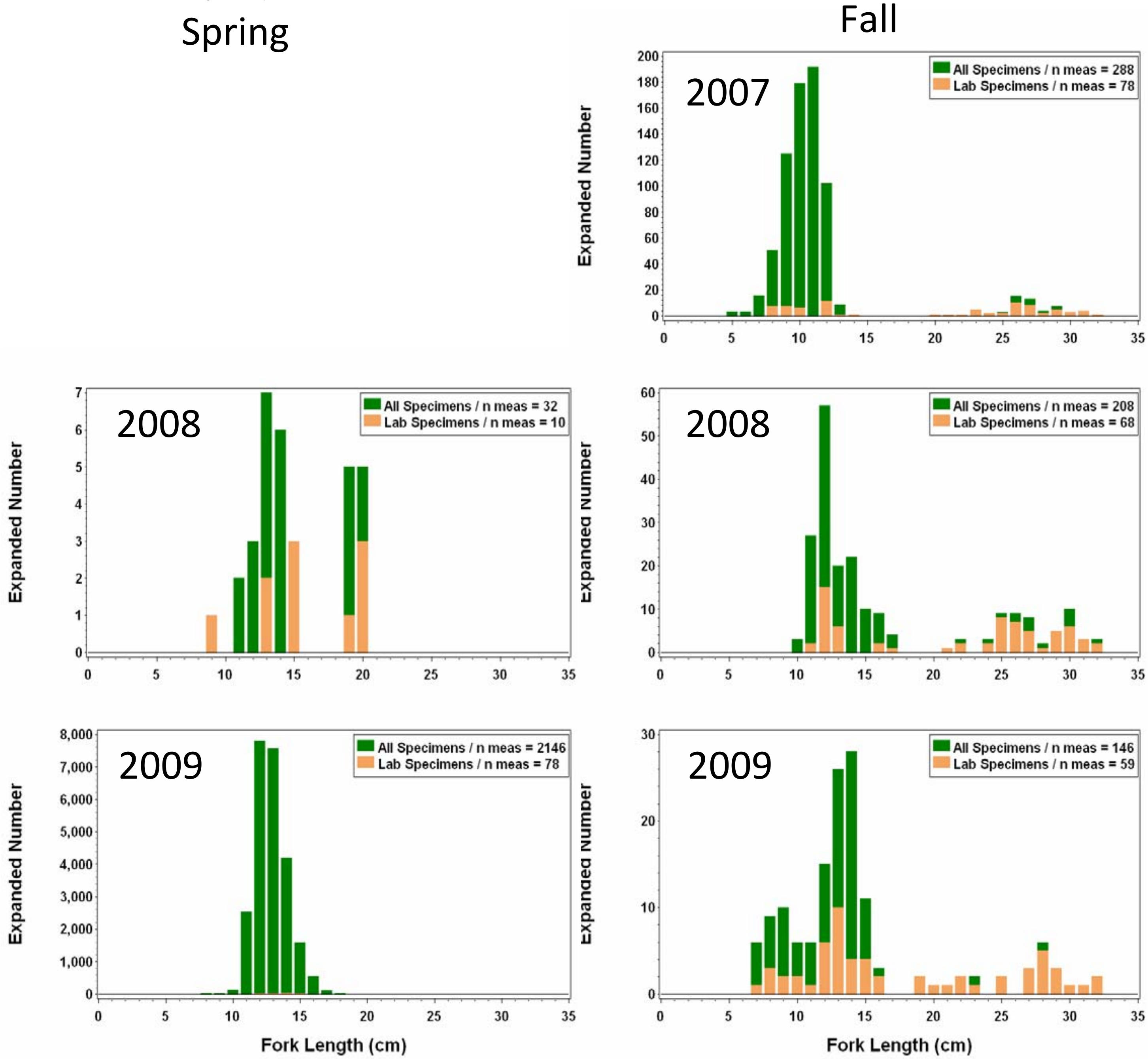
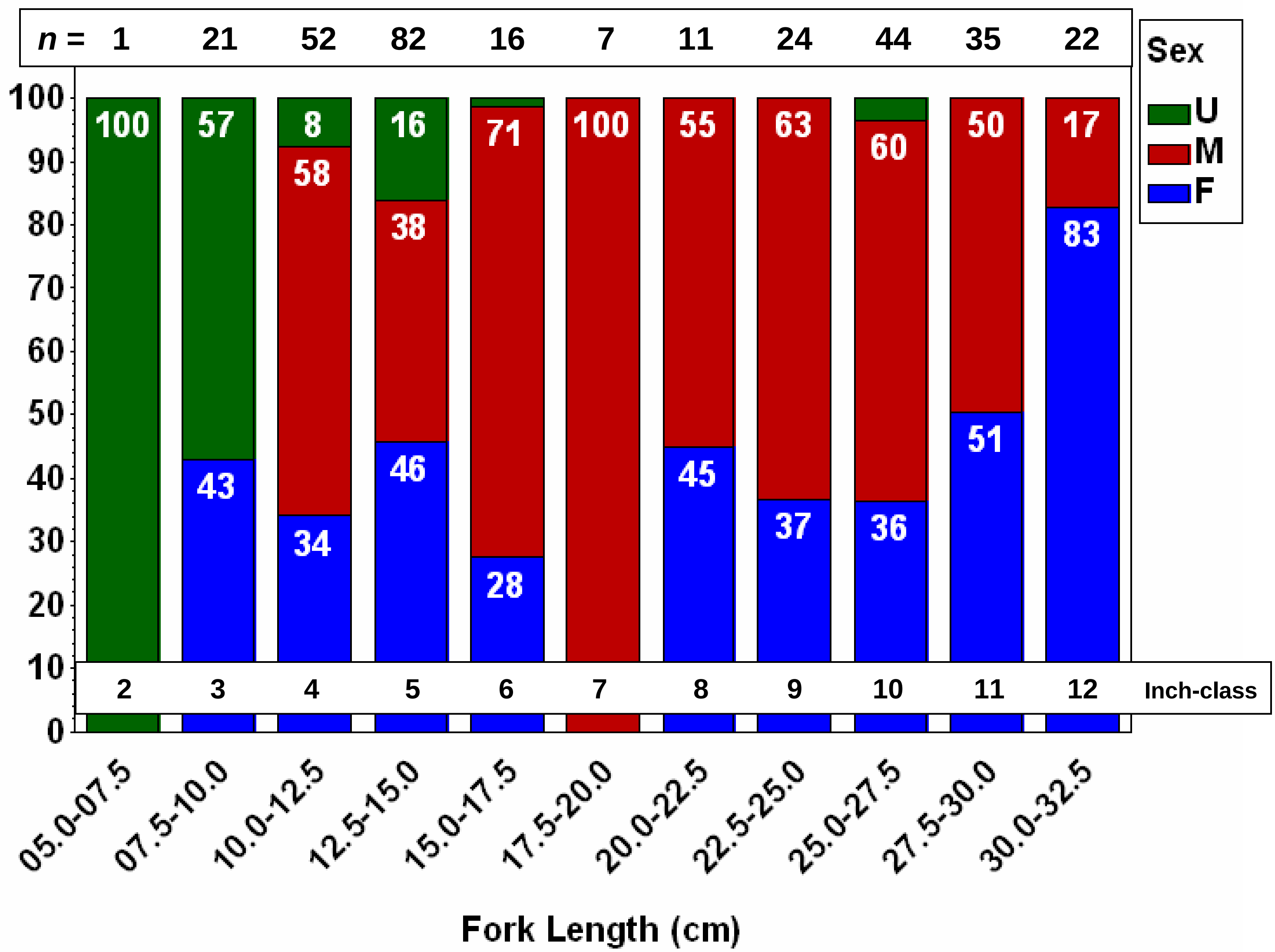


Figure 26. Sex ratio, by length group, for Atlantic menhaden collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



Bay Anchovy (Priority D)

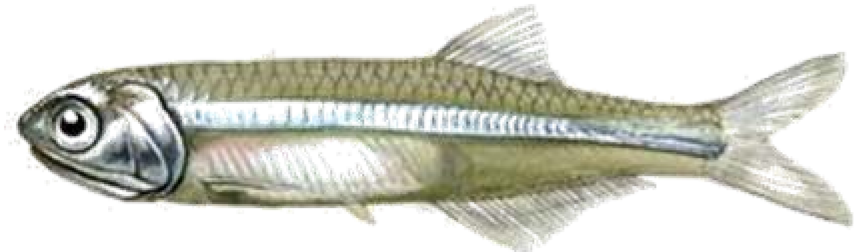


Table 11. Sampling rates and abundance indices of bay anchovy for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	119,741	203.4	3,961					8.74	8.2	0.50	11.4
2008	Spring	23,926	75.8	3,838					7.02	7.3	0.27	13.3
	Fall	35,358	72.6	2,299					5.04	10.8	0.23	16
2009	Spring	62,807	145.9	7,112					12.03	8.1	0.40	10.8
	Fall	50,033	194.3	4,647					8.37	7.7	0.42	12.1

Figure 27. Biomass (kg) of bay anchovy collected at each sampling site for each 2009 NEAMAP cruise.

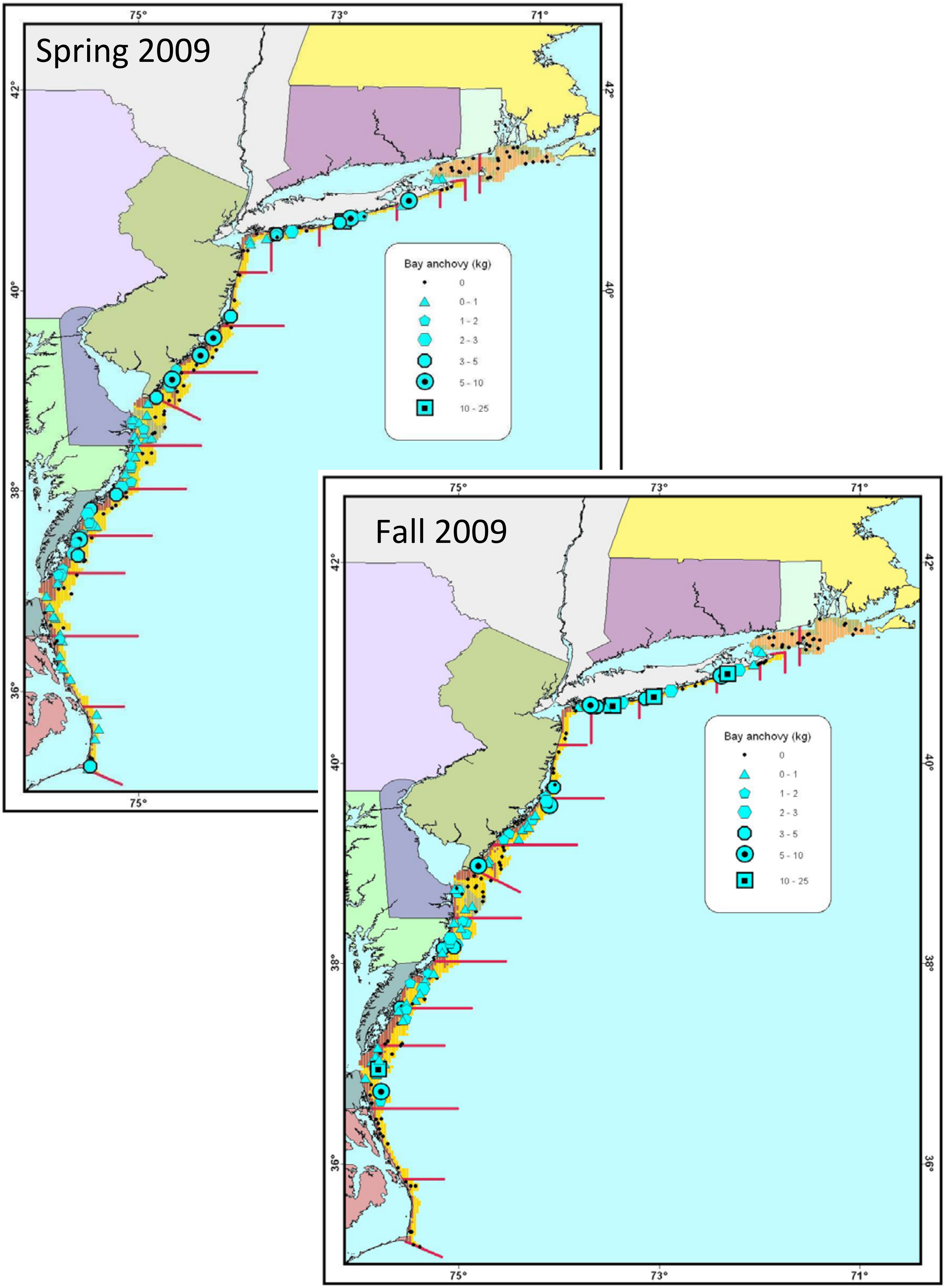
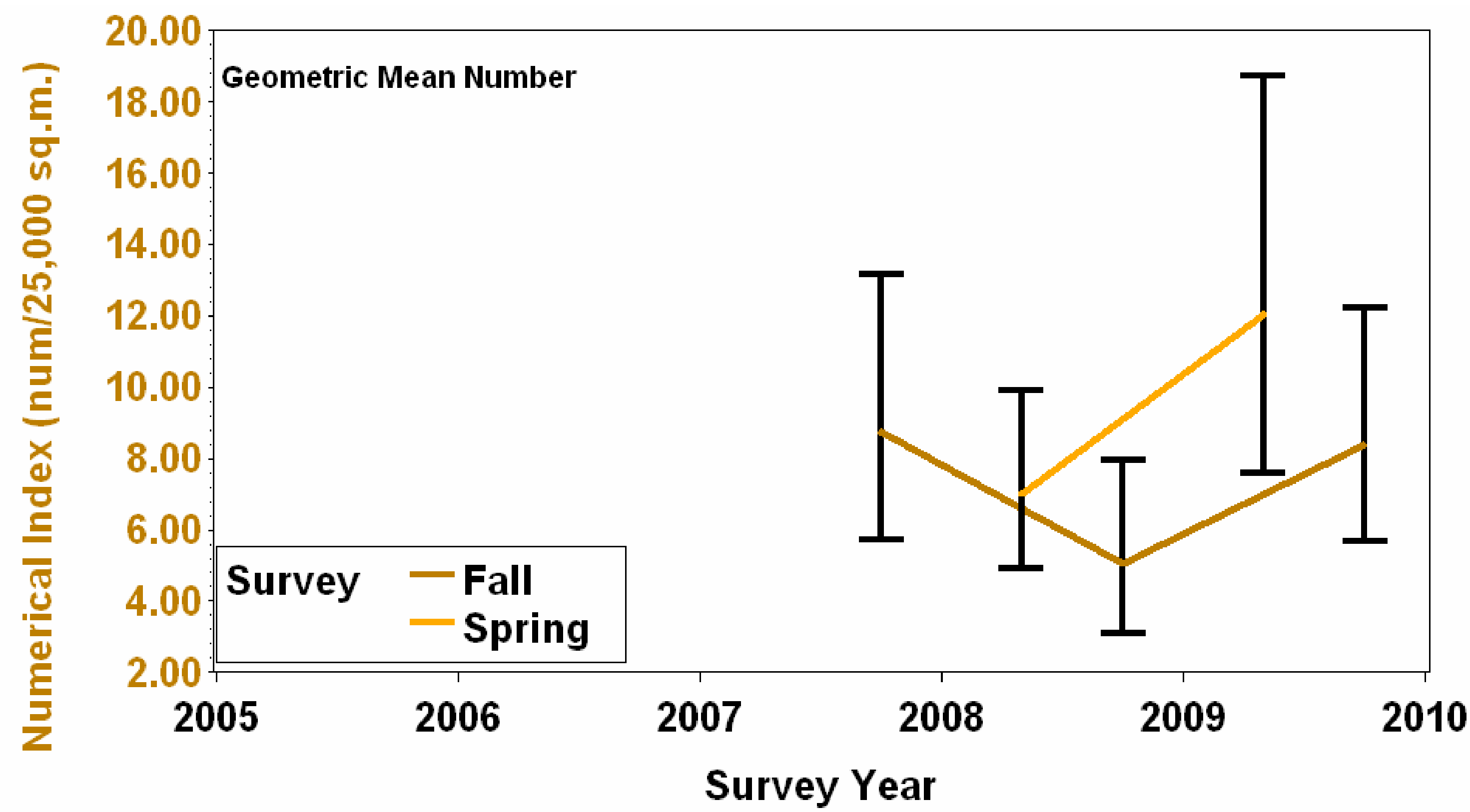


Figure 28. Preliminary indices of abundance, in terms of number and biomass, of bay anchovy for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



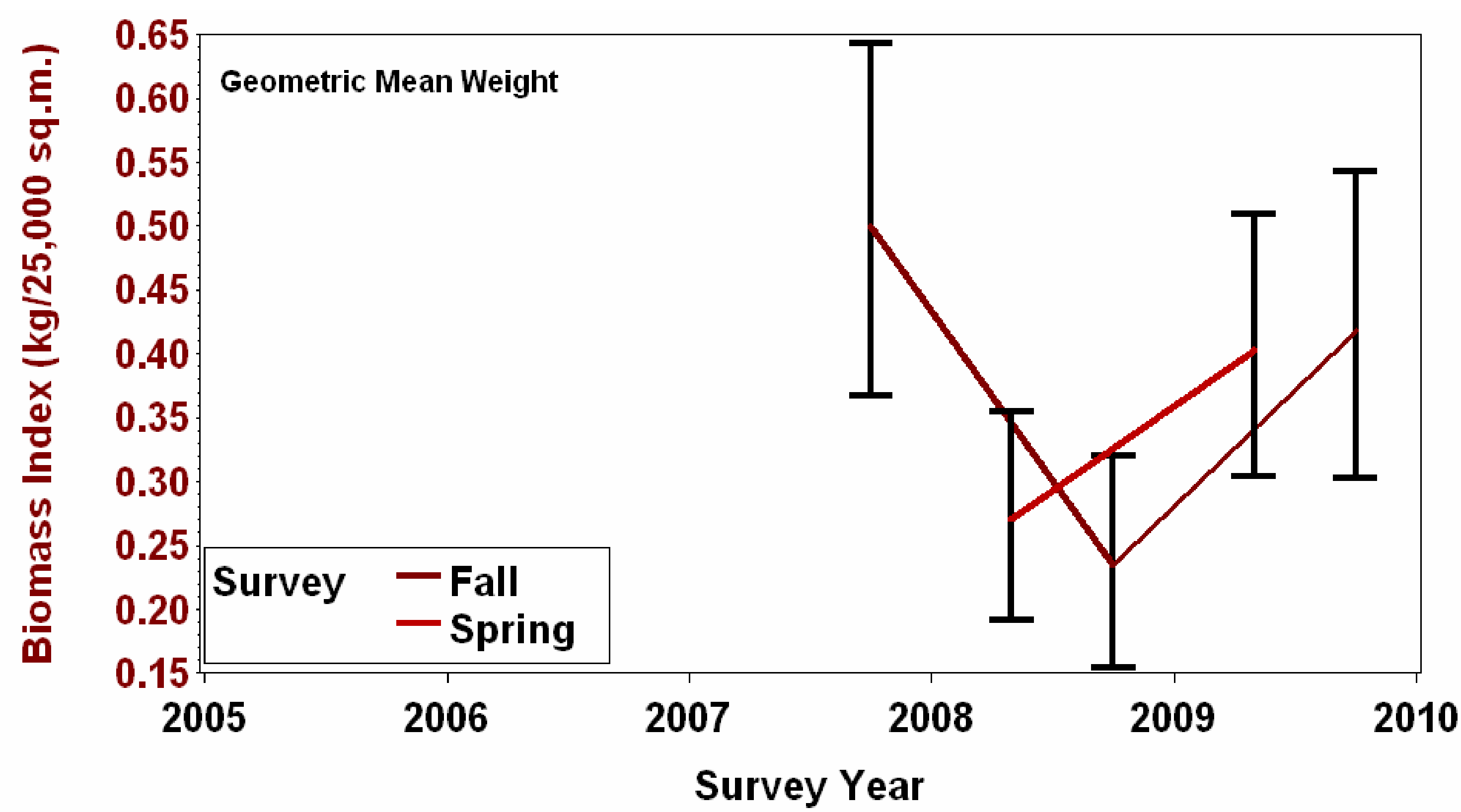
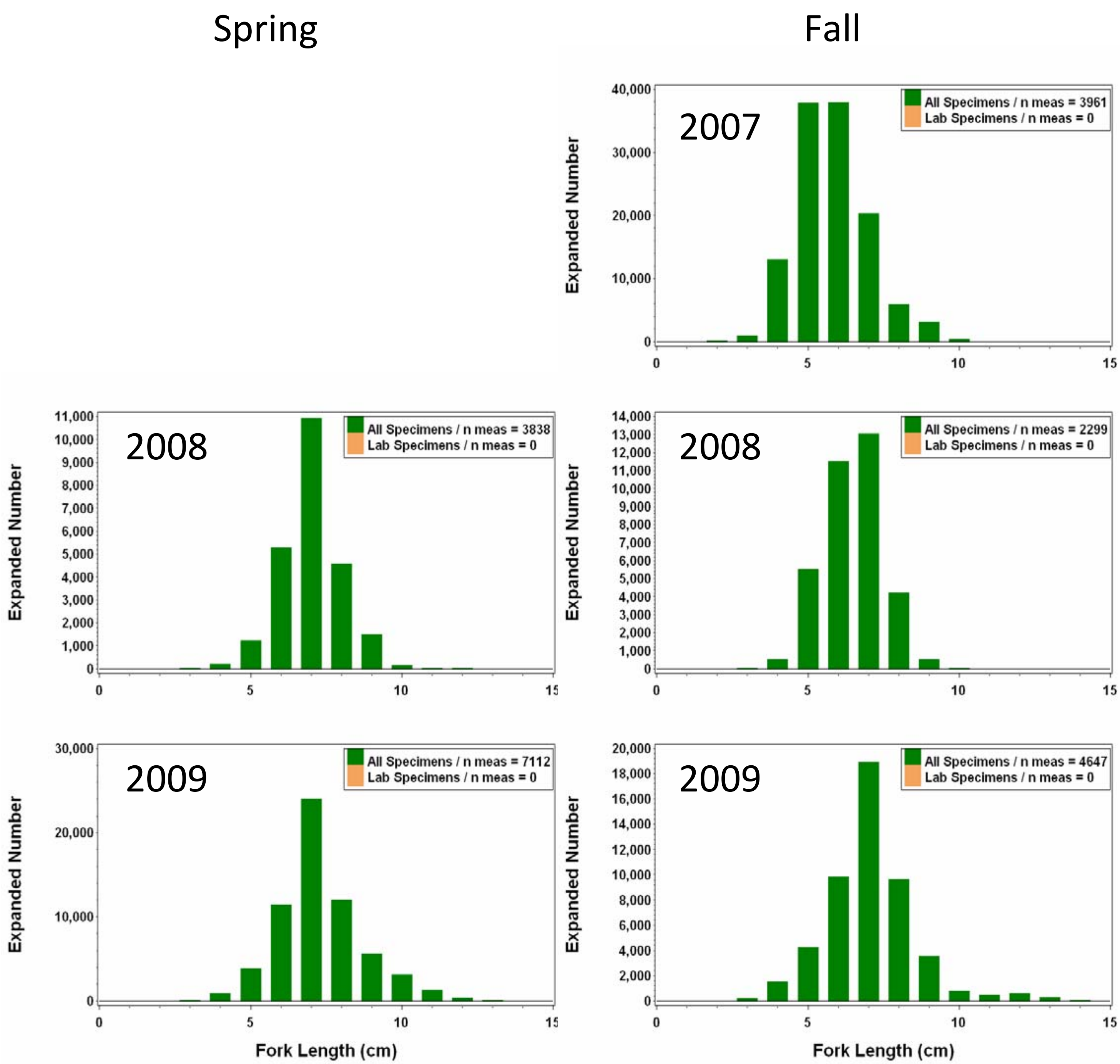


Figure 29. Length-frequency distributions, by cruise, for bay anchovy.



Black Sea Bass (Priority A)

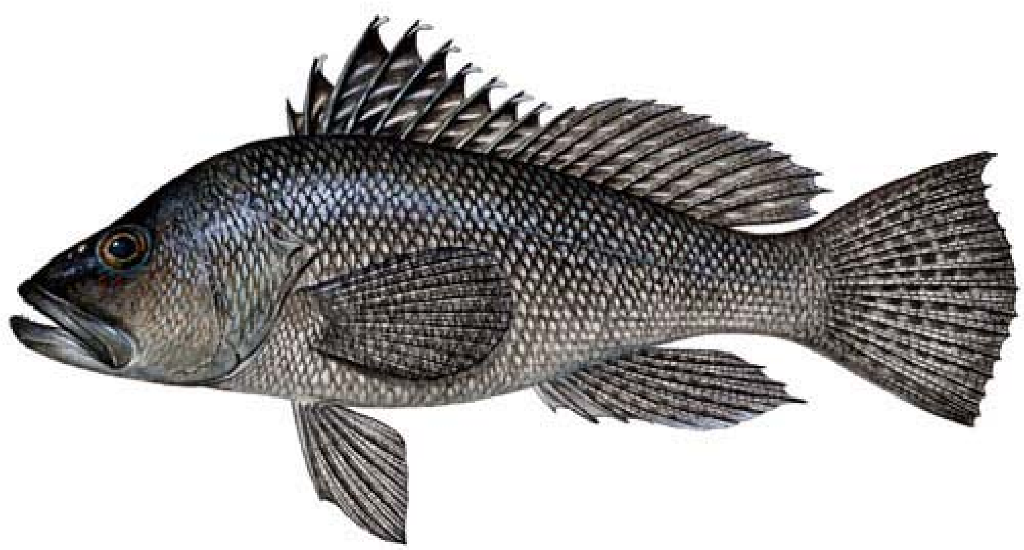


Table 12. Sampling rates and abundance indices of black sea bass for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	401	85.3	401	219	219	211	211	0.84	11.5	0.27	16.7
2008	Spring	166	83.9	166	140	0	119	115	0.51	10	0.26	12.1
	Fall	174	75.2	174	115	0	114	114	0.46	13.8	0.15	24.9
2009	Spring	237	67.6	237	168	0	163	161	0.45	8.8	0.2	12.5
	Fall	470	94.5	375	148	0	138		0.65	14.7	0.25	19.6

Figure 30. Biomass (kg) of black sea bass collected at each sampling site for each 2009 NEAMAP cruise.

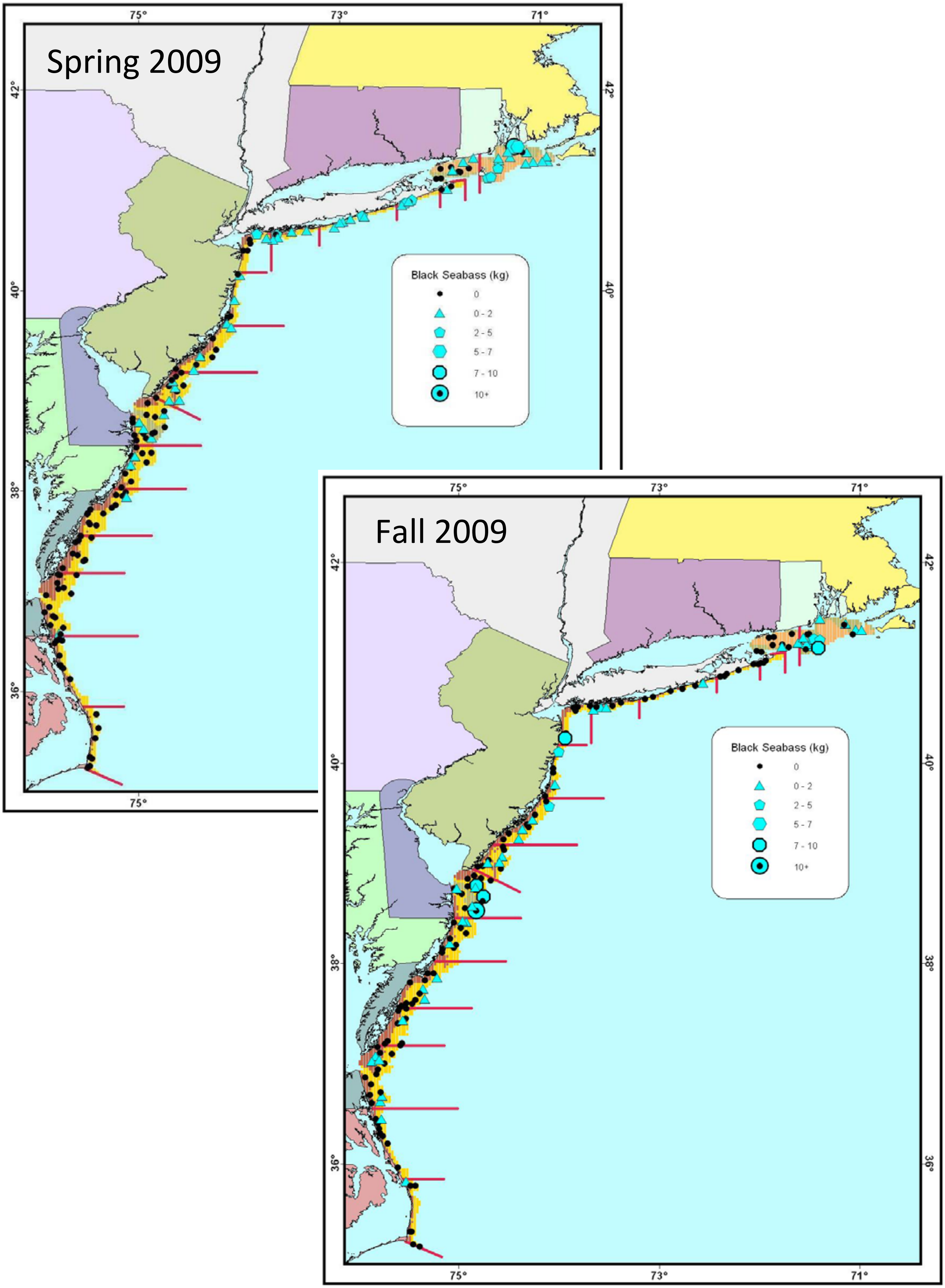


Figure 31. Preliminary indices of abundance, in terms of number and biomass, of black sea bass for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

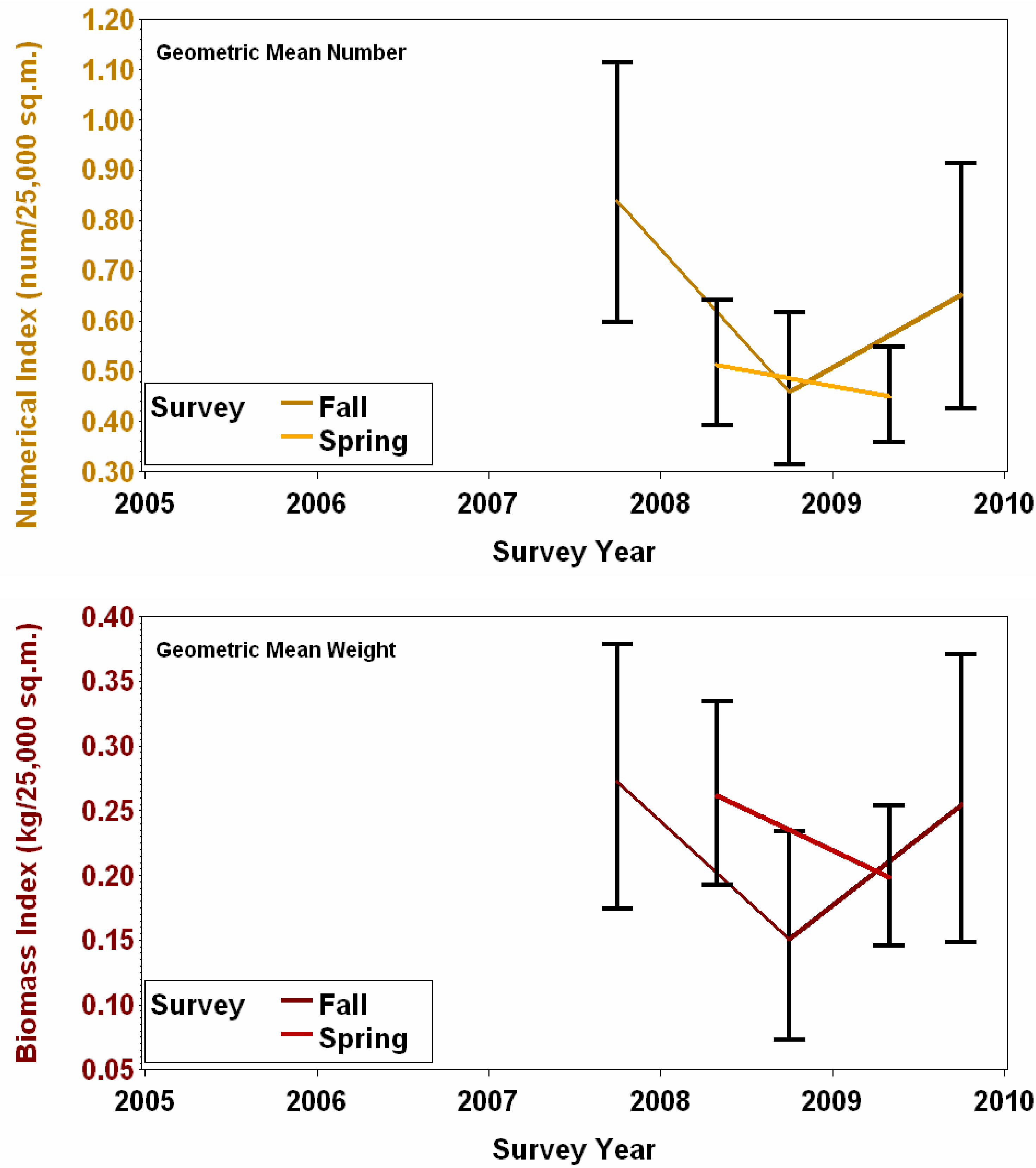


Figure 32. Length-frequency distributions, by cruise, for black sea bass. Numbers taken for full processing, by length, are represented by the orange bars.

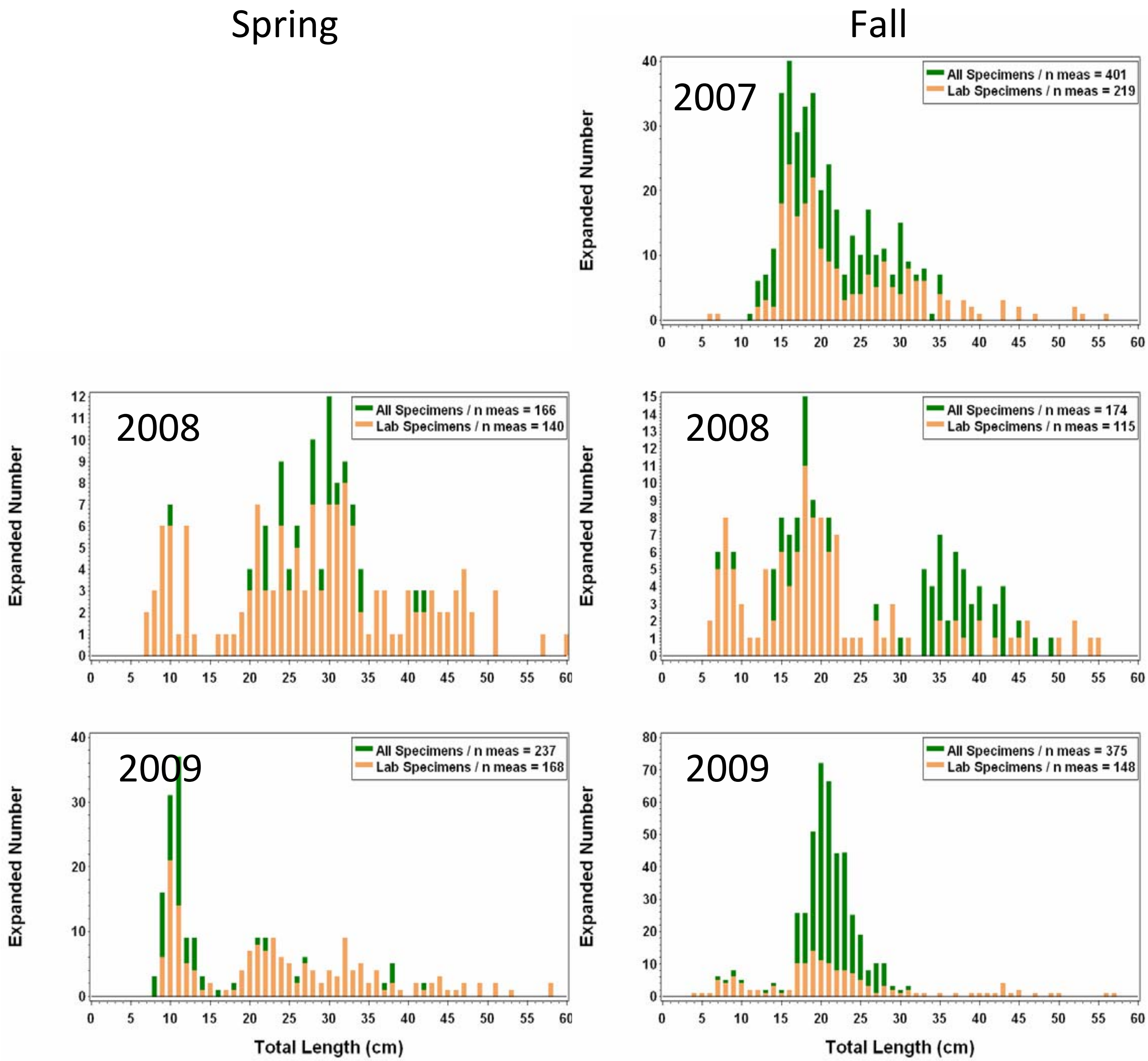


Figure 33. Sex ratio, by length group, for black sea bass collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

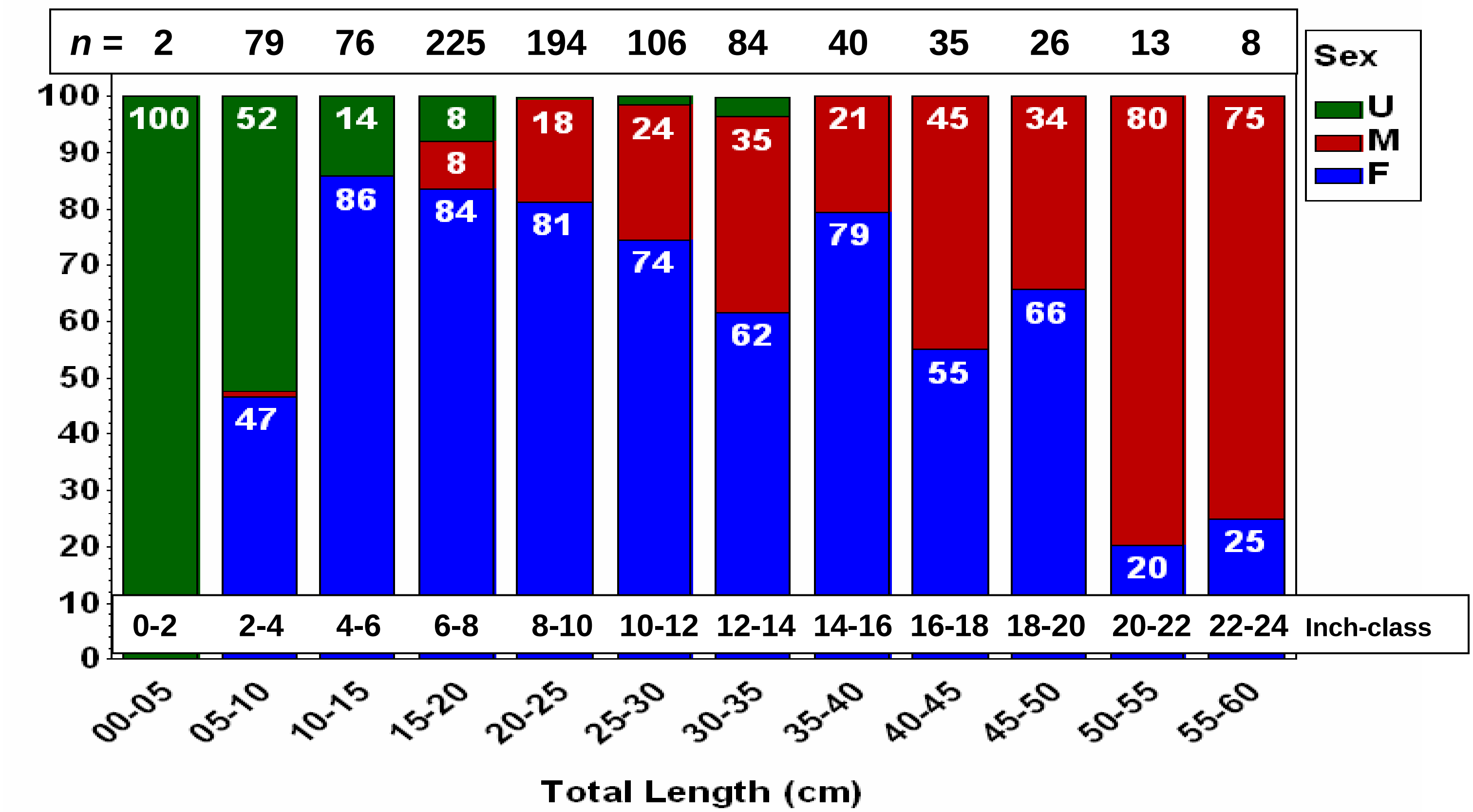


Figure 34. Diet composition, expressed using the percent weight index, of black sea bass collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of sea bass sampled.

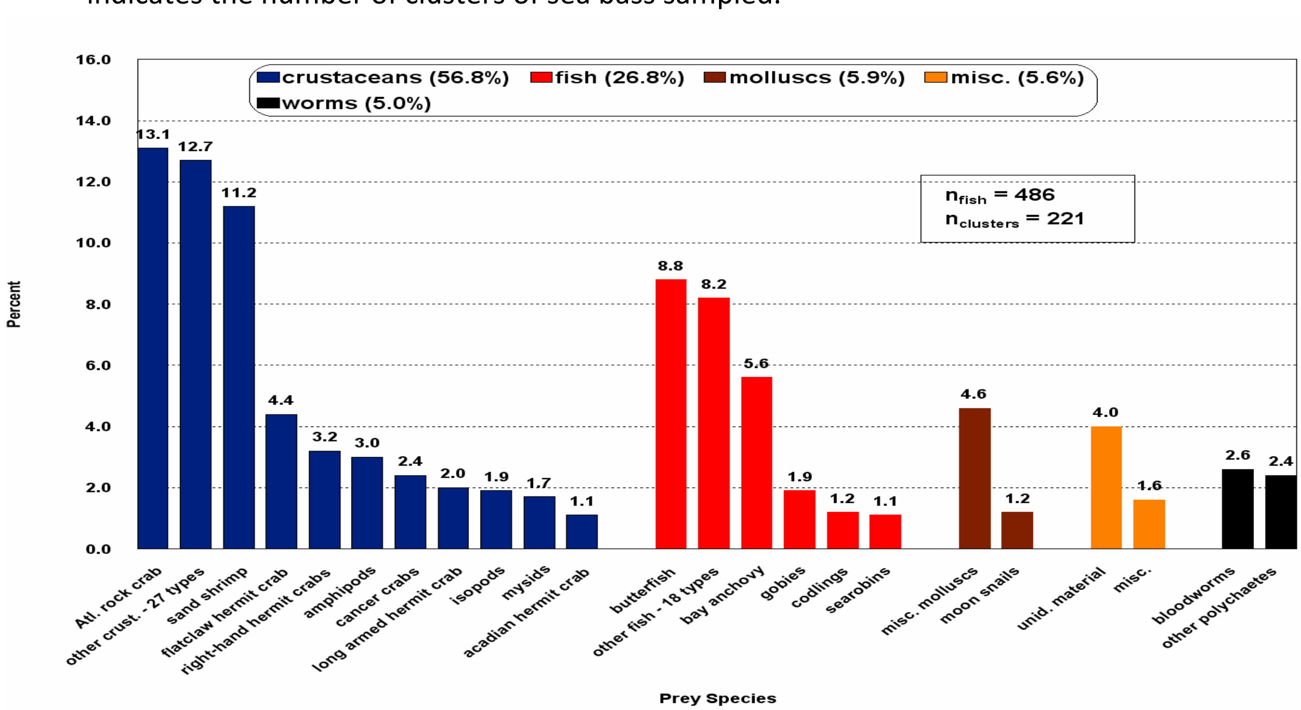
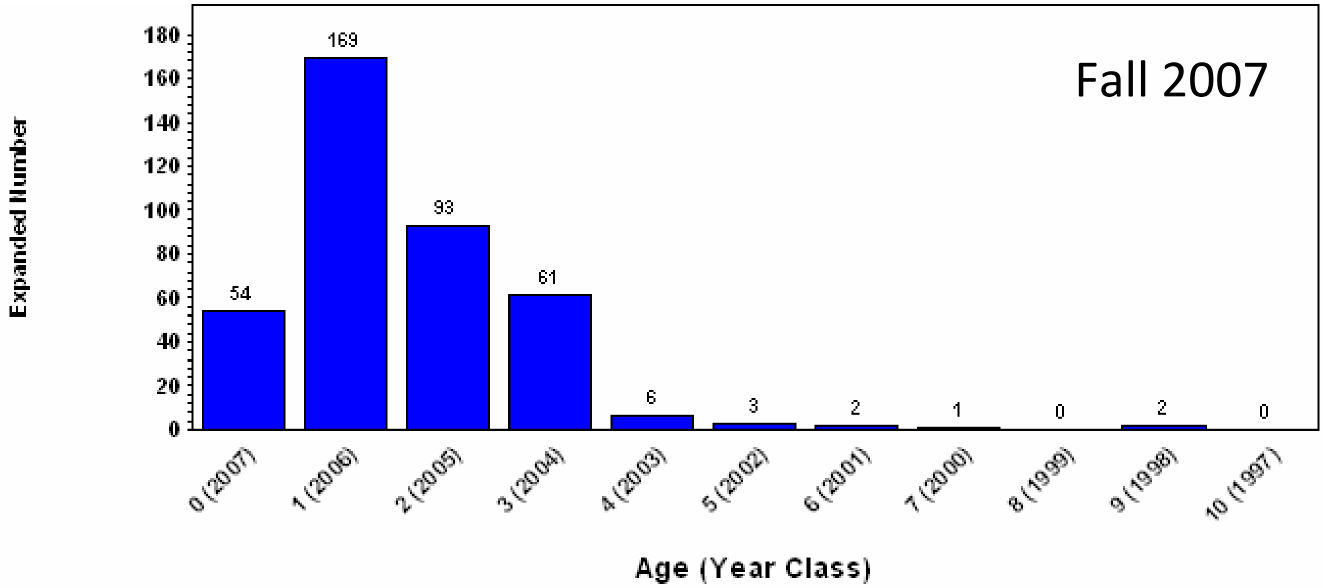


Figure 35. Age-frequency distribution for black sea bass collected during the fall 2007 cruise. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.



Blueback Herring (Priority A)

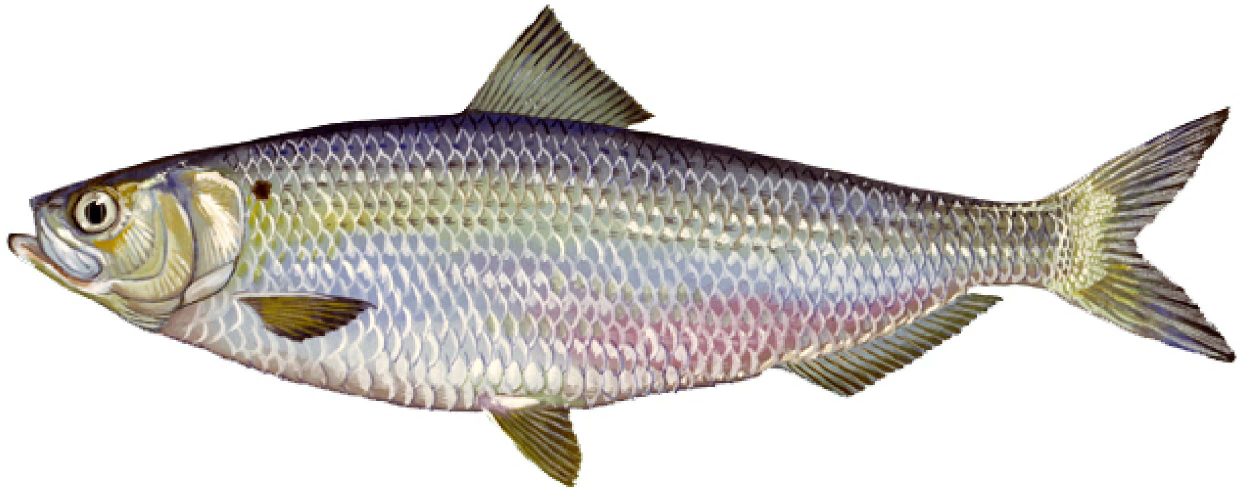


Table 13. Sampling rates and abundance indices of blueback herring for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	50	1.6	50	18		18		0.12	33.4	0.01	60.6
2008	Spring	3,692	62.2	1,774	237		235		1.76	11.9	0.20	18.5
	Fall	20	0.7	20	9		9		0.04	58	0.00	67.5
2009	Spring	5,603	160.3	2,808	315		315		2.30	10.7	0.34	15.4
	Fall	15	0.6	15	6		6		0.03	83.6	0.00	98.2

Figure 36. Biomass (kg) of blueback herring collected at each sampling site for each 2009 NEAMAP cruise.

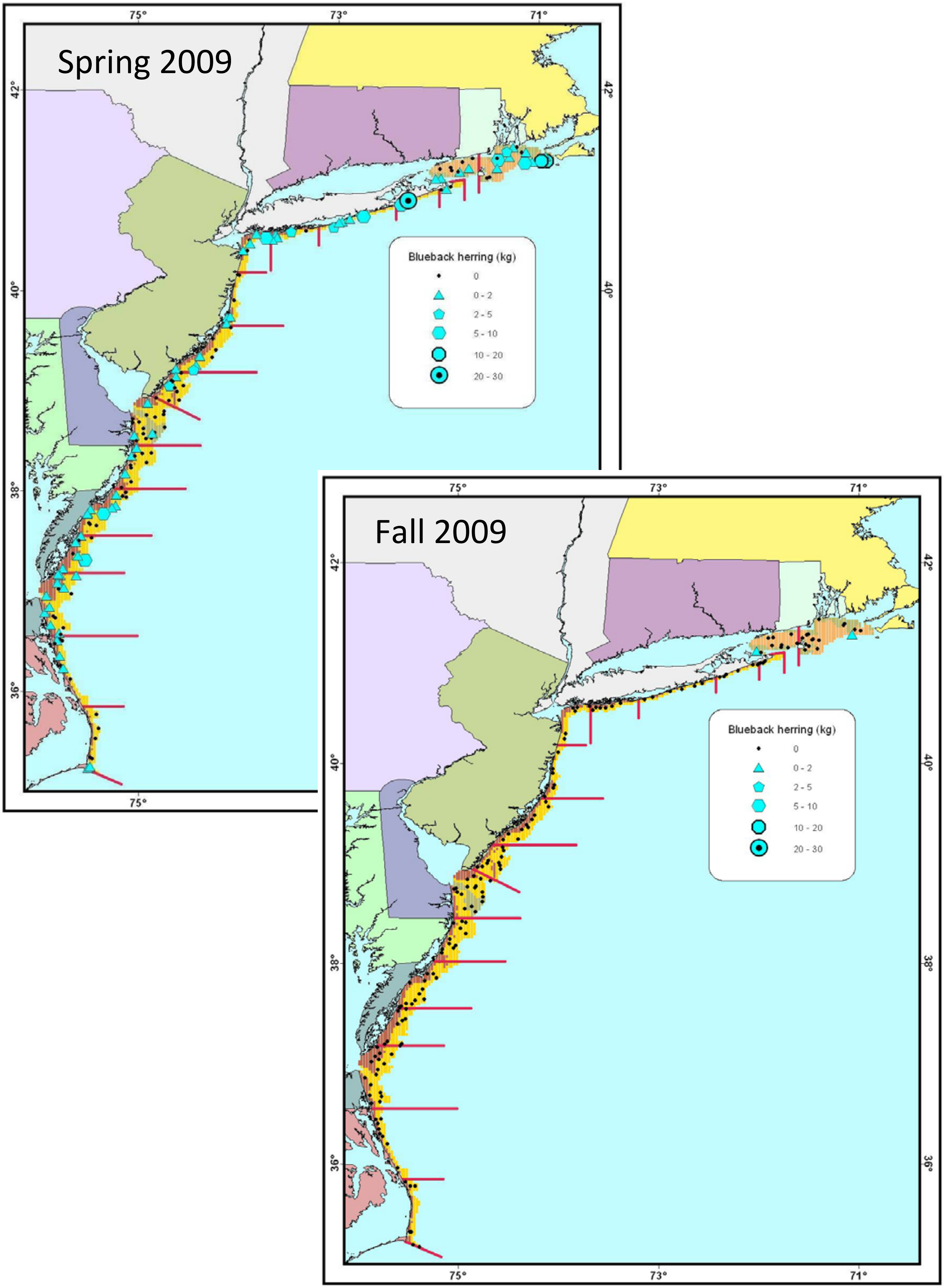
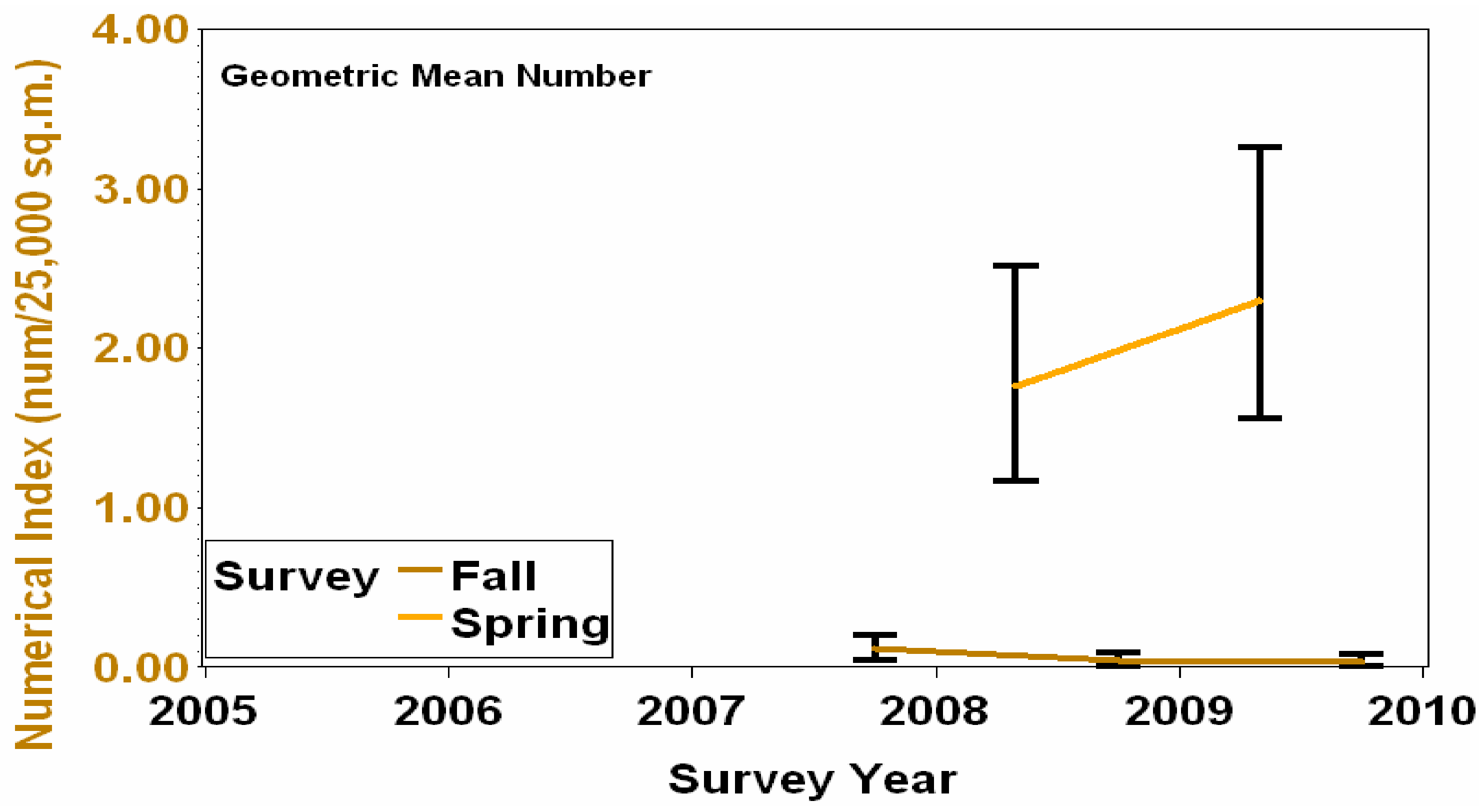


Figure 37. Preliminary indices of abundance, in terms of number and biomass, of blueback herring for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



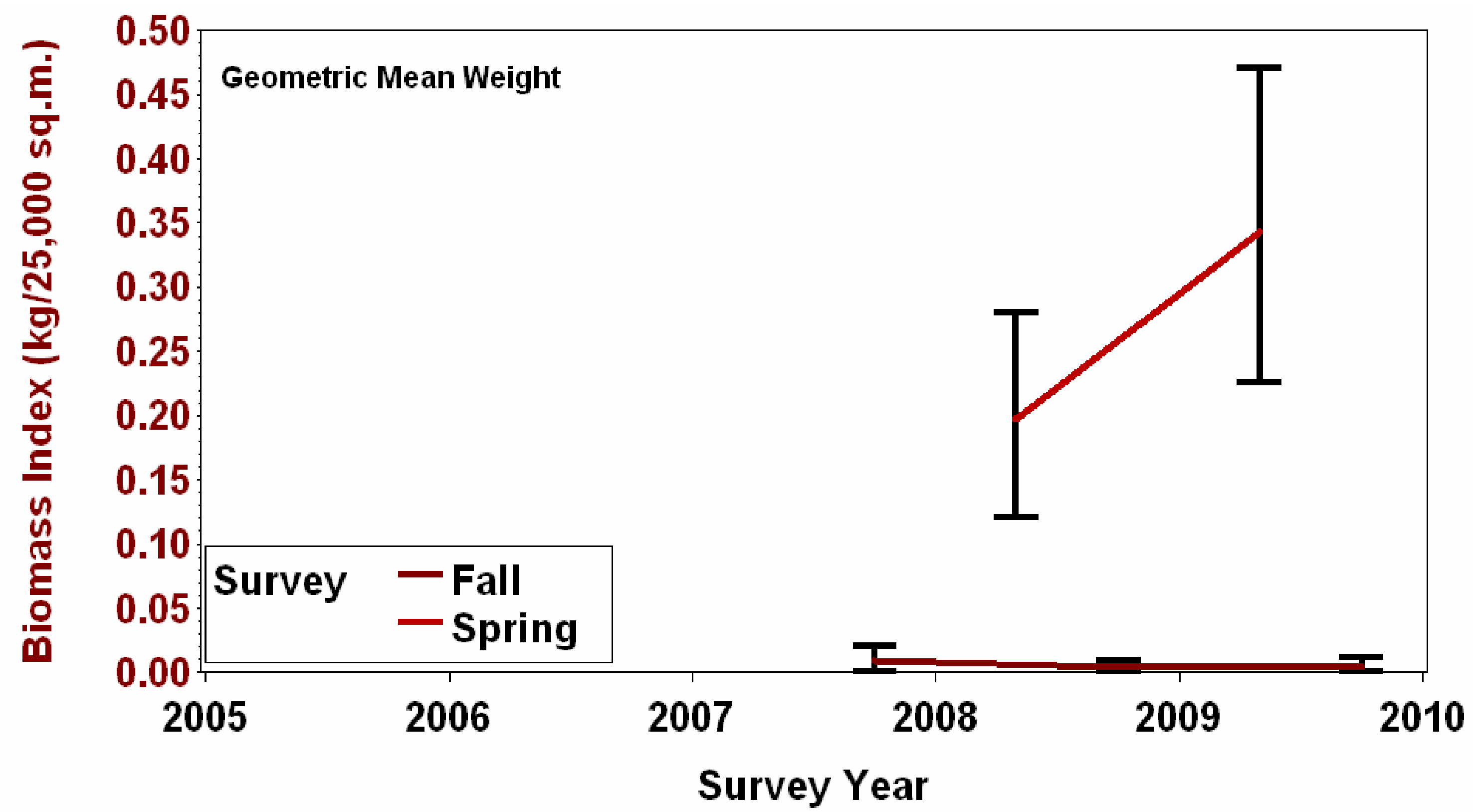


Figure 38. Length-frequency distributions, by cruise, for blueback herring. Numbers taken for full processing, by length, are represented by the orange bars.

