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An Assessment of Sea Scallop Abundance and Distribution in Georges Bank Closed Area II and Surrounds : Final Report

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Final Report

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Project Summary

For the sea scallop, *Placopecten magellanicus*, the concepts of space and time have emerged as the basis of an effective management tool. The strategy of closing or limiting activities in certain areas for specific lengths of time has gained support as a method to conserve and enhance the scallop resource. In the last decade, rotational area management has provided a mechanism to protect juvenile scallops from fishing mortality by closing areas based upon scallop abundance and age distribution. Approximately half of the sea scallop industry's current annual landings come from areas under this rotational harvest strategy. While this represents a management success, it also highlights the extent to which landings are dependent on the success of this strategy. The continued prosperity of scallop spatial management is dependent on both periodic and large incoming year classes, as well as a mechanism to delineate the scale of a recruitment event and subsequently monitor the growth and abundance of these scallops over time. Current and accurate information related to the abundance and distribution of adult and juvenile scallops is essential for managers to respond to changes in resource subunits.

For the present study, we conducted a stratified random survey of the Georges Bank Closed Area II (GBCA II) scallop access area and the GBCA II Extension closure to the south. The primary objective of this survey was the determination of scallop distribution, abundance and biomass in the area. In addition, we characterized the spatially explicit scallop length weight relationship, identified areas of seed and juvenile scallops, quantified species-specific bycatch, provided additional information regarding the size selectivity and efficiency of the New Bedford style commercial dredge and collected data on scallop biology and market condition. We also conducted a tow duration experiment after the conclusion of the survey to assess the impact of a shorten tow duration on scallop catch.

Results indicated that the exploitable biomass in the traditional access area is high, but scallops in the Extension closure remain below marketable sizes. The year class in the Extension closure can potentially represent a source of future recruits to the fishery from this resource subunit and consideration of opening the area should be measured for Framework Amendment 27. Gear performance of the New Bedford style dredge was consistent with previous results for the gear. The tow duration component of the survey provided inconclusive results and additional analysis is needed.

Project Background

The sea scallop, *Placopecten magellanicus*, supports a fishery that, in the 2015 fishing year, landed 35.7 million pounds of meats with an ex-vessel value of over US $438 million (Lowther and Liddel, 2016). These landings resulted in the sea scallop fishery being one of the most valuable single species fishery along the East Coast of the United States. While historically subject to extreme cycles of productivity, the fishery has benefited from recent management measures intended to bring stability and sustainability. These measures included: limiting the number of participants, total effort (days-at-sea), gear and crew restrictions, and a strategy to improve yield by protecting scallops through rotational area closures.

Amendment #10 to the Sea Scallop Fishery Management Plan officially introduced the concept of area rotation to the fishery. This strategy seeks to increase the yield and reproductive potential of the sea scallop resource by identifying and protecting discrete areas of high densities of juvenile scallops from fishing mortality. By delaying capture, the rapid growth rate of scallops is exploited to realize substantial gains in yield over short time periods. In addition to the formal attempts established by Amendment #10 to manage discrete areas of scallops for improved yield, specific areas on Georges Bank (GB) are also subject to area closures. Since 1999, limited access to three closed areas on GB has been allowed for the harvest of scallops. While the boundaries of these access areas have not been spatial adaptive, similar biological principals that guide rotational scallop areas apply to the GB areas and spatial management on GB can be expanded (i.e., Nantucket Lightship Closed Area (NL) extension closure and the GBCA II extension closure) to provide protection for observed recruitment events outside of the established access areas to meet management and fishery objectives.

In order to effectively manage the fishery and carry out a robust rotational area management strategy, current and detailed information regarding the abundance and distribution of sea scallops in the GBCA II access area and the Extension closure are essential. This information forms the basis for both the establishment of a closed area and dictates the timing and intensity of a subsequent re-opening to fishing. Guidelines found in Amendment #10 suggest that an area is a candidate to be closed when the annual scallop growth potential in that area is greater than 30%. Additionally, when the annual growth rate is reduced to less than 15% the area is available for a controlled re-opening. Certain other criteria exist regarding the spatial requirements for a closed area, but growth rates which are determined by the age structure of the population within that area is a key component of that determination. The collection of accurate abundance and age distribution information from discrete areas is a major component of this strategy, and the use of commercial vessels provides a flexible and efficient platform to collect the required information

Cooperative dredge surveys have been successfully completed with the involvement of industry, academic and governmental partners since 2000 through funding from the Sea Scallop Research Set-Aside Program (RSA). The additional information provided by these surveys has been vital in the determination of appropriate Total Allowable Catches (TAC) in the subsequent re-openings of the closed areas, and determination of the number of open area days-at-sea (DAS). This type of survey, using commercial fishing vessels, provides an excellent opportunity to gather required information and also involve stakeholders in the management of the resource.

In addition to collecting data to assess the abundance and distribution of sea scallops in the GBCA II access area and Extension closure, the operational characteristics of commercial scallop vessels allow for the simultaneous towing of two dredges. As in past surveys, we towed two dredges at each survey station. One dredge was a standard National Marine Fisheries Service (NMFS) sea scallop survey dredge and the other was a standard New Bedford style scallop dredge (NBD). This paired design, using one non-selective gear (NMFS) and one selective gear (NBD), allowed for the estimation of the size selective characteristics of the NBD. While gear performance (i.e., size selectivity and relative efficiency) information for the NBD has been documented (Yochum and DuPaul, 2008; NEFSC 2014), continuing to evaluate the performance of this gear will allow for changes in selectivity and efficiency to be monitored and quantified. Understanding time varying changes for the NBD is beneficial for two reasons. First, it could be an important consideration for the stock assessment for scallops in that it provides the size selectivity characteristics of the most recent gear configuration. In addition, selectivity analyses using the SELECT method provide insight to the relative efficiency of the two gears used in the study (Millar, 1992). The relative efficiency measure from this experiment can be used to refine existing absolute efficiency estimates for the NBD.

An advantage of a sea scallop dredge survey is that one can access and sample the target species. This has a number of advantages including accurate measurement of animal length and the ability to collect biological specimens. One attribute routinely measured is the shell height:meat weight relationship. While this relationship is used to determine swept area biomass for the area surveyed at that time, it can also be used to document seasonal shifts in the relationship due to environmental and biological factors. For this reason, data on the shell height:meat weight relationship is routinely gathered by both the NMFS and VIMS scallop surveys. While this relationship may not be a direct indicator of animal health in and of itself, long term data sets may be useful in evaluating changing environmental conditions, food availability and density dependent interactions.

For this study, we pursued multiple objectives. The primary objective was to collect information to characterize the abundance and distribution of sea scallops within the GBCA II access area and Extension closure, ultimately culminating in estimates of scallop biomass to be used for subsequent management actions. Utilizing the same catch data with a different analytical approach, we estimated the size selectivity characteristics of the commercial sea scallop dredge. An additional component of the selectivity analysis allows for supplementary information regarding the efficiency of the commercial dredge relative to the NMFS survey dredge. As a third objective of this study, we collected biological samples to estimate a time and area specific shell height:meat weight relationship. Additional, biological samples were taken to assess product quality for the adult resource and to monitor scallop disease/parasite prevalence. Sea scallop shells were also collected to supplement the NMFS shell collection for ageing. A forth objective of the study was to conduct a tow duration experiment after the conclusion of the survey. The tow duration experiment was conducted to determine if a reduced tow duration is appropriate for the dredge survey in the future.

Methods

Survey Area and Sampling Design

The GBCA II access area and Extension closure to the south were surveyed in June of 2016. Sampling stations for this study were selected using a stratified random sampling design. In the original scope of work, stations were to be allocated to NMFS scallop strata using a hybrid approach consisting of both proportional and optimal allocation techniques using available data sources from 2015 (i.e., the 2015 Northeast Fisheries Science Center (NEFSC) dredge survey data). Unfortunately, there were a limited number stations completed within the strata in the survey domain during the 2015 NMFS dredge survey, resulting in survey stations being allocated using solely proportional allocation based on strata areas. A minimum of two stations were allocated to each stratum. The station locations for the 2016 GBCA II survey are shown in Figure 1.

Sampling Protocols

While at sea, the vessels simultaneously towed two dredges. A NMFS sea scallop survey dredge, 8 feet in width equipped with 2-inch rings, 3.5-inch diamond mesh twine top and a 1.5-inch diamond mesh liner was towed on one side of the vessel. On the other side of the vessel, a 15 foot NBD equipped with 4-inch rings, a 10-inch diamond mesh twine top and no liner was utilized. In this paired design, it is assumed that the dredges cover a similar area of substrate and sample from the same population of scallops.

For each survey tow, the dredges were fished for 15 minutes with a towing speed of approximately 3.8 - 4.0 kts. High-resolution navigational logging equipment was used to accurately determine and record vessel position. A Star-Oddi™ DST sensor was used on the dredge to measure and record dredge tilt angle as well as depth and temperature (Figure 2). With these measurements, the start and end of each tow was estimated. Synchronous time stamps on both the navigational log and DST sensor were used to estimate the linear distance for each tow. A histogram depicting the estimated linear distances covered per tow over the entire survey is shown in Figure 3.

Sampling of the catch was performed using the protocols established by DuPaul and Kirkley, 1995. For each survey tow, the entire scallop catch was placed in baskets. Depending on the total volume of the catch, a fraction of these baskets were measured for sea scallop length frequency. The shell height of each scallop in the sampled fraction was measured to the nearest millimeter (mm) using an electronic Ichthystick measuring board developed by NOAA NMFS and constructed by Dr. Rudders. This protocol allows for the estimation of the size frequency for the entire catch by multiplying the catch at each shell height by the fraction of total number of baskets sampled. Finfish and invertebrate bycatch were quantified, with commercially important finfish and barndoor skates being sorted by species and measured to the nearest 1 mm (total length (TL)). At randomly selected stations, crabs and starfish were identified to the genus or species level and enumerated.

Samples were taken to determine area specific shell height:meat weight relationships as well as monitor product quality. The number of stations and scallop samples taken differed from past survey efforts and was modified to increase the number of samples taken to monitor for the presence of the parasitic nematode observed in scallop meats in the Mid-Atlantic resource area. In the past, at roughly 25 randomly selected stations the shell height of 10 randomly selected scallops were measured to the nearest 1 mm. During this survey, 15 scallops at every station were sampled, based the quantity of scallop catch. These scallops were then carefully shucked and the adductor muscle individually weighed at sea to the nearest 0.5 gram with a Marel™ motion compensating scale. The relationship between shell height and meat weight was estimated using a generalized linear mixed effects model (gamma distribution, log link, random effect at the station level) incorporating depth and Scallop Area Management Simulator (SAMS) zone as an explanatory variable using the glmer function in the lme4 package in R v. 3.2.1. The relationship was estimated with the following models:

$$W\text{=exp(intercept+ }\beta_1\text{*ln(SH) + }\beta_2\text{*ln(D)+ SAMS)}$$

$$W\text{=exp(intercept+ }\beta_1\text{*ln(SH) + }\beta_2\text{*ln(D)+ }\beta_3\text{*(ln(D)+ln(SH))+SAMS)}$$

where W=meat weight (grams), SH=shell height (millimeters), Depth=average depth (meters) SAMS= zone designated by the Scallop Area Management Simulator. β1, β2, and β3 are coefficients to be estimated. Product quality was assessed through visual inspection of each abductor meat. Characteristics evaluated included market condition, color, texture and presence of blister disease. Maturity stage and sex were also recorded.

Station level catch and location information was entered into FEED (Fisheries Environment for Electronic Data), a data acquisition program developed by Chris Bonzak at VIMS. Data from the bridge was entered into FEED using an integrated GPS input. Station level data included location, time, tow-time (break-set/haul-back), tow speed, water depth, weather and comments relative to the quality of the tow. FEED was also used to record detailed catch information at the station level on scallops, finfish and invertebrates. Catch by species was entered into FEED as either the number of baskets caught and measured (scallops) or number of animals (finfish, skates, etc.) caught. Length measurements were recorded using the Ichthystick measuring board connected to the FEED program that allows for automatic recording of length measurements.

Data Analysis

The catch and navigation data were used to estimate swept area biomass within the area surveyed. The methodology to estimate biomass is similar to that used in previous survey work by VIMS. In essence, we estimate a stratified mean catch weight of either all scallops or the fraction available to the commercial gear (exploitable) from the point estimates and scale that value up to the entire area of the domain sampled following methods from Cochran (1977) for calculating a stratified random size of a population. These calculations are given:

Stratified mean biomass per tow in stratum and subarea of interest:

$$\bar{C}_h = \frac{1}{n_h}\sum_{i=1}^{h} C_{i,h} \quad (1)$$

Variance Equation 1

$$Var(\bar{C}_h) = \frac{1}{n_h(n_h - 1)} \sum_{i=1}^{n_h} (C_{i,h} - \bar{C}_h)^2$$

Stratified mean biomass per tow in subarea of interest:

$$\bar{C}_s = \sum_{h=1}^{L} W_h \cdot \bar{C}_h \quad (2)$$

Variance Equation 2

$$Var(\bar{C}_s) = \sum_{h=1}^{L} W_h^2 \cdot \ Var(\bar{C}_h)$$

Total biomass in subarea of interest:

$$\widehat{B_s} = \left(\frac{\left(\frac{\bar{C}_s}{\bar{a}_s} \right)}{E_s} \right) A_s \quad (3)$$

Variance Equation 3

$$Var\left(\widehat{B_s}\right) = Var(\bar{C}_s) \cdot \left(\frac{A_s}{\bar{a}_s} \right)^2$$

where:

L = # of strata
n = # of stations in stratum h
h = stratum
i = station i in stratum h
s = subarea s in survey of interest
A_s = area of survey of interest in subarea s
E_s = gear efficiency estimate for subarea s
$\bar{a}_s$ = mean area swept per tow in subarea s
$\hat{B}_s$ = total biomass in subarea s
$\bar{C}_s$ = stratified mean biomass caught per tow for subarea s
$\bar{C}_{h,s}$ = mean biomass caught per tow in stratum h for subarea s
W_h = proportion of survey/subarea area in stratum h

Stratified mean catch weight per tow of exploitable scallops was calculated from the raw catch data as an expanded size frequency distribution with an area and SAMS appropriate shell height:meat weight relationship applied (length-weight relationships were obtained from the SARC 59 document NEFSC, 2014). Exploitable biomass, defined as that fraction of the population vulnerable to capture by the currently regulated commercial gear, was calculated using two approaches. The observed catch at length data from the NMFS survey dredge (assumed to be non-size selective) was adjusted based upon the size selectivity characteristics of the commercial gear (Yochum and DuPaul, 2008). The observed catch at length data from the commercial dredge was not adjusted due to the fact that these data already represent that fraction of the population that is subject to exploitation by the currently regulated commercial gear.

Utilizing the information obtained from the high resolution GPS, an estimate of area swept per tow was calculated. Throughout the cruise, the location of the ship was logged every second. By determining the start and end of each tow based on the recorded times as delineated by the tilt sensor data, a survey tow can be represented by a series of consecutive coordinates (latitude, longitude). The linear distance of the tow is calculated by:

$$TowDist = \sum_{i=1}^{n} \sqrt{\left(long_2 - long_1\right)^2 + \left(lat_2 - lat_1\right)^2}$$

The linear distance of the tow is multiplied by the width of the gear (either 15 or 8 ft.) to result in an estimate of the area swept during a given survey tow.

The final two components of the estimation of biomass are constants and not determined from experimental data obtained on these cruises. The efficiency estimates for the NMFS survey dredge (41%) and the NBD (65%) were also obtained from the SARC 59 document (NEFSC, 2014). To scale the estimated stratified mean scallop catch to the full domain, the total area of each resource subunit with in the survey domain was calculated in ArcGIS v. 10.1. Biomass estimates were calculated for the GBCA II SAMS region and two zones within the region for the entire survey domain, including area outside of the SAMS regions that were surveyed (Figure 4).

Size Selectivity

The estimation of size selectivity of the NBD was based on a comparative analysis of the catches from the two dredges used in the survey. For this analysis, the NMFS survey dredge is assumed to be non-selective (i.e., a scallop that enters the dredge is retained by the dredge). Catch at length from the selective gear (commercial dredge) were compared to the non-selective gear via the SELECT method (Millar, 1992). With this analytical approach, the selective properties (i.e., the length based probability of retention) of the commercial dredge were estimated. In addition to estimates of the length based probabilities of capture by the commercial dredge, the SELECT method characterizes a measure of relative fishing intensity. Assuming a known quantity of efficiency for one of the two gears (in this case the survey dredge at 41%), insight into the efficiency of the other gear (commercial dredge) can be attained.

Prior to analysis, all comparative tows were evaluated. Any tows that were deemed to have had problems during deployment or at any point during the tow (flipped, hangs, crossed towing wires, etc.) were removed from the analysis. In addition, tows where zero scallops or less than 20 scallops were captured by both dredges were also removed from the analysis. The remaining tow pairs were then used to analyze the size selective properties of the commercial dredge. The SELECT method was used to calculate selectivity and relative efficiency of the NBD for the survey.

The SELECT method has become the preferred method to analyze size-selectivity studies encompassing a wide array of fishing gears and experimental designs (Millar and Fryer, 1999). This analytical approach conditions the catch of the selective gear at length *l* to the total catch (from both the selective gear variant and small mesh control).

$$\Phi_c(l) = \frac{p_c r_c(l)}{p_c r_c(l) + (1 - p_c)}$$

Where *r(l)* is the probability of a fish at length *l* being retained by the gear given contact and *p* is the split parameter (measure of relative efficiency). Traditionally, selectivity curves have been described by the logistic function. This functional form has symmetric tails. In certain cases, other functional forms have been utilized to describe size selectivity of fishing gears. Examples of different functional forms include Richards, log-log and complimentary log-log. Model selection is determined by an examination of model deviance (the likelihood ratio statistic for model goodness of fit) as well as Akaike Information Criterion (AIC) (Xu and Millar, 1993, Sala, *et. al.*, 2008). For towed gears, however, the logistic function is the most common functional form observed in towed fishing gears. Given the logistic function:

$$r(l) = \left(\frac{\exp(a + bl)}{1 + \exp(a + bl)} \right)$$

by substitution:

$$\Phi(L) = \frac{pr(L)}{(1-p) + pr(L)} = \frac{p\frac{e^{a+bL}}{1+e^{a+bL}}}{(1-p) + p\frac{e^{a+bL}}{1+e^{a+bL}}} = \frac{pe^{a+bL}}{(1-p) + e^{ea+bL}}$$

Where *a*, *b*, and *p* are parameters estimated via maximum likelihood. Based on the parameter estimates, L_{50} and the selection range (SR) are calculated.

$$L_{50} = \frac{-a}{b} \qquad SR = \frac{2 * \ln(3)}{b}$$

Where L_{50} defines the length at which an animal has a 50% probability of being retained, given contact with the gear and SR represents the difference between L_{75} and L_{25} which is a measure of the slope of the ascending portion of the logistic curve.

In situations where catch at length data from multiple comparative tows is pooled to estimate an average selectivity curve for the experiment, tow by tow variation is often ignored. Millar *et al.* (2004) developed an analytical technique to address this between-haul variation and incorporate that error into the standard error of the parameter estimates. Due to the inherently variable environment that characterizes the operation of fishing gears, replicate tows typically show high levels of between-haul variation. This variation manifests itself with respect to estimated selectivity curves for a given gear configuration (Fryer 1991, Millar *et. al.*, 2004). If not accounted for, this between-haul variation may result in an underestimate of the uncertainty surrounding estimated parameters increasing the probability of spurious statistical significance (Millar *et. al.,* 2004).

Approaches developed by Fryer (1991) and Millar *et. al.,* (2004) address the issue of between-haul variability. One approach formally models the between-haul variability using a hierarchical mixed effects model (Fryer 1991). This approach quantifies the variability in the selectivity parameters for each haul estimated individually and may be more appropriate for complex experimental designs or experiments involving more than one gear. For more straightforward experimental designs, or studies that involve a single gear, a more intuitive combined-haul approach may be more appropriate.

This combined-hauls approach characterizes and then calculates an overdispersion correction for the selectivity curve estimated from the catch data summed over all tows, which is identical to a curve calculated simultaneously to all individual tows. Given this identity, a replication estimate of between-haul variation (REP) can be calculated and used to evaluate how well the expected catch using the selectivity curve calculated from the combined hauls fits the observed catches for each individual haul (Millar *et. al.* 2004).

REP is calculated as the Pearson chi-square statistic for model goodness of fit divided by the degrees of freedom.

$$REP = \frac{Q}{d}$$

Where Q is equal to the Pearson chi-square statistic for model goodness of fit and d is equal to the degrees of freedom. The degrees of freedom are calculated as the number of terms in the summation, minus the number of estimated parameters. The calculated replicate estimate of between-haul variation was used to calculate observed levels of extra Poisson variation by multiplying the estimated standard errors by $\sqrt{REP}$. This correction is only performed when the data is not overdispersed (Millar, 1993).

A significant contribution of the SELECT model is the estimation of the split parameter which estimates the probability of an animal “choosing” one gear over another (Holst and Revill, 2009). This measure of relative efficiency, while not directly describing the size selectivity properties of the gear, is insightful relative to both the experimental design of the study as well as the characteristics of the gears used. A measure of relative efficiency (on the observational scale) can be calculated in instances where the sampling intensity is unequal. In this case, the sampling intensity is unequal due to differences in dredge width. Relative efficiency can be computed for each individual trip by the following formula:

$$RE = \frac{p/(1-p)}{p_0/(1-p_0)}$$

Where p is equal to the observed (estimated p value) and p_0 represents the expected value of the split parameter based upon the dredge widths in the study (Park *et. al.*, 2007). For this study, a 15 ft. commercial dredge was used with expected split parameter of 0.6521. The computed relative efficiency values were then used to scale the estimate of the NMFS survey dredge efficiency obtained from the optical comparisons (41%). Computing efficiency for the estimated *p* value from Yochum and DuPaul (2008) yields a commercial dredge efficiency of 67.8%.

Meat Quality and Shell Blisters

During the survey, shell blister and meat quality observations were made for all scallops sampled at shell height:meat weight stations. Meats were assessed for quality issues pertaining to color, texture, and overall marketability. The presence and severity of shell blisters were scored as well.

Nematode Monitoring

All scallops sampled at shell height:meat weight stations were also visually examined for the presence and incidence of the parasitic nematode. Gross observation was used to identify scallop meats that were infected with the parasite and the number of parasites was enumerated (incidence).

Scallop Shells

Twenty-five scallop shells were collected at six stations within the survey domain. Five stations were selected to collect shell samples so that scallops collected would be representative of the entire domain, with samples taken from the north, south, east, west and center of the survey domain. The last station were shells were collected was selected by the Northeast Fisheries Science Center (NEFSC) and is a station were shells have been collected by the NEFSC for several years.

Tow Duration Experiment

A tow duration experiment using a paired tow design was implemented in a supplemental experiment to examine the effect of reduced tow duration on scallop catch and scallop length distribution. The paired tow design allows for advanced analyses like GLMMs to be utilized and minimizes between haul variability. After survey stations were completed, 50 paired tows were also completed in the survey domain. This allowed for the use of survey catch information to inform the tow duration experiment to ensure the experiment would be representative of conditions encountered during the survey. Tows were completed in areas of the survey domain that would be representative of a gradient of scallop and sand dollar densities.

At each selected location, a 15-minute and 10-minute tow were conducted. The 15-minute tow represented the standard survey tow duration and the 10-minute tow duration was a reduced tow duration time based on recommendations from the Scallop Survey Peer Review Panel (SSSMPRT, 2015). An alternative paired towing approach was used with an ABBA BAAB method, where A was the 15-minute tow and B was the 10-minute. Tows were made in the same direction and area as close in time as possible. All other procedures for fishing the sampling gear followed standard survey protocols (i.e., gear configuration, towing protocols, catch sampling).

The same experimental approach was employed to conduct a tow duration study in the NL and mid-Atlantic (MAB) areas surveyed by VIMS. The NL study was conducted in 2016 and 2017, while the MAB study was conducted in 2017. VIMS was also funded to survey the same area as well as conduct another tow duration study in GBCA II in 2017. Funding was provided by the Sea Scallop RSA program for all tow duration studies (NA16NMF4540044, NA17NMF4540045 and NA17NMF4540044). Data from all areas and years were combined for analysis.

Analyses consisted of visual examination of scallop and debris catch as well as relative length frequency distributions. Parametric analysis, a generalized linear model (GLMM) and a generalized additive model (GAM) were used to test for differences in scallop catch and catch at length. Scallop catch was analyzed by looking at the expanded number of scallops caught as well as the number of baskets caught. Debris was defined as all material (e.g., sand dollars, mud, rocks) left on deck after all scallops, finfish and skate bycatch were removed. Debris was put into bushel baskets to quantify catch. All analyses were conducted by area (i.e., GBCA II, NL and MAB).

A one-tailed Anova or a Wilcoxon rank sum test were used to test for differences in the mean scallop catch and debris catch between tow durations by area. Assumptions required for an ANOVA (i.e., normality and homogeneity of variance) were tested for prior to implementing the appropriate test. A one-tailed test was used, because there was no expectation that a 15-minute tow would catch less than a 10-minture tow. A Kolmogorov-Smimov (KS) test as used to test for differences in the relative length frequency distributions of scallops between tow durations by area.

GLMMs and GAMs were developed following the approach of Holst and Revill (2009) and Miller (2013). GLMMs and GAMs fit the proportion of scallops caught at length in the 10-

mintue tow conditioned on the total catch at length for a tow pair in both the 10 and 15-mintue tows. The Holst and Revill method uses a binomial polynomial GLMM where length and length^2 can be included as fixed effects (Holst and Revill, 2009). The Miller approach fits several GAMs with a cubic spline smoother across all pairs and within pairs and different error structures (binomial and beta-binomial) (2013). Fixed effects considered for GLMMs were Area, length (mm), length^2, scallop catch (number of baskets), debris catch (number of baskets) and an interaction term of Area and length^2. For GAMs, length was the fixed effect and area-specific models were developed. The random effect for both models was the pair. An offset term to account for subsampling and differences in area swept was included in both models. Forward selection was used for model development (GLMMs) and Akaike information criterion (AIC) was used for model selection (GLMM and GAM). The model with the lowest AIC was selected as the optimal model for both the Holst and Revill approach as well as the Miller approach. All analyses were completed in R v 3.3.2 (R Core Team, 2016).

Results

Abundance and distribution

The survey completed 100 survey stations from the 21th through the 29th of June 2016 onboard the *F/V* K.A.T.E out of New Bedford, MA. Length frequency distributions for scallops captured during the survey by SAMS region and zone are shown in Figures 6 - 7. Maps depicting the spatial distribution of the catches of pre-recruit (≤ 75 mm shell height) and fully recruited (> 75mm shell height) scallops from the survey dredges are shown in Figure 8 - 9. Total and exploitable biomasses calculated using the SARC 59 area-specific shell height:meat weight coefficients, along with confidence intervals and average density by gear type and SAMS zone are shown in Table 1 (total biomass from the NBD catch data is not estimated due to the selective properties of the commercial gear). An estimate of the total number of animals by gear type and SAMS zone are shown in Table 2. The mean estimated scallop meat weight for both the commercial and survey dredges for the SARC 59 area-specific shell height:meat weight relationships is shown in Table 3. Shell height:meat weight relationships were estimated for the two SAMS zones within the survey domain. The resulting parameters as well as the parameters from SARC 59 shown in Table 4. The predicted shell height:meat weight relationships for the two SAMS zones are shown in Figure 10. Catch per unit of effort for finfish bycatch for the survey is shown in Table 5. Length frequency distributions for finfish bycatch with sufficient sample sizes are shown in Figure 11.

Size selectivity

The catch data were evaluated by the SELECT method with a variety of functional forms (logistic, Richards) in an attempt to characterize the most appropriate model. Examination of residual patterns, model deviance, and AIC values indicated that the logistic curve provided the best fit to the data. An additional model run was conducted to determine whether the hypotheses of equal fishing intensity (i.e., the two gears fished equally) was supported. Visual examination of residuals and values of model deviance and AIC indicated the model with an estimated split parameter provided the best fit to the data. Parameter estimates using the logistic function and with p being estimated are shown in Table 6. Fitted curve and deviance residuals are shown in Figure 12. The selectivity curve is shown in Figure 13.

The analysis that estimated the relative efficiency of the two gears based upon the expected and observed split parameter values resulted in an estimated relative efficiency value of 1.828. Assuming the survey dredge operates with 41% efficiency, the expected value for the efficiency of the commercial dredge was 65.2%. These results are consistent with those found in Yochum and DuPaul (2008) and suggest a similar efficiency for the NBD on this cruise to the 60% efficiency value in the previously calculated estimates of total and exploitable biomass. This also indicates the relative efficiency of the NBD has remained relatively consistent over time, although this is a smaller sample size compared to that analyzed by Yochum and DuPaul (2008).

Meat Quality and Shell Blisters

A total of 1,002 scallops were sampled at shell height:meat weight stations, with 665 sampled in the CAII-AC zone and 337 sampled in the CAII_ext zone. Summary information on sex, market category, color, texture and blister disease stage are provided in Table 7. Table 8 provides the classifications for market category, color, texture and blister codes. The majority of scallops were classified as marketable with no texture or color deviations. Only 15 scallops showed evidence of blister disease.

Nematode Monitoring

A total of 1,002 scallops were sampled at shell height:meat weight stations, with 665 sampled in the CAII-AC zone and 337 sampled in the CAII_ext zone. No scallops were observed to be infected with the parasitic nematode.

Scallop Shells

A total of 150 scallop shells were collected. All shell samples will be archived and added to the NEFSC shell collection.

Tow Duration Experiment

Figure 14 shows the location of all tow duration pairs by area. Table 9 provides summary information by area. Total expanded number of scallops caught, average scallop catch (expanded number) and results of parametric tests by tow duration and area are provided in Table 10. There was no significant difference in the mean catch between tow durations for the MAB or NL. There was a significant difference for GBCA II, with the 15-minute tow catching more scallops than the 10-minute tow (Table 10). Bland-Altman plots by area for the expanded number of scallops, debris catch and total catch (number of baskets of scallops + number of baskets of debris) are shown in Figures 15 – 17. Table 11 shows debris catch, average debris catch and results of parametric tests by tow duration and area. There were no significant differences in debris catch between the 10 and 15-minute tows. Relative length frequency distributions are provided in Figure 18. The K-S tests indicated there were no significant differences in length distributions between the two tow durations.

GLMM results indicated the optimal model had an interaction term of area and $length^2$ as well as a length effect term. The predicted proportion caught at length by area is shown in Figure 19. There was an increase in the relative efficiency for the 10-minute tow as length increased for GBCA II and NL. For the MAB, the relative efficiency was higher for the 10-minute across all length classes (Figure 19). Results from the Miller approach showed a binomial model with an intercept and smoother of size for across pair effects and for the random effects fit the data the best (Figure 20). The predicted proportion caught at length graphs showed a similar trend for the relative efficiency of the 10-minute tow.

Outreach

As part of the outreach component of this project, a presentation detailing the results of the survey was compiled. This presentation was delivered to the Sea Scallop Plan Development Team (SSPDT) at their meeting in Falmouth, MA during August 30 - 31, 2016. Results of this survey were used in the decision making process for Framework Adjustment (FW) 28 to the Sea Scallop Fishery Management Plan. The presentation is included as a supporting document to this final report (Appendix A). A presentation describing the continued investigation of the nematode parasite and observations from VIMS 2016 survey efforts was also presented at the same meeting and included as a supporting document (Appendix B). An industry report was generated to summarize results from VIMS 2016 survey efforts and distributed to stakeholders (Appendix C).

During the survey, we also collected special collections for several organizations. Information on red hake (*Urophycis chuss*) was collected for Ms. Tasha O'Hara of the NEFSC. The number of red hake observed in scallops sampled at shell:height meat weight stations was enumerated and TL measurements were taken. Data on red hake along with station-level information were provided to Ms. O'Hara. Scallop meat samples were also collected for Dr. Susan Inglis of the School for Marine Science and Technology for another Sea Scallop RSA project. Scallop meats from areas selected by Dr. Inglis were preserved and delivered to Dr. Inglis. Accompanying station-level data were also sent to Dr. Inglis.

Presentations

Several other presentations were given that included information regarding this survey and survey results:

- 2018 Benchmark Sea Scallop Assessment Data Meeting, February 5 – 9, 2018, Woods Hole, MA.
    - Effect of Tow Duration on Scallop Catch for the VIMS Scallop Dredge Survey
    - VIMS Sea Scallop Dredge Survey Overview
- 2018 Benchmark Sea Scallop Assessment Data Meeting, March 26 – 29, 2018, Woods Hole, MA.
    - Updated Tow Duration Analysis
    - Selectivity Estimates from VIMS Dredge Survey

Discussion

Fine scale surveys of important resource areas like the GBCA II area are an important endeavor. These surveys provide information about a critical component of the resource that includes a rotational access area and open area (e.g., the Extension Closure). Additionally, the timing of industry-based surveys can be tailored to give managers current information to guide important management decisions. This information can help time access to closed areas, set Total Allowable Catches (TAC) for re-opening of access areas, and determine the number of allowable DAS for open area fishing. Finally, this type of survey is important in that it involves the stakeholders of the fishery in the management of the resource.

Our results suggest that significant biomass exists in the traditional access area of GBCA II and that the composition of scallops in the Extension closure remains under commercially harvestable sizes. The traditional access area could support an access area trip in FW 28, while scallops in the Extension closure could be protected for an additional year to allow for additional growth and increased yield to the fishery in the future. These pre-recruits represent important size classes and have the ability to realize year over year increases in growth as well as the potential to sustain open area landings in subsequent years. Information obtained from assessing meat quality indicated meat quality in the area is excellent and no signs of nematode infections were observed.

The use of commercial scallop vessels in a project of this magnitude presents some interesting challenges. One such challenge is the use of the commercial gear. This gear is not designed to be a survey gear; it is designed to be efficient in a commercial setting. The design of this current experiment however provides insight into the utility of using a commercial gear as a survey tool. One advantage of the use of this gear is that the catch from this dredge represents exploitable biomass and no further correction is needed. A disadvantage lies in the fact that there is very little ability of this gear to detect recruitment events. However, since this survey is designed to estimate exploitable biomass, this is not a critical issue.

The concurrent use of two different dredge configurations provides a means to not only test for agreement of results between the two gears, but also simultaneously conduct size selectivity experiments. In this instance, our experiment provided information regarding the NBD. Selectivity of the NBD was estimated by Yochum and DuPaul (2008), and while expectation is that the selectivity of the NBD would not change over time, the utilization of this survey to estimate selectivity for this gear is beneficial. Results were similar to those estimated by Yochum and DuPaul and indicate selectivity of the gear has not changed over time. This information is useful for managers and assessment scientists.

Biomass estimates are sensitive to other assumptions made about the biological characteristics of the resource; specifically, the use of appropriate shell height:meat weight parameters. Parameters generated from data collected during the course of the study were appropriate for the area and time sampled. There is, however, a large variation in this relationship as a result of many factors. Seasonal and inter-annual variation can result in some of the largest differences in shell height:meat weight values. Traditionally, when the sea scallop undergoes its annual spawning cycle, metabolic energy is directed toward the production of gametes and the somatic tissue of the scallop is still recovering and is at some of their lowest levels relative to shell size (Serchuk and Smolowitz, 1989). While accurately representative for the month of the survey, biomass has the potential to be different relative to other times of the year. For comparative purposes, our results were also shown using the parameters from SARC 59 (NEFSC, 2014). This allowed a comparison of results that may be reflective of some of the variations in biomass due to the fluctuations in the relationship between shell height and adductor muscle weight. Area and time specific shell height:meat weight parameters are another topic that merits continued study.

The tow duration experiment did not provide conclusive results regarding the impact of a reduced tow time on scallop catch rates. While catch rates of scallops in GBCA II were reduced in the 10-minuite tow compared to the standard 15-minute tow, the MAB and NL results were confounding and did not follow expectations. It was also difficult to determine if and when dredge saturation was occurring. This is important in the context of the potential for reduced dredge efficiency at high densities. Dredge saturation may be occurring in discrete areas with extreme densities of scallops in the MAB and NL. Several recommendations for continued analysis were provided by the 2018 sea scallop stock assessment working group, and analysis following these recommendations will continue.

The project budget and project compensation are included as Appendix D.

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<u>Figure 1</u> Locations of sampling stations for the 2016 survey of Georges Bank Closed Area II access area and the Extension closure.

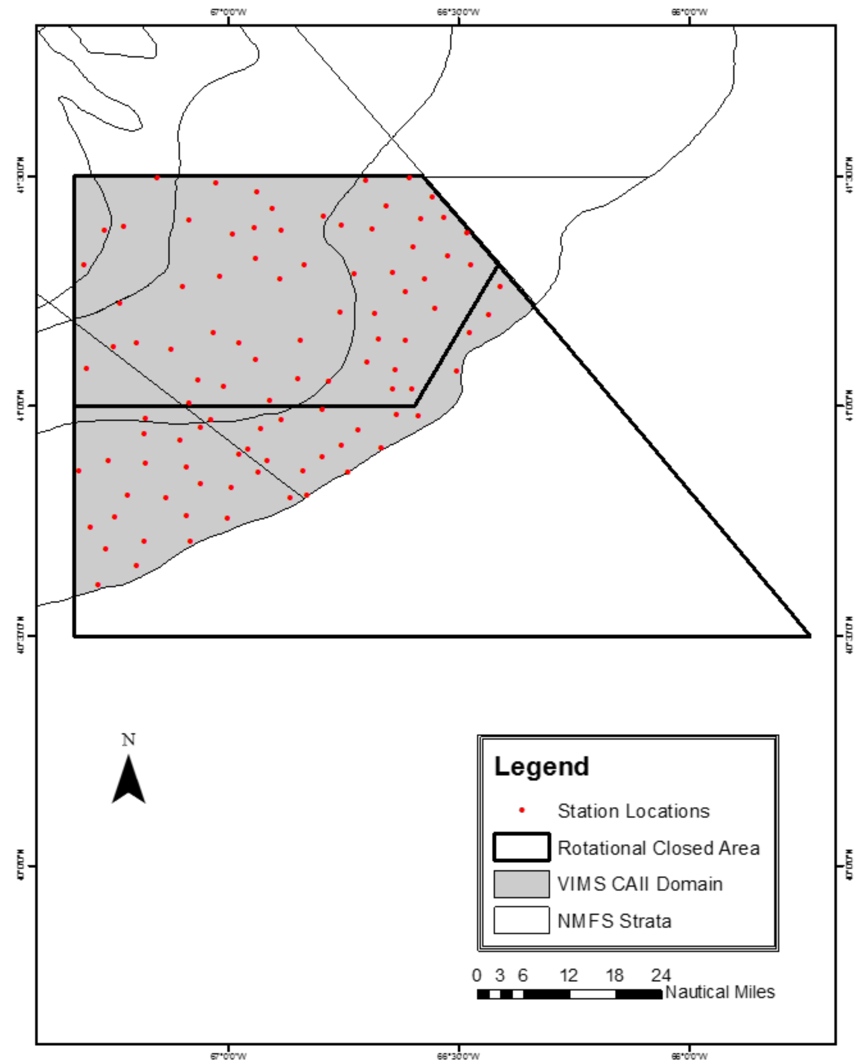
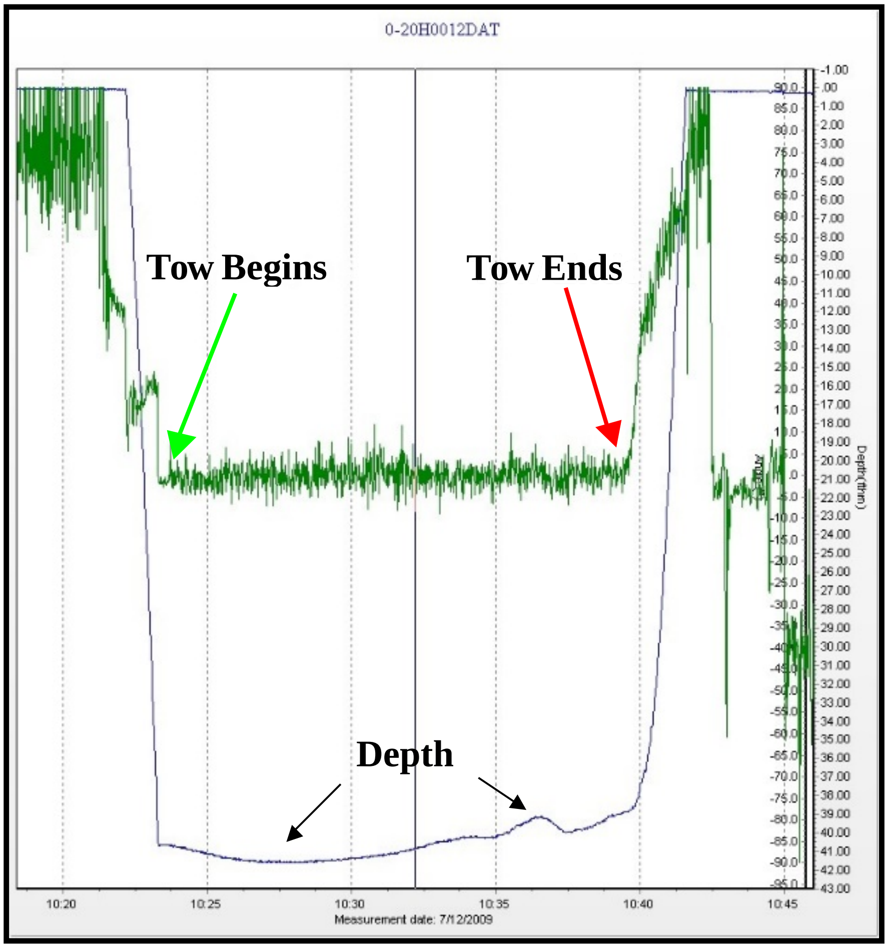


Figure 2 An example of the output from the Star-Oddi™ DST sensor. Arrows indicate the interpretation of the start and end of the dredge tow.



<u>Figure 3</u> Histogram of calculated tow lengths from the 2016 survey of Georges Bank Closed Area II access area and the Extension closure. Mean tow length was 1854.86 m with a standard deviation of 81.04 m.

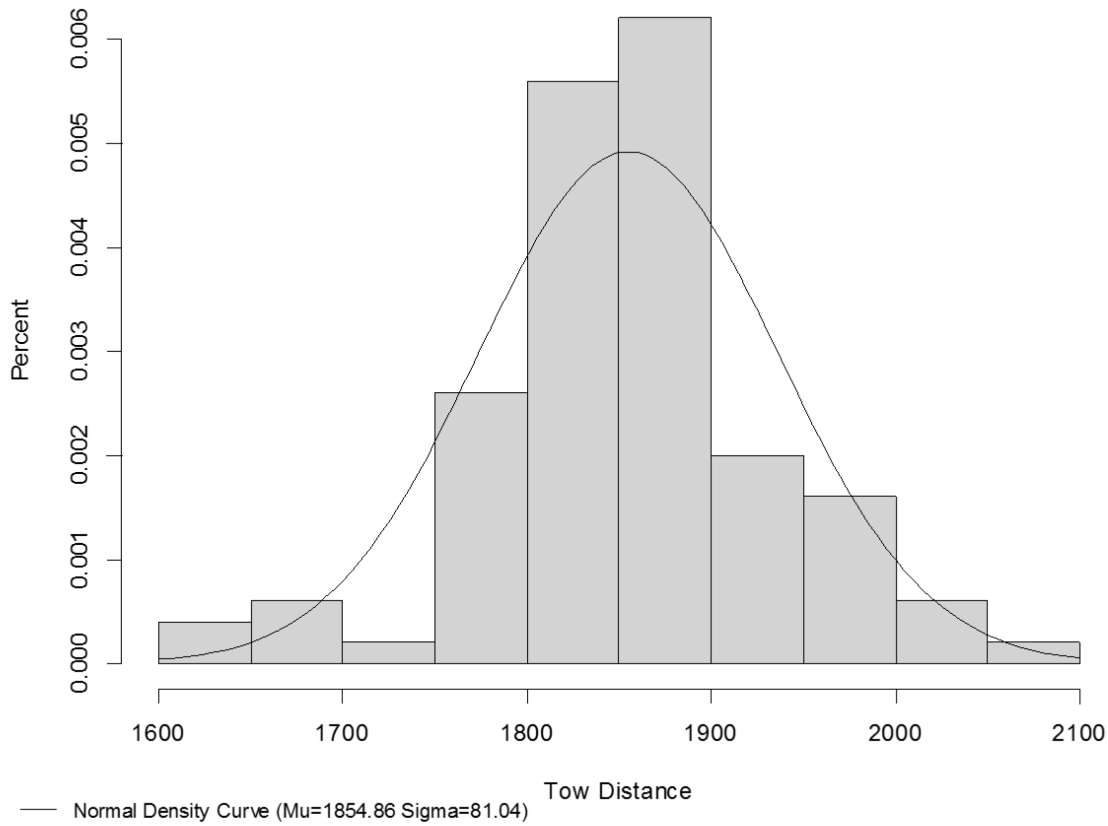


Figure 4 Map of the 2016 survey domain of Georges Bank Closed Area II access area and the Extension closure with the region/zone designations and NMFS and VIMS extents (blue and coral). The region is CAII_S and the zones are CAII_S_AC and CA_S_Ext.

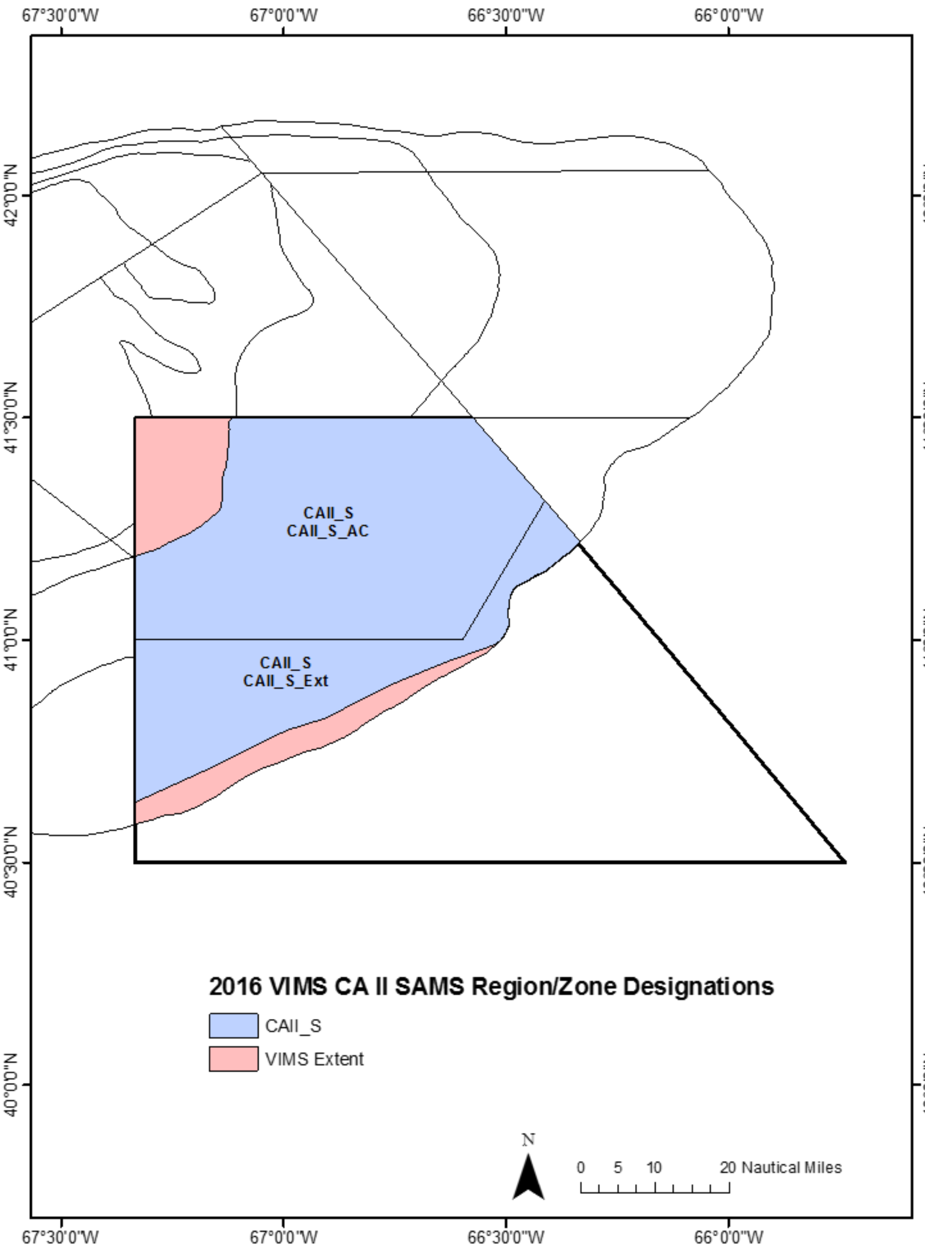


Figure 6 Shell height relative frequencies for the two dredge configurations used to survey the Georges Bank Closed Area II access area and the Extension closure during 2016 for the CAII SAMS region. The relative frequencies represent the expanded but unadjusted catches of the two gears for all sampled tows. The number of scallops sampled by gear are also provided.

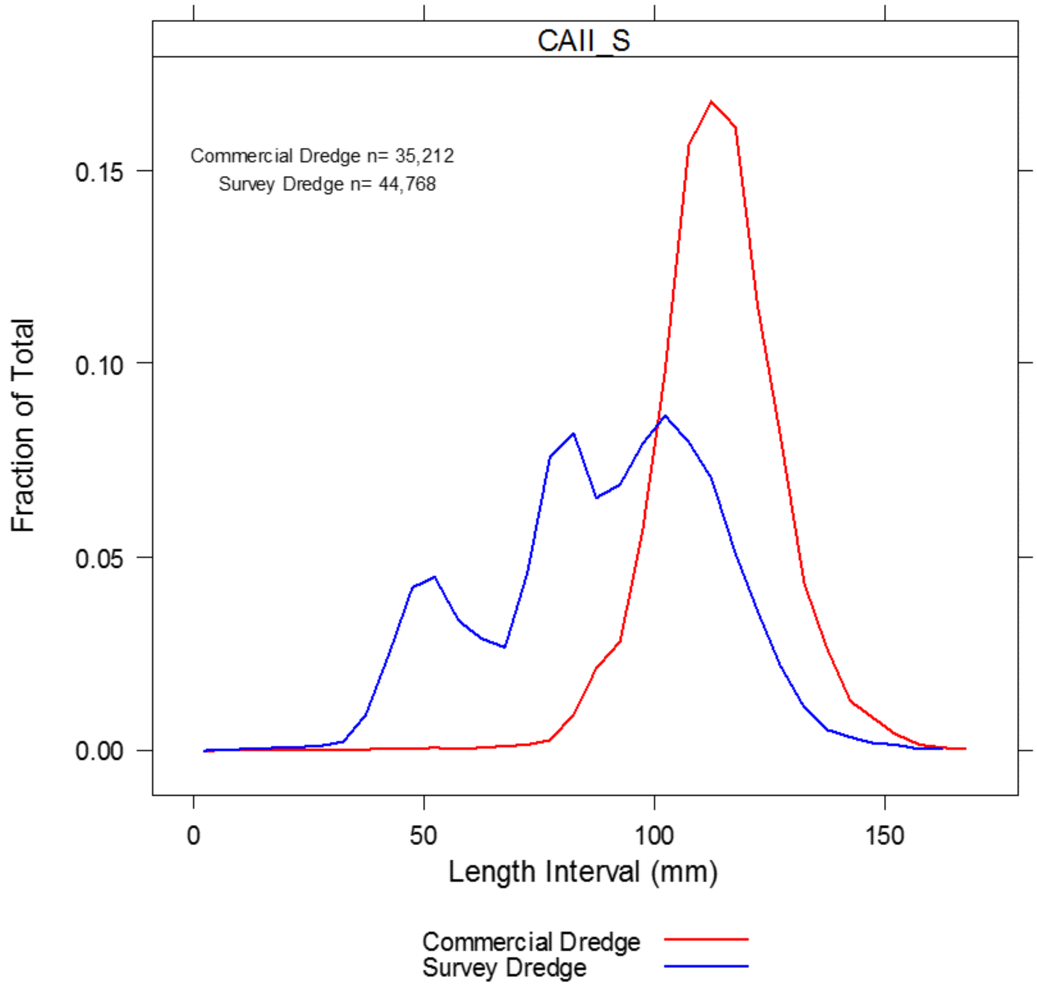


Figure 7 Shell height relative frequencies for the two dredge configurations used to survey the Georges Bank Closed Area II access area and the Extension closure during 2016 for the CAII SAMS zones (CAII_S_AC and CAII_S_ext). The relative frequencies represent the expanded but unadjusted catches of the two gears for all sampled tows. The number of scallops sampled by gear are also provided.

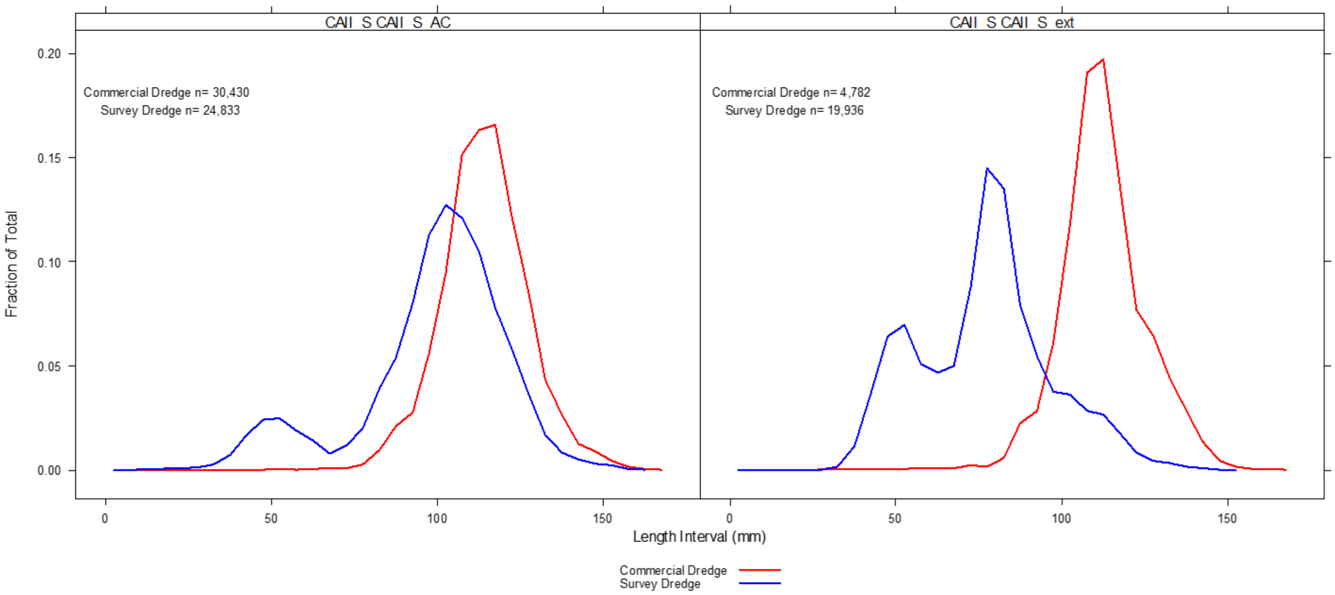


Figure 8 Spatial distribution of the number of sea scallop caught per m^2 in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Georges Bank Closed Area II access area and the Extension closure during June 2016. This figure represents the catch of pre-recruit sea scallops (≤ 30mm (A) and >30mm ≤ 75mm (B)).

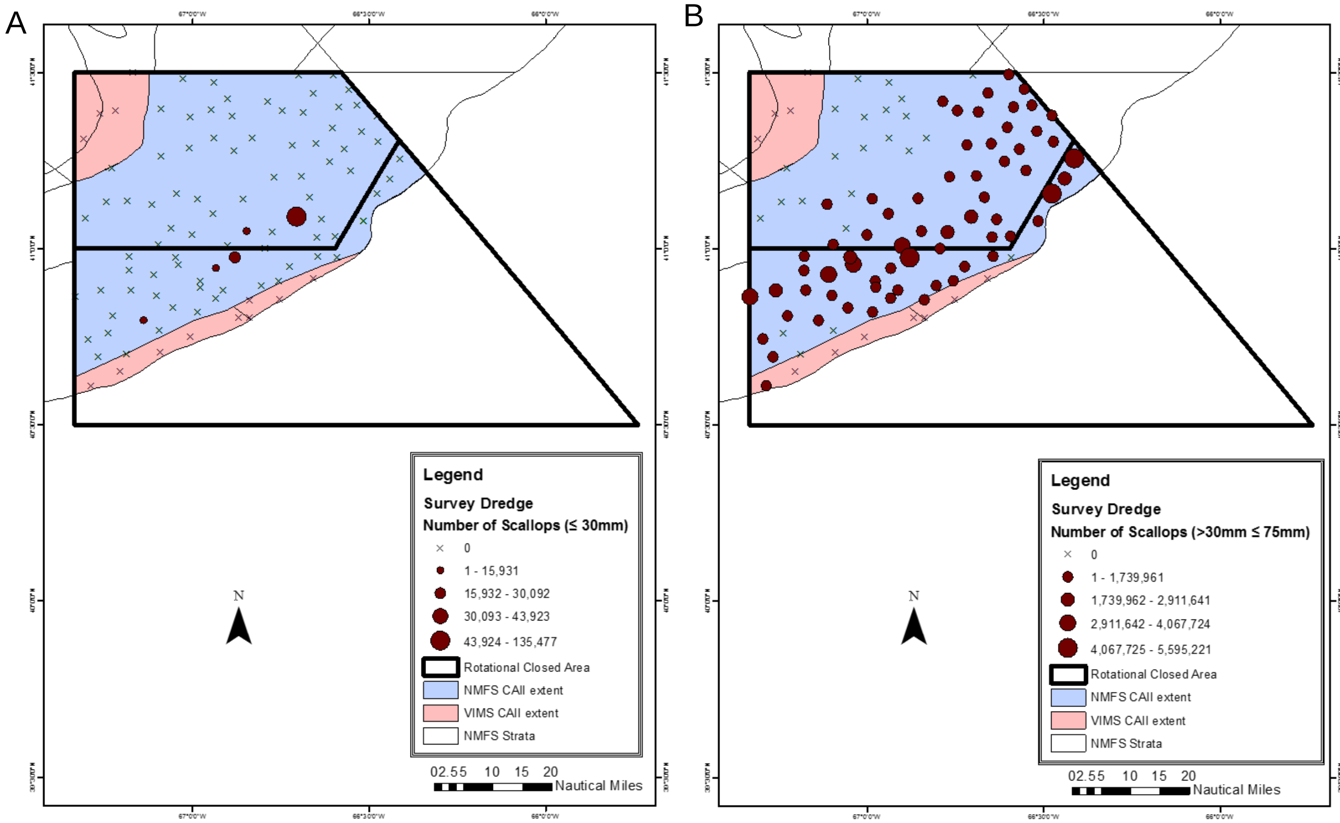


Figure 9 Spatial distribution of the number of sea scallop caught per m^2 in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Georges Bank Closed Area II access area and the Extension closure during June 2016. This figure represents the catch of recruited sea scallops (> 75 mm).

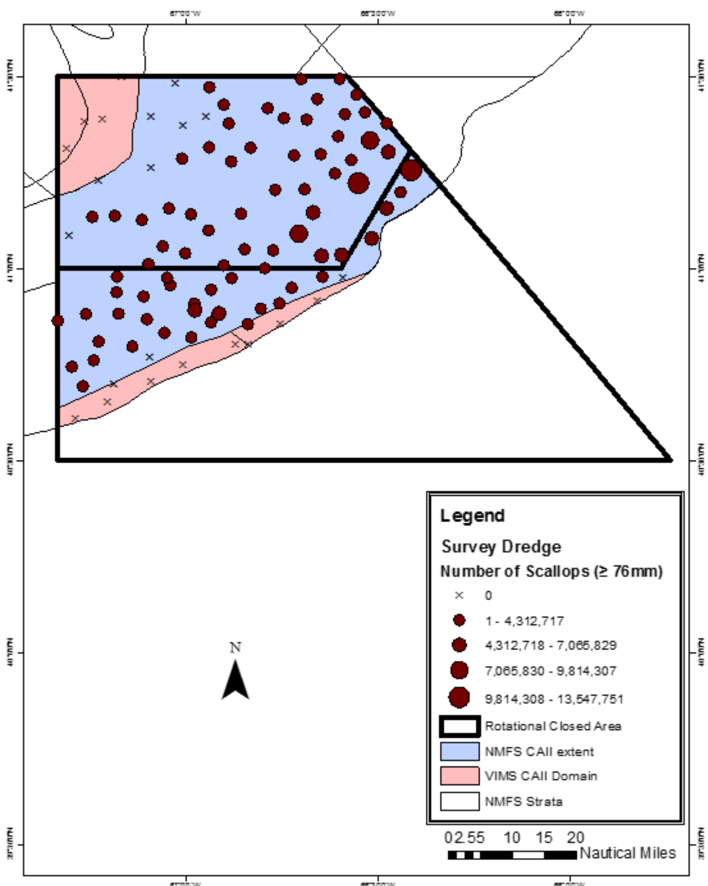
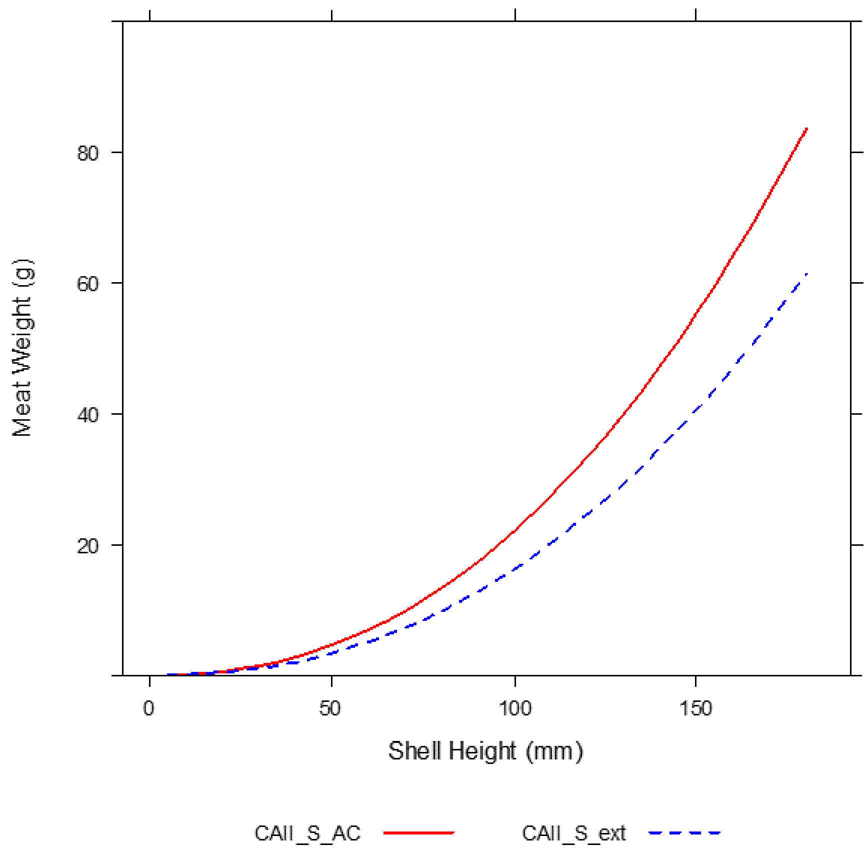
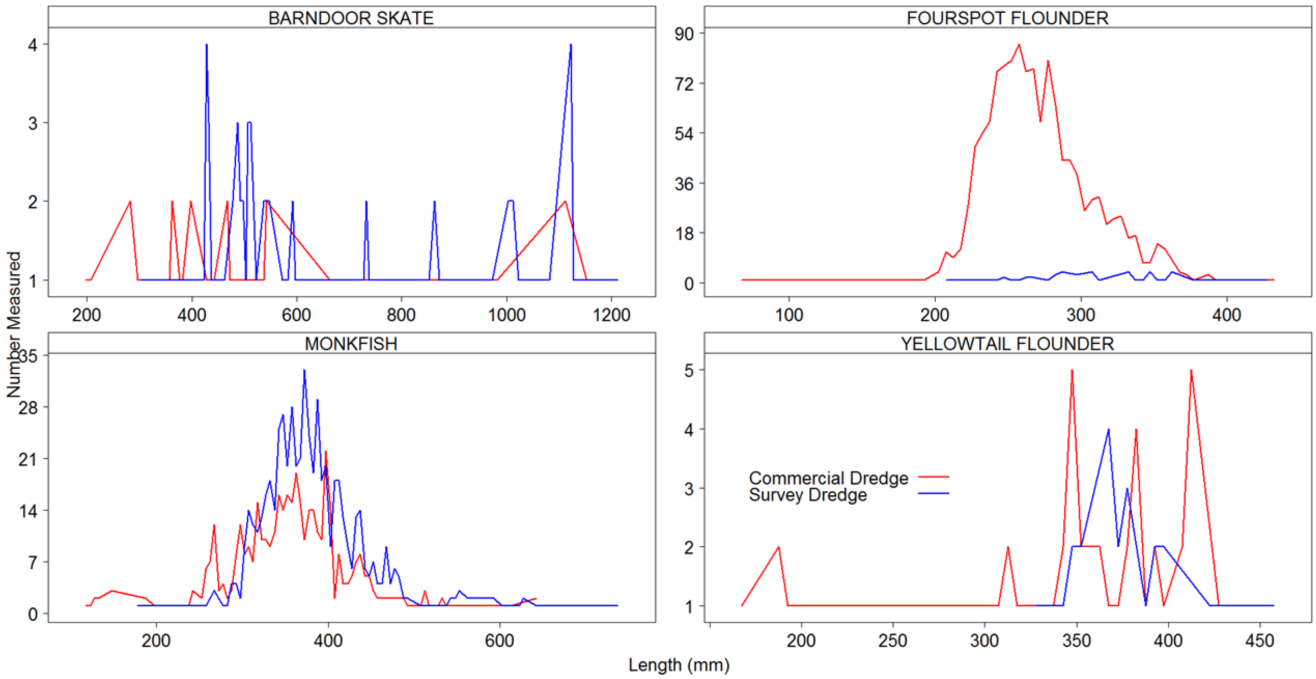


Figure 10 Predicted shell height:meat weight relationships by SAMS zone estimated from scallops sampled during the Georges Bank Closed Area II access area and the Extension closure during June 2016.



<u>Figure 11</u> Length frequency distributions of bycatch by dredge with sufficient sample sizes for the Georges Bank Closed Area II access area and the Extension closure survey conducted during June 2016. Samples sizes are also provided.



<u>Figure 12</u> <u>Left:</u> Logistic SELECT curve fit to the proportion of the total catch in the commercial dredge relative to the total catch (survey and commercial) for the 2016 Georges Bank Closed Area II access area and the Extension closure survey. <u>Right</u>: Deviance residuals for the model fit.

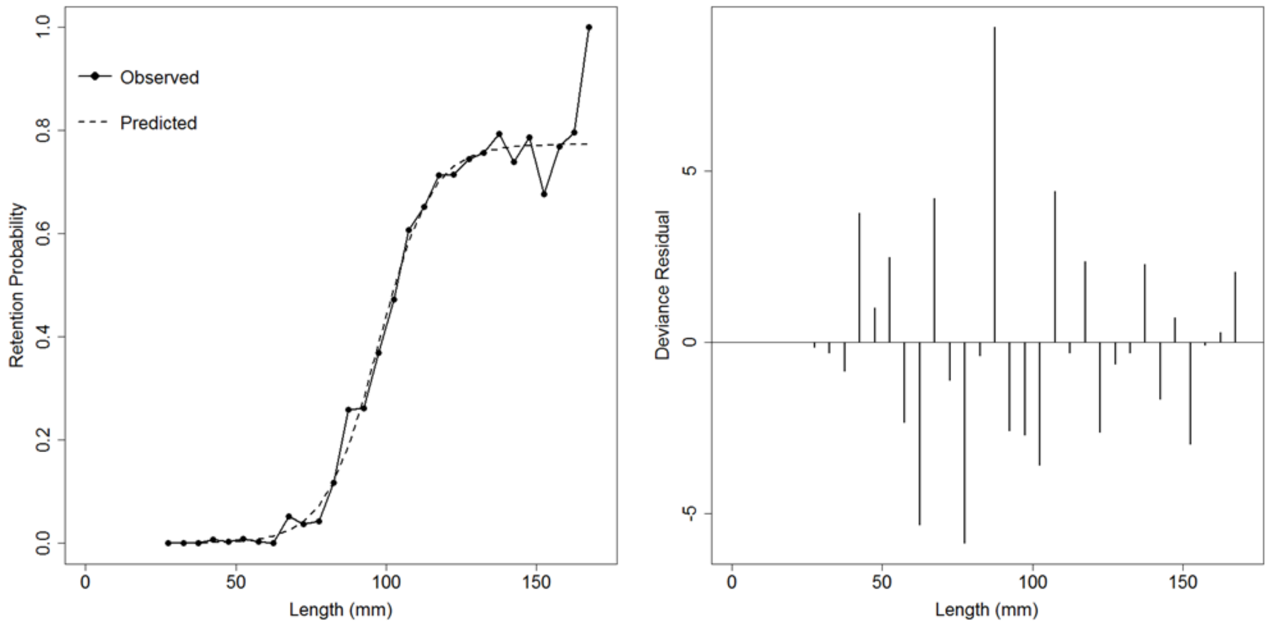


Figure 13 Estimated selectivity curve for the New Bedford Style commercial dredge based on data from the 2016 Georges Bank Closed Area II access area and the Extension closure survey. The middle dashed line represents the length at 50% retention probability. The upper and lower dashed lines represent the lengths at 25% and 75% retention probability.

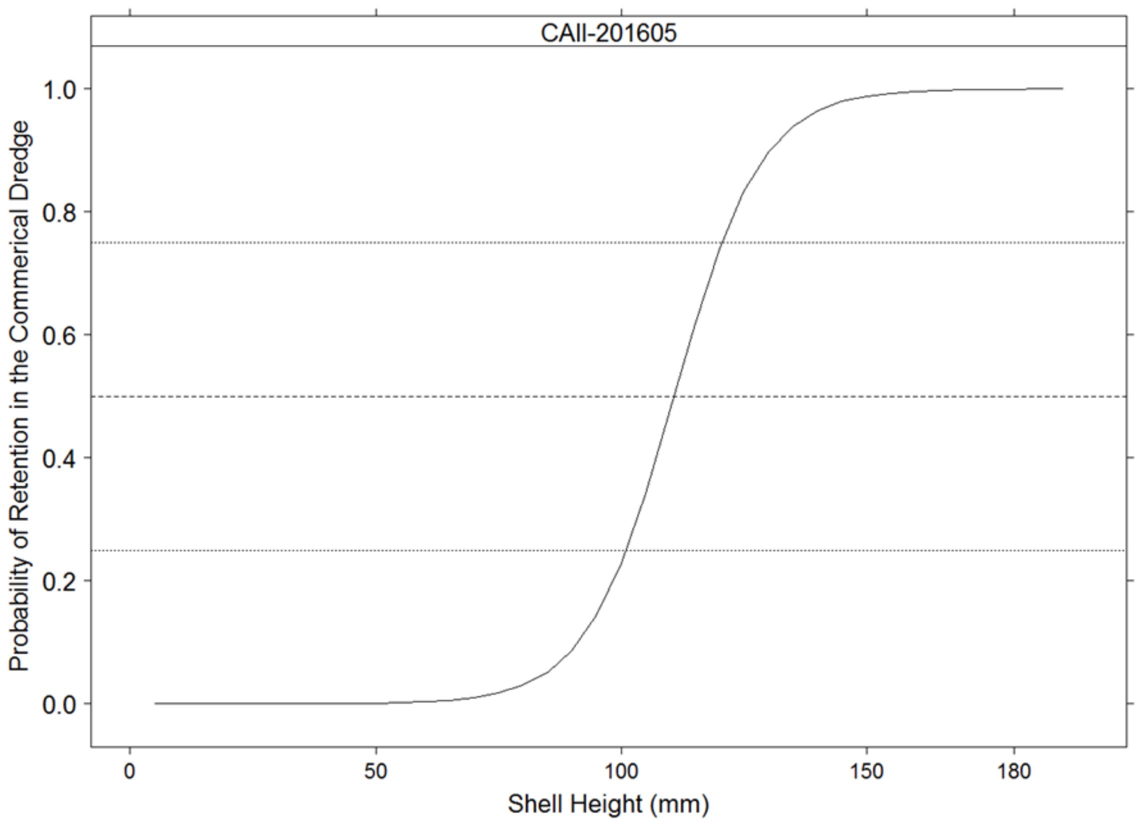


Figure 14 Location of all tow duration pairs by area. Top: Closed Area II, Middle: Nantucket Lightship, Bottom: mid-Atlantic.

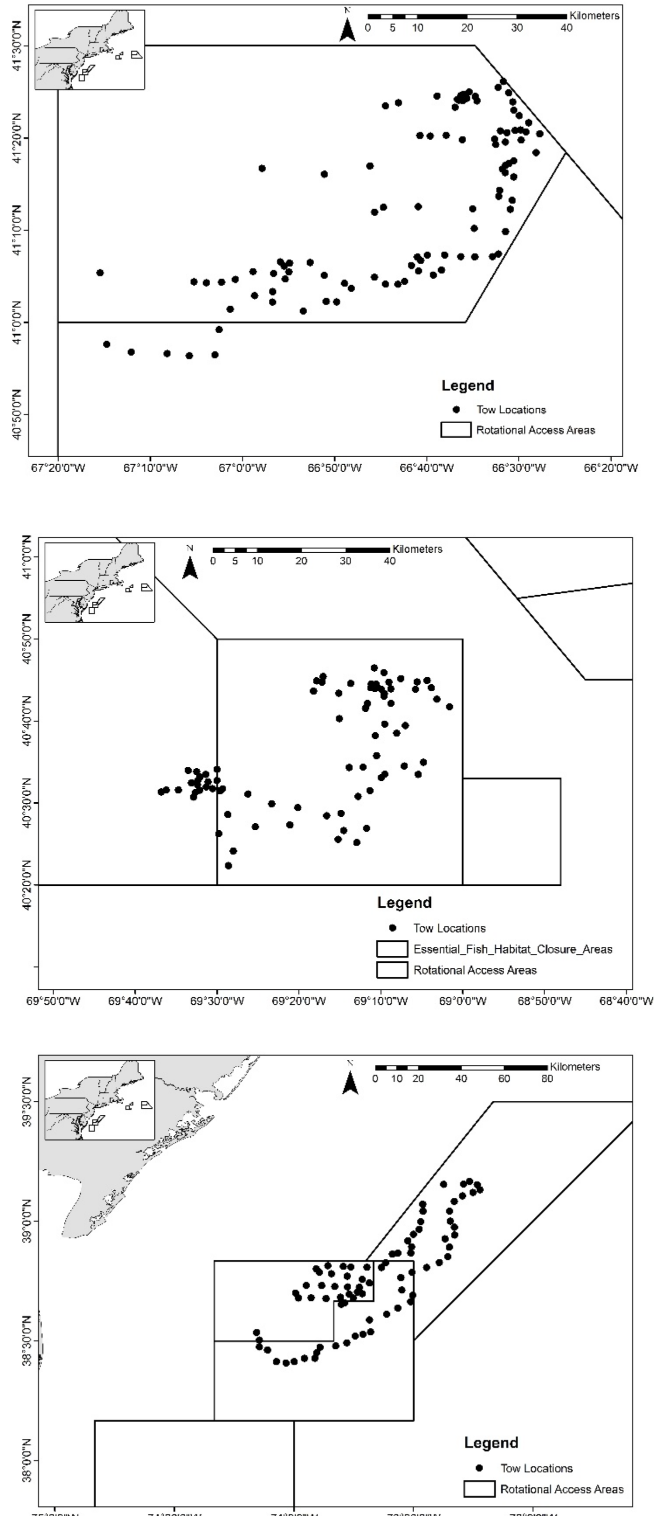
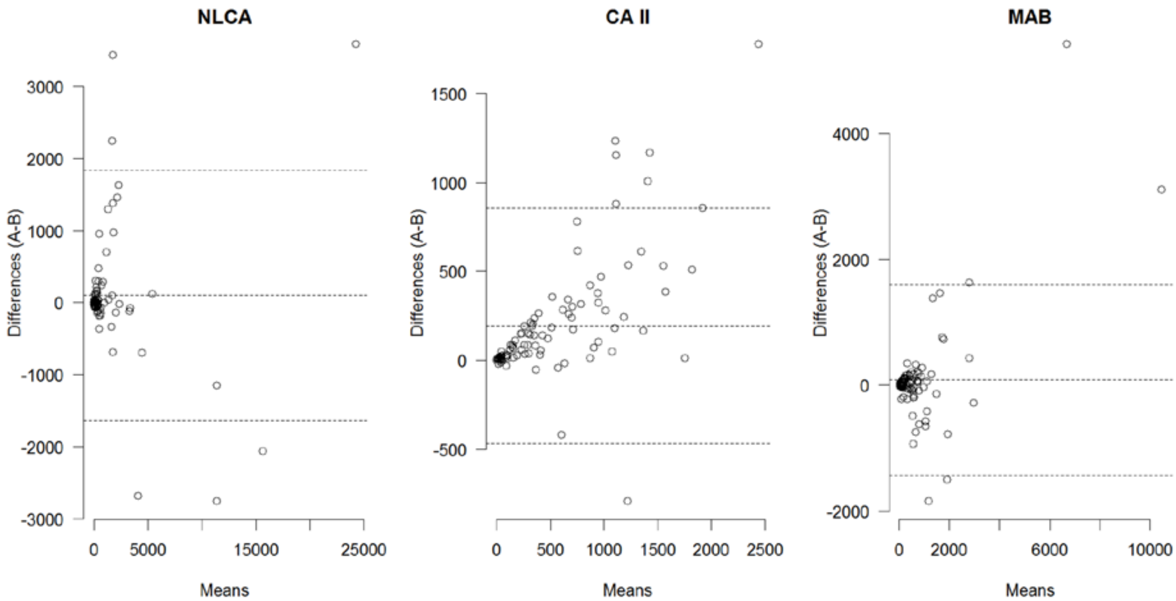


Figure 15 Bland-Altman plots by area for the expanded number of scallops. A is the 15-minute tow and B is the 10-minute tow. The x axis is the mean of the paired catch (A+B/2). The y axis is the difference between the paired catch (A-B). The middle dashed line is the mean of the difference and the upper and lower dashed lines are 95% confidence intervals.