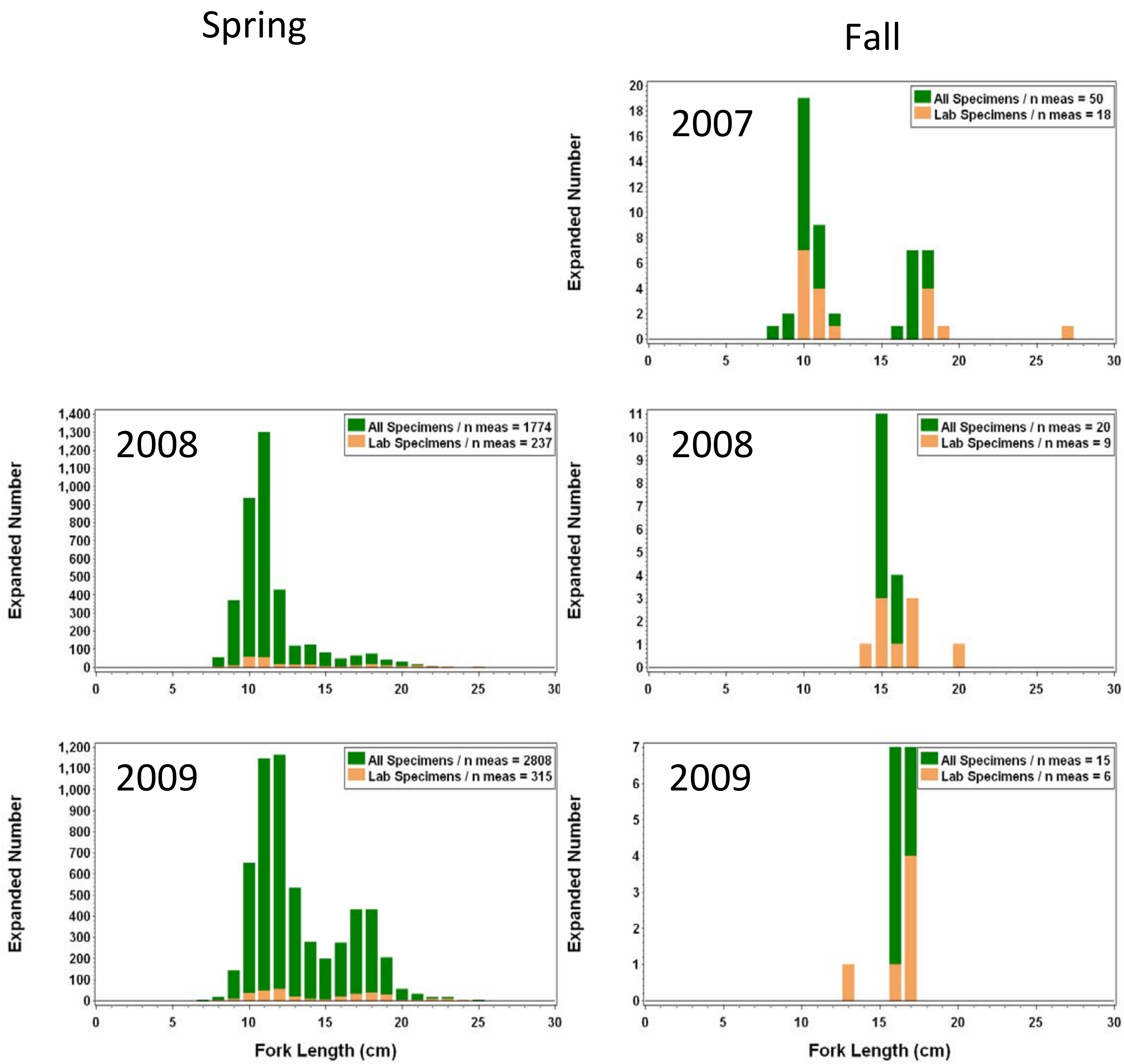
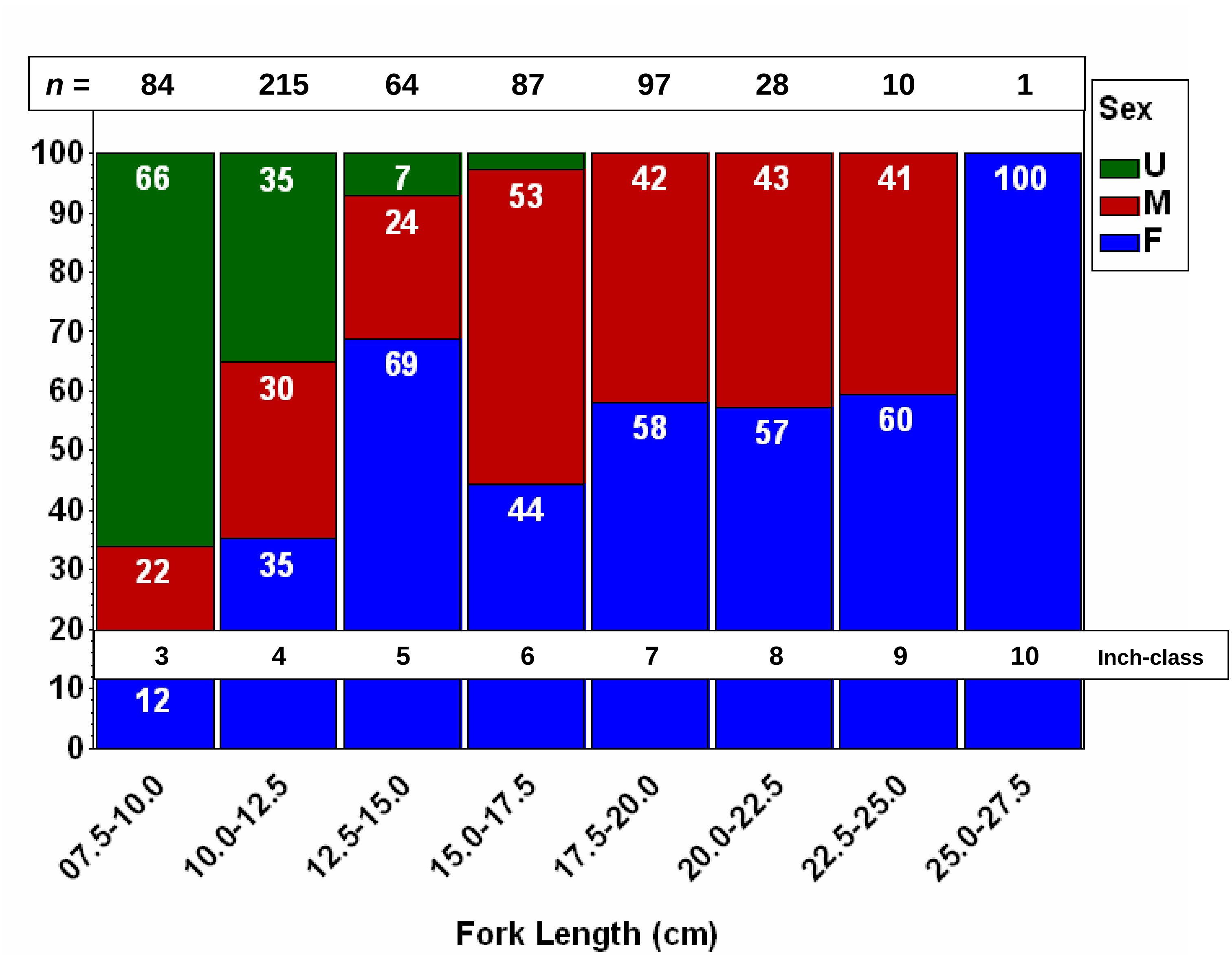


Figure 39. Sex ratio, by length group, for blueback herring collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



Bluefish (Priority A)

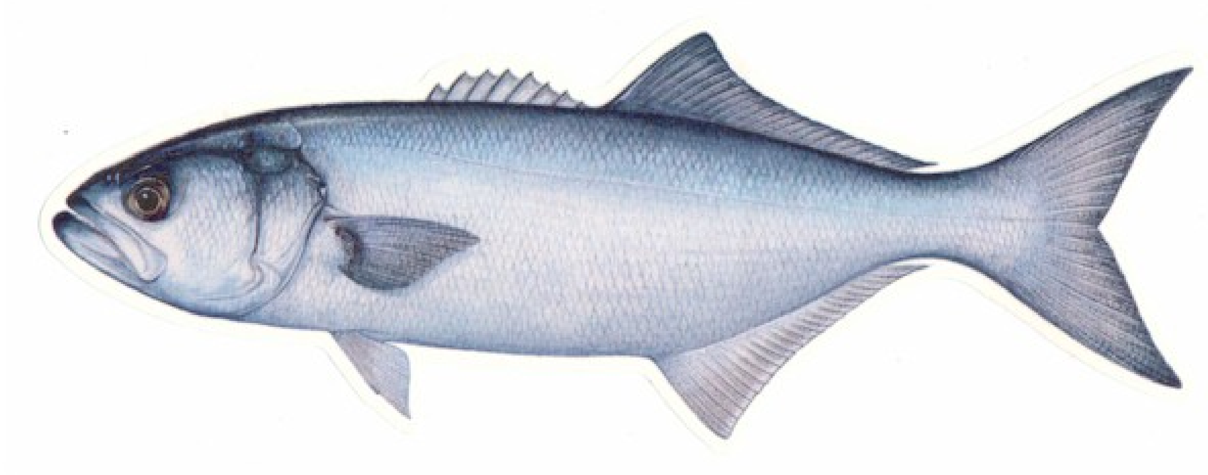


Table 14. Sampling rates and abundance indices of bluefish for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	4,635	394.5	2,613	588	588	485	476	4.36	7.2	1.29	7.9
2008	Spring	37	10.9	37	27	0	24	24	0.08	38	0.04	42.5
	Fall	7,120	908.7	2,214	529	0	409	401	5.52	6.9	1.33	9.8
2009	Spring	1,580	91.2	274	35	0	14	13	0.13	16.9	0.10	20.4
	Fall	18,075	910.7	4,016	632	0	428		5.53	6.3	0.95	9.1

Figure 40. Biomass (kg) of bluefish collected at each sampling site for each 2009 NEAMAP cruise.

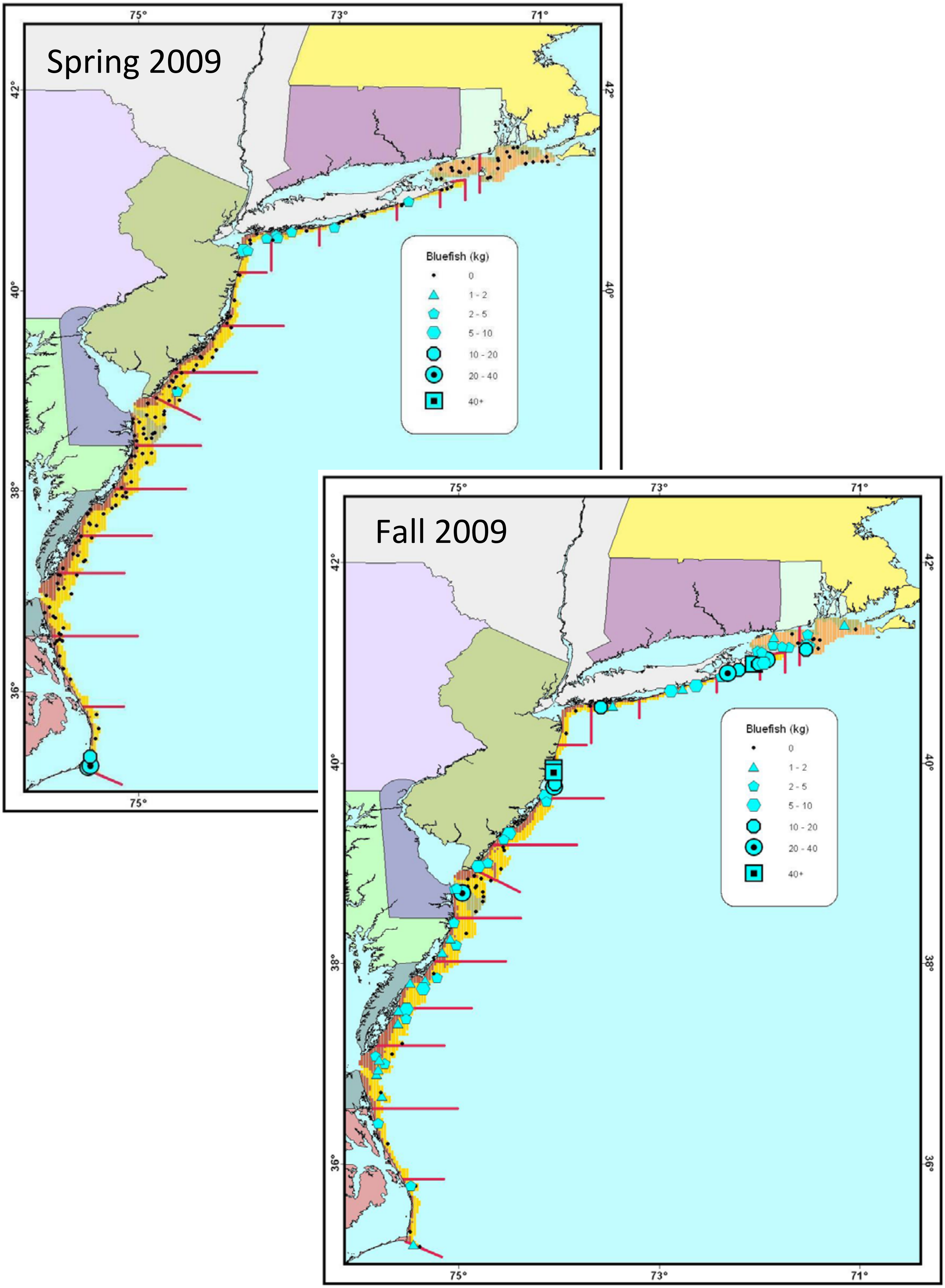
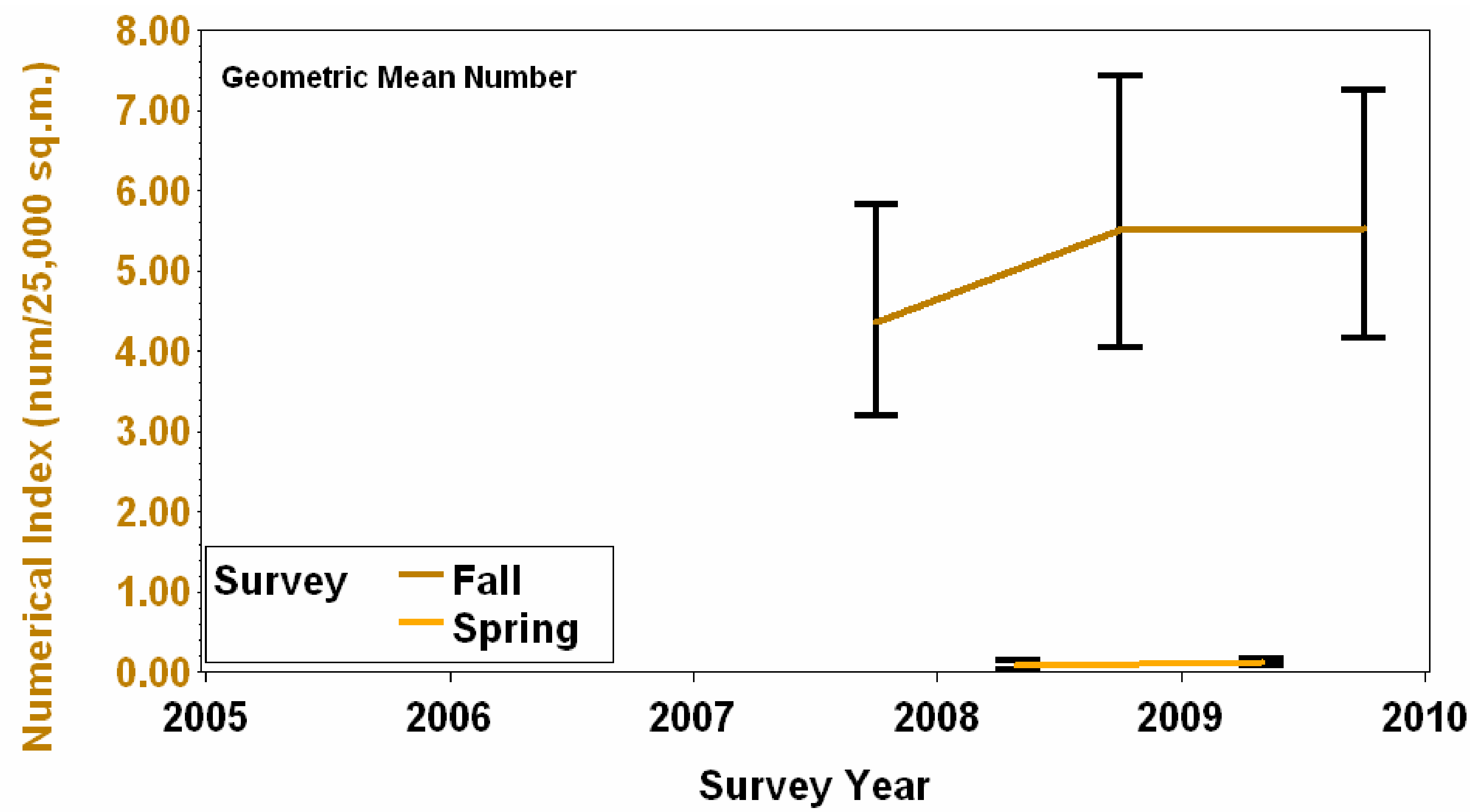


Figure 41. Preliminary indices of abundance, in terms of number and biomass, of bluefish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



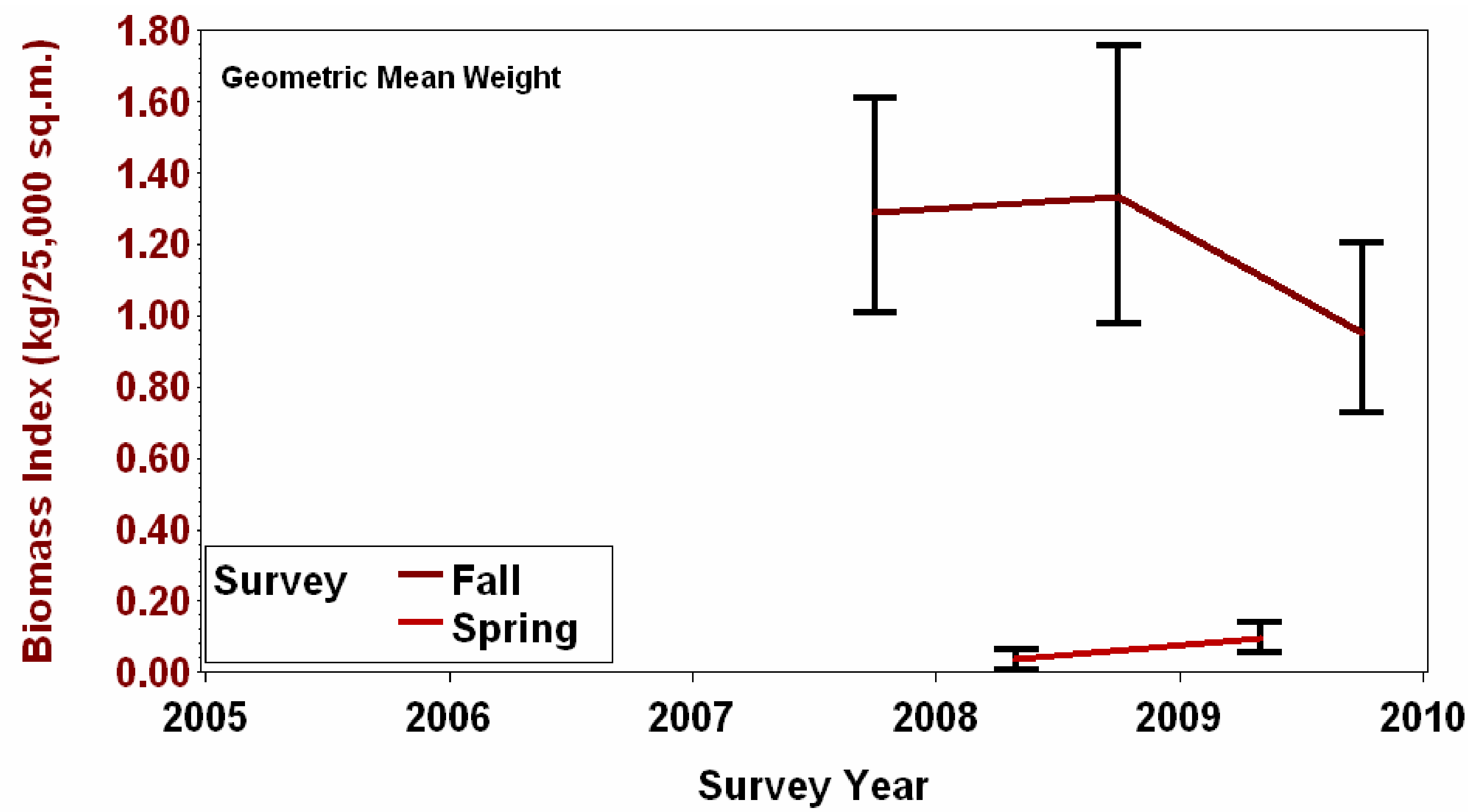


Figure 42. Length-frequency distributions, by cruise, for bluefish. Numbers taken for full processing, by length, are represented by the orange bars.

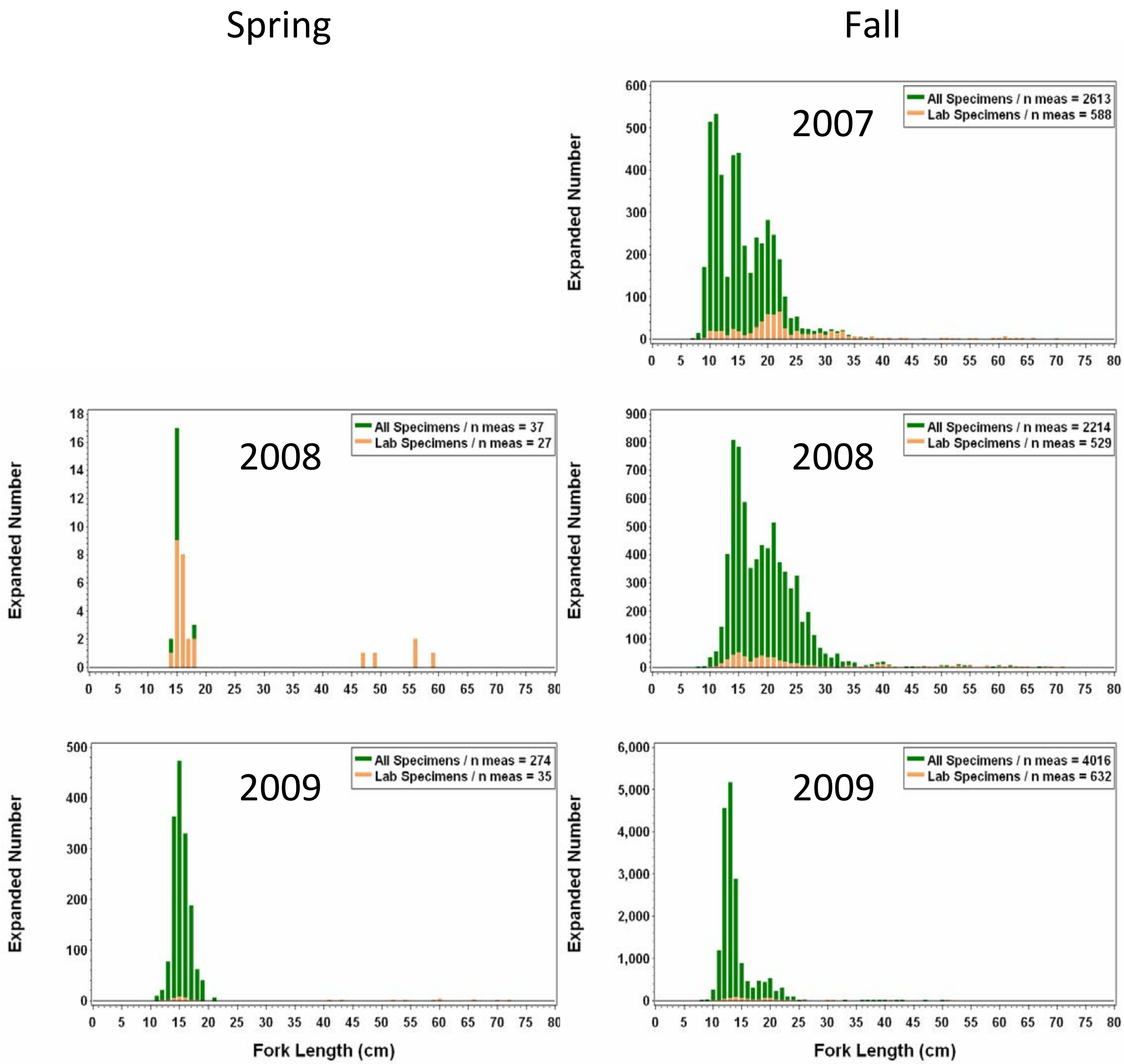


Figure 43. Sex ratio, by length group, for bluefish collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

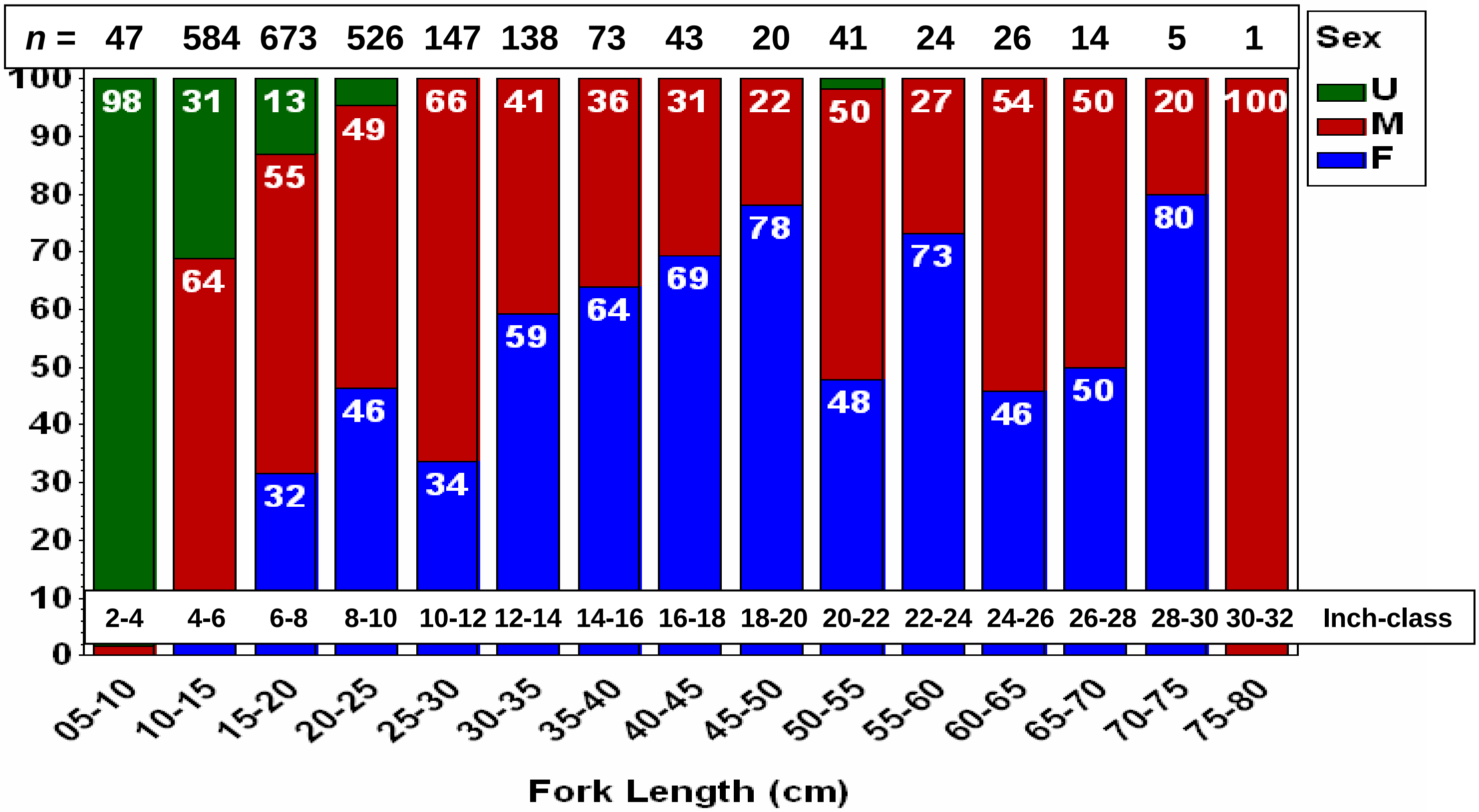


Figure 44. Diet composition, expressed using the percent weight index, of bluefish collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of bluefish sampled.

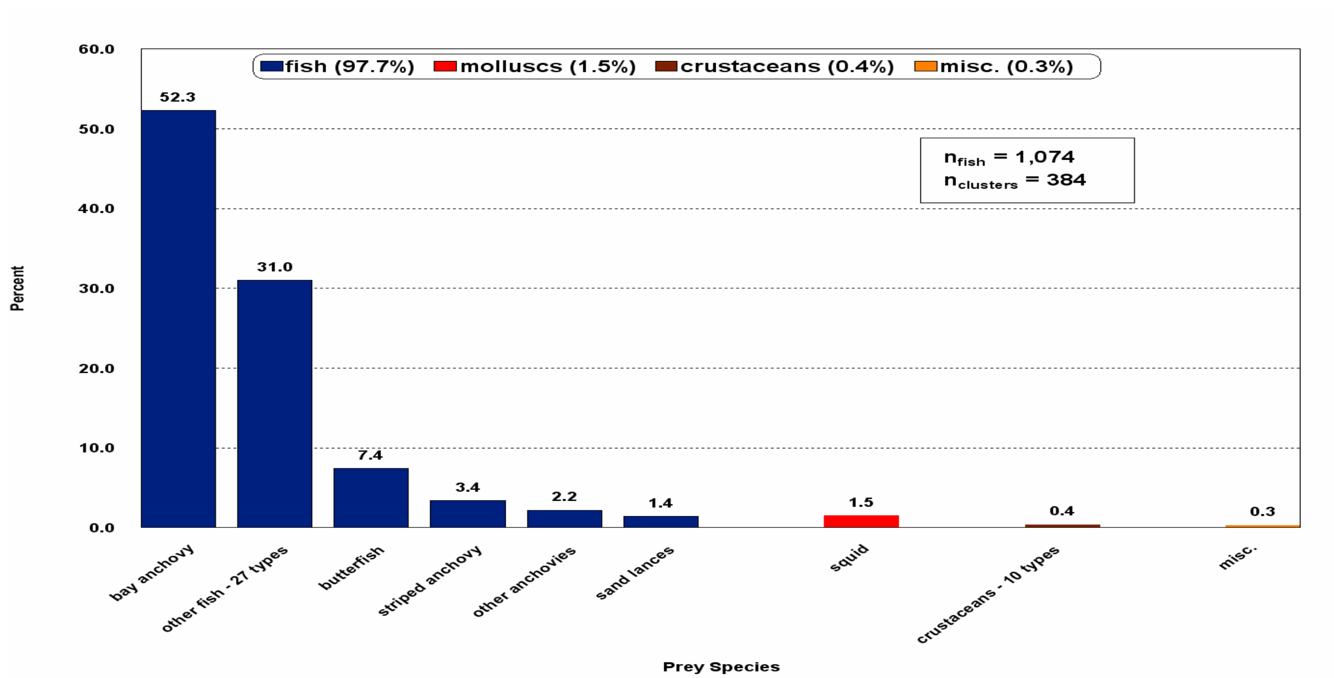
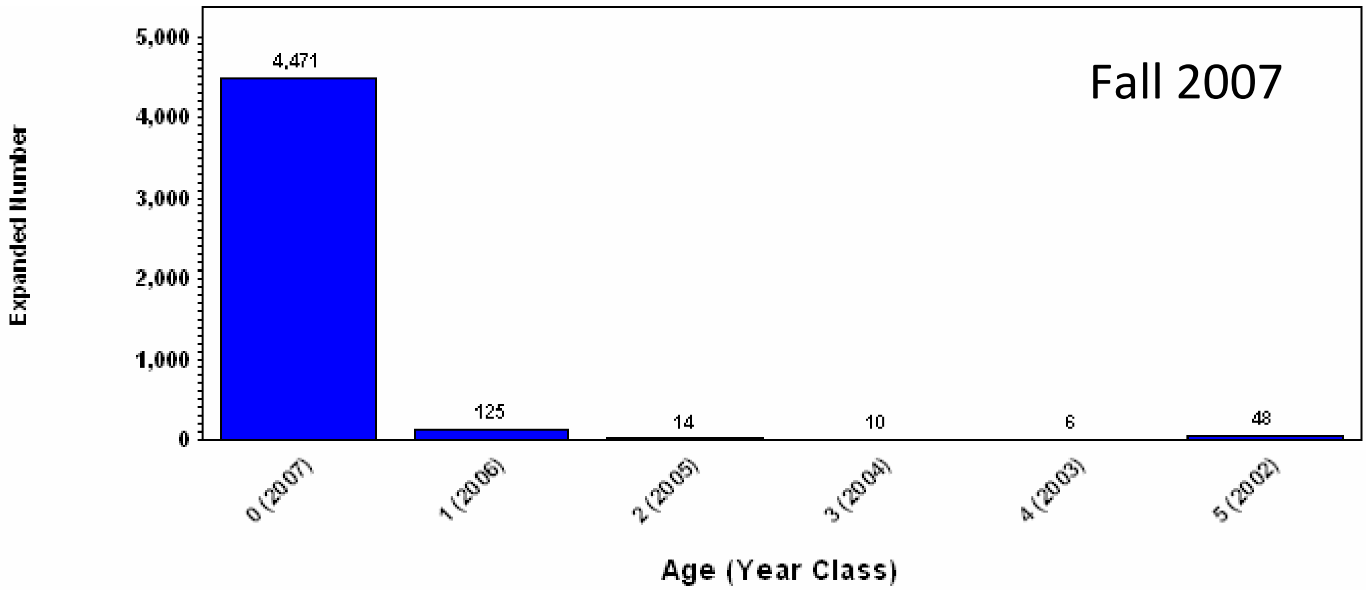


Figure 45. Age-frequency distribution for bluefish collected during the fall 2007 cruise. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.



Brown Shrimp (Priority E)

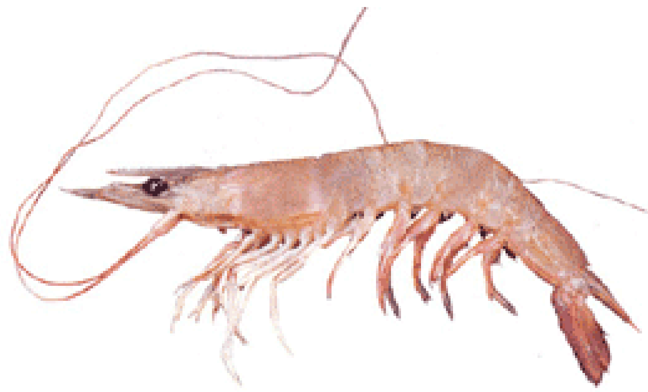


Table 15. Sampling rates and abundance indices of brown shrimp for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	898	21.6	459					0.44	16.1	0.06	19.2
2008	Spring	5	0.2	5					0.02	51.5	0.00	52.8
	Fall	509	15.3	372					0.61	16.1	0.07	24.2
2009	Spring	7	0.1	7					0.01	52.5	0.00	67.9
	Fall	45	0.9	45					0.11	29.8	0.01	37.6

Figure 46. Biomass (kg) of brown shrimp collected at each sampling site for each 2009 NEAMAP cruise.

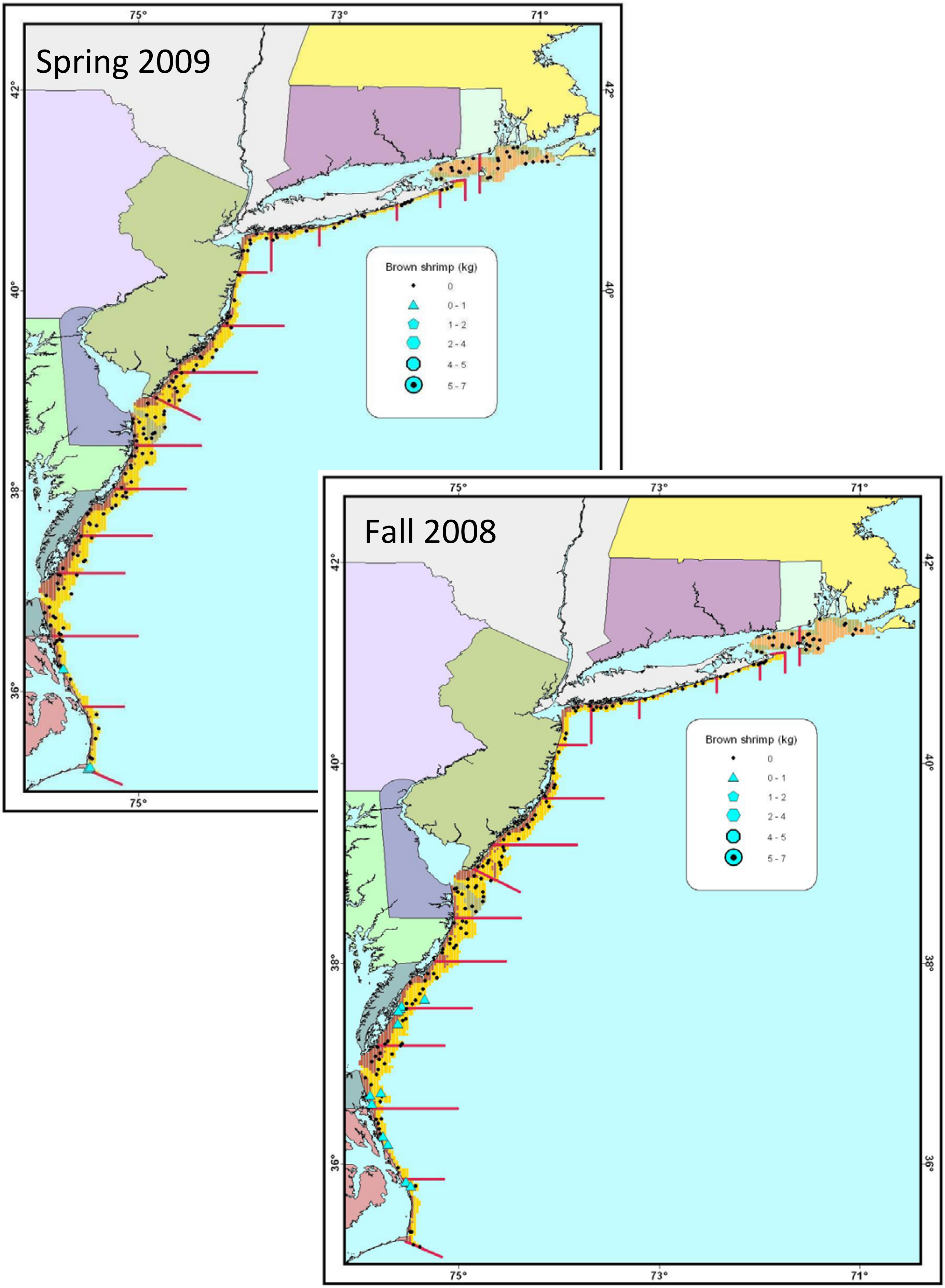
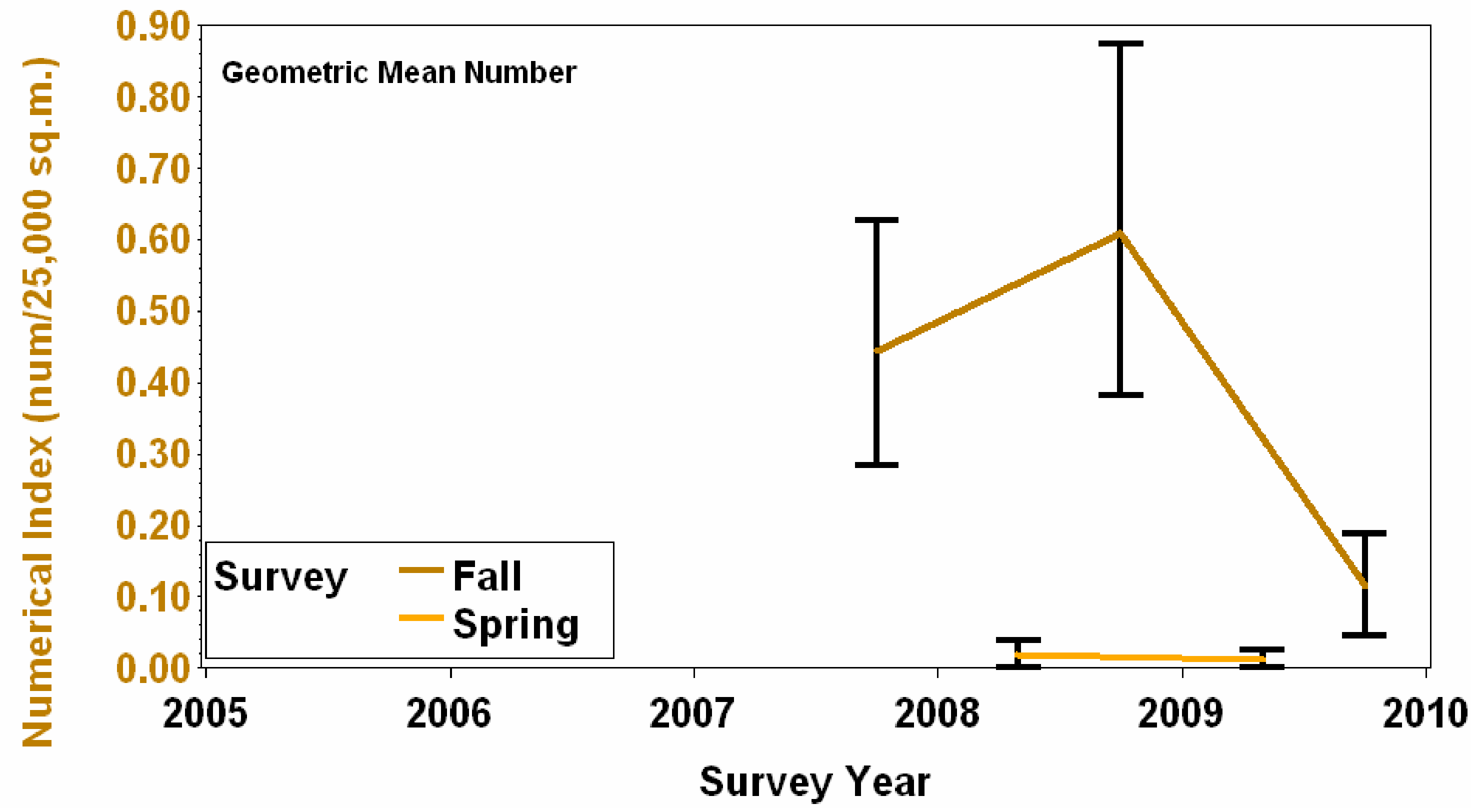


Figure 47. Preliminary indices of abundance, in terms of number and biomass, of brown shrimp for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



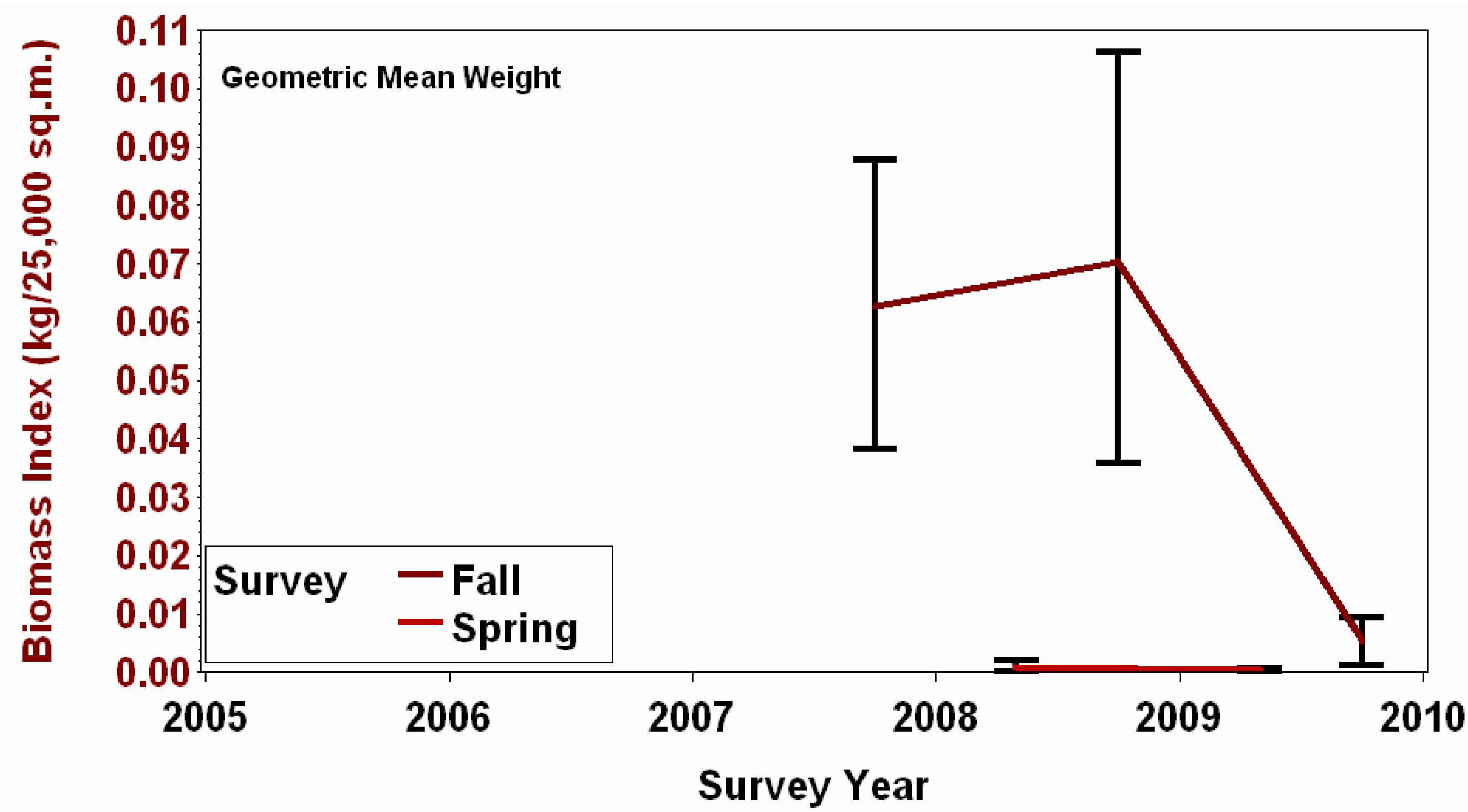
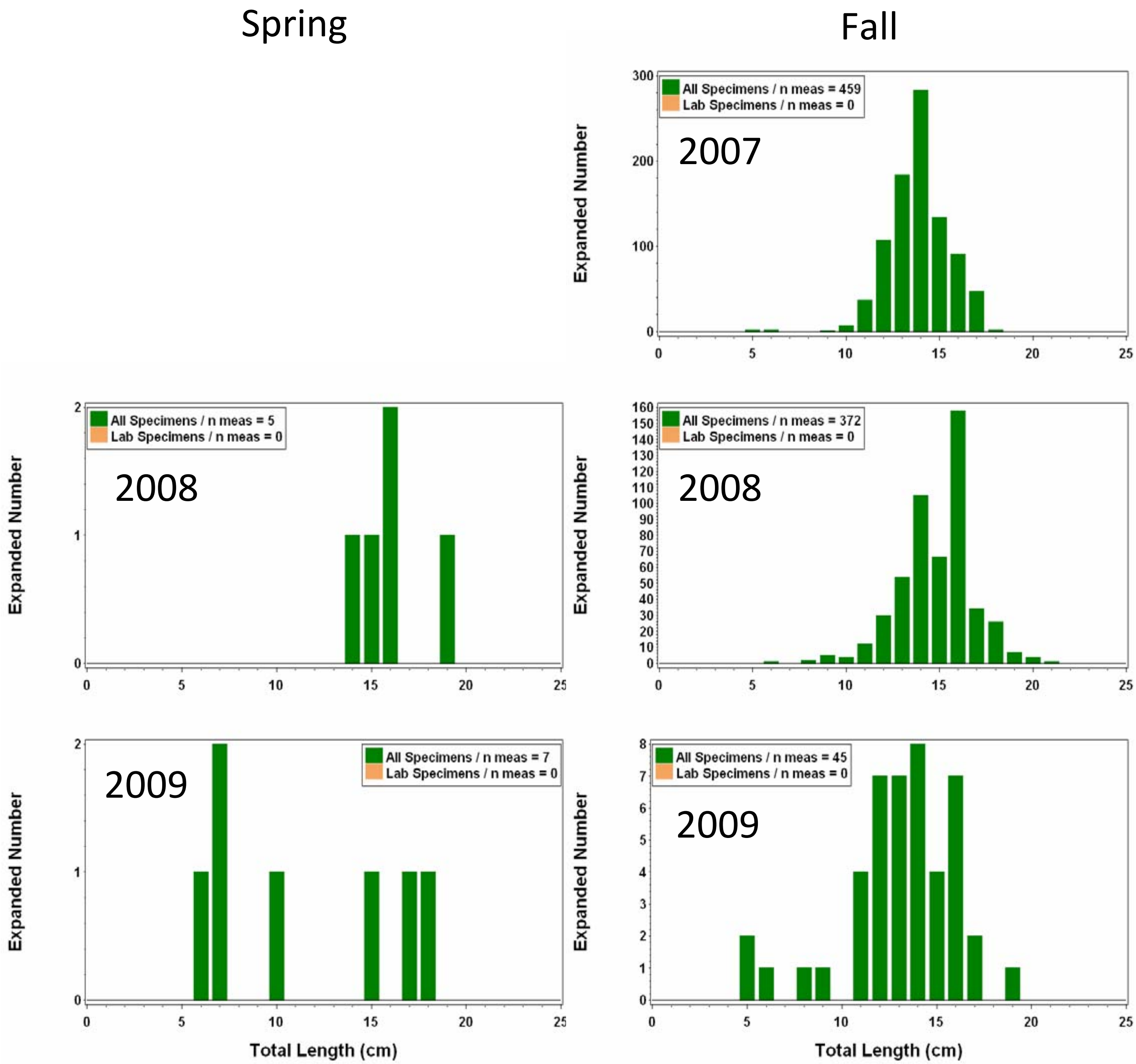


Figure 48. Length-frequency distributions, by cruise, for brown shrimp.



Butterfish (Priority A)

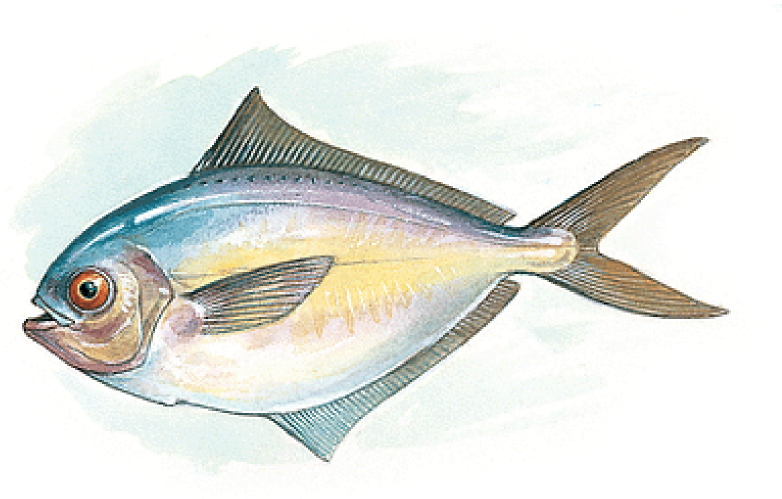


Table 16. Sampling rates and abundance indices of butterfish for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	148,182	1,904.9	6,015	538	0	11		70.71	3.4	2.82	6.8
2008	Spring	47,742	689.2	8,315	746	0			44.53	4.1	2.29	6.6
	Fall	168,269	2,120.6	10,091	551	0	8		207.34	2.7	4.71	5.6
2009	Spring	35,588	816.5	16,089	1,045	0			64.83	2.5	2.01	5.7
	Fall	544,718	8,677.5	20,670	774	0			166.55	2.4	5.86	4.6

Figure 49. Biomass (kg) of butterfish collected at each sampling site for each 2009 NEAMAP cruise.

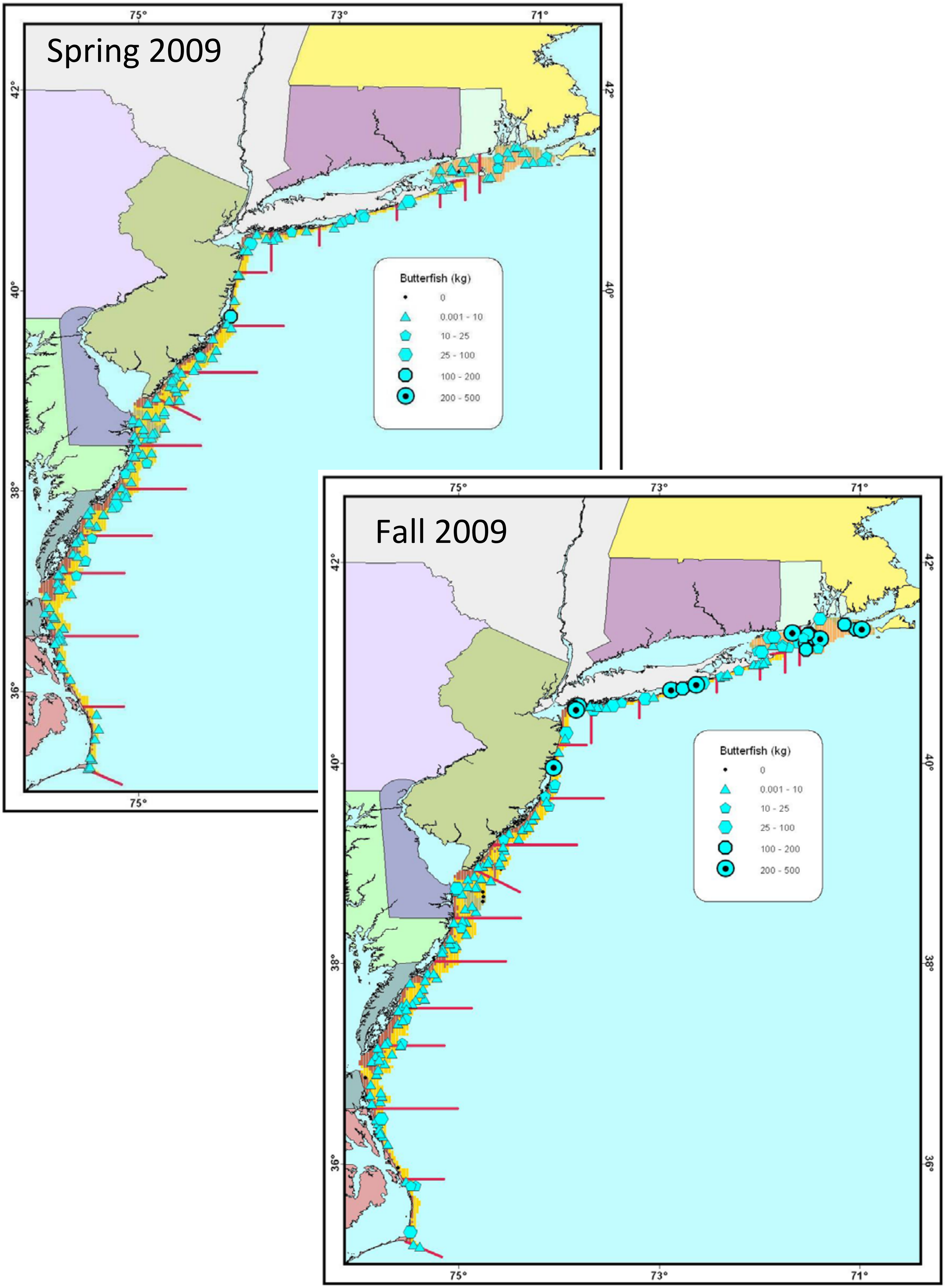


Figure 50. Preliminary indices of abundance, in terms of number and biomass, of butterfish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

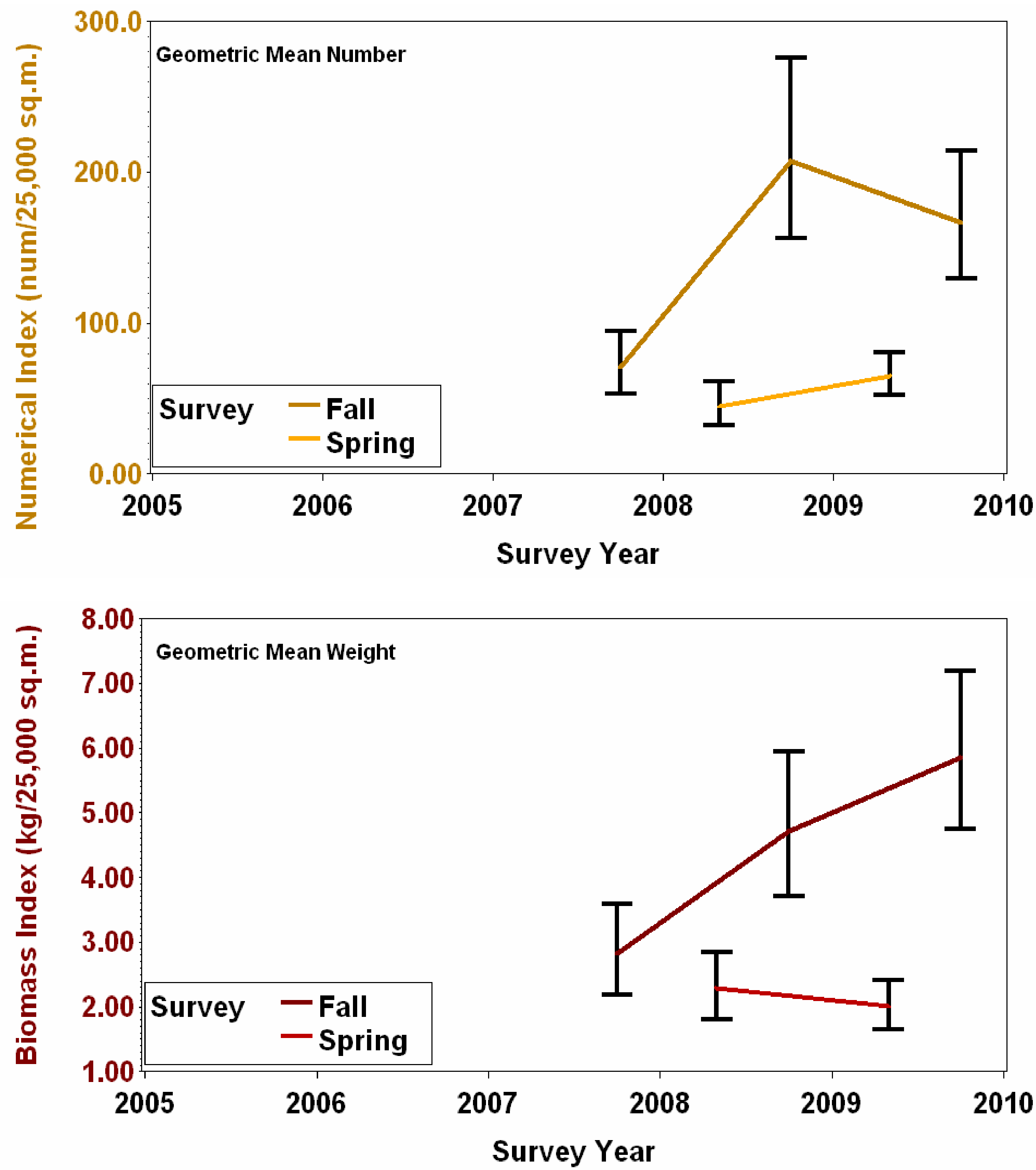


Figure 51. Length-frequency distributions, by cruise, for butterfish. Numbers taken for full processing, by length, are represented by the orange bars (difficult to see due to scale of y-axis).

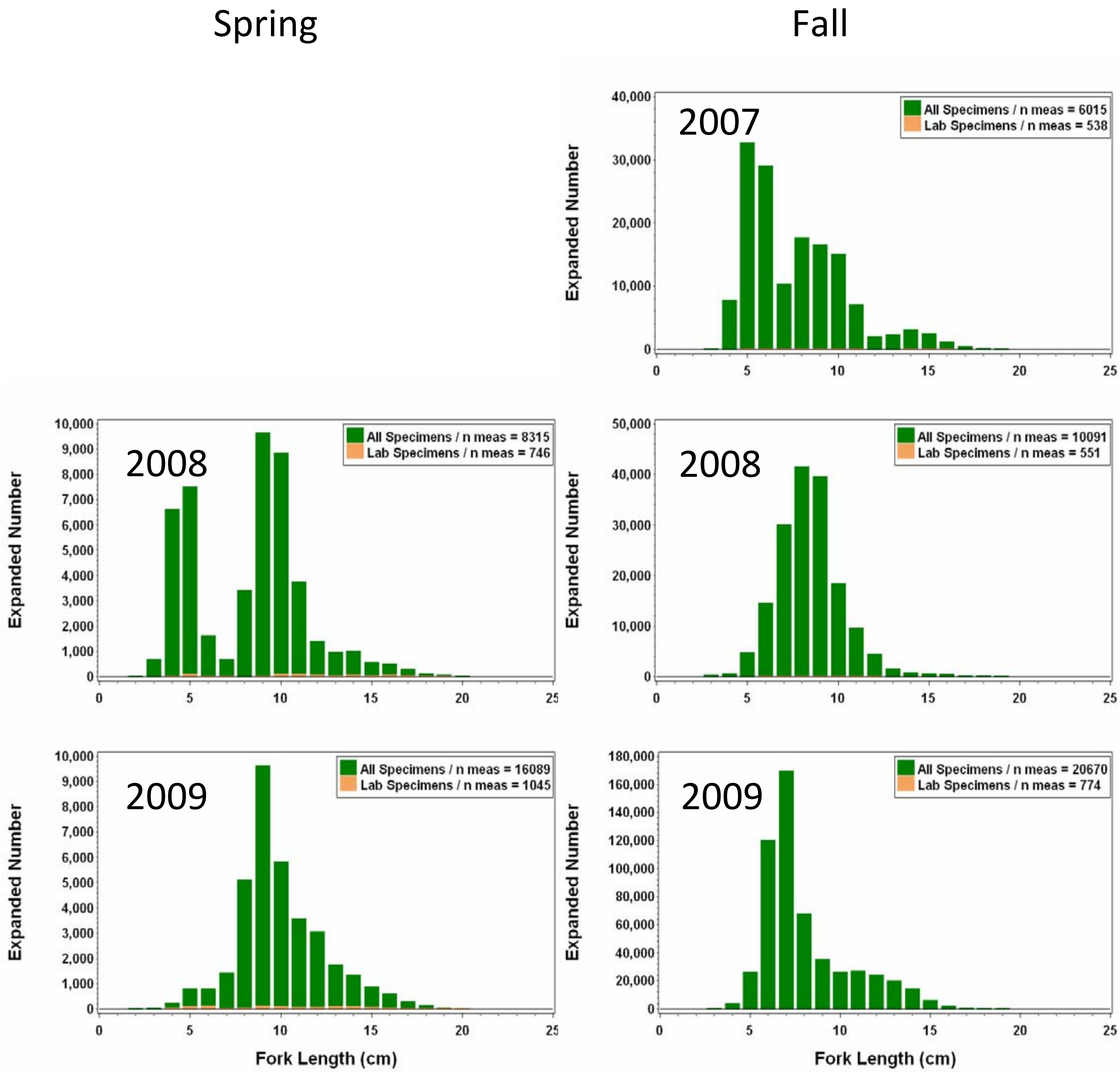
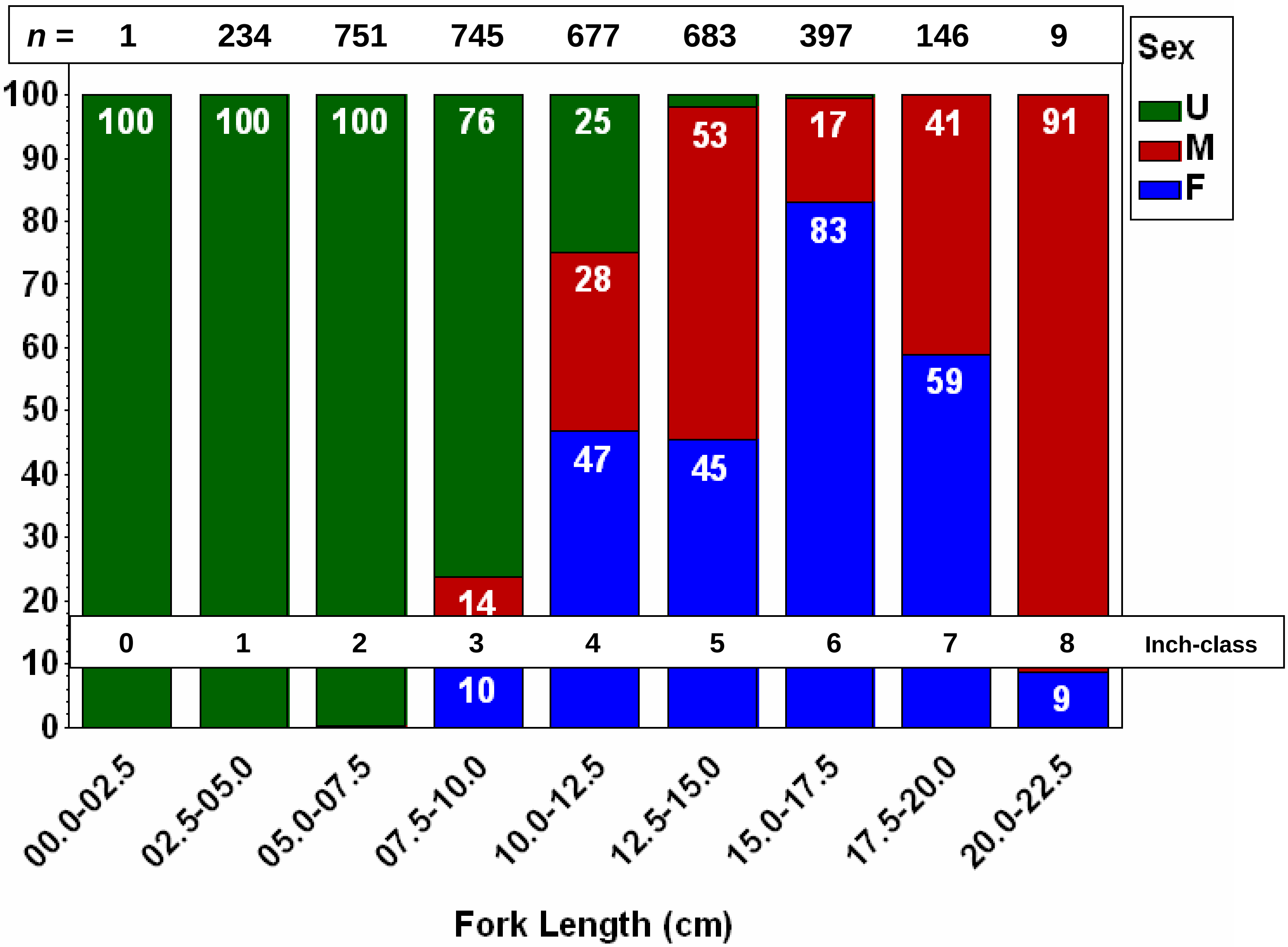


Figure 52. Sex ratio, by length group, for butterfish collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



Clearnose Skate (Priority A)

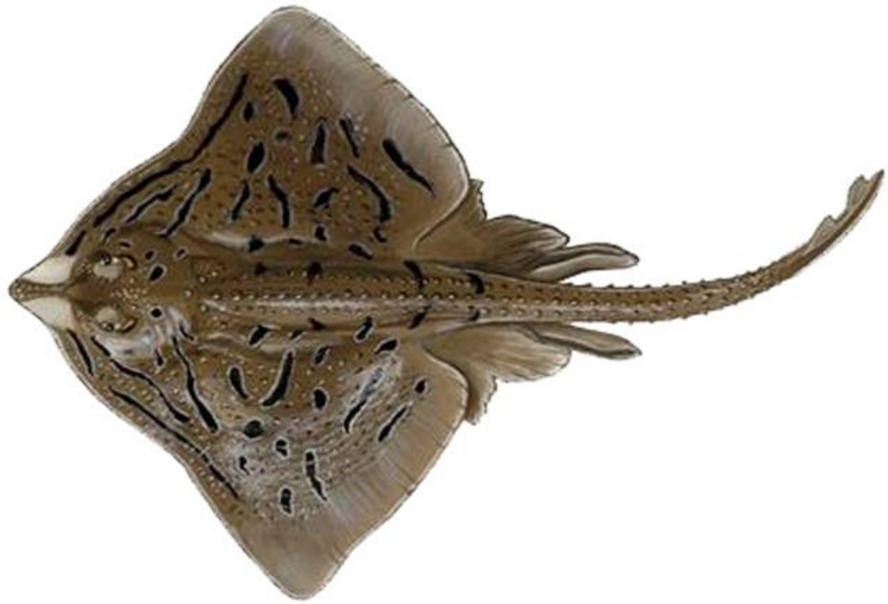


Table 17. Sampling rates and abundance indices of clearnose skate for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	1,505	1,854.6	1,361	346	0	330	294	4.99	3.4	5.86	3.5
2008	Spring	3,219	4,237.3	1,050	212	0	207	205	3.85	3.8	4.42	3.7
	Fall	885	1,196.2	806	289	0	287	286	3.06	3.7	3.71	4
2009	Spring	2,429	3,382.1	1,431	205	0	188	181	2.75	5.5	3.27	5.5
	Fall	1,107	1,352.1	1,007	335	0	306		3.66	3.4	4.23	3.4

Figure 53. Biomass (kg) of clearnose skate collected at each sampling site for each 2009 NEAMAP cruise.