<u>Figure 16</u> Bland-Altman plots by area for debris catch (baskets). A is the 15-minute tow and B is the 10-minute tow. The x axis is the mean of the paired catch (A+B/2). The y axis is the difference between the paired catch (A-B). The middle dashed line is the mean of the difference and the upper and lower dashed lines are 95% confidence intervals.

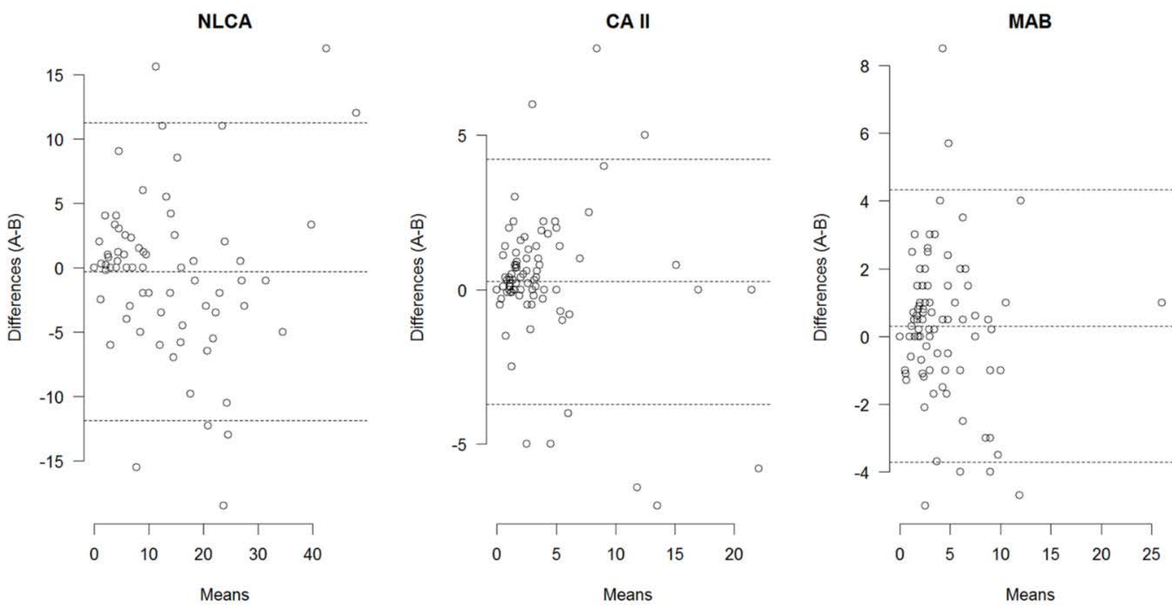


Figure 17 Bland-Altman plots by area for total catch (number of baskets of scallop catch + number of baskets of debris catch). A is the 15-minute tow and B is the 10-minute tow. The x axis is the mean of the paired catch (A+B/2). The y axis is the difference between the paired catch (A-B). The middle dashed line is the mean of the difference and the upper and lower dashed lines are 95% confidence intervals.

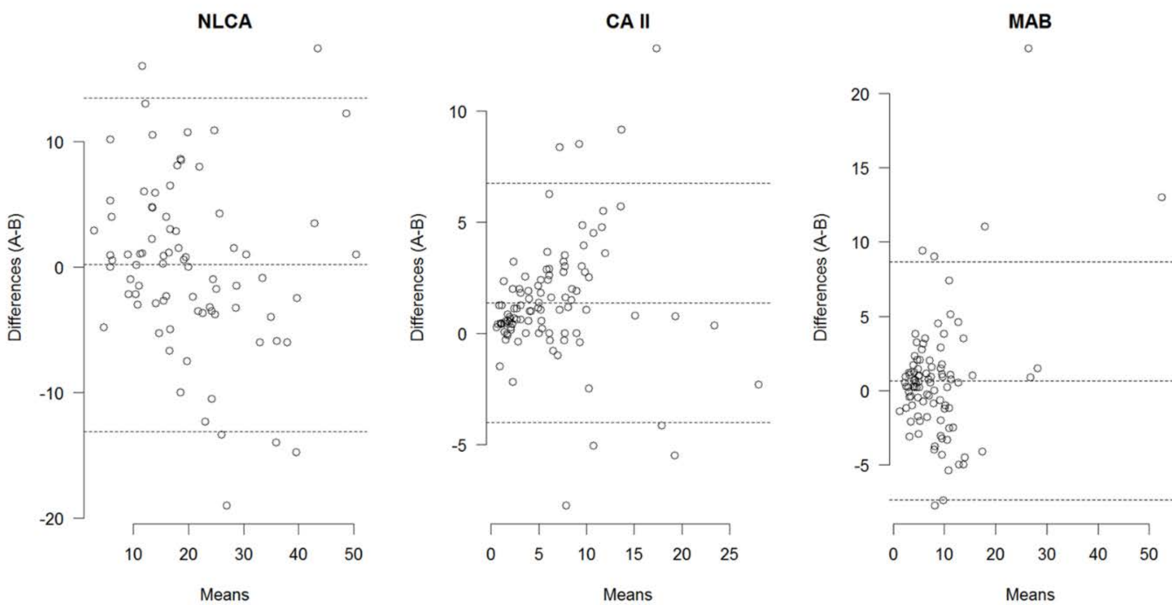


Figure 18 Relative length frequency distributions by area for the 10-minute tow (blue line) and the 15-minute tow (red dashed line).

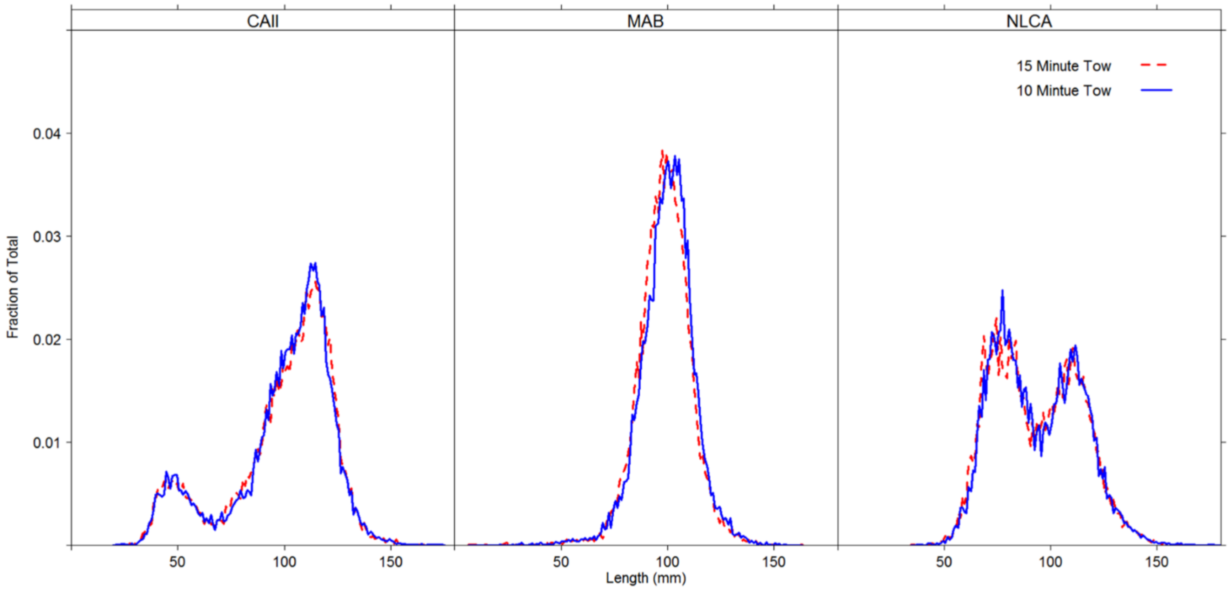
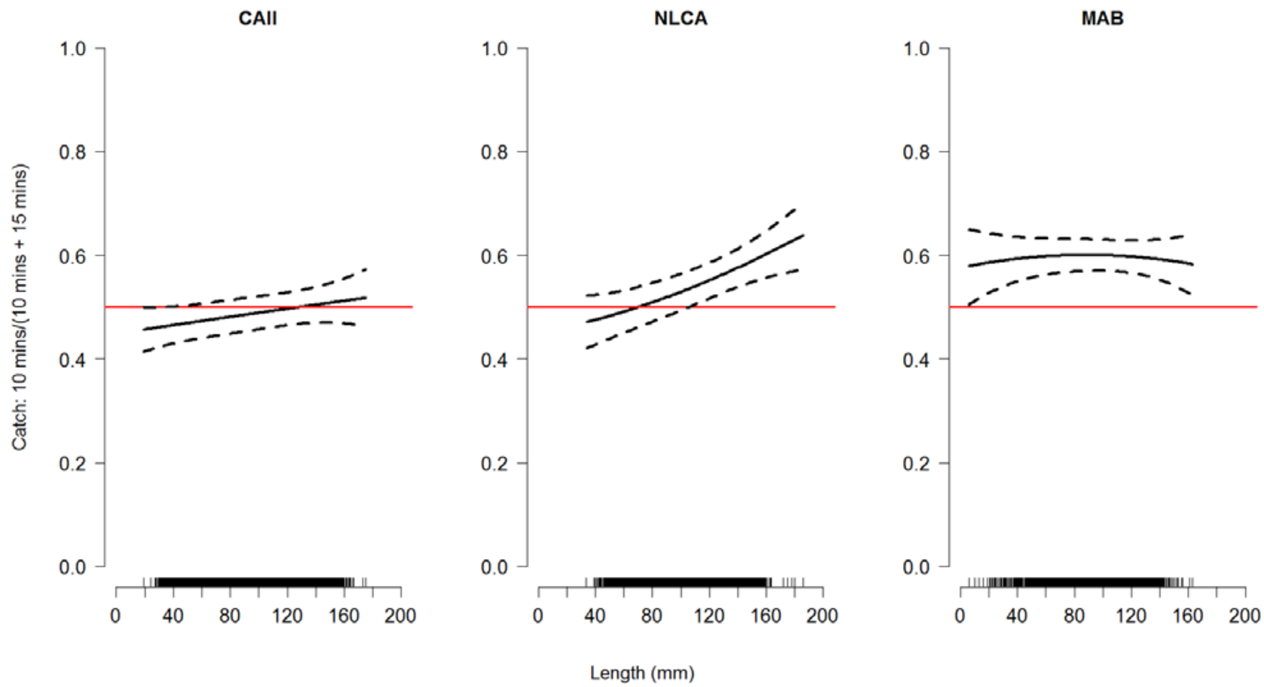


Figure 19 Predicted proportion caught at length in the 10-minute tow conditioned on total catch at length with 95% confidence intervals by area for the optimal GLMM. The red horizontal line of 0.5 indicates equal relative efficiency. A value greater than 0.5 indicates the 10-minute tow had a greater relative efficiency. The rug on the x axis are the observed lengths.



<u>Figure 20</u> Predicted proportion caught at length in the 10-minute tow conditioned on total catch at length with 95% confidence intervals by area for the optimal GAM. The red horizontal line of 1 indicates equal relative efficiency. A value greater than 1 indicates the 10-minute tow had a greater relative efficiency. The rug on the x axis are the observed lengths, <u>Top</u>: mid-Atlantic, <u>Middle</u>: Nantucket Lightship, <u>Bottom</u>: Closed Area II.

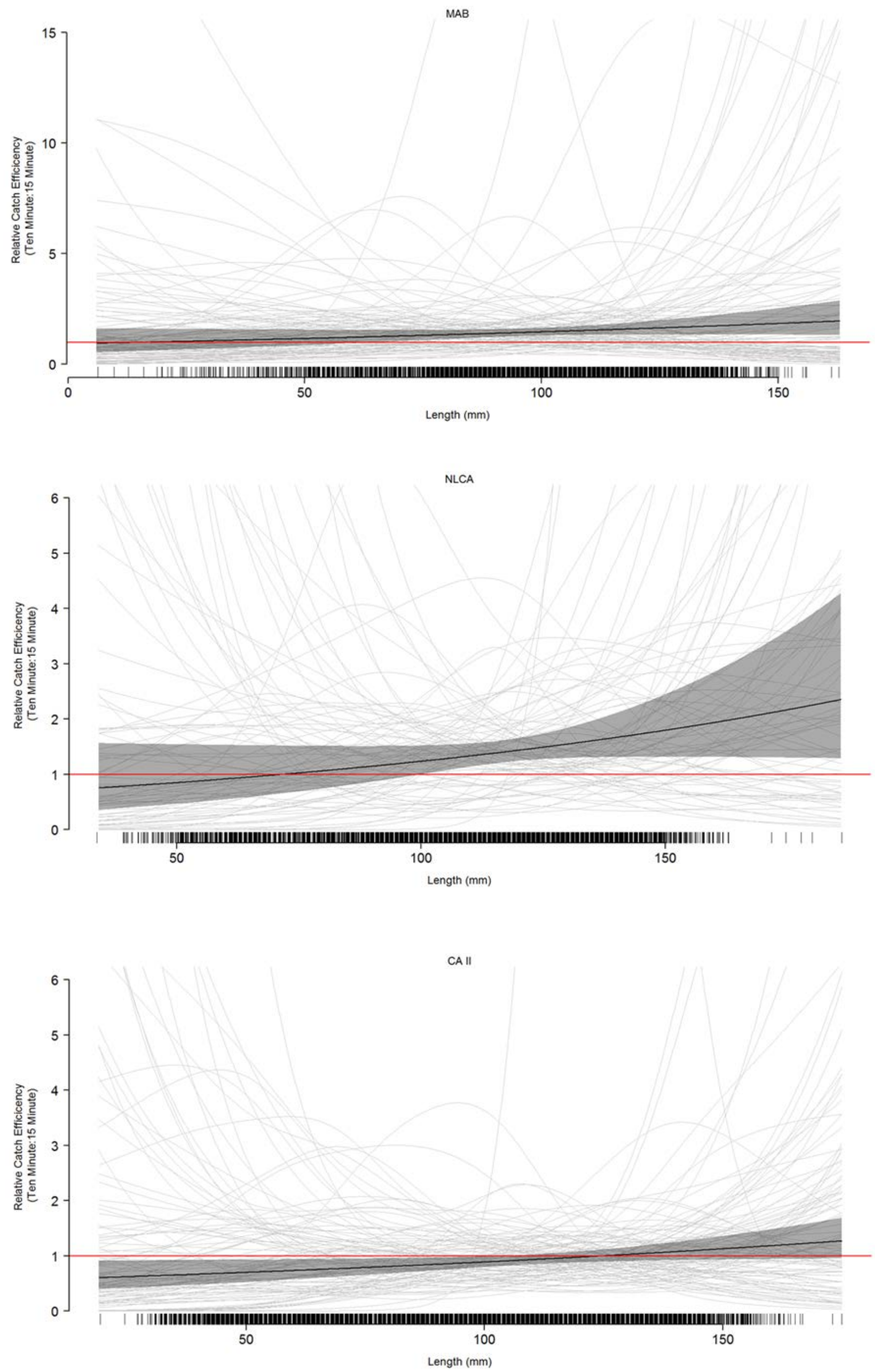


Table 1 Estimated total and exploitable biomass for the NMFS survey dredge and New Bedford style commercial dredge for the Georges Bank Closed Area II access area and the Extension closure surveyed during 2016 for the CAII SAMS zones (CAII_S_AC and CAII_S_ext). 95% confidence intervals and average density (scallops/m^2) are also provided.

	Survey Dredge					
	SAMS Zone	Total Biomass (mt)	95% CI	Lower Bound 95% CI	Upper Bound 95% CI	Average Density (scallops/m^2)
Total Biomass	CAII_AC	13,875.77	1,697.48	12,178.29	15,573.25	0.26
	CAII_ext	4,963.42	837.74	4,125.68	5,801.16	0.25
Exploitable Biomass	CAII_AC	8,997.18	1,019.75	7,977.43	10,016.94	0.13
	CAII_ext	1,720.24	298.35	1,421.89	2,018.59	0.25
	Commercial Dredge					
Exploitable Biomass	CAII_AC	6,149.25	1,193.97	4,955.28	7,343.22	0.10
	CAII_ext	775.98	221.54	554.44	997.52	0.02

Table 2 Estimated total number of scallops for the NMFS survey dredge and New Bedford style commercial dredge for the Georges Bank Closed Area II access area and the Extension closure surveyed during 2016 for the CAII SAMS zones (CAII_S_AC and CAII_S_ext).

		Survey Dredge	Commercial Dredge
	SAMS Zone	Number	Number
Total	CAII_AC	688,469,033.23	-
	CAII_ext	477,721,662.76	-
Exploitable	CAII_AC	347,640,879.00	205,831,201.40
	CAII_ext	92,805,506.65	28,511,190.65

Table 3 Average meat weight for the NMFS survey dredge and New Bedford style commercial dredge for the Georges Bank Closed Area II access area and the Extension closure surveyed during 2016 for the CAII SAMS zones (CAII_S_AC and CAII_S_ext).

Gear	SAMS Zone	Mean Meat Weight (g) Total Scallops	Mean Meat Weight (g) Exploitable Scallops
Survey	CAII_AC	20.23	25.51
	CAII_ext	10.34	18.13
Commercial	CAII_AC	-	29.29
	CAII_ext	-	26.52

Table 4 Shell height:meat weight parameters estimated from scallops sampled during the Georges Bank Closed Area II access area and the Extension closure survey during June 2016 along with SARC 59 parameter estimates.

VIMS	**SAMS**	**Estimate**
Intercept		-3.36
lnSH		2.26
lnDepth		-0.91
SAMS	CAII_ext	-0.31
SARC 59 Area Specific		
Intercept		-16.98
lnSH		4.6
lnDepth		1.93
lnSH*lnDepth		-0.48
SAMS	CAII_AC	0.004
	CAII_ext	-0.07

Table 5 Total catch (number of animals) and catch per unit effort for bycatch for the June 2016 survey of the Georges Bank Closed Area II access area and the Extension closure for the NMFS survey dredge and the New Bedford style commercial dredge.

Species Name	Commerical Dredge		Survey Dredge	
	Total Catch	CPUE	Total Catch	CPUE
AMERICAN LOBSTER	2	0	3	0.01
SUMMER FLOUNDER	1	0	9	0.04
AMERICAN PLAICE	1	0	1	0
MONKFISH	438	1.94	589	2.61
BARNDOOR SKATE	40	0.18	79	0.35
OCEAN POUT	47	0.21	0	0
BLACKBACK FLOUNDER	1	0.00	3	0.01
WINDOWPANE FLOUNDER	16	0.07	38	0.17
BUTTERFISH	2	0.01	0	0
FOURSPOT FLOUNDER	1,275	5.64	49	0.22
WHITE HAKE	9	0	4	0.02
GREY SOLE	16	0.07	7	0.03
UNCLASSIFIED SKATES	2,033	9.00	844	3.74
HADDOCK	254	1.12	2	0.01
SILVER HAKE	903	4.00	7	0.03
LONGHORN SCULPIN	20	0.09	0	0
SPINY DOGFISH	13	0.06	4	0.02
SEA RAVEN	3	0.01	0	0
SPOTTED HAKE	11	0.05	0	0
RED HAKE	2,744	12.14	10	0.04
YELLOWTAIL FLOUNDER	45	0.20	22	0.10

Table 6 Selectivity curve parameter values estimated with a logistic curve and estimated split parameter (*p*). Improvements with respect to model fit were assessed by an examination of model deviance and AIC values.

Parameter	Parameter Estimate	S.E.
a	-12.52	
b	0.11	
p	0.77	0.02
L_{25}	100.94	1.50
L_{50}	110.65	1.94
L_{75}	120.36	2.43
Selection Range	19.42	1.16
REP Factor	14.97	
Number of Tows	57.00	

Table 7 Summary or scallops assessed for marketability, color, texture and blister disease at shell height:meat weight stations during the 2016 survey of the Georges Bank Closed Area II access area and the Extension closure.

	Market Classification			
Sex	1	2	3	4
Female	3	8	35	307
Male	2	13	44	322
Unknown	0	1	13	254
	Color Classification			
	1	2	3	4
Female	1	1	9	342
Male	0	0	5	376
Unknown	0	0	0	268
	Texture Classification			
	1	2	3	4
Female	3	8	48	294
Male	2	14	79	286
Unknown	0	1	15	252
	Disease Classification			
	1	2	3	4
Female	0	3	4	346
Male	0	2	6	373
Unknown	0	0	0	268

Table 8 Description of marketability, color, texture and blister codes for Table 8.

Classification	Color	Texture	Marketability	Blister
1	Extreme color deviation	Extreme stringiness, tearing, flaccid	Unmarketable	Blister in advanced stage
2	Noticeable color deviation	Noticeable stringiness, tearing, flaccid	Marginally marketable	Moderate blister severity
3	Slight color deviation	Slight stringiness, tearing, flaccid	Slightly inferior marketability	Blister in early stage
4	No color deviation	No texture concern	Marketable	No blister present

Table 9 Summary information for tow duration studies in Georges Bank Closed Area II, Nantucket Lightship and the mid-Atlantic.

Area	Number of Trips	Number of Pairs	Total Number of Pairs for Area	Dates	Vessel
MAB	1	96	96	9/12/2017-9/18/2017	F/V Nancy Elizabeth
NLCA	2	40	80	6/3/2016-6/10/2016	F/V Celtic
		40		7/27/2017-8/3/2017	F/V Celtic
CAII	2	50	100	6/21/2016-6/29/2016	F/V KATE
		50		6/16/2017-6/24/2017	F/V Falvian S

Table 10 Total expanded number of scallops caught, average expanded number of scallops caught and parametric p-values by tow duration (A= 15-minute, B= 10-minute) by area.

Area	Total Number (B)	Total Number (A)	Average Catch (B)	Average Catch (A)	P-value
CAII	42,588.55	61,900.58	425.89	619.01	0.04
MAB	67,511.95	75,609.23	703.25	787.60	0.44
NLCA	120,094.66	127,956.82	1,501.18	1,599.46	0.34

Table 11 Total baskets of debris caught, average baskets of debris caught and parametric p-values by tow duration (A= 15-minute, B= 10-minute) by area.

Area	Total Amount (B)	Total Amount (A)	Average Catch (B)	Average Catch (A)	P-value
CAII	313.20	339.00	3.13	3.39	0.29
MAB	371.50	400.90	3.87	4.18	0.41
NLCA	962.30	930.10	12.03	11.63	0.34

VIMS

An Assessment of Sea Scallop Abundance and Distribution in the Mid-Atlantic Bight, Nantucket Lightship Closed Area and Closed Area II

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Sally Roman

Hunter Tipton

Virginia Institute of Marine Science

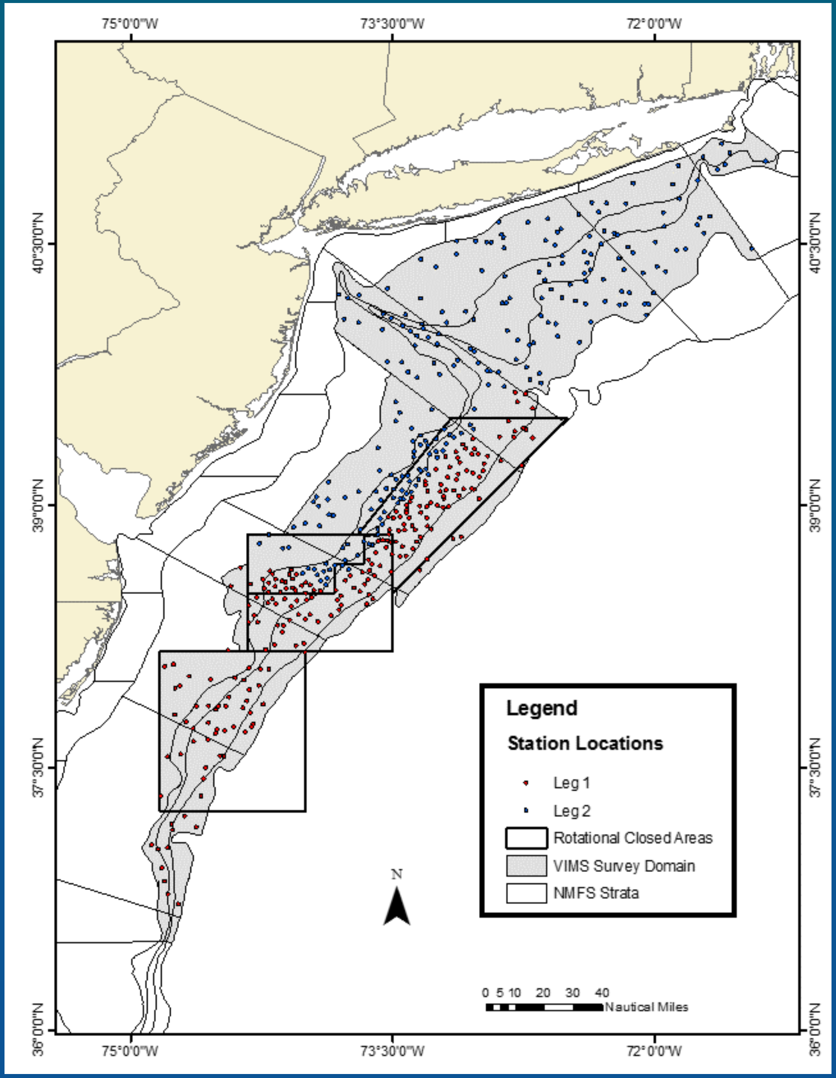
Sea Scallop Plan Development Team

Falmouth, MA

August 30-31, 2016

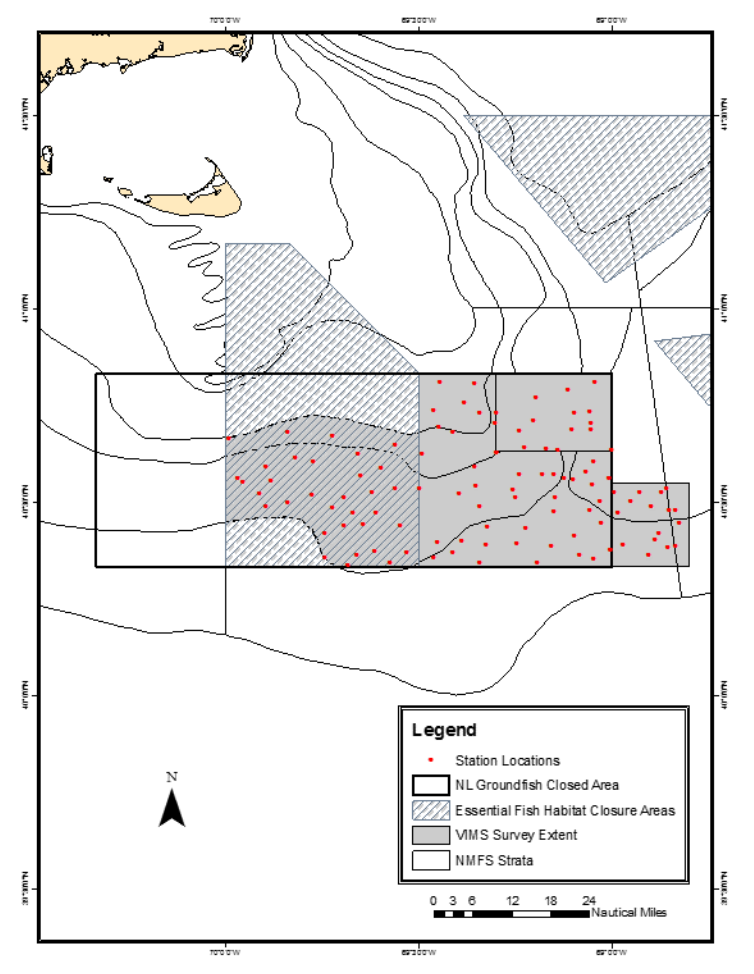
Preliminary – PDT use only.

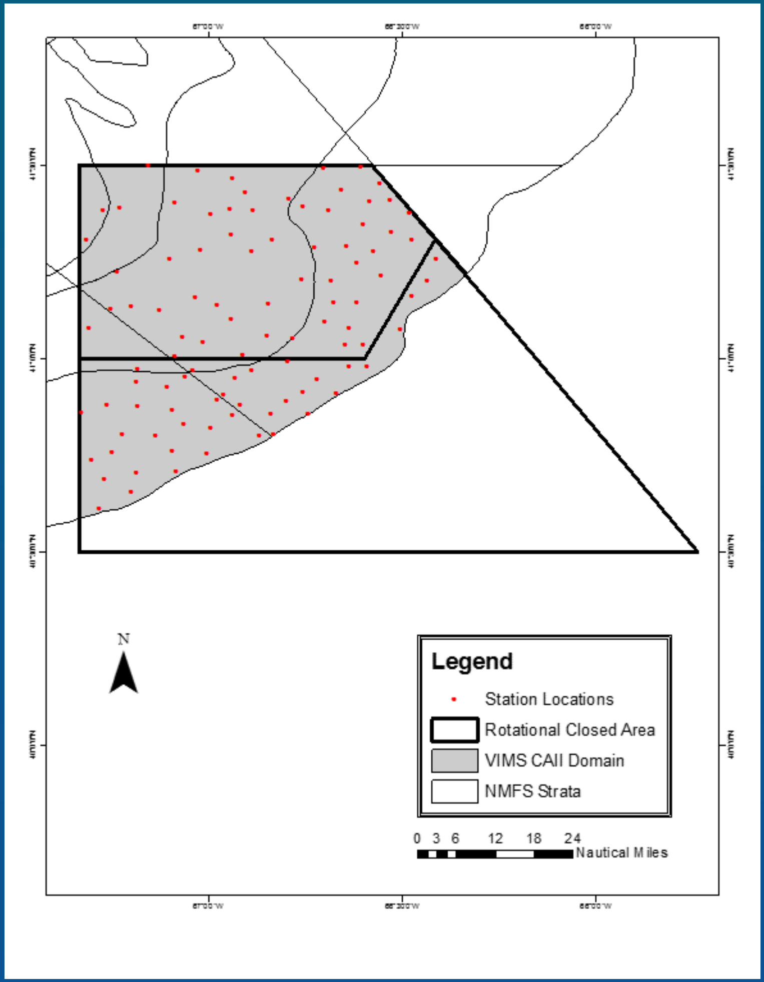
2016 VIMS-Industry Cooperative Surveys
Mid-Atlantic Bight



2016 VIMS-Industry Cooperative Surveys

NLCA and CA II





2016 VIMS-Industry Cooperative Surveys
Primary Project Objectives

- **Assess the abundance and distribution of scallops in the Mid-Atlantic Bight, NLCA and CAII.**
  - Mid-Atlantic Bight (Block Island to VA/NC)
    - 2015 SAMS Area
    - 2015 SAMS Extended Area
  - NLCA and surrounds
    - 2015 SAMS Area
    - 2015 SAMS Extended Area
  - CA II and surrounds
    - 2015 SAMS Area
    - 2015 SAMS Extended Area

- **Estimate exploitable biomass.**
  - Biomass of scallops available for capture with 4 inch ring commercial dredge.

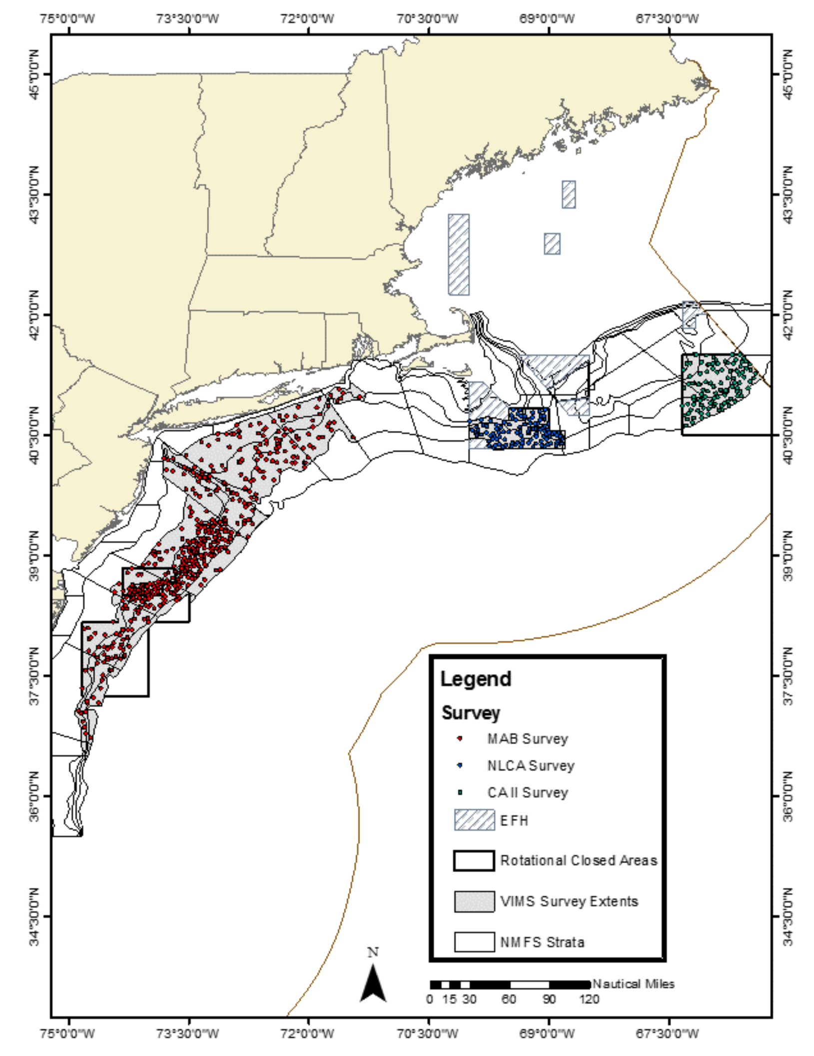
2016 VIMS-Industry Cooperative Surveys
Secondary Project Objectives

- **Gear performance**
  - **Estimate size selectivity and relative performance of 4.0 ring turtle CFTDD.**
- **Scallop Biology & Product Quality**
  - **Spatially and temporally explicit shell height:meat weight relationships.**
  - **Assess metrics associated with product quality.**
  - **Examine the incidence and pathology of the shell disease observed in survey areas.**
  - **Investigate the spatial distribution including incidence and intensity of the parasitic nematode observed in scallop meats.**

- **Finfish Bycatch**
  - **Obtain a snapshot of finfish bycatch rates and species assemblages in the surveyed areas from the commercial dredge.**

- **Scallop Predators**
  - **Quantify the species composition, spatial extent and abundance of scallop predators (crabs and starfish).**
- **Additional Sample Requests**
  - **Jonah crabs, scallops for gray meat analysis, hake sp., and *Astarte***

2016 VIMS-Industry Cooperative Surveys



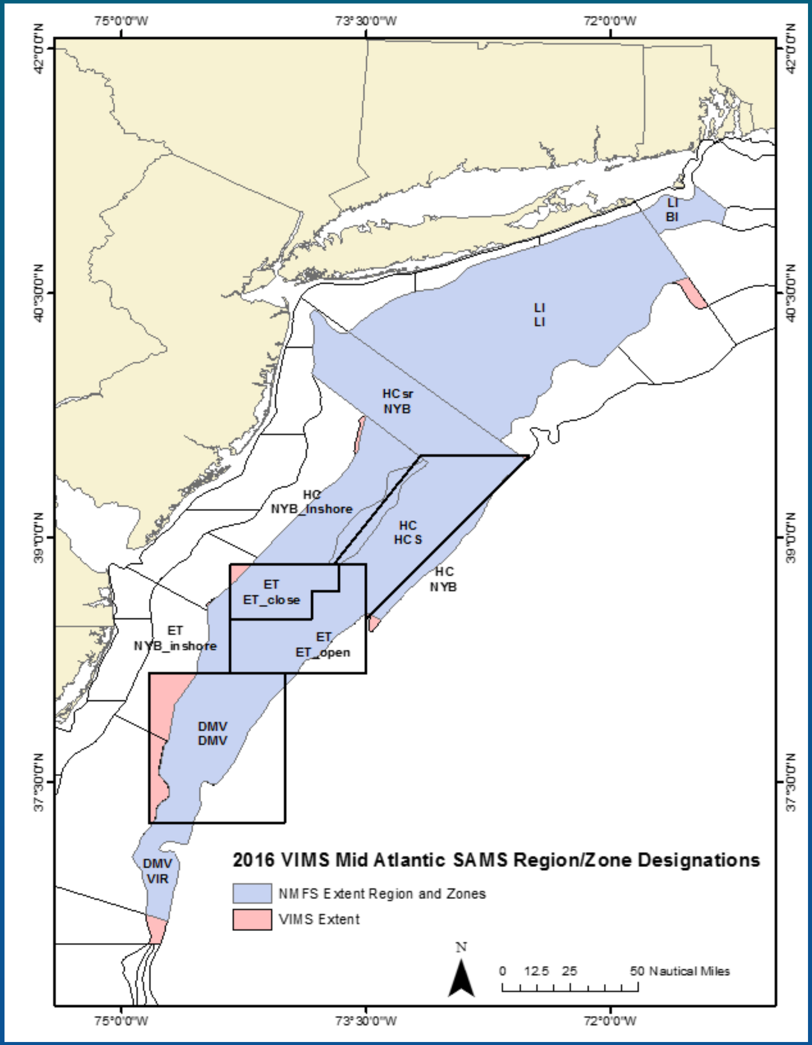
- **Sampling design**
  - Stratified random design
    - NMFS shellfish strata plus
      - Allocation
        - Area, prior year catch data (biomass, number) or modified proportional allocation (CA II and NLCA)
- **Vessels**
  - MAB Survey: 2 vessels with 1 new to the survey
    - Carolina Capes II (veteran), Sea Hawk (new)
  - NLCA Survey: Celtic (veteran)
  - NLCA Survey: KATE (veteran)
- **Data acquisition system**
  - Electronic boards (1mm res.)
  - Custom front end to Access DB
  - Integrated with Marel scale
  - Automated recording of wheel house data
- **All other protocols remained the same (see scallop survey peer review materials for details)**

2016 VIMS-Industry Cooperative Surveys
Analytical Framework

- **Area swept per tow**
  - Navigational info
  - Tilt sensor
- **Catch weight per tow (stratified means and variances)**
  - Length frequencies
  - Length-weight relationship (for this analysis regional SARC 59).
  - Selectivity (Yochum and DuPaul, 2008)
- **Efficiency (constant)**
  - Values from SARC 2014
    - 65%Commercial Dredge
    - 40% NMFS Survey Dredge
- **Exploitable Biomass**
  - Selectivity curve applied to catch for both the survey and commercial dredges (Yochum and DuPaul, 2008)
- **Sub-Area (constant)**
  - Dependent upon the spatial extent of the survey domain
    - 2015 NMFS SAMS regions and zones
    - 2016 SAMS VIMS extended

$$TotalBiomass = \sum_j \left(\frac{\left(\frac{CatchWtperTowinSubarea_j}{AreaSweptperTow} \right)}{Efficiency} \right) SubArea_j$$

2016 VIMS-Industry Cooperative Surveys
SAMS Regions/Zones



- The projection model (SAMS) examines the resource on a variety of spatial scales.
  - region, zone
- The VIMS surveys included some areas outside of the NMFS area specification.
- Biomass estimates will be presented in the context of the VIMS expanded areas.