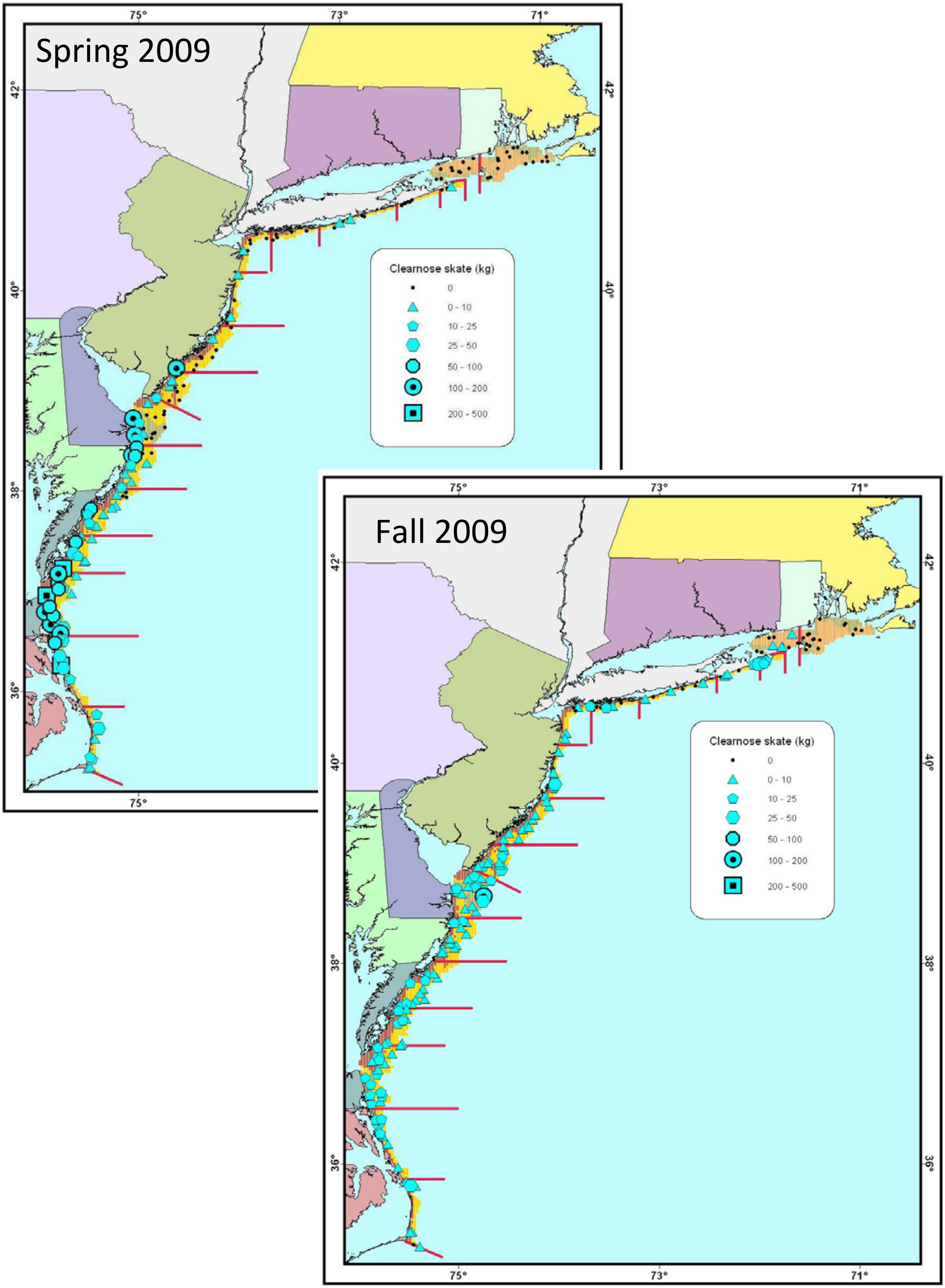


Figure 54. Preliminary indices of abundance, in terms of number and biomass, of clearnose skate for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

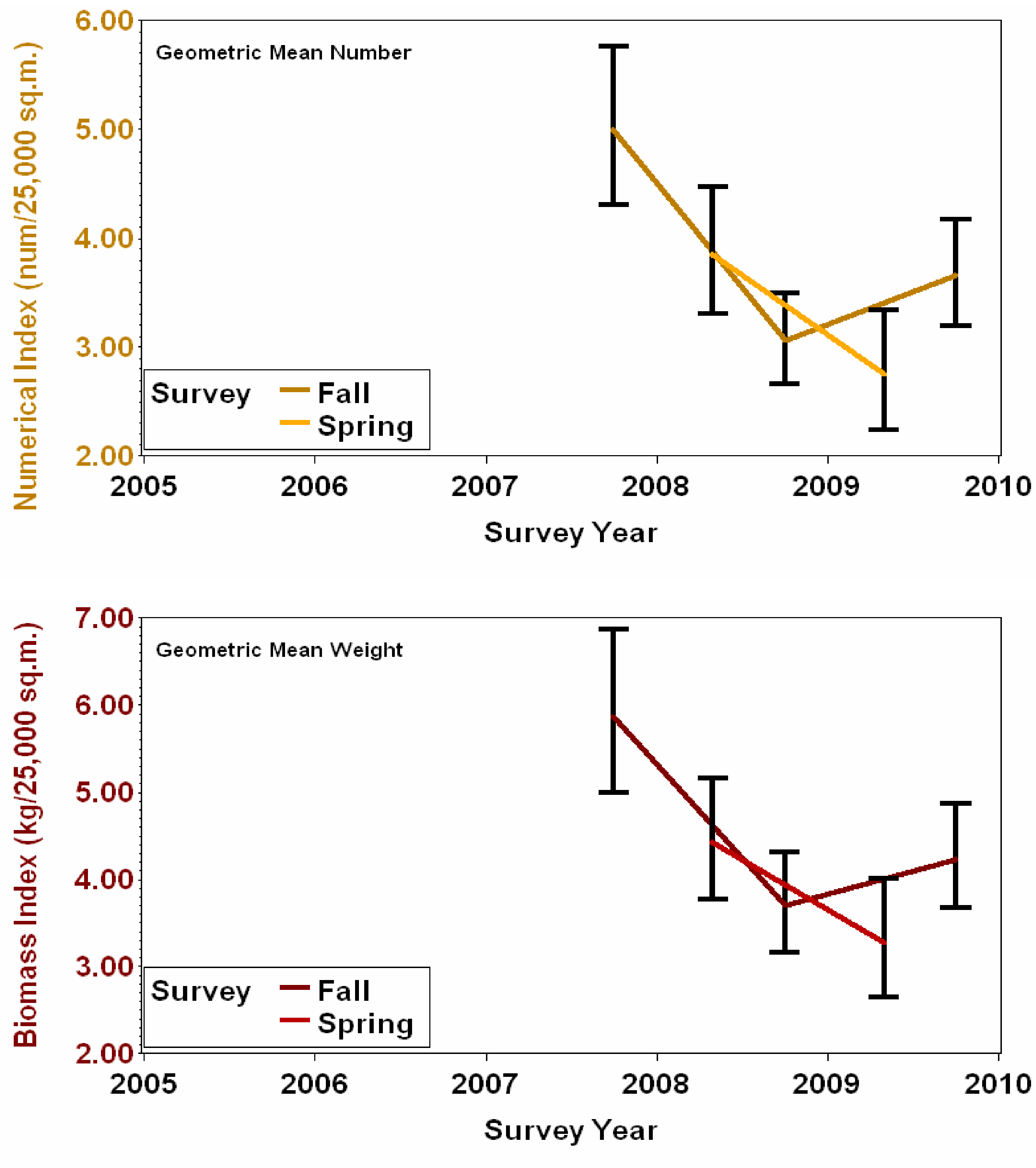


Figure 55. Width-frequency distributions, by cruise, for clearnose skate. Numbers taken for full processing, by length, are represented by the orange bars.

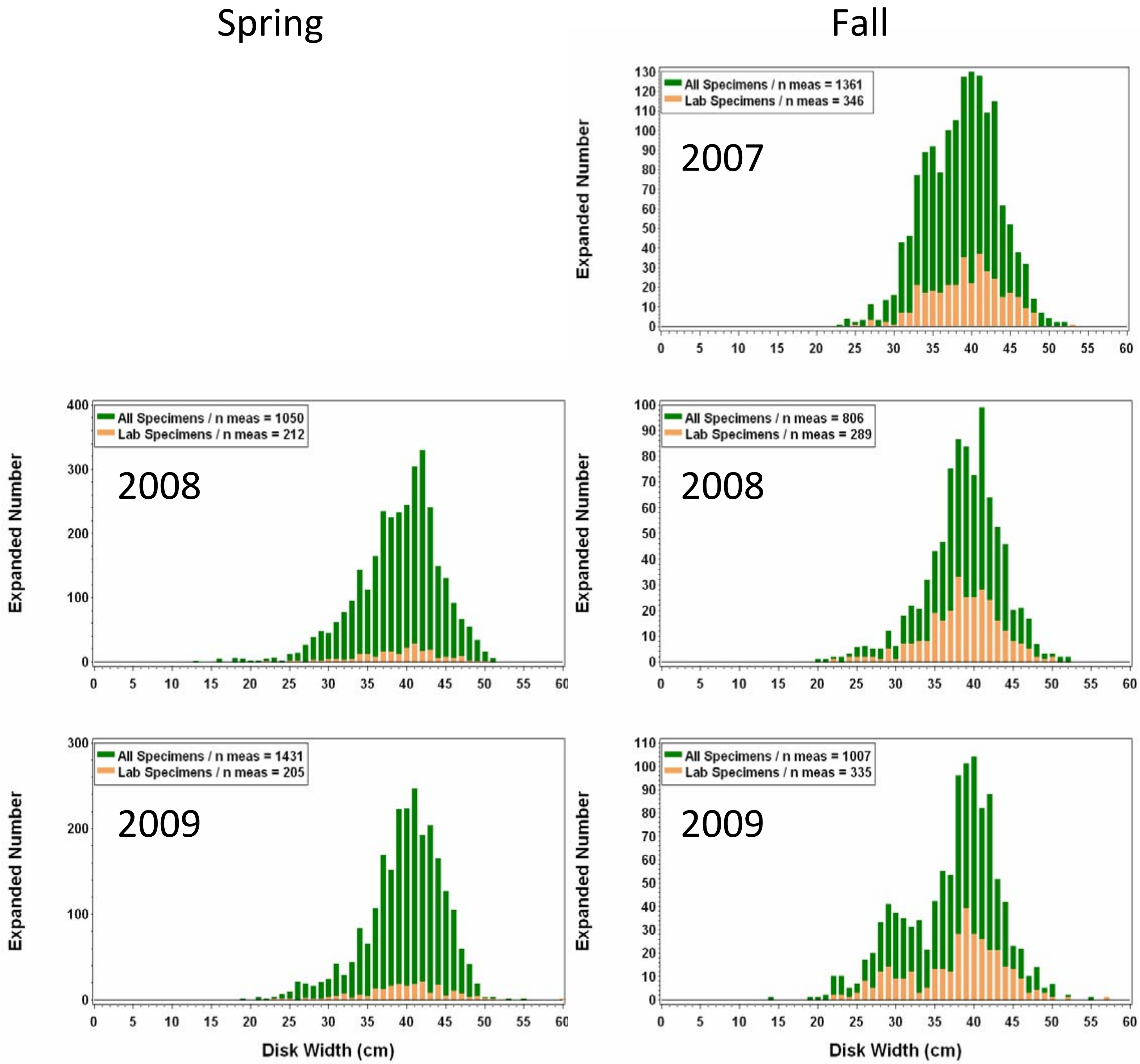


Figure 56. Sex ratio, by length group, for clearnose skate collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

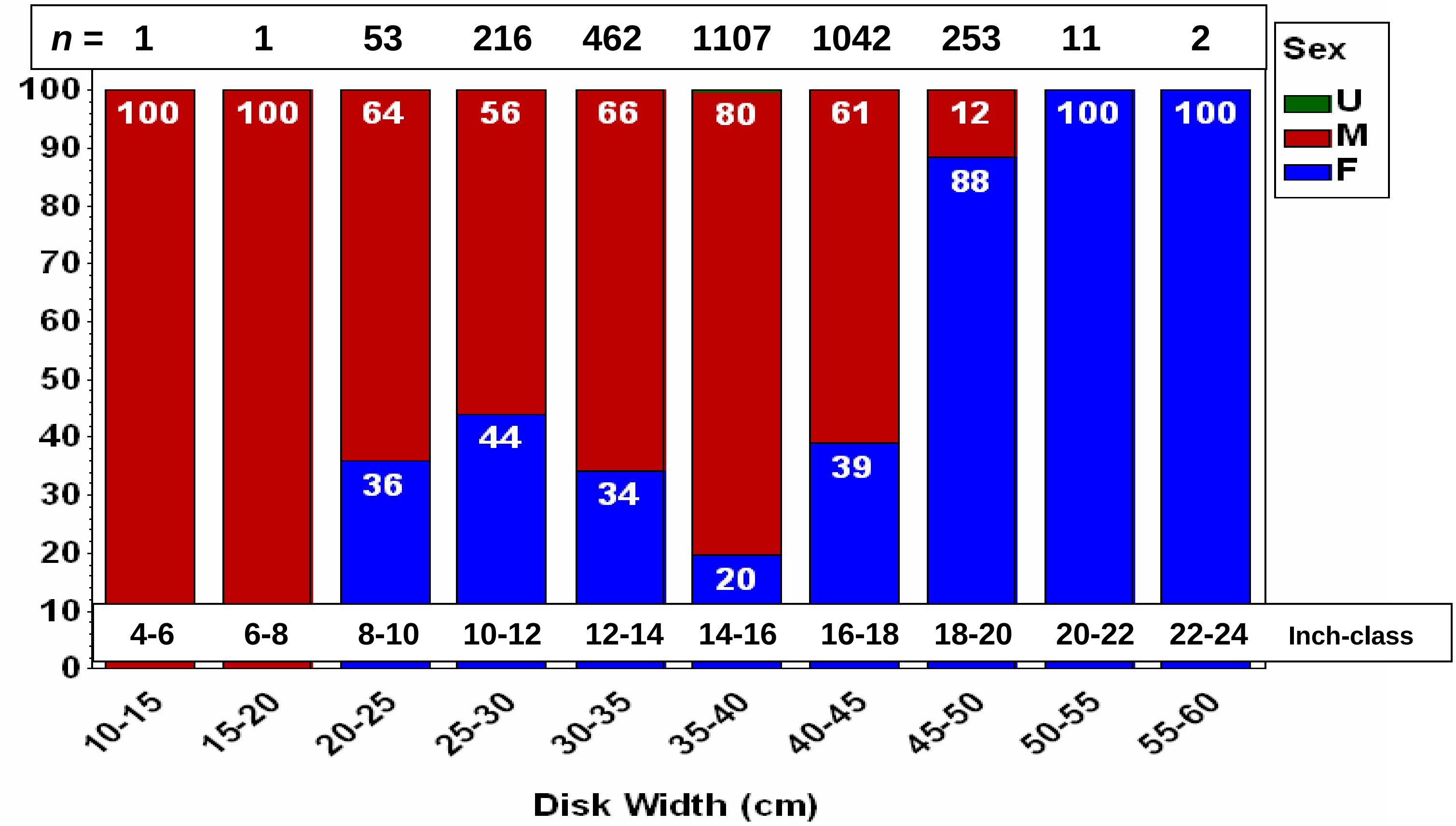
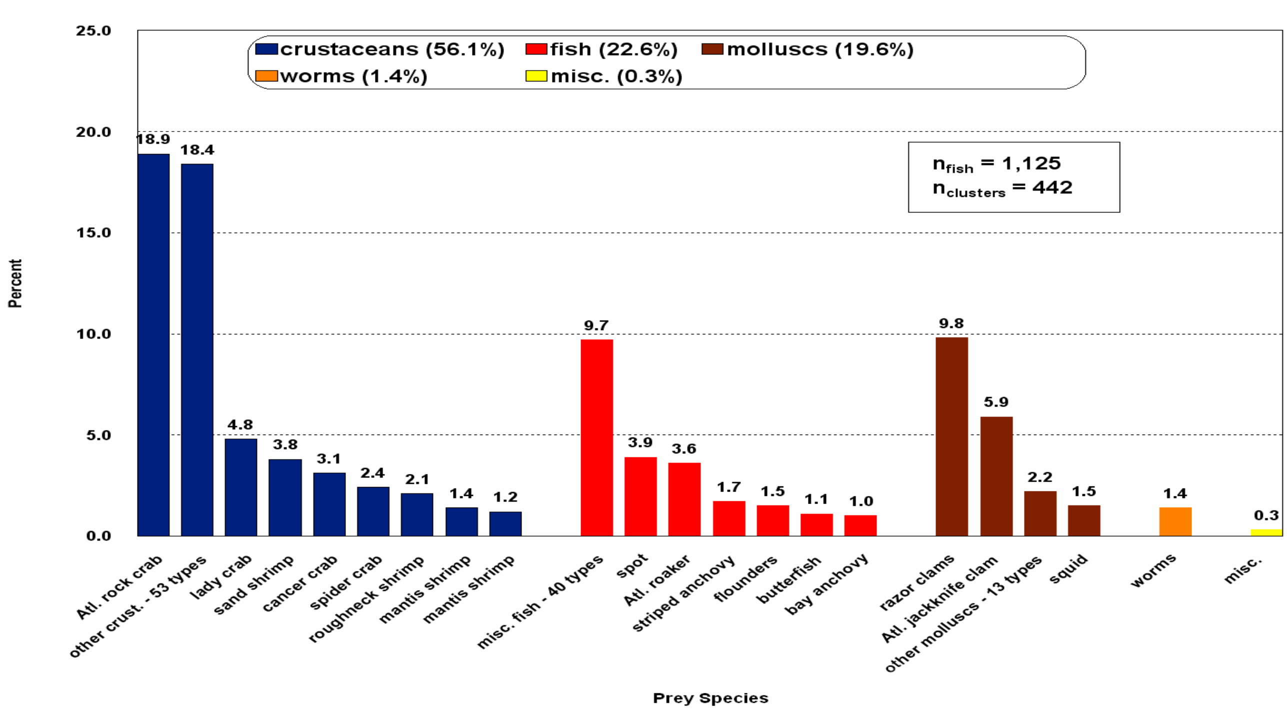


Figure 57. Diet composition, expressed using the percent weight index, of clearnose skate collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of clearnose skate sampled.

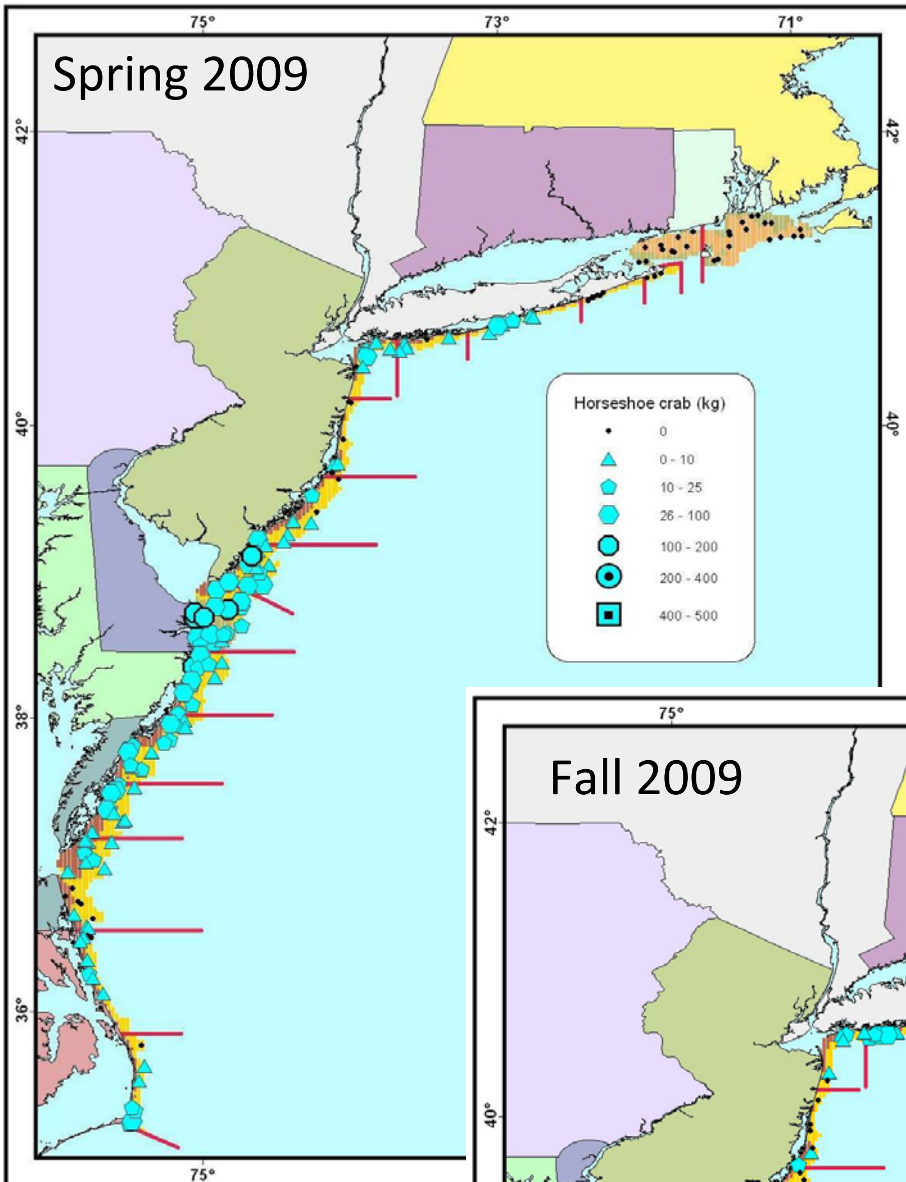


Horseshoe Crab (Priority E)

Table 18. Sampling rates and abundance indices of horseshoe crab for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	795	1,447.9	342					0.78	12.4	1.04	12.1
2008	Spring	1,201	1,229.6	774					2.23	6.1	2.42	6.1
	Fall	1,149	1,839.4	473					1.32	10.7	1.73	10.2
2009	Spring	2,388	2,702.1	1,673					4.22	4	4.80	3.9
	Fall	1,931	2,164.4	1,092					1.80	9.6	1.95	9.5

Figure 58. Biomass (kg) of horseshoe crab collected at each sampling site for each 2009 NEAMAP cruise.



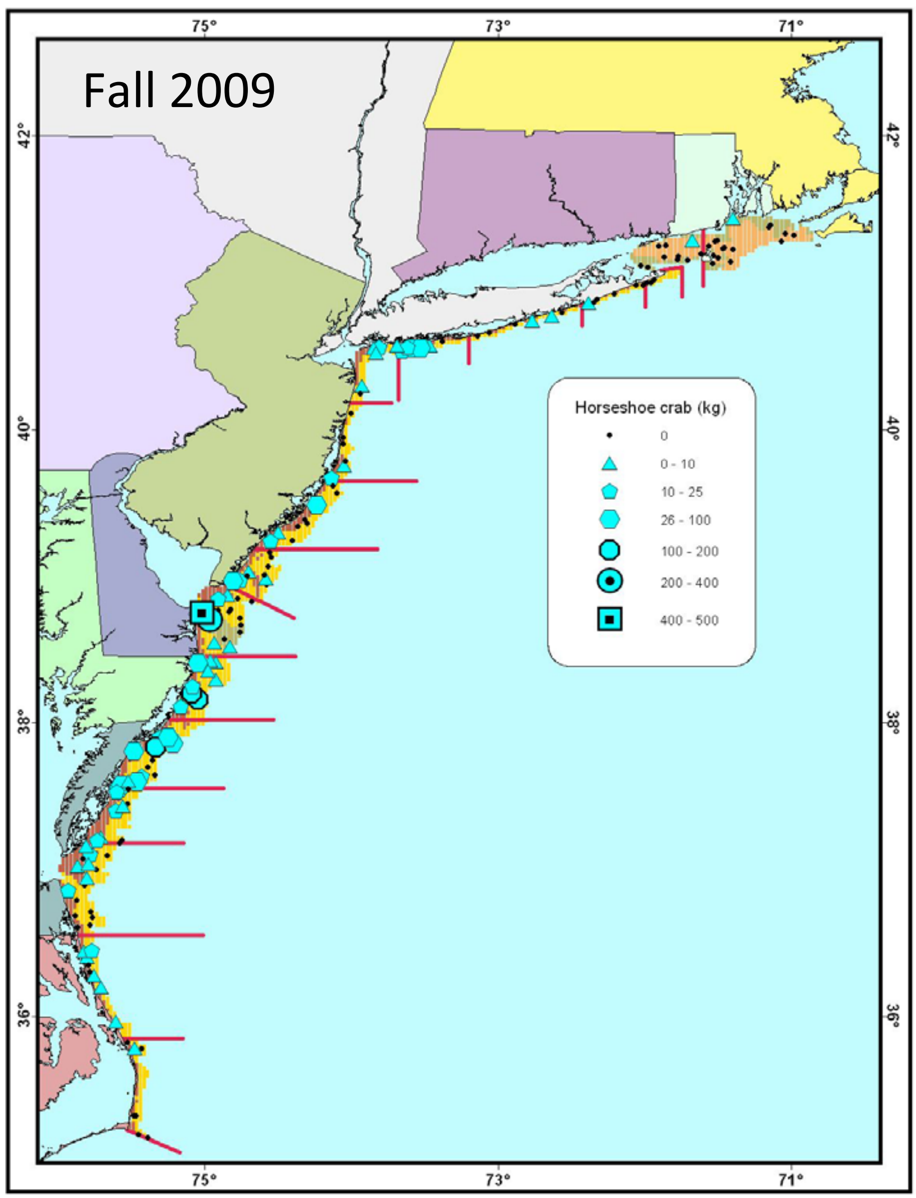


Figure 59. Preliminary indices of abundance, in terms of number and biomass, of horseshoe crab for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

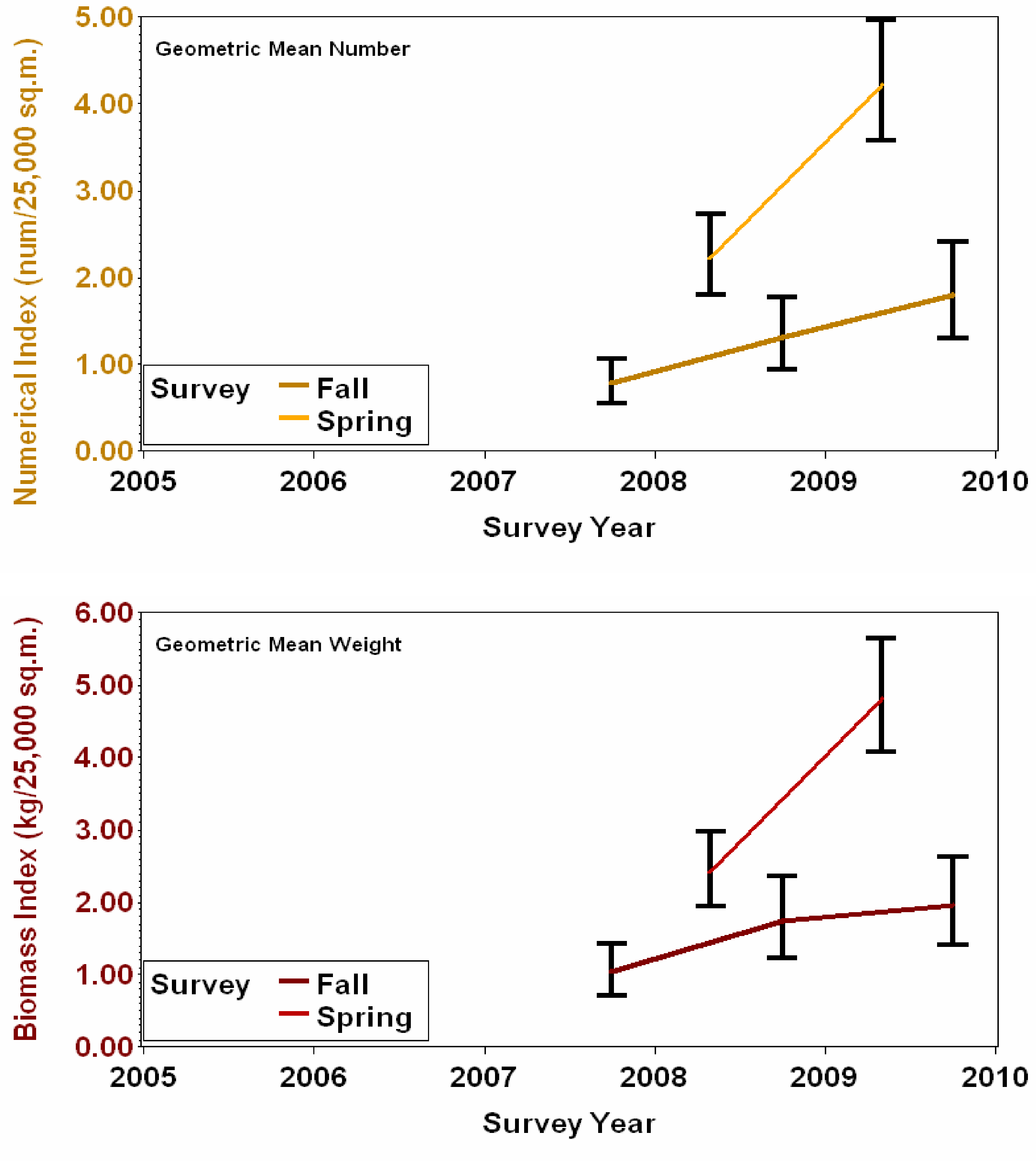


Figure 60. Width-frequency distributions, by cruise, for horseshoe crab.

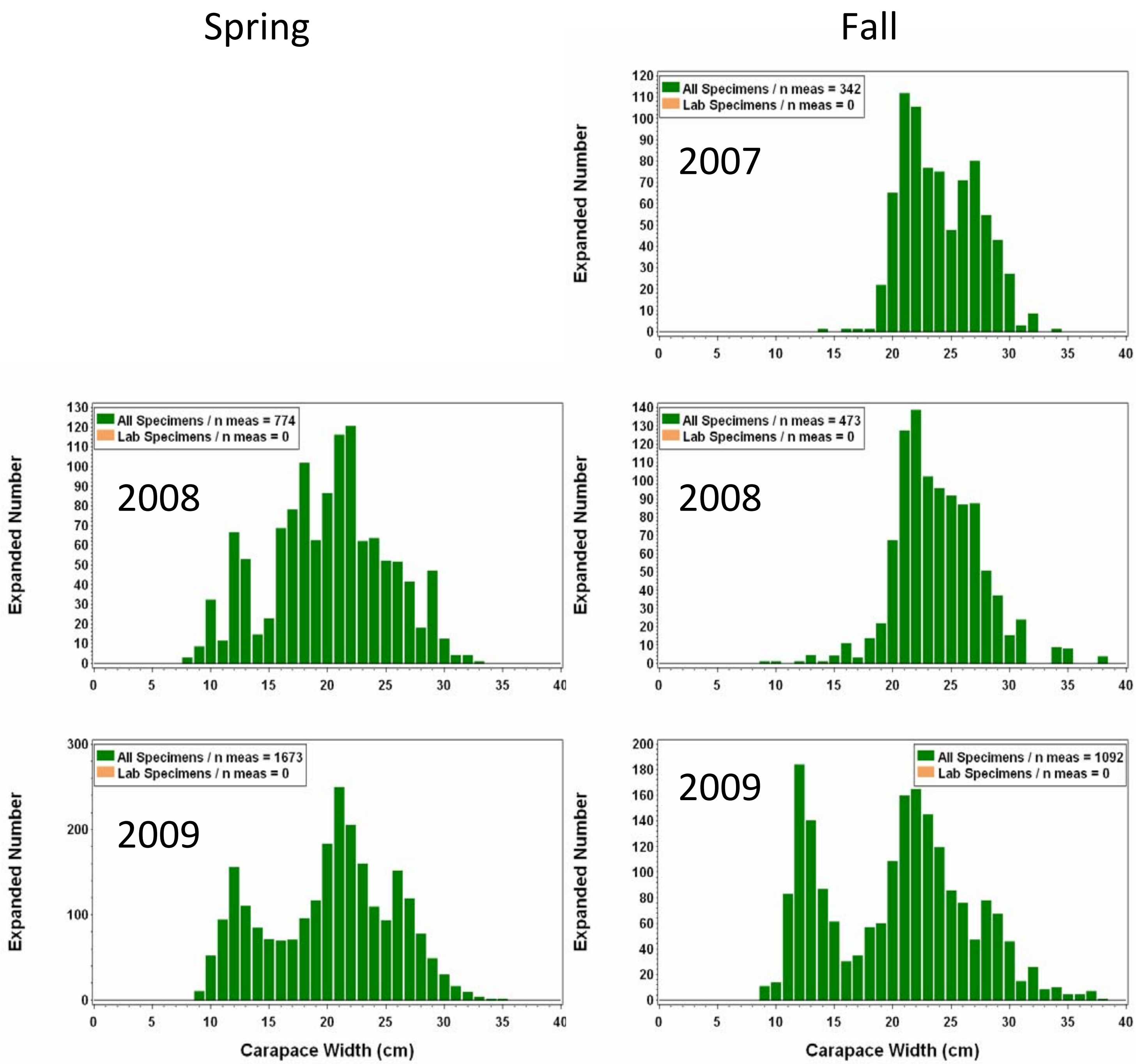
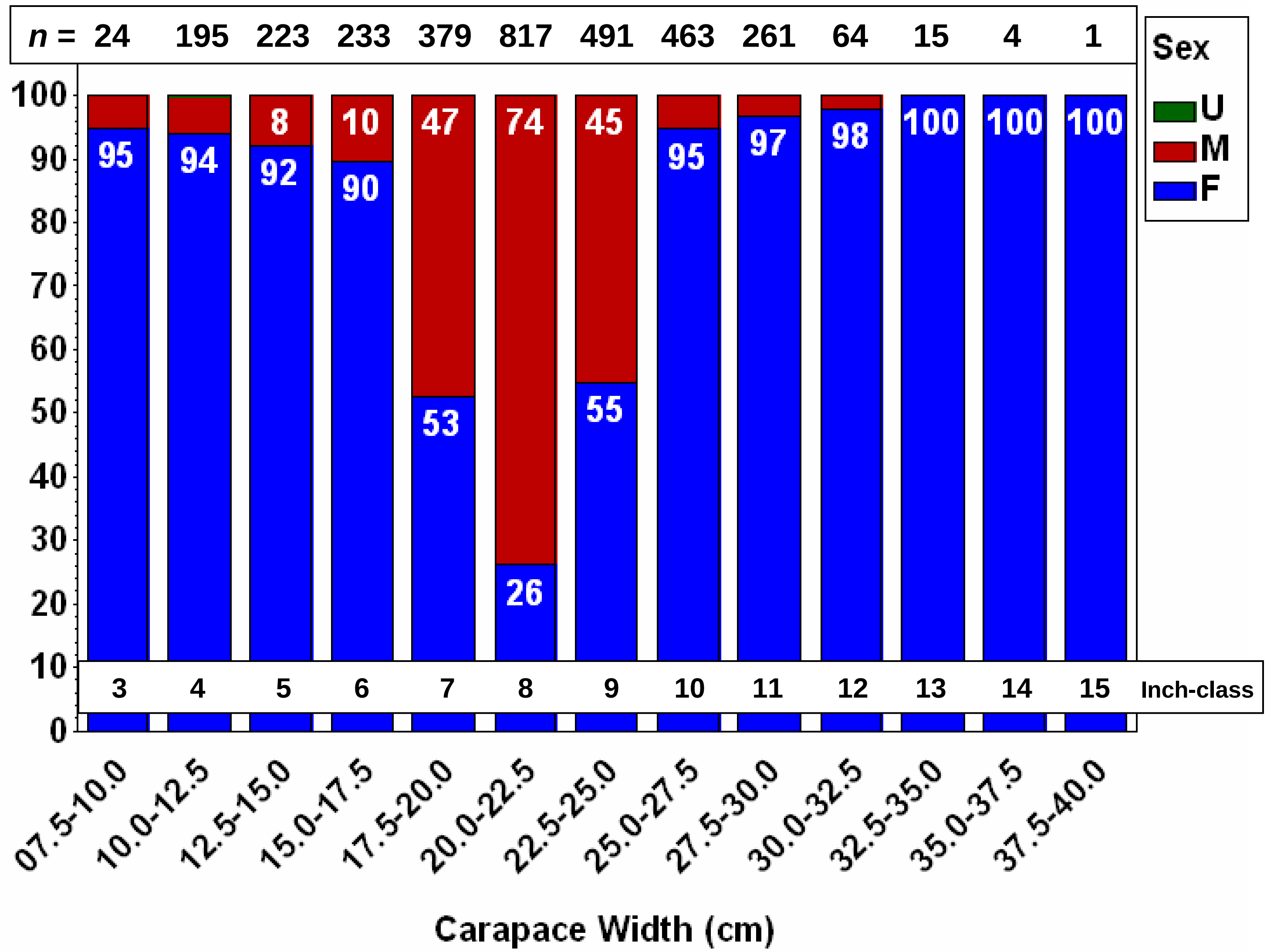


Figure 61. Sex ratio, by length group, for horseshoe crab collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



Kingfishes (Priority D)

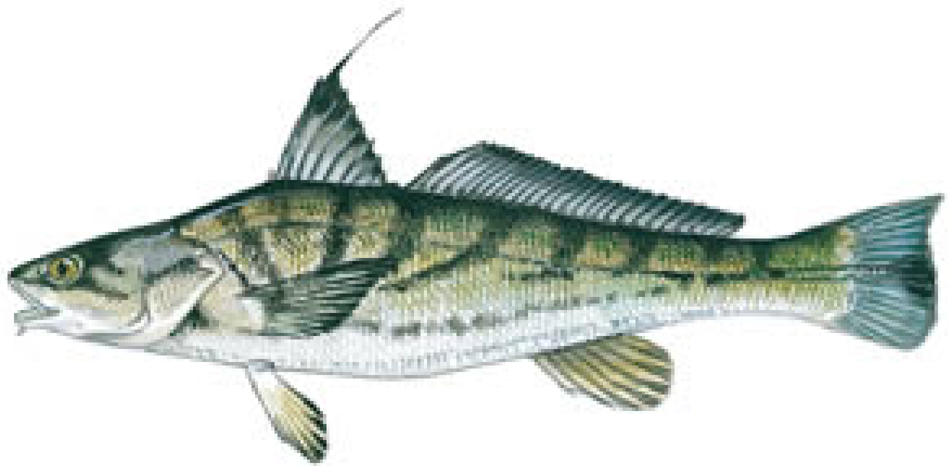


Table 19. Sampling rates and abundance indices of kingfishes for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	9,124	1,398.8	1,707					3.81	7.5	1.21	10
2008	Spring	6,638	699.8	759					1.86	7.7	0.62	11
	Fall	8,026	1,254.4	1,502					4.88	6.3	1.77	7.7
2009	Spring	1,742	207.8	483					0.62	10.6	0.21	12.8
	Fall	7,969	888.9	3,303					6.64	4.4	1.66	5.9

Figure 62. Biomass (kg) of kingfishes collected at each sampling site for each 2009 NEAMAP cruise.

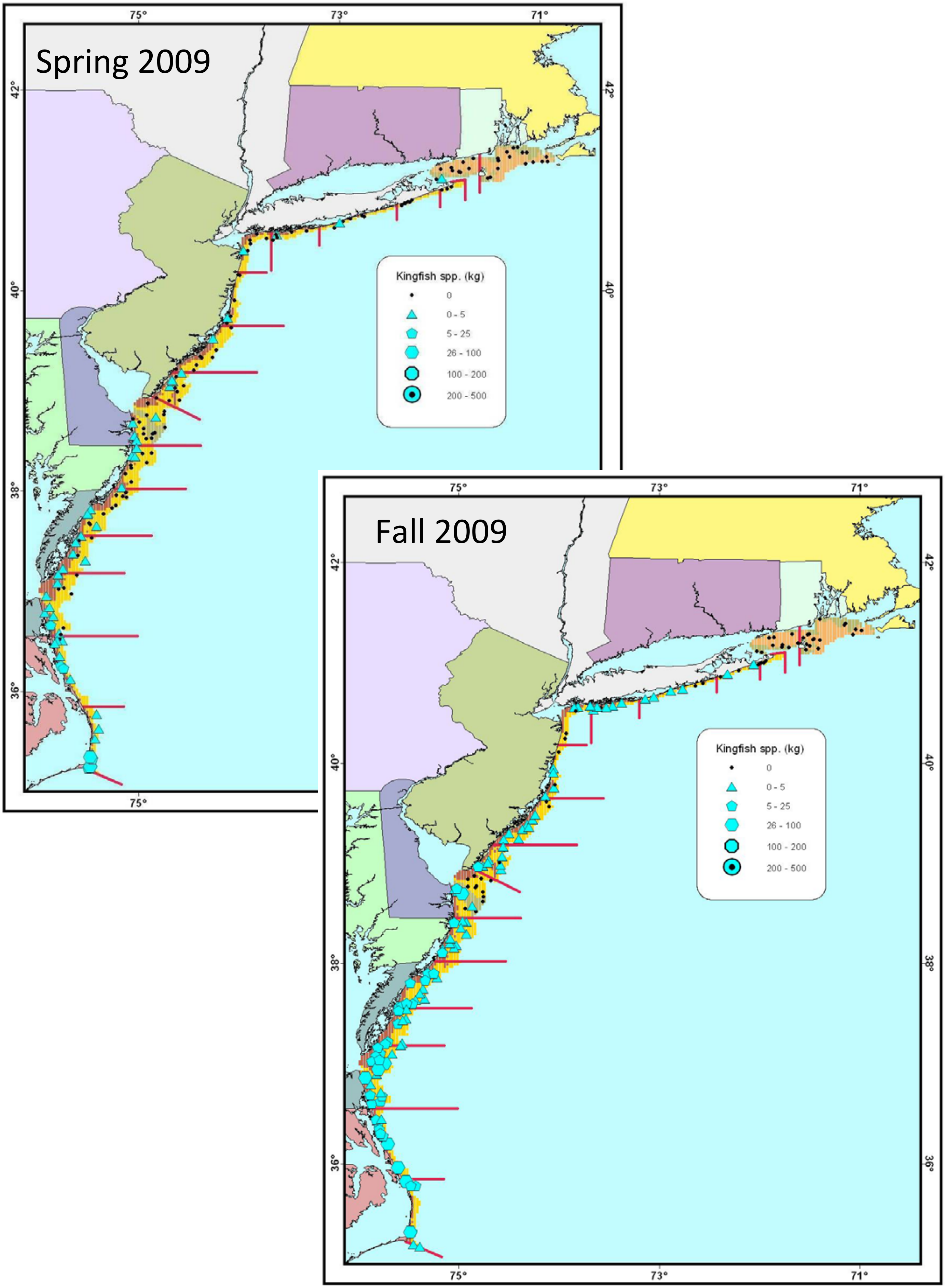


Figure 63. Preliminary indices of abundance, in terms of number and biomass, of kingfishes for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

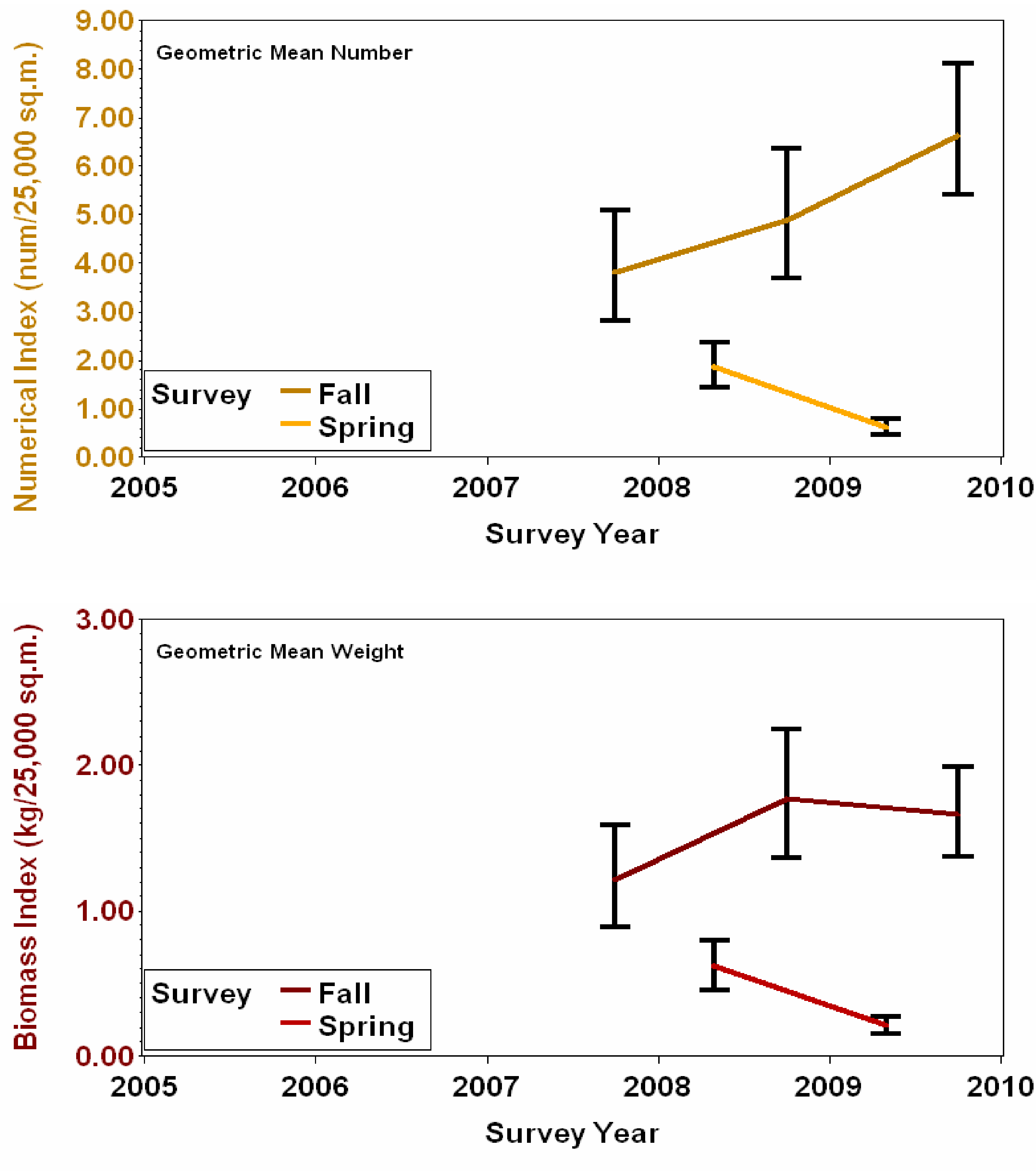
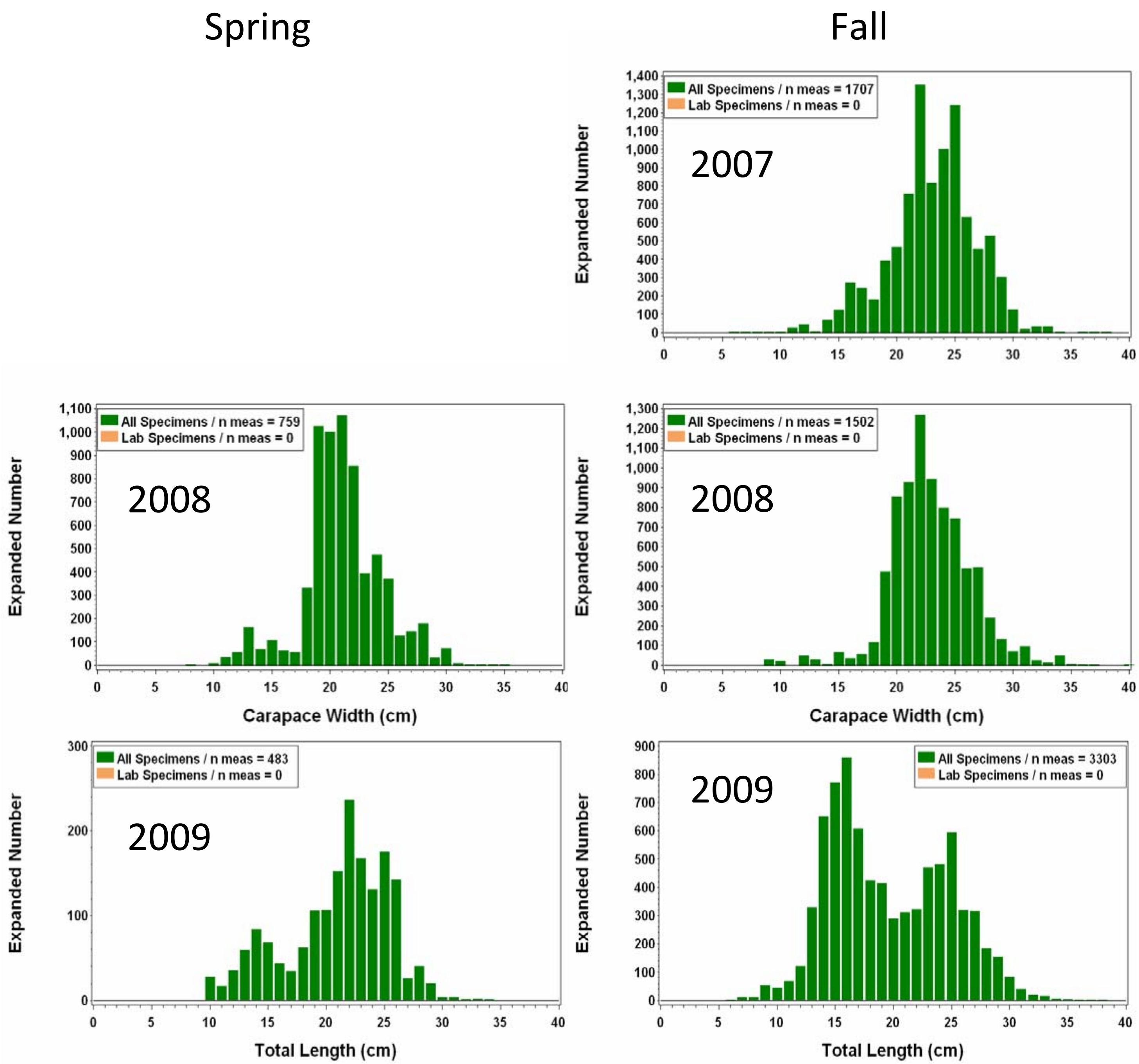


Figure 64. Length-frequency distributions, by cruise, for kingfishes.



Little Skate (Priority A)

Table 20. Sampling rates and abundance indices of little skate for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	5,288	3,026.2	2,659	194	0	188	181	3.53	4.5	2.71	4.8
2008	Spring	9,873	5,862.5	2,991	312	0	301	299	14.87	2.3	10.25	2.5
	Fall	7,014	4,104.8	2,247	263	0	259	256	6.31	3.1	4.51	3.4
2009	Spring	23,391	12,463.6	5,115	397	0	383	377	21.10	2	13.17	2.3
	Fall	8,441	4,964.4	4,370	303	0	283		8.35	1.9	5.74	2

Figure 65. Biomass (kg) of little skate collected at each sampling site for each 2009 NEAMAP cruise.

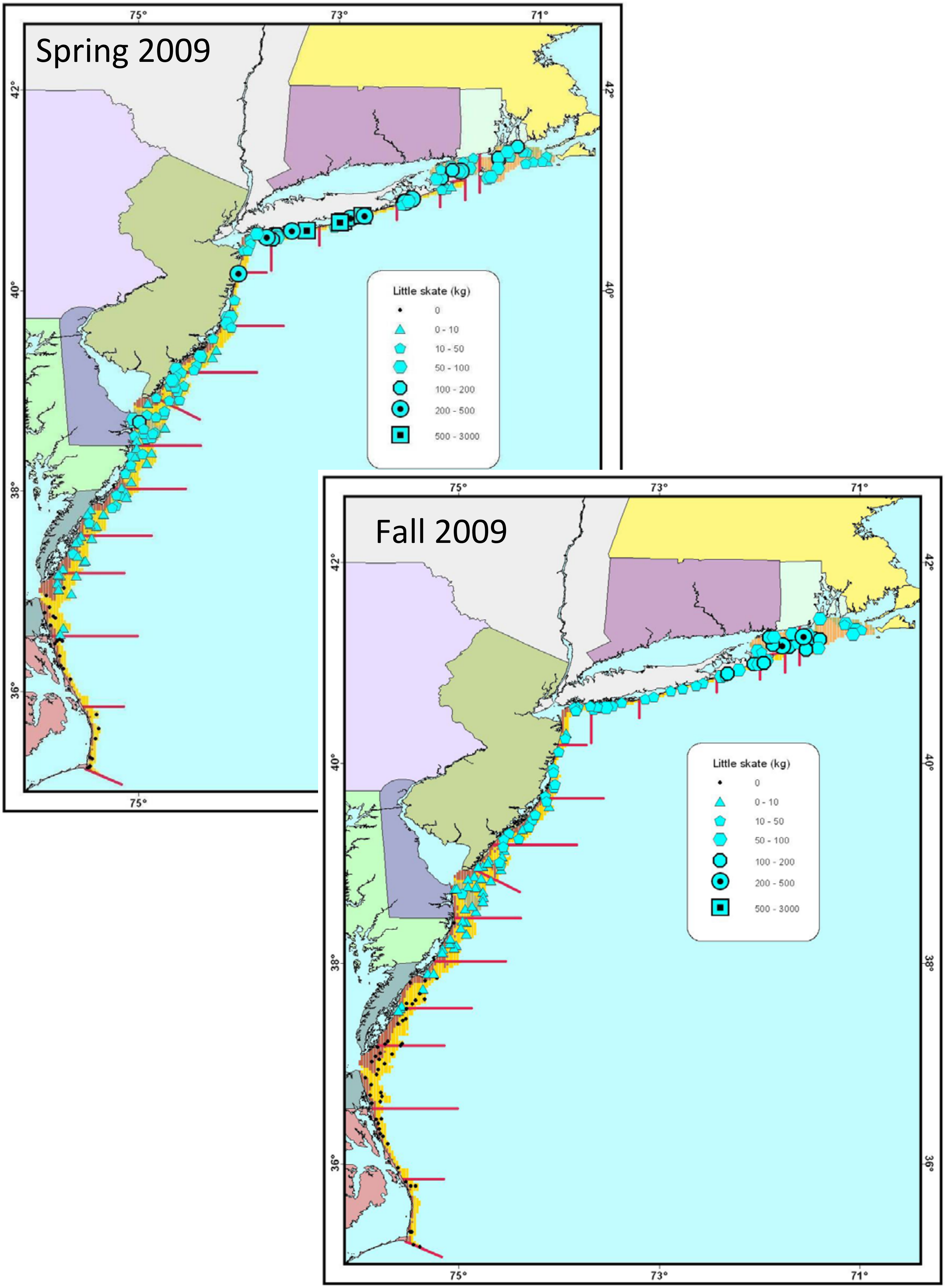
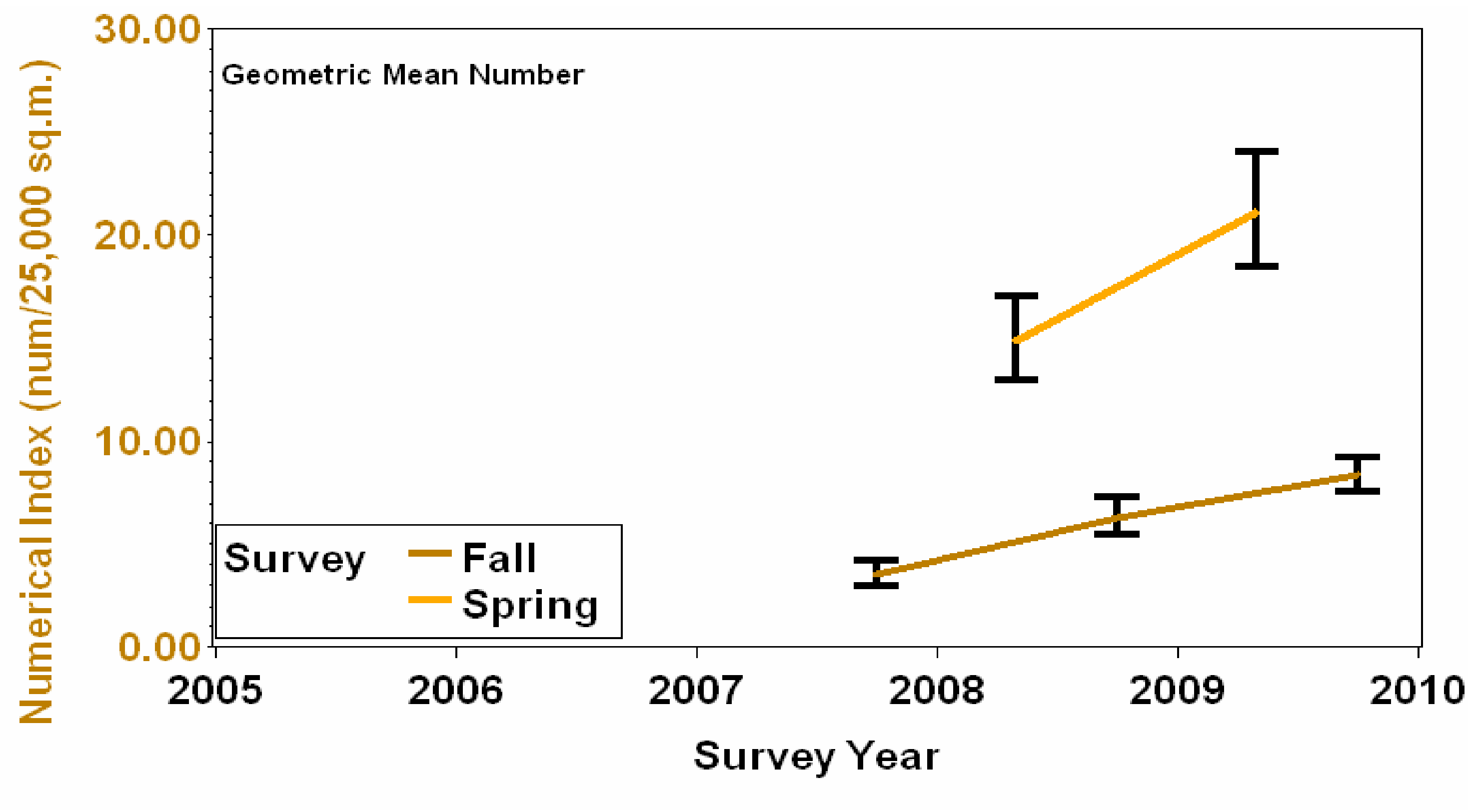


Figure 66. Preliminary indices of abundance, in terms of number and biomass, of little skate for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



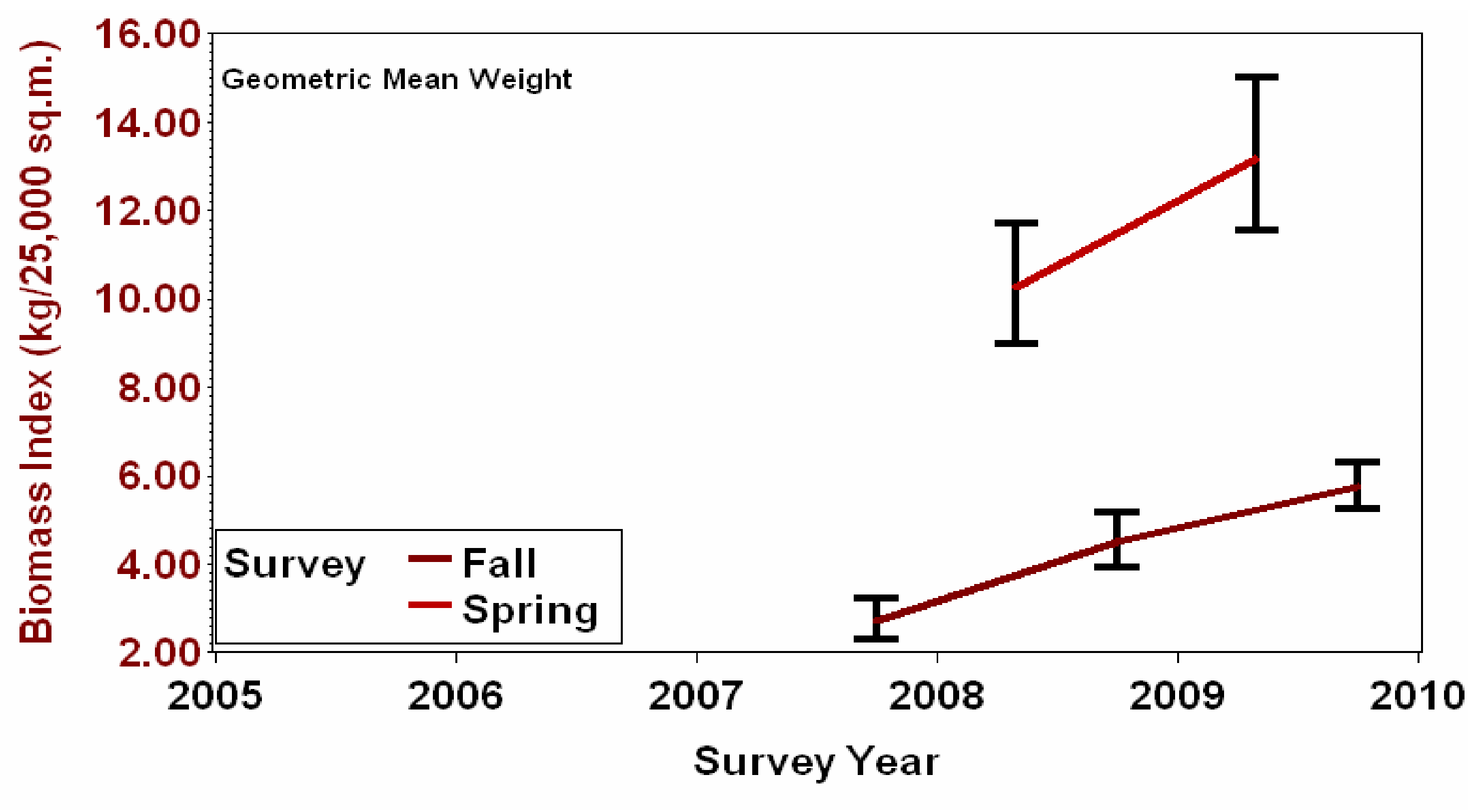


Figure 67. Width-frequency distributions, by cruise, for little skate. Numbers taken for full processing, by length, are represented by the orange bars.