2016 VIMS-Industry Cooperative Surveys
SH:MW Relationship

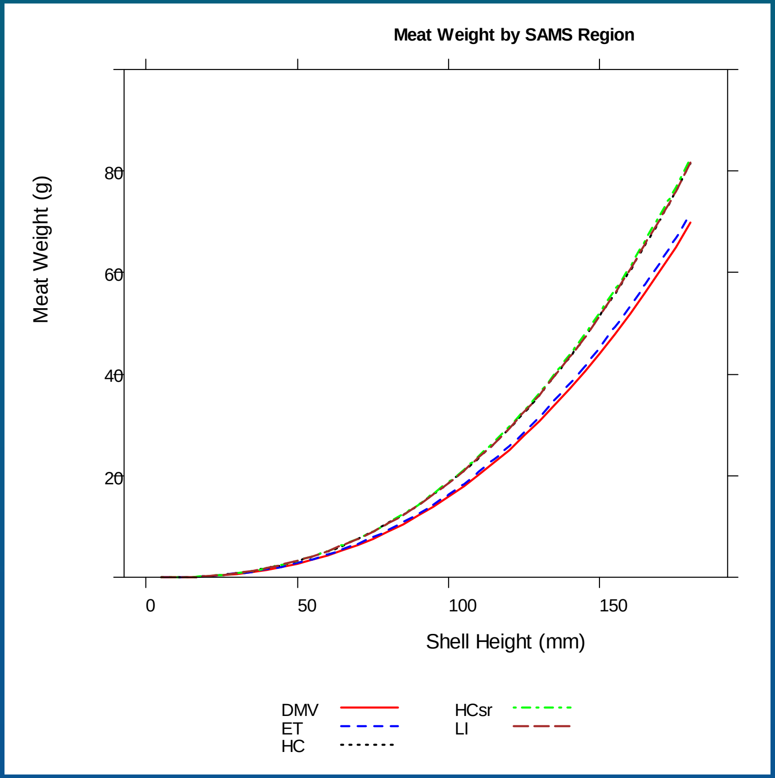
- SH:MW samples were taken from all stations that had scallops (15/station):
  - MAB Survey: ~5000
  - NLCA and CA II Surveys: ~ 1,000/survey

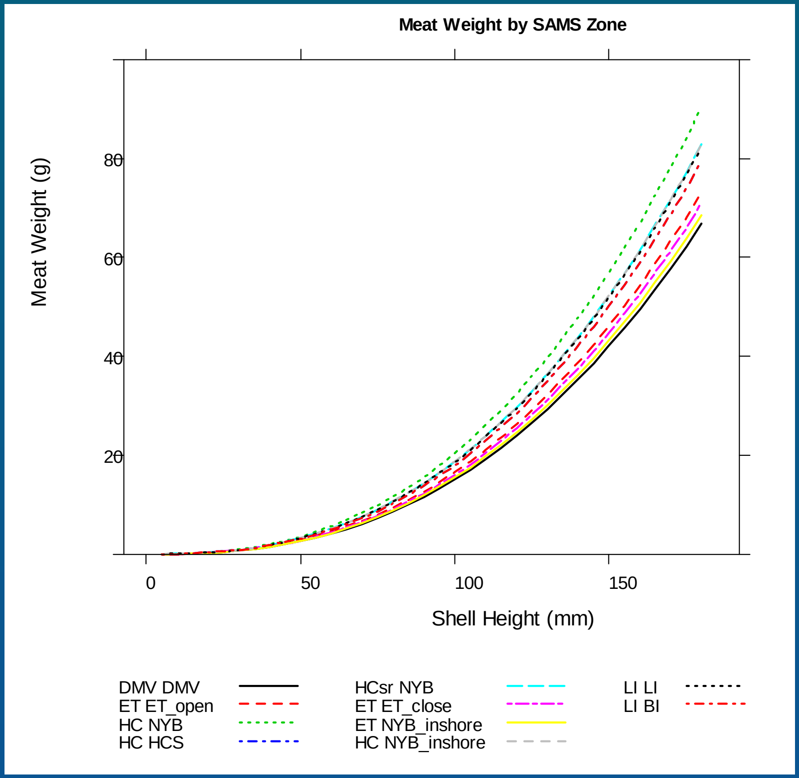
- The objective is to construct a model to predict meat weight based on a suite of potential covariates (i.e. shell height, depth, SAMS area, sex, disease…).

- Average depth was calculated for each tow from tilt sensor

- A GLMM was used to fit model (Gamma distribution, log link, random effect at the station level) with R v 3.3.1 Package lme4.

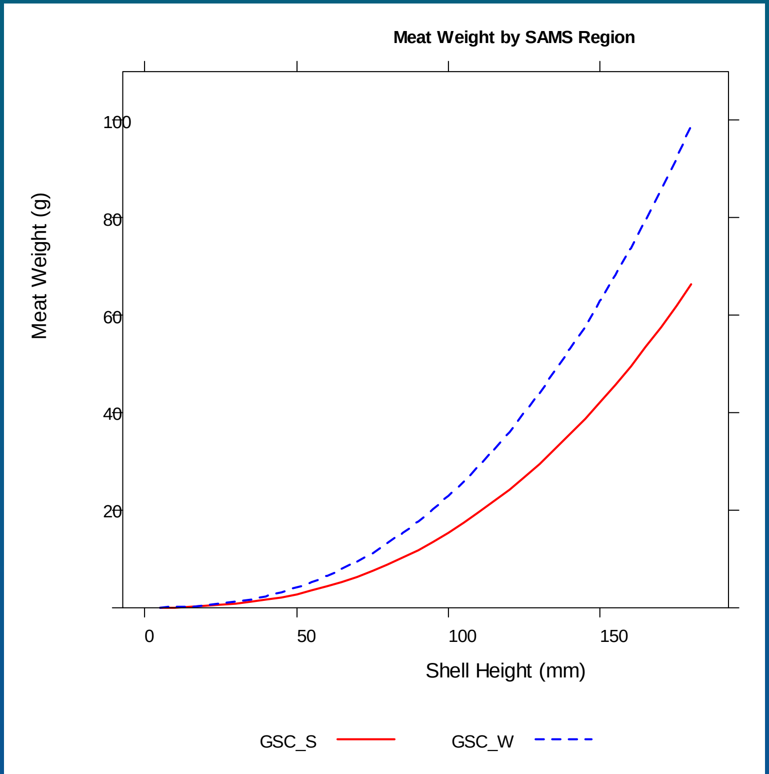
2016 VIMS-Industry Cooperative MAB Survey
SH:MW Results

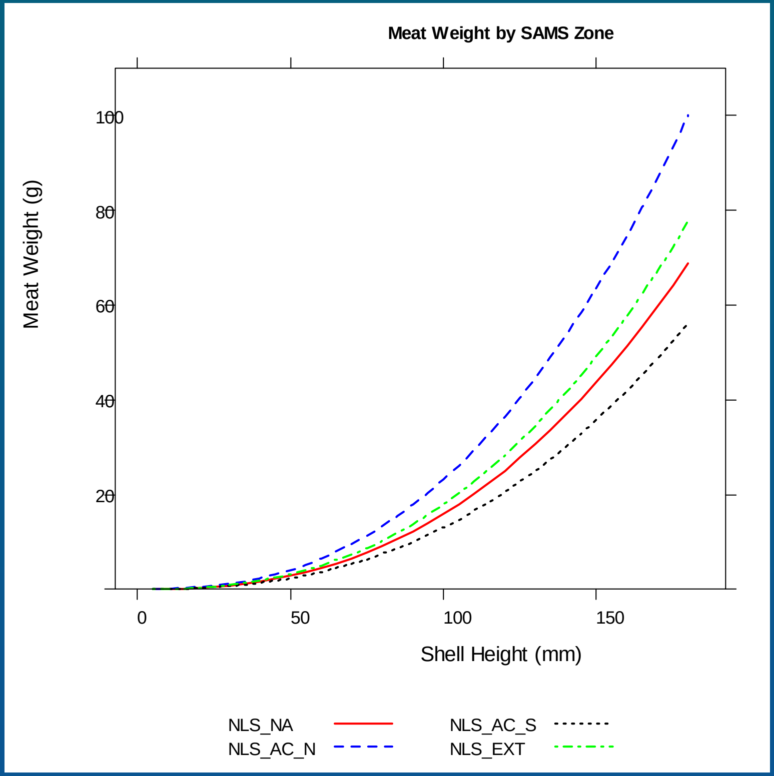




- MAB SAMS Areas
  - Significantly different relationships between SAMS Regions and Zone.
  - Likely a function of average depths for each of subarea, as well as the temporal spread of the sampling

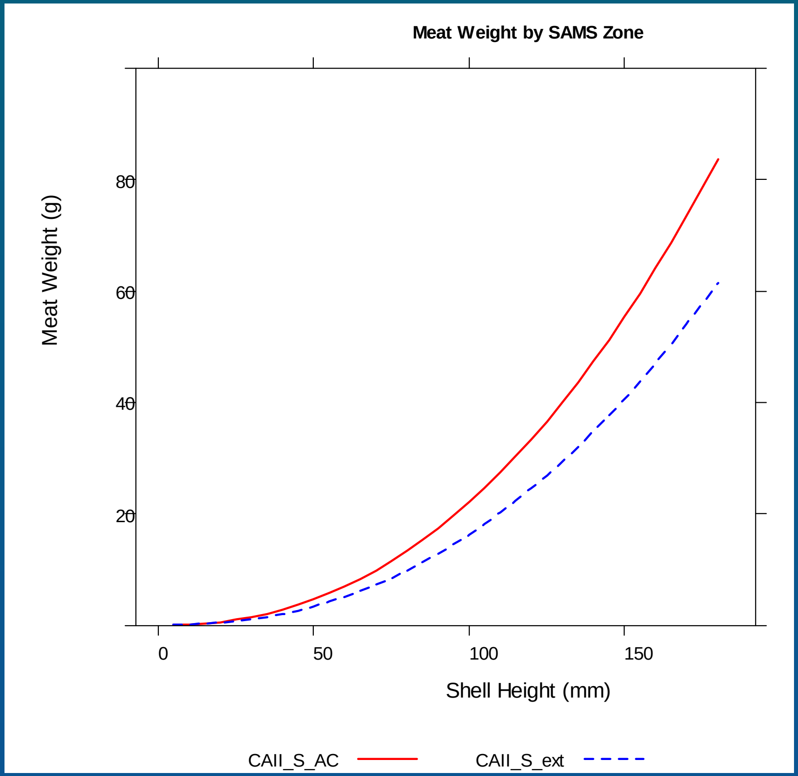
2016 VIMS-Industry Cooperative NLCA Survey
SH:MW Results





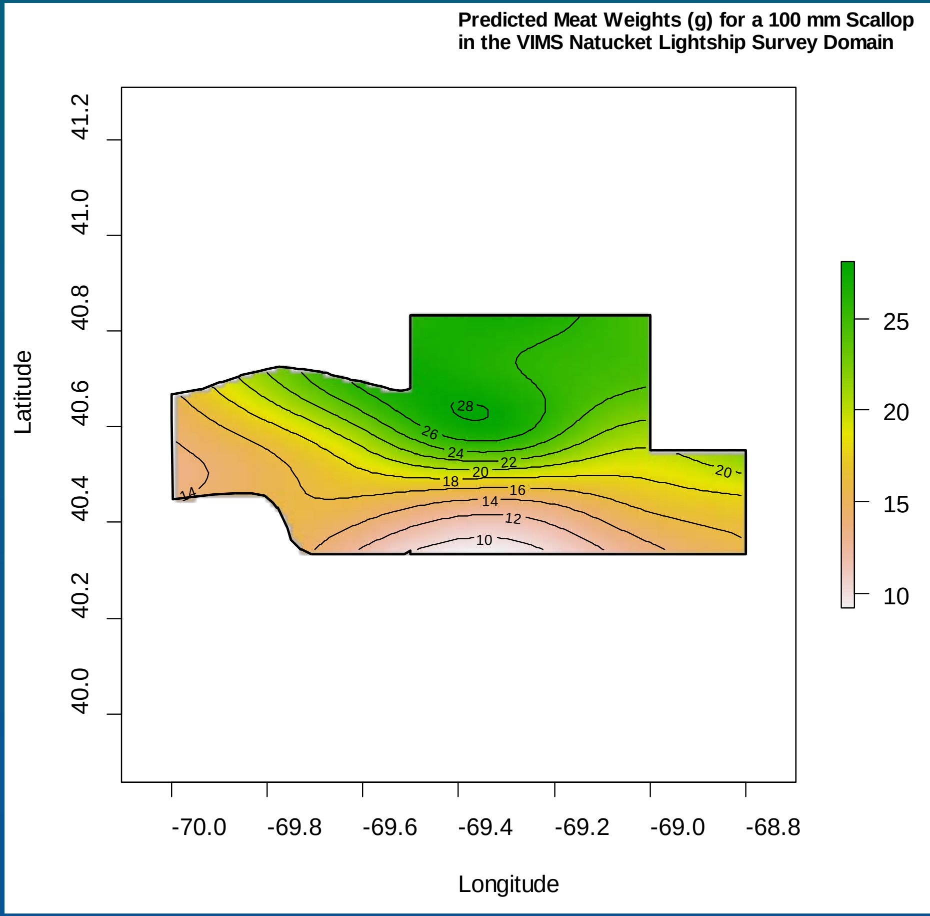
- **NLCA SAMS Areas**
  - **Significantly different relationships between SAMS Regions and Zones.**
  - **Likely a function of average depths for each of subarea, as well as the density of scallops and temporal spread of the sampling**

2016 VIMS-Industry Cooperative CA II Survey
SH:MW Results



- **CA II SAMS Areas**
  - **Significantly different relationships between SAMS Zones.**
  - **Likely a function of average depths for each of subarea, as well as the temporal spread of the sampling**

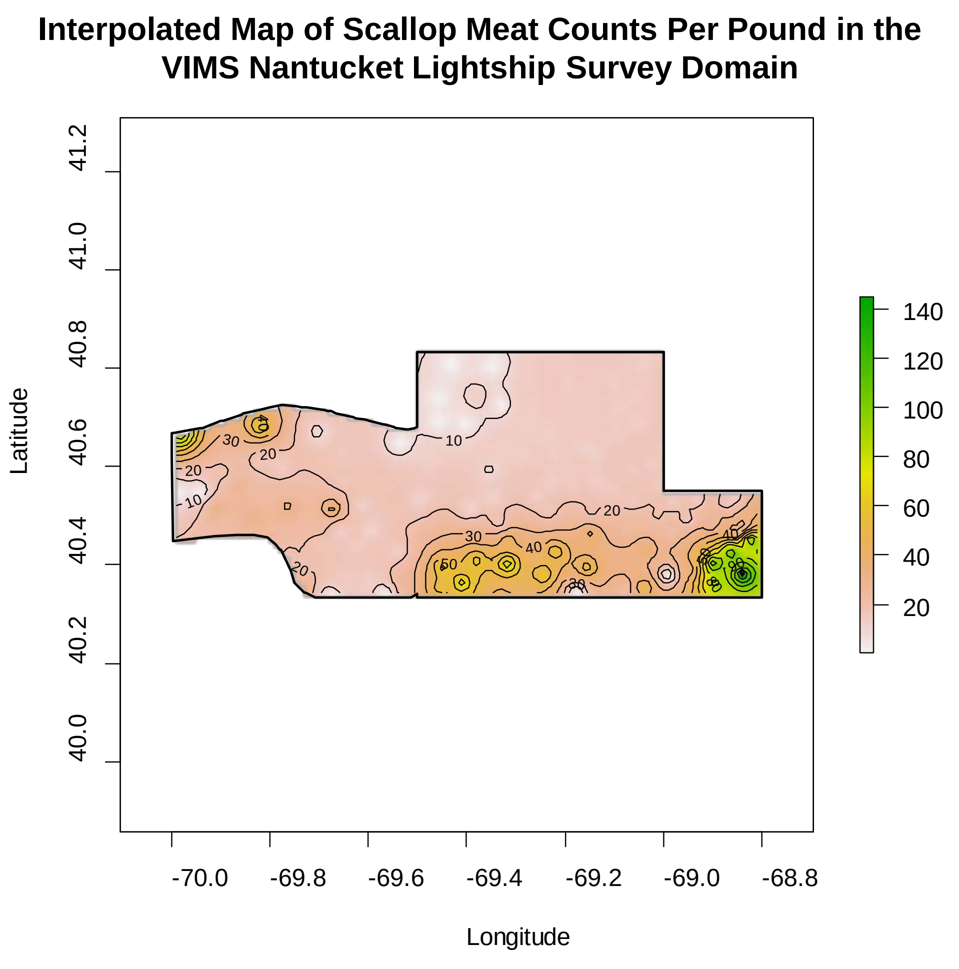
2015 VIMS-Industry Cooperative Surveys
SH:MW Results – NLCA Survey

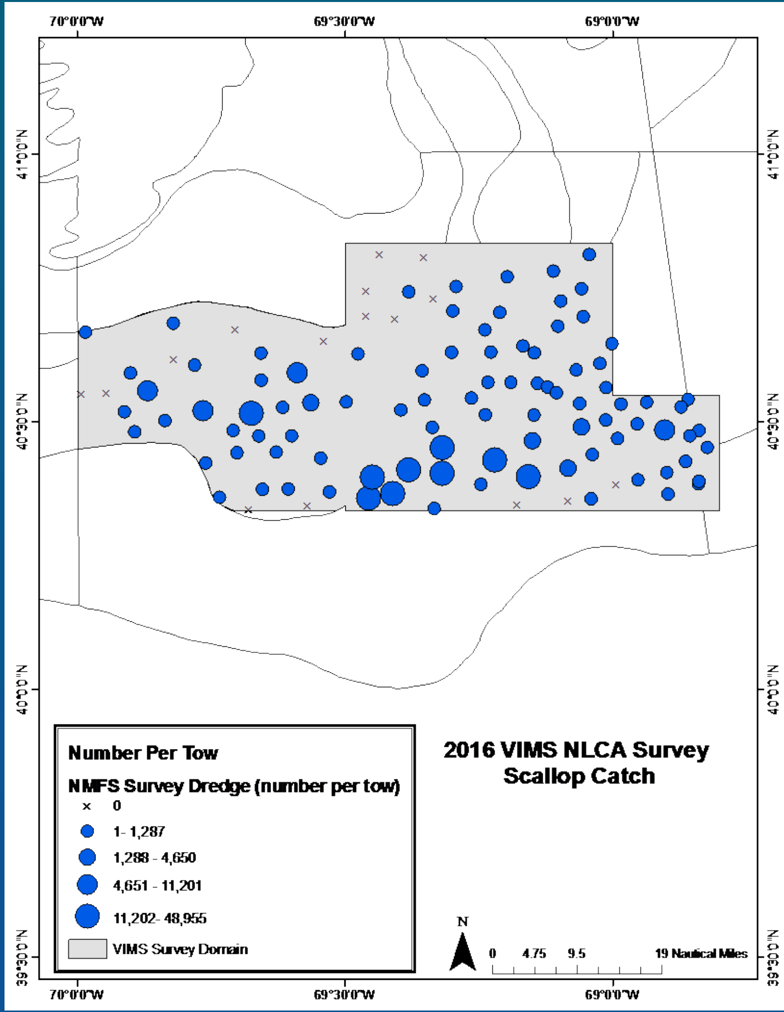


- Contour plot of meat weights predicted from a GAMM for a 100 mm scallop in the NLCA survey area.
- Gradient of meat weights was observed in the survey area.
    - Small meats observed in the south in deeper water with high densities of scallops .
- Biomass of an area is a dynamic process that has significant spatial and temporal components that warrant consideration in the specification process.
- SARC 59 estimates one subarea coefficient for the NLCA.

2015 VIMS-Industry Cooperative Surveys

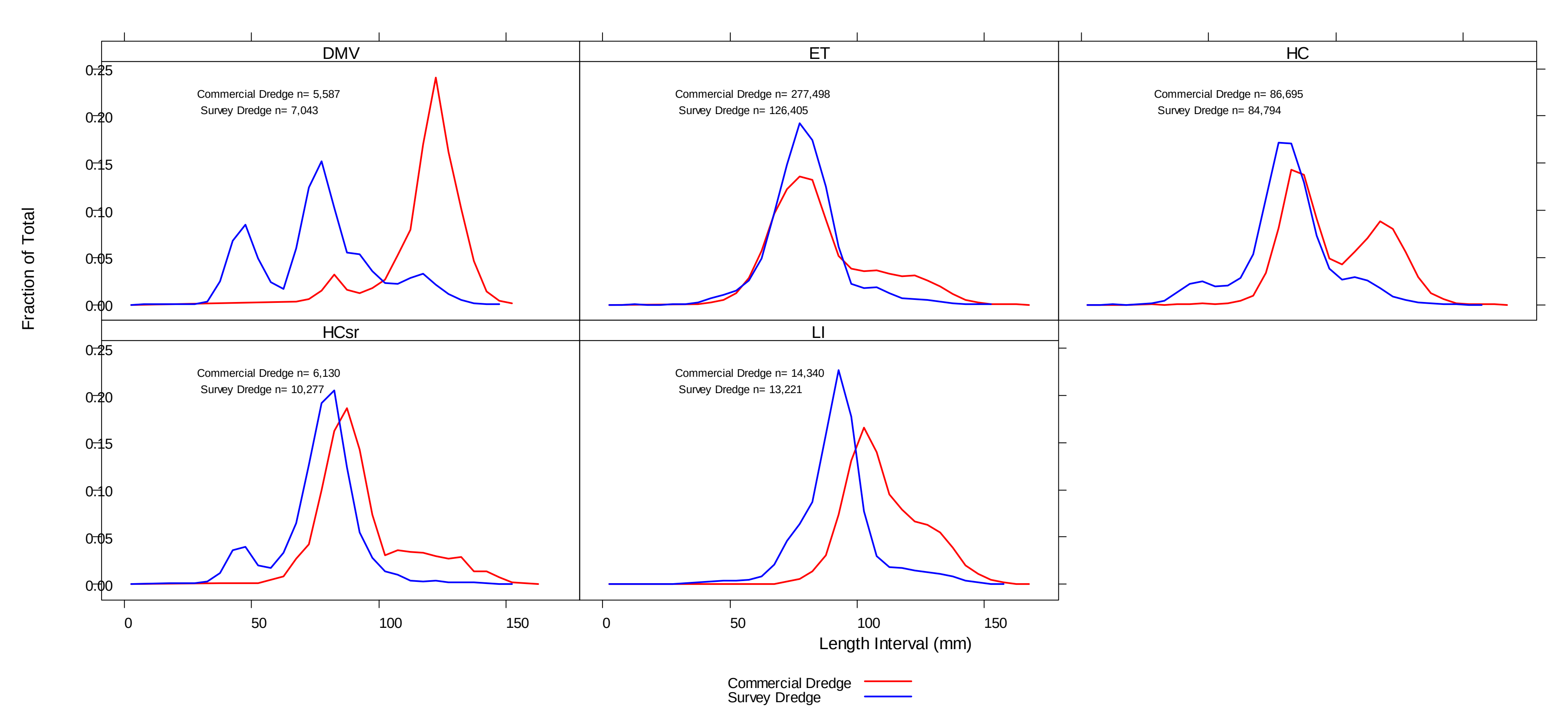
NLCA Survey





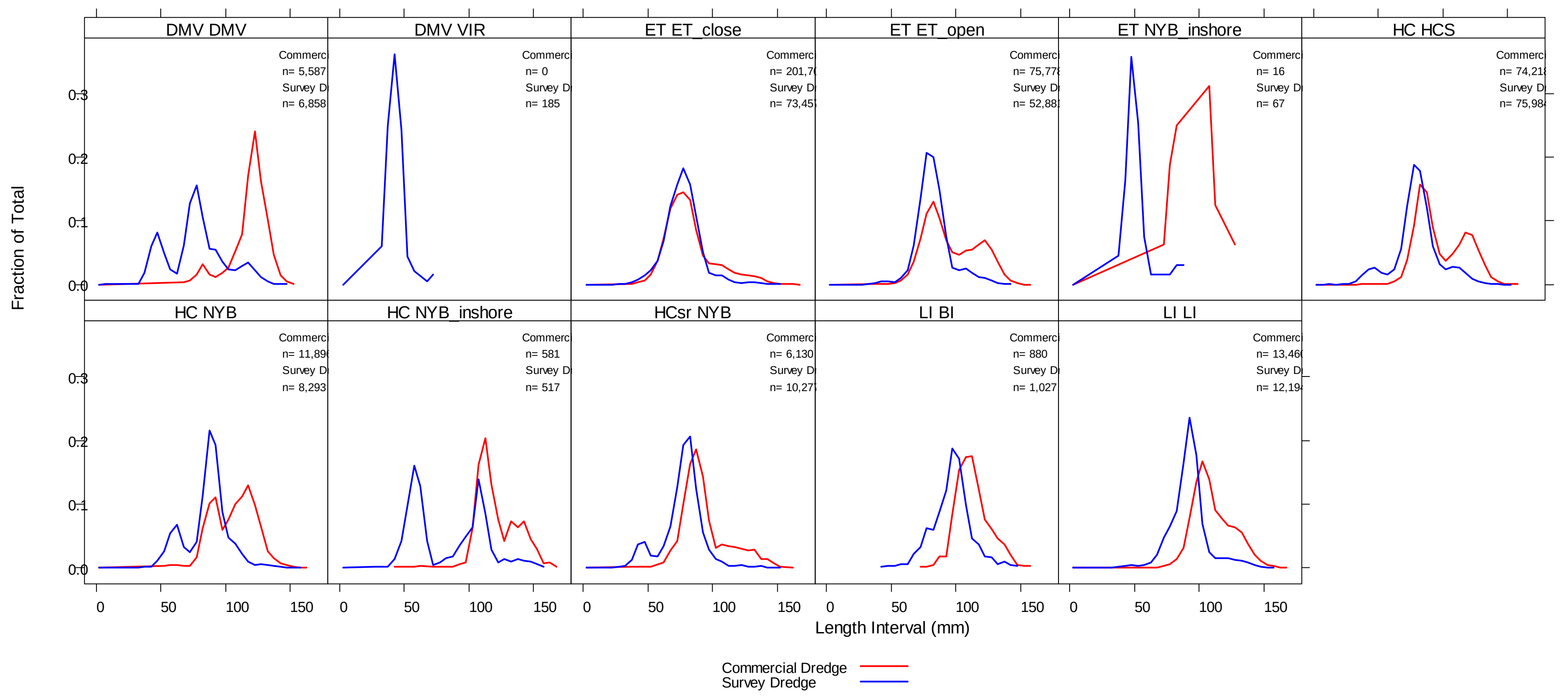
2016 VIMS-Industry Cooperative MAB Survey

Length Frequency- SAMS Region



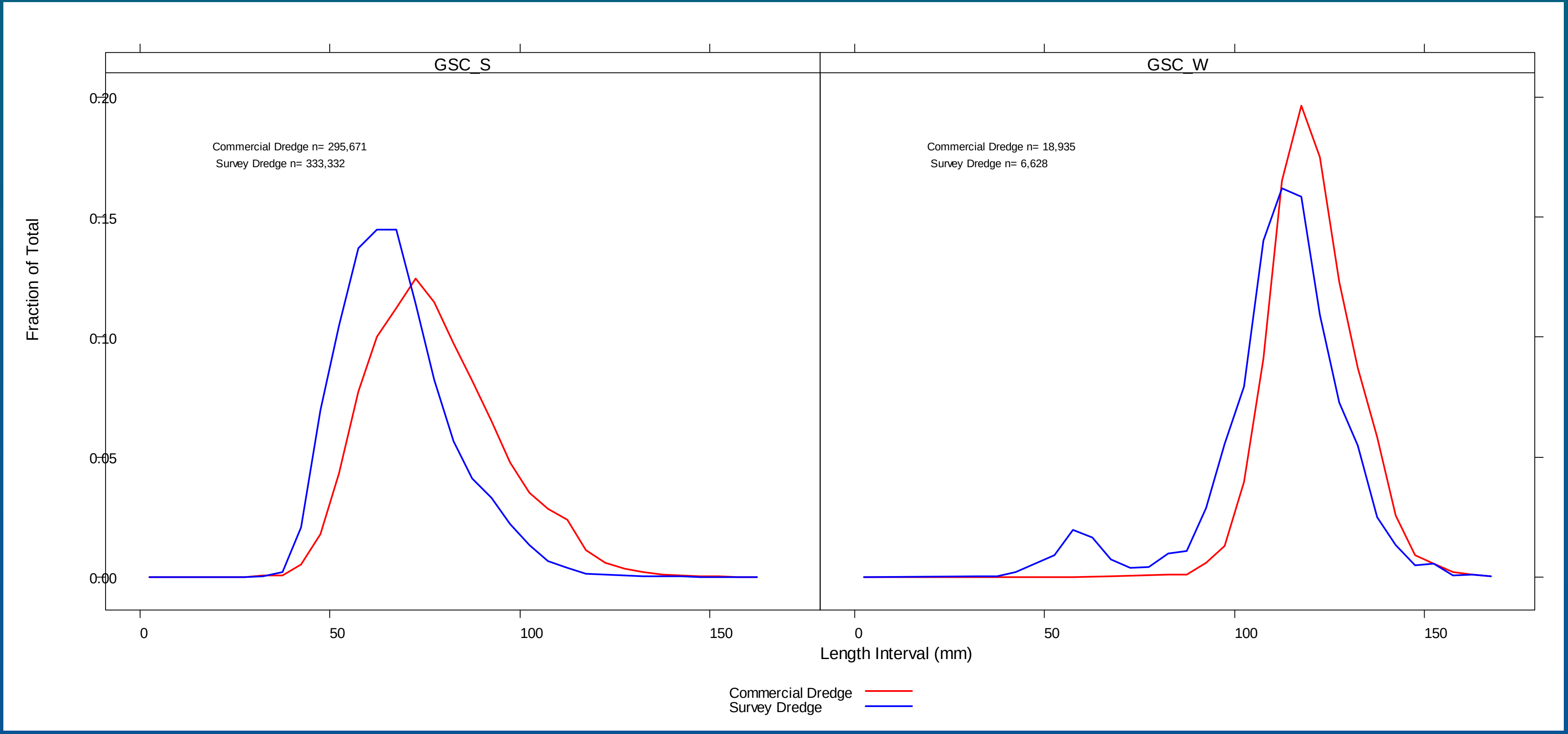
2016 VIMS-Industry Cooperative MAB Survey

Length Frequency- SAMS Zone



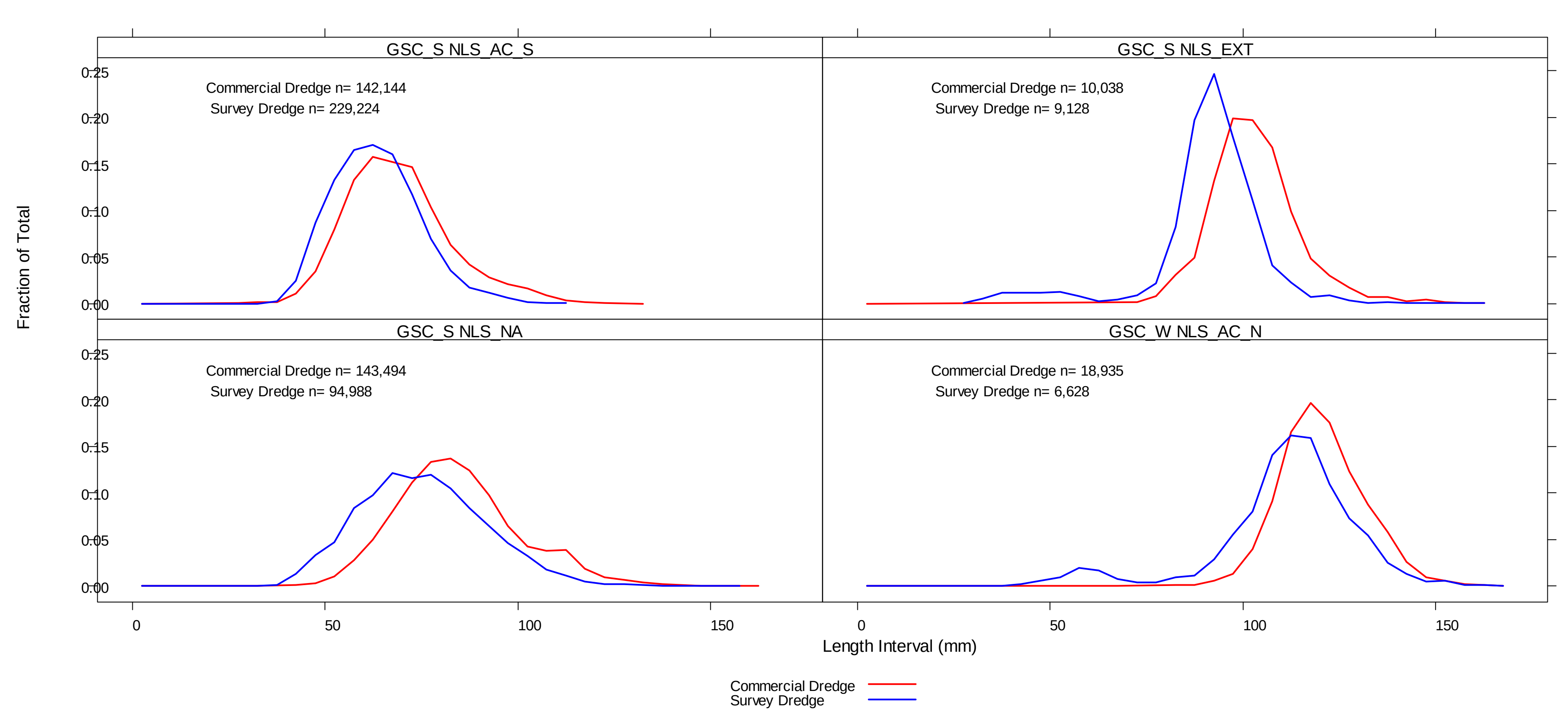
2016 VIMS-Industry Cooperative NLCA Survey

Length Frequency- SAMS Region

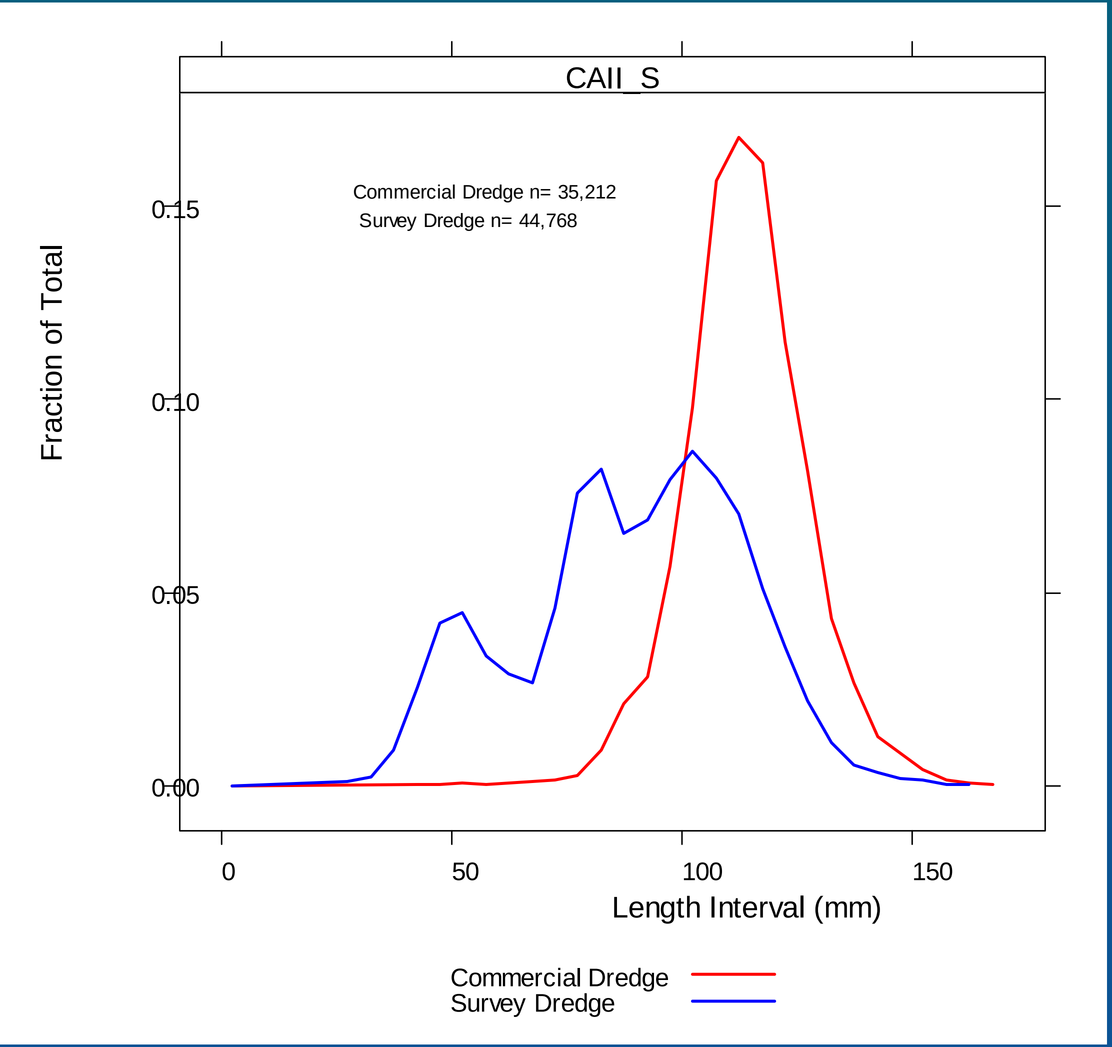


2016 VIMS-Industry Cooperative NLCA Survey

Length Frequency- SAMS Zone

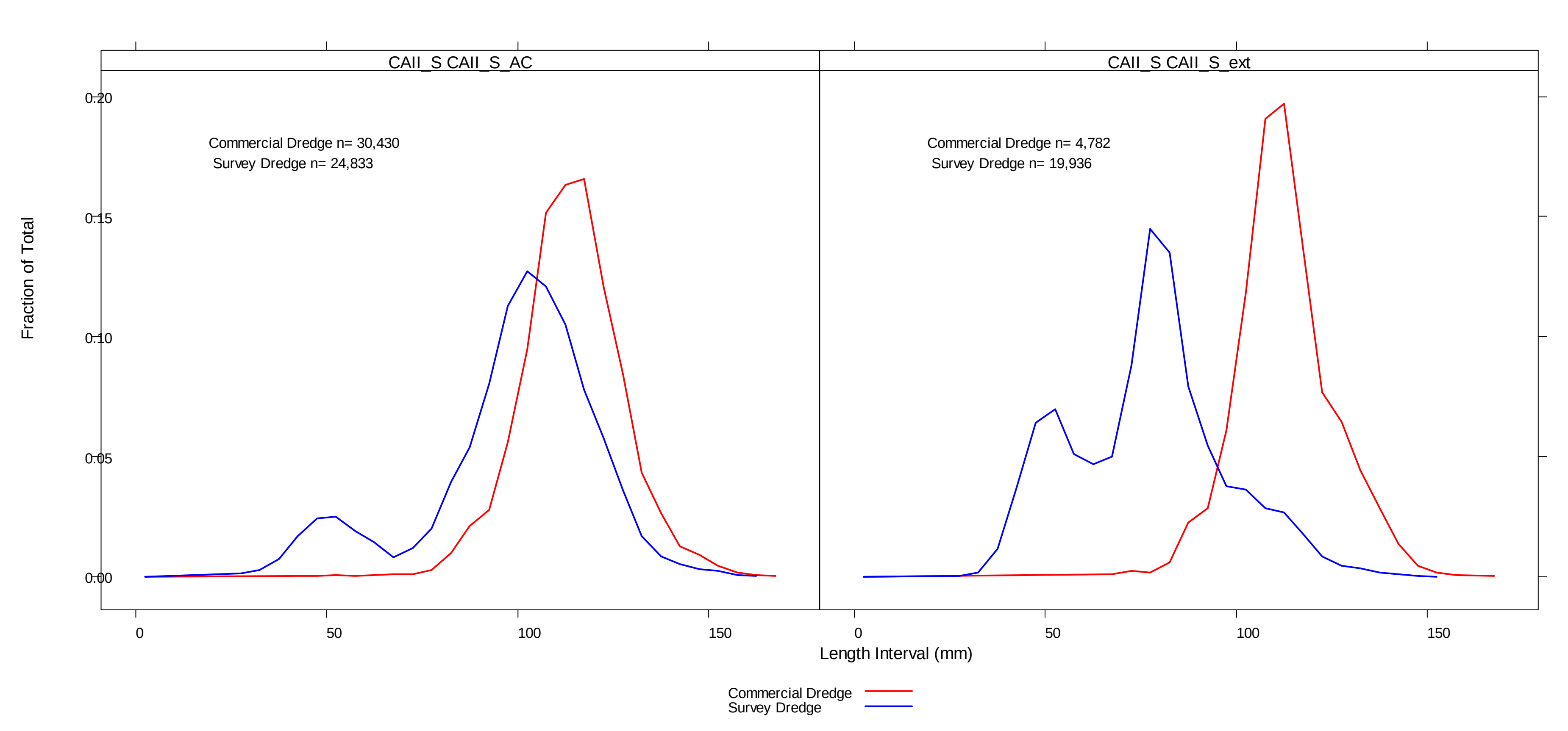


2016 VIMS-Industry Cooperative CA II Survey
Length Frequency- SAMS Region

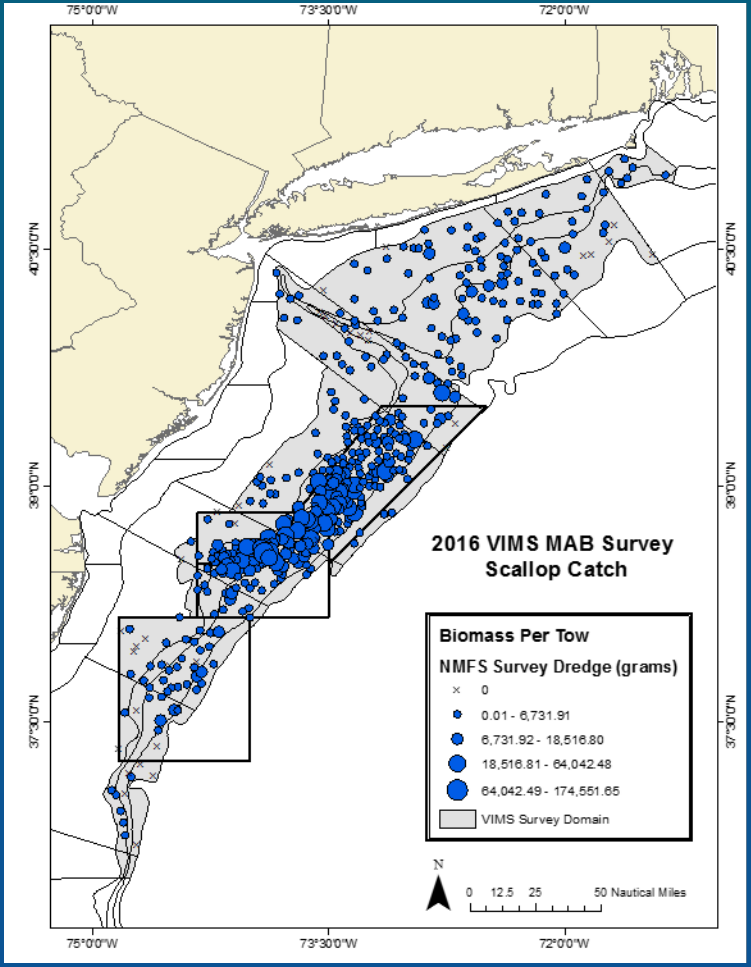


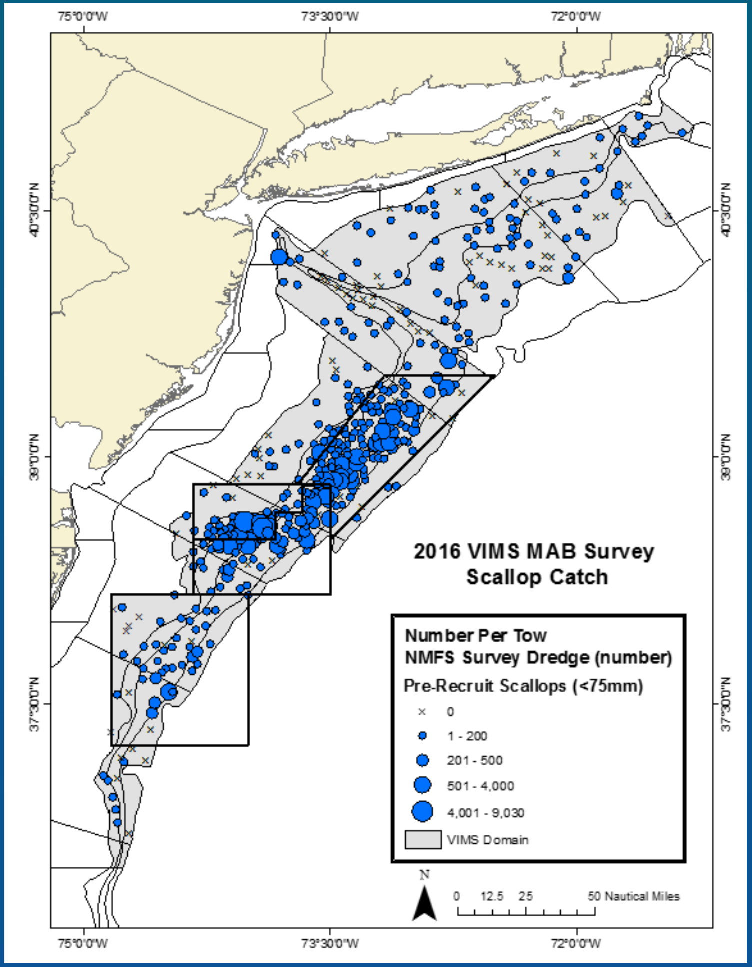
2016 VIMS-Industry Cooperative CA II Survey

Length Frequency- SAMS Zone



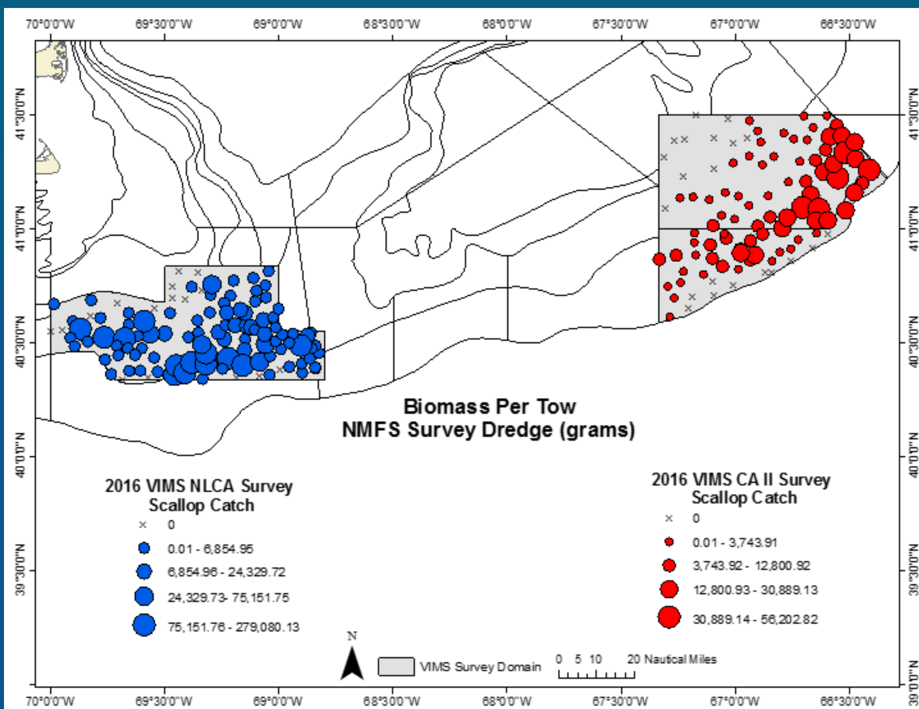
2016 VIMS-Industry Cooperative MAB Survey
Scallop Distribution

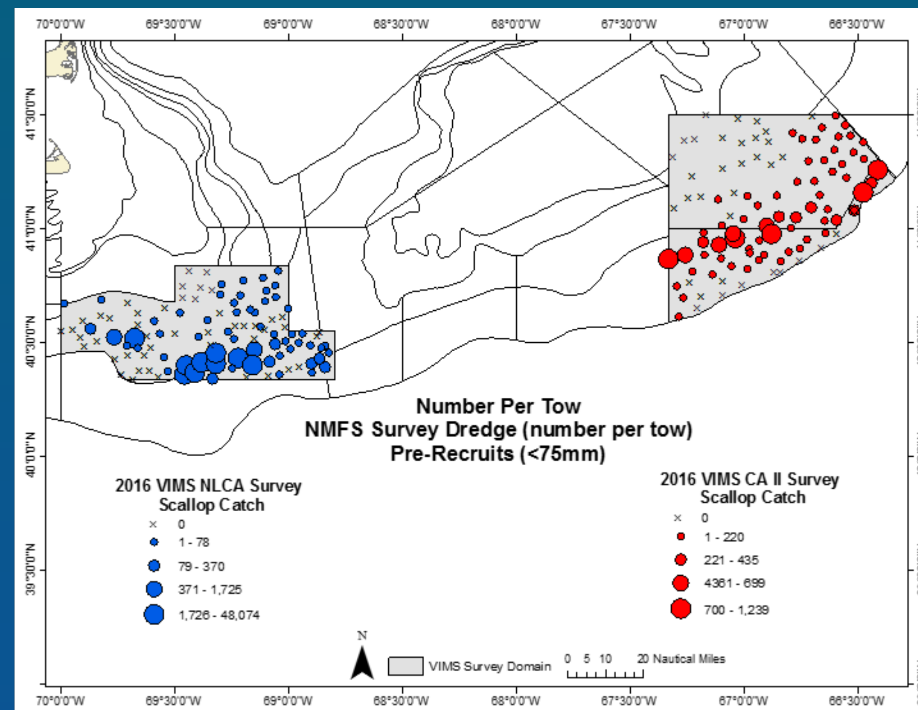




2016 VIMS-Industry Cooperative NLCA & CA II Surveys

Scallop Distribution





2016 VIMS-Industry Cooperative Surveys
Total Biomass - Region

Survey	SAMS Region	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV	4,125.96	434.32	0.07	11.24	394,116,594.99
	ET	22,485.56	1,023.28	0.70	10.47	2,035,382,047.86
	HC	17,115.44	722.81	0.33	12.07	1,395,865,849.41
	HCsr	4,937.67	917.70	0.17	10.42	492,190,000.77
	LI	16,202.76	742.02	0.07	17.41	922,179,496.32
NLCA	GSC_S	58,706.81	5,353.98	2.56	8.62	6,723,574,032.92
	GSC_W	3,571.57	298.14	0.12	30.06	118,974,287.52
	VIMS_45	5.41	2.00	0.00	30.20	179,063.89
CA II	CAII_S	18,229.87	994.76	0.26	15.83	1,160,535,650.77

2016 VIMS-Industry Cooperative Surveys
Total Biomass – Region/Zone

Survey	SAMS Region Zone	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV DMV	4,031.45	397.25	0.09	11.49	375,179,508.77
	DMV VIR	16.77	1.79	0.01	2.24	7,471,138.85
	ET ET_close	10,975.09	855.54	1.06	9.83	1,015,942,940.96
	ET ET_open	11,324.17	450.02	0.48	11.37	989,468,483.68
	ET NYB_inshore	61.55	0.41	0.01	3.39	19,618,868.30
	HC HCS	13,812.14	633.46	0.44	11.78	1,170,351,530.61
	HC NYB	2,603.36	339.48	0.18	14.46	180,727,689.59
	HC NYB_inshore	665.22	73.62	0.01	16.58	40,129,837.46
	HCsr NYB	4,937.66	917.75	0.17	10.42	492,176,971.18
	LI BI	1,508.47	83.34	0.10	20.41	73,974,647.90
	LI LI	14,713.37	736.31	0.07	17.16	848,918,181.20
NLCA	GSC_S NLS_AC_S	22,657.69	2,344.53	7.48	7.04	3,217,822,591.33
	GSC_S NLS_EXT	1,696.60	509.55	0.31	17.49	100,240,930.77
	GSC_S NLS_NA	25,801.89	3,970.65	1.38	11.58	2,230,524,250.16
	GSC_W NLS_AC_N	3,571.57	298.14	0.12	30.06	118,974,287.52
	VIMS_45	5.41	2.00	0.00	30.20	179,063.89
CA II	CAII_S CAII_S_AC	13,875.77	866.06	0.26	20.23	477,721,662.76
	CAII_S CAII_S_ext	4,963.42	427.42	0.25	10.34	688,469,033.23

2016 VIMS-Industry Cooperative Surveys
Exploitable Biomass Survey - Region

Survey	SAMS Region	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV	1,469.98	157.07	0.07	21.79	70,117,637.93
	ET	6,587.21	241.11	0.70	15.95	390,650,676.93
	HC	5,785.78	253.78	0.07	18.60	300,577,220.62
	HCsr	1,363.84	144.69	0.03	15.98	74,358,084.86
	LI	7,301.62	312.27	0.07	22.34	321,313,419.67
NLCA	GSC_S	9,721.64	1,004.46	2.56	16.16	595,200,859.59
	GSC_W	2,782.11	212.06	0.09	33.72	81,548,737.32
	VIMS_45	3.62	1.34	0.001	32.55	111,077.97
CAII	CAII_S	10,186.87	592.36	0.26	23.80	420,696,521.70

2016 VIMS-Industry Cooperative Surveys
Exploitable Biomass Survey – Region/Zone

Survey	SAMS Region Zone	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV DMV	1,440.98	145.99	0.09	21.81	68,868,929.86
	DMV VIR	0.18	0.03	0.00	3.71	47,855.93
	ET ET_close	3,159.04	197.06	1.06	15.59	183,249,825.64
	ET ET_open	3,415.01	131.55	0.10	16.32	203,522,665.83
	ET NYB_inshore	3.45	0.05	0.00	9.23	383,992.95
	HC HCS	4,422.69	229.24	0.09	18.28	239,014,768.09
	HC NYB	959.68	98.96	0.05	19.90	48,270,214.98
	HC NYB_inshore	405.64	39.40	0.00	30.80	13,169,425.83
	HCsr NYB	1,363.19	144.63	0.03	15.98	74,324,998.92
	LI BI	799.24	39.25	0.04	25.04	31,933,585.39
	LI LI	6,515.49	309.41	0.07	22.05	289,852,478.73
NLCA	GSC_S NLS_AC_S	1,741.46	185.82	7.48	11.03	157,851,406.44
	GSC_S NLS_EXT	681.89	180.23	0.11	20.79	32,824,672.28
	GSC_S NLS_NA	6,509.38	929.39	0.21	19.13	340,146,590.83
	GSC_W NLS_AC_N	2,782.11	212.06	0.09	33.72	81,548,737.32
	VIMS_45 VIMS_45	3.62	1.34	0.00	32.55	111,077.97
CA II	CAII_S CAII_S_AC	8,997.18	520.28	0.13	25.51	347,640,879.00
	CAII_S CAII_S_ext	1,720.24	152.22	0.25	18.13	92,805,506.65

2016 VIMS-Industry Cooperative Surveys
Exploitable Biomass - Commercial by Region

Survey	SAMS Region	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV	2,520.01	500.68	0.02	32.78	78,783,082.93
	ET	12,431.27	927.26	0.55	23.75	502,606,892.42
	HC	10,885.20	1,868.13	0.06	26.82	403,258,055.37
	HCsr	1,219.18	149.83	0.01	26.16	40,744,069.92
	LI	7,183.71	531.89	0.03	31.31	224,762,172.76
NLCA	GSC_S	8,756.97	1,910.63	0.80	21.38	407,904,423.34
	GSC_W	3,463.90	323.75	0.13	36.61	93,837,894.39
	VIMS_45	1.36	0.82	0.00	46.91	29,038.49
CAII	CAII_S	6,574.37	668.20	0.07	28.92	221,450,176.26

2016 VIMS-Industry Cooperative Surveys

Exploitable Biomass - Commercial by Region/Zone

Survey	SAMS Region_Zone	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV DMV	2,488.60	490.24	0.02	32.78	77,805,762.73
	DMV VIR	0.00	0.00	0.00	0.00	0.00
	ET ET_close	6,740.28	929.89	1.04	22.67	283,002,777.88
	ET ET_open	6,119.70	478.98	0.24	25.27	234,758,902.35
	ET NYB_inshore	3.11	1.09	0.00	26.20	118,684.81
	HC HCS	6,645.94	1,143.73	0.15	26.48	255,826,265.84
	HC NYB	3,700.39	1,433.83	0.09	27.47	134,610,305.82
	HC NYB_inshore	526.10	73.59	0.01	41.32	12,731,296.67
	HCsr NYB	1,219.10	149.82	0.04	26.16	40,742,725.13
	LI BI	522.31	31.63	0.03	32.86	15,906,955.82
	LI LI	6,665.26	530.08	0.03	31.20	208,962,219.62
NLCA	GSC_S NLS_AC_S	960.14	289.76	1.62	15.15	63,359,444.84
	GSC_S NLS_EXT	516.61	216.69	0.06	25.78	20,020,927.73
	GSC_S NLS_NA	6,774.37	1,819.28	0.18	22.94	295,157,372.01
	GSC_W NLS_AC_N	3,463.90	323.75	0.10	36.61	93,837,894.39
	VIMS_45 VIMS_45	1.36	0.82	0.00	46.91	29,038.49
CAII	CAII_S CAII_S_AC	6,149.25	609.17	0.10	29.29	138,811,858.69
	CAII_S CAII_S_ext	775.98	113.03	0.02	26.52	9,745,384.04

2016 VIMS-Industry Cooperative Surveys
Summary

- <u>The good</u>
  - Biomass in the MAB closed areas and traditional NLCA and CA II access areas appear to be strong.
- <u>Causes of concern</u>
  - General lack of strong recruiting year class across all surveyed areas.
  - How to handle the age 4 scallops in the southern portion of the NLS if growth is a not realized. This may result in a limited contribution in terms of yield to the fishery.
  - Continued and expanded presence of a nematode parasite observed in the scallop meats which may limit effort in south portions of the resource (DMV and parts of ET).

Acknowledgements

- The owners, captains and crews;
  - F/V *Carolina Capes II*
  - *F/V Sea Hawk*
  - F/V *K.A.T.E*
  - F/V *Celtic*

- Daniel Smith, Lee Rollins, Chase Long and Nick Cardoso

- Support from NMFS NEFSC: Dvora Hart, Russ Brown, Vic Nordahl.

- Funding through Sea Scallop RSA program.

A continued investigation into the emergence of a parasite in sea scallops

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Sea Scallop Plan Development Team
Falmouth, MA
August 30-31, 2016

Preliminary – PDT use only.

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Affected scallops

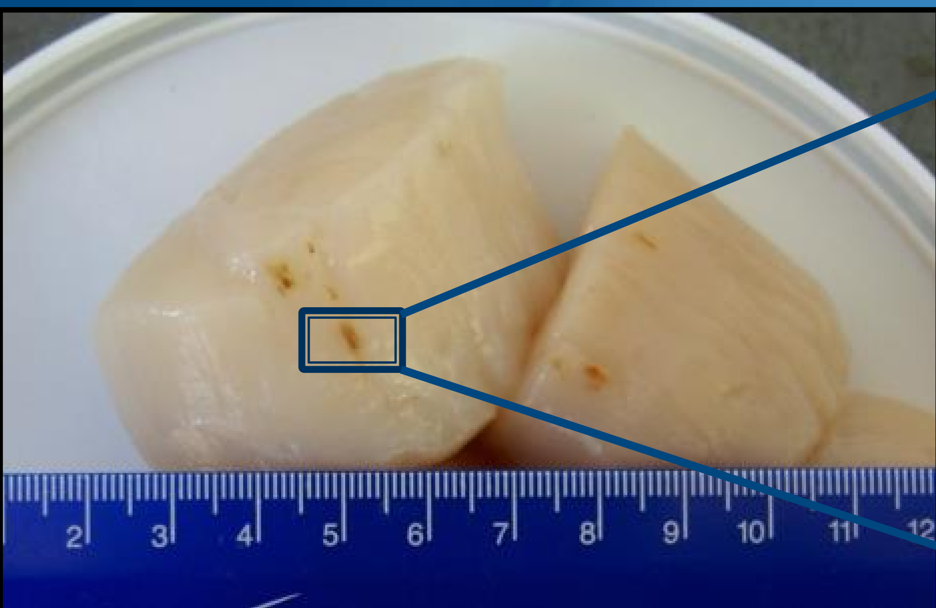
- Typical gross appearance and intensity of affected scallops.
- Reports from industry concerning infected scallops began in May of 2015 and have continued throughout 2016.
- Reports of infected scallops began in the DMV and have extended into the ET.

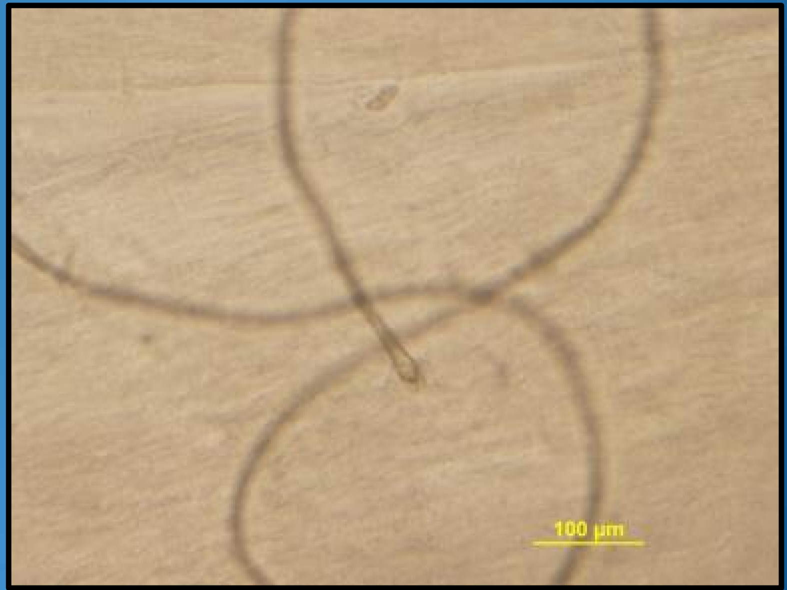
Appearance of affected scallops

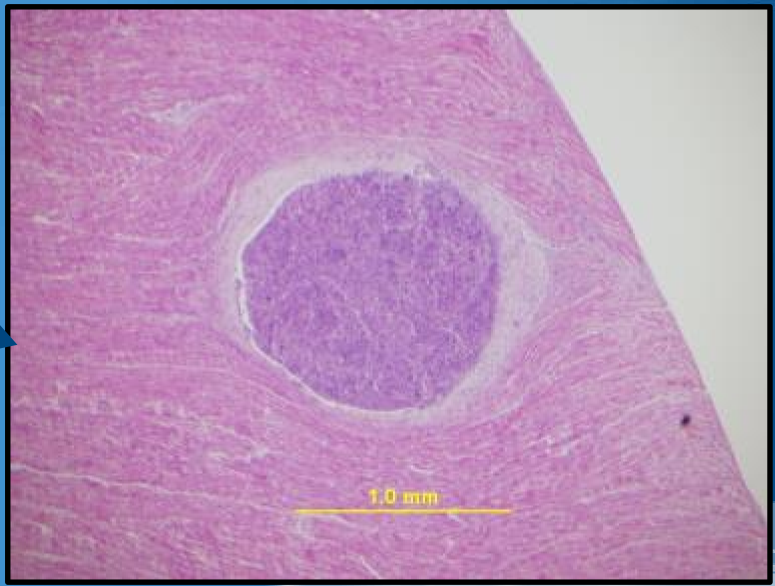
- Typical lesion size with number per scallop meat ranging from 1-6.
- The lesions presented on the exterior of the adductor muscle, typically opposite the sweet meat.
- Visible to the naked eye against the white meat. (~2-5mm)

Preliminary histology

Fresh squash mount







Histologically processed: pink=muscle, blue=hemocytes surrounding foreign object (host response)

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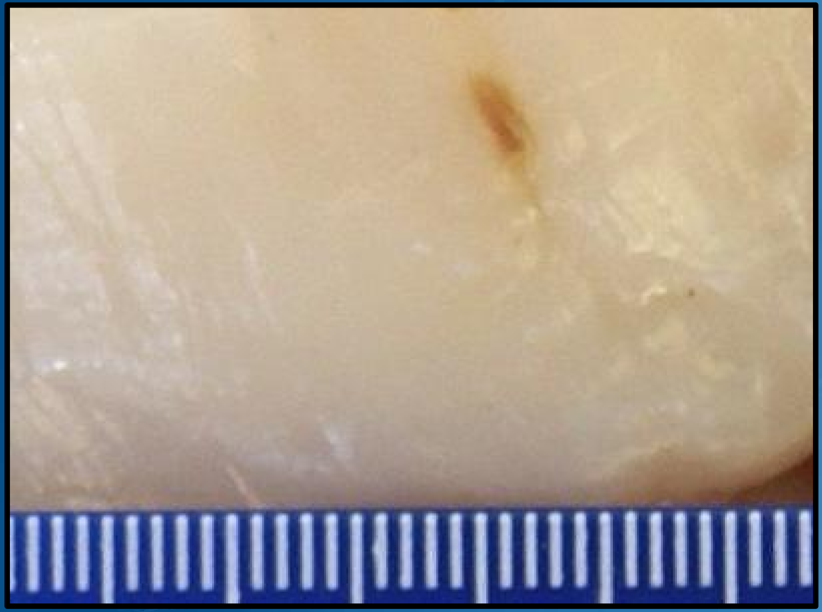
Preliminary histology



Fourth stage nematode larvae coiled within brownish lesion in sea scallop adductor muscle

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Preliminary identification

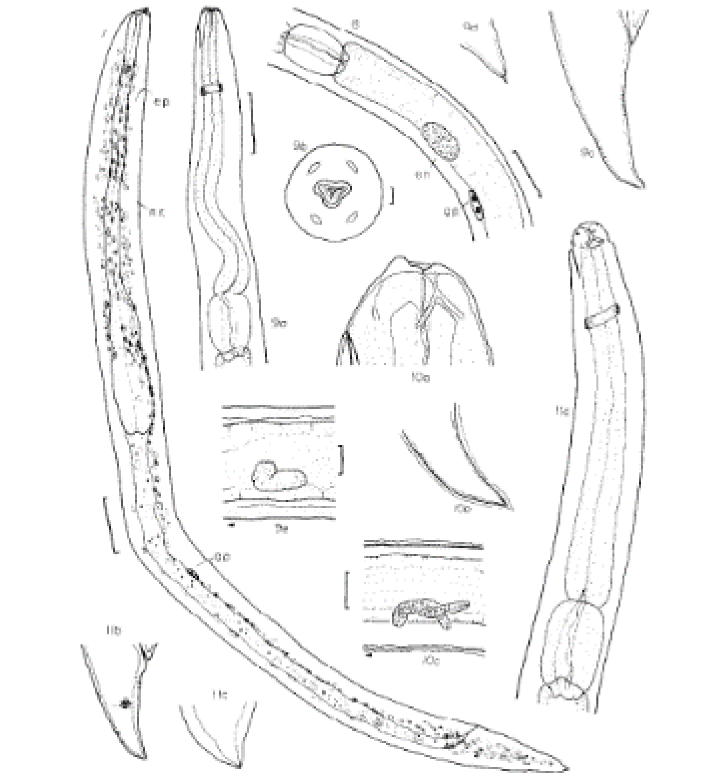

FIG. 7. Third stage larva from egg stained with aceto-orcein to show nuclei (Scale 0·02 mm): e.p., excretory pore; g.p., genital primordium; n.r., nerve ring.
FIG. 8. Lateral view of middle region of third stage larva from bivalve (*Meliua ephippium*) infected 55 days previously (Scale 0·05 mm): e.n., excretory nucleus; g.p., genital primordium.
FIG. 9 (a–e). Third stage larva from bivalve (*Melina ephippium*) infected 86 days previously. (a) Oesophageal region (Scale 0·2 mm). (b) *En face* view (Scale 0·01 mm). (c) Tail showing no apparent phasmid (Scale as for FIG. 8). (d) Tip of tail showing mucron (Scale as for FIG. 7). (e) Latero-ventral view of middle region showing genital primordium. Arrow indicates anterior end (Scale 0·02 mm).
FIG. 10 (a–c). Third stage larva about to moult to fourth stage larva from bivalve (*Melina ephippium*) infected 115 days previously. (a) Head showing third stage cuticle with fourth stage lips forming below. (Scale as for FIG. 9e). (b) Tip of tail with third and fourth stage cuticles. (Scale as for FIG. 7). (c) Latero-ventral view of middle region showing genital primordium and third and fourth stage cuticles (Scale 0·05 mm).
FIG. 11 (a–c). Fourth stage larva from bivalve (*Melina ephippium*) infected 115 days previously. (a) Oesophageal region. (Scale as for FIG. 9a). (b) Tail showing phasmid. (Scale as for FIG. 10c). (c) Tip of tail showing no mucron. (Scale as for FIG. 7).

From Berry and Cannon, 1981

- Preliminary histology and molecular analysis has been completed on samples taken from the 2015 MAB survey.
- DNA results concluded that the sequences analyzed have a 99% identity with *Sulcascaris sulcata* .
- This species is cosmopolitan and has been identified in many genera of bivalve molluscs.
- Saucer scallop (Aus.), Calico scallop (US), Surf clams (US).
- Similar ephemeral observation of similar affected sea scallops was reported in May 2003.

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Sulcascaris sulcata life cycle

- The life cycle of *Sulcascaris sulcata* involves two hosts.
- Adult nematodes attach to the esophagus of Loggerhead and Green sea turtles.
- Eggs pass through the GI tract and enter the benthos via the feces.
- Eggs are filtered by benthic molluscs and the larval stages (1-4) develop.
- Fourth stage larvae are ingested by turtles.

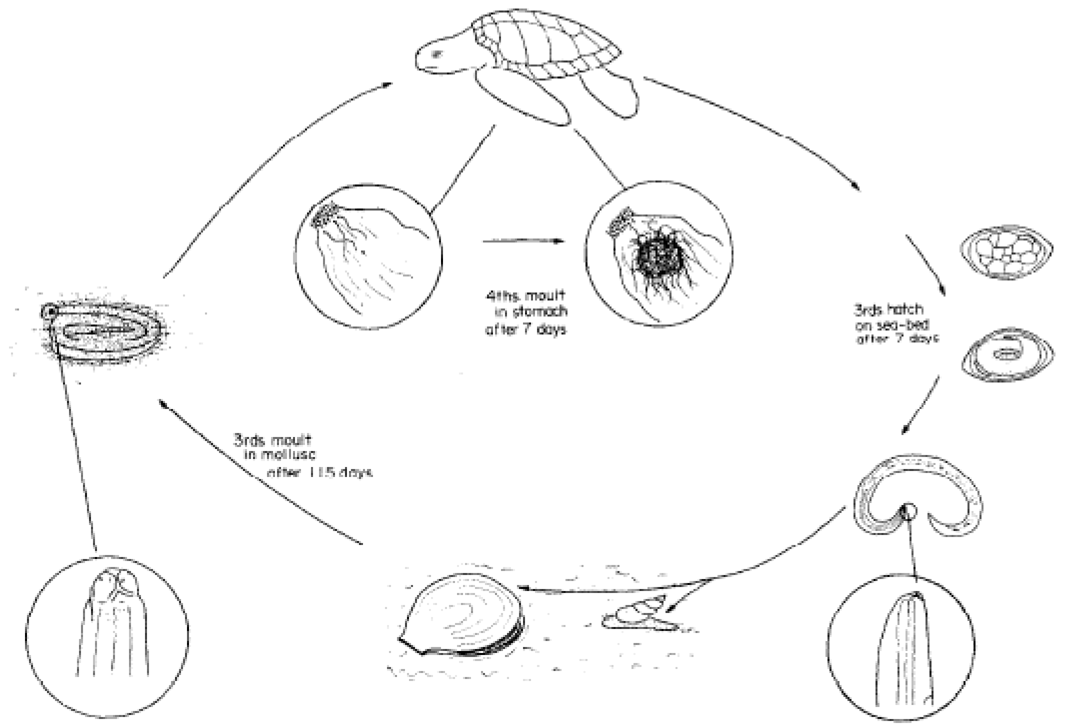

FIG. 16. Life history of *S. sulcata* in *C. caretta* and marine molluscs. Time intervals are minima found experimentally at 25° C.

From Berry and Cannon, 1981

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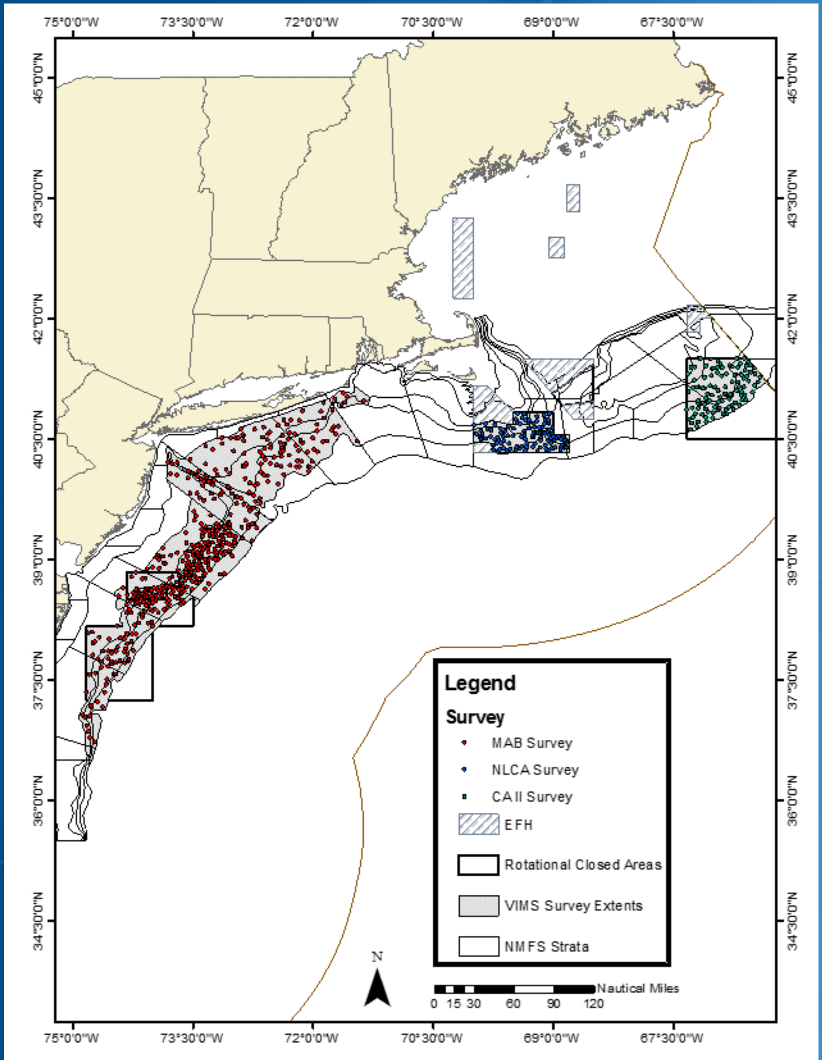
Parasite surveillance



- For the 2016 surveys, VIMS continued an expanded biological sampling protocol to capture the spatial extent of the parasite as well as the prevalence and intensity of infected scallops.
- Sampled 15 animals at every station that had scallops .
  - Histological and genetic samples.
  - Gross observation of the number of nematodes present in an infected scallop.
  - Gross observation of the number of infected animals.