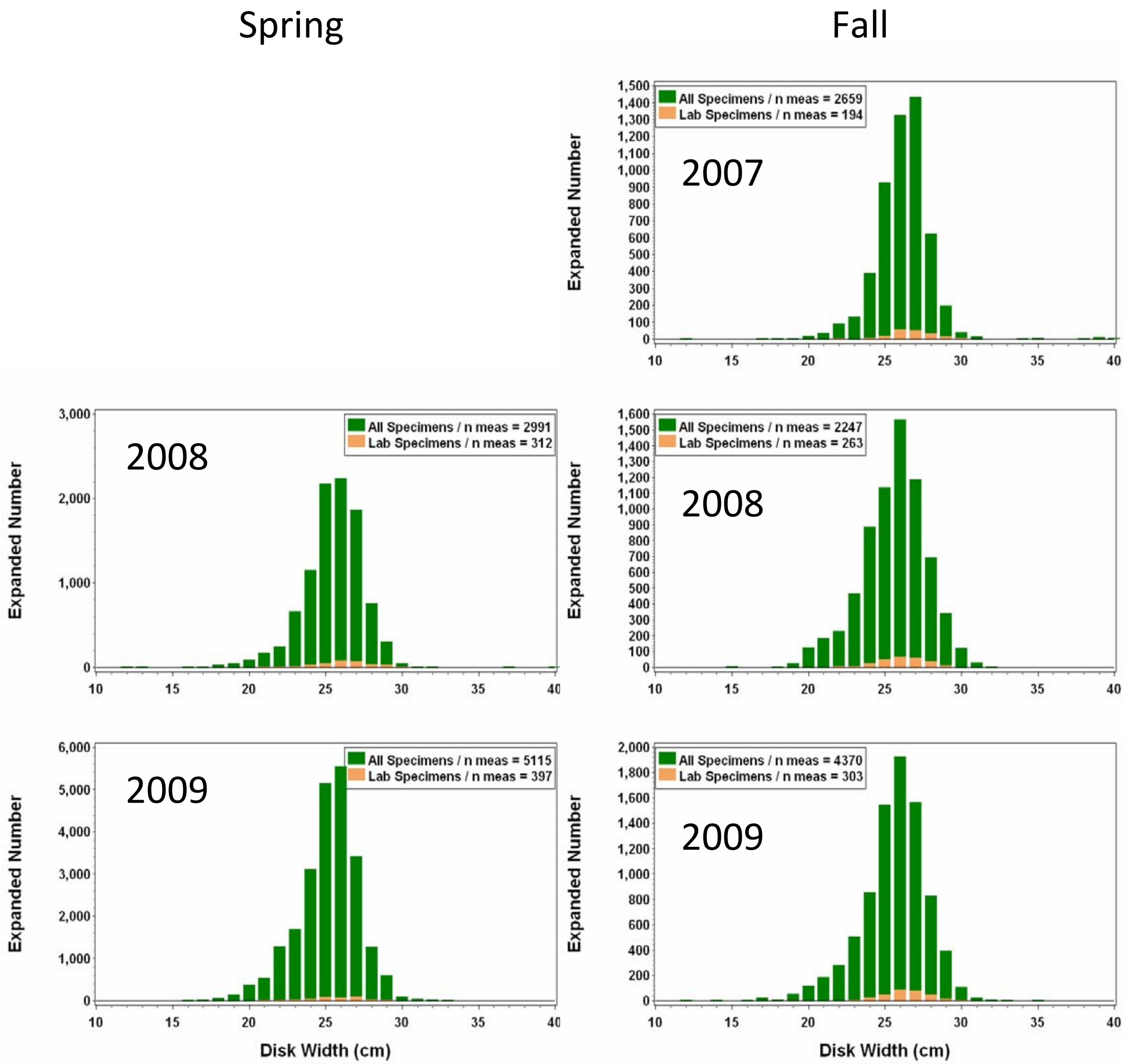


Figure 68. Sex ratio, by length group, for little skate collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

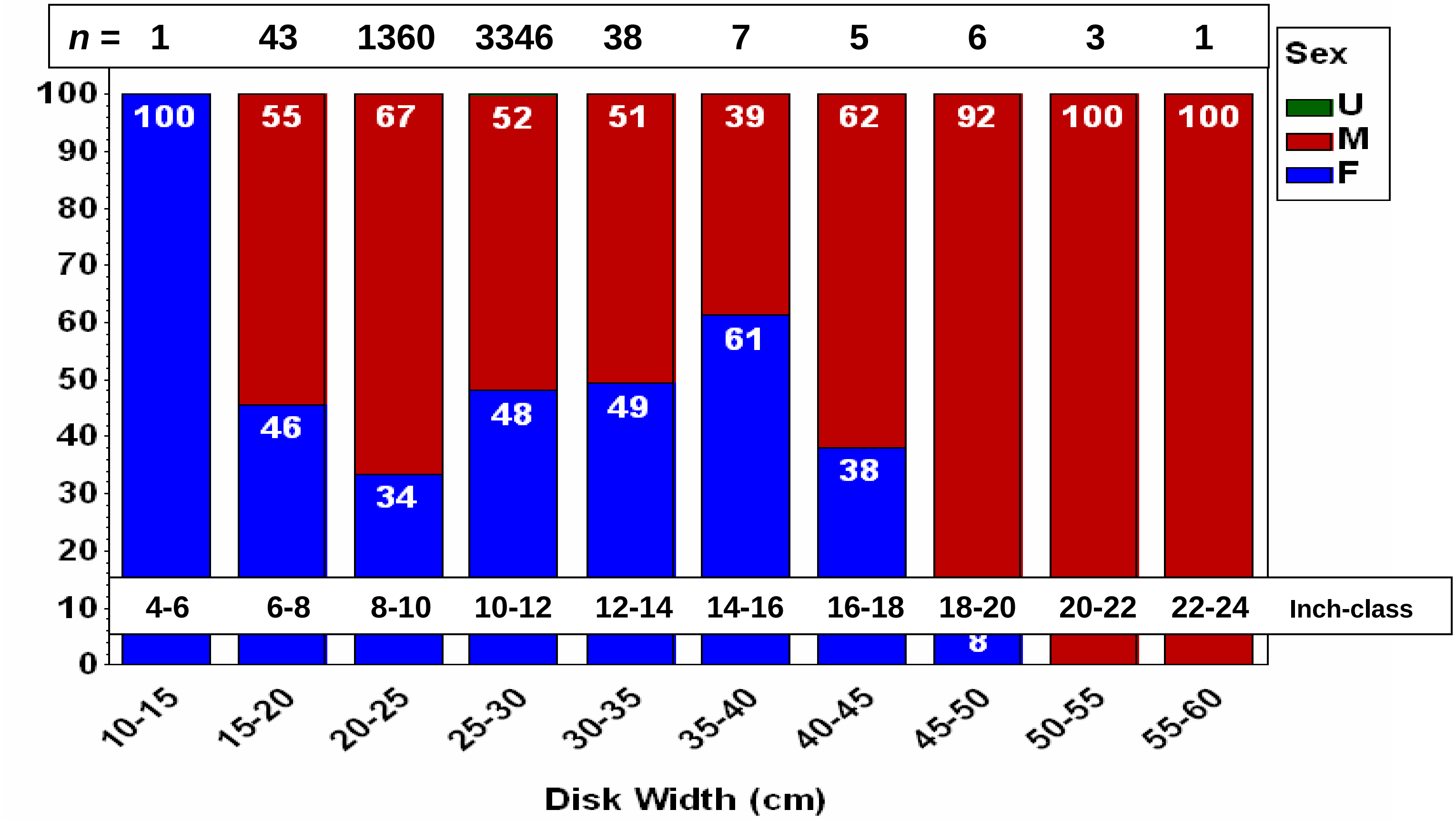
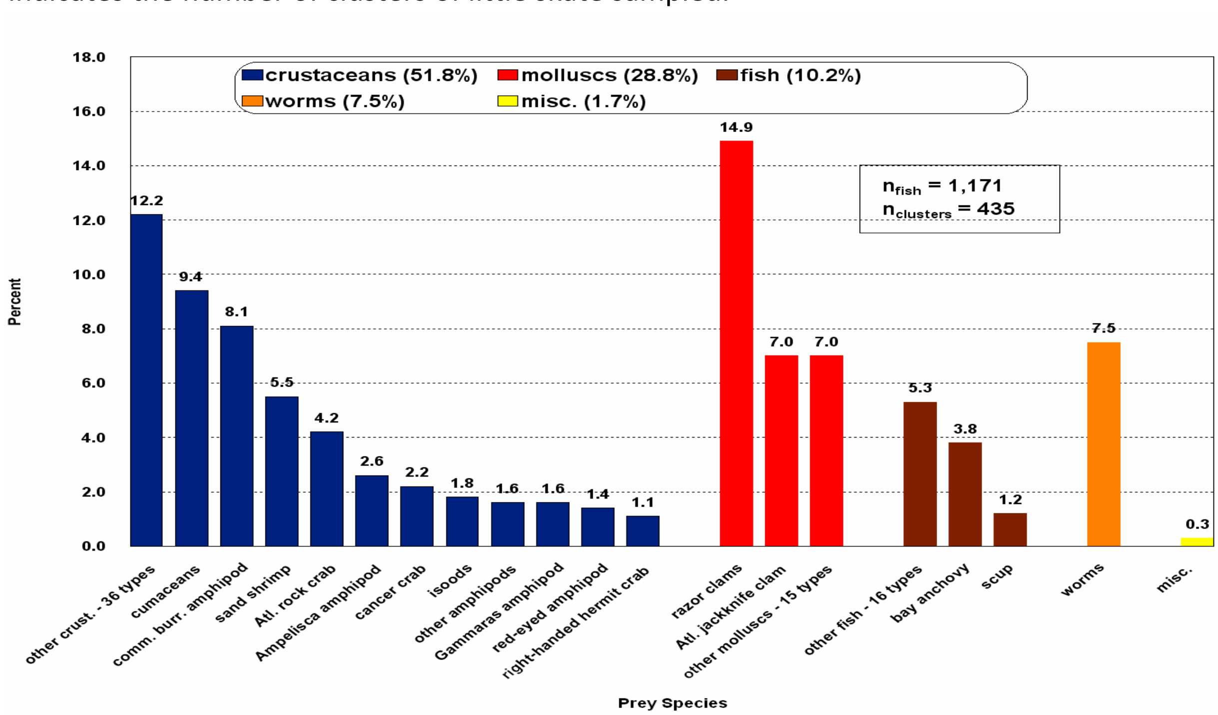


Figure 69. Diet composition, expressed using the percent weight index, of little skate collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of little skate sampled.



Loligo Squid (Priority E)

Table 21. Sampling rates and abundance indices of *Loligo* squid for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	119,512	2,278.6	9,625					147.03	2	5.03	3.9
2008	Spring	19,549	776.2	5,127					35.23	3.2	2.42	5.4
	Fall	93,383	1,357.9	5,998					48.16	2.9	2.83	4.5
2009	Spring	12,451	501.6	5,710					23.43	3.1	1.59	5.6
	Fall	242,495	3,406.4	10,005					114.95	2.5	5.73	3.5

Figure 70. Biomass (kg) of *Loligo* squid collected at each sampling site for each 2009 NEAMAP cruise.

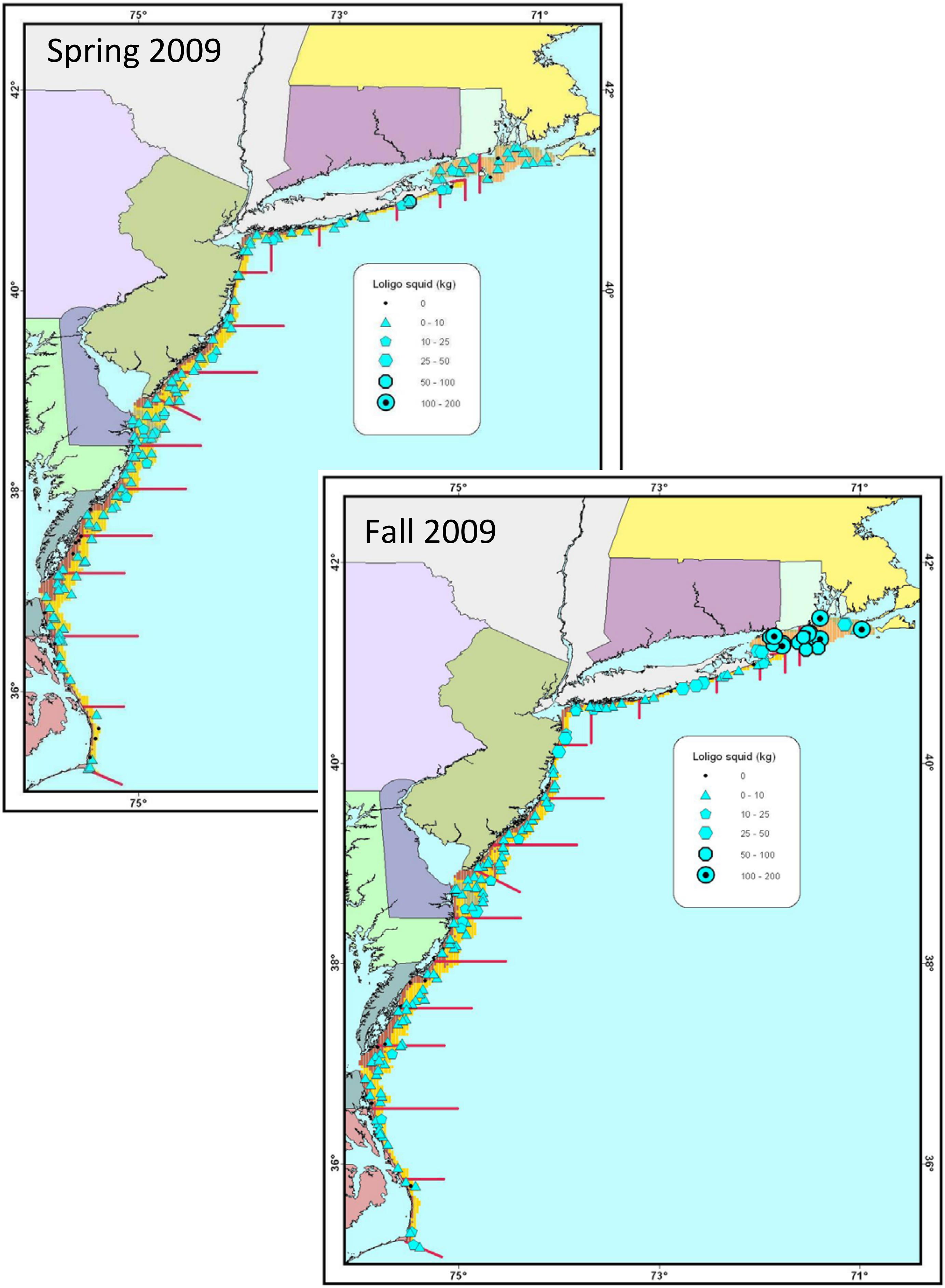
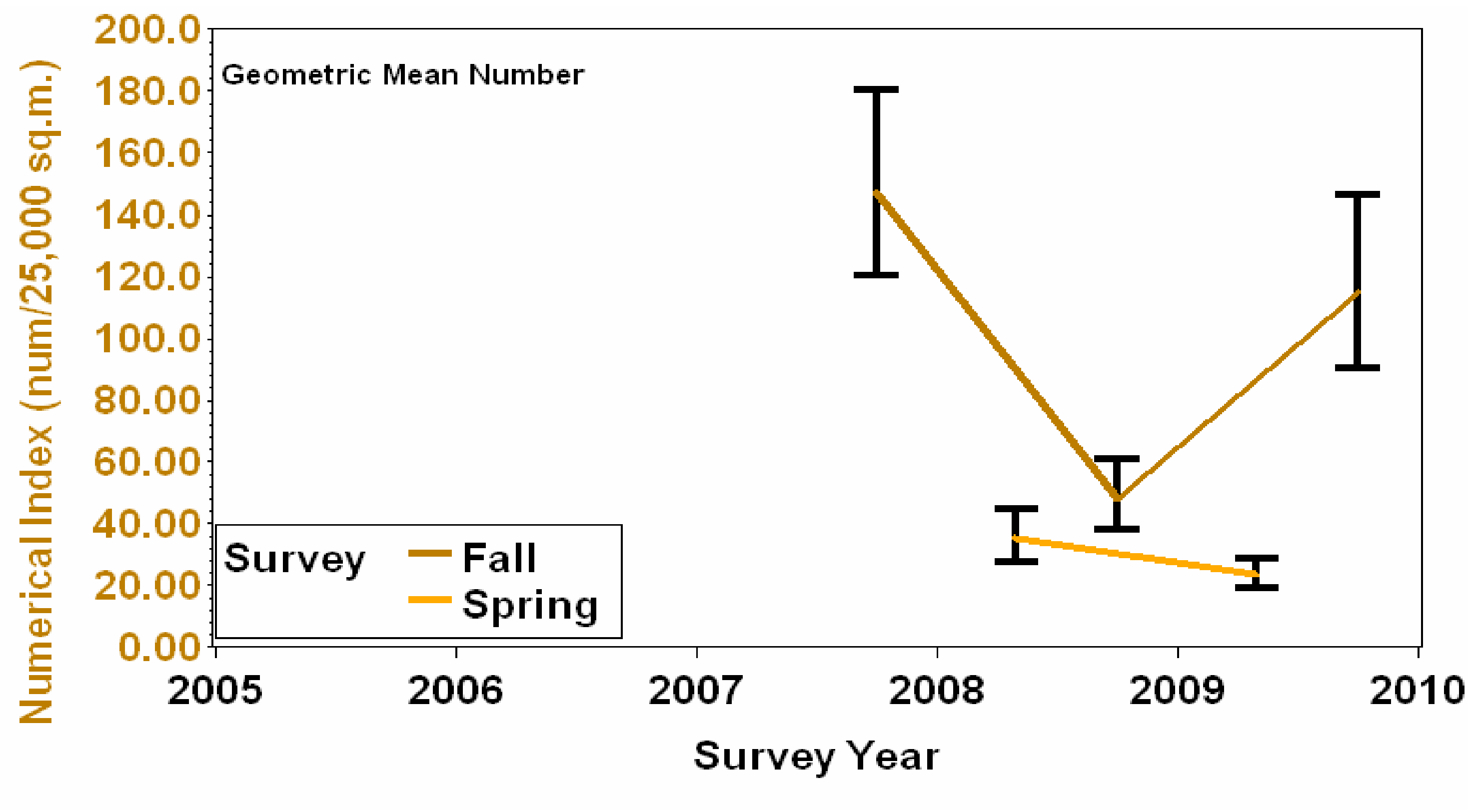


Figure 71. Preliminary indices of abundance, in terms of number and biomass, of *Loligo* squid for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



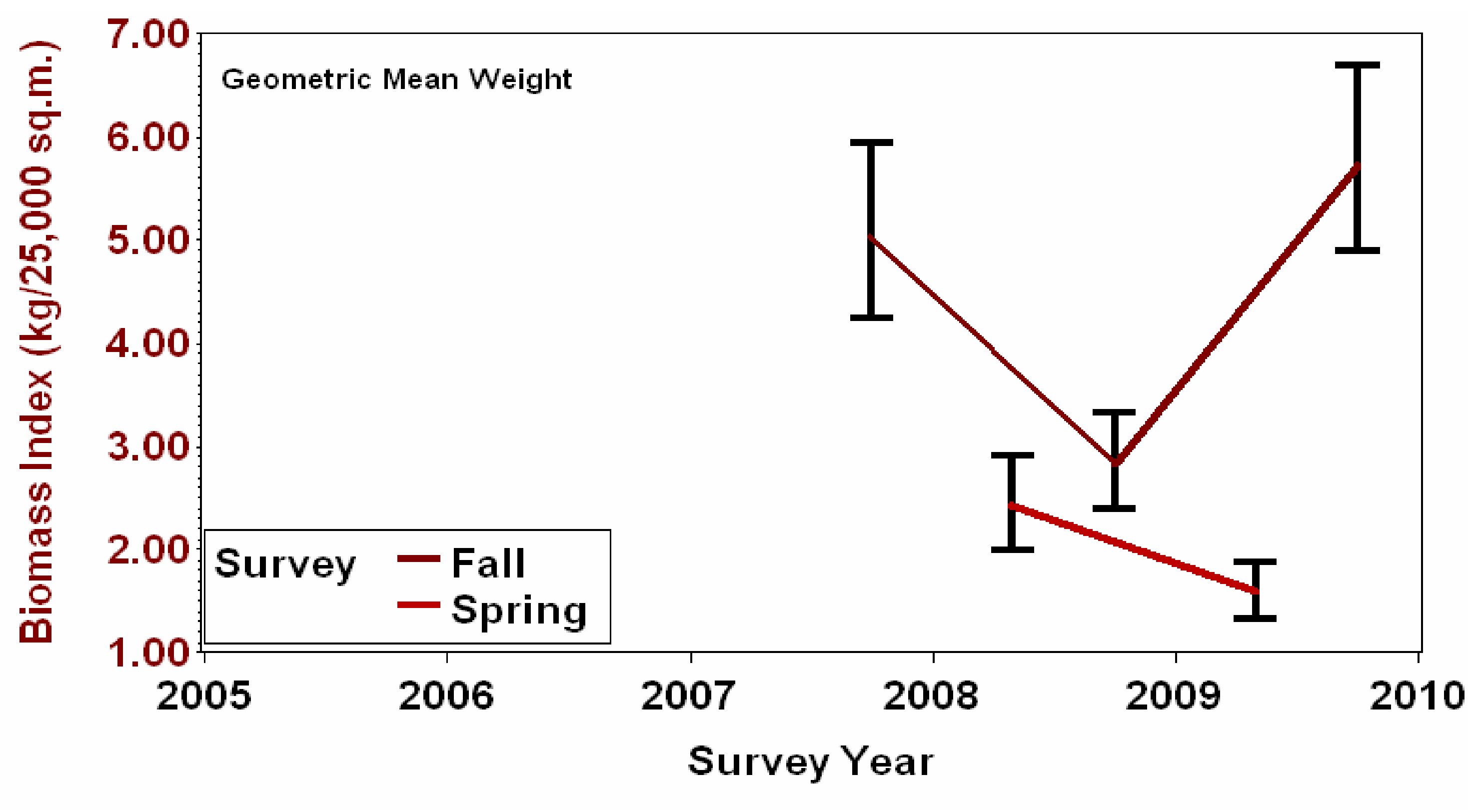
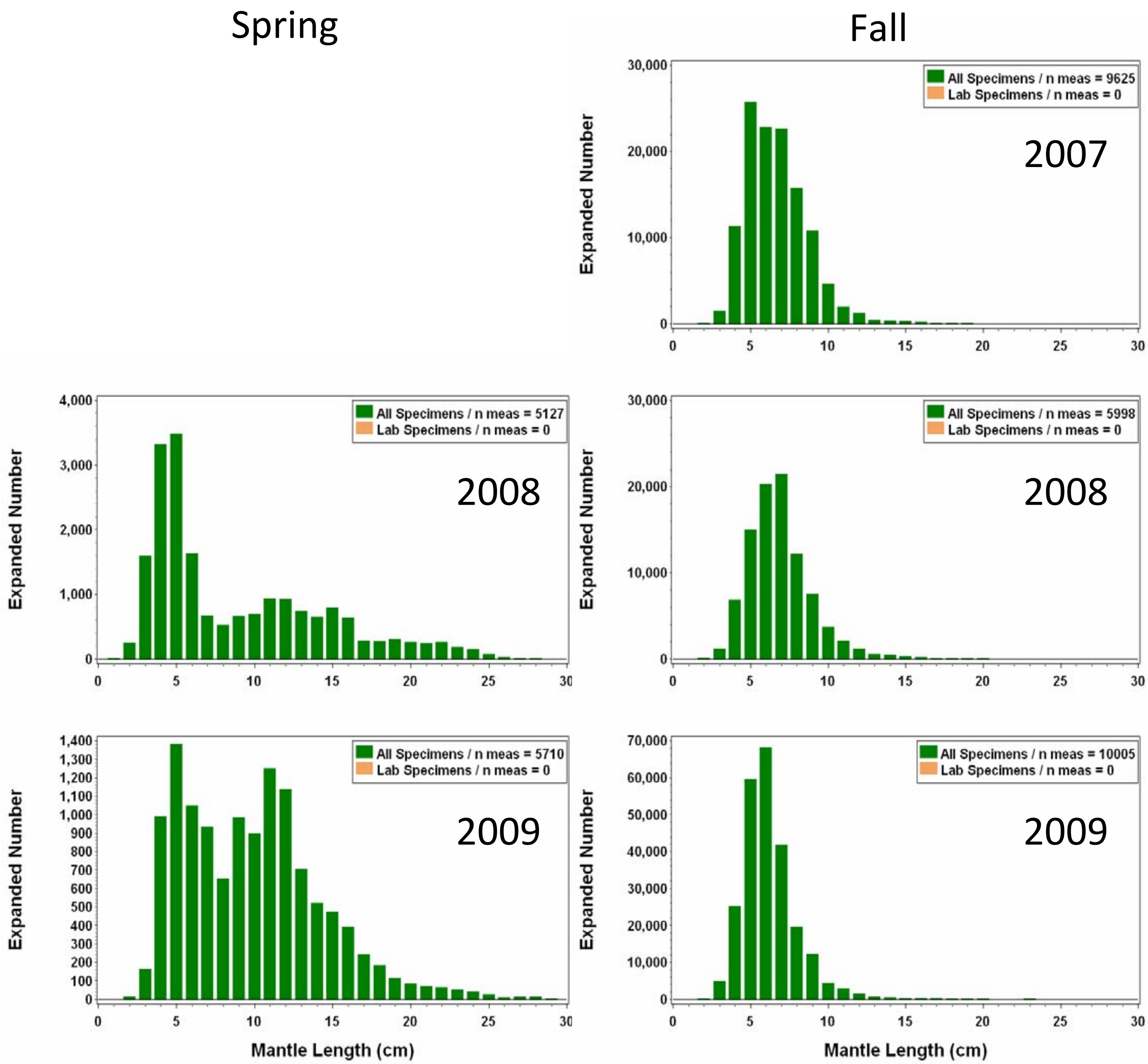


Figure 72. Length-frequency distributions, by cruise, for *Loligo* squid.



Scup (Priority A)

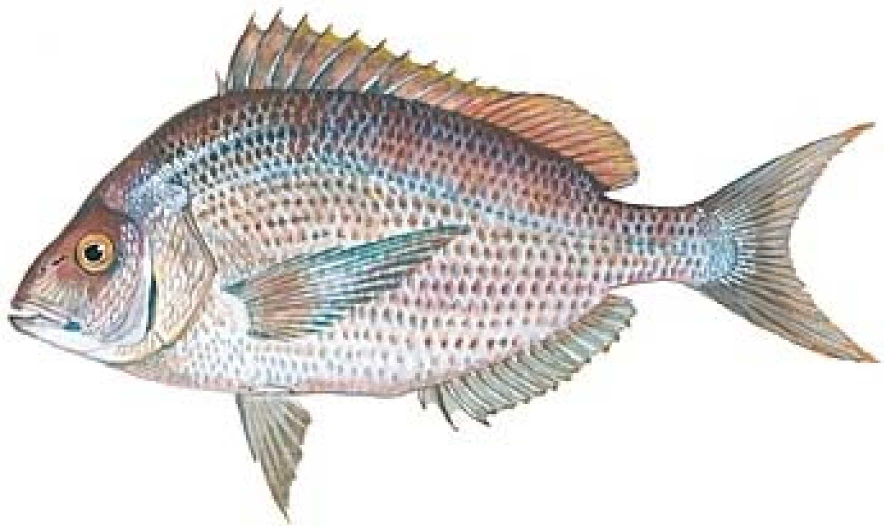


Table 22. Sampling rates and abundance indices of scup for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	276,237	3,928.8	13,721	811	808	802	795	117.07	4	7.48	5.6
2008	Spring	51,629	1,256.1	7,167	869	0	754	744	24.82	3.9	2.05	6.4
	Fall	77,858	2,503.2	6,946	670	0	668	661	24.78	5.1	3.15	6.6
2009	Spring	16,884	2,827.3	7,043	740	0	708	698	6.79	6.3	1.32	10.8
	Fall	158,567	2,577.8	12,792	897	0	887		39.03	4.4	3.82	5.6

Figure 73. Biomass (kg) of scup collected at each sampling site for each 2009 NEAMAP cruise.

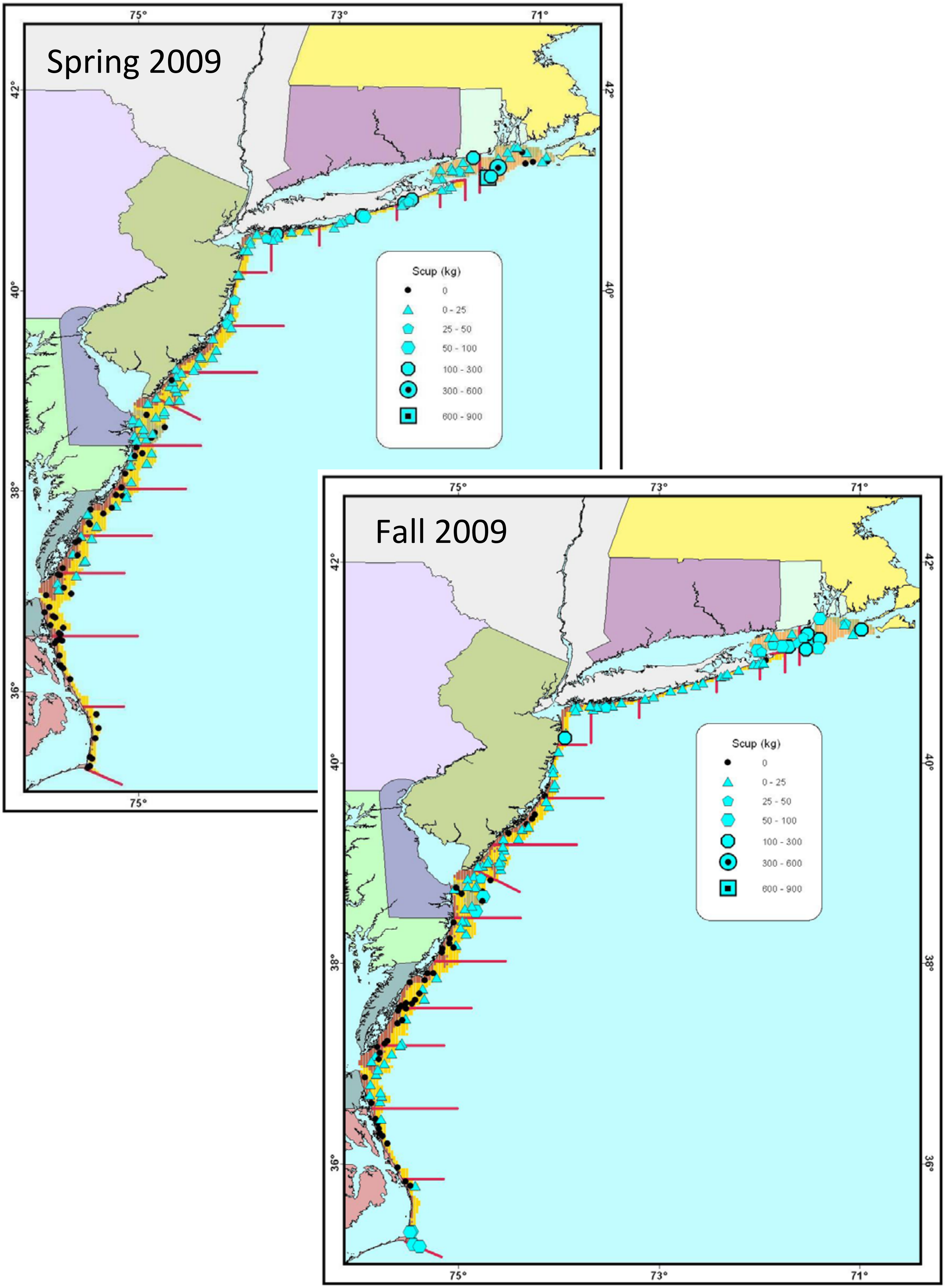


Figure 74. Preliminary indices of abundance, in terms of number and biomass, of scup for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

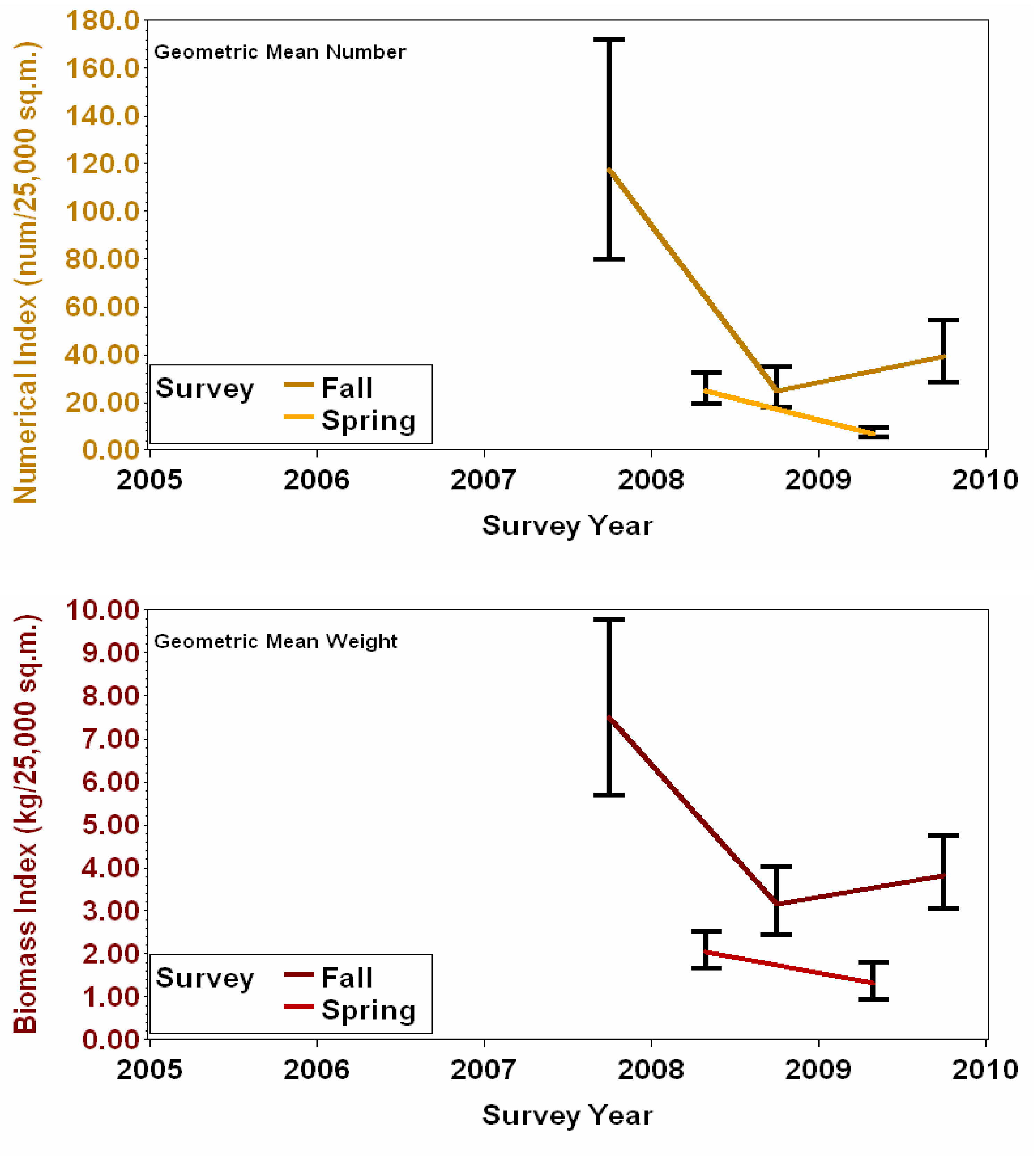


Figure 75. Length-frequency distributions, by cruise, for scup. Numbers taken for full processing, by length, are represented by the orange bars (difficult to see due to scale of y-axis).

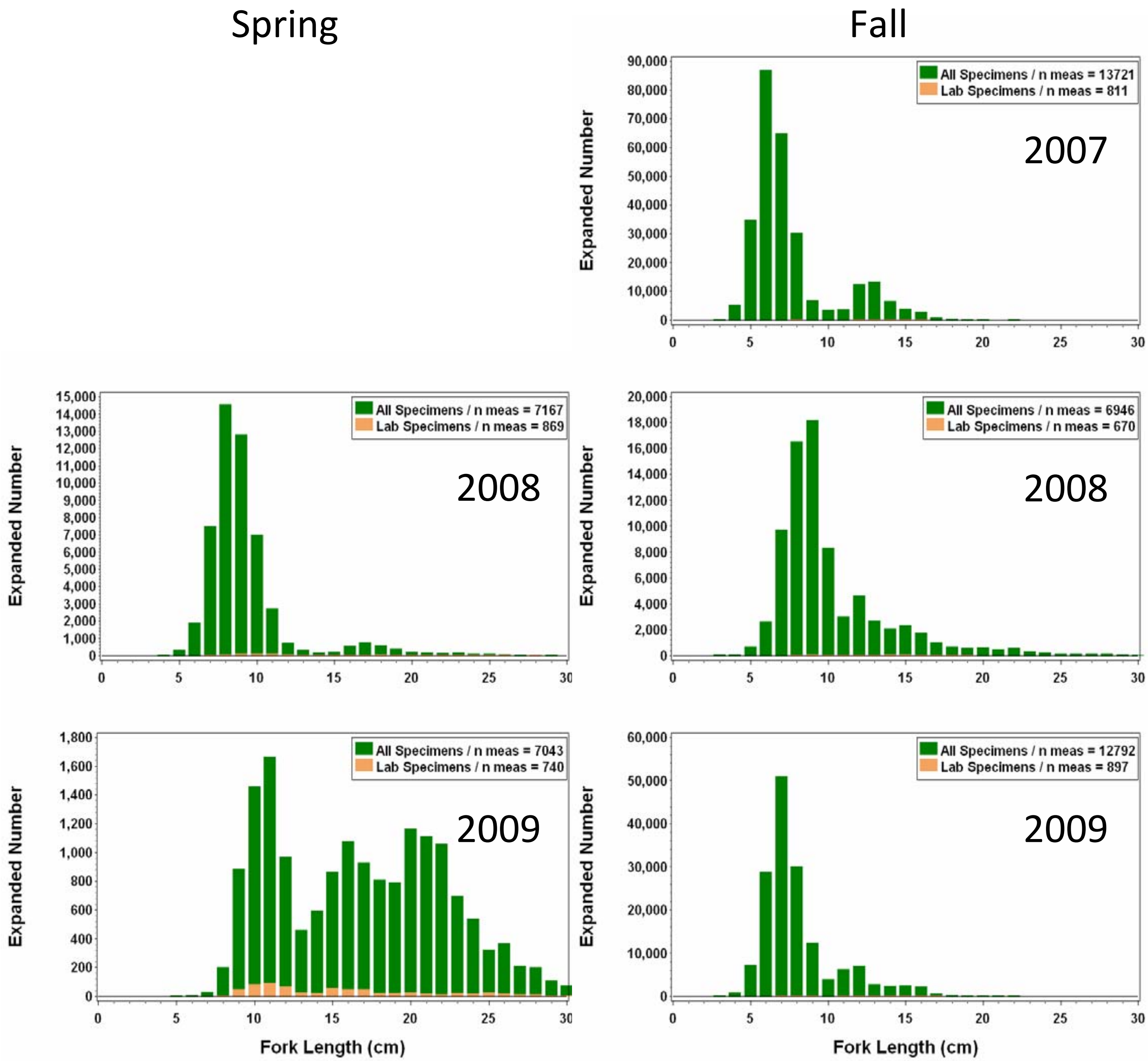


Figure 76. Sex ratio, by length group, for scup collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

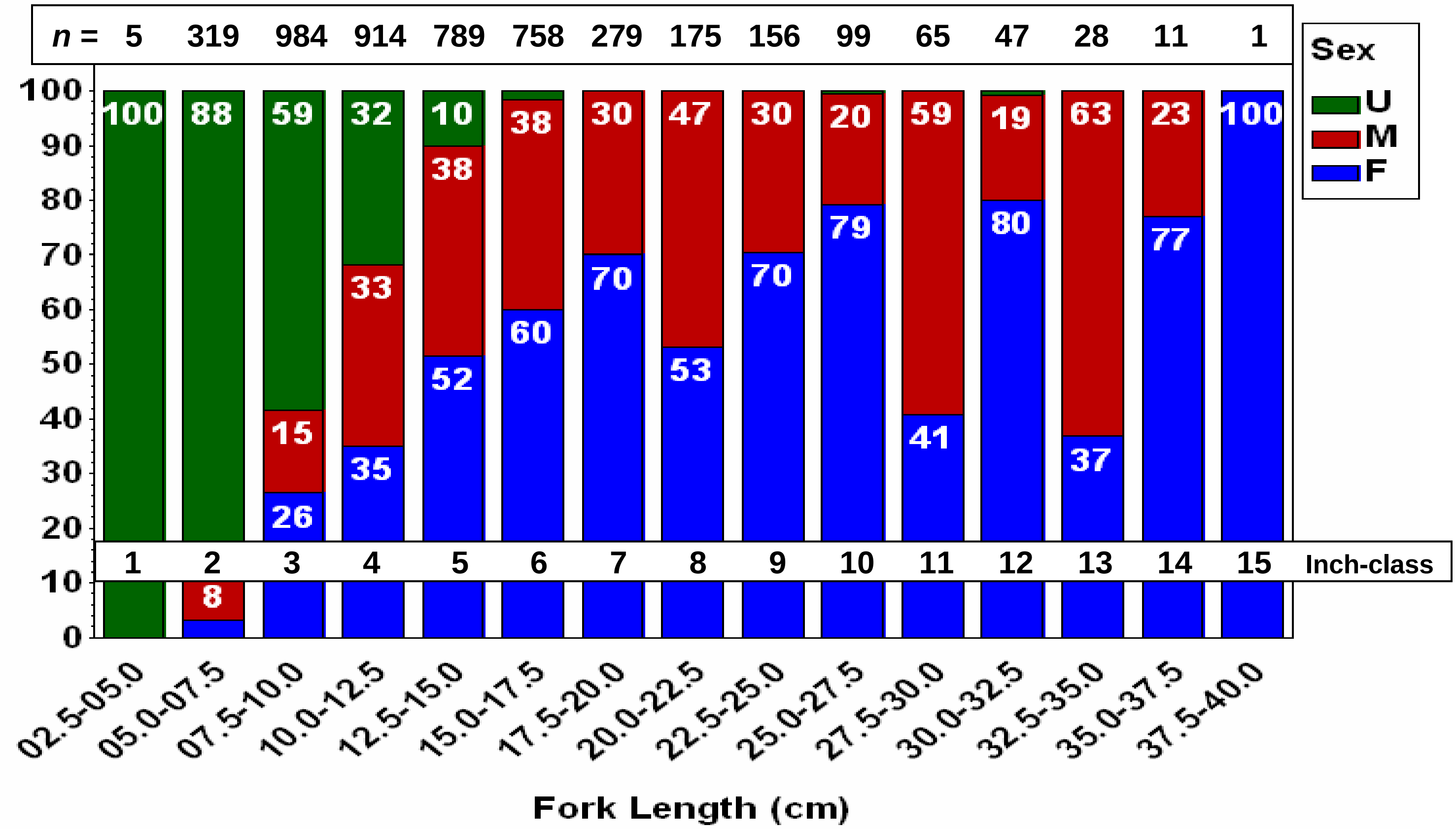
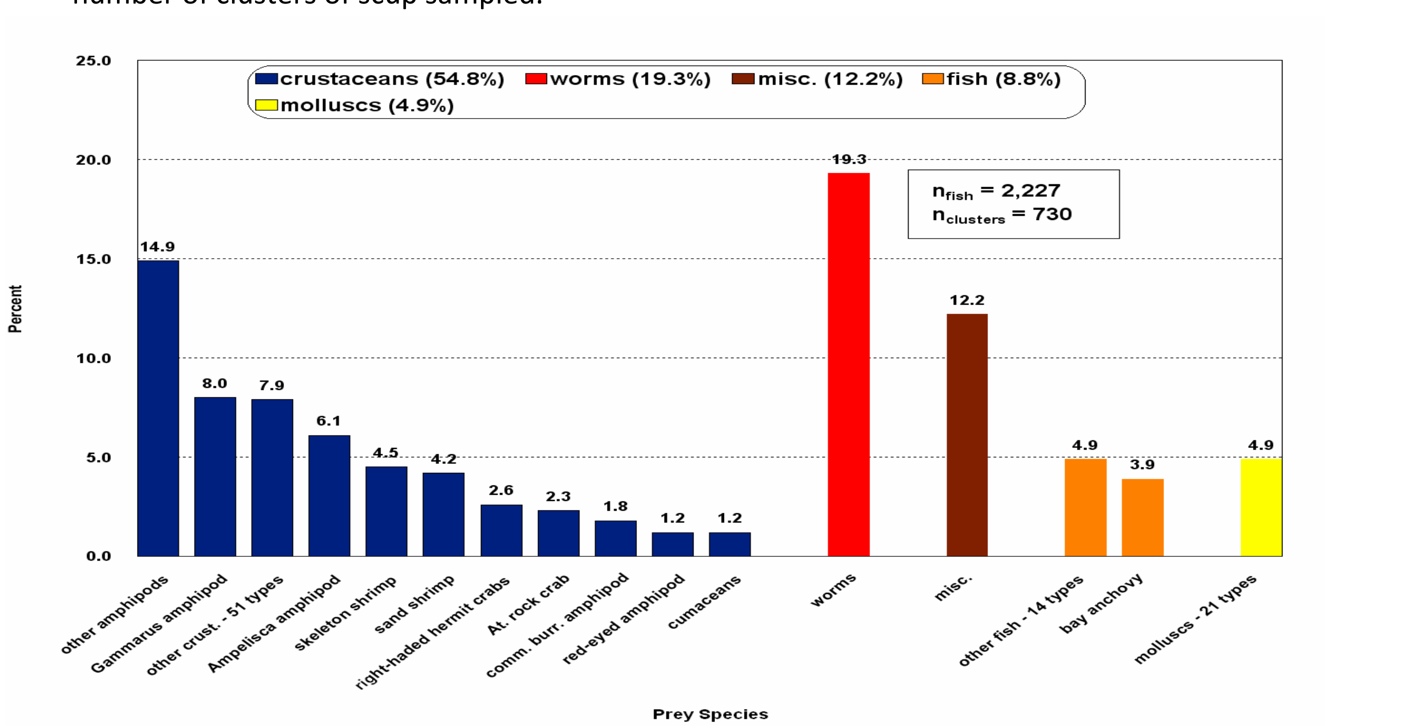


Figure 77. Diet composition, expressed using the percent weight index, of scup collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of scup sampled.



Silver Hake (Priority A)

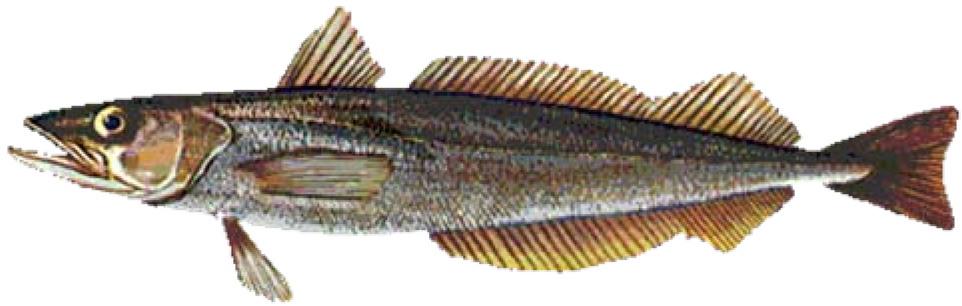


Table 23. Sampling rates and abundance indices of silver hake for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	346	24.8	346	59	0	59	59	0.32	21.3	0.06	37.9
2008	Spring	28,765	549.8	3,063	409	0	398	391	6.13	5.8	0.73	9.7
	Fall	3,125	183.9	515	96	0	88	87	0.48	19.9	0.09	48.4
2009	Spring	5,153	105.7	1,789	406	0	402	398	3.10	7.7	0.28	15.8
	Fall	1,470	17.3	499	125	0	118		0.51	17.2	0.05	46.4

Figure 78. Biomass (kg) of silver hake collected at each sampling site for each 2009 NEAMAP cruise.

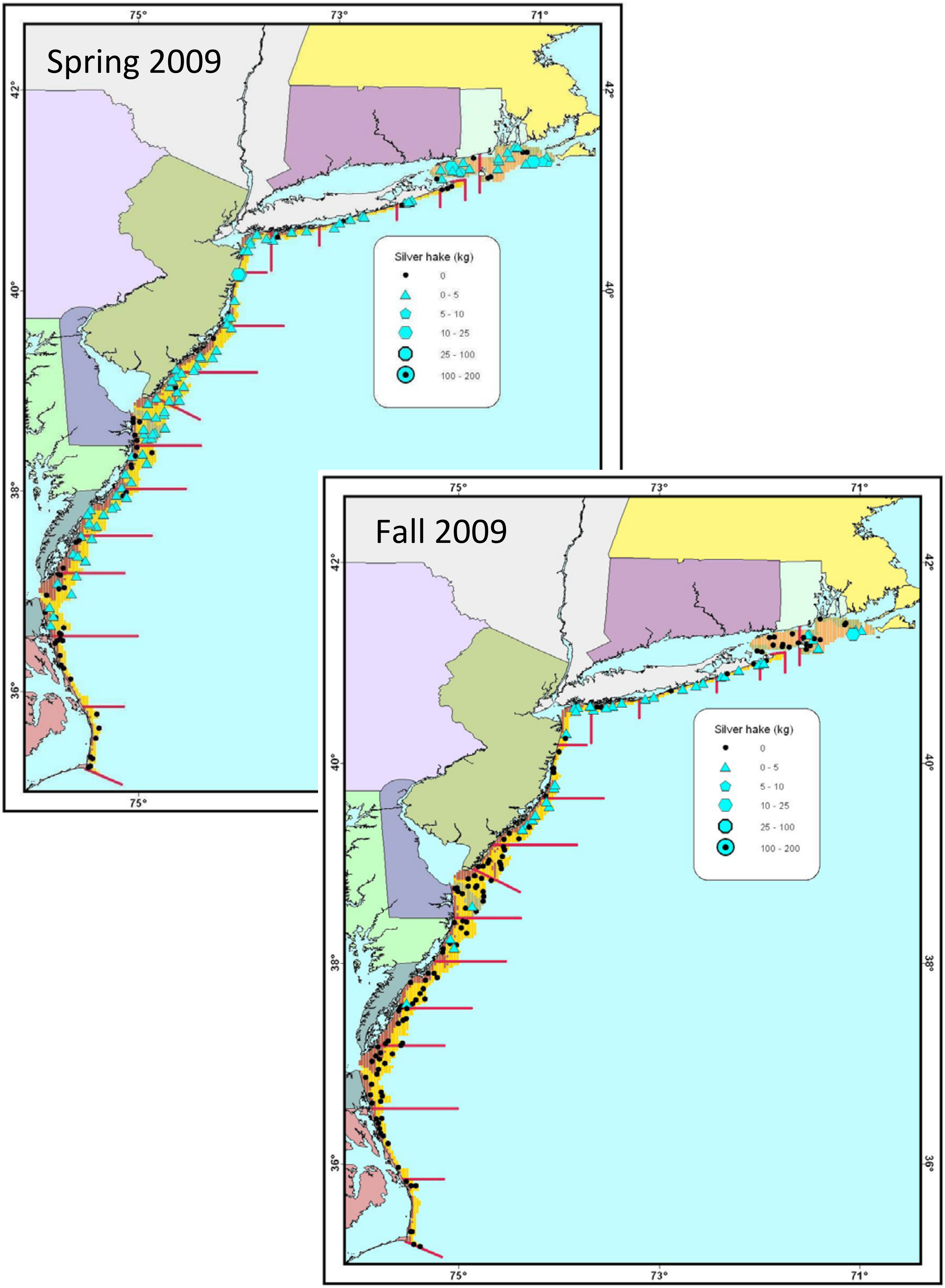
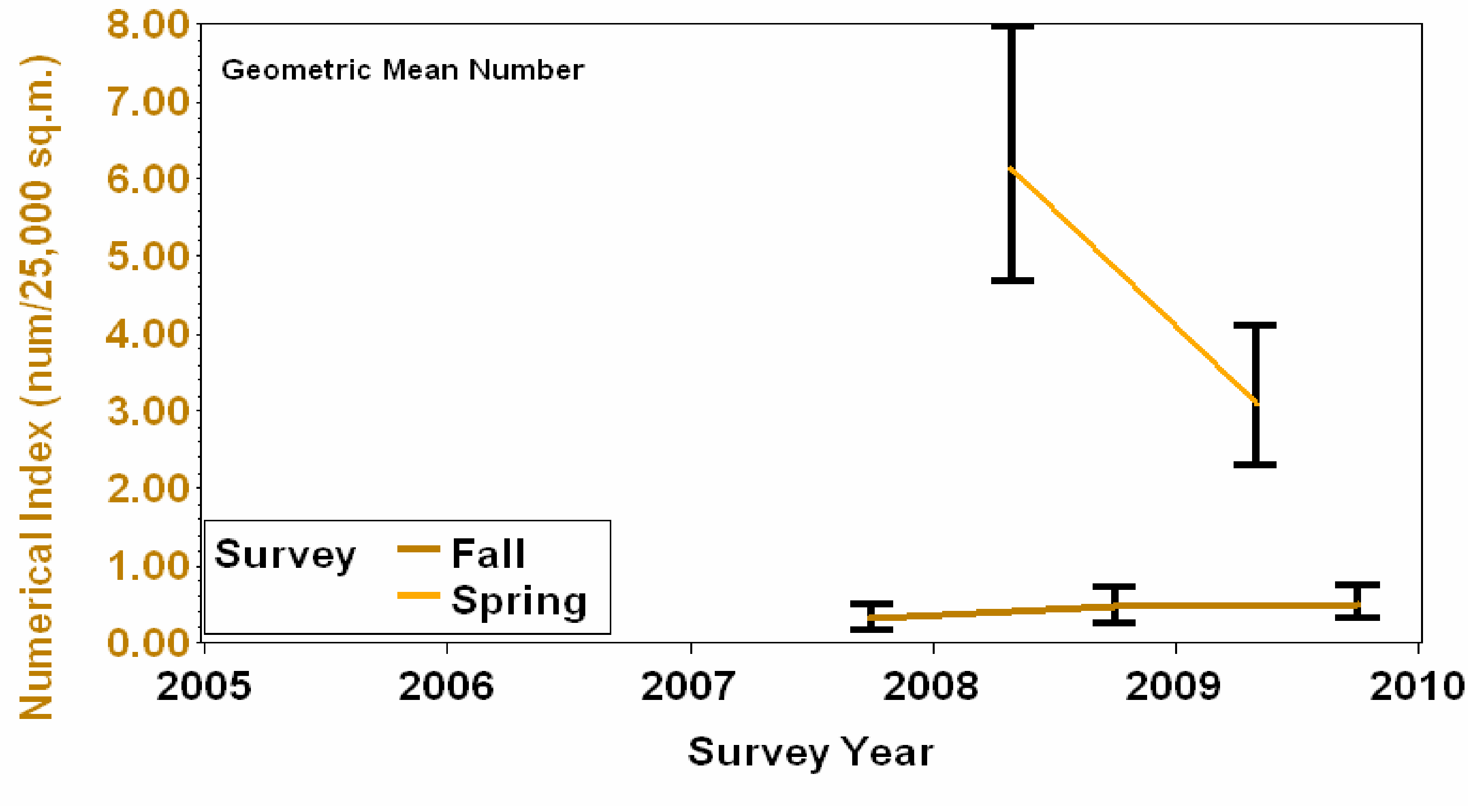


Figure 79. Preliminary indices of abundance, in terms of number and biomass, of silver hake for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



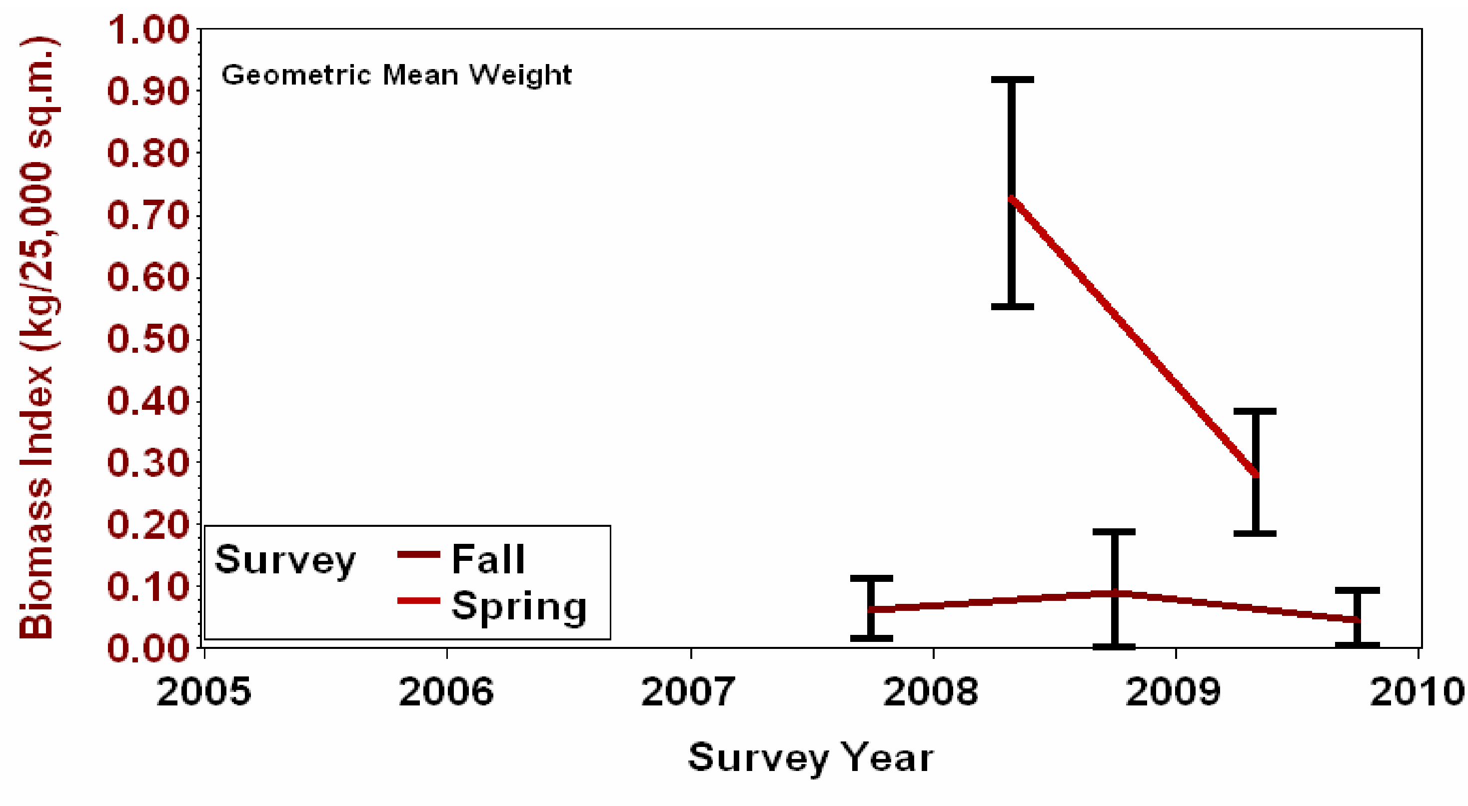


Figure 80. Length-frequency distributions, by cruise, for silver hake. Numbers taken for full processing, by length, are represented by the orange bars.