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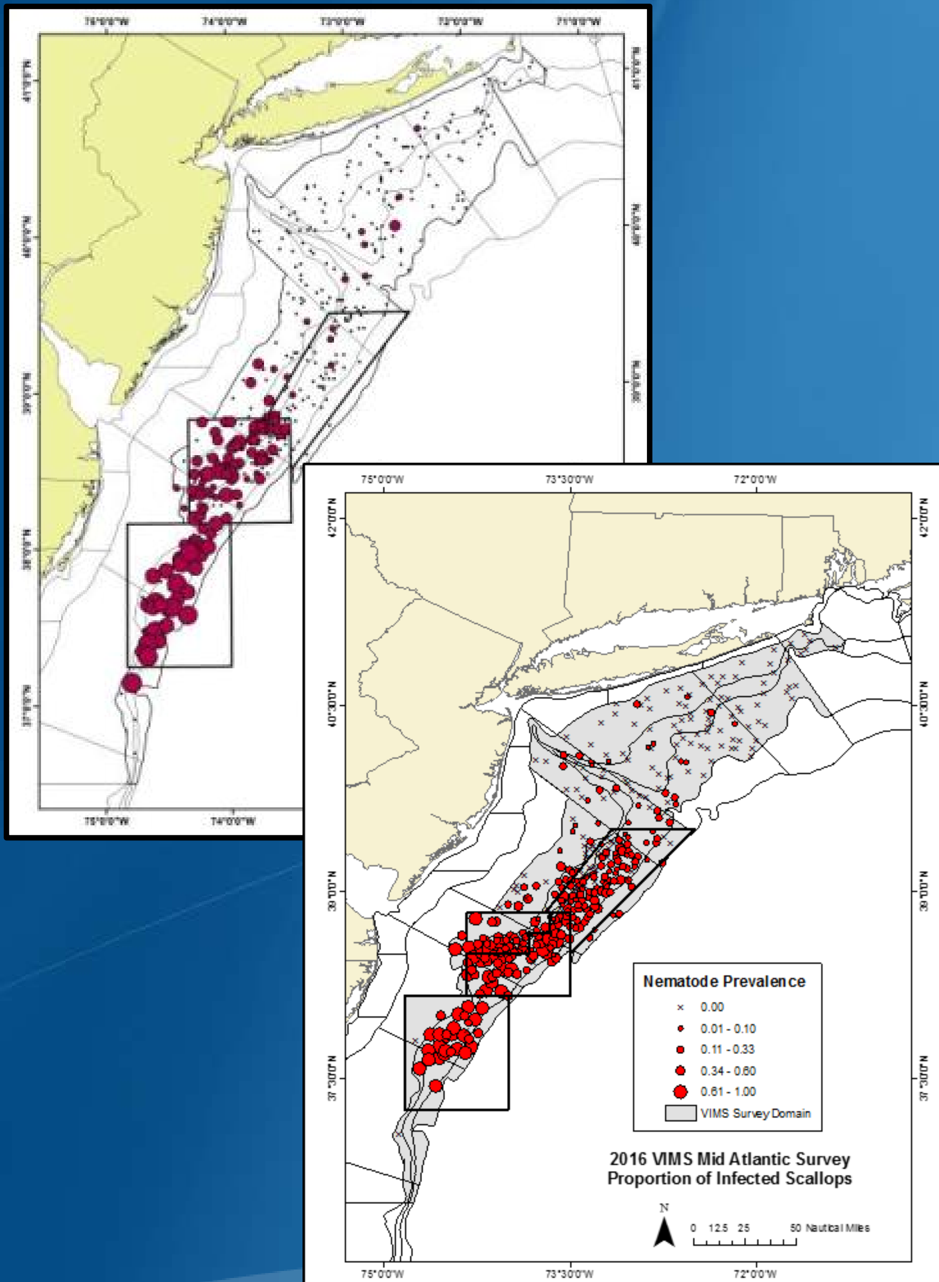
Nematode Prevalence



- Spatial distribution of the prevalence of the parasite in the sampled scallops.
- No infected scallops observed in the NLCA or the CA II survey areas.
- For each station with sampled scallops, a proportion of the sample that contained at least one nematode was calculated.
- Intensity appears to increase as a function if decreasing latitude.
- Prevalence appears to be increasing in the ET and Hudson Canyon compared to 2015.

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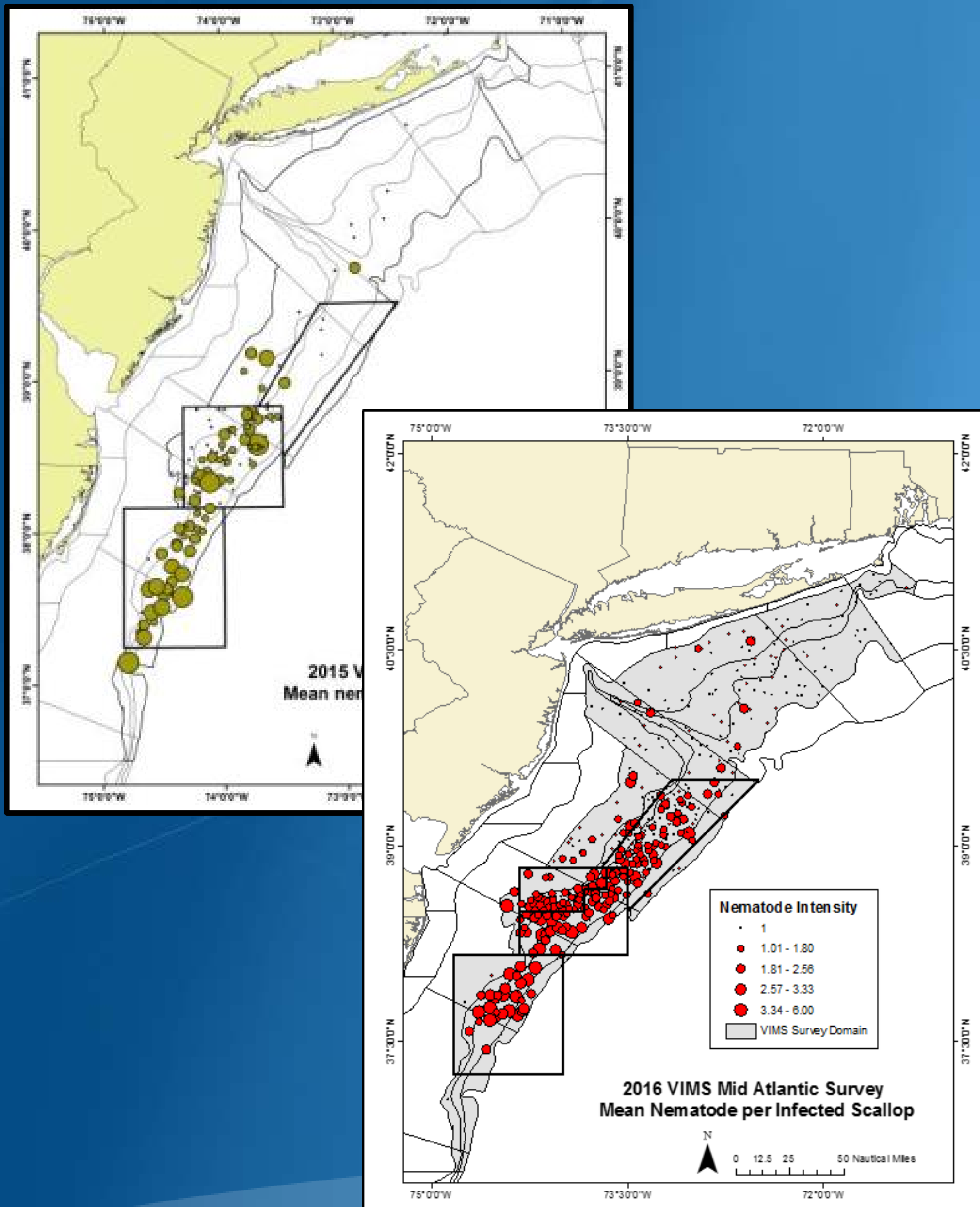
Nematode Intensity



- Spatial distribution of the intensity of the parasite in the sampled scallops.
- For each positive identification at a given station, the mean number of nematodes per scallop was calculated.
- Intensity appears to increase as a function if decreasing latitude.
- Intensity in northern areas is also increasing compared to 2015.

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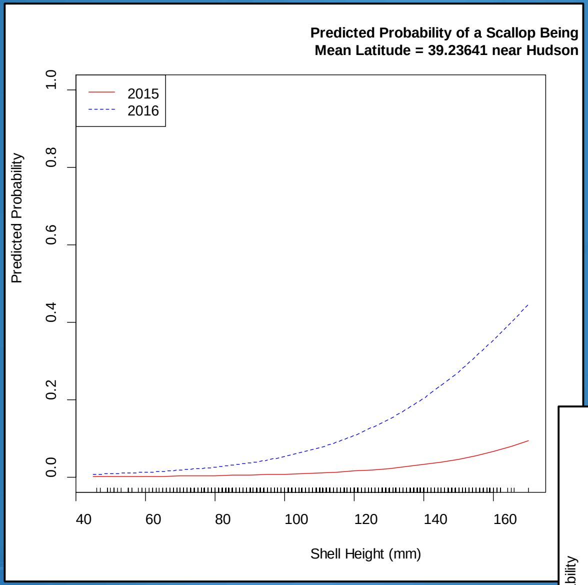
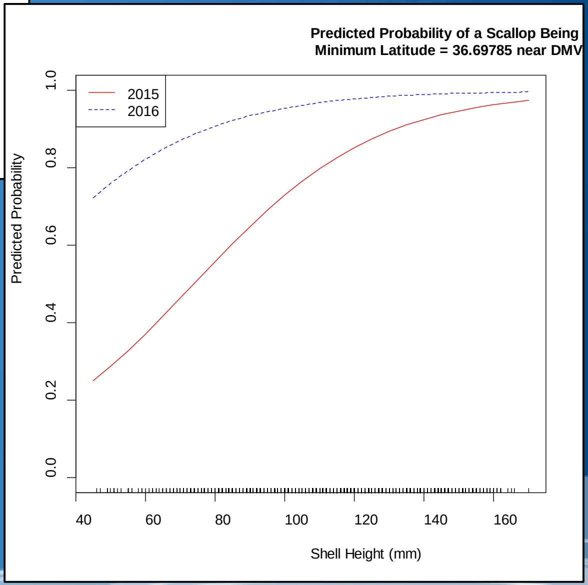
Logistic Regression for Nematode Presence

- Logistic regression was developed to predict the probability of a scallop being infected with nematodes.
- Significant predictor variables included year (2015 & 2016), latitude & shell height.
- The probability of a scallop being infected increased as a function of shell height and for 2016 and decreased as a function of latitude.
- Predictions are sensitive to the latitude value used.





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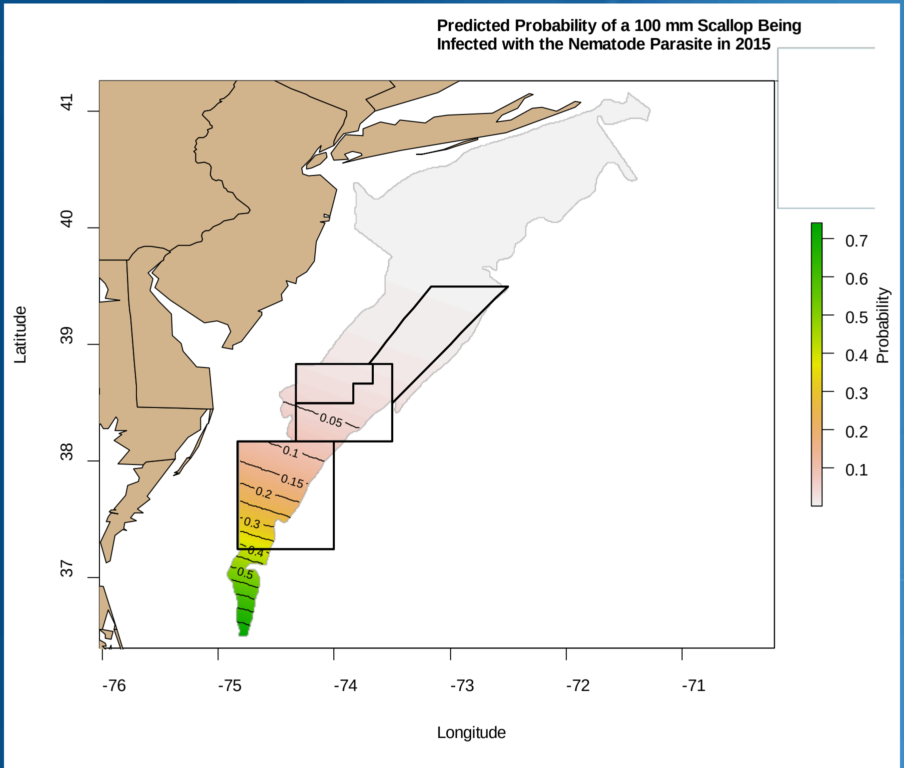
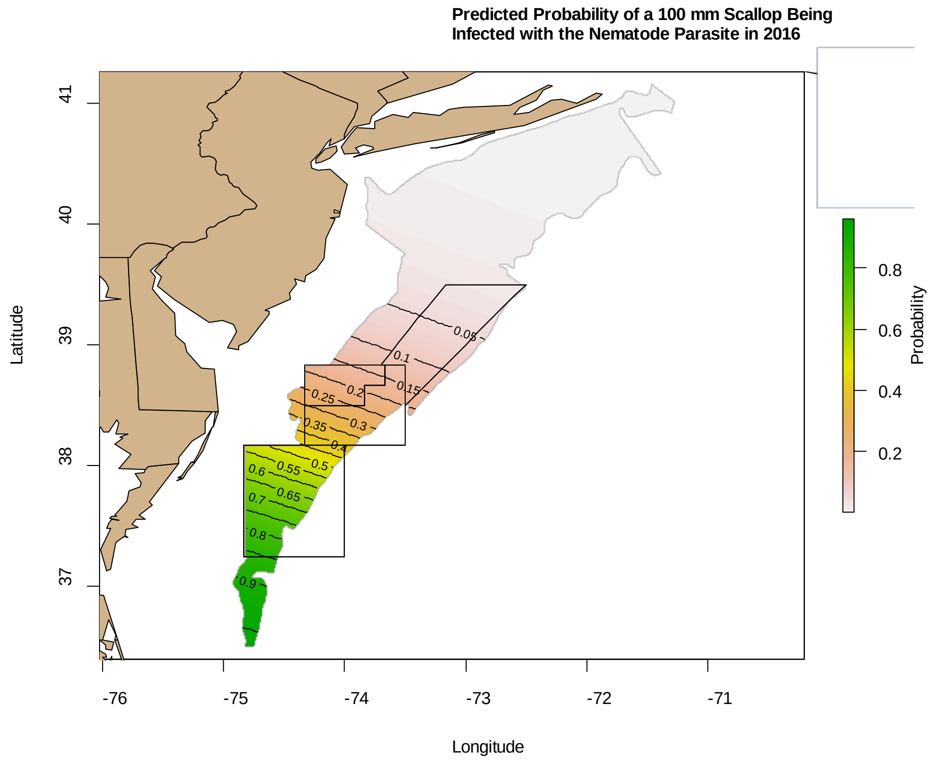
GAMM for Nematode Presence





- GAMM was developed to predict the probability of a scallop being infected with nematodes.
- Significant predictor variables included year (2015 & 2016), tensor product of latitude & longitude & shell height.

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Summary

- One parasite has been positively identified using taxonomic and genetic techniques.
- Data collected from the 2016 MAB survey will be analyzed using histology and molecular analysis to determine if more than one parasite is infecting animals and to understand the biology of the parasite and how it affects the host(s).
- Impact on fishery.
  - Clear overlap with the core of the current scallop biomass and the highest prevalence and intensity of the parasite.
  - In May of 2003, reports waned over time and there were no additional reported sightings until 2015.

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Results for the 2016 VIMS Industry Cooperative Surveys of the Mid-Atlantic, Nantucket Lightship Closed Area, and Closed Area II Resource Areas

Submitted to:
Sea Scallop Fishing Industry

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MARINE ADVISORY SERVICES

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The Virginia Institute of Marine Science (VIMS) conducted high resolution sea scallop dredge surveys of the entire Mid-Atlantic (MAB) sea scallop resource area, the Nantucket Lightship (NLCA) access area and surrounds, and the CA II access area and Extension Closure to the south during May-June of 2016 (Figure 1). These surveys were funded by the Sea Scallop Research Set-Aside Program (RSA). Exploitable biomass for each survey is shown in Table 1 by spatially structured model (SAMS) region (Figure 2-4). SAMS regions take into account differences in recruitment, vital rates, and fishing effort. At the time of the surveys, exploitable biomass estimated from the survey dredge was 1,470 mt or 3.2 million pounds for the Delmarva (DMV) SAMS region, 6,587 mt or 14.5 million pounds for the Elephant Truck (ET) SAMS region and 7,302 mt or 16.1 million pounds in Long Island (LI) SAMS region in the MAB resource area. In the NLCA, the exploitable biomass in the southern region (GSC_S SAMS region in Table 1) was 10,531.55 mt or 23.2 million pounds. Exploitable biomass in the CAII survey domain was 10,187 mt or 22.4 million pounds.

The MAB survey was conducted aboard two commercial vessels: F/V *Carolina Capes II* and F/V *Sea Hawk* during May 2016. Each vessel completed one survey leg and approximately 225 stations in different regions of the survey area. The NLCA and CA II surveys were each conducted by a single commercial vessel in June of 2016. The F/V *Celtic* conducted the NLCA survey and completed 110 stations throughout the survey area. The F/V *K.A.T.E.* completed 100 stations throughout the CA II survey area. All surveys employed a stratified random survey design. All vessels towed a NMFS 8 foot survey dredge along with either a 14 foot Coonamessett Farm Turtle Deflector Dredge (CFTDD) equipped with a 10 inch diamond mesh twine top with a 1.76 hanging ratio (60 meshes, 34 rings) and 8.5 meshes on the side or a 14 foot or 15 foot New Bedford style commercial dredge. While the comparison of catches between the survey dredge and the commercial dredge is informative on a relative basis, for the purposes of this report, we present only the catch data from the commercial dredges during a 15 minute survey tow at 3.8 kts with a 3:1 scope in Table 2. This information is more applicable to what the industry is likely to encounter.

Catch data in tabular form is shown in Table 2. The density and number of scallops caught in three size classes (0-30mm, 31-75mm, and >75mm) in each tow is shown in Figures 5-13. In Figures 14-16, the shell height frequency distribution from the catches by the survey dredge and commercial dredges are shown for the different surveys and SAMS regions.

In addition to data on scallop abundance and biomass, we conducted a survey of meat quality during each survey. This includes documenting the presence and intensity of a parasitic nematode observed in the scallop meat. Infected scallops have rust colored lesions on the meats (Figure 17). Nematode infected scallops were observed only during the MAB survey. The typical number of nematodes observed per scallop meat ranged from 1-6 and nematodes were usually present on the exterior of the adductor muscle, typically opposite the sweet meat. The prevalence (% of sampled scallops sampled at a given station) of nematodes observed in the survey is shown in Figure 18. Intensity appears to increase as a function of decreasing latitude. Compared to 2015 observations, there appears to be an increase in the number of infected scallops sampled in the Hudson Canyon Access Area. VIMS will continue to investigate the nematode infection. This includes identifying the parasite, trying to understand the biology of the parasite and how it affects scallops, and the impact to the fishery.

Table 1. Exploitable biomass for scallops captured in the commercial and survey dredges during the VIMS/Industry cooperative surveys by survey, gear, and SAMS region during May-June 2016.

Survey	SAMS Region	Gear	Exploitable Biomass (mt)	95% CI Lower Bound	95% CI Upper Bound
MAB	DMV	COMM	2,520.01	1,538.68	3,501.33
	DMV	SURVEY	1,469.98	1,162.12	1,777.84
	ET	COMM	12,431.27	10,613.84	14,248.71
	ET	SURVEY	6,587.21	6,114.64	7,059.78
	HC	COMM	10,883.96	7,223.66	14,546.74
	HC	SURVEY	5,785.78	5,289.31	6,284.19
	HCsr	COMM	1,219.07	925.51	1,512.85
	HCsr	SURVEY	1,363.84	1,080.34	1,647.60
	LI	COMM	7,183.71	6,141.20	8,226.22
	LI	SURVEY	7,301.62	6,689.56	7,913.67
NLCA	GSC_S	COMM	10,877.03	7,356.89	14,397.18
	GSC_S	SURVEY	10,531.55	8,721.56	12,341.54
	GSC_W	COMM	512.80	91.14	934.45
	GSC_W	SURVEY	676.43	325.73	1,027.13
CA II	CAII_S	COMM	6,574.37	5,264.69	7,884.05
	CAII_S	SURVEY	10,186.87	9,025.85	11,347.90

Table 2. Catch data for the commercial dredges from the VIMS/Industry cooperative surveys completed during May-June 2016. Nematode prevalence (% of sampled scallops sampled at a given station infected with nematodes) is also provided for each station.

Survey	StationID	Latitude (degrees)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	Scallop (number)	Scallop (lbs)	Scallop (baskets)	Scallop Density	Nematode Prevalence
MAB	201602001	36	43.09	74	43.43	0	0.00	0.00	0.00	0
MAB	201602002	36	46.49	74	47.03	0	0.00	0.00	0.00	0
MAB	201602003	36	50.95	74	48.11	0	0.00	0.00	0.00	0
MAB	201602004	36	55.46	74	49.17	0	0.00	0.00	0.00	0
MAB	201602005	37	2.49	74	47.10	0	0.00	0.00	0.00	0
MAB	201602006	37	1.92	74	50.49	0	0.00	0.00	0.00	0
MAB	201602007	37	3.36	74	52.58	0	0.00	0.00	0.00	0
MAB	201602008	37	8.57	74	45.45	0	0.00	0.00	0.00	0
MAB	201602009	37	10.44	74	45.81	0	0.00	0.00	0.00	0
MAB	201602010	37	9.44	74	37.27	0	0.00	0.00	0.00	0
MAB	201602011	37	13.34	74	41.32	0	0.00	0.00	0.00	0
MAB	201602012	37	20.22	74	35.64	0	0.00	0.00	0.00	0
MAB	201602013	37	26.13	74	34.81	99	0.00	1.00	0.02	0.71
MAB	201602014	37	29.93	74	34.02	462	0.02	4.30	0.09	0
MAB	201602015	37	33.91	74	29.06	59	0.00	0.50	0.01	0
MAB	201602016	37	33.87	74	27.76	0	0.00	0.00	0.00	0
MAB	201602017	37	42.57	74	27.46	8	0.00	0.10	0.00	0.50
MAB	201602018	37	43.91	74	24.39	325	0.01	3.80	0.06	0.87
MAB	201602019	37	42.11	74	20.54	532	0.01	6.25	0.10	0.80
MAB	201602020	37	44.05	74	18.30	1	0.00	0.01	0.00	1.00
MAB	201602021	37	44.89	74	17.65	941	0.03	11.25	0.18	0.93
MAB	201602022	37	48.72	74	18.72	42	0.00	0.25	0.01	0.60
MAB	201602023	37	50.46	74	21.20	645	0.02	9.50	0.13	0.80
MAB	201602024	37	51.66	74	14.25	4	0.00	0.01	0.00	0.33
MAB	201602025	37	52.88	74	19.93	1	0.00	0.01	0.00	0
MAB	201602026	37	56.64	74	18.99	20	0.00	0.10	0.00	0.20
MAB	201602027	37	58.18	74	15.74	446	0.01	5.00	0.09	0.67
MAB	201602028	37	59.99	74	20.97	97	0.00	1.50	0.02	0.53
MAB	201602029	38	0.79	74	23.97	7	0.00	0.10	0.00	0.63
MAB	201602030	38	4.25	74	19.17	58	0.00	0.50	0.01	0.80
MAB	201602031	38	3.74	74	15.31	0	0.00	0.00	0.00	0
MAB	201602032	38	3.68	74	12.34	197	0.01	2.00	0.04	0.67
MAB	201602033	38	10.46	74	13.46	1,172	0.03	10.50	0.23	0.53
MAB	201602034	38	12.17	74	10.50	318	0.01	3.00	0.06	1.00

MAB	201602035	38	11.80	74	3.07	223	0.01	2.50	0.04	0.87
MAB	201602036	38	9.60	73	59.97	5	0.00	0.10	0.00	0.33
MAB	201602037	38	12.60	74	0.38	0	0.00	0.00	0.00	0
MAB	201602038	38	16.35	74	7.74	1	0.00	0.10	0.00	1.00
MAB	201602039	38	18.74	74	9.28	942	0.03	9.50	0.18	0.67
MAB	201602040	38	18.68	74	7.45	672	0.02	8.00	0.13	0.60
MAB	201602041	38	20.48	74	5.31	664	0.02	10.00	0.13	0.60
MAB	201602042	38	22.41	74	2.15	422	0.01	7.00	0.08	0.87
MAB	201602043	38	20.88	73	59.92	394	0.01	7.00	0.08	0.40
MAB	201602044	38	22.43	73	58.21	160	0.00	2.50	0.03	0.80
MAB	201602045	38	20.06	73	55.59	915	0.03	13.00	0.18	0.47
MAB	201602046	38	22.03	73	50.98	28	0.00	0.20	0.01	0.13
MAB	201602047	38	24.03	73	48.26	0	0.00	0.00	0.00	0
MAB	201602048	38	25.76	73	47.49	2	0.00	0.01	0.00	0
MAB	201602049	38	27.36	73	48.85	15	0.00	0.10	0.00	0.33
MAB	201602050	38	28.92	73	47.66	872	0.02	13.50	0.17	0.33
MAB	201602051	38	25.97	73	38.70	154	0.00	3.00	0.03	0.47
MAB	201602052	38	27.80	73	36.69	5	0.00	0.10	0.00	0.33
MAB	201602053	38	29.38	73	37.89	1	0.00	0.01	0.00	0.07
MAB	201602054	38	30.37	73	41.09	2	0.00	0.01	0.00	1.00
MAB	201602055	38	31.66	73	43.09	769	0.02	11.00	0.15	0.71
MAB	201602056	38	32.80	73	39.44	980	0.02	12.00	0.19	0.27
MAB	201602057	38	34.45	73	38.35	475	0.01	4.50	0.09	0.40
MAB	201602058	38	35.84	73	36.16	719	0.02	9.00	0.14	0.67
MAB	201602059	38	37.19	73	30.34	1,423	0.04	15.00	0.28	0.36
MAB	201602060	38	37.72	73	20.58	283	0.01	2.20	0.05	0.27
MAB	201602061	38	41.43	73	17.95	4	0.00	0.10	0.00	0.07
MAB	201602062	38	42.49	73	25.32	2	0.00	0.10	0.00	0.33
MAB	201602063	38	42.34	73	27.24	498	0.01	5.00	0.10	0.21
MAB	201602064	38	43.11	73	30.07	785	0.02	7.00	0.15	0.20
MAB	201602065	38	45.76	73	26.51	641	0.02	6.00	0.12	0.27
MAB	201602066	38	45.09	73	22.89	68	0.00	0.75	0.01	0.14
MAB	201602067	38	47.44	73	21.50	29	0.00	0.50	0.01	0.14
MAB	201602068	38	49.06	73	20.34	1,920	0.05	19.00	0.37	0.13
MAB	201602069	38	48.46	73	9.05	2,824	0.08	26.00	0.55	0.07
MAB	201602070	38	49.17	73	6.22	22	0.00	0.10	0.00	0.27
MAB	201602071	38	51.72	73	16.59	2	0.00	0.01	0.00	0.33
MAB	201602072	38	52.84	73	17.88	388	0.01	5.00	0.08	0.33
MAB	201602073	38	51.45	73	22.08	82	0.00	1.00	0.02	0.27
MAB	201602074	38	52.95	73	23.13	1,033	0.03	18.00	0.20	0.20
MAB	201602075	38	55.65	73	24.09	397	0.01	5.00	0.08	0.13

MAB	201602076	38	55.68	73	18.20	717	0.02	11.00	0.14	0.33
MAB	201602077	38	57.51	73	20.19	77	0.00	1.00	0.01	0.40
MAB	201602078	38	59.76	73	20.57	311	0.01	7.25	0.06	0.27
MAB	201602079	38	59.43	73	18.11	950	0.01	19.50	0.18	0.20
MAB	201602080	39	0.79	73	16.85	140	0.00	1.80	0.03	0.40
MAB	201602081	38	59.98	73	14.47	54	0.00	1.00	0.01	0.40
MAB	201602082	38	59.27	73	12.56	17	0.00	0.10	0.00	0.33
MAB	201602083	38	59.56	73	10.49	40	0.00	0.50	0.01	0.20
MAB	201602084	39	2.16	73	0.19	12	0.00	0.10	0.00	0.27
MAB	201602085	39	3.20	73	7.03	0	0.00	0.00	0.00	0
MAB	201602086	39	2.29	73	12.19	148	0.01	1.50	0.03	0.07
MAB	201602087	39	3.09	73	12.31	35	0.00	0.25	0.01	0.13
MAB	201602088	39	4.68	73	13.52	225	0.01	1.90	0.04	0.27
MAB	201602089	39	5.15	73	11.58	349	0.01	3.00	0.07	0.20
MAB	201602090	39	5.00	73	8.75	277	0.01	2.50	0.05	0.20
MAB	201602091	39	5.55	73	5.52	1,453	0.04	16.00	0.28	0.33
MAB	201602092	39	5.38	73	1.83	57	0.00	0.50	0.01	0.13
MAB	201602093	39	5.76	73	2.59	2	0.00	0.10	0.00	0
MAB	201602094	39	8.83	73	7.95	60	0.00	0.60	0.01	0.07
MAB	201602095	39	10.64	73	7.39	204	0.01	1.90	0.04	0.07
MAB	201602096	39	11.89	73	4.39	62	0.00	1.00	0.01	0.13
MAB	201602097	39	11.02	73	2.34	143	0.00	2.00	0.03	0.20
MAB	201602098	39	9.70	72	59.96	13	0.00	0.20	0.00	0
MAB	201602099	39	11.73	72	58.77	58	0.00	0.50	0.01	0.06
MAB	201602100	39	14.19	72	58.46	12	0.00	0.10	0.00	0.13
MAB	201602101	39	16.79	72	57.24	186	0.00	2.00	0.04	0.20
MAB	201602102	39	15.19	72	52.71	2,244	0.05	30.00	0.44	0.07
MAB	201602103	39	13.61	72	45.37	8	0.00	0.10	0.00	0.18
MAB	201602104	39	23.08	72	41.76	1	0.00	0.01	0.00	0
MAB	201602106	39	26.56	72	45.00	11	0.00	0.10	0.00	0
MAB	201602107	39	33.19	72	41.82	97	0.00	1.50	0.02	0.13
MAB	201602108	39	38.13	72	44.24	110	0.00	1.50	0.02	0
MAB	201602109	39	38.80	72	47.79	52	0.00	0.80	0.01	0.13
MAB	201602110	39	35.46	72	47.00	668	0.01	12.00	0.13	0.20
MAB	201602111	39	28.77	72	50.05	294	0.01	2.80	0.06	0.07
MAB	201602112	39	25.36	72	47.90	657	0.02	5.20	0.13	0.13
MAB	201602113	39	23.40	72	48.24	137	0.00	1.10	0.03	0.20
MAB	201602114	39	23.48	72	53.12	69	0.00	0.75	0.01	0.07
MAB	201602115	39	22.73	73	2.32	96	0.01	1.00	0.02	0.27
MAB	201602116	39	20.87	73	5.75	117	0.00	1.25	0.02	0.40
MAB	201602117	39	19.45	73	4.80	240	0.01	2.25	0.05	0.40

MAB	201602118	39	19.26	73	1.62	196	0.01	1.75	0.04	0.20
MAB	201602119	39	17.54	73	0.52	667	0.02	6.10	0.13	0.20
MAB	201602120	39	17.47	73	2.55	465	0.01	4.50	0.09	0.06
MAB	201602121	39	18.27	73	8.14	118	0.00	1.20	0.02	0.07
MAB	201602122	39	16.70	73	11.68	29	0.00	0.30	0.01	0
MAB	201602123	39	16.30	73	7.58	190	0.01	1.75	0.04	0.13
MAB	201602124	39	14.65	73	6.78	99	0.00	1.00	0.02	0.13
MAB	201602125	39	13.01	73	10.22	258	0.01	2.50	0.05	0.20
MAB	201602126	39	12.30	73	14.93	136	0.00	1.50	0.03	0.27
MAB	201602127	39	9.61	73	10.90	140	0.00	1.50	0.03	0.07
MAB	201602128	39	7.17	73	13.24	245	0.01	2.50	0.05	0.13
MAB	201602129	39	8.17	73	18.62	182	0.01	2.00	0.04	0.13
MAB	201602130	39	6.90	73	18.52	137	0.00	1.50	0.03	0.13
MAB	201602131	39	4.82	73	17.86	399	0.01	3.80	0.08	0
MAB	201602132	39	2.70	73	23.25	82	0.00	2.10	0.02	0
MAB	201602133	39	1.11	73	23.92	97	0.00	1.10	0.02	0.07
MAB	201602134	38	59.80	73	25.06	695	0.01	7.50	0.13	0.13
MAB	201602135	38	58.39	73	24.95	549	0.01	7.10	0.11	0.13
MAB	201602136	38	57.50	73	25.11	829	0.01	12.00	0.16	0.20
MAB	201602137	38	57.79	73	28.67	698	0.02	7.20	0.14	0.20
MAB	201602138	38	55.81	73	31.35	326	0.01	4.00	0.06	0
MAB	201602139	38	55.56	73	29.61	866	0.02	9.00	0.17	0.27
MAB	201602140	38	55.92	73	27.30	650	0.01	8.00	0.13	0.07
MAB	201602141	38	53.34	73	25.94	679	0.02	8.00	0.13	0.13
MAB	201602142	38	51.48	73	25.77	1,112	0.03	12.10	0.22	0.20
MAB	201602143	38	51.26	73	27.75	1,026	0.02	15.10	0.20	0.27
MAB	201602144	38	51.55	73	30.98	1,529	0.04	17.00	0.30	0.47
MAB	201602145	38	50.02	73	31.01	204	0.01	2.50	0.04	0.20
MAB	201602146	38	47.42	73	28.71	1,279	0.04	12.80	0.25	0.20
MAB	201602148	38	47.87	73	31.71	966	0.03	12.00	0.19	0.27
MAB	201602149	38	47.98	73	33.21	0	0.00	0.00	0.00	0
MAB	201602150	38	47.57	73	34.86	552	0.01	7.00	0.11	0.60
MAB	201602151	38	45.56	73	32.01	220	0.00	2.50	0.04	0.40
MAB	201602152	38	43.67	73	35.67	671	0.01	10.00	0.13	0.20
MAB	201602153	38	41.20	73	38.08	590	0.02	7.00	0.11	0.67
MAB	201602154	38	39.69	73	36.95	870	0.02	9.50	0.17	0.40
MAB	201602155	38	39.12	73	34.19	1,314	0.03	10.00	0.26	0.40
MAB	201602156	38	37.58	73	37.73	254	0.01	2.90	0.05	0.53
MAB	201602157	38	37.00	73	40.21	348	0.01	4.00	0.07	0.64
MAB	201602158	38	35.77	73	44.46	524	0.01	8.00	0.10	0.67
MAB	201602159	38	34.15	73	46.10	972	0.02	15.00	0.19	0.27

MAB	201602160	38	30.75	73	49.44	786	0.02	10.20	0.15	0.40
MAB	201602161	38	30.48	73	54.71	810	0.02	10.50	0.16	0.27
MAB	201602162	38	30.74	73	56.92	1,103	0.02	16.50	0.21	0.20
MAB	201602163	38	32.56	73	58.19	1,715	0.02	31.00	0.33	0.47
MAB	201602164	38	33.46	73	59.60	700	0.02	9.50	0.14	0.40
MAB	201602165	38	36.26	74	2.90	556	0.02	8.00	0.11	0.13
MAB	201602166	38	37.83	74	4.66	577	0.02	8.00	0.11	0.40
MAB	201602167	38	36.24	74	5.34	282	0.01	3.25	0.05	0.13
MAB	201602168	38	34.72	74	4.19	1,790	0.06	24.00	0.35	0.40
MAB	201602169	38	32.43	74	1.10	988	0.02	15.25	0.19	0.27
MAB	201602170	38	29.84	73	59.78	1,401	0.02	22.00	0.27	0.47
MAB	201602171	38	28.43	73	57.75	777	0.02	9.00	0.15	0.20
MAB	201602172	38	27.37	73	59.35	1,667	0.03	22.00	0.32	0.20
MAB	201602173	38	27.25	74	2.74	216	0.01	3.25	0.04	0.60
MAB	201602174	38	30.74	74	3.17	43	0.00	1.00	0.01	0.40
MAB	201602175	38	31.65	74	4.26	246	0.01	2.75	0.05	0.80
MAB	201602176	38	31.44	74	6.47	614	0.02	7.00	0.12	0.53
MAB	201602177	38	33.59	74	6.62	223	0.01	3.50	0.04	0.53
MAB	201602178	38	33.97	74	7.89	398	0.02	5.00	0.08	0.33
MAB	201602179	38	34.60	74	10.03	178	0.01	2.00	0.03	0.13
MAB	201602180	38	36.37	74	11.09	420	0.01	4.80	0.08	0.53
MAB	201602181	38	37.36	74	11.99	1,439	0.03	16.00	0.28	0.13
MAB	201602182	38	38.60	74	22.06	6	0.00	0.10	0.00	0.33
MAB	201602183	38	34.58	74	14.39	827	0.02	10.90	0.16	0.43
MAB	201602184	38	33.36	74	12.43	545	0.02	7.50	0.11	0.87
MAB	201602185	38	32.18	74	10.25	384	0.01	4.00	0.07	0.47
MAB	201602186	38	30.11	74	8.44	1,021	0.05	13.00	0.20	0.80
MAB	201602187	38	27.78	74	6.89	1,233	0.03	17.00	0.24	0.60
MAB	201602188	38	25.26	74	4.78	158	0.00	1.50	0.03	0.60
MAB	201602189	38	26.07	74	9.90	380	0.01	6.00	0.07	0.47
MAB	201602190	38	26.48	74	12.78	156	0.00	1.70	0.03	0.67
MAB	201602191	38	27.83	74	11.08	399	0.01	3.80	0.08	0.47
MAB	201602192	38	30.23	74	12.46	517	0.02	7.25	0.10	0.63
MAB	201602193	38	31.37	74	14.04	26	0.00	0.20	0.01	0.80
MAB	201602194	38	32.97	74	18.74	14	0.00	0.10	0.00	0.67
MAB	201602195	38	32.09	74	25.38	1	0.00	0.01	0.00	1.00
MAB	201602196	38	28.29	74	16.49	53	0.00	0.50	0.01	0.65
MAB	201602197	38	25.64	74	19.36	10	0.00	0.01	0.00	0.58
MAB	201602198	38	22.20	74	17.44	106	0.00	1.00	0.02	0.53
MAB	201602199	38	19.85	74	16.12	205	0.01	2.25	0.04	0.60
MAB	201602200	38	19.77	74	19.25	10	0.00	0.01	0.00	0.71

MAB	201602201	38	10.12	74	26.36	0	0.00	0.00	0.00	0
MAB	201602202	38	5.28	74	45.13	0	0.00	0.00	0.00	0
MAB	201602203	38	4.68	74	48.14	0	0.00	0.00	0.00	0
MAB	201602204	37	57.15	74	44.46	0	0.00	0.00	0.00	0
MAB	201602205	37	58.06	74	42.95	0	0.00	0.00	0.00	0
MAB	201602206	38	1.30	74	39.74	0	0.00	0.00	0.00	0
MAB	201602207	38	0.12	74	32.40	0	0.00	0.00	0.00	0.33
MAB	201602208	37	54.16	74	26.15	99	0.00	1.10	0.02	0.73
MAB	201602209	37	51.04	74	27.20	18	0.00	0.20	0.00	0.93
MAB	201602210	37	50.96	74	29.59	22	0.00	0.25	0.00	0.53
MAB	201602211	37	49.84	74	30.70	7	0.00	0.10	0.00	1.00
MAB	201602212	37	51.08	74	33.06	25	0.00	0.40	0.00	0.67
MAB	201602213	37	51.00	74	37.32	2	0.00	0.01	0.00	1.00
MAB	201602214	37	48.09	74	44.69	0	0.00	0.01	0.00	0
MAB	201602215	37	45.61	74	40.82	0	0.00	0.00	0.00	0
MAB	201602216	37	43.33	74	38.34	5	0.00	0.10	0.00	0.83
MAB	201602217	37	45.36	74	33.16	16	0.00	0.10	0.00	0.87
MAB	201602218	37	43.13	74	30.16	103	0.00	1.00	0.02	0.73
MAB	201602219	37	41.56	74	30.68	182	0.01	2.00	0.04	0.87
MAB	201602220	37	39.62	74	33.25	15	0.00	0.15	0.00	0.93
MAB	201602221	37	38.93	74	38.23	3	0.00	0.01	0.00	0.75
MAB	201602222	37	34.55	74	42.64	1	0.00	0.01	0.00	1.00
MAB	201602223	37	33.63	74	47.11	0	0.00	0.00	0.00	0
MAB	201602224	37	20.19	74	49.56	0	0.00	0.00	0.00	0
MAB	201603001	38	45.41	74	5.64	106	0.00	1.50	0.02	0.40
MAB	201603002	38	45.22	74	7.52	2	0.00	0.01	0.00	0.40
MAB	201603003	38	46.84	74	15.55	3	0.00	0.01	0.00	0.67
MAB	201603004	38	49.87	74	12.37	0	0.00	0.00	0.00	0
MAB	201603005	38	52.42	74	3.89	1	0.00	0.01	0.00	0
MAB	201603006	38	53.74	73	59.86	10	0.00	0.01	0.00	0.27
MAB	201603007	38	52.91	73	54.89	40	0.00	0.25	0.01	0.47
MAB	201603008	38	56.42	73	50.29	21	0.00	0.25	0.00	0.33
MAB	201603009	38	56.74	73	51.70	14	0.00	0.15	0.00	0
MAB	201603010	38	59.65	73	55.20	1	0.00	0.01	0.00	0
MAB	201603011	39	1.12	73	57.05	2	0.00	0.02	0.00	0
MAB	201603012	39	2.78	73	56.02	2	0.00	0.02	0.00	0
MAB	201603013	39	1.94	73	52.11	10	0.00	0.20	0.00	0.17
MAB	201603014	39	2.56	73	46.24	48	0.00	0.50	0.01	0.13
MAB	201603015	39	4.65	73	41.54	12	0.00	0.20	0.00	0
MAB	201603016	39	8.02	73	51.90	3	0.00	0.01	0.00	0
MAB	201603017	39	11.89	73	34.34	21	0.00	0.20	0.00	0.33

MAB	201603018	39	19.57	73	34.87	33	0.00	0.40	0.01	0.07
MAB	201603019	39	26.33	73	23.46	37	0.00	0.20	0.01	0
MAB	201603020	39	28.80	73	28.67	17	0.00	0.10	0.00	0.07
MAB	201603021	39	31.79	73	27.39	9	0.00	0.01	0.00	0.08
MAB	201603022	39	32.78	73	16.39	49	0.00	0.66	0.01	0.07
MAB	201603023	39	35.38	73	28.78	8	0.00	0.10	0.00	0
MAB	201603024	39	44.90	73	13.79	88	0.00	1.00	0.02	0
MAB	201603025	39	48.76	73	15.64	53	0.00	0.60	0.01	0.20
MAB	201603026	39	43.82	73	21.46	16	0.00	0.25	0.00	0.09
MAB	201603027	39	45.75	73	24.51	11	0.00	0.10	0.00	0
MAB	201603028	39	49.10	73	26.62	27	0.00	0.40	0.01	0
MAB	201603029	39	49.09	73	31.68	35	0.00	0.40	0.01	0
MAB	201603030	40	2.67	73	41.50	6	0.00	0.15	0.00	0
MAB	201603031	40	3.80	73	46.52	2	0.00	0.02	0.00	0
MAB	201603032	40	12.29	73	48.27	0	0.00	0.00	0.00	0
MAB	201603033	40	11.02	73	45.22	0	0.00	0.00	0.00	0
MAB	201603034	40	12.02	73	41.35	0	0.00	0.00	0.00	0
MAB	201603035	40	0.31	73	33.36	5	0.00	0.05	0.00	0.20
MAB	201603036	40	5.67	73	33.08	7	0.00	0.05	0.00	0.14
MAB	201603037	40	4.22	73	30.24	0	0.00	0.00	0.00	0
MAB	201603038	40	1.55	73	26.54	3	0.00	0.03	0.00	0
MAB	201603039	39	59.72	73	23.72	3	0.00	0.03	0.00	0
MAB	201603040	39	58.17	73	21.53	0	0.00	0.00	0.00	0
MAB	201603041	39	54.76	73	22.16	44	0.00	0.50	0.01	0
MAB	201603042	39	55.29	73	14.58	1	0.00	0.01	0.00	0
MAB	201603043	39	58.70	73	14.06	52	0.00	0.90	0.01	0
MAB	201603044	39	57.60	73	17.54	0	0.00	0.00	0.00	0
MAB	201603045	40	0.74	73	19.41	100	0.00	1.20	0.02	0.07
MAB	201603046	40	2.18	73	19.88	57	0.00	0.80	0.01	0.07
MAB	201603047	40	5.35	73	25.40	77	0.00	1.00	0.02	0.20
MAB	201603048	40	14.36	73	31.63	1	0.00	0.01	0.00	0
MAB	201603049	40	10.94	73	20.20	26	0.00	0.20	0.01	0
MAB	201603050	40	6.27	73	12.79	42	0.00	0.25	0.01	0
MAB	201603051	40	2.62	73	11.32	79	0.00	1.00	0.02	0.07
MAB	201603052	40	3.68	73	1.95	111	0.00	1.50	0.02	0
MAB	201603053	40	6.54	73	4.79	99	0.00	1.00	0.02	0
MAB	201603054	40	9.40	72	52.27	52	0.00	0.75	0.01	0.07
MAB	201603055	40	9.33	72	50.84	90	0.00	1.00	0.02	0
MAB	201603056	40	11.06	72	49.64	62	0.00	0.80	0.01	0.07
MAB	201603057	40	18.52	72	51.33	111	0.00	1.25	0.02	0
MAB	201603058	40	20.51	72	59.22	110	0.00	1.25	0.02	0

MAB	201603059	40	21.70	73	14.95	22	0.00	0.25	0.00	0
MAB	201603060	40	24.39	73	20.10	0	0.00	0.00	0.00	0
MAB	201603061	40	26.06	73	7.90	7	0.00	0.01	0.00	0
MAB	201603062	40	30.71	73	7.83	2	0.00	0.01	0.00	0
MAB	201603063	40	30.70	73	1.35	0	0.00	0.00	0.00	0
MAB	201603064	40	30.24	72	57.50	10	0.00	0.10	0.00	0.20
MAB	201603065	40	30.17	72	55.90	32	0.00	0.20	0.01	0
MAB	201603066	40	28.26	72	51.55	511	0.01	4.90	0.11	0
MAB	201603068	40	32.88	72	52.46	24	0.00	0.20	0.01	0
MAB	201603069	40	37.23	72	53.39	0	0.00	0.00	0.00	0
MAB	201603070	40	37.03	72	43.36	9	0.00	0.01	0.00	0
MAB	201603071	40	30.81	72	37.31	29	0.00	0.20	0.01	0
MAB	201603072	40	29.25	72	33.99	26	0.00	0.20	0.01	0
MAB	201603073	40	33.64	72	33.37	17	0.00	0.10	0.00	0.07
MAB	201603074	40	34.80	72	32.08	34	0.00	0.25	0.01	0
MAB	201603075	40	38.33	72	36.56	73	0.00	1.00	0.01	0
MAB	201603076	40	39.75	72	25.97	50	0.00	0.50	0.01	0
MAB	201603077	40	43.83	72	21.49	8	0.00	0.10	0.00	0
MAB	201603078	40	40.57	72	18.98	8	0.00	0.10	0.00	0
MAB	201603079	40	43.63	72	16.32	7	0.00	0.10	0.00	0
MAB	201603080	40	43.48	72	9.79	8	0.00	0.10	0.00	0
MAB	201603081	40	50.51	72	7.24	6	0.00	0.10	0.00	0
MAB	201603082	40	50.09	71	53.65	39	0.00	0.50	0.01	0
MAB	201603083	40	56.49	71	51.70	2	0.00	0.02	0.00	0
MAB	201603084	40	59.50	71	43.27	130	0.00	1.25	0.03	0
MAB	201603085	41	4.05	71	36.80	86	0.00	1.00	0.02	0
MAB	201603086	41	0.90	71	34.06	117	0.00	1.25	0.03	0
MAB	201603087	40	58.00	71	21.79	100	0.00	1.00	0.02	0
MAB	201603088	40	56.87	71	35.74	51	0.00	0.60	0.01	0
MAB	201603089	40	55.08	71	38.32	140	0.00	1.40	0.03	0
MAB	201603090	40	51.45	71	45.00	187	0.01	2.25	0.04	0
MAB	201603091	40	45.25	71	51.32	43	0.00	0.40	0.01	0
MAB	201603092	40	40.44	71	56.79	181	0.00	1.75	0.04	0
MAB	201603093	40	35.66	71	56.58	218	0.01	3.00	0.05	0
MAB	201603094	40	33.32	71	42.94	3	0.00	0.01	0.00	0
MAB	201603095	40	36.17	71	45.19	146	0.01	2.00	0.03	0
MAB	201603096	40	38.66	71	44.29	11	0.00	0.10	0.00	0
MAB	201603097	40	39.15	71	40.88	1	0.00	0.01	0.00	0
MAB	201603098	40	28.04	71	26.52	0	0.00	0.00	0.00	0
MAB	201603099	40	27.91	71	49.30	0	0.00	0.00	0.00	0
MAB	201603100	40	27.42	71	52.22	0	0.00	0.00	0.00	0

MAB	201603101	40	30.29	71	59.65	104	0.00	1.33	0.02	0
MAB	201603102	40	26.67	72	7.27	25	0.00	0.33	0.01	0
MAB	201603103	40	28.57	72	8.96	42	0.00	0.50	0.01	0
MAB	201603105	40	33.26	72	13.67	76	0.00	1.00	0.01	0
MAB	201603106	40	34.01	72	17.14	30	0.00	0.35	0.01	0
MAB	201603107	40	32.29	72	22.36	8	0.00	0.01	0.00	0
MAB	201603108	40	29.54	72	18.19	57	0.00	1.00	0.01	0
MAB	201603109	40	26.93	72	24.04	23	0.00	0.10	0.01	0
MAB	201603110	40	26.04	72	21.77	31	0.00	0.25	0.01	0.13
MAB	201603111	40	24.66	72	12.15	56	0.00	1.00	0.01	0
MAB	201603112	40	20.77	72	10.42	119	0.00	1.50	0.03	0.07
MAB	201603113	40	19.73	72	3.81	30	0.00	0.25	0.01	0
MAB	201603114	40	21.89	71	58.98	2	0.00	0.01	0.00	0
MAB	201603115	40	20.18	71	56.07	11	0.00	0.10	0.00	0
MAB	201603116	40	12.80	72	0.18	36	0.00	0.25	0.01	0
MAB	201603117	40	12.85	72	8.48	21	0.00	0.20	0.00	0
MAB	201603118	40	13.32	72	11.13	66	0.00	1.00	0.01	0
MAB	201603119	40	17.49	72	17.47	95	0.00	1.33	0.02	0
MAB	201603120	40	16.91	72	23.40	890	0.02	11.75	0.18	0
MAB	201603121	40	19.58	72	23.98	234	0.01	3.00	0.05	0
MAB	201603122	40	20.67	72	21.86	374	0.01	4.00	0.07	0
MAB	201603123	40	23.23	72	22.99	67	0.00	0.80	0.01	0
MAB	201603124	40	25.51	72	31.54	21	0.00	0.33	0.00	0
MAB	201603125	40	23.01	72	31.55	53	0.00	0.80	0.01	0
MAB	201603126	40	22.60	72	36.09	87	0.00	0.90	0.02	0
MAB	201603127	40	20.06	72	39.55	177	0.00	2.00	0.03	0
MAB	201603128	40	17.17	72	37.56	126	0.00	1.50	0.02	0
MAB	201603129	40	14.09	72	35.38	79	0.00	1.00	0.02	0
MAB	201603130	40	11.03	72	38.57	97	0.00	1.33	0.02	0
MAB	201603131	40	11.21	72	31.66	43	0.00	0.66	0.01	0
MAB	201603132	40	15.75	72	28.84	972	0.02	9.50	0.22	0
MAB	201603133	40	10.12	72	27.06	20	0.00	0.15	0.00	0
MAB	201603134	40	9.05	72	23.67	13	0.00	0.20	0.00	0
MAB	201603135	40	9.98	72	16.90	35	0.00	0.40	0.01	0
MAB	201603136	40	8.77	72	11.96	1	0.00	0.01	0.00	0
MAB	201603137	40	8.88	72	9.93	16	0.00	0.10	0.00	0
MAB	201603139	40	8.93	72	1.95	90	0.00	1.00	0.02	0
MAB	201603140	40	5.26	72	2.76	7	0.00	0.01	0.00	0
MAB	201603141	40	2.87	72	21.65	103	0.00	1.10	0.02	0
MAB	201603142	39	55.90	72	25.68	35	0.00	0.25	0.01	0
MAB	201603143	39	57.93	72	33.15	207	0.01	2.00	0.04	0

MAB	201603144	40	2.21	72	33.83	334	0.01	3.25	0.07	0.07
MAB	201603145	40	2.67	72	36.41	66	0.00	1.00	0.01	0.07
MAB	201603146	40	4.96	72	38.82	473	0.01	4.75	0.10	0
MAB	201603147	39	59.89	72	50.44	197	0.01	2.50	0.04	0
MAB	201603148	39	56.60	72	46.89	84	0.00	1.33	0.02	0
MAB	201603149	39	55.72	72	41.43	31	0.00	0.50	0.01	0
MAB	201603150	39	54.93	72	42.95	54	0.00	1.00	0.01	0
MAB	201603151	39	49.91	72	47.37	63	0.00	1.00	0.01	0
MAB	201603152	39	52.71	73	1.72	166	0.01	2.50	0.03	0
MAB	201603153	39	53.74	73	3.20	30	0.00	0.80	0.01	0
MAB	201603154	39	49.78	73	7.58	53	0.00	0.66	0.01	0.13
MAB	201603155	39	47.98	73	8.88	44	0.00	0.66	0.01	0
MAB	201603156	39	48.77	73	0.42	10	0.00	0.10	0.00	0
MAB	201603158	39	45.93	72	56.18	21	0.00	0.50	0.00	0
MAB	201603159	39	45.57	72	53.51	1	0.00	0.01	0.00	0
MAB	201603160	39	47.34	72	43.87	47	0.00	0.75	0.01	0.13
MAB	201603161	39	45.14	72	39.40	70	0.00	0.90	0.02	0.20
MAB	201603162	39	41.95	72	38.89	15	0.00	0.10	0.00	0.07
MAB	201603163	39	43.03	72	42.63	38	0.00	0.40	0.01	0
MAB	201603164	39	40.76	72	51.47	478	0.01	5.50	0.10	0
MAB	201603165	39	41.35	72	56.87	34	0.00	0.50	0.01	0.07
MAB	201603166	39	33.03	73	1.71	90	0.00	1.20	0.02	0.07
MAB	201603167	39	27.52	73	3.20	152	0.00	2.10	0.04	0.07
MAB	201603168	39	26.01	73	2.03	428	0.01	6.00	0.09	0.07
MAB	201603169	39	24.70	73	6.22	288	0.01	3.00	0.06	0.13
MAB	201603170	39	23.35	73	8.84	62	0.00	0.90	0.01	0
MAB	201603171	39	24.19	73	10.33	40	0.00	0.50	0.01	0
MAB	201603172	39	26.05	73	12.13	69	0.00	0.90	0.01	0
MAB	201603173	39	22.72	73	14.79	229	0.01	2.50	0.05	0.07
MAB	201603174	39	22.12	73	18.57	176	0.01	1.75	0.04	0
MAB	201603175	39	23.95	73	20.14	23	0.00	0.33	0.01	0.13
MAB	201603176	39	22.05	73	22.93	35	0.00	0.33	0.01	0
MAB	201603177	39	20.70	73	20.38	56	0.00	0.75	0.01	0
MAB	201603178	39	20.47	73	17.69	201	0.01	2.00	0.04	0
MAB	201603179	39	21.08	73	11.38	52	0.00	0.80	0.01	0
MAB	201603180	39	18.67	73	12.58	6	0.00	0.07	0.00	0.14
MAB	201603181	39	18.39	73	14.84	36	0.00	0.50	0.01	0
MAB	201603182	39	16.41	73	14.52	100	0.00	1.00	0.02	0.20
MAB	201603183	39	17.44	73	17.13	58	0.00	0.50	0.01	0
MAB	201603184	39	18.39	73	22.58	91	0.00	1.00	0.02	0
MAB	201603185	39	16.56	73	22.61	38	0.00	0.50	0.01	0

MAB	201603187	39	11.71	73	20.26	119	0.00	1.10	0.02	0
MAB	201603188	39	12.37	73	18.33	275	0.01	2.50	0.06	0
MAB	201603189	39	10.48	73	17.52	78	0.00	1.00	0.01	0
MAB	201603190	39	8.78	73	20.90	241	0.01	3.50	0.05	0
MAB	201603191	39	10.23	73	24.64	111	0.00	1.50	0.02	0
MAB	201603192	39	9.88	73	26.58	42	0.00	0.50	0.01	0.07
MAB	201603193	39	10.36	73	30.28	82	0.00	1.00	0.02	0.13
MAB	201603194	39	8.86	73	28.67	69	0.00	0.90	0.01	0.13
MAB	201603195	39	8.12	73	23.97	302	0.01	3.01	0.06	0
MAB	201603196	39	6.70	73	21.83	201	0.01	2.00	0.05	0.07
MAB	201603197	39	4.48	73	23.49	155	0.01	1.80	0.03	0.27
MAB	201603198	39	3.92	73	25.01	207	0.01	2.10	0.04	0.33
MAB	201603199	39	4.98	73	26.63	663	0.01	7.10	0.14	0.07
MAB	201603200	39	5.47	73	29.43	216	0.01	2.00	0.04	0.20
MAB	201603201	39	5.70	73	32.00	43	0.00	0.50	0.01	0.27
MAB	201603202	39	4.65	73	35.43	87	0.00	0.90	0.02	0.20
MAB	201603203	39	1.63	73	33.81	593	0.01	7.50	0.13	0.27
MAB	201603204	39	2.48	73	29.60	259	0.01	2.75	0.06	0.13
MAB	201603206	39	2.03	73	26.15	472	0.01	5.50	0.11	0
MAB	201603207	39	0.78	73	27.95	483	0.01	5.50	0.10	0
MAB	201603208	38	57.70	73	32.78	173	0.01	1.80	0.03	0.40
MAB	201603209	38	58.46	73	37.18	153	0.00	1.60	0.03	0.13
MAB	201603210	38	55.34	73	34.07	73	0.00	0.90	0.02	0.20
MAB	201603211	38	53.32	73	33.47	612	0.02	6.00	0.12	0.07
MAB	201603212	38	51.71	73	34.97	333	0.01	3.00	0.07	0
MAB	201603213	38	51.54	73	41.01	140	0.00	1.50	0.03	0
MAB	201603214	38	50.00	73	34.80	251	0.01	4.00	0.05	0
MAB	201603215	38	46.37	73	36.76	94	0.00	1.00	0.02	0.13
MAB	201603216	38	46.64	73	37.98	1,948	0.04	19.00	0.41	0.07
MAB	201603217	38	47.51	73	39.78	1,280	0.03	11.00	0.24	0.07
MAB	201603218	38	46.62	73	45.30	770	0.02	6.50	0.17	0.07
MAB	201603219	38	45.36	73	46.92	2,023	0.05	19.00	0.44	0.33
MAB	201603220	38	42.74	73	41.96	2,336	0.06	21.00	0.50	0.33
MAB	201603221	38	41.03	73	46.09	2,996	0.08	27.00	0.62	0.20
MAB	201603222	38	37.98	73	44.99	436	0.01	4.50	0.09	0.27
MAB	201603223	38	39.23	73	47.15	453	0.01	4.10	0.09	0.07
MAB	201603224	38	39.39	73	49.68	1,868	0.05	19.00	0.39	0.07
MAB	201603225	38	39.91	73	52.69	4,776	0.12	53.50	1.00	0.13
MAB	201603226	38	37.81	73	51.44	1,079	0.03	11.00	0.24	0.13
MAB	201603227	38	37.27	73	53.57	980	0.02	8.75	0.24	0
MAB	201603228	38	38.06	73	56.74	891	0.02	12.00	0.22	0.13

MAB	201603229	38	38.31	73	58.74	293	0.01	3.25	0.07	0.47
MAB	201603230	38	36.56	74	0.75	3,923	0.05	90.00	0.90	0.13
MAB	201603231	38	36.09	73	55.78	1,968	0.03	40.25	0.43	0.13
MAB	201603232	38	34.95	73	52.41	2,406	0.03	42.50	0.51	0.27
MAB	201603233	38	34.03	73	54.54	5,226	0.07	86.00	1.20	0
MAB	201603234	38	32.60	73	52.79	668	0.01	8.00	0.14	0.40
NLCA	201604001	40	39.98	69	59.27	0	0.00	0.00	0.00	0
NLCA	201604002	40	40.93	69	50.12	1	0.00	0.01	0.00	0
NLCA	201604003	40	40.28	69	43.24	3	0.00	0.01	0.00	0
NLCA	201604004	40	38.95	69	33.44	0	0.00	0.00	0.00	0
NLCA	201604005	40	37.51	69	29.33	1	0.00	0.01	0.00	0
NLCA	201604006	40	40.90	69	24.52	0	0.00	0.00	0.00	0
NLCA	201604007	40	41.77	69	26.81	0	0.00	0.00	0.00	0
NLCA	201604008	40	44.30	69	27.58	0	0.00	0.00	0.00	0
NLCA	201604009	40	48.68	69	26.66	0	0.00	0.00	0.00	0
NLCA	201604010	40	48.46	69	21.14	0	0.00	0.00	0.00	0
NLCA	201604011	40	45.41	69	22.83	4	0.00	0.01	0.00	0
NLCA	201604012	40	43.87	69	20.50	0	0.00	0.00	0.00	0
NLCA	201604013	40	42.31	69	17.94	119	0.01	1.40	0.02	0
NLCA	201604014	40	43.84	69	17.84	1,207	0.04	13.25	0.22	0
NLCA	201604016	40	46.34	69	11.73	94	0.00	1.10	0.02	0
NLCA	201604017	40	42.68	69	12.03	98	0.00	1.10	0.02	0
NLCA	201604018	40	41.04	69	14.21	160	0.01	2.00	0.03	0
NLCA	201604019	40	38.46	69	13.56	339	0.01	4.00	0.06	0
NLCA	201604020	40	37.68	69	17.75	57	0.00	0.80	0.01	0
NLCA	201604021	40	35.61	69	21.28	158	0.01	2.33	0.03	0
NLCA	201604022	40	32.45	69	21.05	318	0.01	4.00	0.06	0
NLCA	201604023	40	31.26	69	23.59	82	0.00	1.00	0.02	0
NLCA	201604024	40	32.15	69	29.78	686	0.03	9.00	0.14	0
NLCA	201604025	40	32.12	69	33.62	2,401	0.06	30.00	0.47	0
NLCA	201604026	40	31.60	69	37.04	16	0.00	0.33	0.00	0
NLCA	201604027	40	34.08	69	38.94	117	0.00	1.33	0.02	0
NLCA	201604028	40	35.37	69	35.73	10,649	0.31	119.00	2.13	0
NLCA	201604029	40	37.59	69	39.30	12	0.00	0.33	0.00	0
NLCA	201604030	40	36.30	69	46.13	7	0.00	0.10	0.00	0
NLCA	201604031	40	36.91	69	48.94	1	0.00	0.01	0.00	0
NLCA	201604032	40	35.48	69	53.69	0	0.00	0.00	0.00	0
NLCA	201604033	40	33.68	69	57.97	0	0.00	0.00	0.00	0
NLCA	201604034	40	33.15	69	57.08	0	0.00	0.00	0.00	0
NLCA	201604035	40	33.37	69	52.74	5,648	0.10	78.00	1.09	0
NLCA	201604036	40	31.40	69	54.62	0	0.00	0.00	0.00	0

NLCA	201604037	40	29.37	69	53.68	0	0.00	0.00	0.00	0
NLCA	201604038	40	30.01	69	50.31	0	0.00	0.00	0.00	0
NLCA	201604039	40	31.18	69	46.49	6,207	0.10	87.00	1.22	0
NLCA	201604040	40	30.84	69	41.36	5,750	0.07	120.00	1.18	0
NLCA	201604041	40	29.15	69	43.22	4	0.00	0.01	0.00	0
NLCA	201604042	40	28.30	69	40.12	28	0.00	0.25	0.01	0
NLCA	201604043	40	28.34	69	36.48	35	0.00	0.50	0.01	0
NLCA	201604044	40	26.35	69	32.66	163	0.01	1.90	0.03	0
NLCA	201604045	40	26.53	69	38.55	54	0.00	0.80	0.01	0
NLCA	201604046	40	26.45	69	41.51	3	0.00	0.01	0.00	0
NLCA	201604047	40	25.28	69	44.53	1	0.00	0.01	0.00	0
NLCA	201604048	40	21.43	69	44.37	0	0.00	0.00	0.00	0
NLCA	201604049	40	20.16	69	40.80	0	0.00	0.00	0.00	0
NLCA	201604050	40	21.90	69	39.49	1	0.00	0.01	0.00	0
NLCA	201604051	40	22.44	69	36.81	1	0.00	0.01	0.00	0
NLCA	201604052	40	20.54	69	34.28	0	0.00	0.00	0.00	0
NLCA	201604053	40	22.11	69	31.76	3	0.00	0.03	0.00	0
NLCA	201604054	40	21.41	69	27.58	404	0.00	8.50	0.08	0
NLCA	201604055	40	23.70	69	26.88	797	0.01	19.00	0.17	0
NLCA	201604056	40	22.21	69	24.61	189	0.00	8.50	0.04	0
NLCA	201604057	40	24.07	69	23.29	1,775	0.02	42.00	0.34	0
NLCA	201604058	40	20.60	69	20.36	0	0.00	0.00	0.00	0
NLCA	201604059	40	23.50	69	19.42	2,184	0.02	60.00	0.42	0
NLCA	201604060	40	26.28	69	19.24	4,456	0.07	73.00	0.86	0
NLCA	201604061	40	29.26	69	20.44	2,631	0.08	34.00	0.50	0
NLCA	201604062	40	30.73	69	14.87	1,921	0.06	22.00	0.38	0
NLCA	201604063	40	32.05	69	15.29	1,609	0.06	24.50	0.31	0
NLCA	201604064	40	34.39	69	14.18	986	0.04	11.00	0.19	0
NLCA	201604066	40	34.35	69	10.77	1,962	0.07	23.00	0.39	0
NLCA	201604067	40	34.30	69	8.81	299	0.01	3.50	0.06	0
NLCA	201604068	40	33.81	69	7.27	213	0.01	2.40	0.04	0
NLCA	201604069	40	33.48	69	5.91	93	0.00	1.10	0.02	0
NLCA	201604070	40	30.79	69	8.74	0	0.00	0.00	0.00	0
NLCA	201604071	40	28.58	69	8.91	70	0.00	1.00	0.01	0
NLCA	201604072	40	25.94	69	13.17	972	0.01	24.25	0.19	0
NLCA	201604073	40	23.58	69	14.65	0	0.00	0.01	0.00	0
NLCA	201604074	40	20.70	69	11.47	0	0.00	0.00	0.00	0
NLCA	201604075	40	23.19	69	9.38	0	0.00	0.01	0.00	0
NLCA	201604076	40	24.81	69	5.63	3	0.00	0.01	0.00	0
NLCA	201604077	40	21.88	69	4.93	1	0.00	0.01	0.00	0
NLCA	201604078	40	21.15	69	2.65	0	0.00	0.00	0.00	0

NLCA	201604079	40	22.52	69	0.23	0	0.00	0.00	0.00	0
NLCA	201604080	40	23.44	68	58.09	0	0.00	0.01	0.00	0
NLCA	201604081	40	21.81	68	54.28	0	0.00	0.00	0.00	0
NLCA	201604082	40	22.96	68	51.21	0	0.00	0.00	0.00	0
NLCA	201604083	40	23.21	68	50.04	0	0.00	0.00	0.00	0
NLCA	201604084	40	24.15	68	53.31	1	0.00	0.01	0.00	0
NLCA	201604085	40	25.16	68	52.60	0	0.00	0.00	0.00	0
NLCA	201604086	40	26.84	68	49.49	0	0.00	0.00	0.00	0
NLCA	201604087	40	28.76	68	50.11	4	0.00	0.05	0.00	0
NLCA	201604088	40	28.87	68	51.12	2	0.00	0.04	0.00	0
NLCA	201604089	40	32.13	68	51.46	32	0.00	0.50	0.01	0
NLCA	201604090	40	31.51	68	52.30	361	0.01	4.50	0.07	0
NLCA	201604091	40	29.43	68	53.89	4,405	0.10	46.00	0.84	0
NLCA	201604092	40	31.57	68	55.70	309	0.01	4.50	0.06	0
NLCA	201604093	40	30.20	68	57.00	139	0.00	1.50	0.03	0
NLCA	201604094	40	28.27	68	59.00	13	0.00	0.10	0.00	0
NLCA	201604095	40	26.75	69	1.55	6	0.00	0.08	0.00	0
NLCA	201604096	40	28.71	69	3.39	2,776	0.06	26.00	0.53	0
NLCA	201604097	40	30.06	69	1.71	66	0.00	1.00	0.01	0
NLCA	201604098	40	31.46	68	59.50	144	0.01	1.75	0.03	0
NLCA	201604099	40	33.72	69	0.40	97	0.00	1.10	0.02	0
NLCA	201604100	40	32.73	69	2.94	1,213	0.04	13.50	0.22	0
NLCA	201604101	40	34.80	69	3.90	873	0.03	10.00	0.17	0
NLCA	201604102	40	36.39	69	2.76	782	0.03	9.00	0.16	0
NLCA	201604103	40	38.10	69	0.04	100	0.00	1.00	0.02	0
NLCA	201604105	40	42.26	69	3.13	339	0.01	4.25	0.07	0
NLCA	201604106	40	44.14	69	3.37	255	0.01	3.00	0.05	0
NLCA	201604108	40	48.66	69	2.60	468	0.02	6.50	0.09	0
NLCA	201604109	40	47.37	69	6.62	97	0.00	1.50	0.02	0
NLCA	201604110	40	43.91	69	5.73	585	0.02	7.00	0.11	0
NLCA	201604111	40	41.30	69	6.11	257	0.01	3.25	0.05	0
NLCA	201604112	40	38.12	69	8.30	569	0.02	7.25	0.11	0
NLCA	201604113	40	38.26	69	10.02	790	0.03	8.25	0.16	0
CA II	201605001	41	18.39	67	18.80	0	0.00	0.00	0.00	0
CA II	201605003	41	22.99	67	16.10	0	0.00	0.00	0.00	0
CA II	201605004	41	23.43	67	13.52	0	0.00	0.00	0.00	0
CA II	201605008	41	29.88	67	9.19	0	0.00	0.00	0.00	0
CA II	201605009	41	29.20	67	1.53	0	0.00	0.00	0.00	0
CA II	201605010	41	24.22	67	5.01	0	0.00	0.00	0.00	0
CA II	201605012	41	22.47	66	59.46	0	0.00	0.00	0.00	0
CA II	201605013	41	23.28	66	56.61	1	0.00	1.00	0.00	0

CA II	201605014	41	27.95	66	56.22	0	0.00	0.00	0.00	0
CA II	201605015	41	25.79	66	54.22	8	0.00	0.08	0.00	0
CA II	201605016	41	22.99	66	53.00	29	0.00	0.50	0.01	0
CA II	201605017	41	19.27	66	56.40	41	0.00	0.75	0.01	0
CA II	201605018	41	16.58	66	53.24	52	0.00	0.80	0.01	0
CA II	201605019	41	18.40	66	50.08	75	0.00	1.10	0.01	0
CA II	201605020	41	24.79	66	47.53	95	0.00	1.75	0.02	0
CA II	201605021	41	23.53	66	45.20	137	0.01	2.00	0.03	0
CA II	201605022	41	23.09	66	41.31	118	0.00	1.66	0.02	0
CA II	201605023	41	26.10	66	39.39	131	0.01	2.00	0.03	0
CA II	201605024	41	29.45	66	42.07	40	0.00	0.60	0.01	0
CA II	201605025	41	29.72	66	36.37	159	0.01	2.00	0.03	0
CA II	201605026	41	27.20	66	33.43	425	0.01	5.25	0.08	0
CA II	201605027	41	24.39	66	34.88	576	0.02	6.00	0.11	0
CA II	201605028	41	24.62	66	31.87	679	0.02	8.00	0.13	0
CA II	201605029	41	20.77	66	35.87	598	0.02	6.25	0.12	0
CA II	201605031	41	17.32	66	43.54	200	0.01	2.00	0.04	0
CA II	201605033	41	17.44	66	38.51	474	0.02	4.50	0.09	0
CA II	201605034	41	14.89	66	36.86	994	0.03	9.80	0.18	0
CA II	201605035	41	12.78	66	33.18	2,501	0.06	25.00	0.49	0
CA II	201605036	41	16.57	66	34.36	1,658	0.05	15.00	0.30	0
CA II	201605037	41	19.56	66	31.50	2,062	0.05	19.00	0.40	0
CA II	201605038	41	22.63	66	28.90	452	0.01	5.00	0.09	0
CA II	201605039	41	18.36	66	28.42	1,271	0.03	17.50	0.24	0
CA II	201605040	41	15.56	66	24.64	21	0.00	0.20	0.00	0
CA II	201605041	41	11.99	66	26.11	0	0.00	0.00	0.00	0
CA II	201605042	41	9.60	66	28.49	0	0.00	0.00	0.00	0
CA II	201605043	41	4.49	66	30.28	0	0.00	0.00	0.00	0
CA II	201605044	41	8.64	66	36.86	890	0.03	8.50	0.18	0
CA II	201605045	41	12.10	66	41.00	409	0.01	4.85	0.09	0
CA II	201605046	41	12.19	66	45.40	143	0.01	2.00	0.03	0
CA II	201605047	41	8.78	66	40.43	1,088	0.03	12.00	0.21	0
CA II	201605048	41	5.74	66	41.98	2,969	0.09	33.00	0.57	0
CA II	201605049	41	4.72	66	38.21	824	0.02	8.00	0.16	0
CA II	201605050	41	2.20	66	38.65	319	0.01	4.00	0.06	0
CA II	201605051	41	2.17	66	36.02	2	0.00	0.02	0.00	0
CA II	201605052	40	58.71	66	35.28	0	0.00	0.00	0.00	0
CA II	201605053	40	58.86	66	38.11	1	0.00	0.01	0.00	0
CA II	201605055	40	54.52	66	40.02	0	0.00	0.00	0.00	0
CA II	201605056	40	56.87	66	43.06	3	0.00	0.10	0.00	0
CA II	201605057	40	54.80	66	45.32	1	0.00	0.01	0.00	0