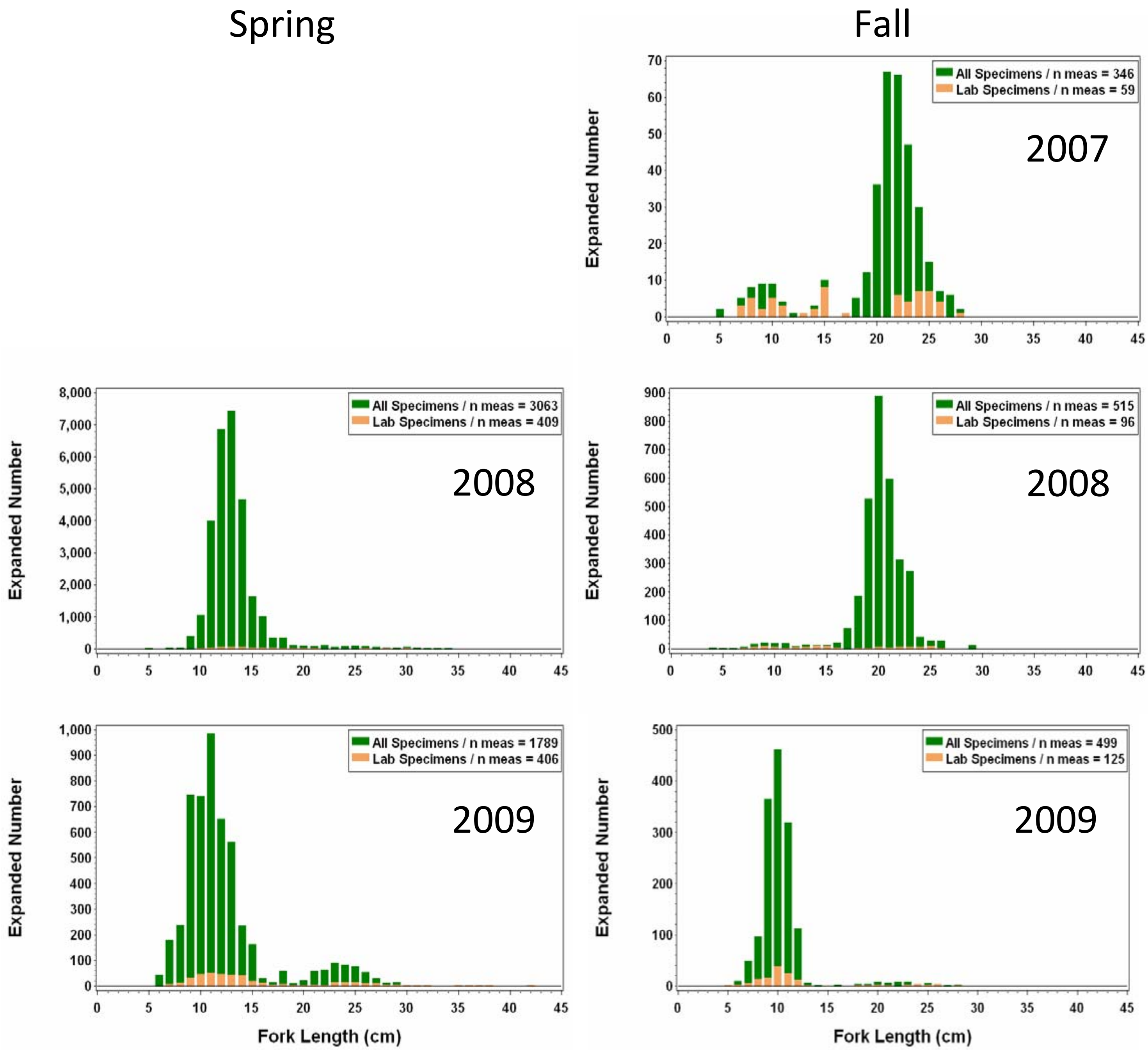


Figure 81. Sex ratio, by length group, for silver hake collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

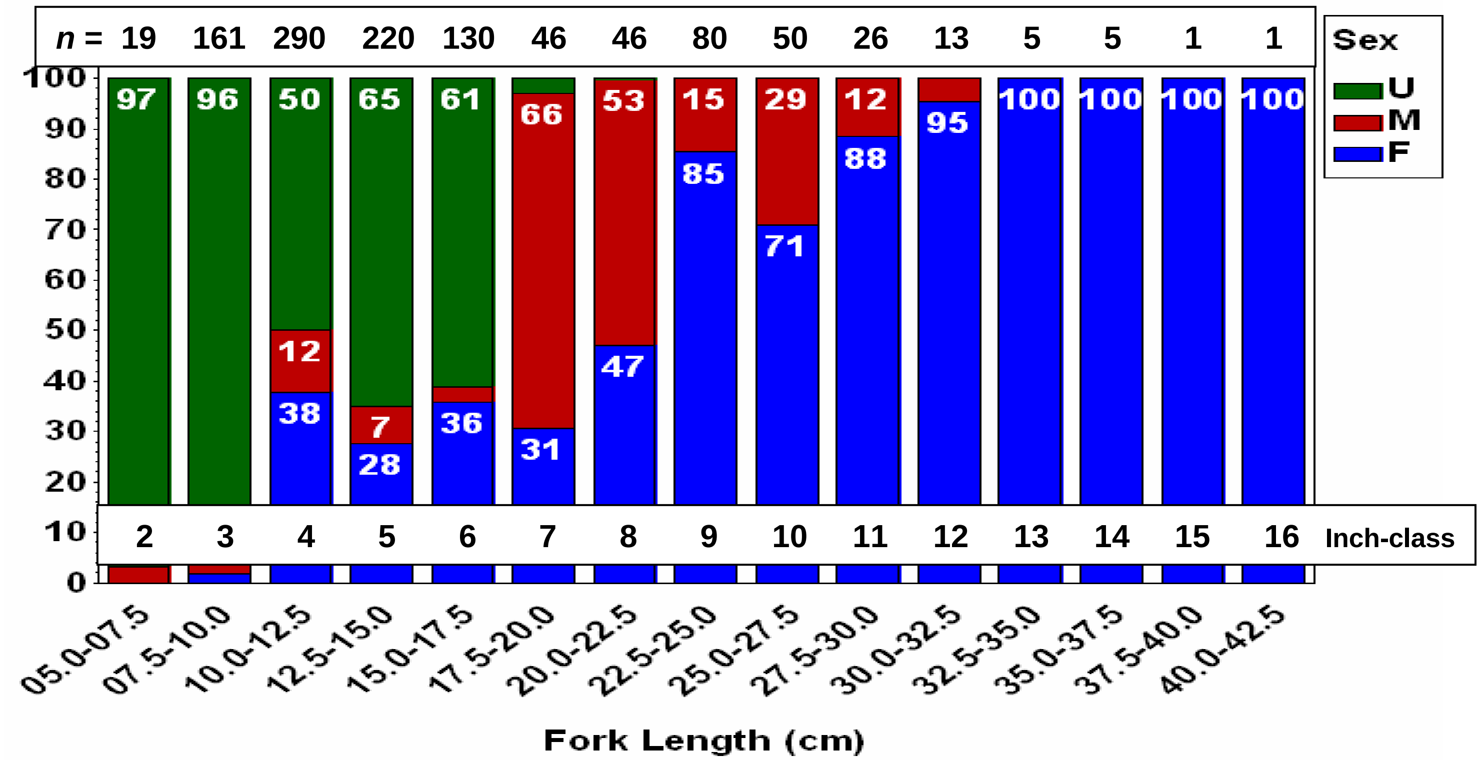
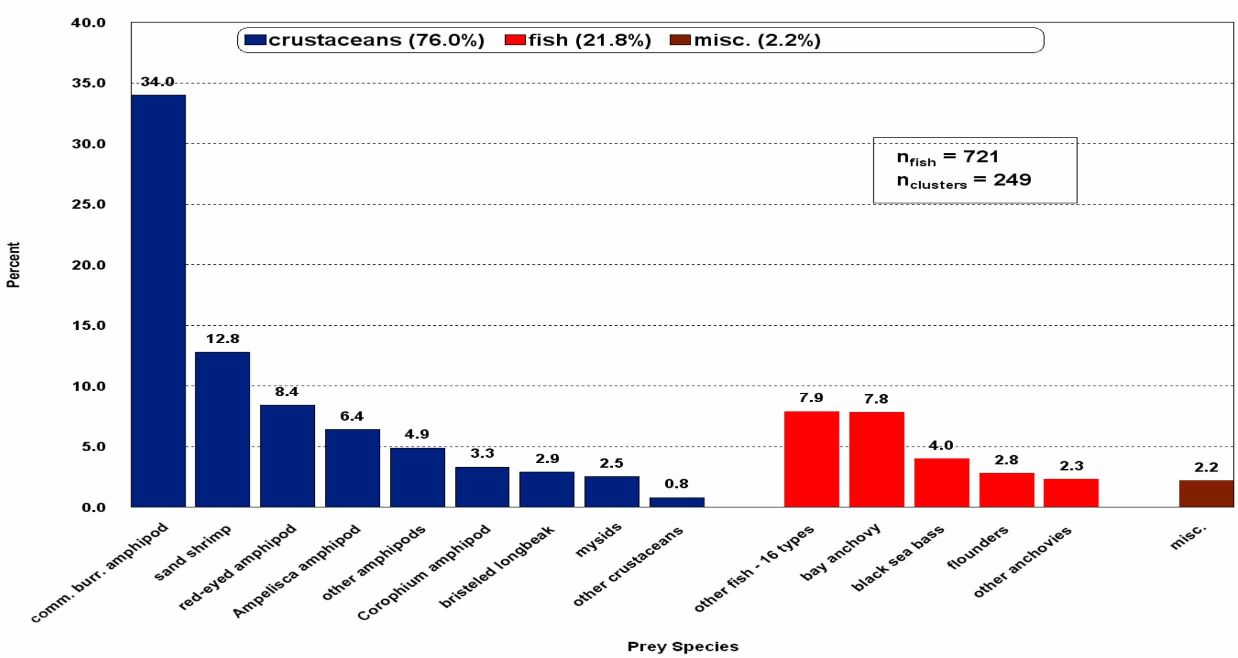


Figure 82. Diet composition, expressed using the percent weight index, of silver hake collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of hake sampled.



Smooth Dogfish (Priority A)

Table 24. Sampling rates and abundance indices of smooth dogfish for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	1,684	1,548.7	759	196	0	194	192	1.94	8.4	1.74	8.7
2008	Spring	927	2,501.7	688	297	0	288	286	3.34	4.4	7.49	3.9
	Fall	414	365.4	386	162	0	161	161	1.07	9.7	0.95	10.6
2009	Spring	947	2,741.4	725	236	0	221	212	2.24	5.8	4.56	5.4
	Fall	1,156	843.5	1,156	333	0	329		3.33	4.7	2.64	5.7

Figure 83. Biomass (kg) of smooth dogfish collected at each sampling site for each 2009 NEAMAP cruise.

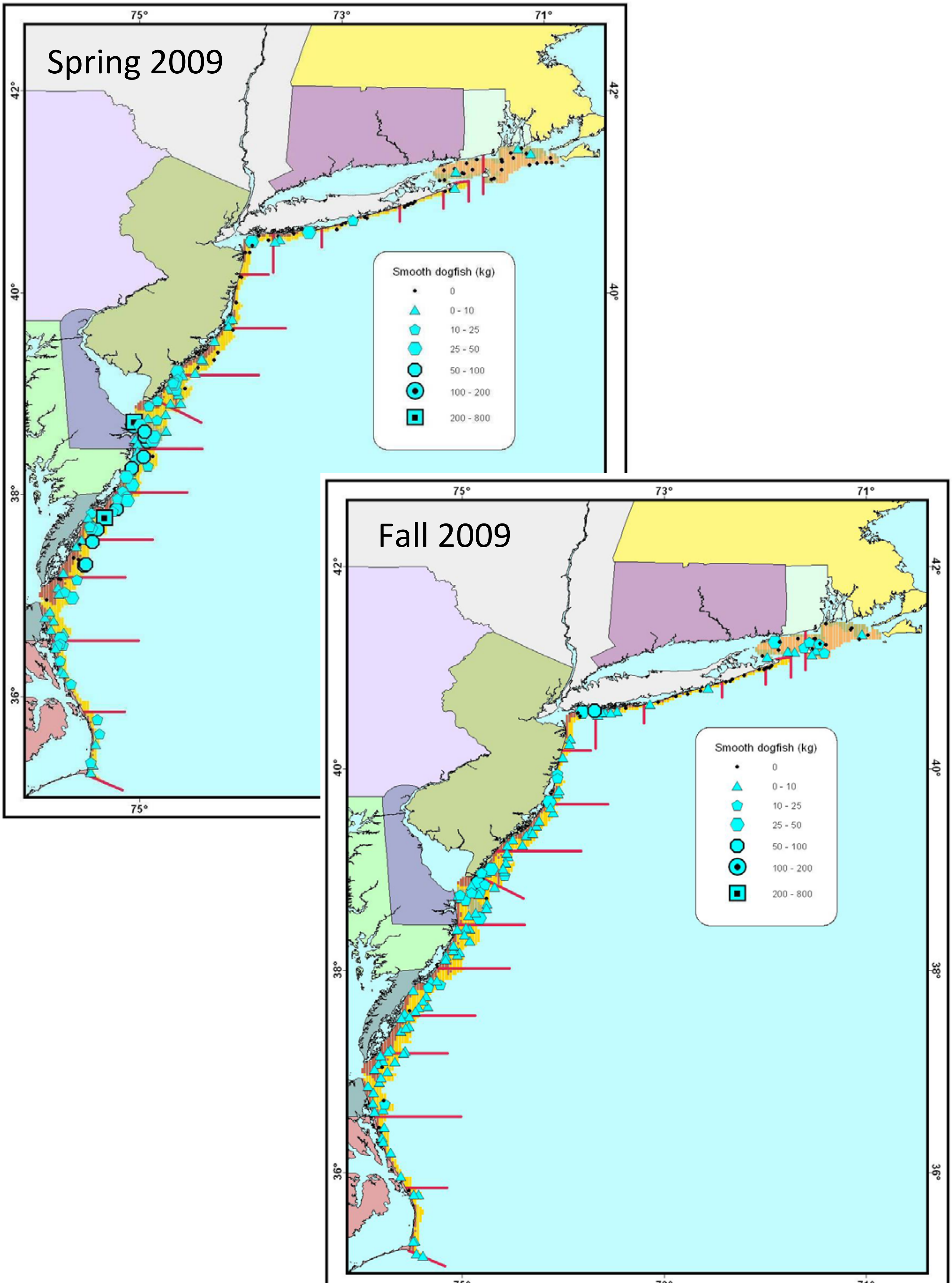
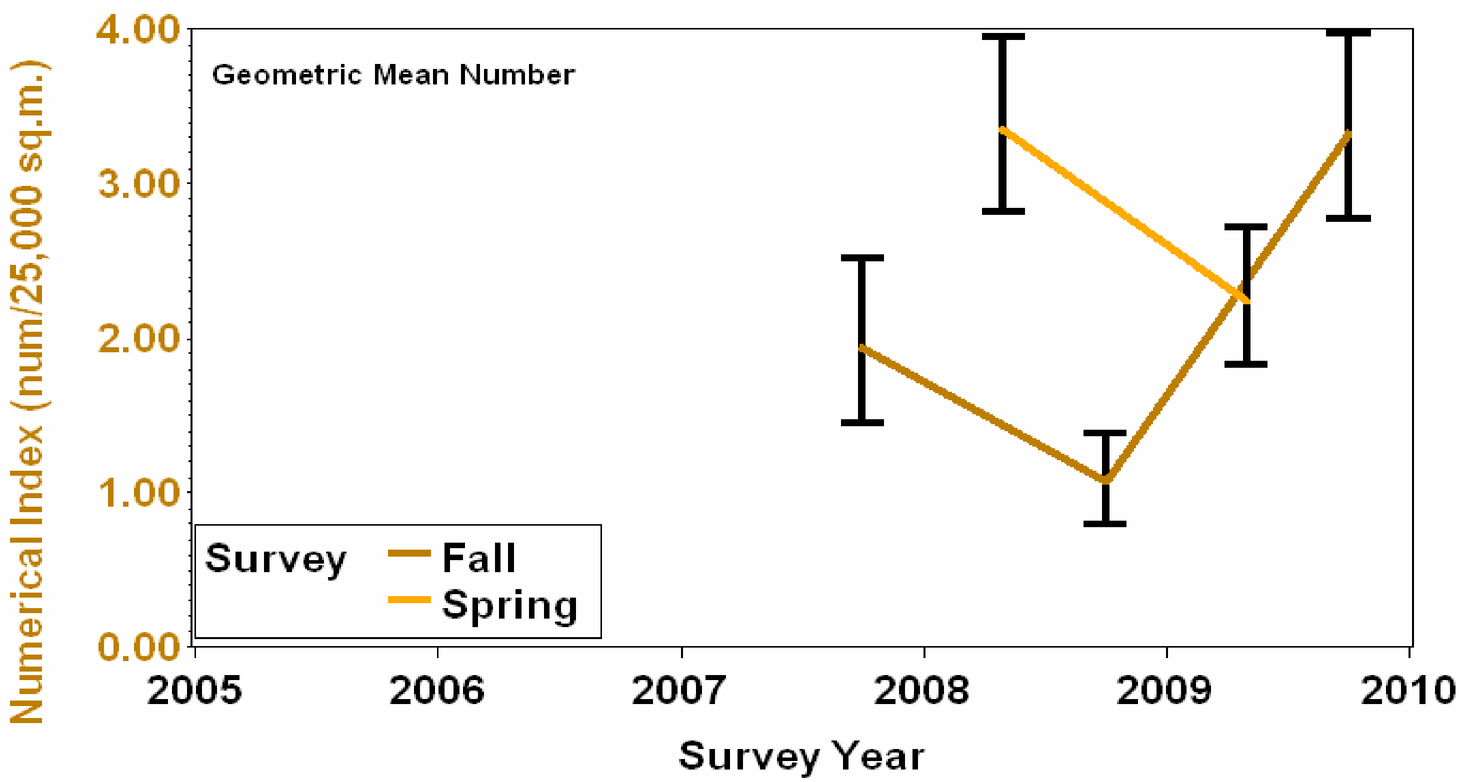


Figure 84. Preliminary indices of abundance, in terms of number and biomass, of smooth dogfish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



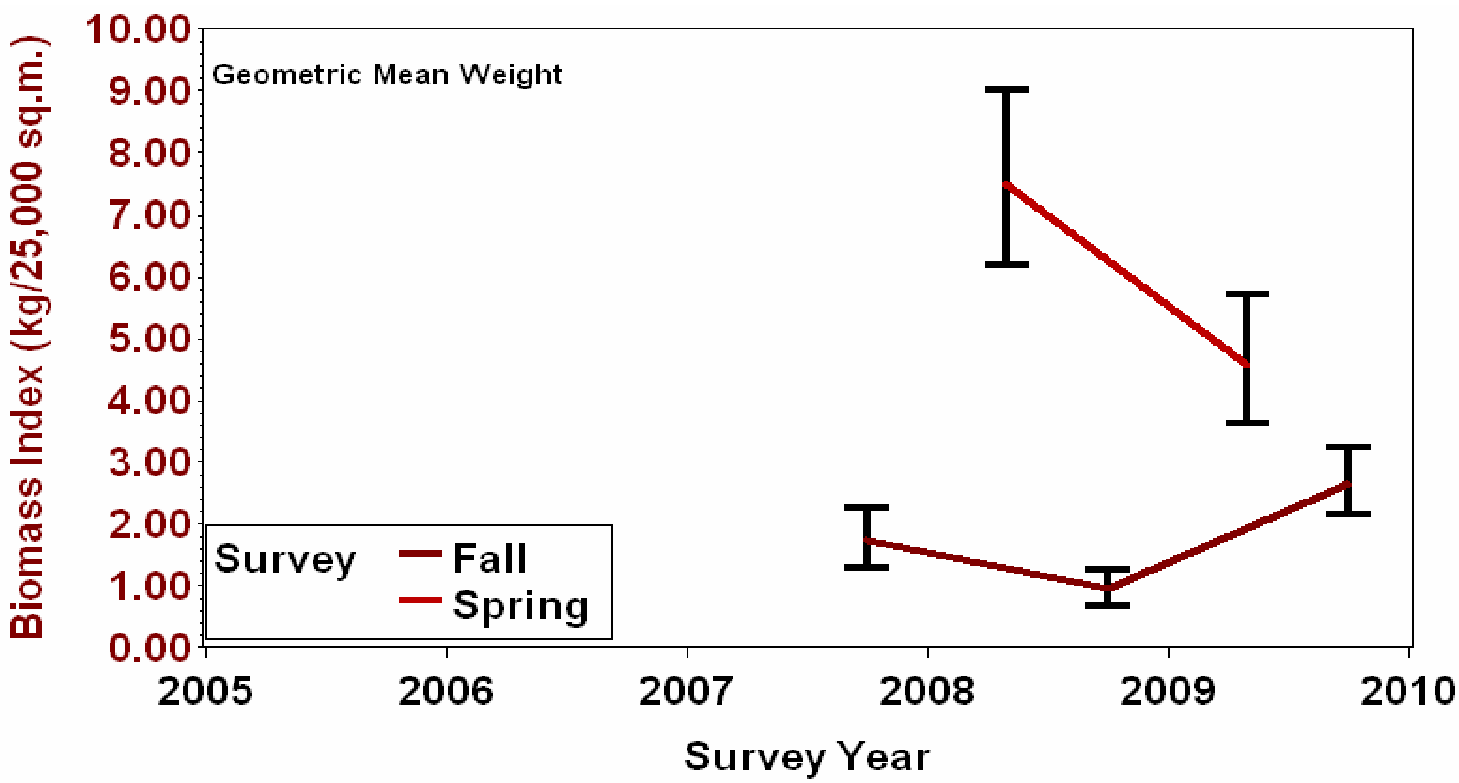


Figure 85. Length-frequency distributions, by cruise, for smooth dogfish. Numbers taken for full processing, by length, are represented by the orange bars.

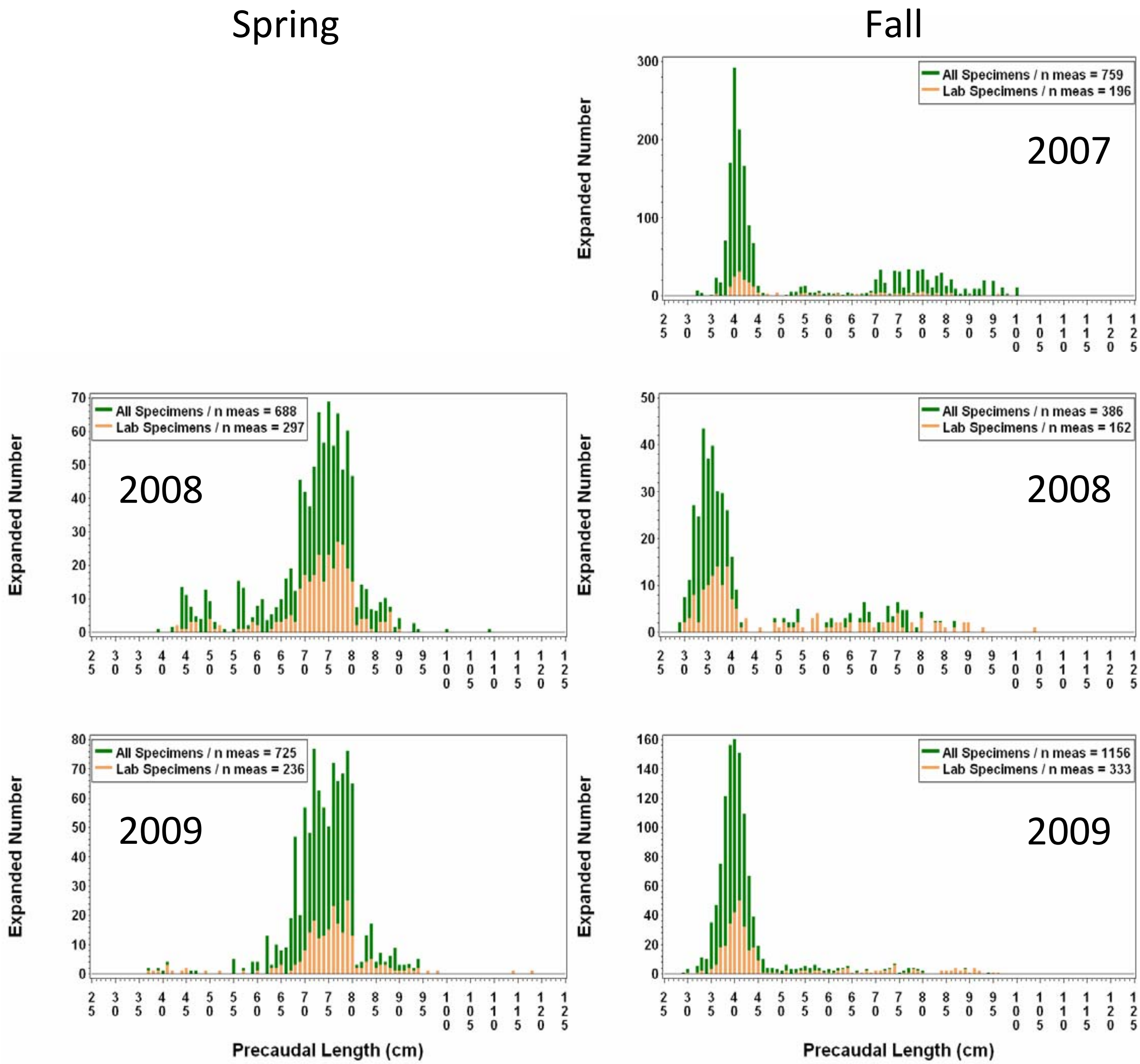


Figure 86. Sex ratio, by length group, for smooth dogfish collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

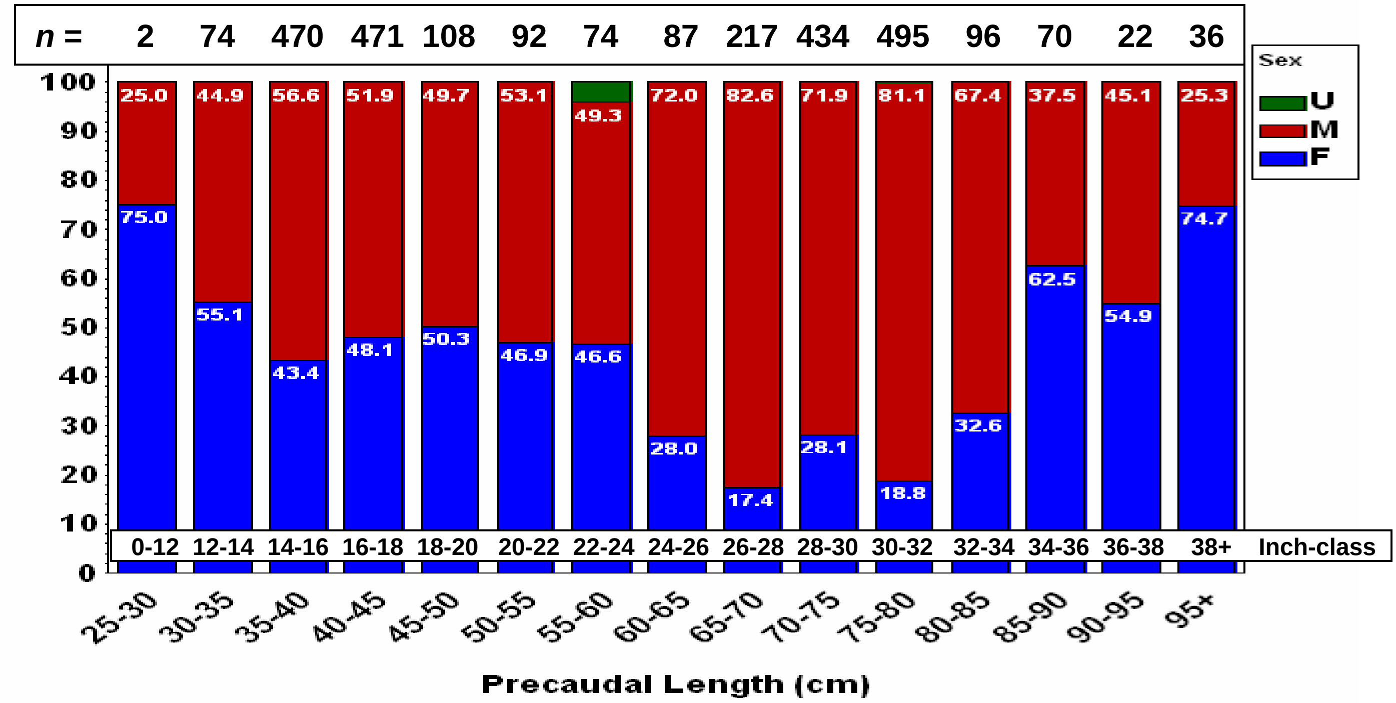
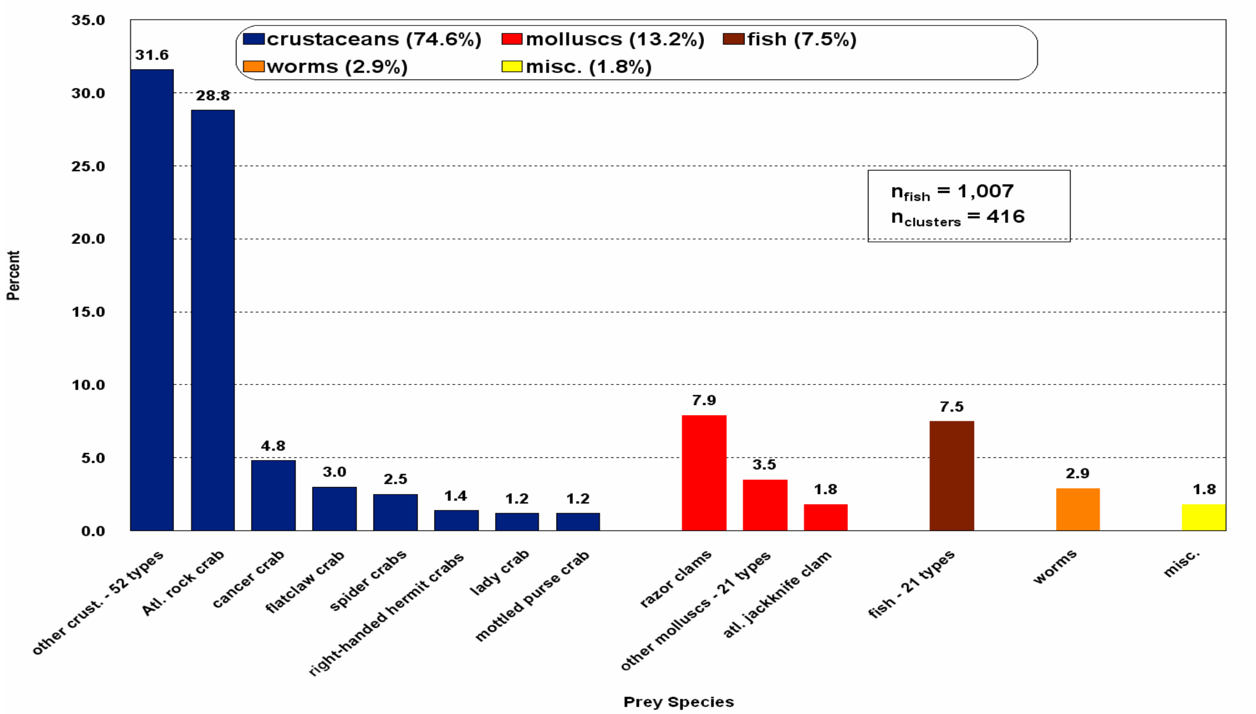


Figure 87. Diet composition, expressed using the percent weight index, of smooth dogfish collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of dogfish sampled.



Spanish Mackerel (Priority A)

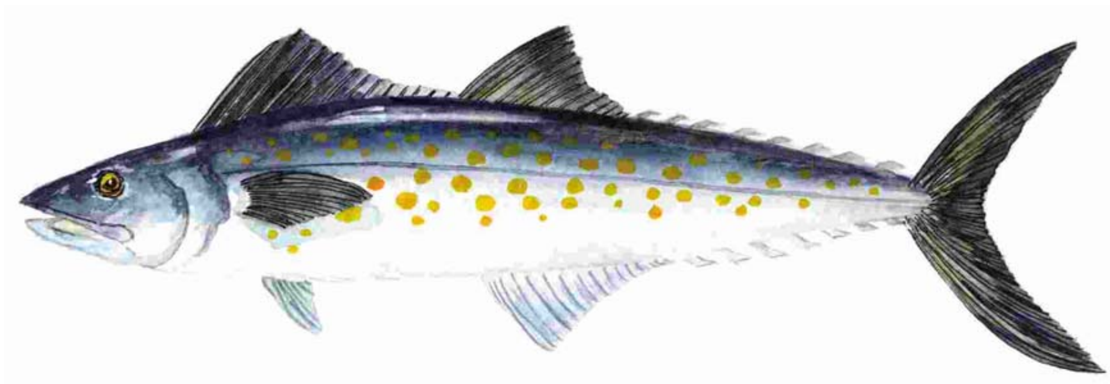


Table 25. Sampling rates and abundance indices of Spanish mackerel for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	161	42.5	161		0			0.26	18.6	0.13	19.4
2008	Spring								0.00		0.00	
	Fall	14	2.0	14		0			0.02	100	0.01	100
2009	Spring								0.00		0.00	
	Fall	31	3.9	31	12	0	10		0.03	56.7	0.01	65

Figure 88. Biomass (kg) of Spanish mackerel collected at each sampling site for each 2009 NEAMAP cruise.

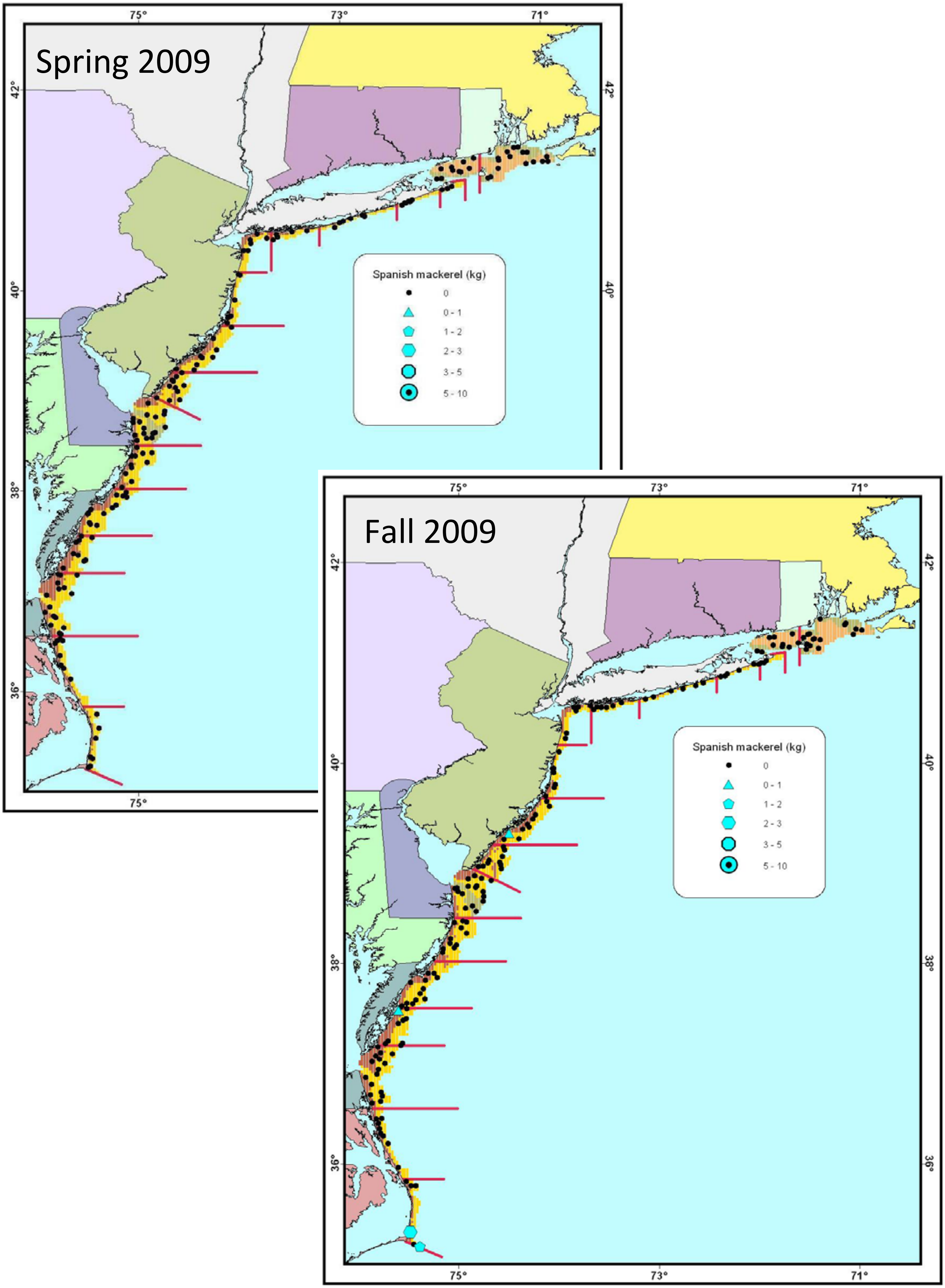


Figure 89. Preliminary indices of abundance, in terms of number and biomass, of Spanish mackerel for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

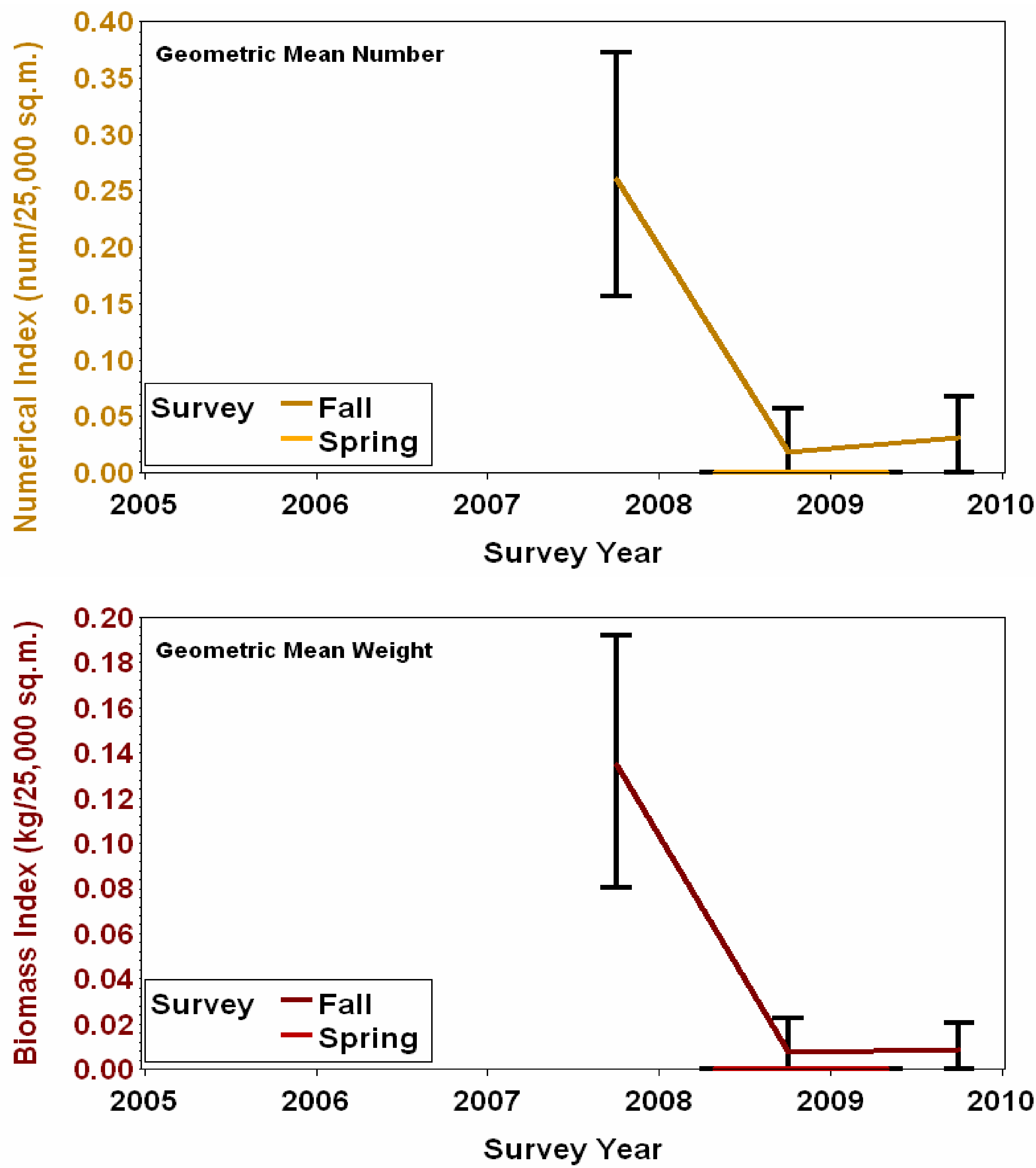
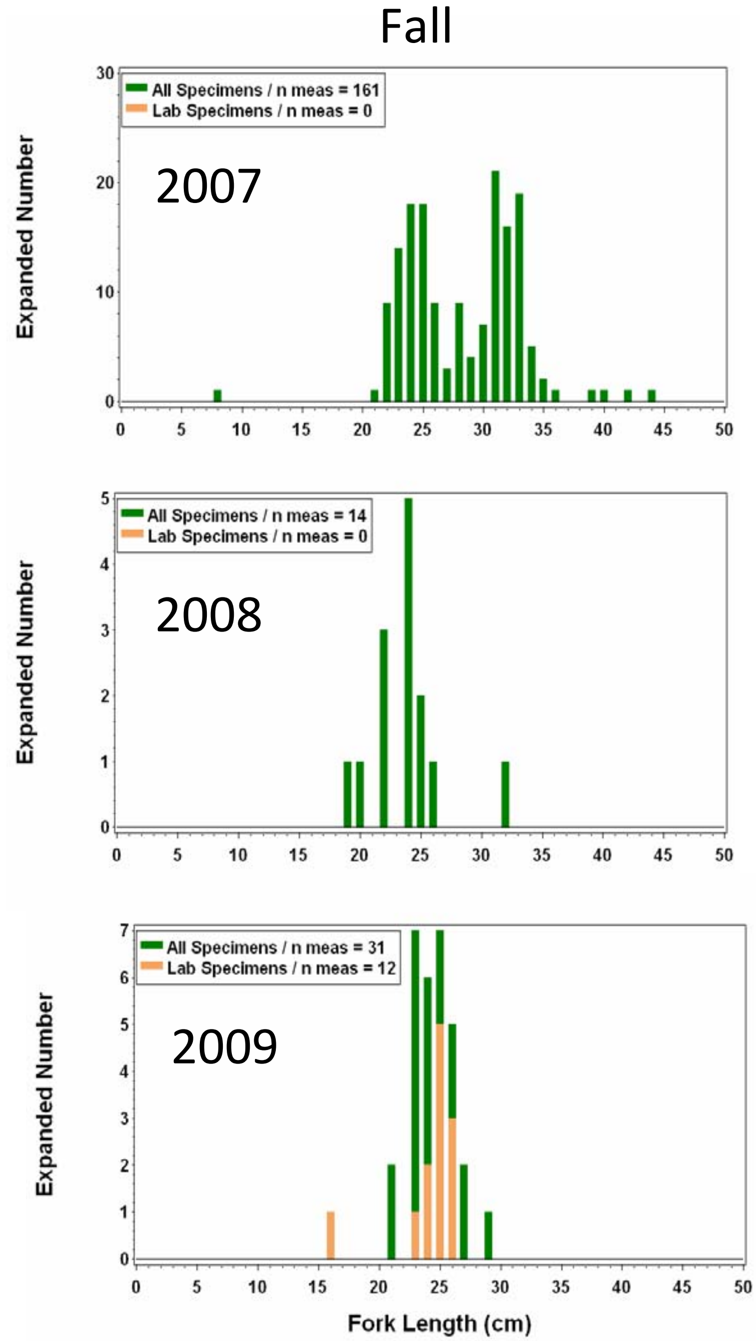


Figure 90. Length-frequency distributions, by cruise, for Spanish mackerel. Numbers taken for full processing, by length, are represented by the orange bars. This species was absent from spring survey collections.



Spiny Dogfish (Priority A)

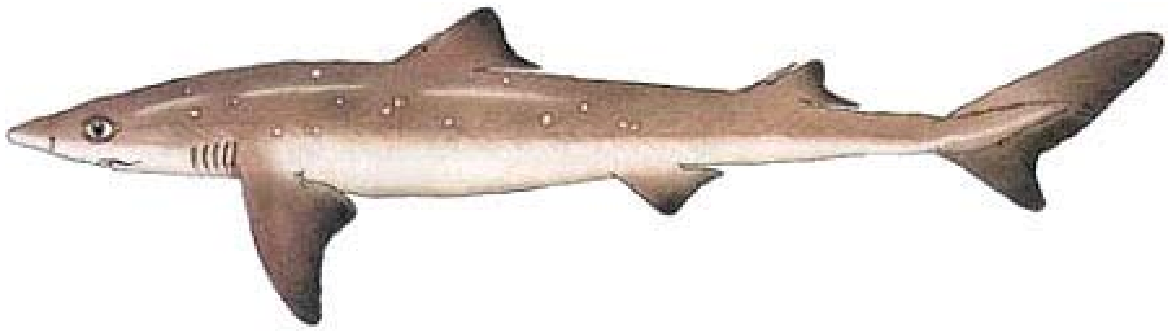


Table 26. Sampling rates and abundance indices of spiny dogfish for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	17	51.3	17	13	0	12	12	0.05	47.2	0.07	45.3
2008	Spring	1,332	3,396.0	950	325	0	247	247	4.95	3.6	10.72	3.5
	Fall	735	1,621.1	161	41	0	39	39	0.36	25.8	0.37	27.9
2009	Spring	1,271	3,562.7	1,137	359	0	261	248	4.98	3.8	12.39	3.3
	Fall	795	1,750.0	483	52	0	45		0.35	22	0.42	20.8

Figure 91. Biomass (kg) of spiny dogfish collected at each sampling site for each 2009 NEAMAP cruise.

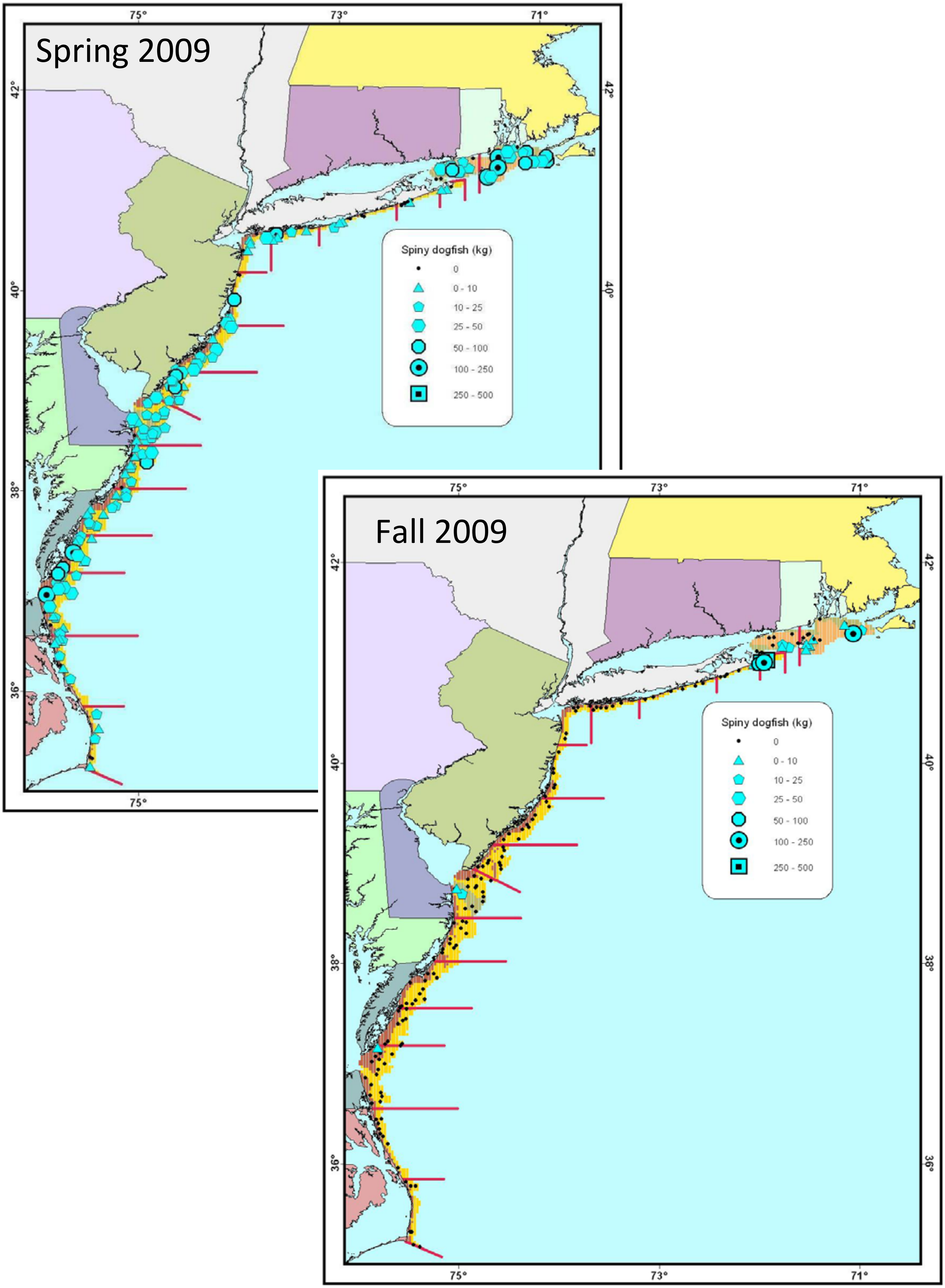
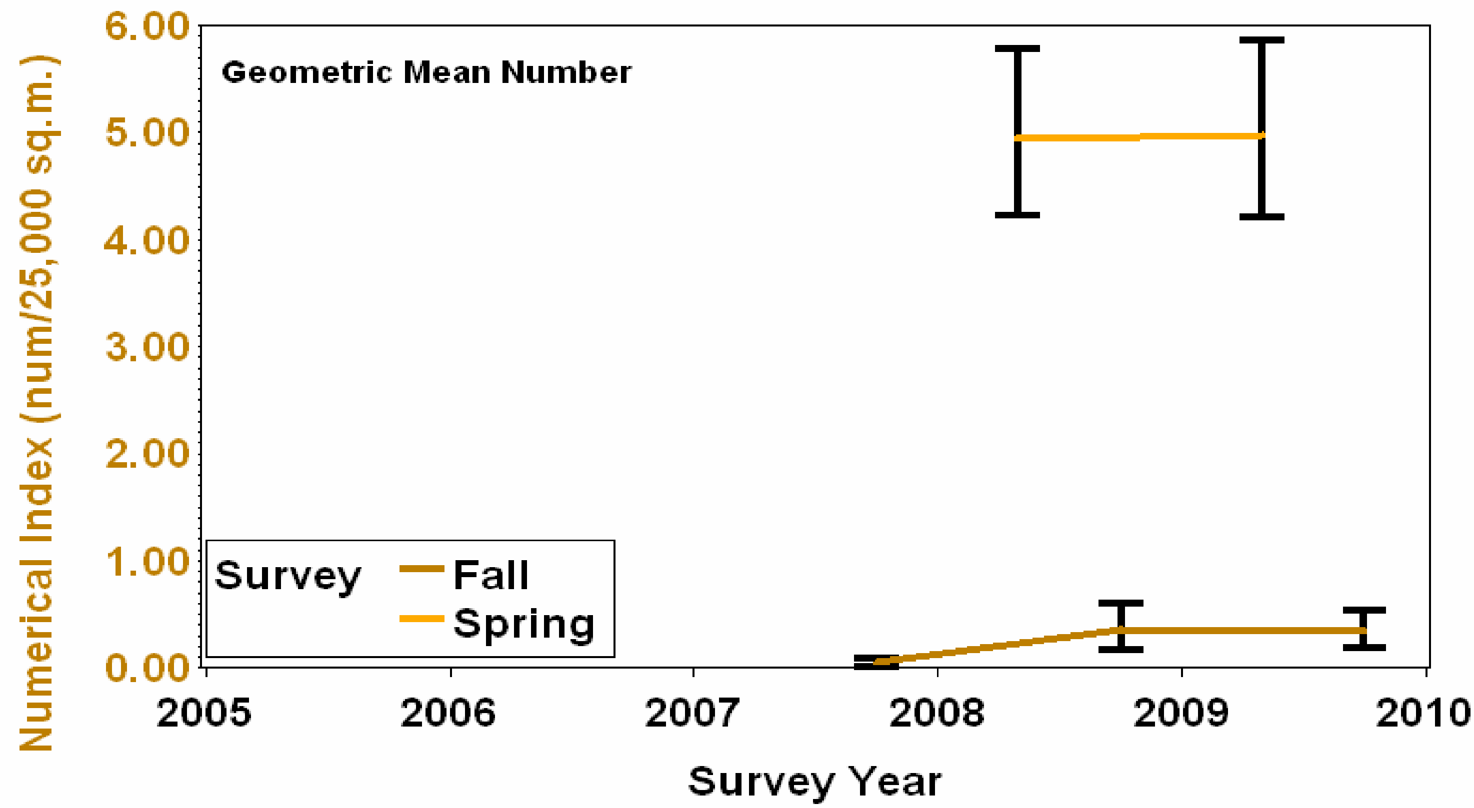


Figure 92. Preliminary indices of abundance, in terms of number and biomass, of spiny dogfish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



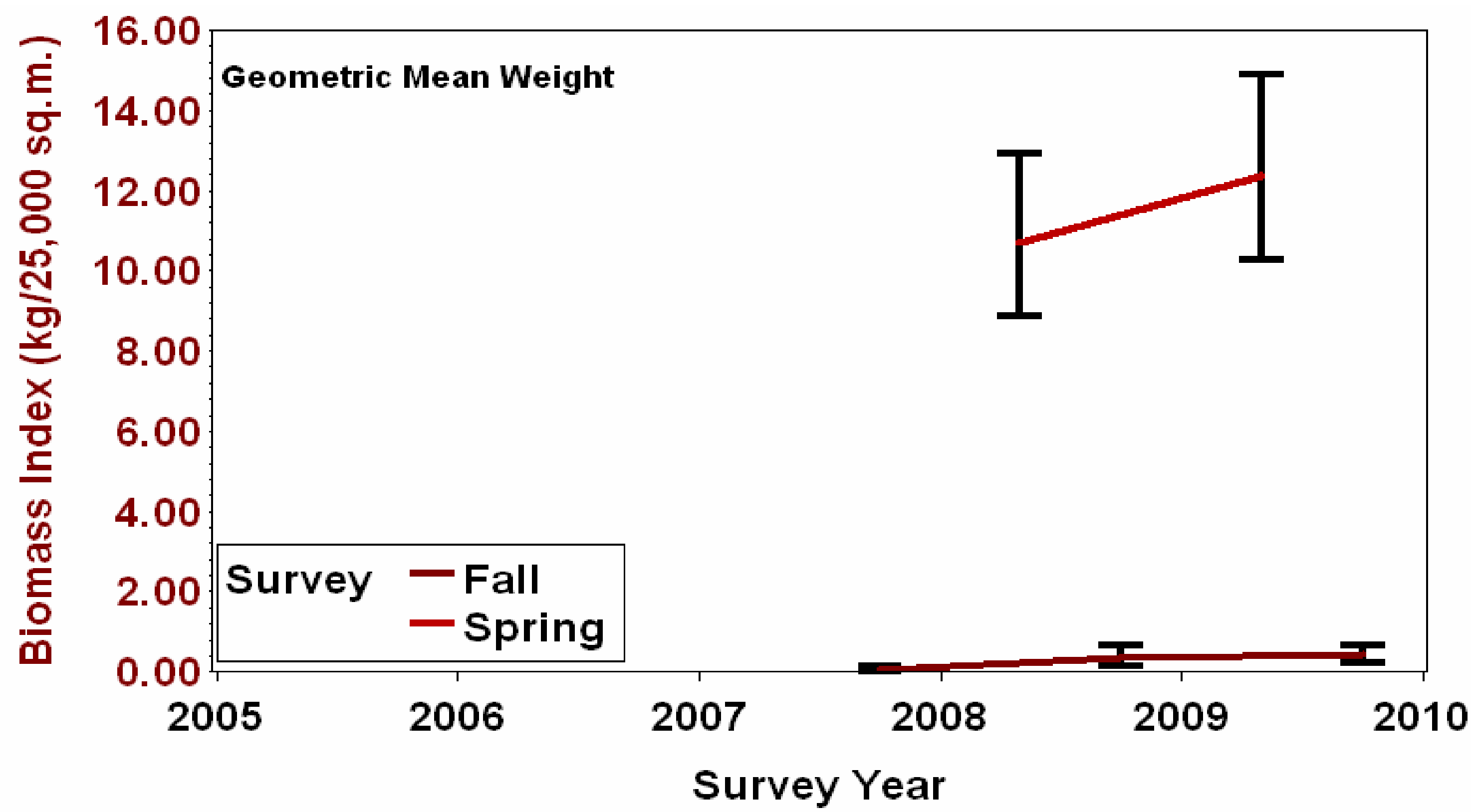


Figure 93. Length-frequency distributions, by cruise, for spiny dogfish. Numbers taken for full processing, by length, are represented by the orange bars.

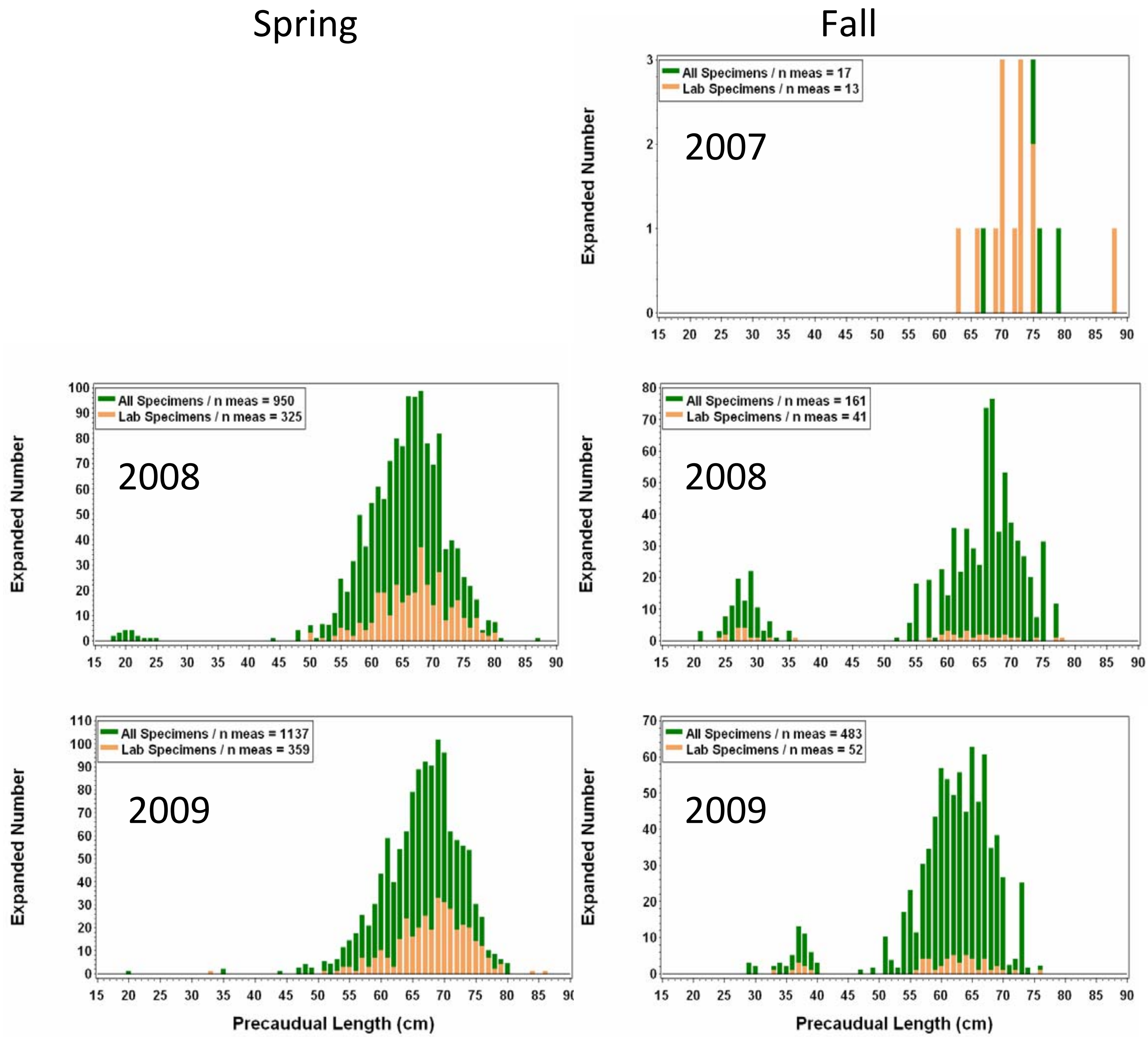


Figure 94. Sex ratio, by length group, for spiny dogfish collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

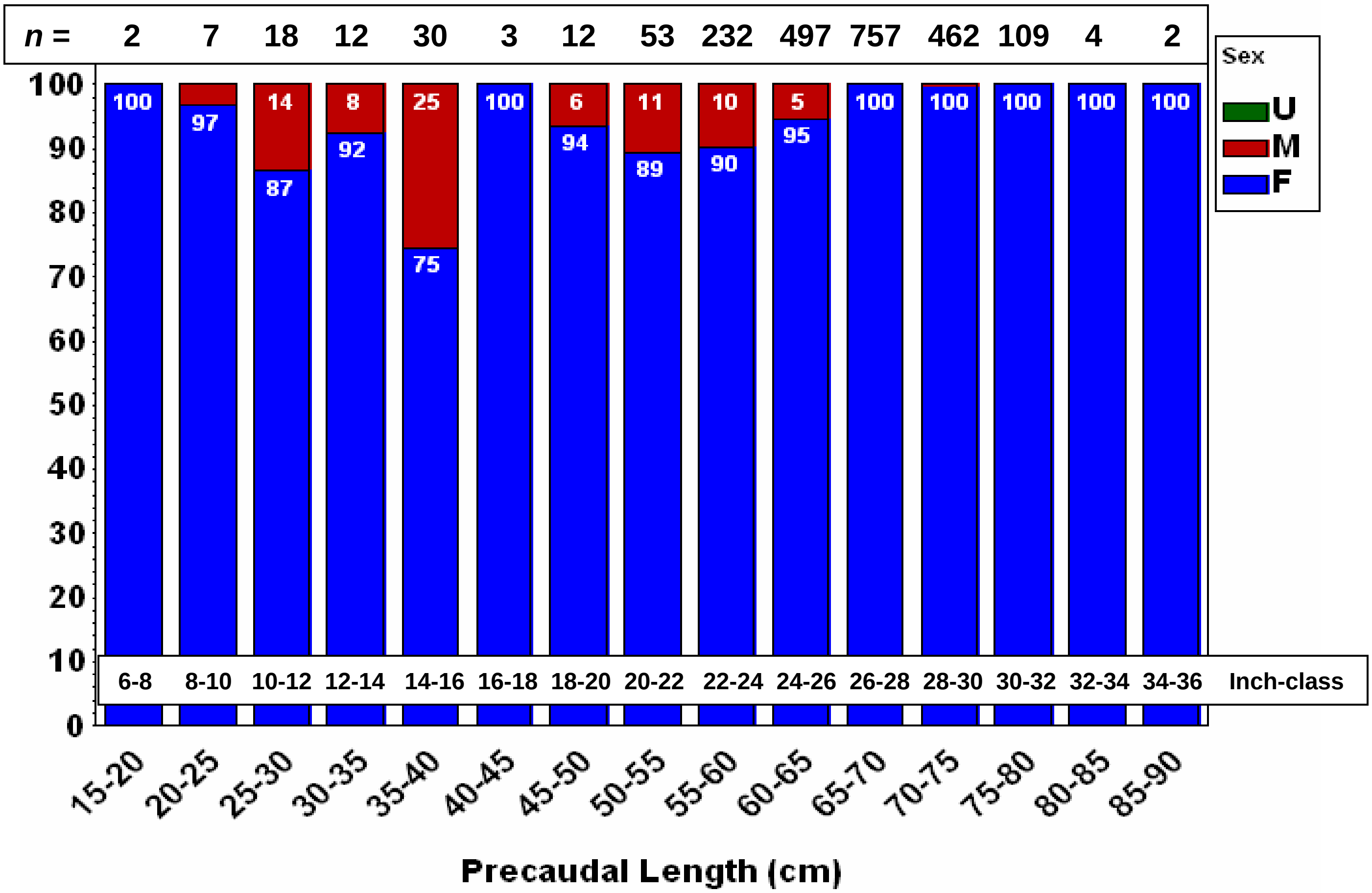
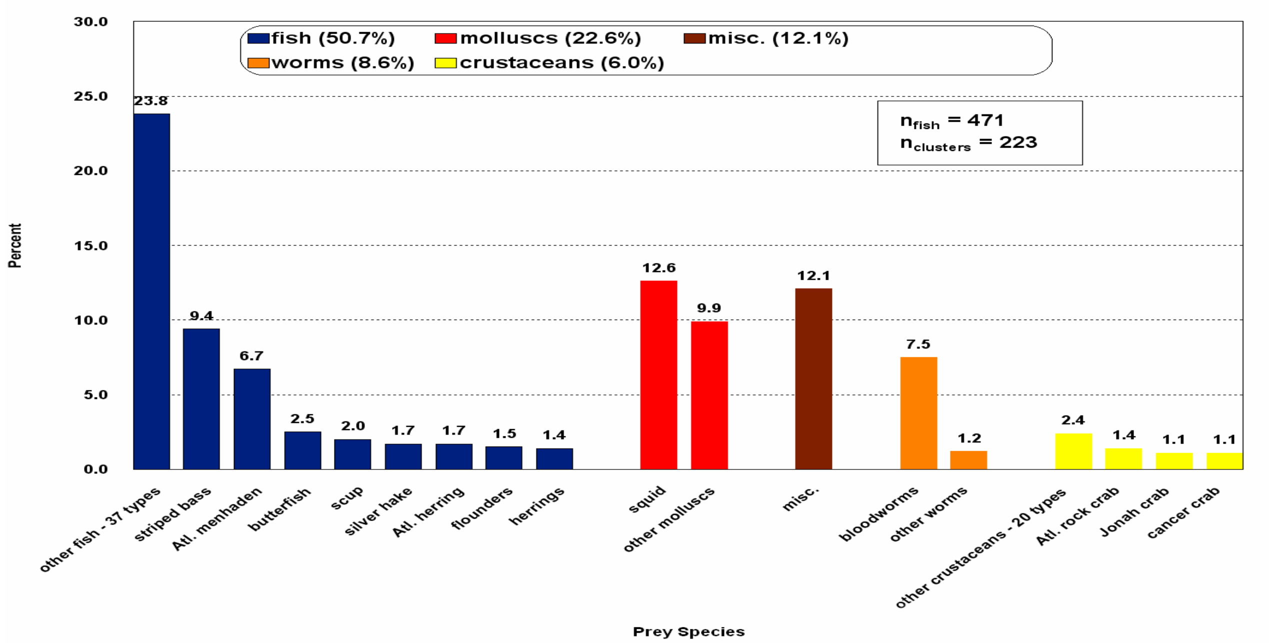


Figure 95. Diet composition, expressed using the percent weight index, of spiny dogfish collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of spiny dogfish sampled.



Spot (Priority A)

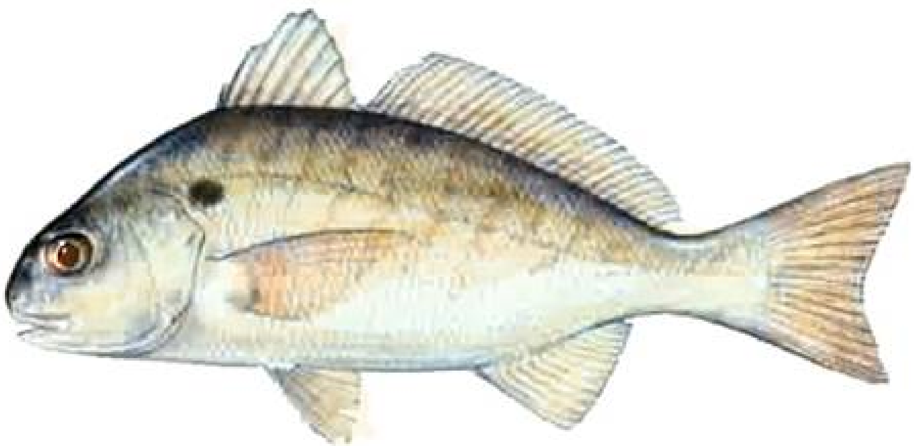


Table 27. Sampling rates and abundance indices of spot for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	44,437	3,942.0	2,507	160	0	9		5.32	9.2	1.87	10.9
2008	Spring	28,561	1,059.2	1,220	61	0			0.91	13	0.33	15.8
	Fall	56,878	3,872.0	3,435	213	0			11.77	7.5	3.05	8.8
2009	Spring	29,643	824.9	3,454	59	0			0.91	17.1	0.34	22.2
	Fall	8,428	593.0	2,699	169	0			2.40	8.2	0.61	12.3

Figure 96. Biomass (kg) of spot collected at each sampling site for each 2009 NEAMAP cruise.

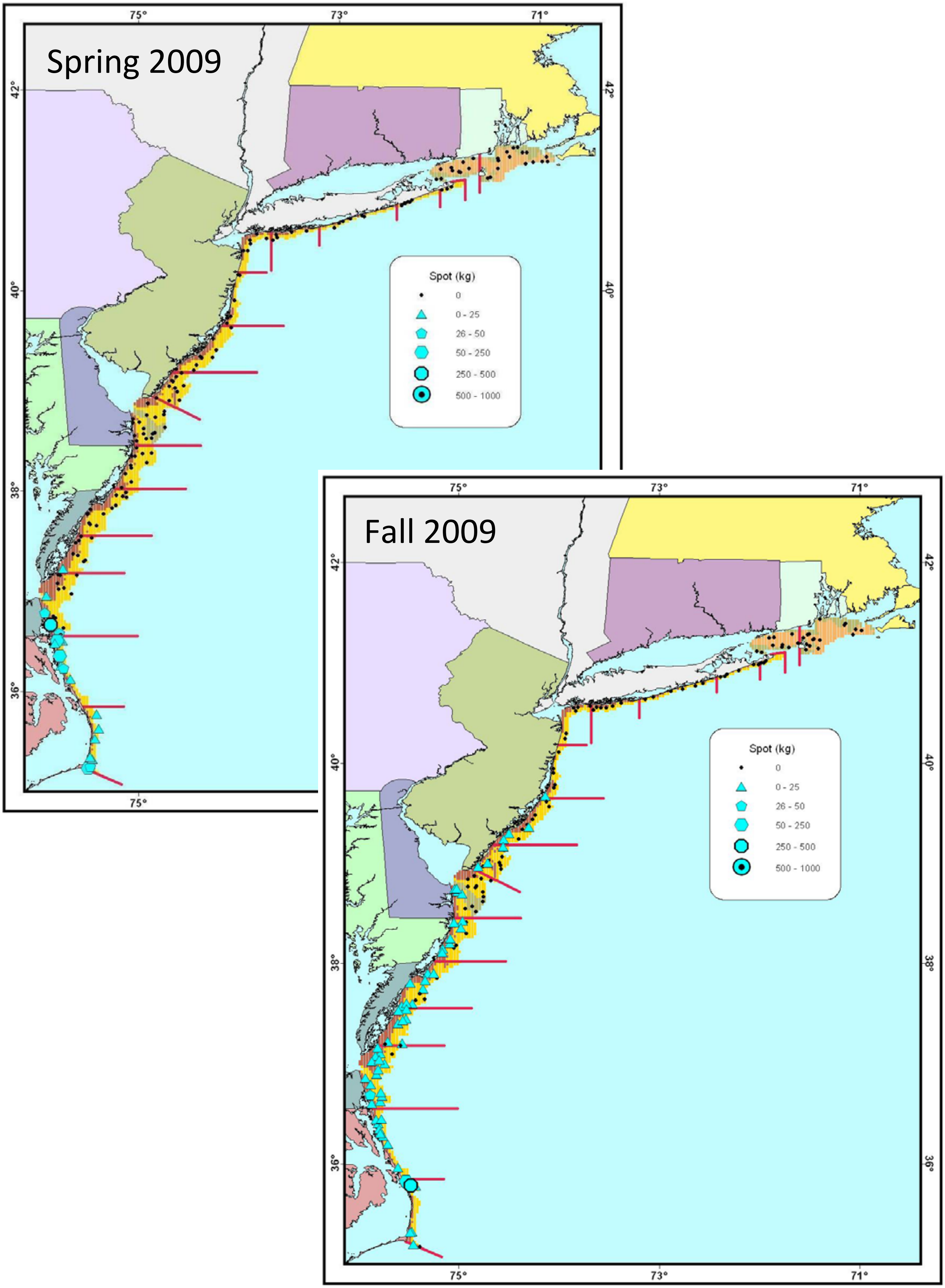


Figure 97. Preliminary indices of abundance, in terms of number and biomass, of spot for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

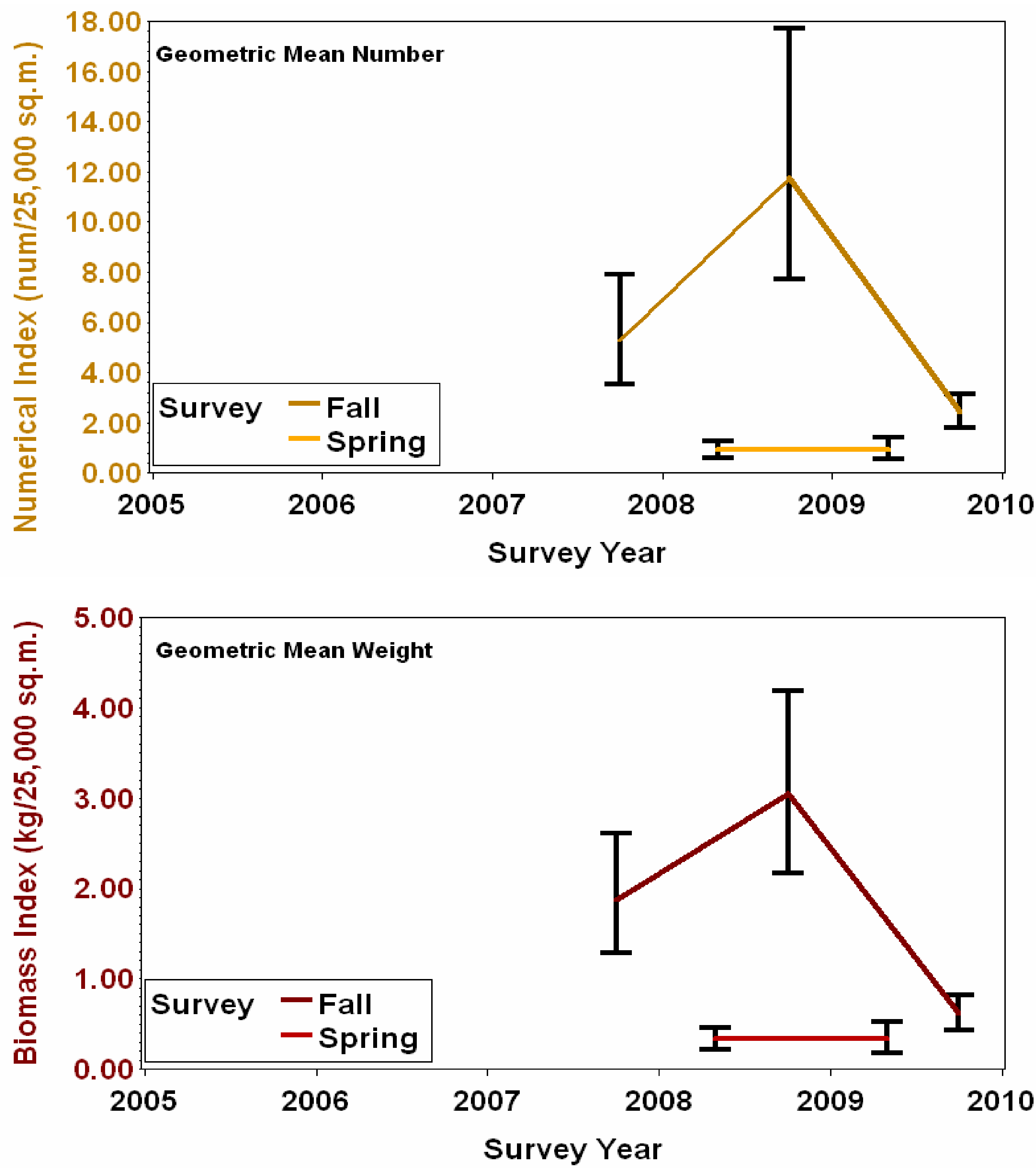


Figure 98. Length-frequency distributions, by cruise, for spot. Numbers taken for full processing, by length, are represented by the orange bars (difficult to see due to scale of y-axis).

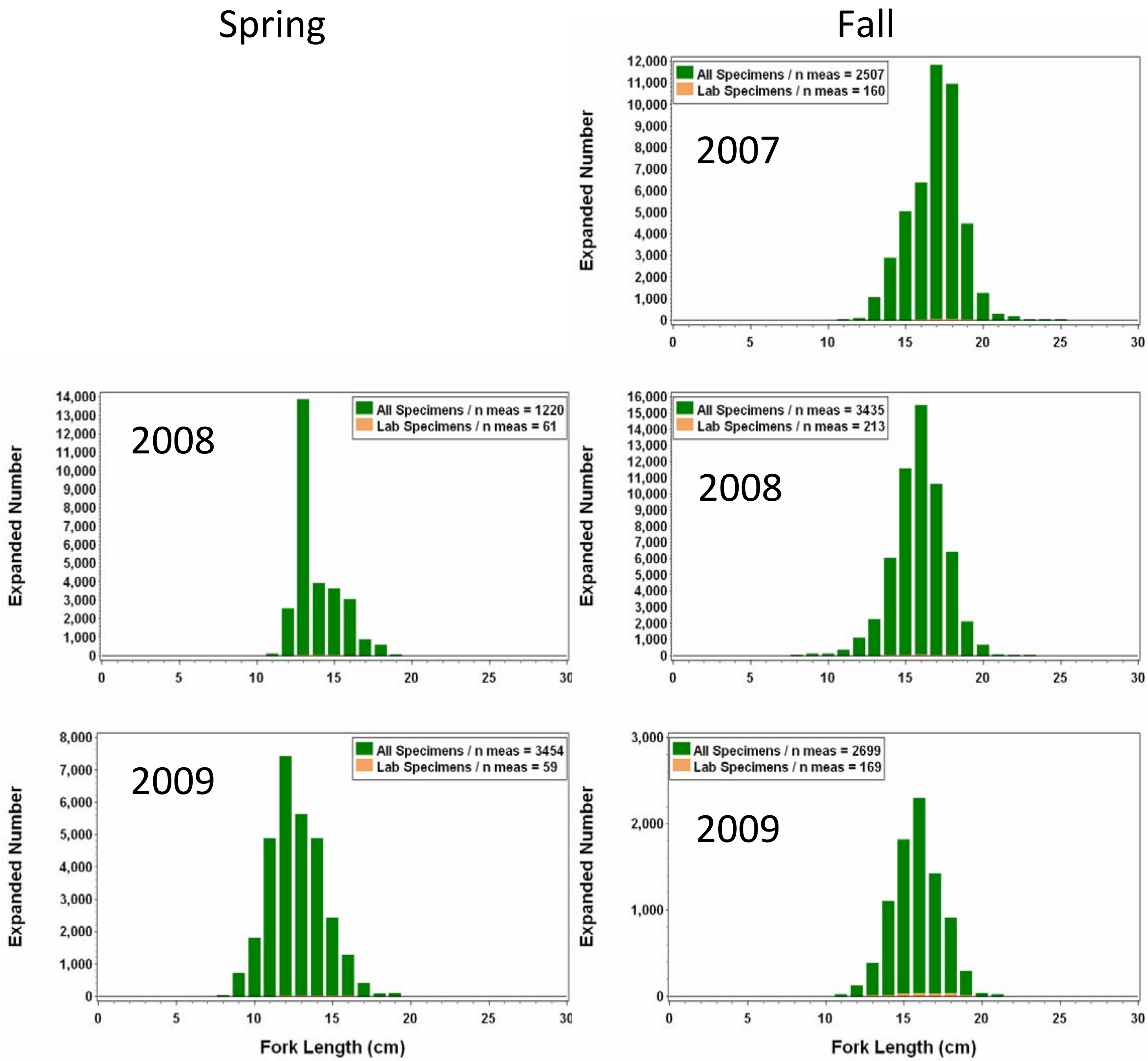
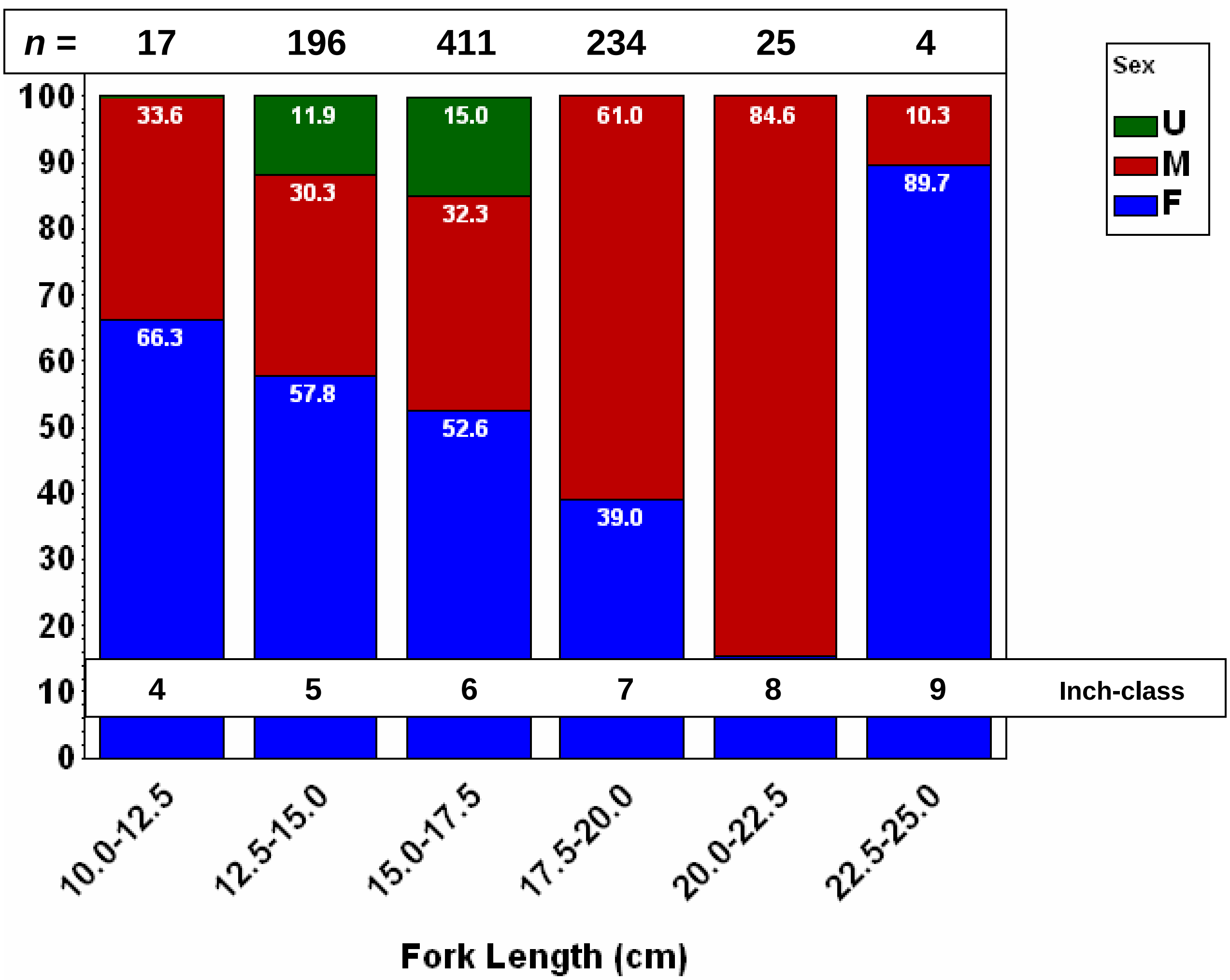


Figure 99. Sex ratio, by length group, for spot collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.



Striped Anchovy (Priority D)

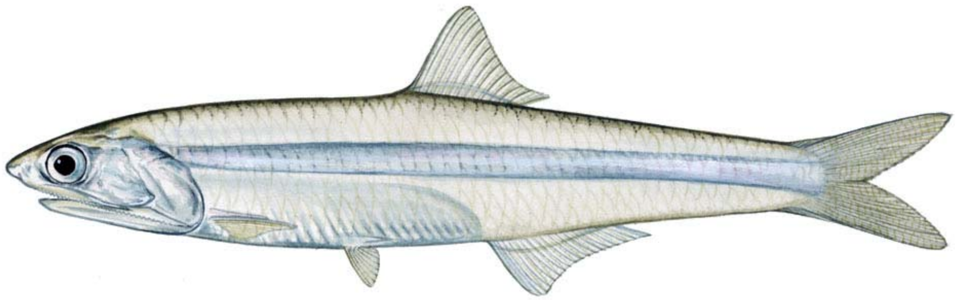


Table 28. Sampling rates and abundance indices of striped anchovy for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	224,369	2,519.3	4,990					17.22	6	1.42	10
2008	Spring	1,198	19.0	471					0.70	12.5	0.06	30
	Fall	84,833	1,009.1	3,357					11.01	6.7	1.21	10.4
2009	Spring	104	1.5	104					0.03	100	0.01	100
	Fall	8,605	113.4	2,171					1.85	9.1	0.21	16

Figure 100. Biomass (kg) of striped anchovy collected at each sampling site for each 2009 NEAMAP cruise.

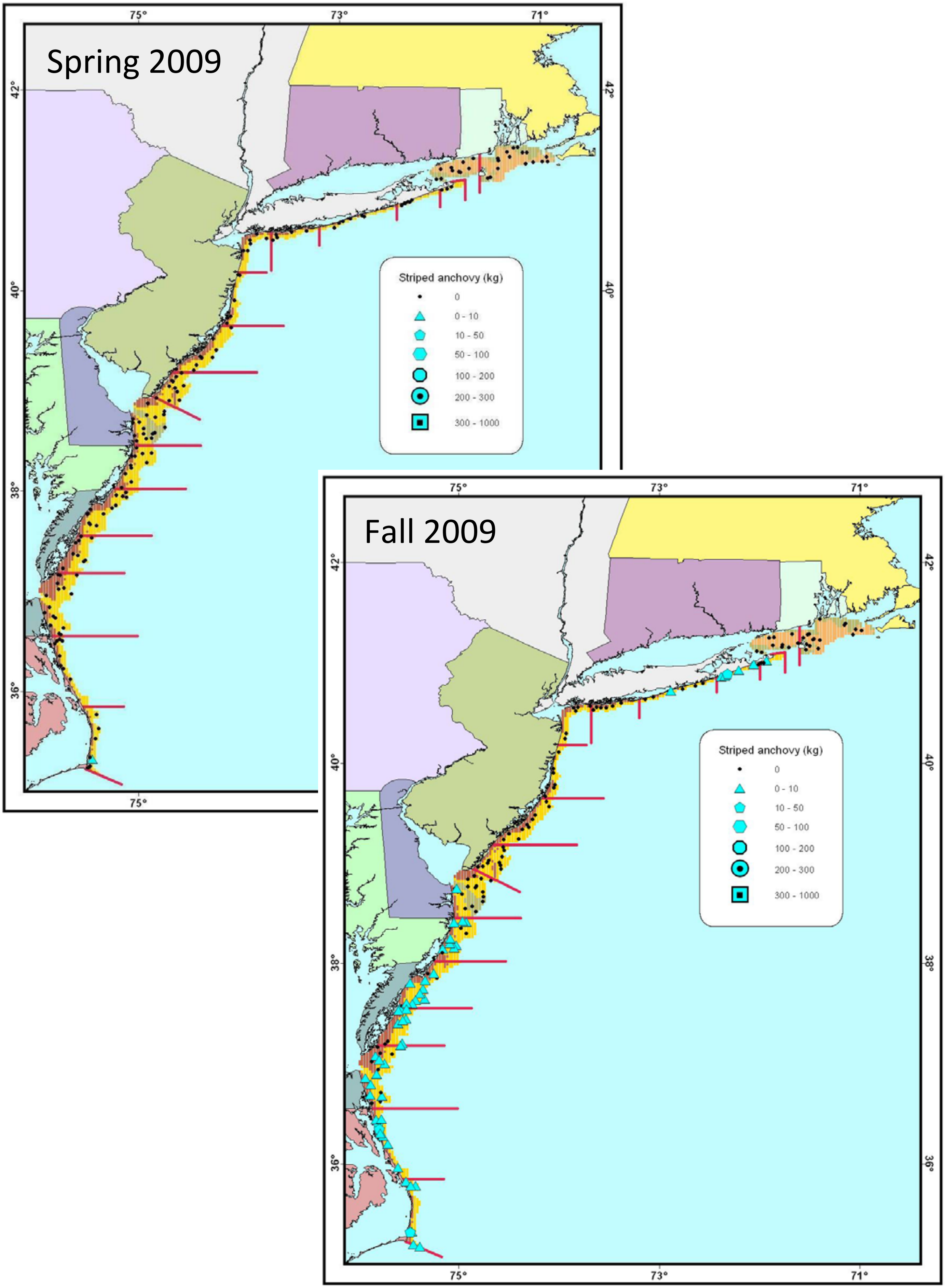


Figure 101. Preliminary indices of abundance, in terms of number and biomass, of striped anchovy for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

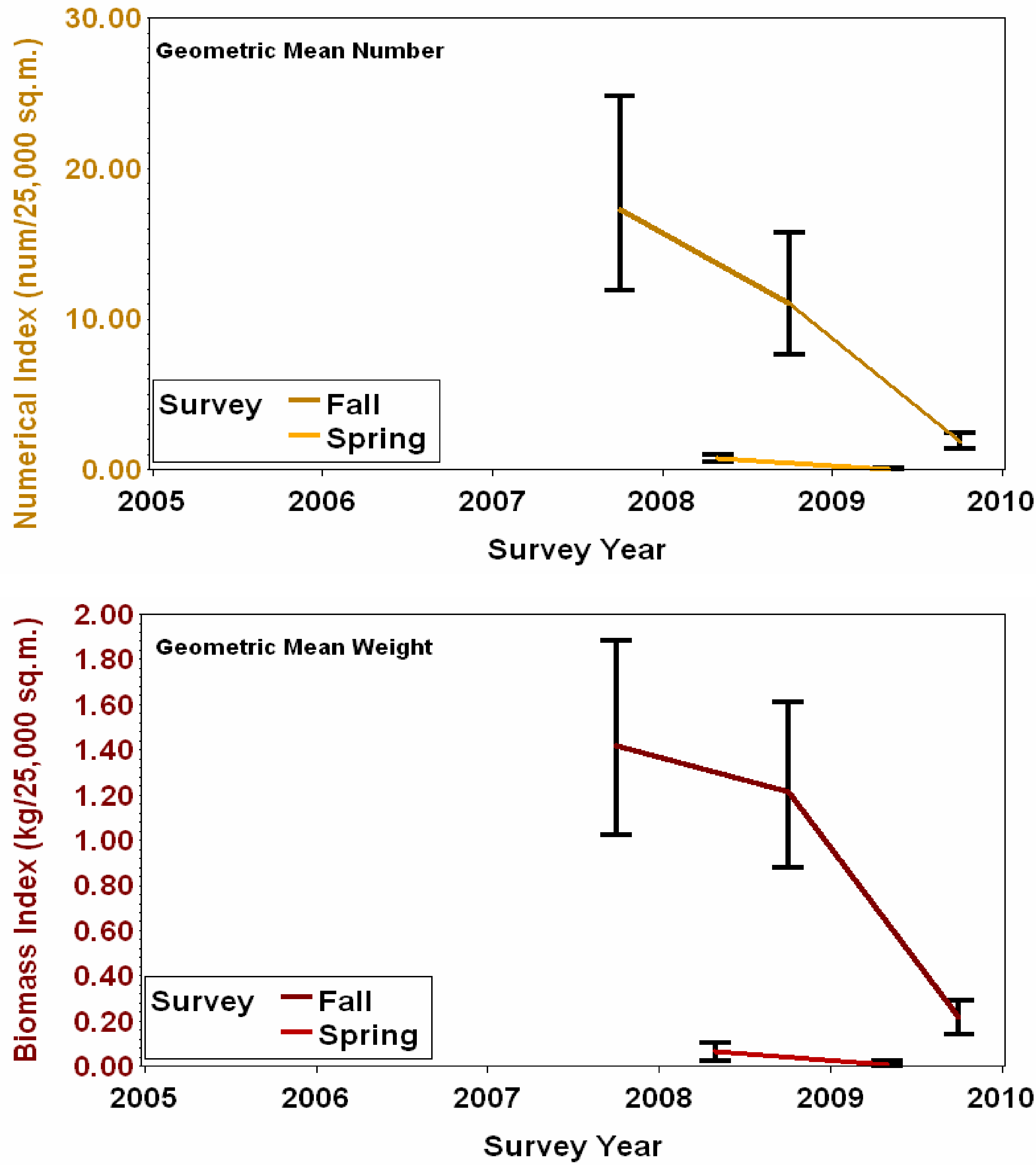
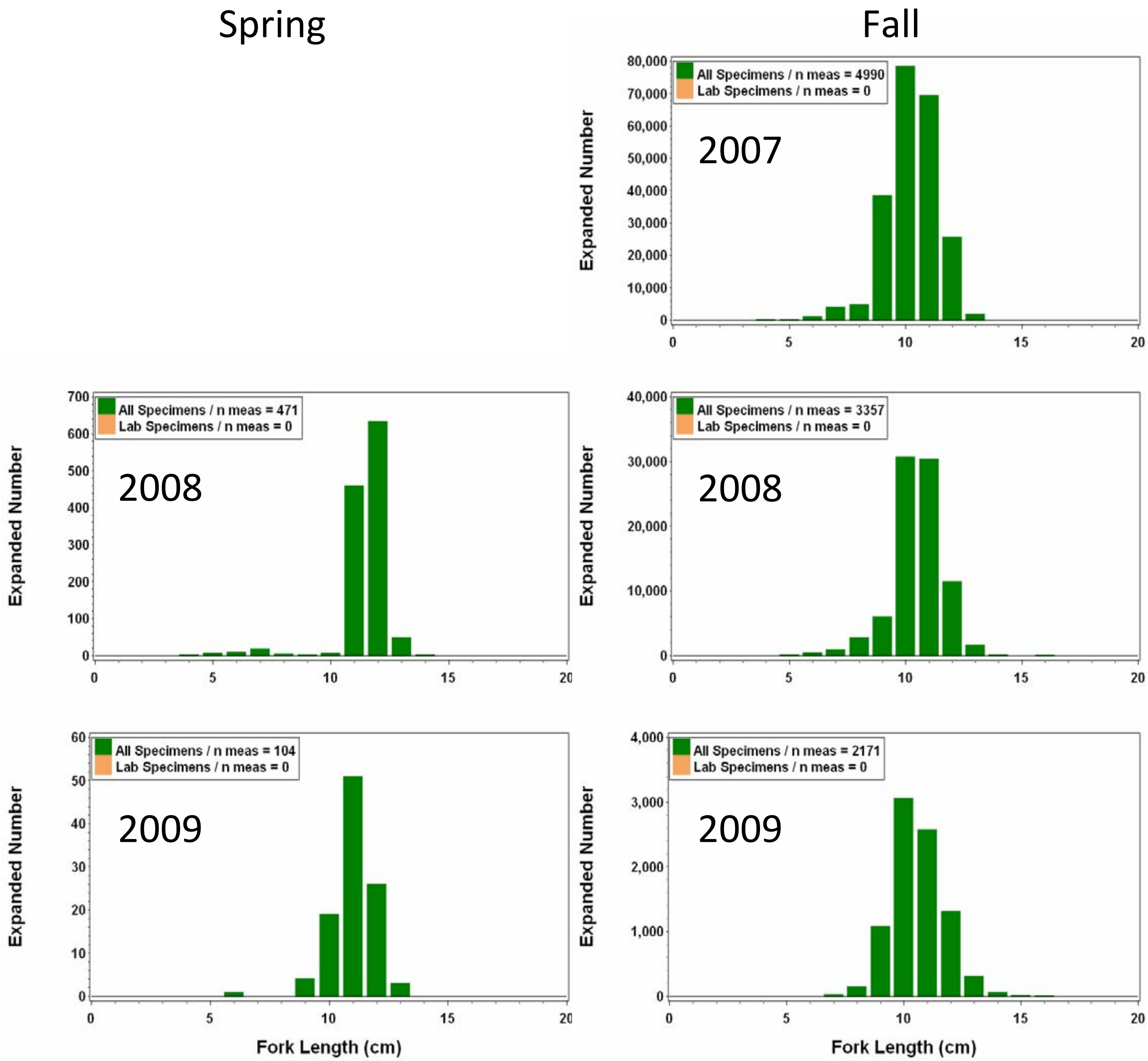


Figure 102. Length-frequency distributions, by cruise, for striped anchovy.



Striped Bass (Priority A)

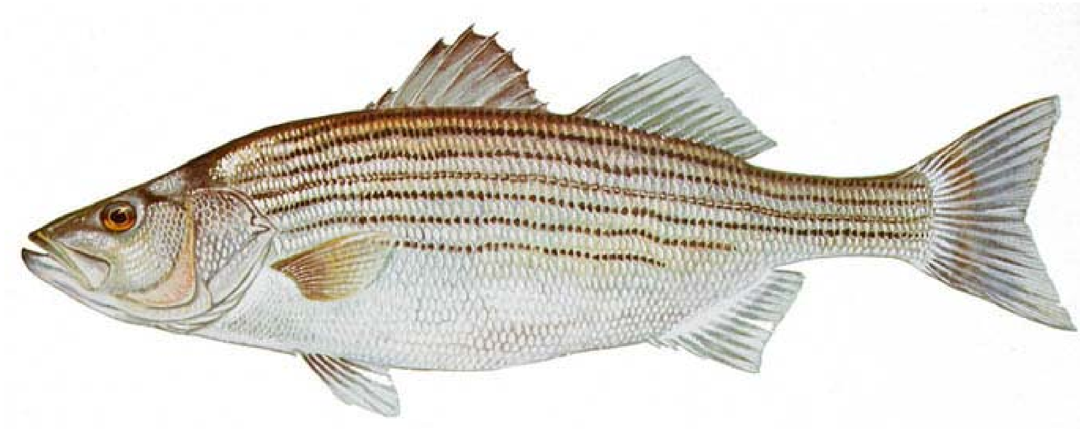


Table 29. Sampling rates and abundance indices of striped bass for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	17	66.3	17	16	16	16	16	0.05	42.6	0.10	39.8
2008	Spring	40	171.1	40	39	40	33	32	0.12	20.3	0.27	20.7
	Fall	1,559	4,611.9	95	43	59	21	20	0.18	34.2	0.30	27
2009	Spring	162	388.9	162	78	0	48	46	0.17	20.2	0.30	18.4
	Fall	352	1,523.7	127	32	0	22		0.05	30.9	0.10	35.4

Figure 103. Biomass (kg) of striped bass collected at each sampling site for each 2009 NEAMAP cruise.

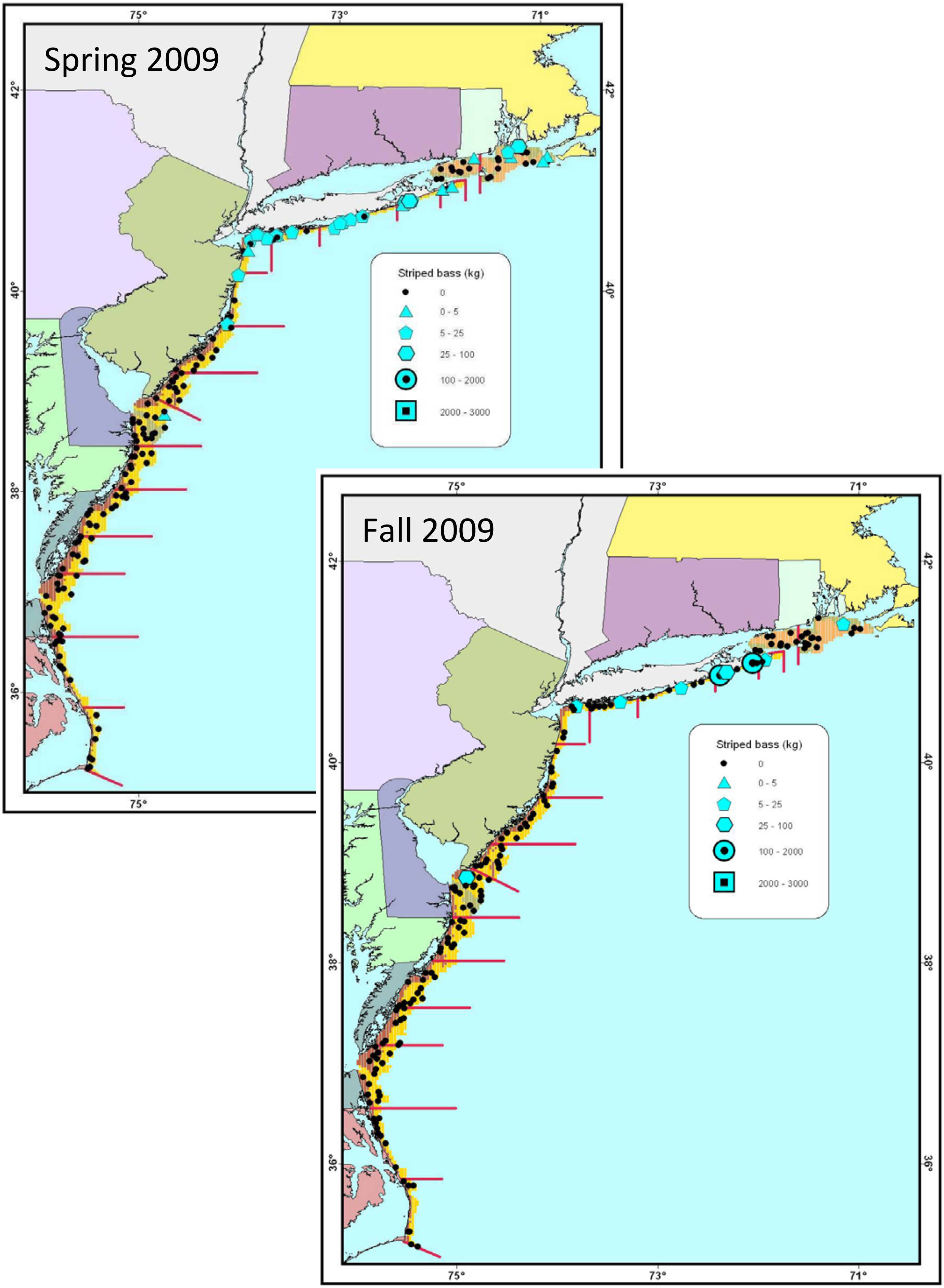


Figure 104. Preliminary indices of abundance, in terms of number and biomass, of striped bass for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

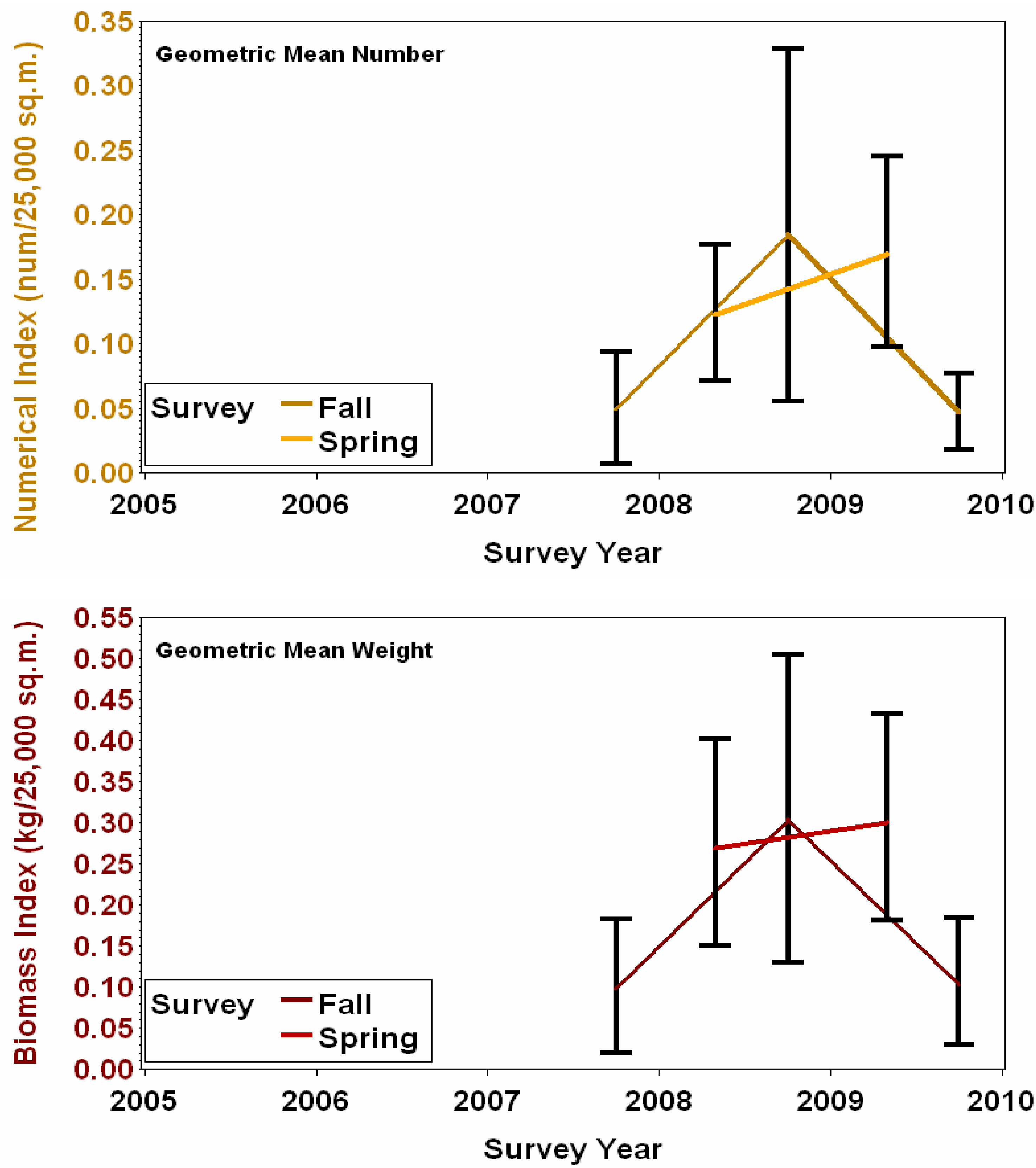


Figure 105. Length-frequency distributions, by cruise, for striped bass. Numbers taken for full processing, by length, are represented by the orange bars.

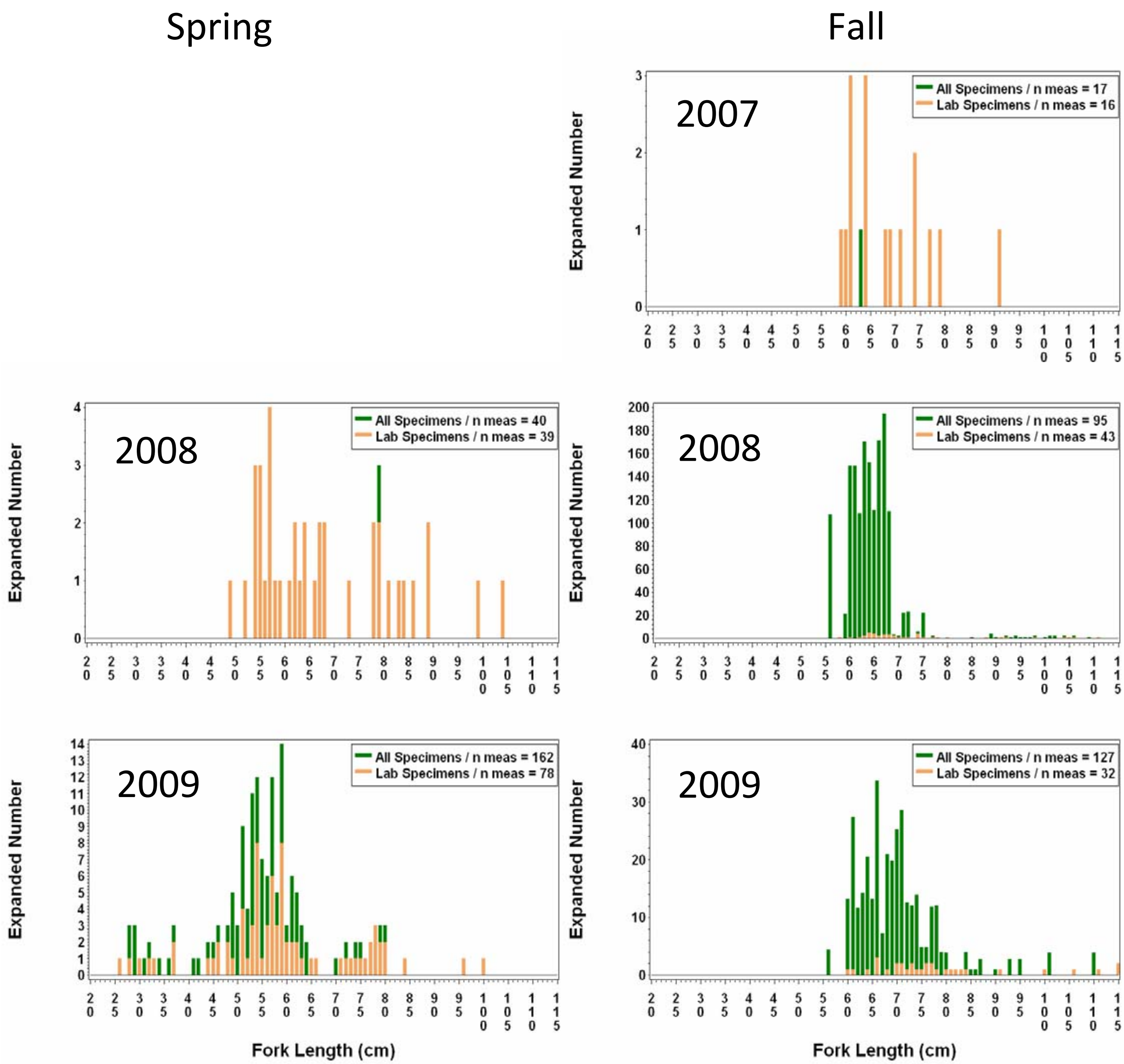


Figure 106. Sex ratio, by length group, for striped bass collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

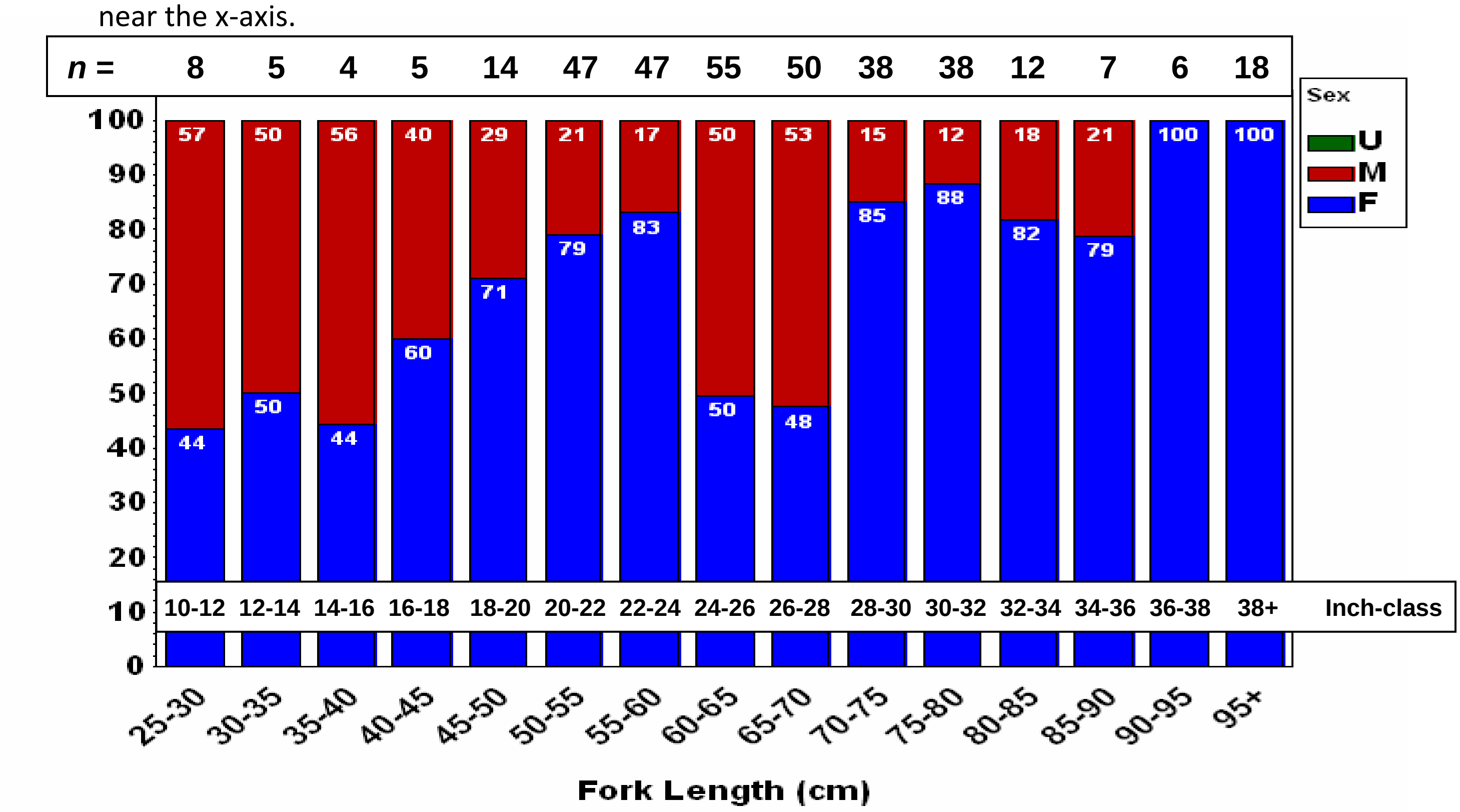


Figure 107. Diet composition, expressed using the percent weight index, of striped bass collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of stripers sampled.

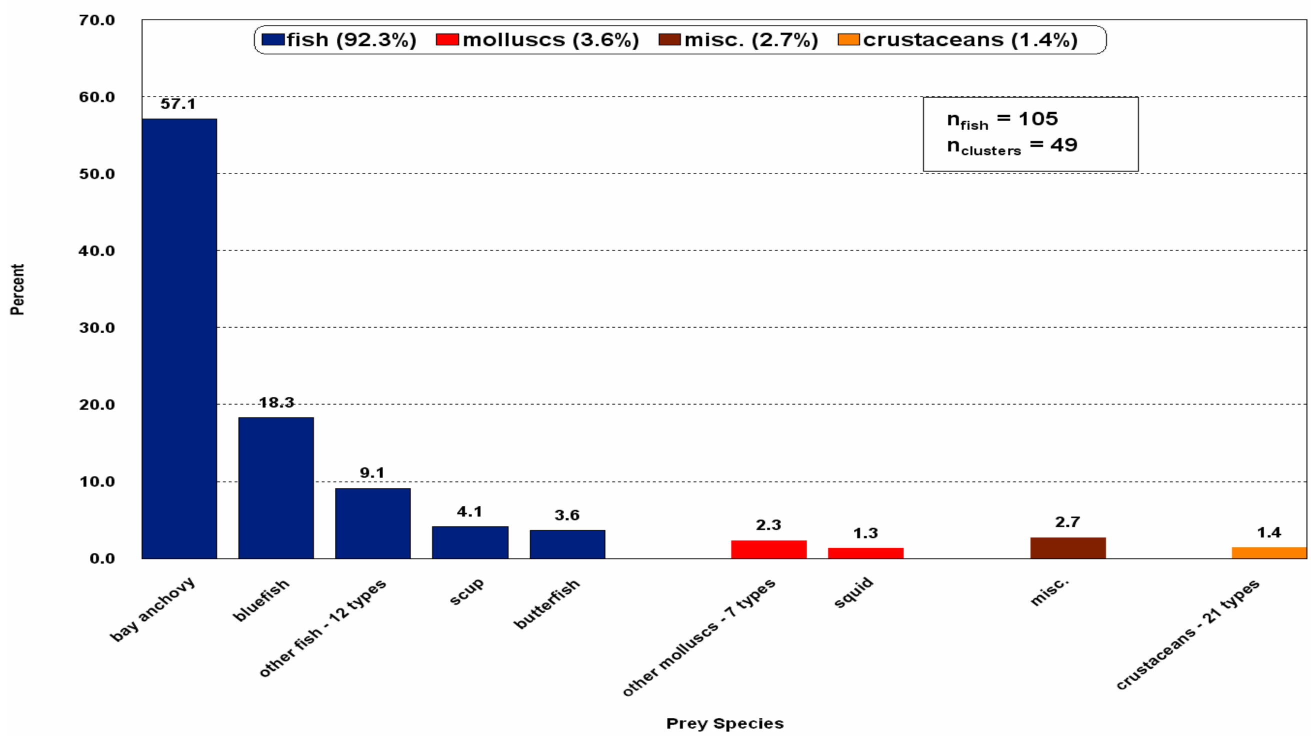
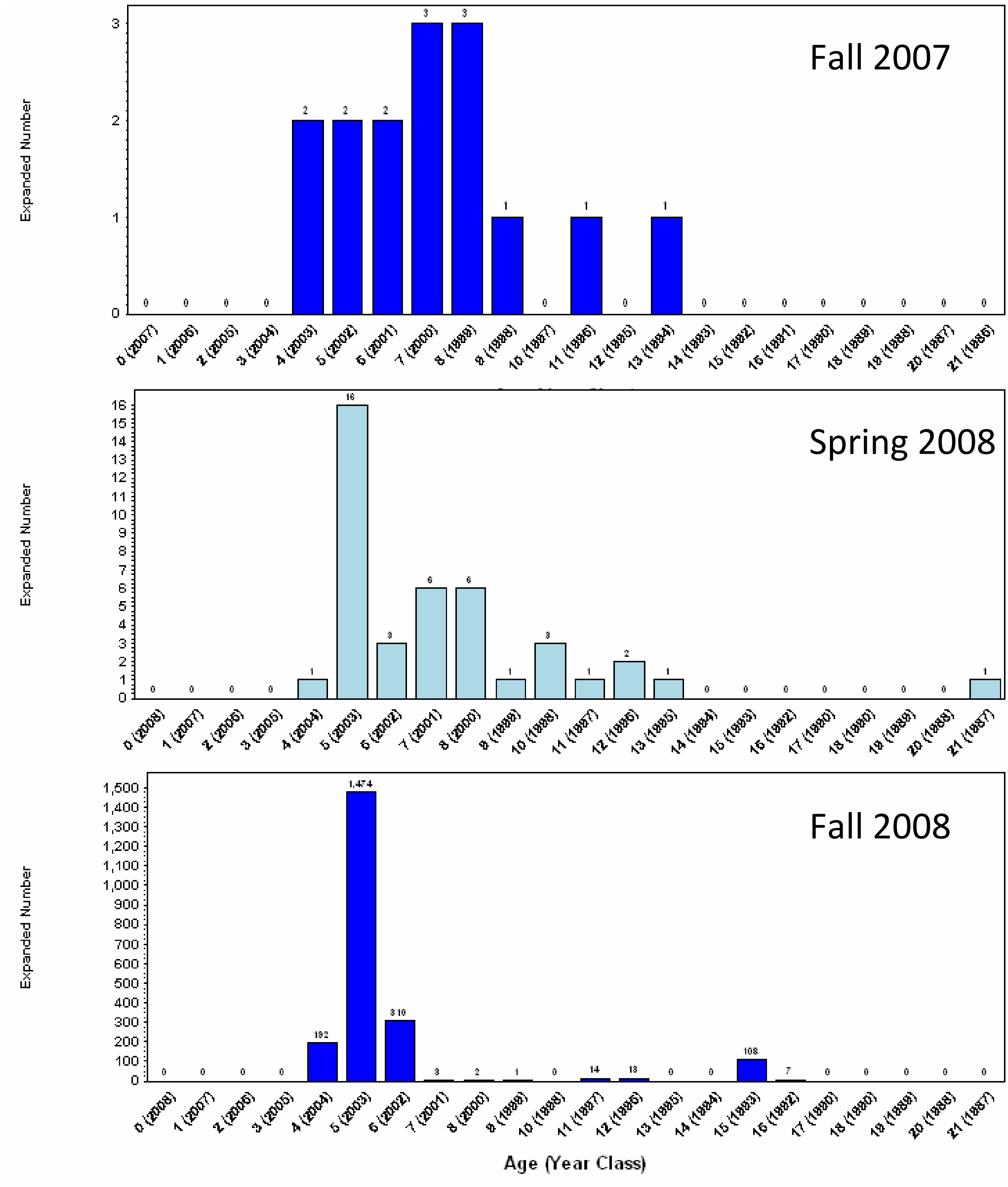


Figure 108. Age-frequency distribution, by cruise, for striped bass. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.



Summer Flounder (Priority A)

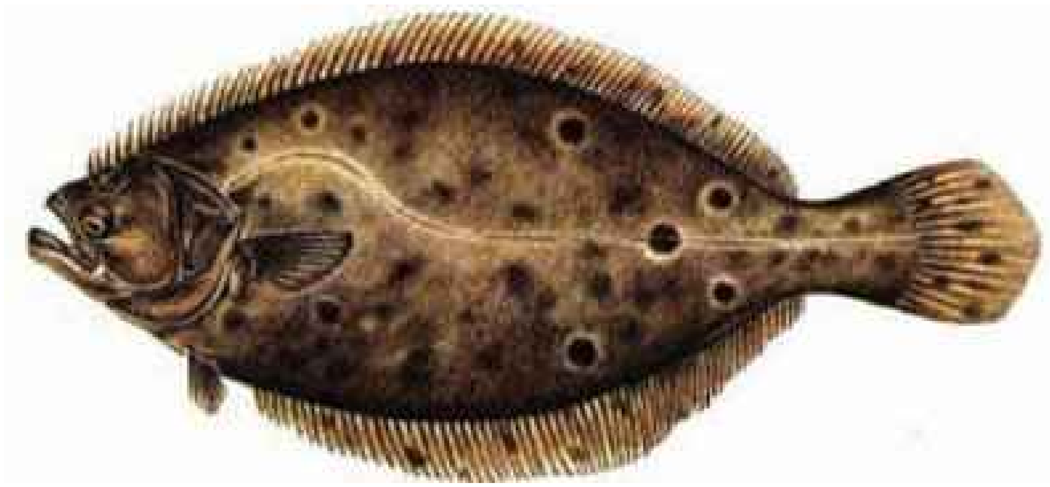


Table 30. Sampling rates and abundance indices of summer flounder for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	957	625.4	923	713	713	446	438	3.91	3.4	2.37	4.4
2008	Spring	768	527.0	768	522	522	375	366	2.76	4.5	1.73	5
	Fall	683	418.0	676	440	440	310	304	2.55	5	1.54	5.3
2009	Spring	974	518.3	974	620	0	361	349	2.41	4.9	1.39	5.8
	Fall	1,117	545.8	1,117	745	0	533		4.47	4	2.18	4.3

Figure 109. Biomass (kg) of summer flounder collected at each sampling site for each 2009 NEAMAP cruise.

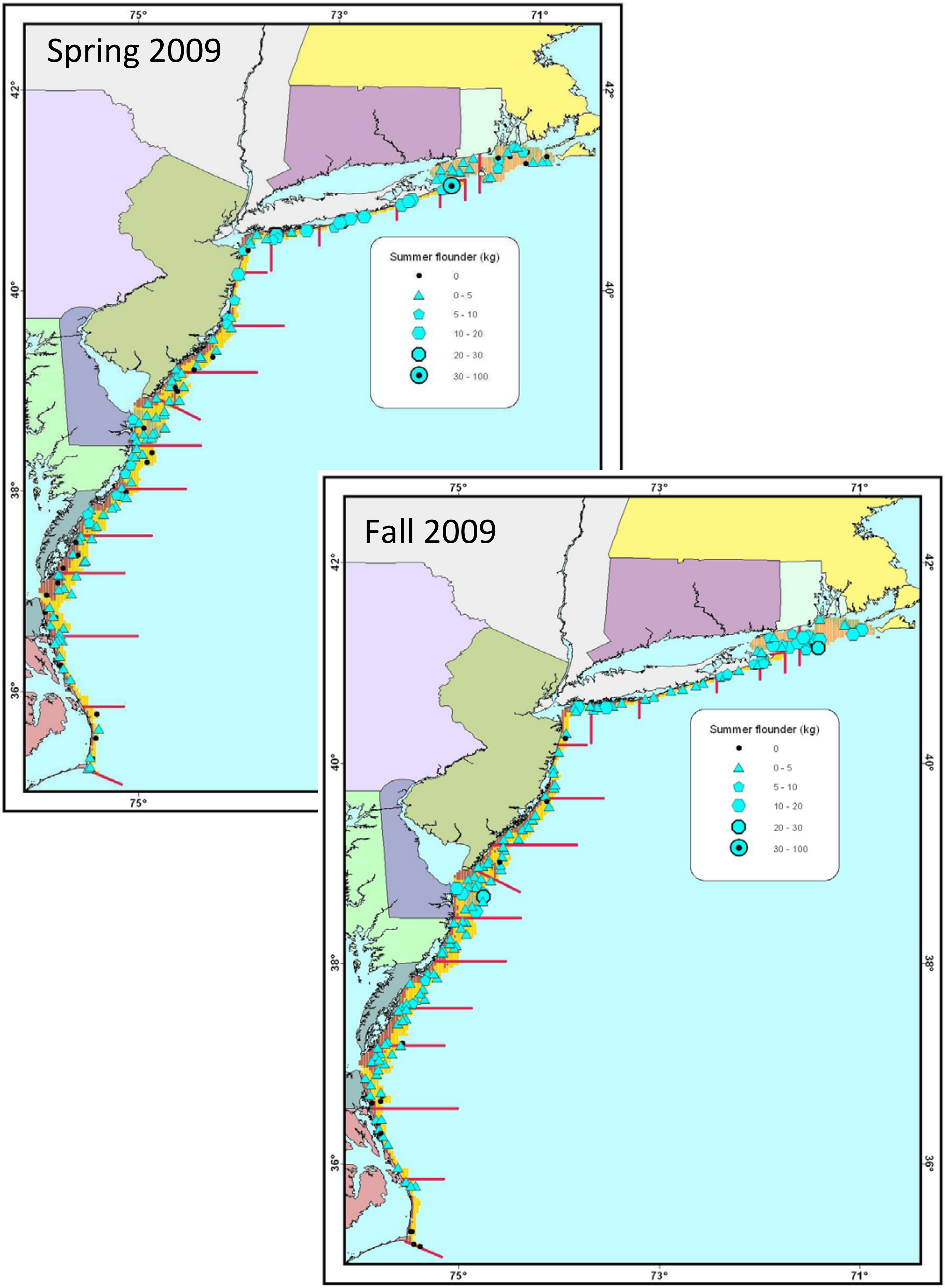


Figure 110. Preliminary indices of abundance, in terms of number and biomass, of summer flounder for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

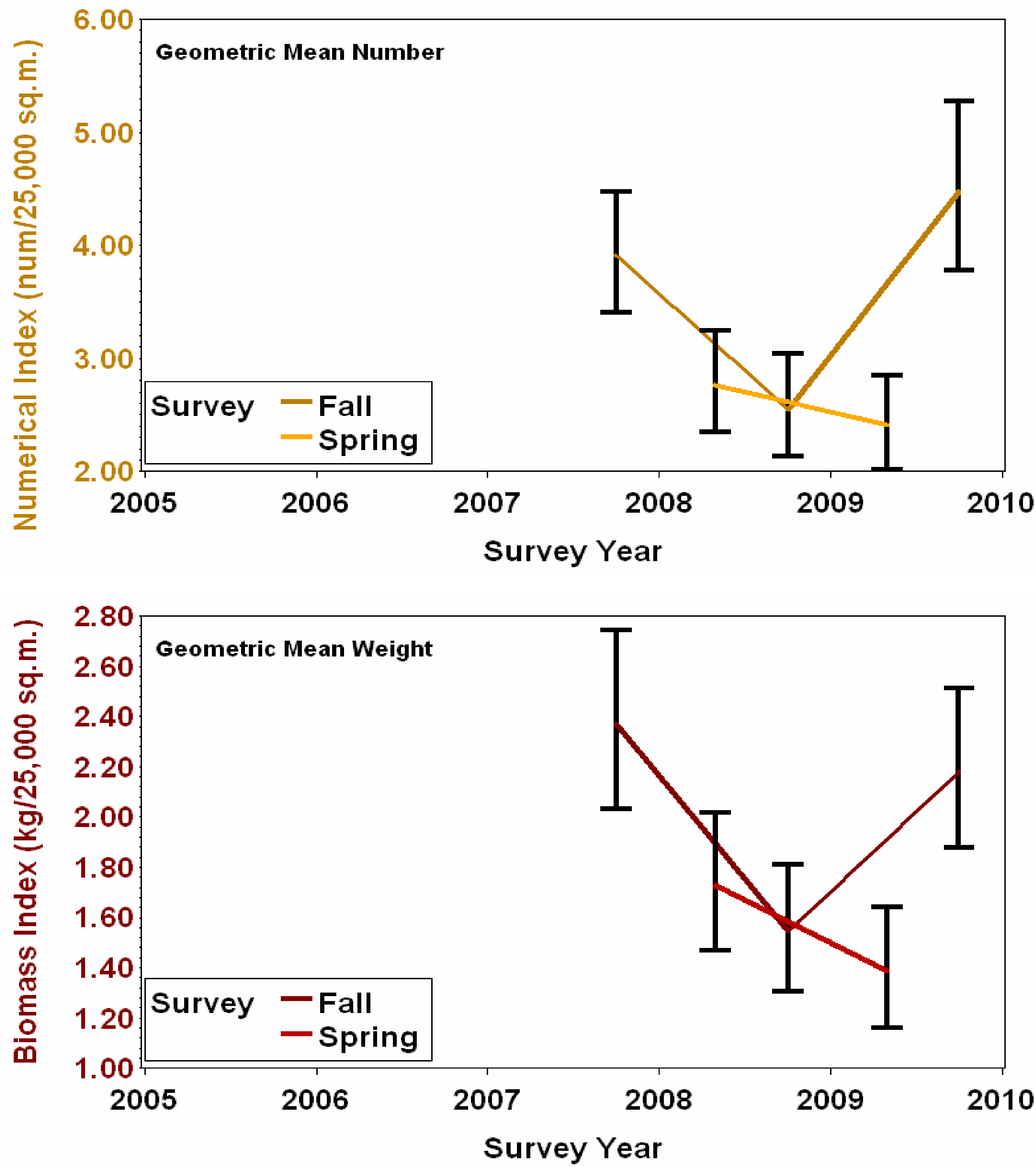


Figure 111. Length-frequency distributions, by cruise, for summer flounder. Numbers taken for full processing, by length, are represented by the orange bars.

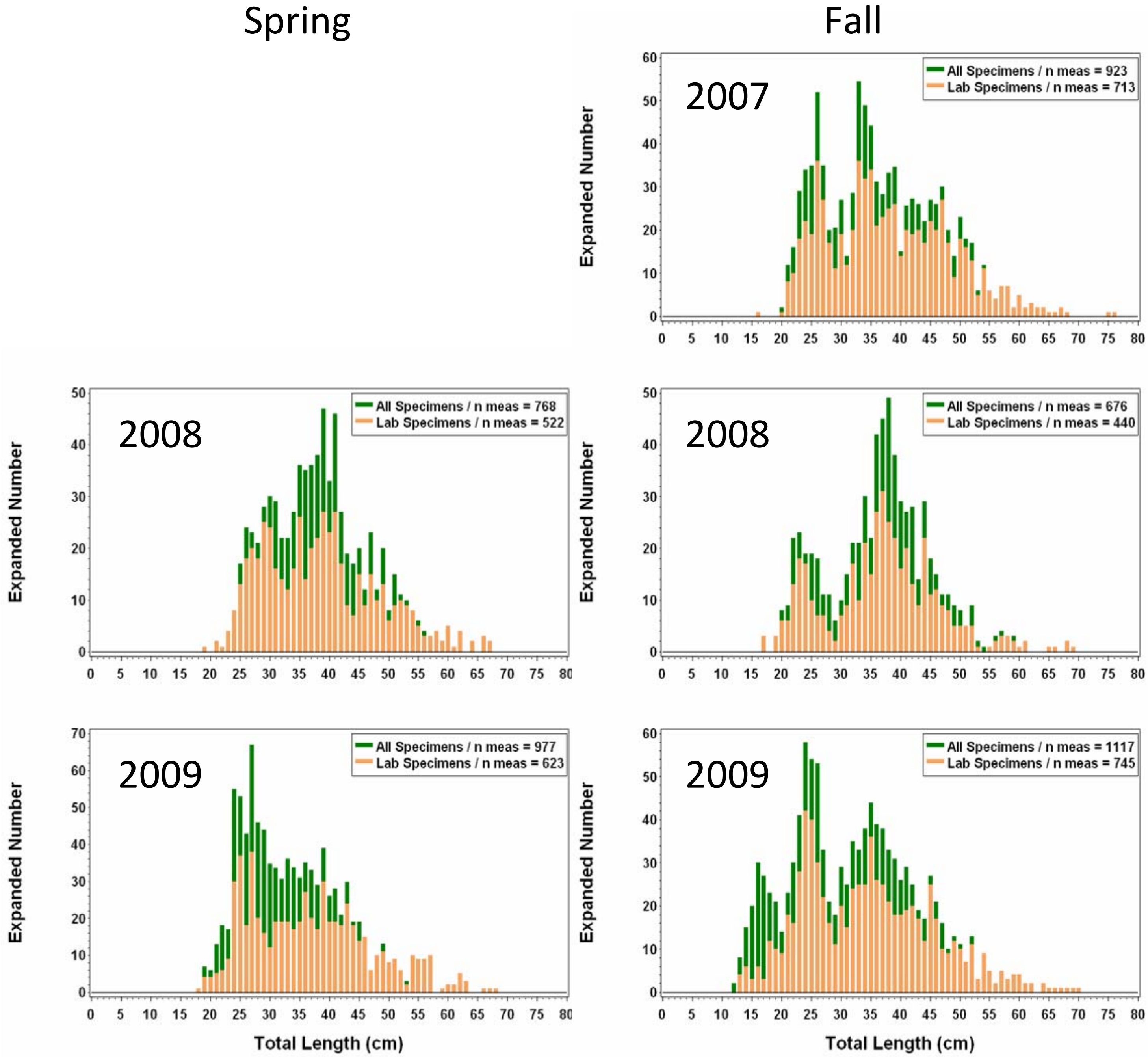


Figure 112. Sex ratio, by length group, for summer flounder collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

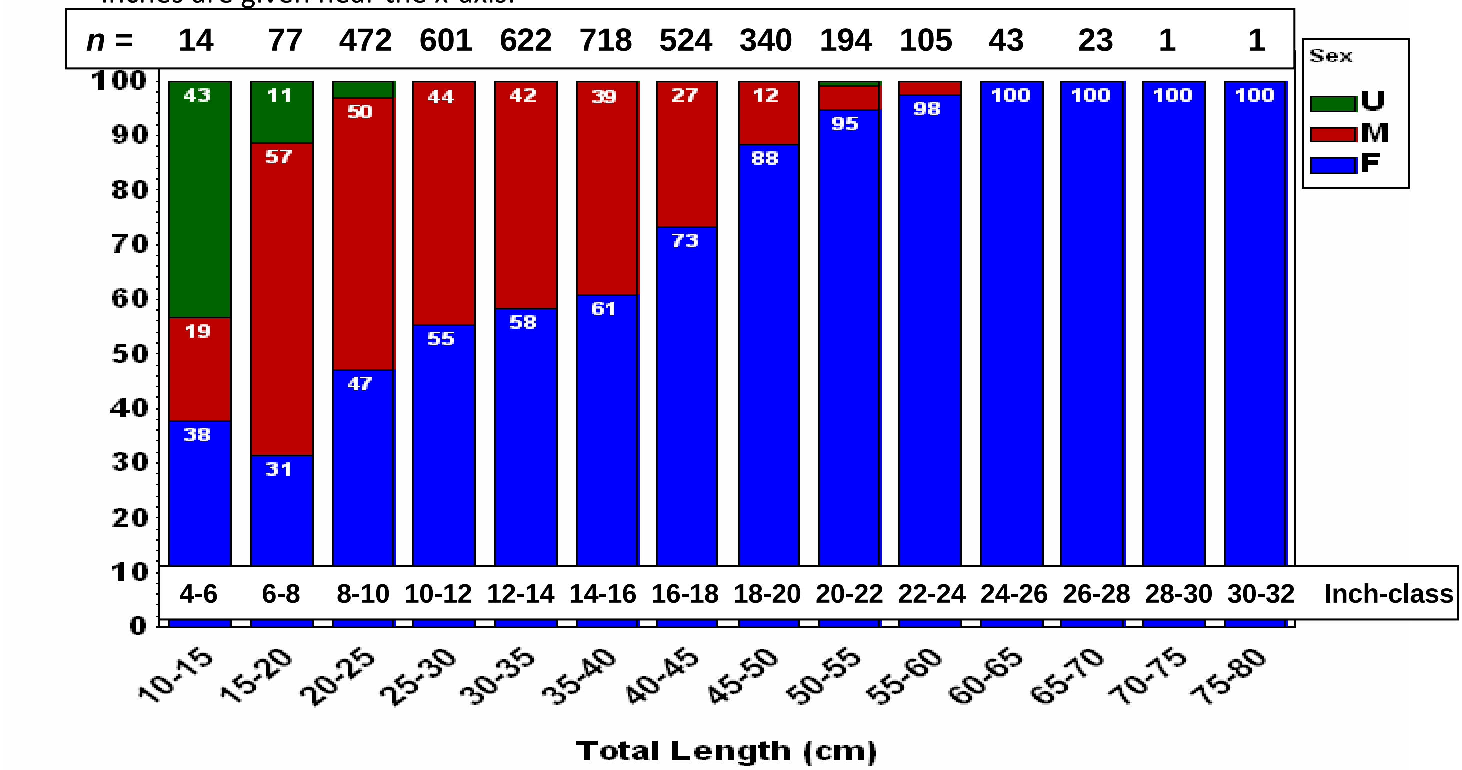


Figure 113. Diet composition, expressed using the percent weight index, of summer flounder collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of flounder sampled.

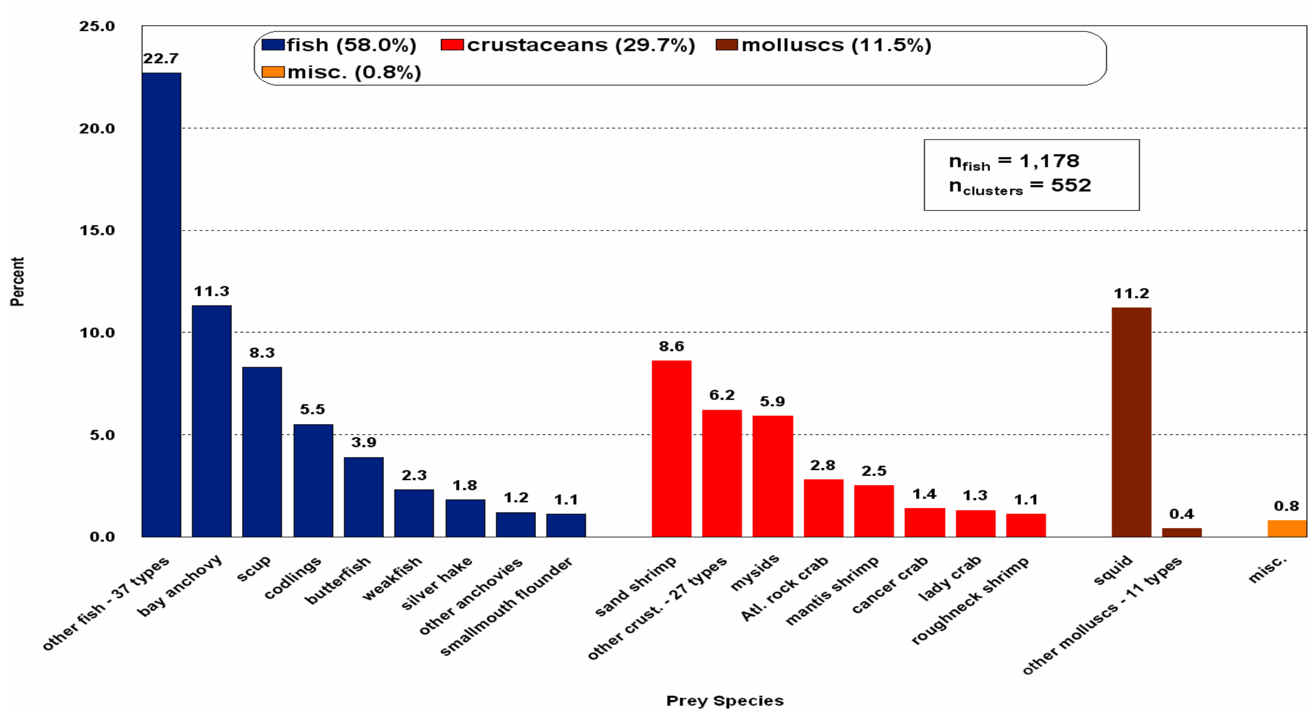
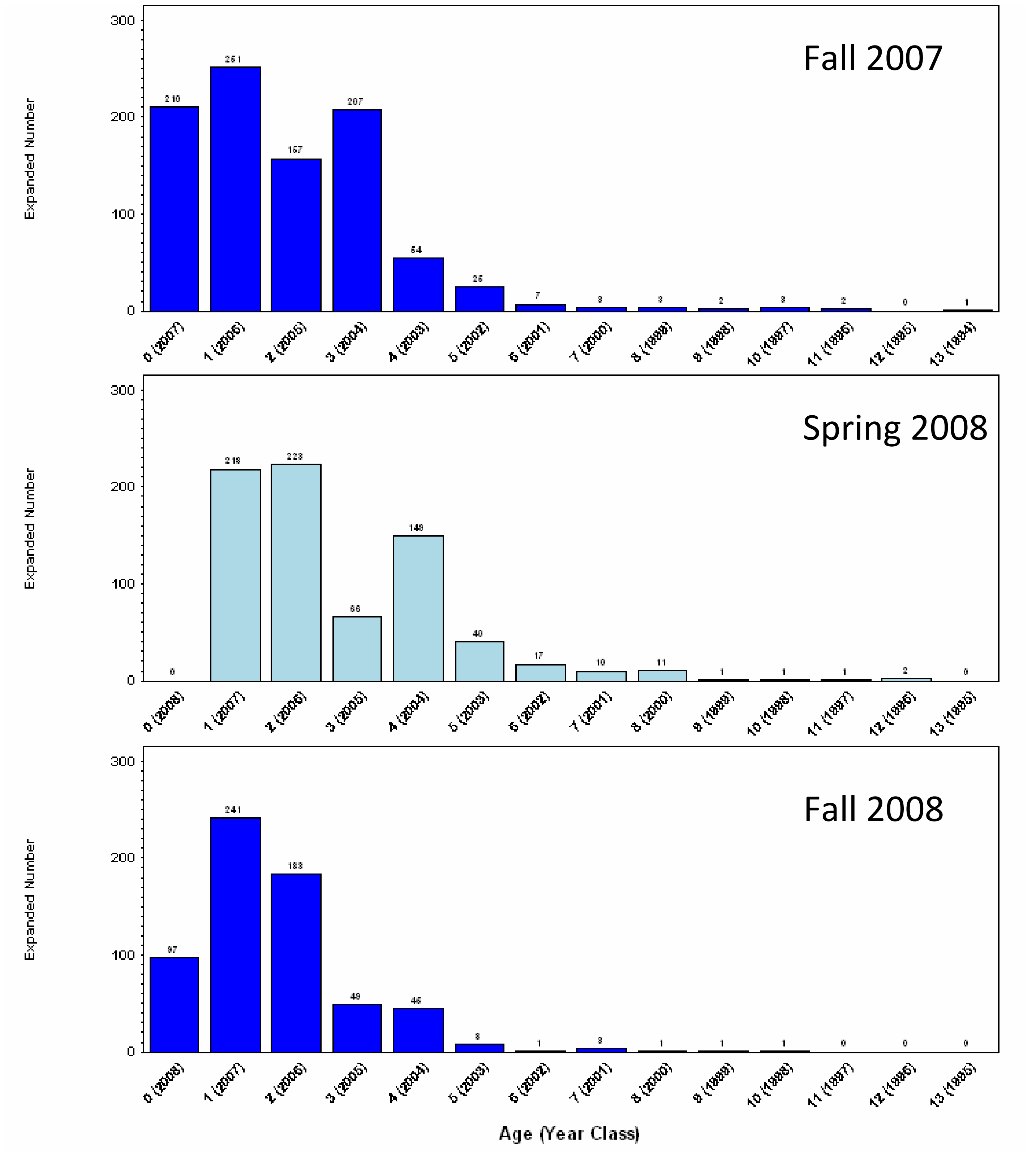


Figure 114. Age-frequency distribution, by cruise, for summer flounder. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.



Weakfish (Priority A)

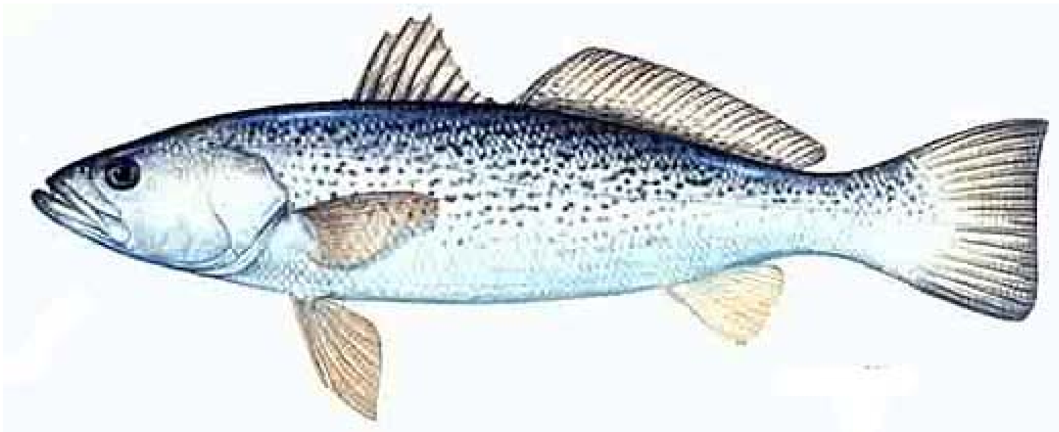


Table 31. Sampling rates and abundance indices of weakfish for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	60,990	4,168.1	5,747	572	572	472	466	11.27	7.4	3.05	8.7
2008	Spring	39,580	2,198.8	2,174	305	305	279	277	3.12	6.8	0.81	10.3
	Fall	44,779	3,990.4	3,879	464	464	333	320	9.65	7.7	2.82	9.3
2009	Spring	8,785	339.3	1,654	189	0	143	136	1.14	11.8	0.28	16.5
	Fall	96,394	5,556.9	13,012	872	0	644		26.70	5.3	5.55	6.6

Figure 115. Biomass (kg) of weakfish collected at each sampling site for each 2009 NEAMAP cruise.

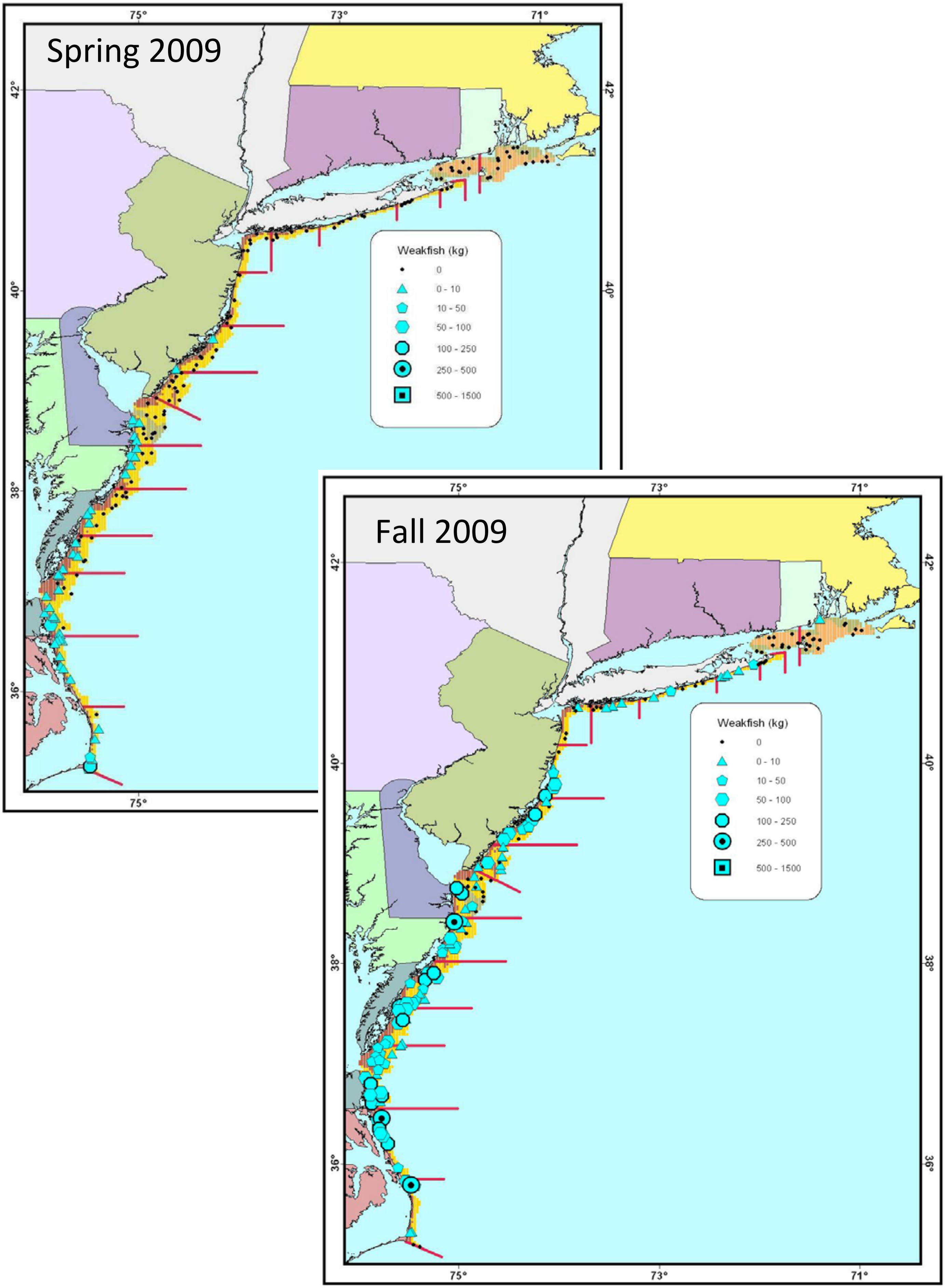
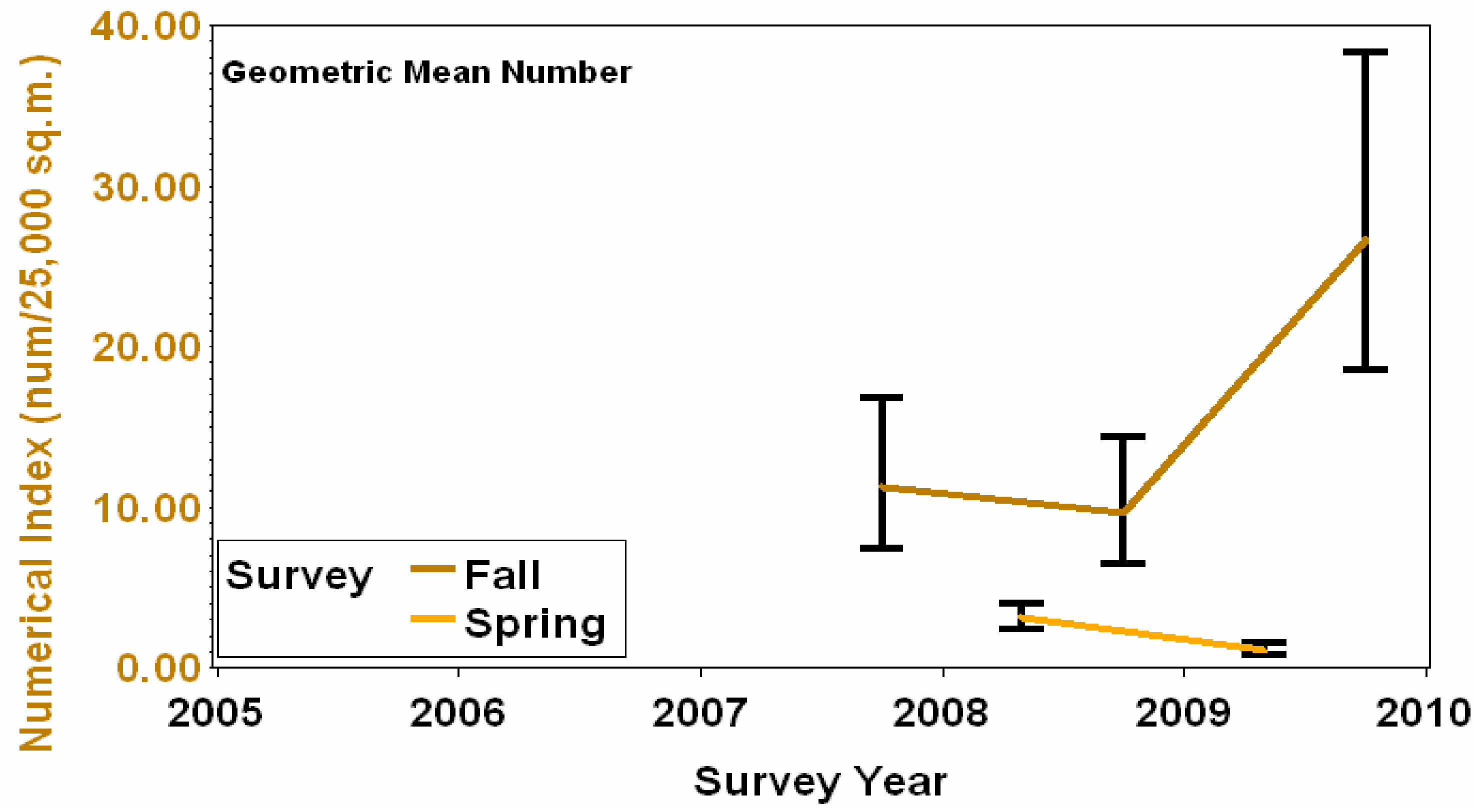


Figure 116. Preliminary indices of abundance, in terms of number and biomass, of weakfish for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



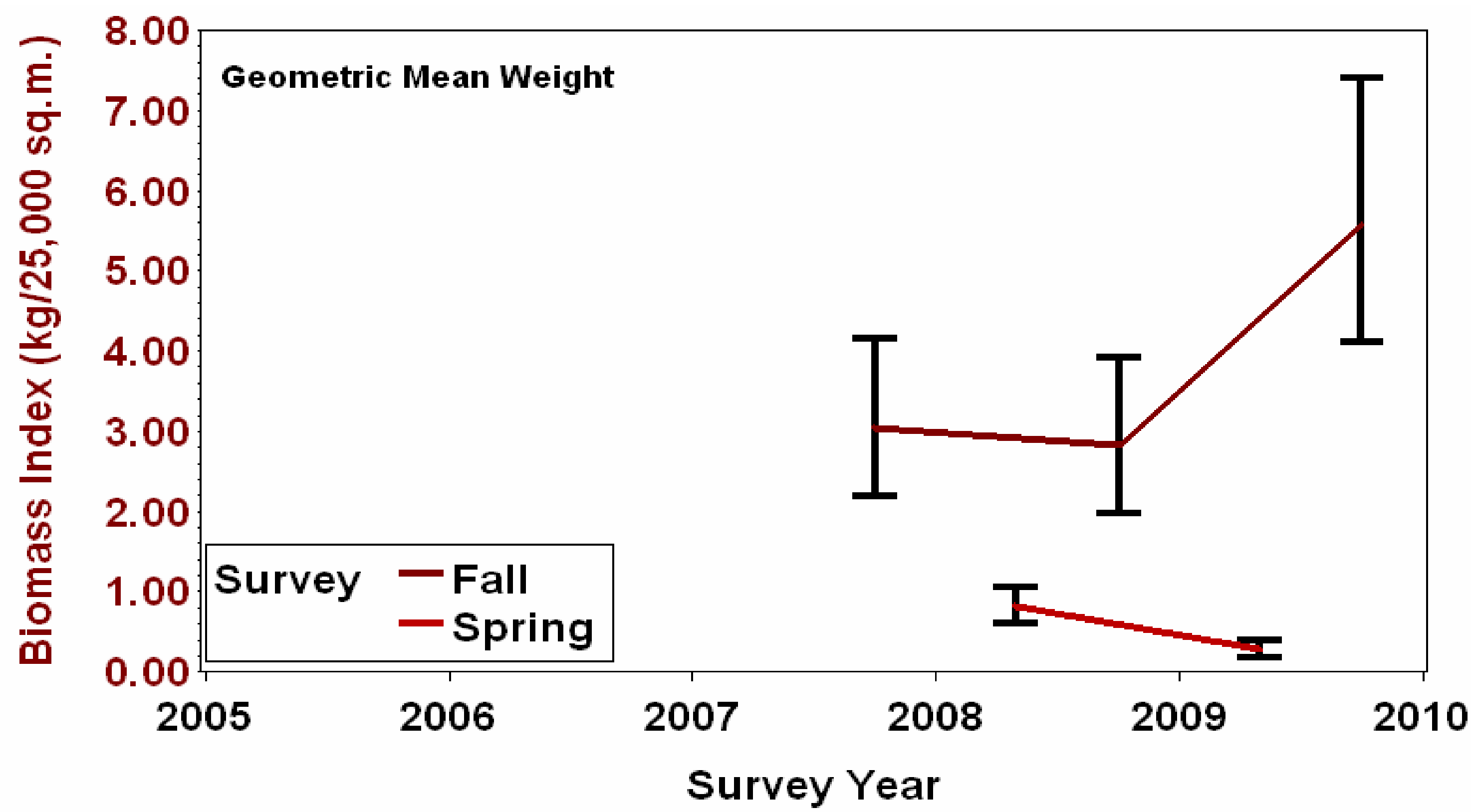


Figure 117. Length-frequency distributions, by cruise, for weakfish. Numbers taken for full processing, by length, are represented by the orange bars (difficult to see due to scale of y-axis).

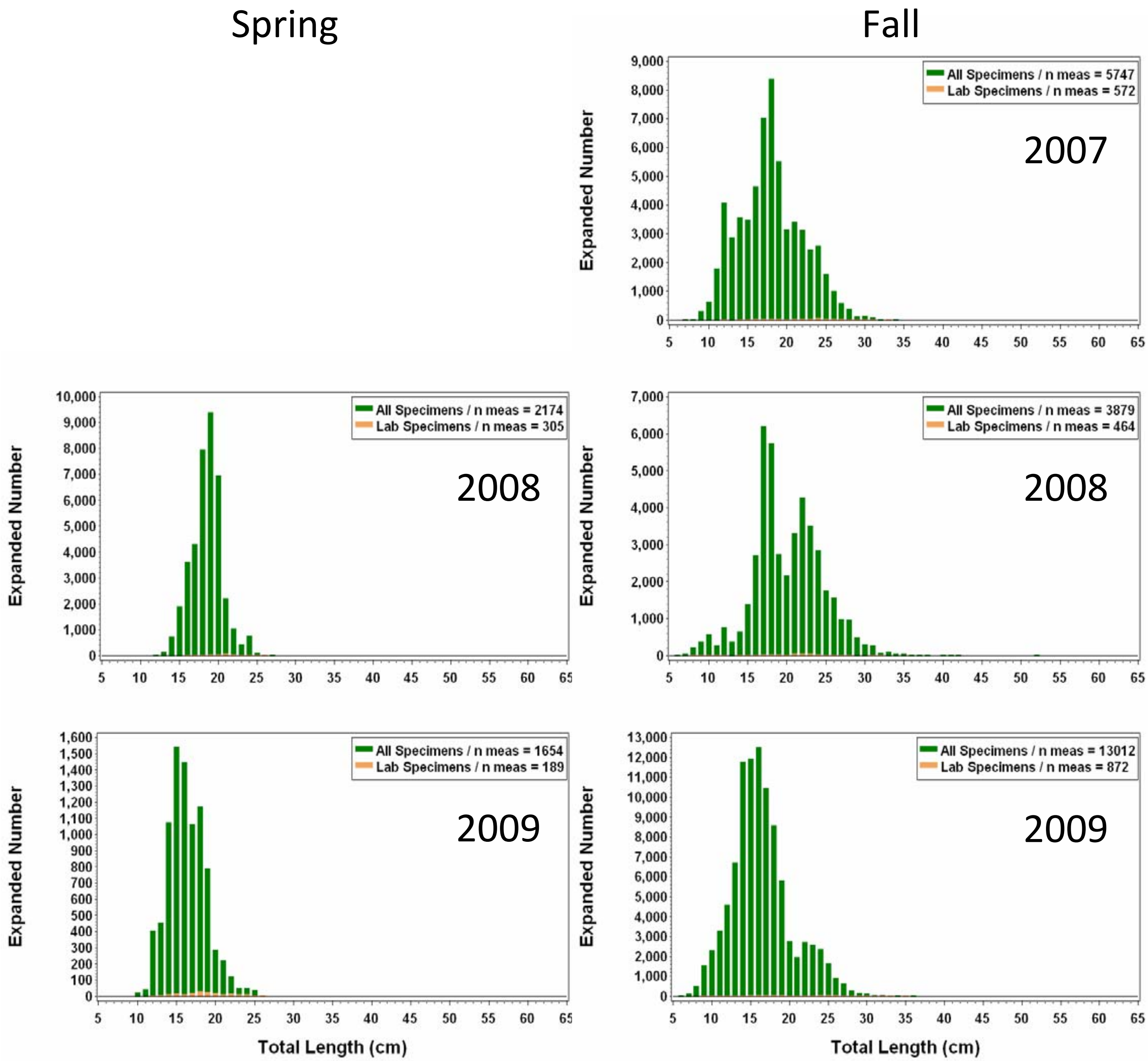


Figure 118. Sex ratio, by length group, for weakfish collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

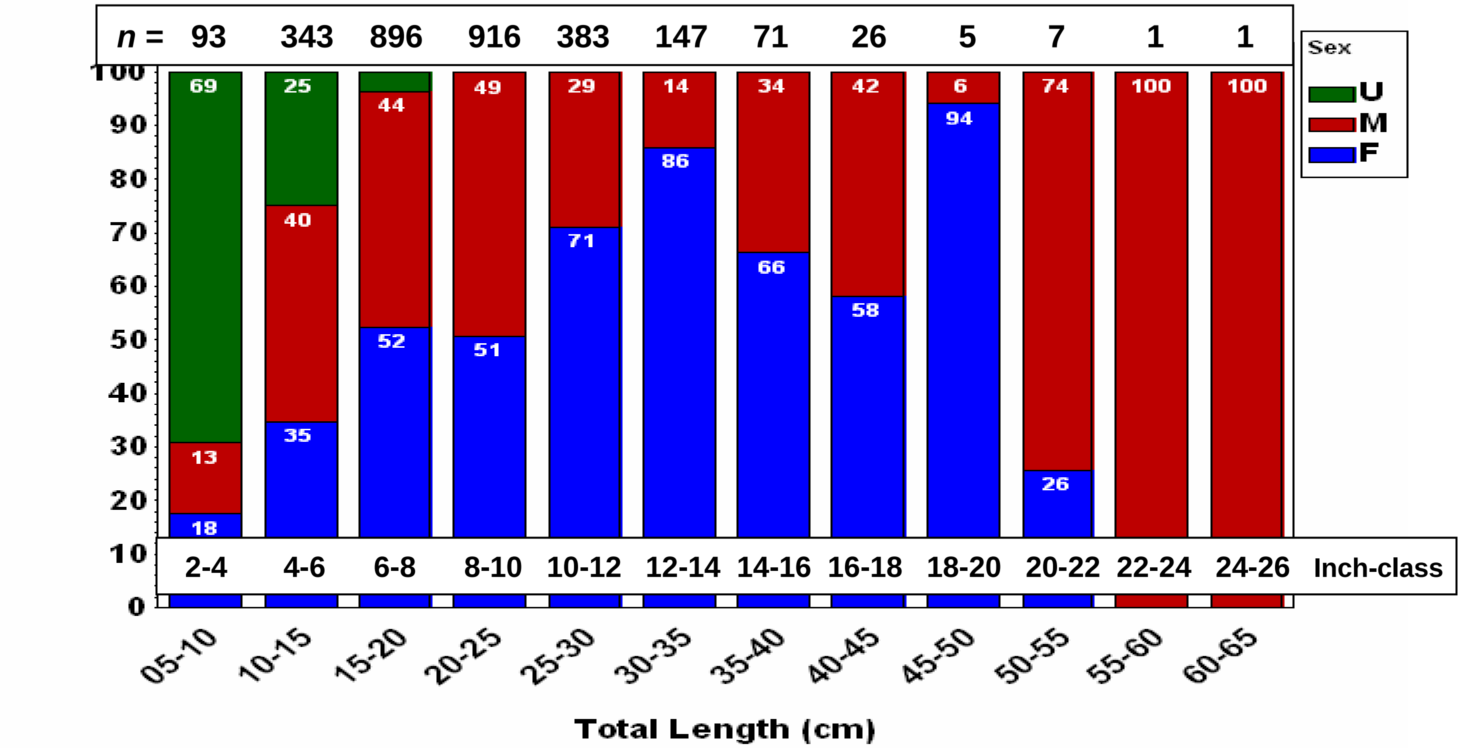


Figure 119. Diet composition, expressed using the percent weight index, of weakfish collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of weakfish sampled.

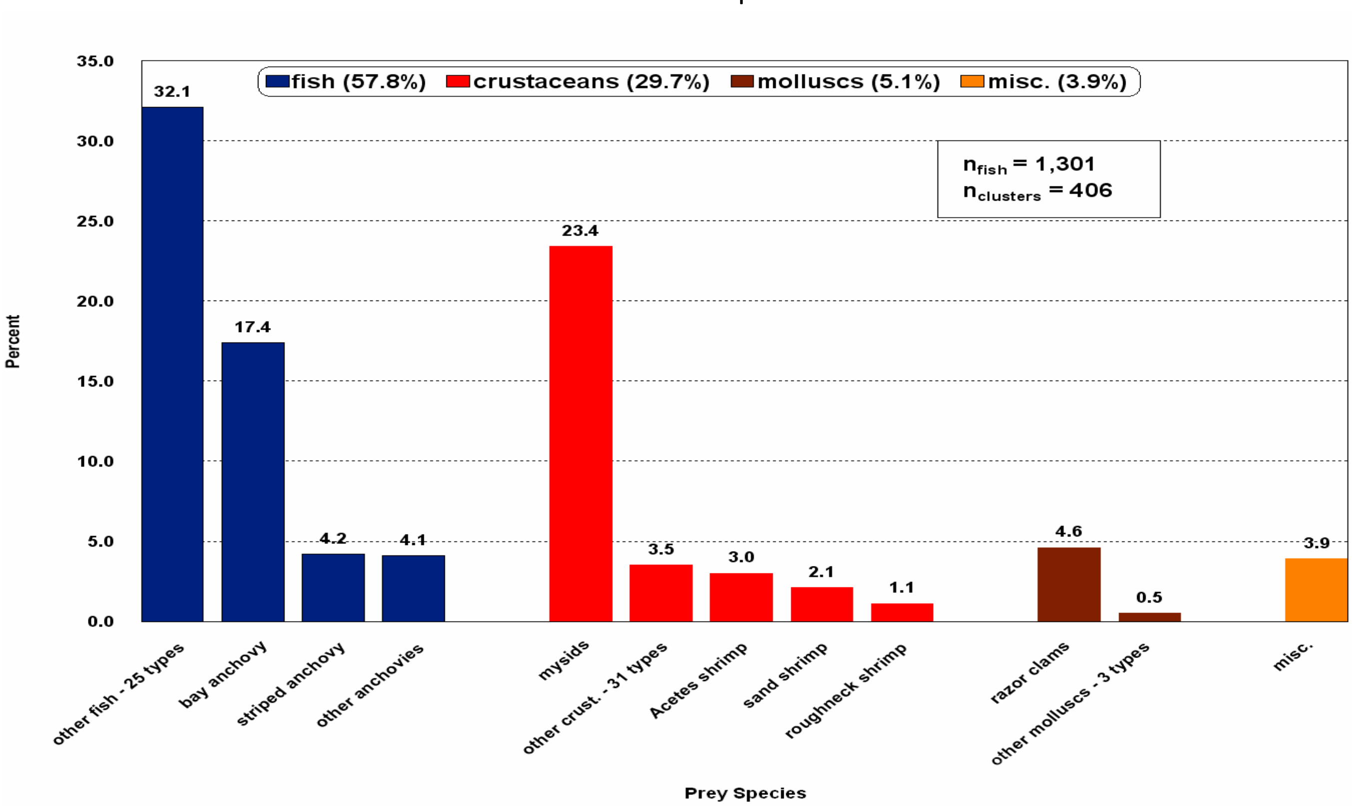
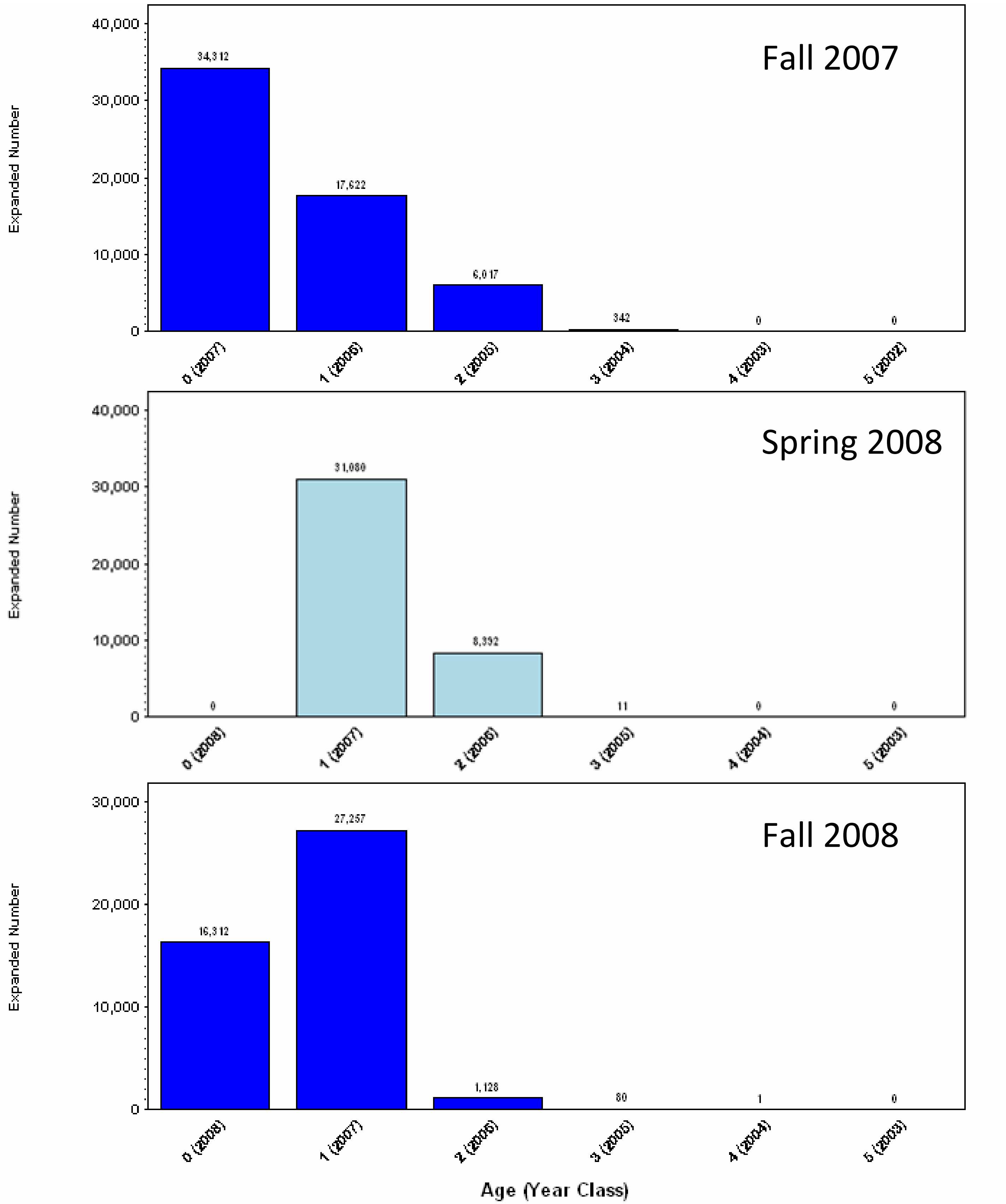


Figure 120. Age-frequency distribution, by cruise, for weakfish. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.



White Shrimp (Priority E)

Table 32. Sampling rates and abundance indices of white shrimp for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	48	1.8	20					0.07	30.6	0.01	45.5
2008	Spring								0.00		0.00	
	Fall	753	19.7	267					0.30	25.2	0.06	36.4
2009	Spring	23	0.7	23					0.02	62.4	0.00	90
	Fall	451	6.6	451					0.30	20.6	0.03	33.1

Figure 121. Biomass (kg) of white shrimp collected at each sampling site for each 2009 NEAMAP cruise.

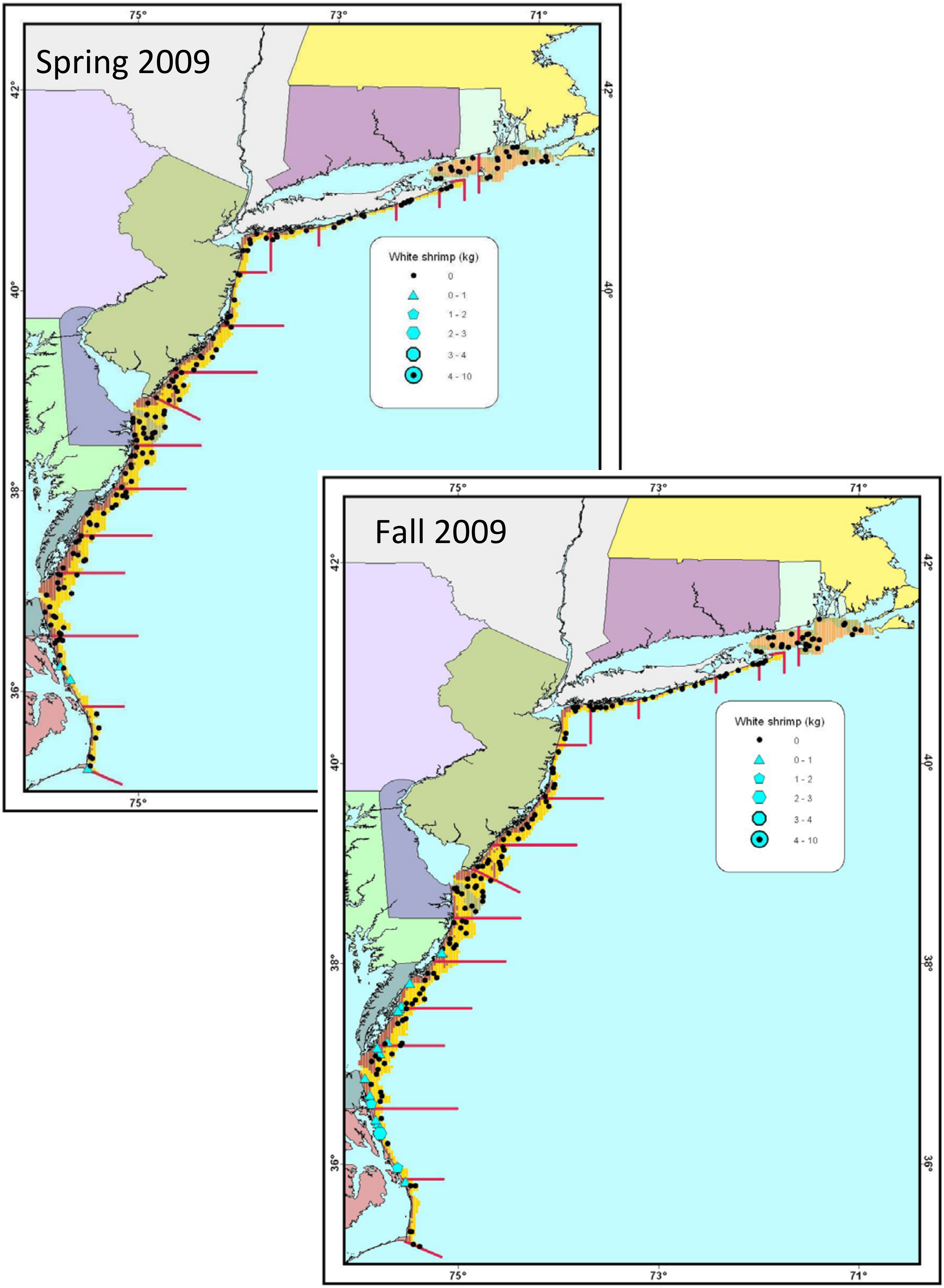
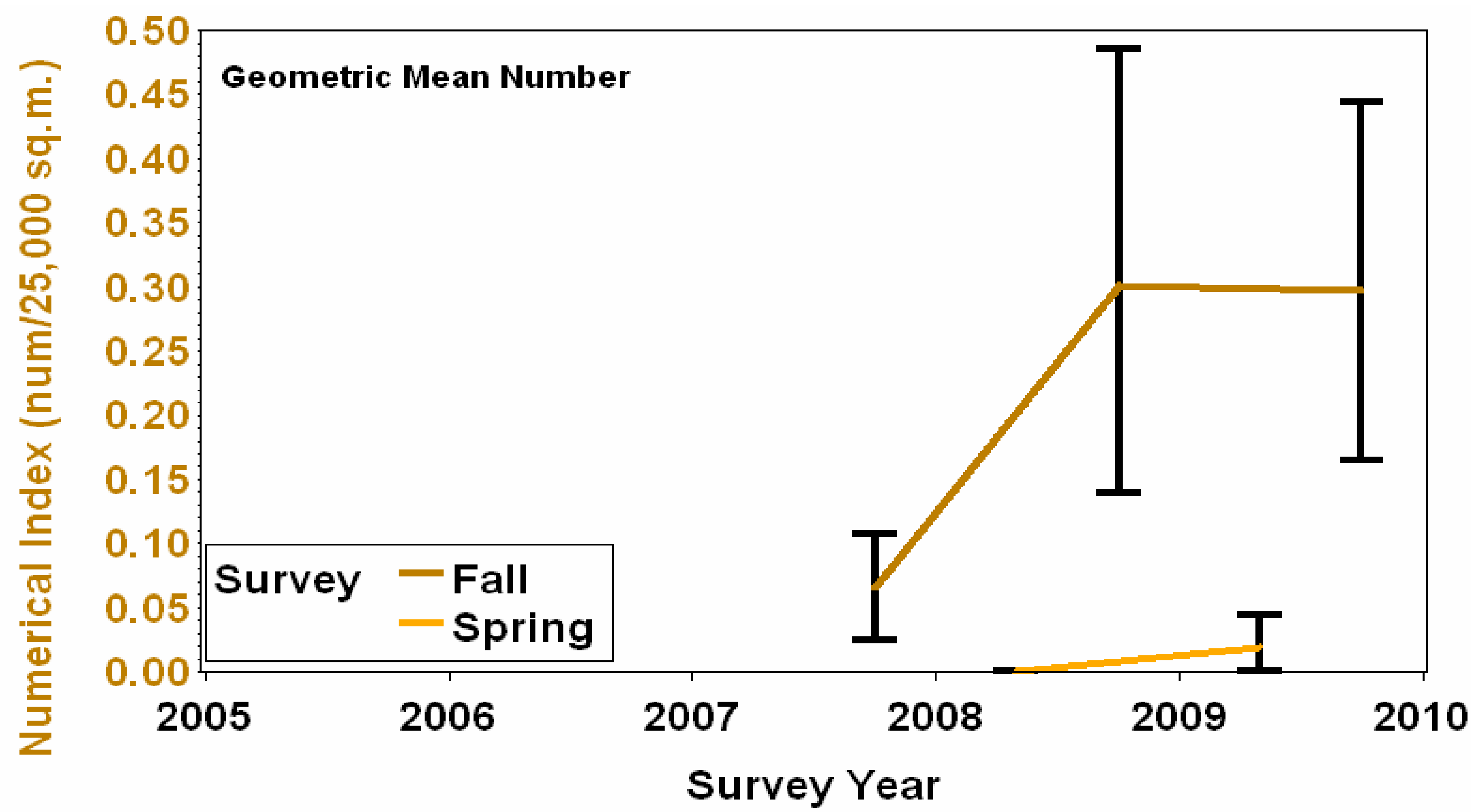


Figure 122. Preliminary indices of abundance, in terms of number and biomass, of white shrimp for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



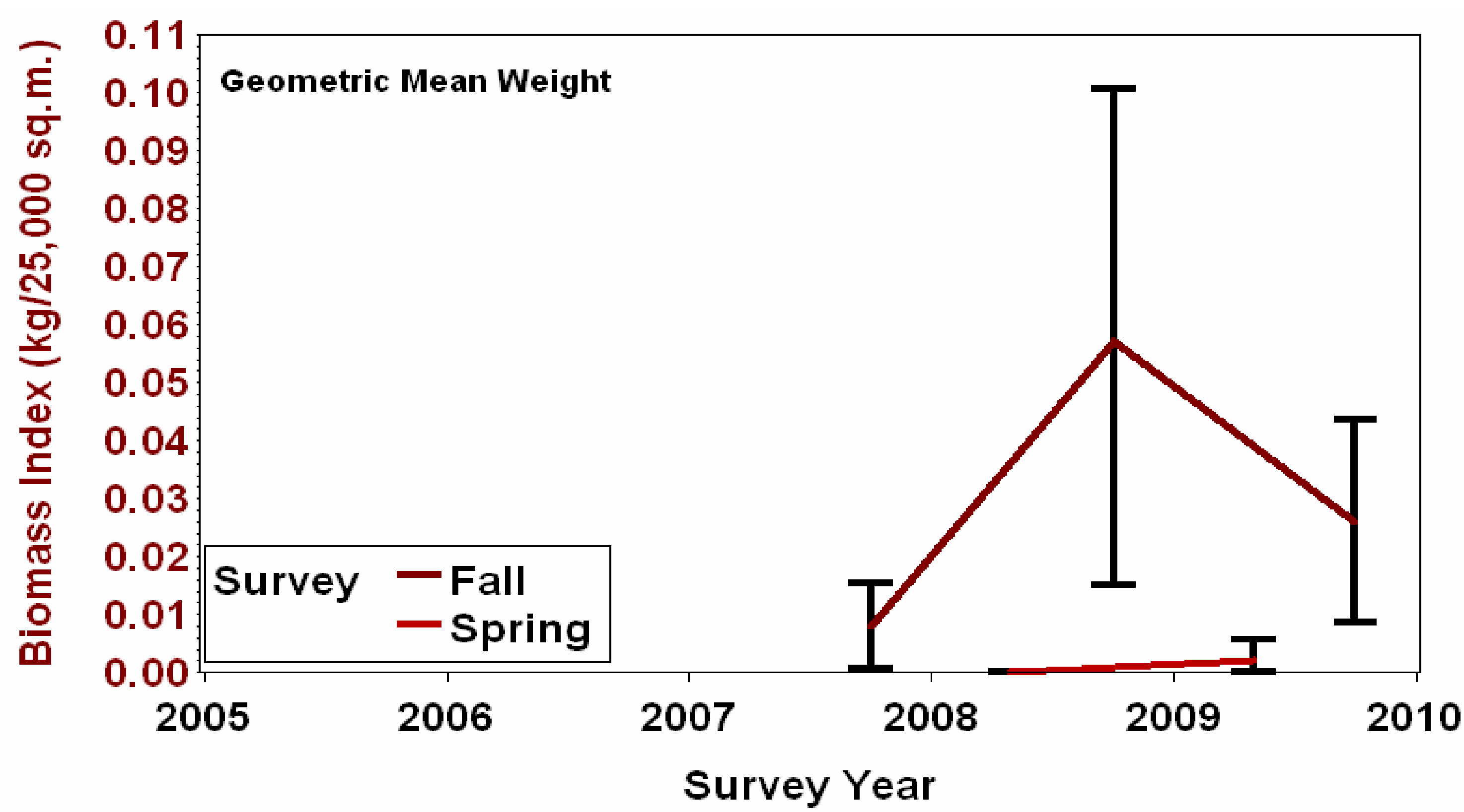
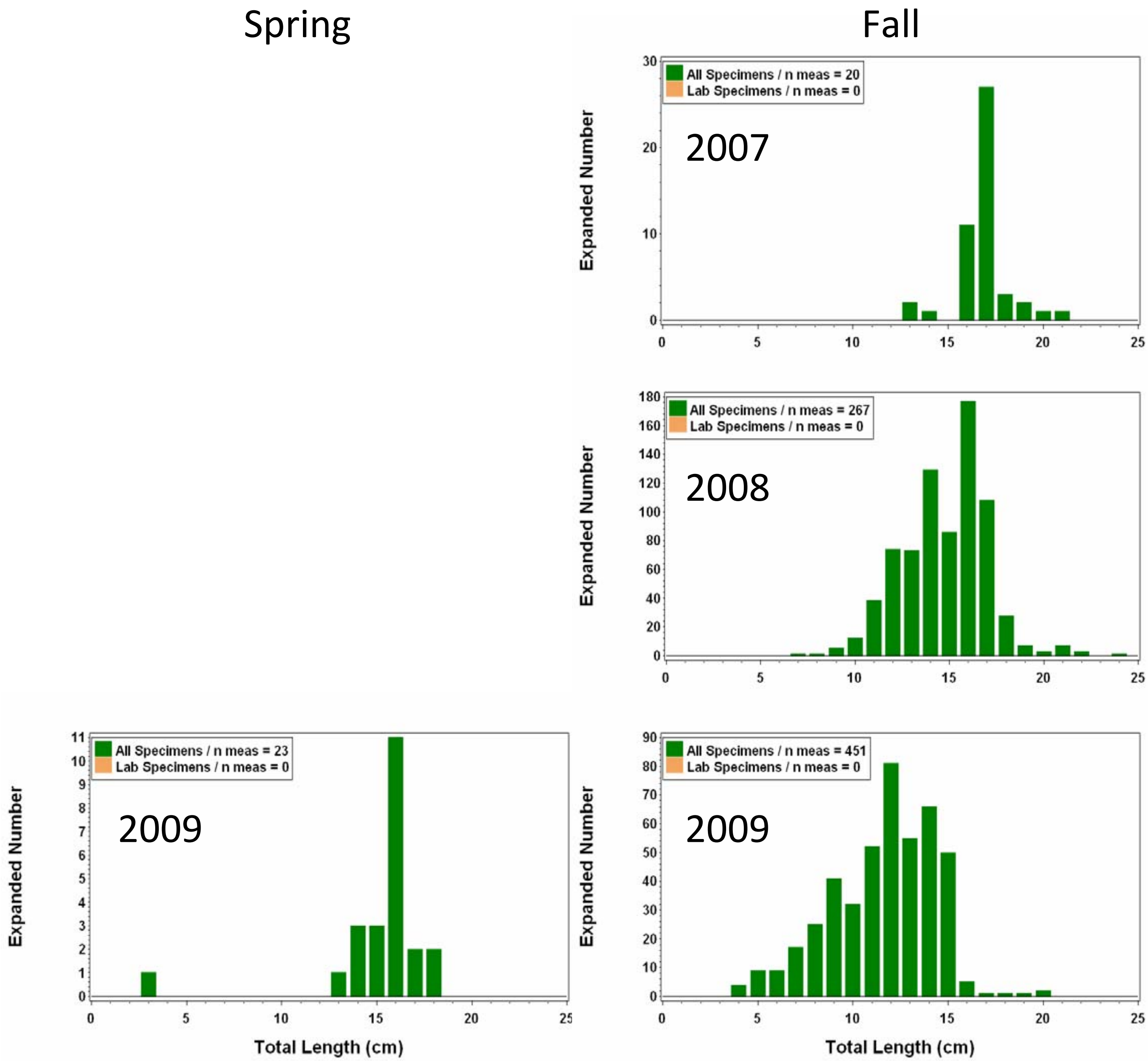


Figure 123. Length-frequency distributions, by cruise, for white shrimp. This species was absent from collections during the spring 2008 survey.



Windowpane Flounder (Priority D)

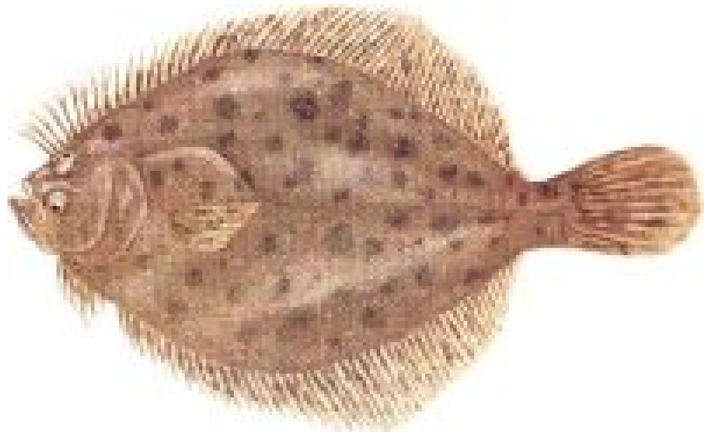


Table 33. Sampling rates and abundance indices of windowpane flounder for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	744	114.0	694					2.21	5.6	0.49	7.5
2008	Spring	756	191.0	697					2.12	5.4	0.68	6.6
	Fall	475	79.4	410					1.08	7.9	0.27	11
2009	Spring	1,067	268.2	868					1.80	5.3	0.58	6.8
	Fall	1,155	211.2	1,155					2.63	5.6	0.69	7.6

Figure 124. Biomass (kg) of windowpane flounder collected at each sampling site for each 2009 NEAMAP cruise.

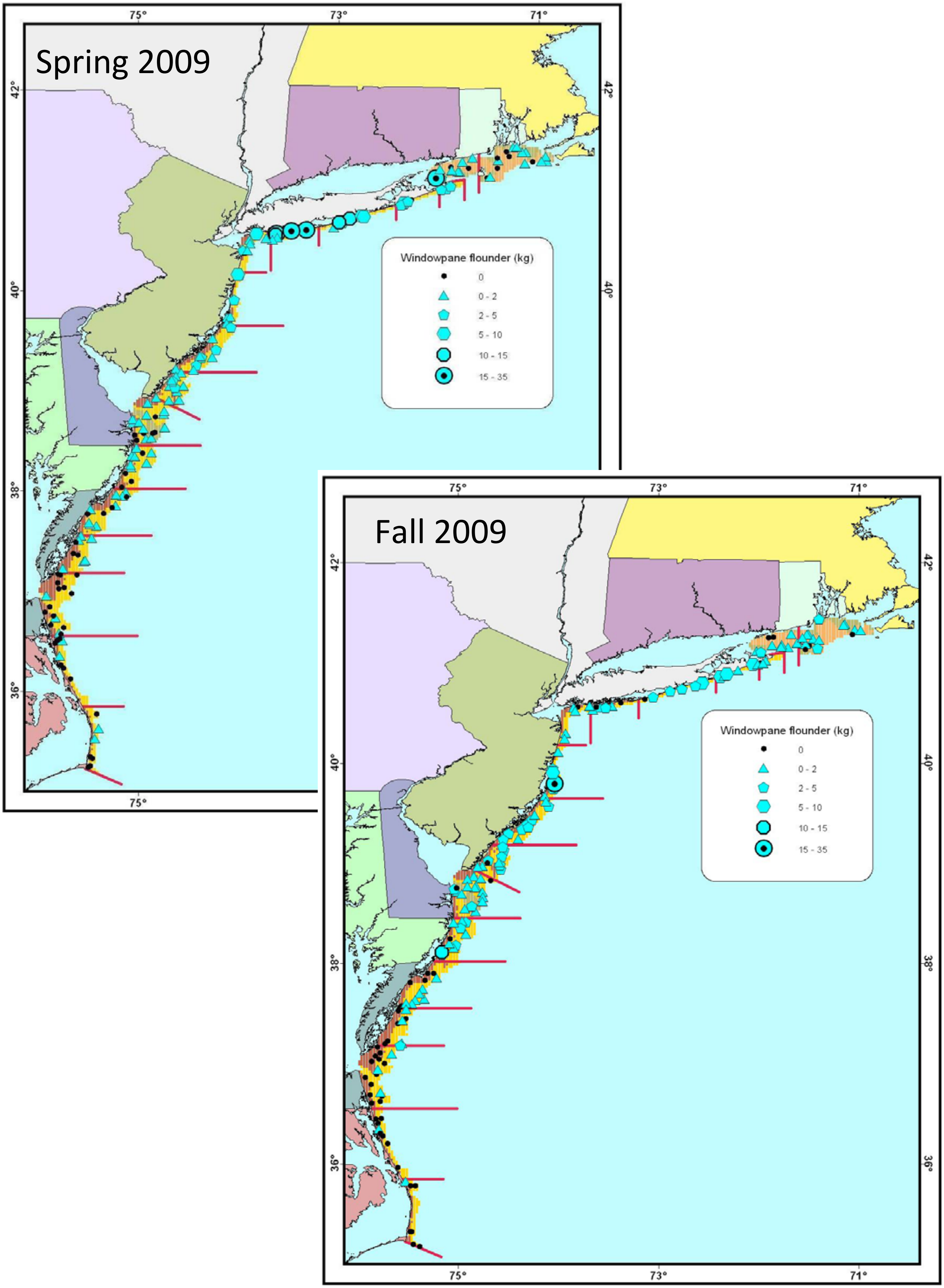


Figure 125. Preliminary indices of abundance, in terms of number and biomass, of windowpane flounder for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.

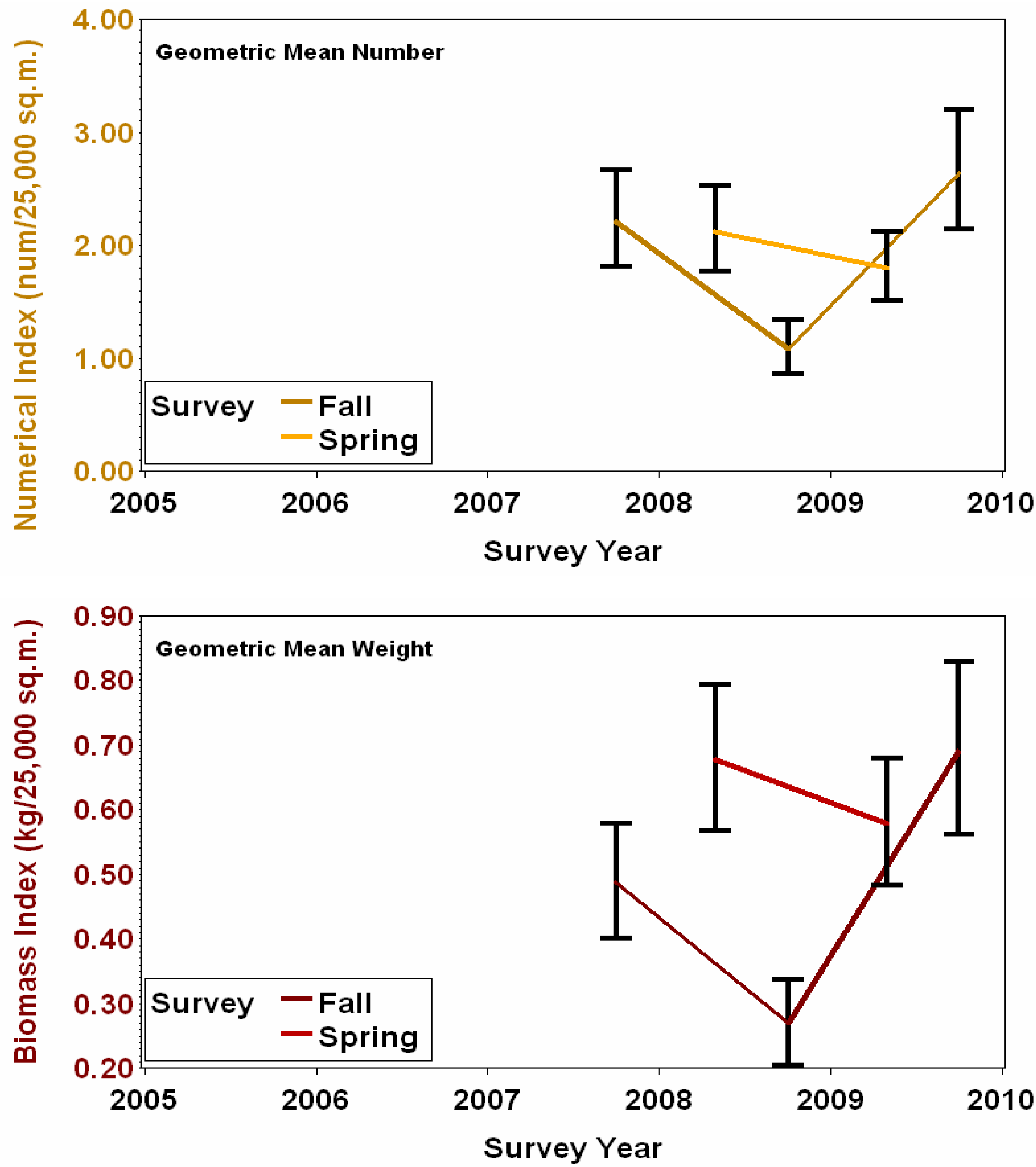
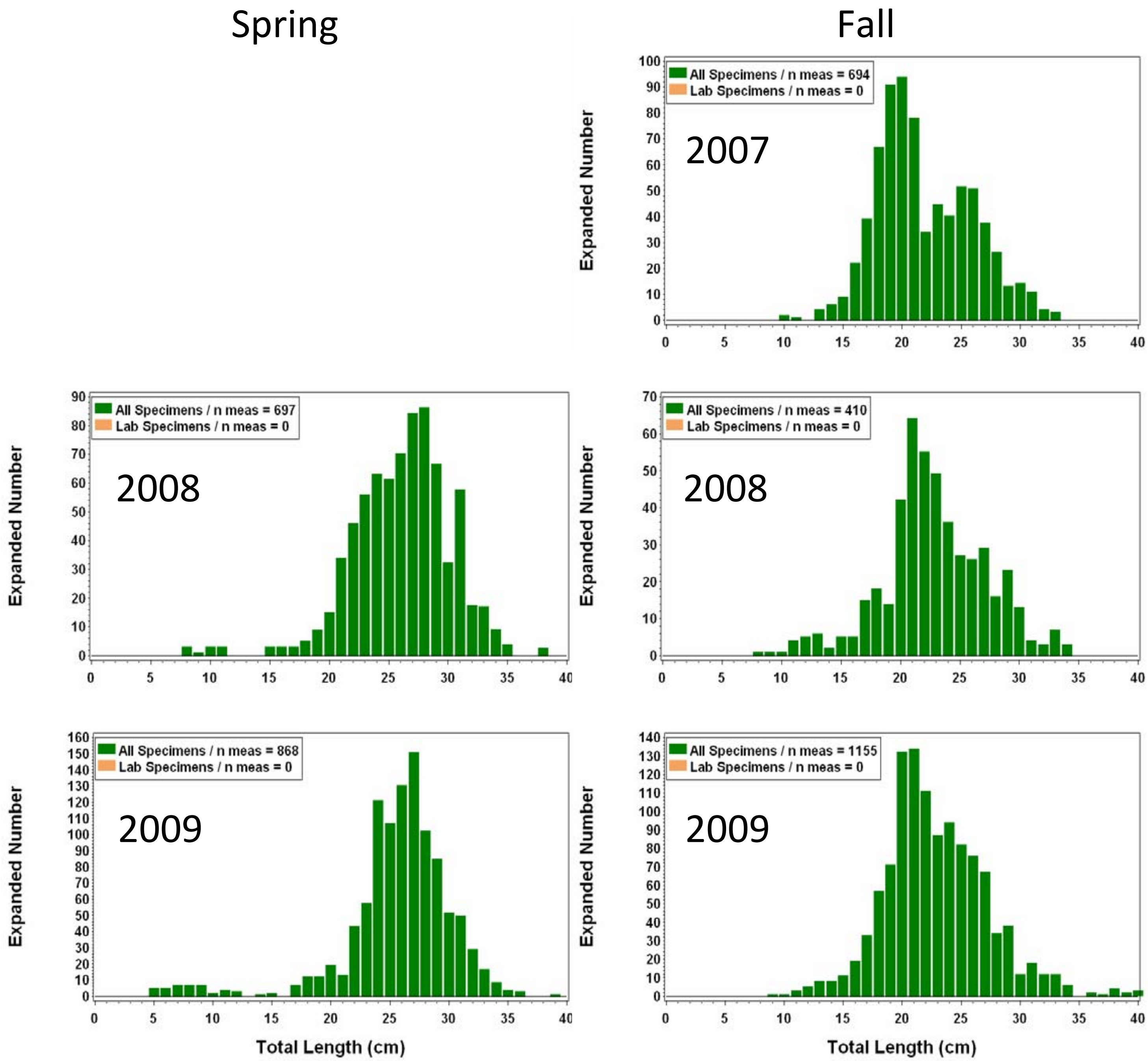


Figure 126. Length-frequency distributions, by cruise, for windowpane flounder.



Winter Flounder (Priority A)

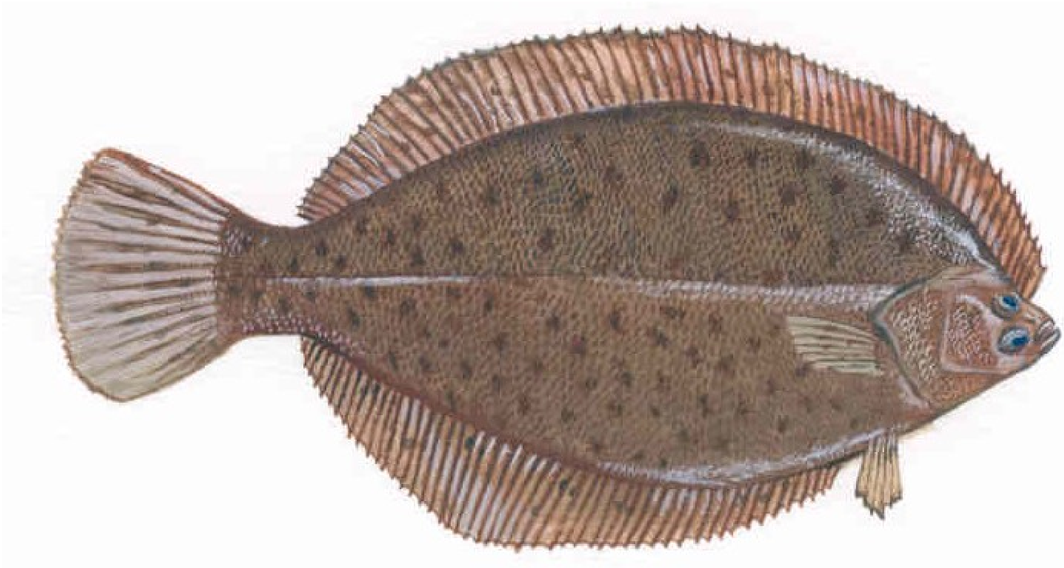
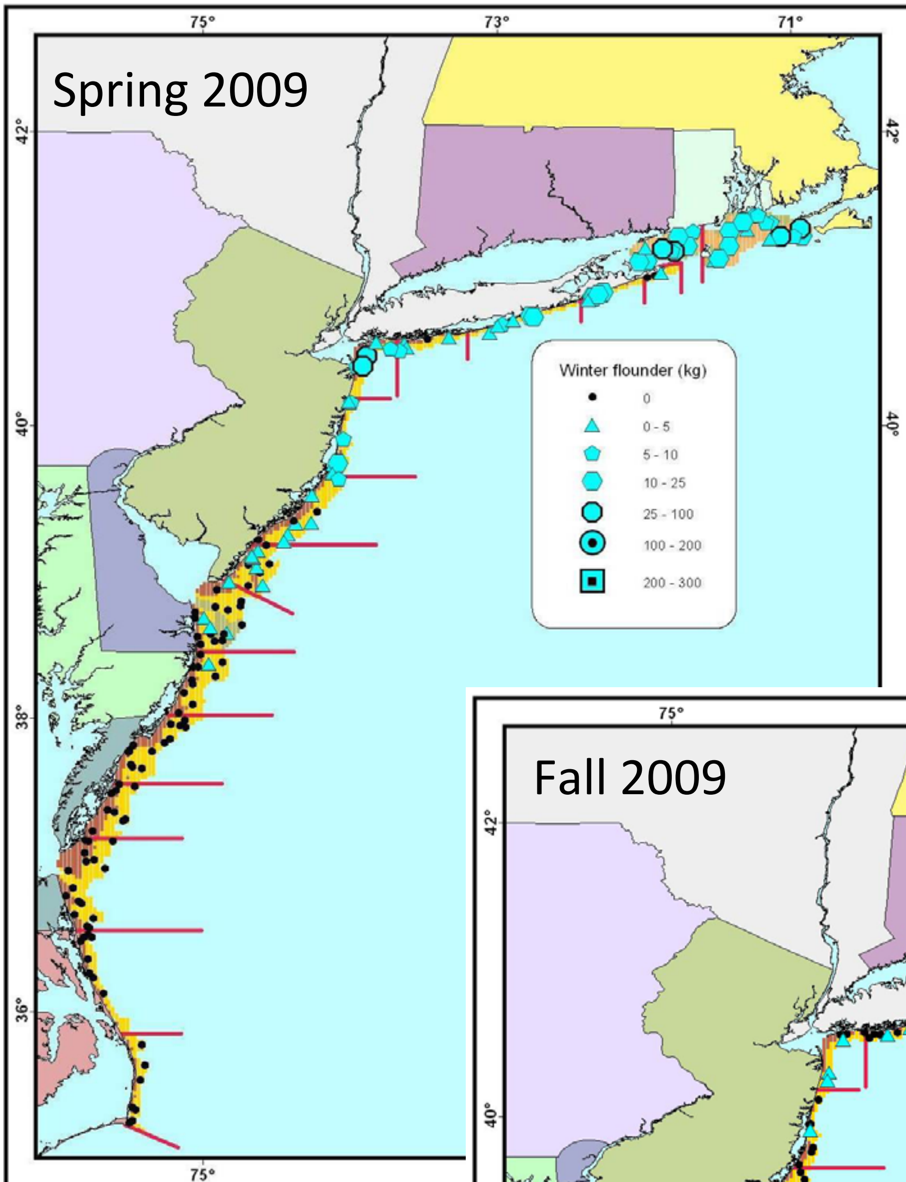


Table 34. Sampling rates and abundance indices of winter flounder for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	392	99.1	392	119	119	116	114	0.39	15.8	0.21	18
2008	Spring	1,863	554.1	1525	466	466	450	443	1.96	5.7	0.99	7.3
	Fall	670	142.0	522	137	137	133	131	0.61	10.7	0.30	13.6
2009	Spring	1,954	628.2	1,746	543	0	526	512	1.96	4.8	1.06	5.8
	Fall	558	127.4	558	214	0	177		0.69	9.1	0.32	13.1

Figure 127. Biomass (kg) of winter flounder collected at each sampling site for each 2009 NEAMAP cruise.



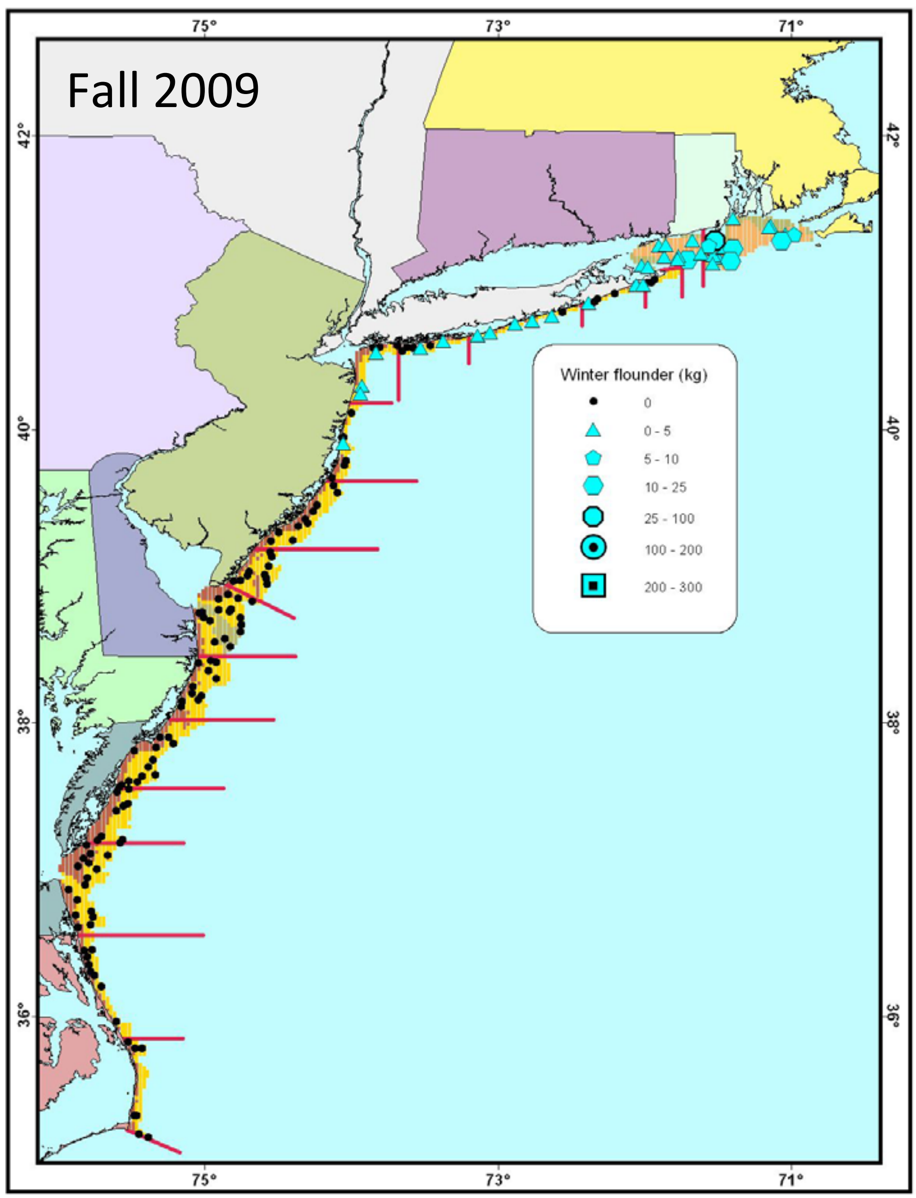
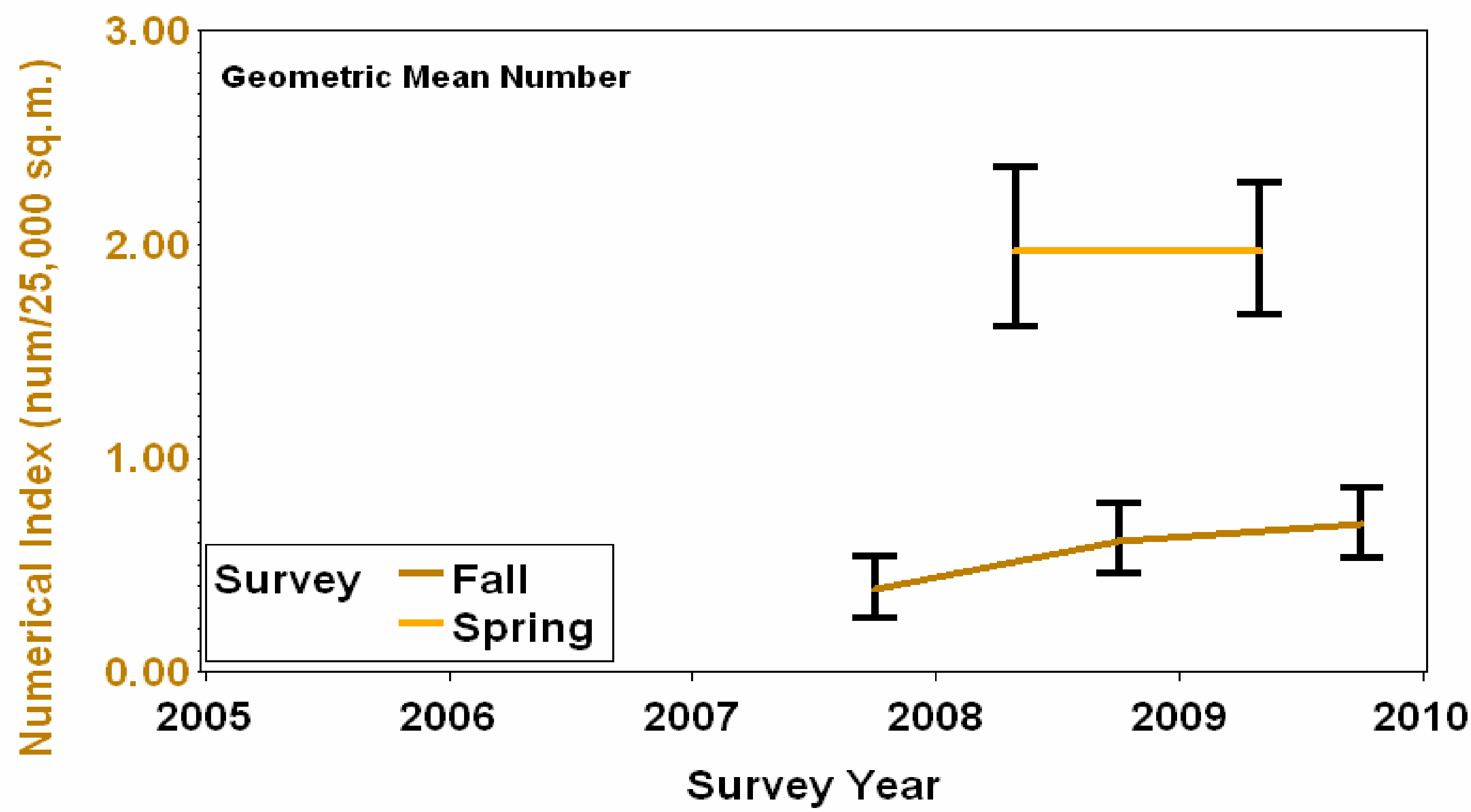


Figure 128. Preliminary indices of abundance, in terms of number and biomass, of winter flounder for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



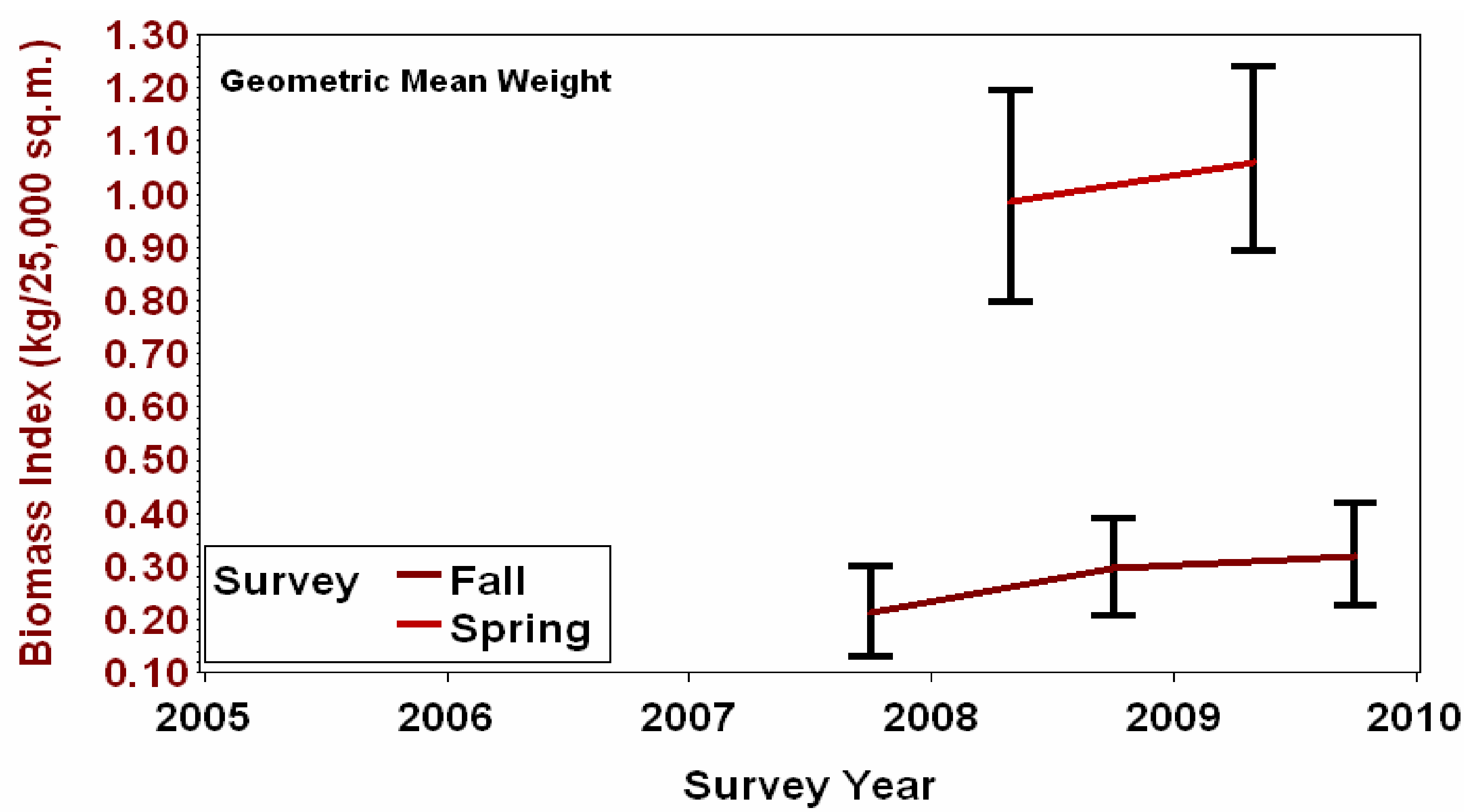


Figure 129. Length-frequency distributions, by cruise, for winter flounder. Numbers taken for full processing, by length, are represented by the orange bars.

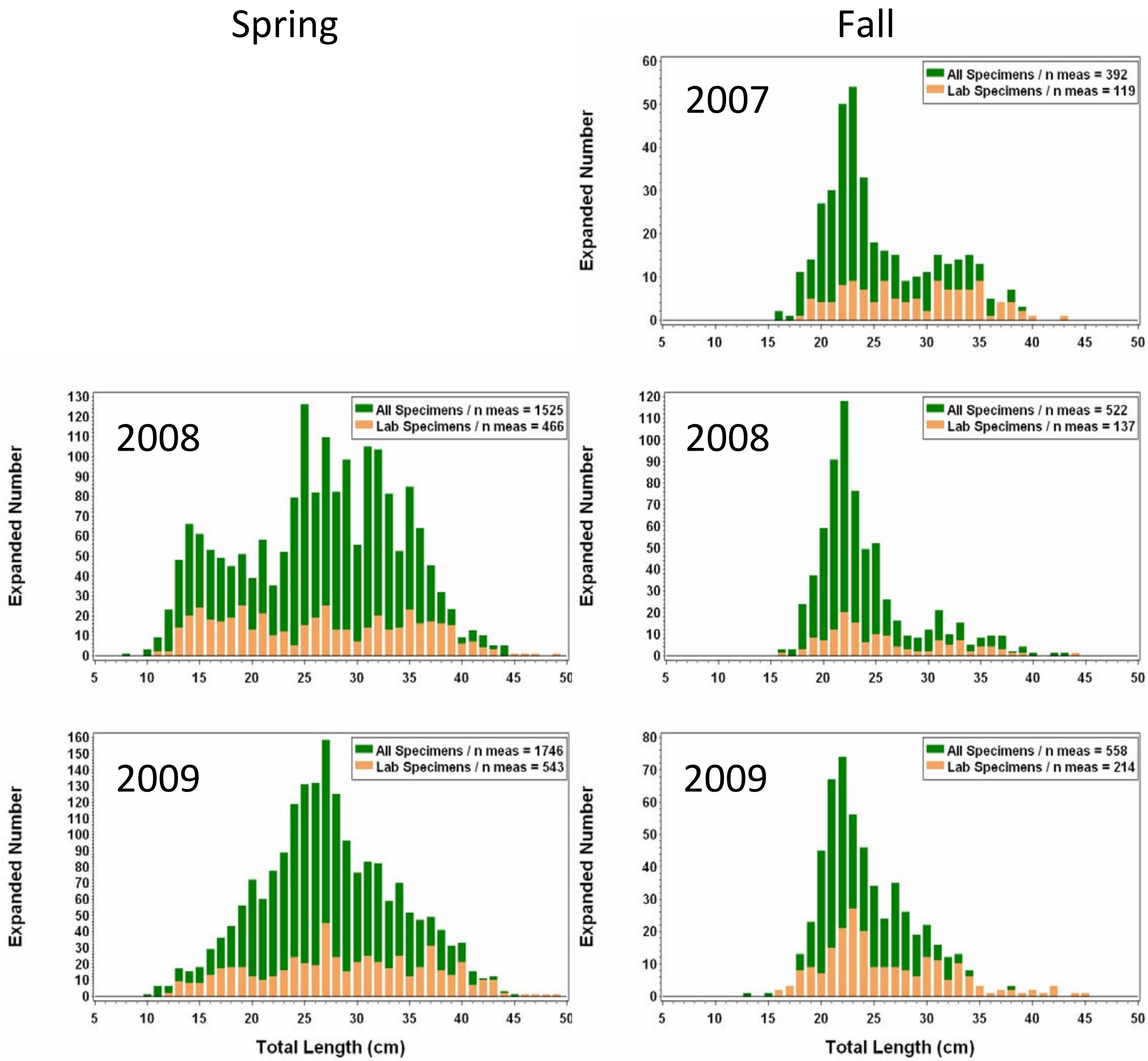


Figure 130. Sex ratio, by length group, for winter flounder collected on all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

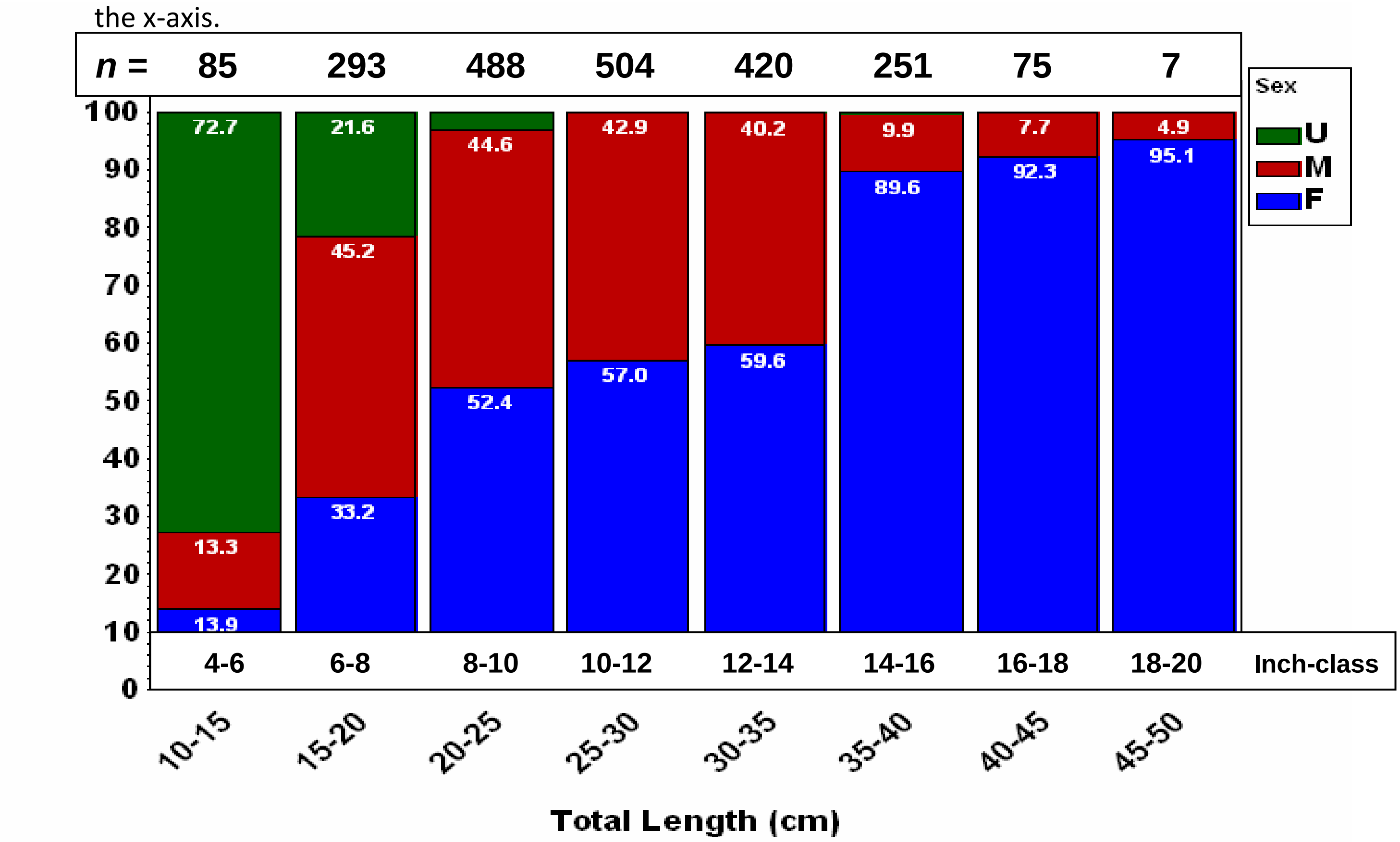


Figure 131. Diet composition, expressed using the percent weight index, of winter flounder collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of winter flounder sampled.

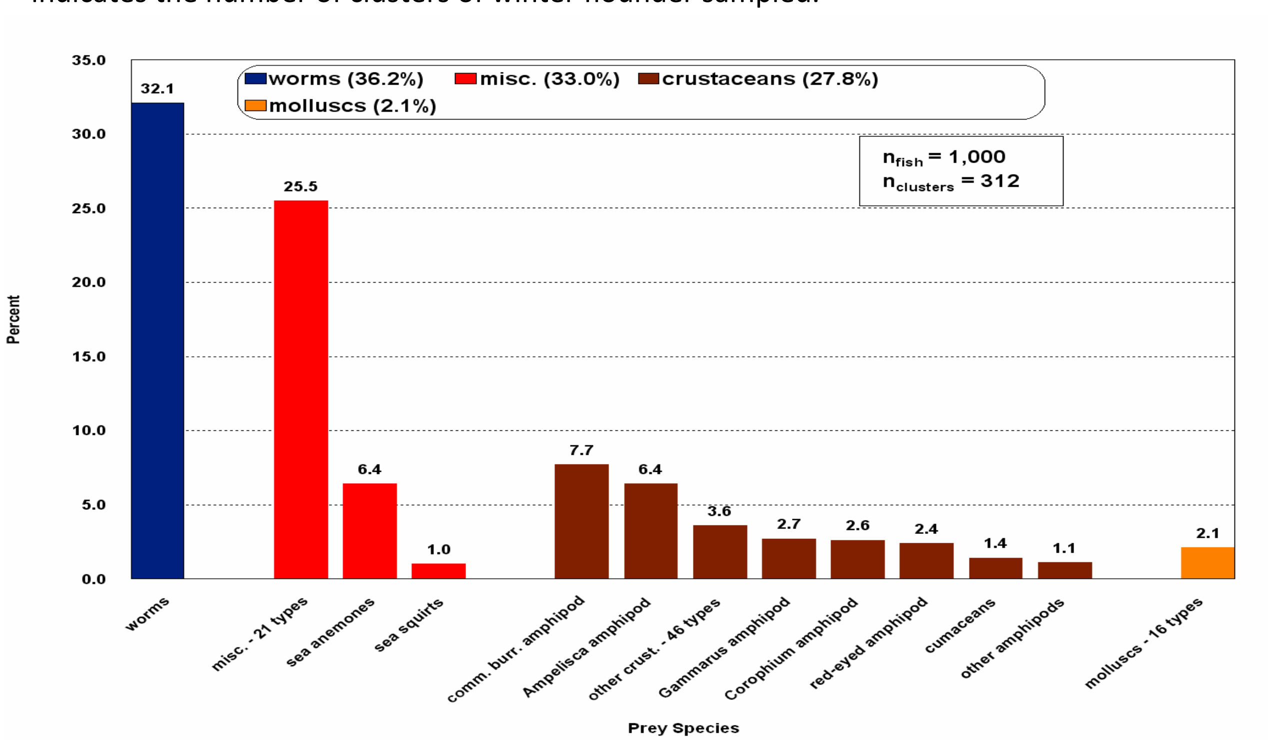
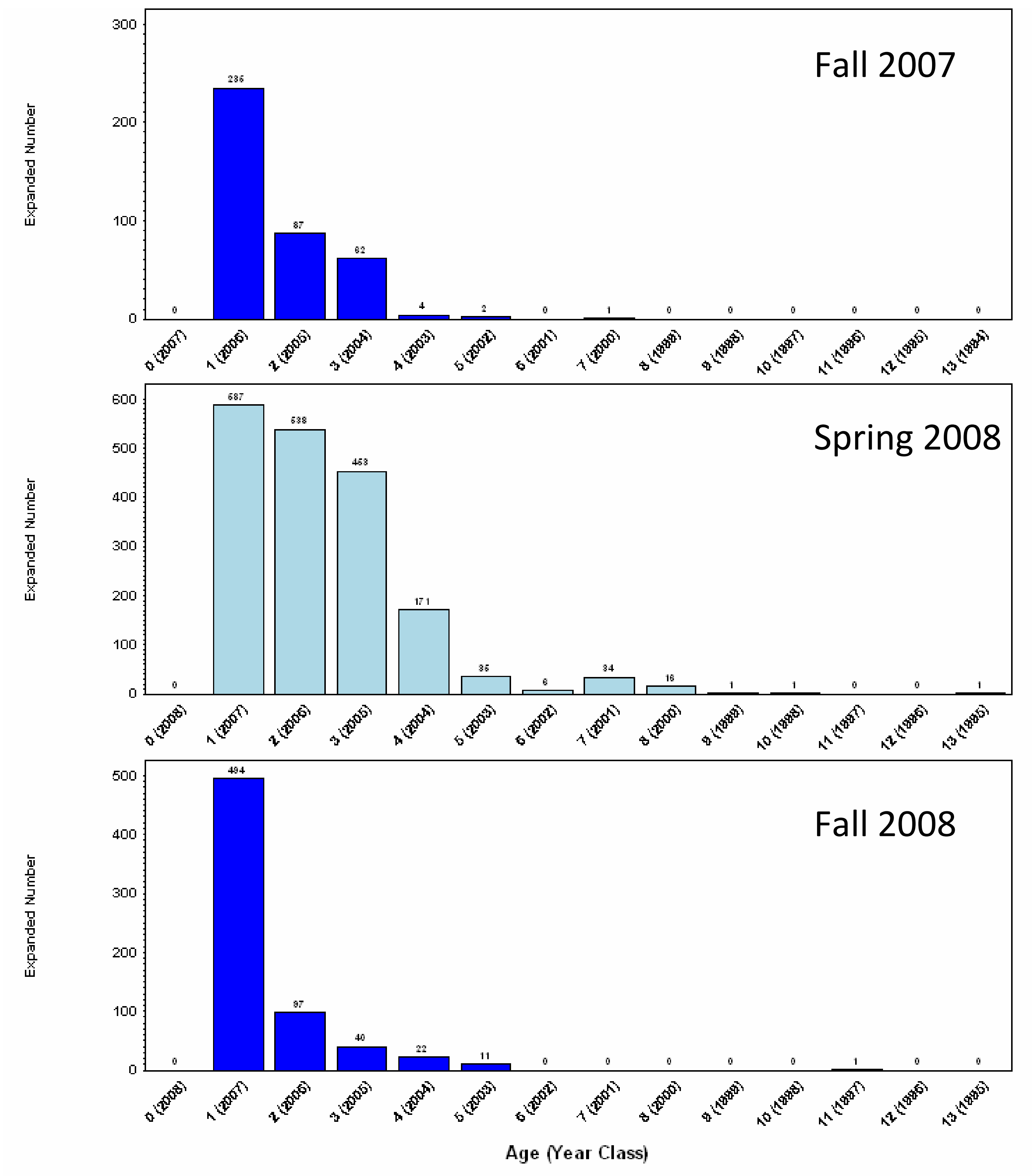


Figure 132. Age-frequency distribution, by cruise, for winter flounder. Ages are given on the x-axis, while corresponding year-classes are in parenthesis. The number collected at a given age is provided above each corresponding bar.



Winter Skate (Priority A)

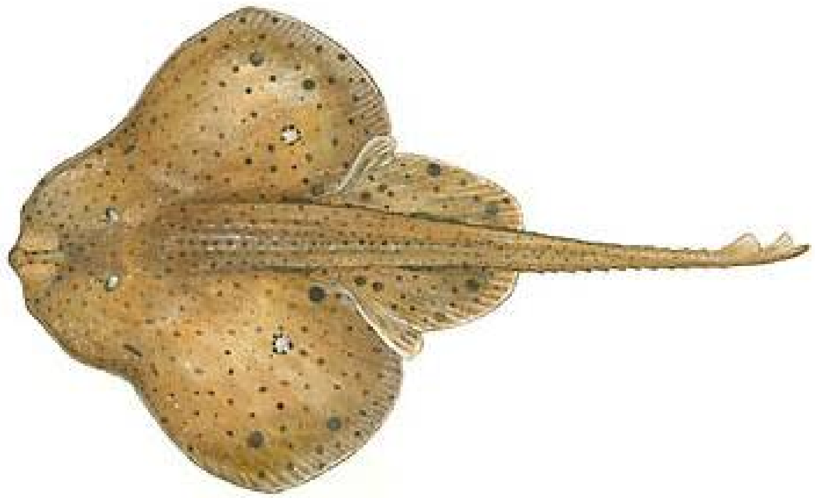


Table 35. Sampling rates and abundance indices of winter skate for each NEAMAP cruise.

Year	Season	Number Caught	Biomass Caught	Number Measured	Age Specimens	Ages Read	Stomach Specimens	Stomachs Read	Numerical Index	Index CV	Biomass Index	Index CV
2007	Fall	951	925.3	735	171	0	160	159	0.83	7.2	0.87	6.7
2008	Spring	1,716	3,174.2	1217	320	0	302	300	5.01	3.5	8.21	3.6
	Fall	619	921.0	399	120	0	115	114	0.75	5.8	0.94	5.4
2009	Spring	3,595	6,843.0	1,778	374	0	345	334	5.29	3.3	10.50	3.2
	Fall	1,787	4,040.3	623	123	0	106		0.60	7.7	0.82	7.4

Figure 133. Biomass (kg) of winter skate collected at each sampling site for each 2009 NEAMAP cruise.

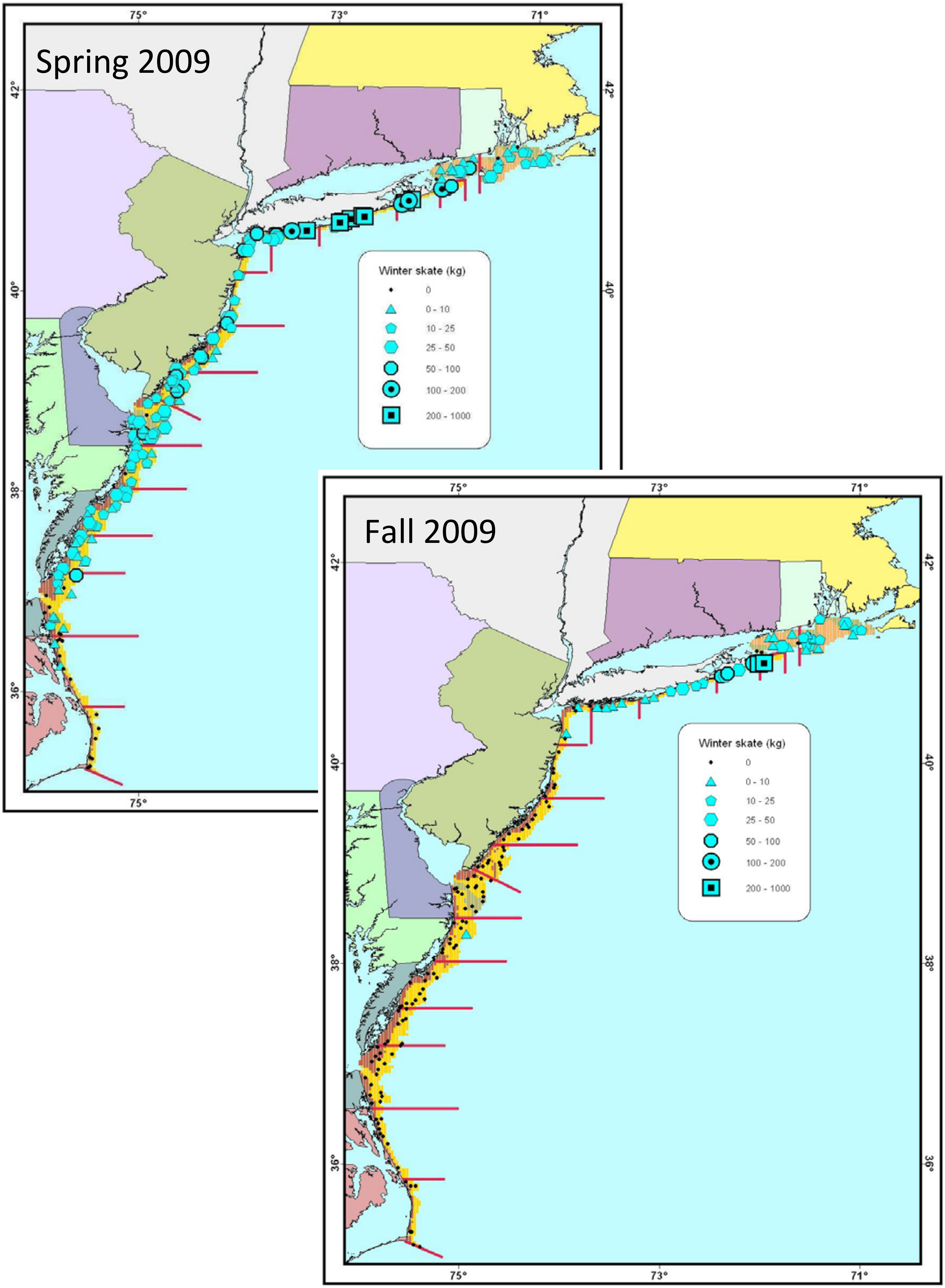
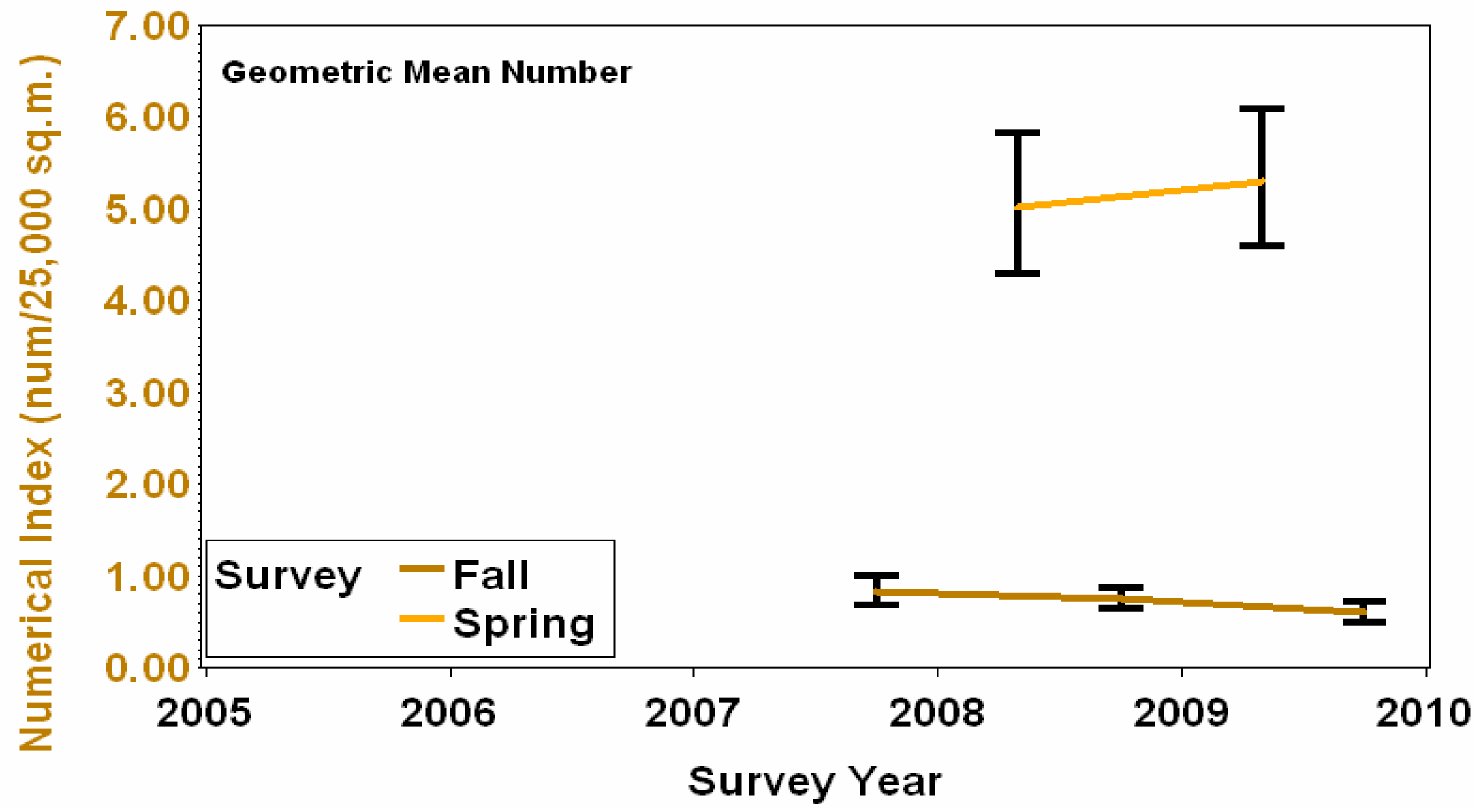


Figure 134. Preliminary indices of abundance, in terms of number and biomass, of winter skate for spring and fall NEAMAP surveys. 95% confidence intervals are provided for each abundance estimate.



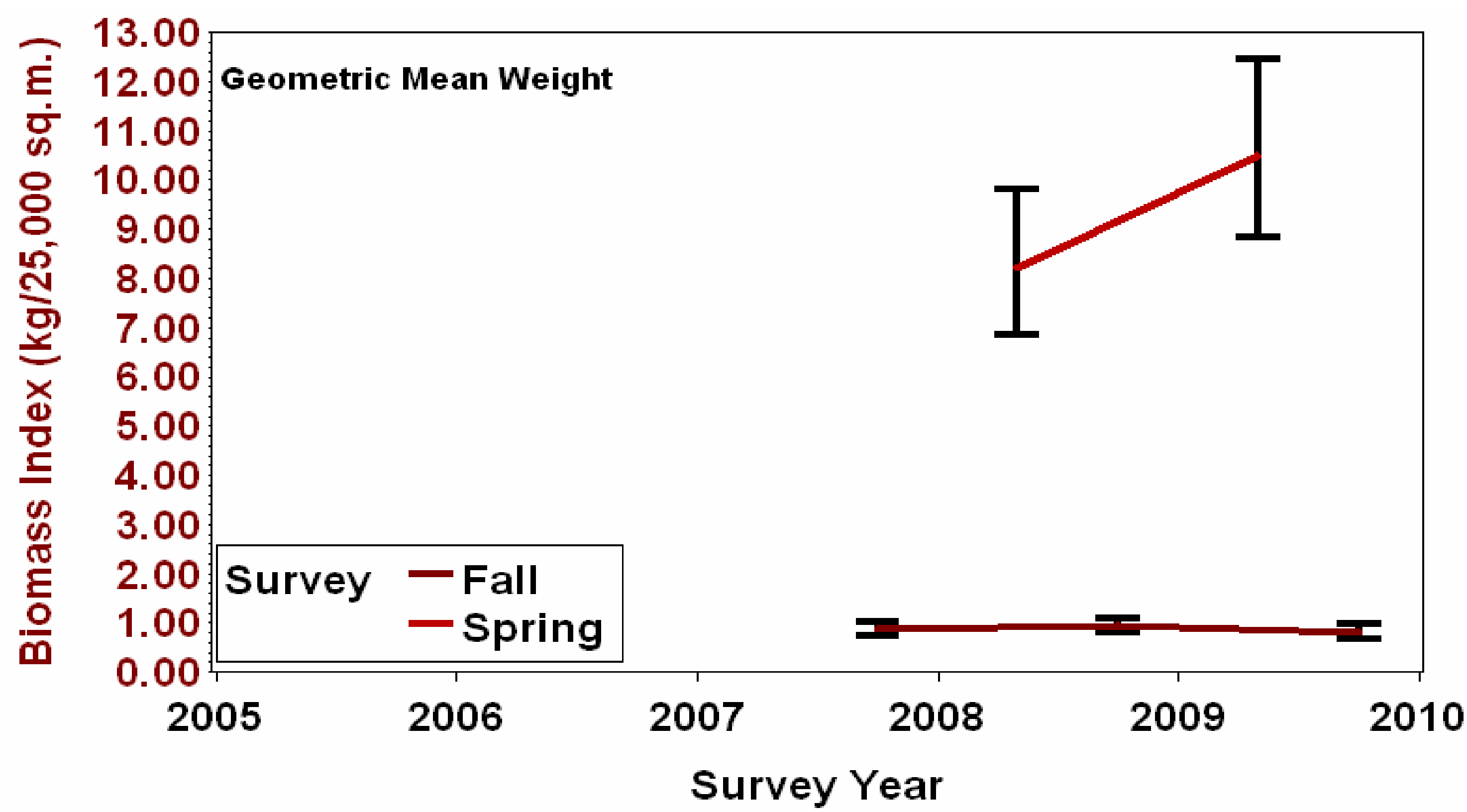


Figure 135. Length-frequency distributions, by cruise, for winter skate. Numbers taken for full processing, by length, are represented by the orange bars.

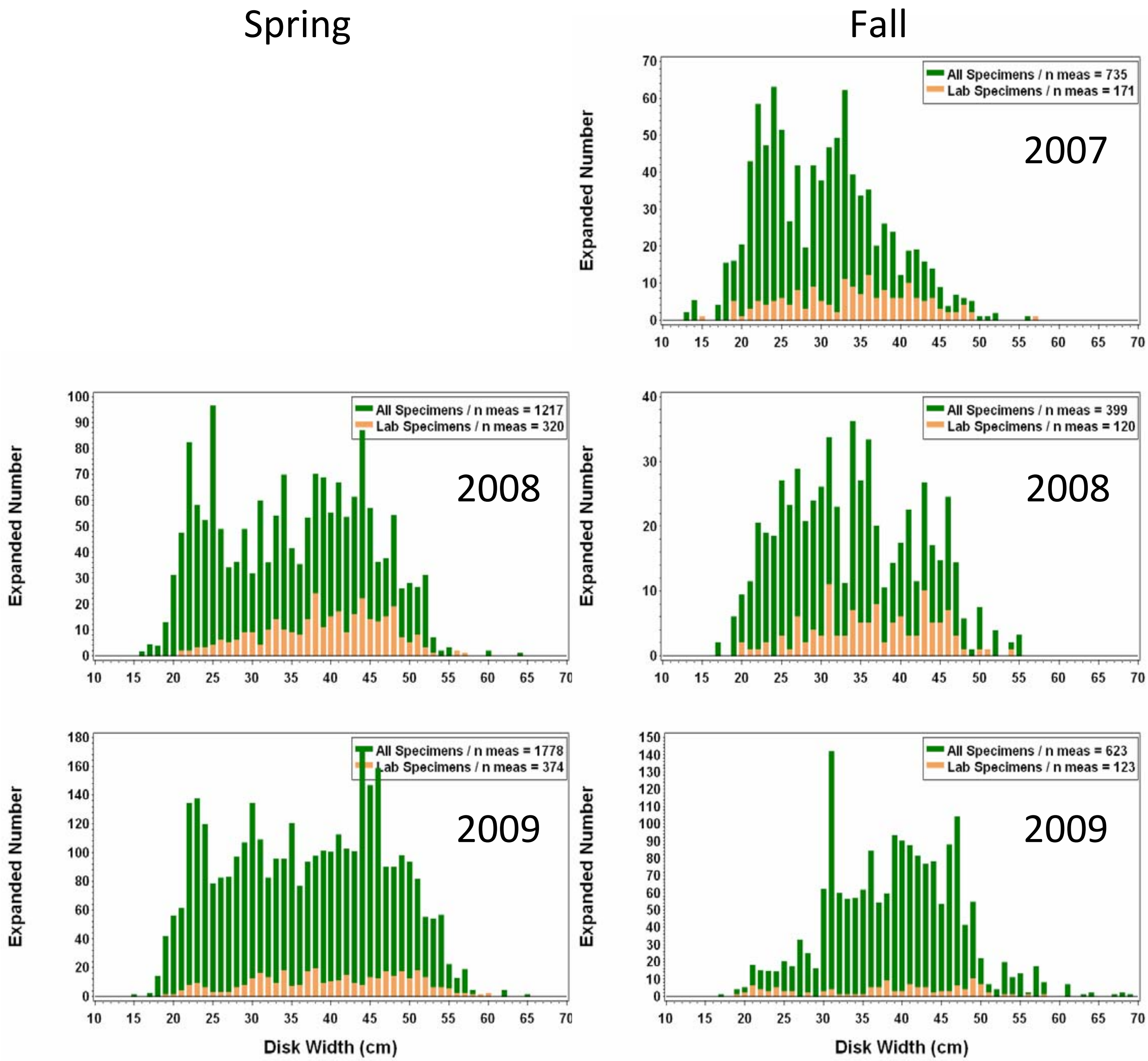


Figure 136. Sex ratio, by length group, for winter skate collected on the all NEAMAP cruises conducted to date. Females are given in blue, males in red, and green represents unknown specimens. The percentages for each category are given in their respective bars. The number sampled for sex determination is provided above each bar, and the length categories expressed in inches are given near the x-axis.

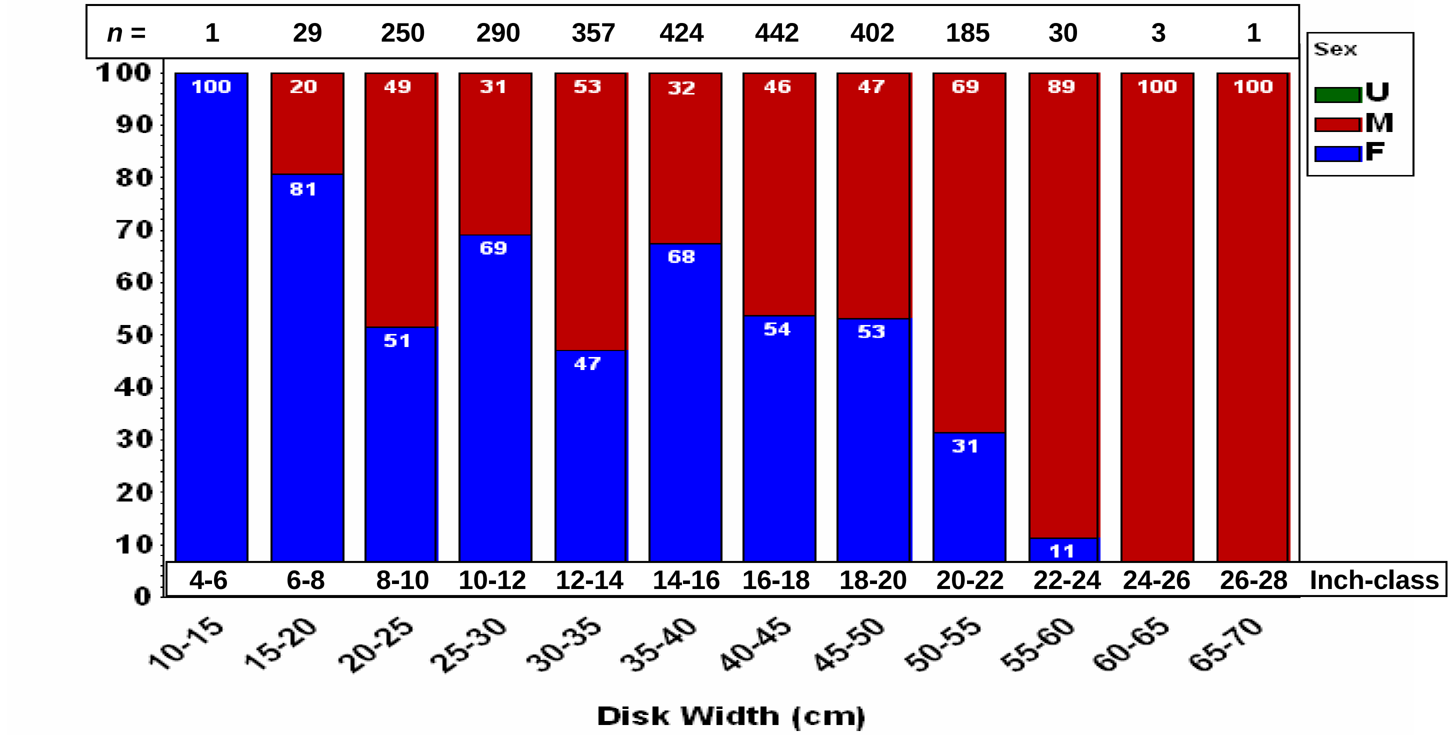


Figure 137. Diet composition, expressed using the percent weight index, of winter skate collected during five NEAMAP survey cruises. The number of fish sampled for diet is given by n_{fish}, while $n_{clusters}$ indicates the number of clusters of skate sampled.