CA II	201605058	40	51.35	66	44.50	0	0.00	0.00	0.00	0
CA II	201605059	40	53.40	66	47.78	5	0.00	0.10	0.00	0
CA II	201605060	40	51.48	66	50.21	0	0.00	0.00	0.00	0
CA II	201605061	40	48.32	66	49.74	0	0.00	0.00	0.00	0
CA II	201605062	40	48.10	66	51.96	0	0.00	0.00	0.00	0
CA II	201605063	40	51.28	66	56.16	55	0.00	0.60	0.01	0
CA II	201605064	40	52.79	66	54.88	192	0.00	2.25	0.03	0
CA II	201605065	40	54.35	66	57.43	195	0.01	1.75	0.04	0
CA II	201605066	40	53.64	66	58.55	514	0.01	6.00	0.10	0
CA II	201605067	40	51.97	67	5.37	203	0.01	2.20	0.04	0
CA II	201605068	40	49.94	67	3.63	104	0.00	1.00	0.02	0
CA II	201605069	40	49.28	66	59.58	1	0.00	0.01	0.00	0
CA II	201605070	40	45.32	67	0.08	0	0.00	0.00	0.00	0
CA II	201605071	40	42.42	67	4.89	0	0.00	0.00	0.00	0
CA II	201605072	40	45.75	67	5.49	0	0.00	0.00	0.00	0
CA II	201605073	40	47.95	67	8.01	1	0.00	0.01	0.00	0
CA II	201605074	40	42.27	67	10.99	0	0.00	0.00	0.00	0
CA II	201605075	40	39.25	67	11.85	0	0.00	0.00	0.00	0
CA II	201605076	40	36.67	67	16.85	0	0.00	0.00	0.00	0
CA II	201605077	40	41.35	67	15.92	0	0.00	0.00	0.00	0
CA II	201605078	40	44.22	67	17.87	0	0.00	0.00	0.00	0
CA II	201605079	40	45.53	67	14.76	1	0.00	0.01	0.00	0
CA II	201605080	40	48.31	67	13.12	23	0.00	0.15	0.00	0
CA II	201605081	40	51.54	67	19.47	193	0.01	2.00	0.04	0
CA II	201605082	40	52.83	67	15.52	165	0.00	2.00	0.03	0
CA II	201605083	40	52.58	67	10.73	128	0.00	1.50	0.03	0
CA II	201605084	40	55.50	67	6.25	109	0.00	1.20	0.02	0
CA II	201605086	40	56.36	67	10.90	112	0.00	1.33	0.02	0
CA II	201605087	40	58.36	67	10.71	97	0.00	1.25	0.02	0
CA II	201605088	40	57.23	67	3.49	189	0.01	2.10	0.04	0
CA II	201605089	40	58.19	67	2.24	58	0.00	0.80	0.01	0
CA II	201605090	41	0.30	67	5.05	194	0.01	2.20	0.04	0
CA II	201605091	41	3.36	67	3.85	152	0.01	2.20	0.03	0
CA II	201605092	41	2.48	67	0.64	287	0.01	3.00	0.06	0
CA II	201605093	41	0.67	66	54.62	369	0.01	4.85	0.08	0
CA II	201605094	40	57.07	66	55.74	187	0.00	2.00	0.04	0
CA II	201605095	40	58.19	66	53.14	153	0.00	1.50	0.03	0
CA II	201605098	40	59.58	66	47.70	679	0.02	6.00	0.13	0
CA II	201605100	41	3.19	66	46.86	763	0.02	7.25	0.15	0
CA II	201605102	41	3.47	66	50.83	490	0.02	5.00	0.09	0
CA II	201605103	41	8.60	66	50.59	119	0.00	1.40	0.02	0

CA II	201605105	41	6.11	66	56.35	95	0.00	1.10	0.02	0
CA II	201605106	41	8.30	66	58.51	131	0.01	1.60	0.02	0
CA II	201605107	41	9.51	67	1.97	78	0.00	1.00	0.02	0
CA II	201605109	41	7.42	67	7.45	73	0.00	0.90	0.01	0
CA II	201605111	41	8.16	67	11.86	37	0.00	0.40	0.01	0
CA II	201605112	41	7.77	67	14.94	10	0.00	0.10	0.00	0
CA II	201605113	41	4.83	67	18.34	10	0.00	0.10	0.00	0
CA II	201605114	41	13.49	67	14.06	1	0.00	0.01	0.00	0
CA II	201605115	41	15.53	67	5.92	2	0.00	0.01	0.00	0
CA II	201605116	41	16.92	67	1.03	8	0.00	0.15	0.00	0

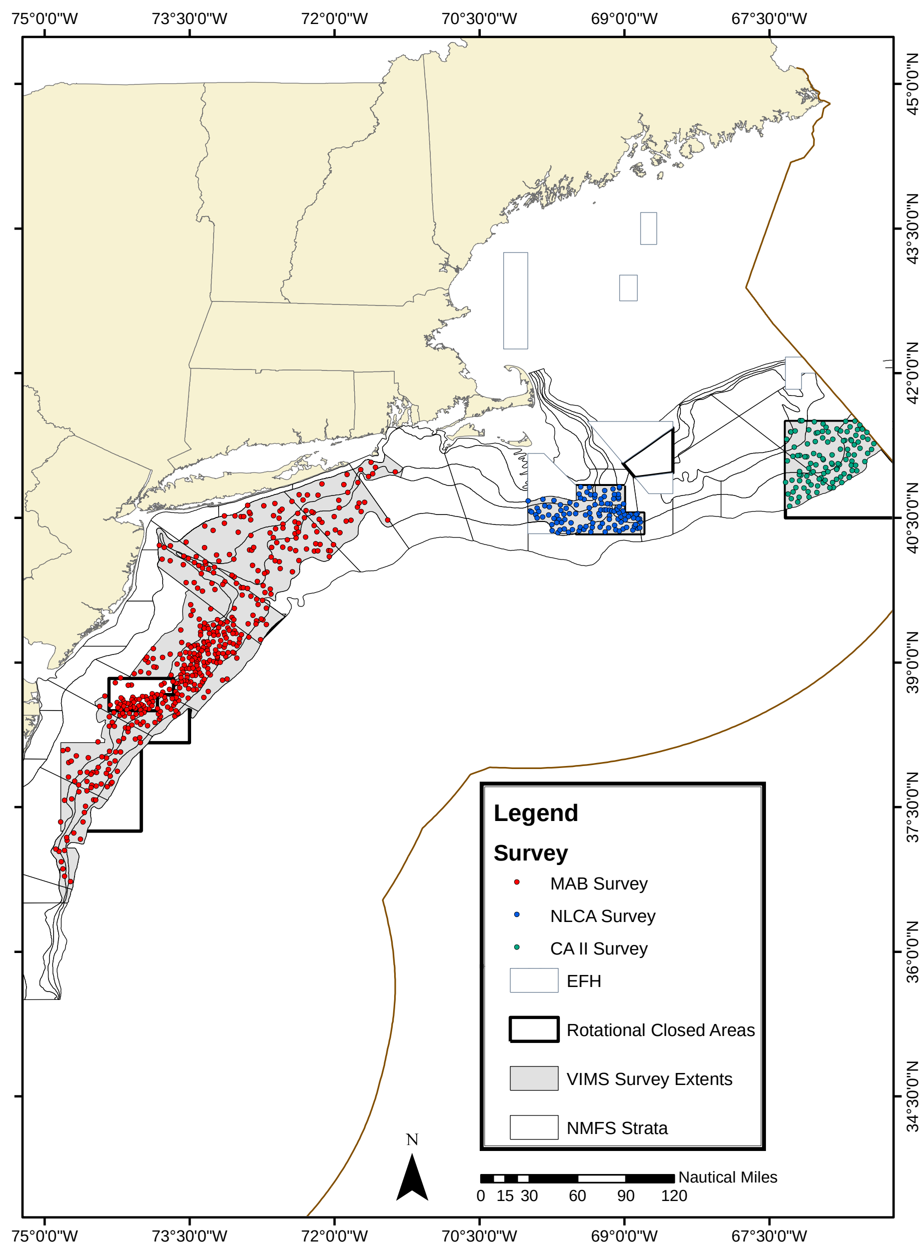


Figure 1. Survey domains with station locations for the VIMS/Industry cooperative surveys of the Mid-Atlantic sea scallop resource area, Nantucket Lightship Closed Area, and Closed Area II completed during May-June 2016.

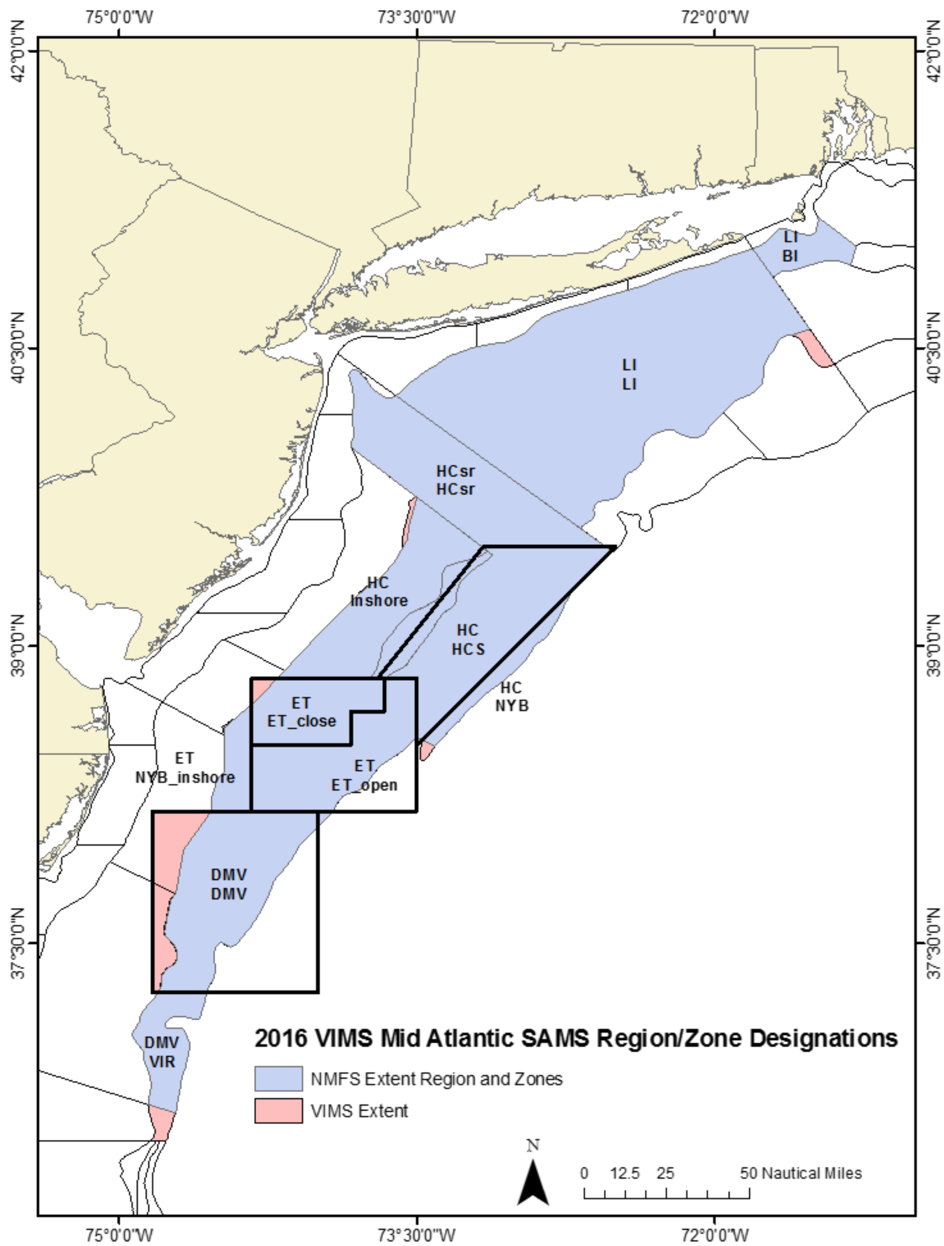


Figure 2. SAMS regions and zones used to calculate biomass estimates for the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource during May-June 2016.

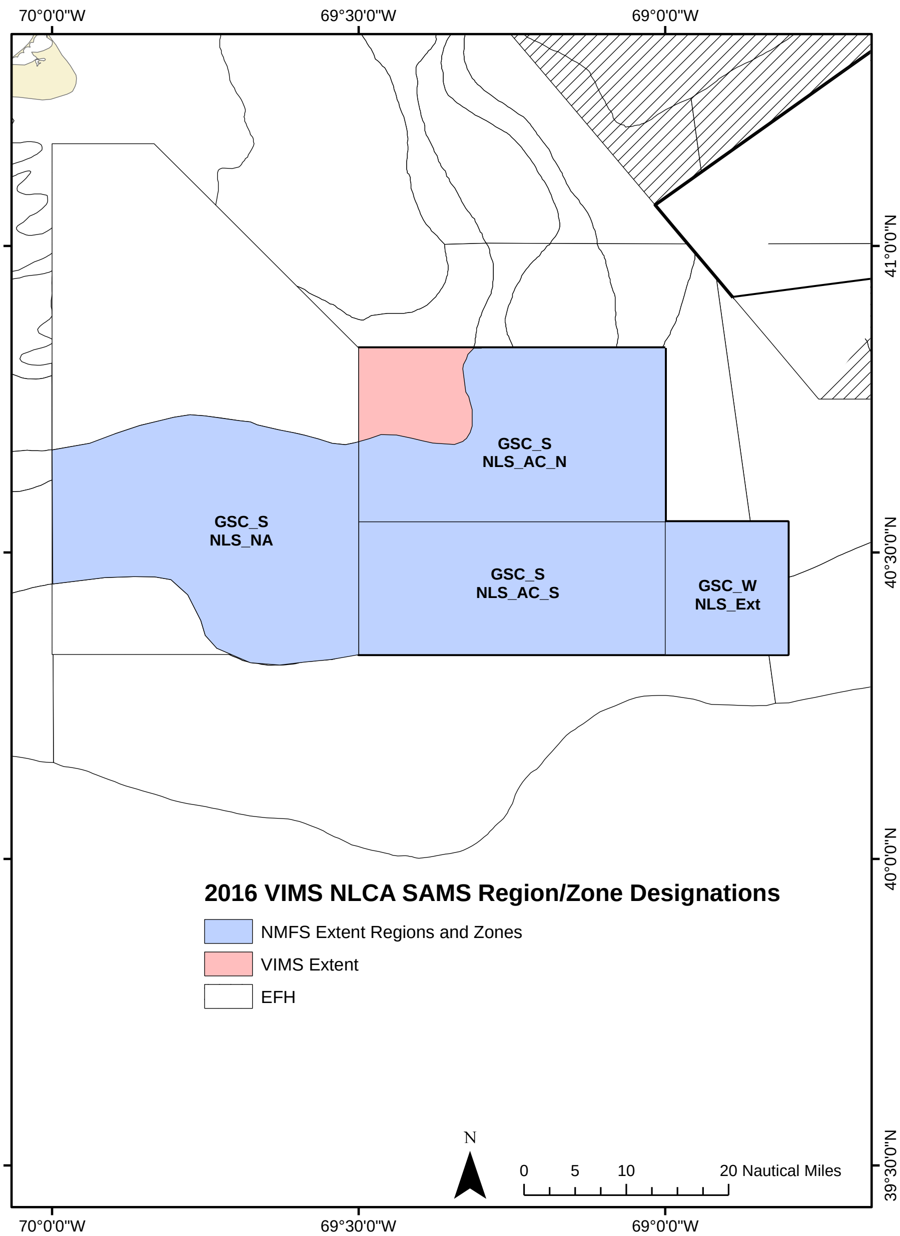


Figure 3. SAMS regions and zones used to calculate biomass estimates for the VIMS/Industry cooperative survey of the Nantucket Lightship access area and surrounds resource during May-June 2016.

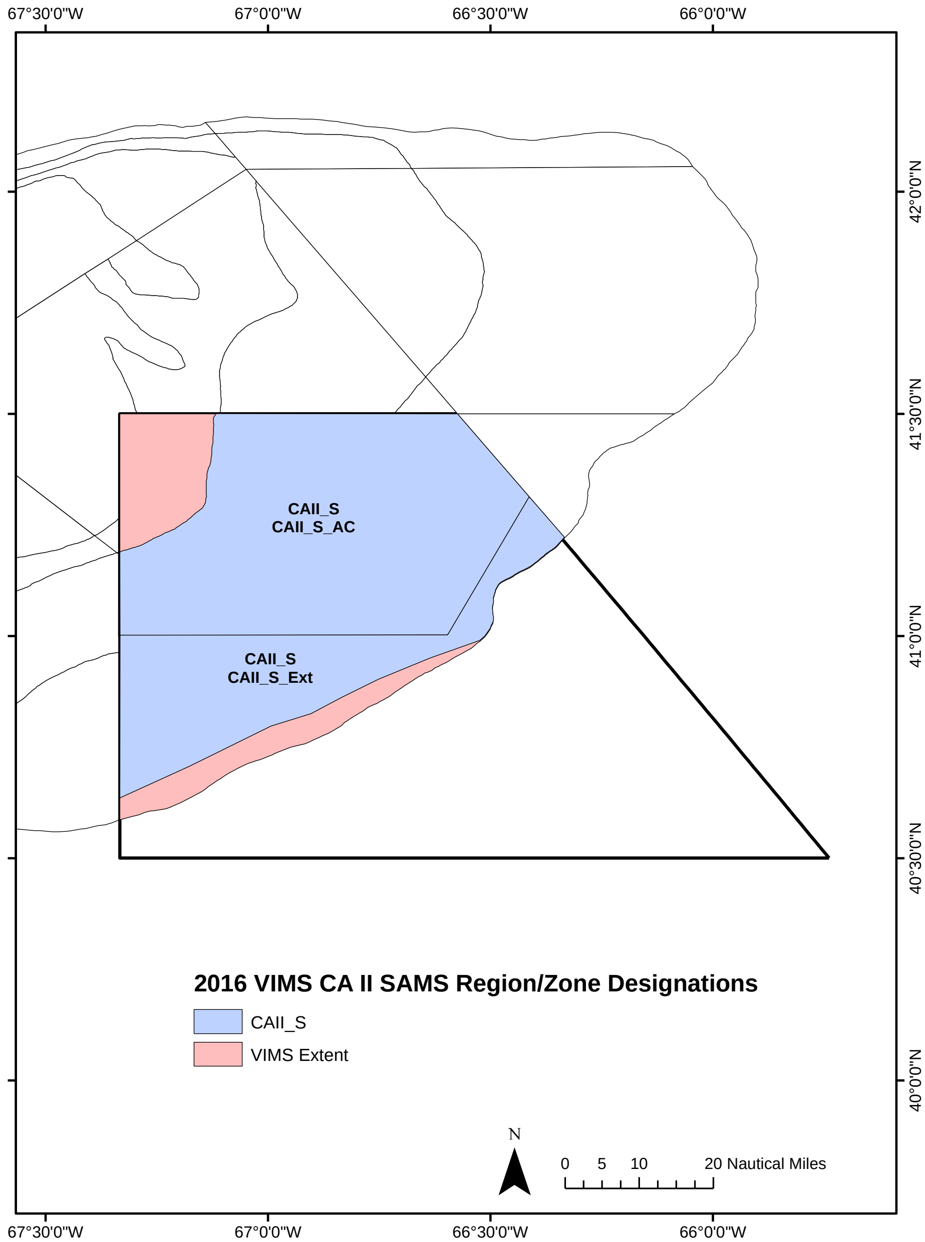


Figure 4. SAMS regions and zones used to calculate biomass estimates for the VIMS/Industry cooperative survey of the Closed Area II access area and southern Extension closure during May-June 2016.

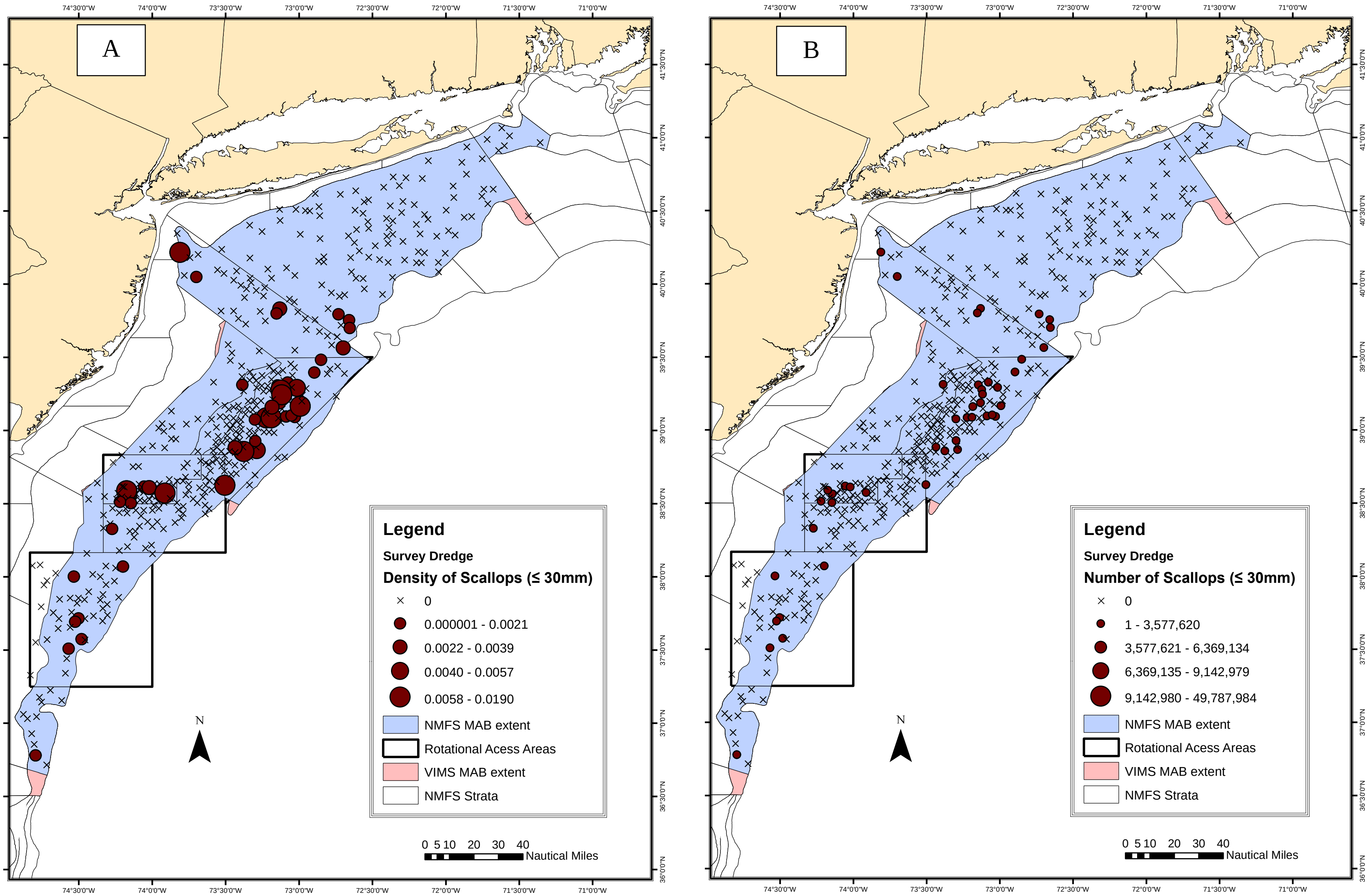


Figure 5. Density (A) and number (B) of scallops 0-30mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource during May-June 2016.

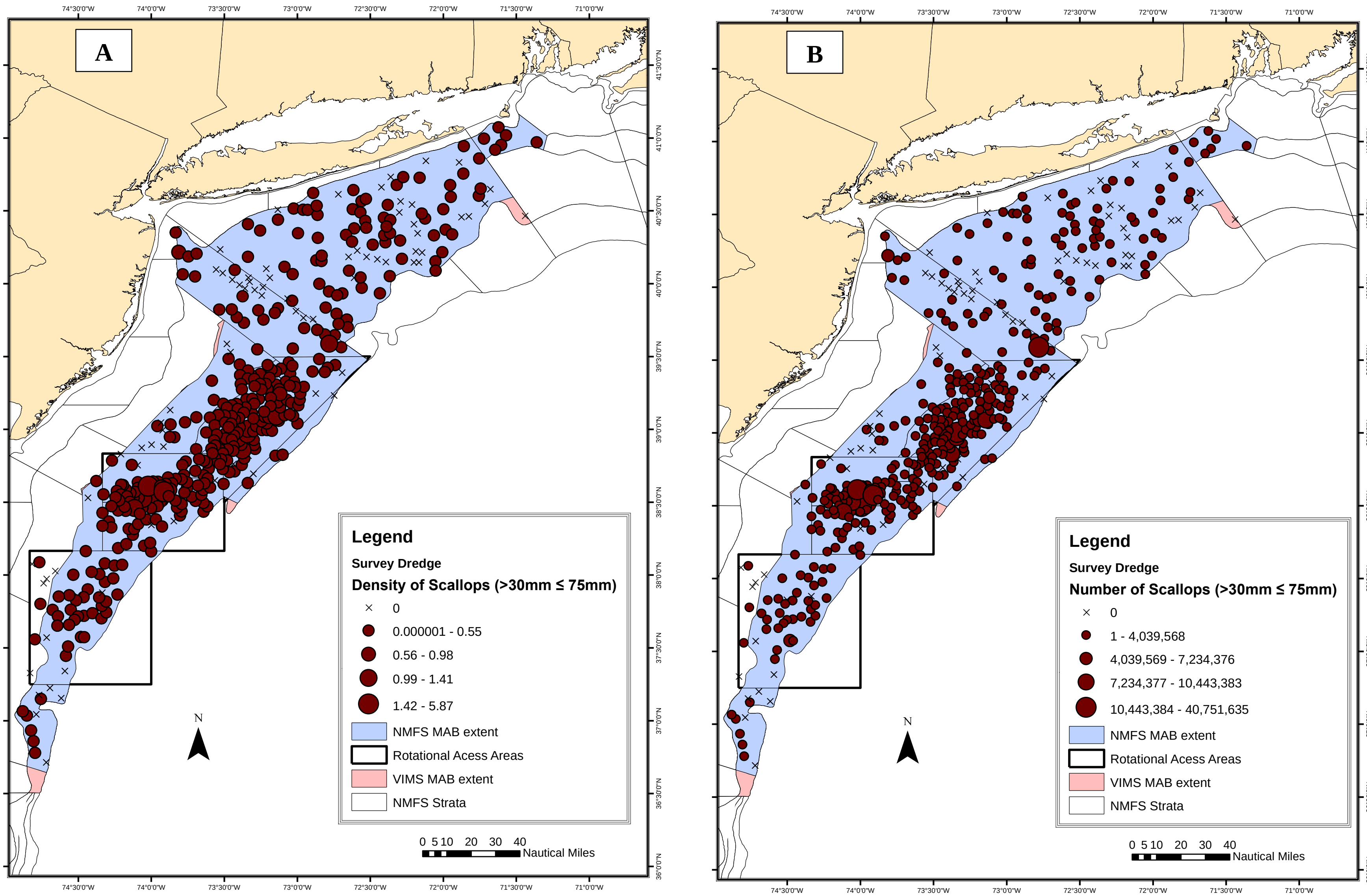


Figure 6. Density (A) and number (B) of scallops 31-75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource during May-June 2016.

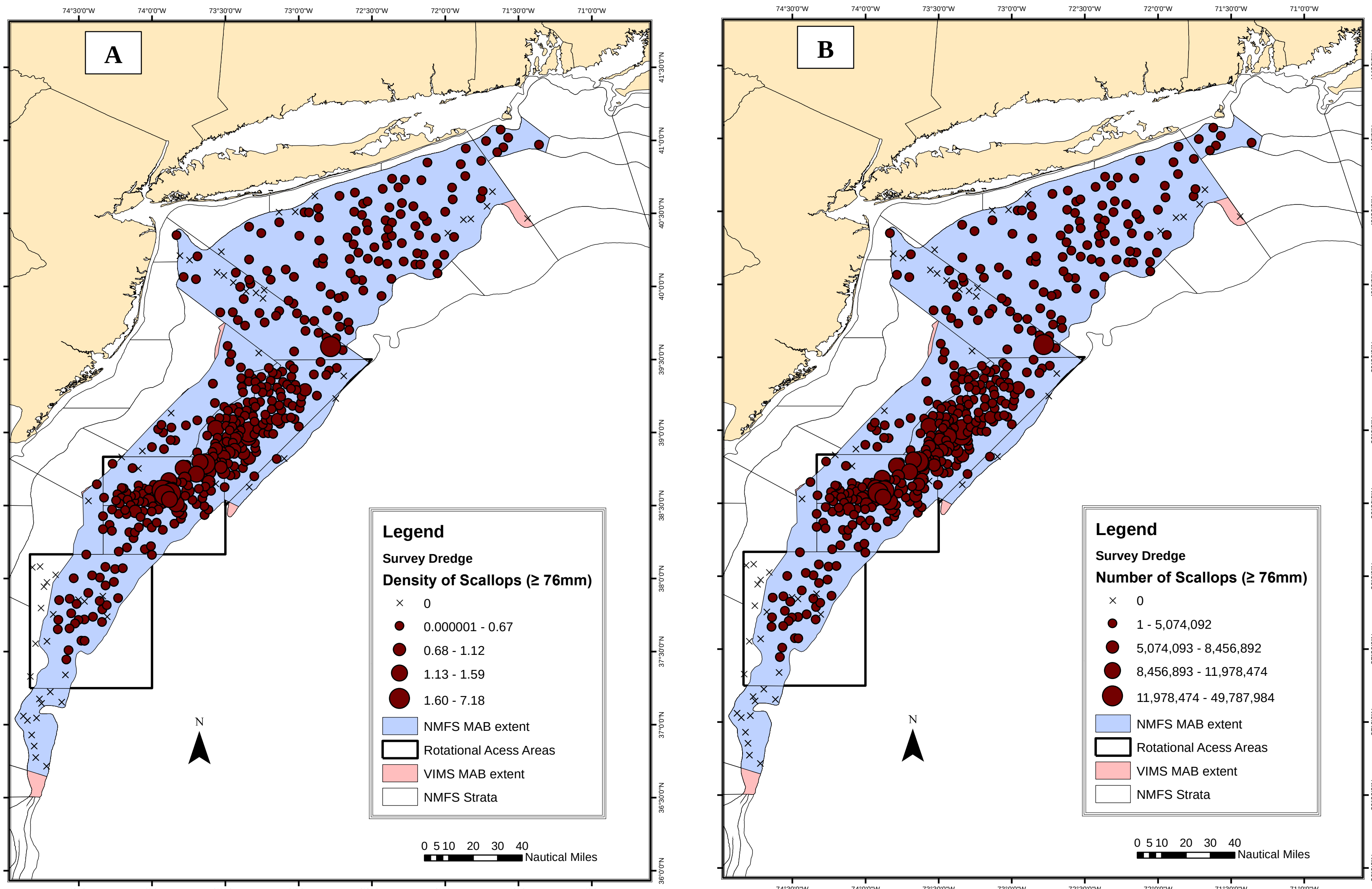


Figure 7. Density (A) and number (B) of scallops greater than 75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource during May-June 2016.

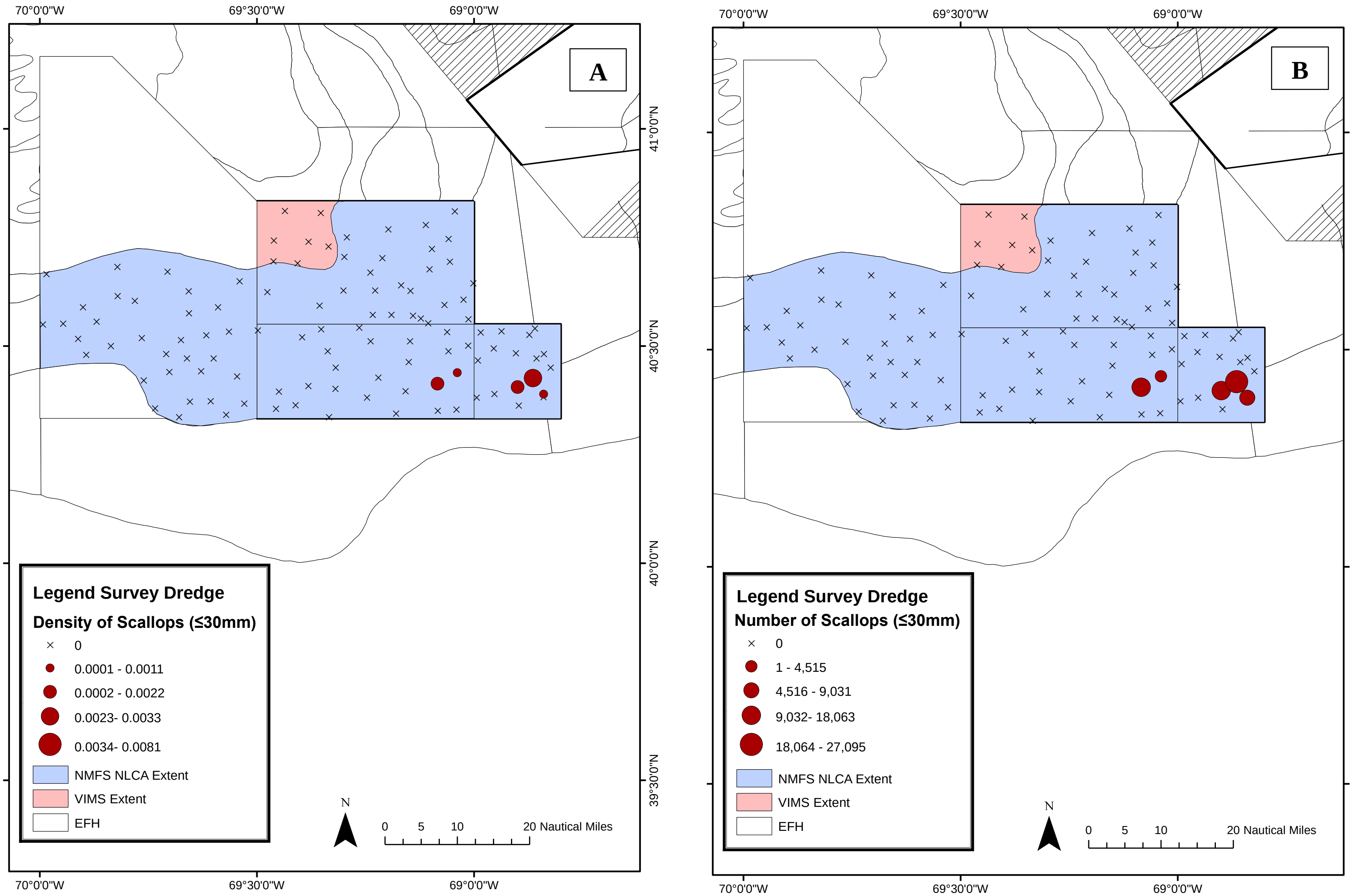


Figure 8. Density (A) and number (B) of scallops 0-30mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Nantucket Lightship Access Area and surrounds during May-June 2016.

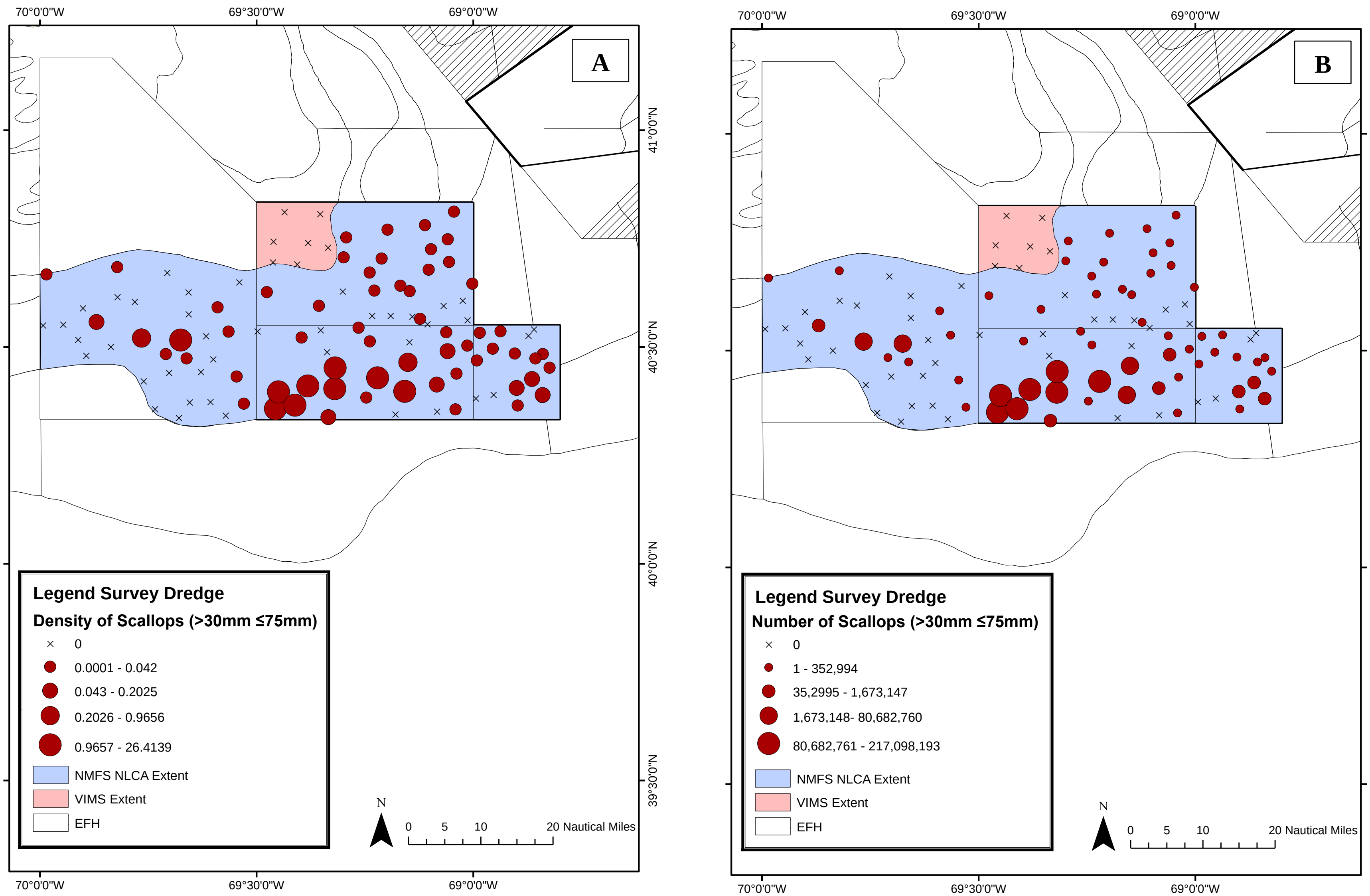


Figure 9. Density (A) and number (B) of scallops 31-75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Nantucket Lightship Access Area and surrounds during May-June 2016.

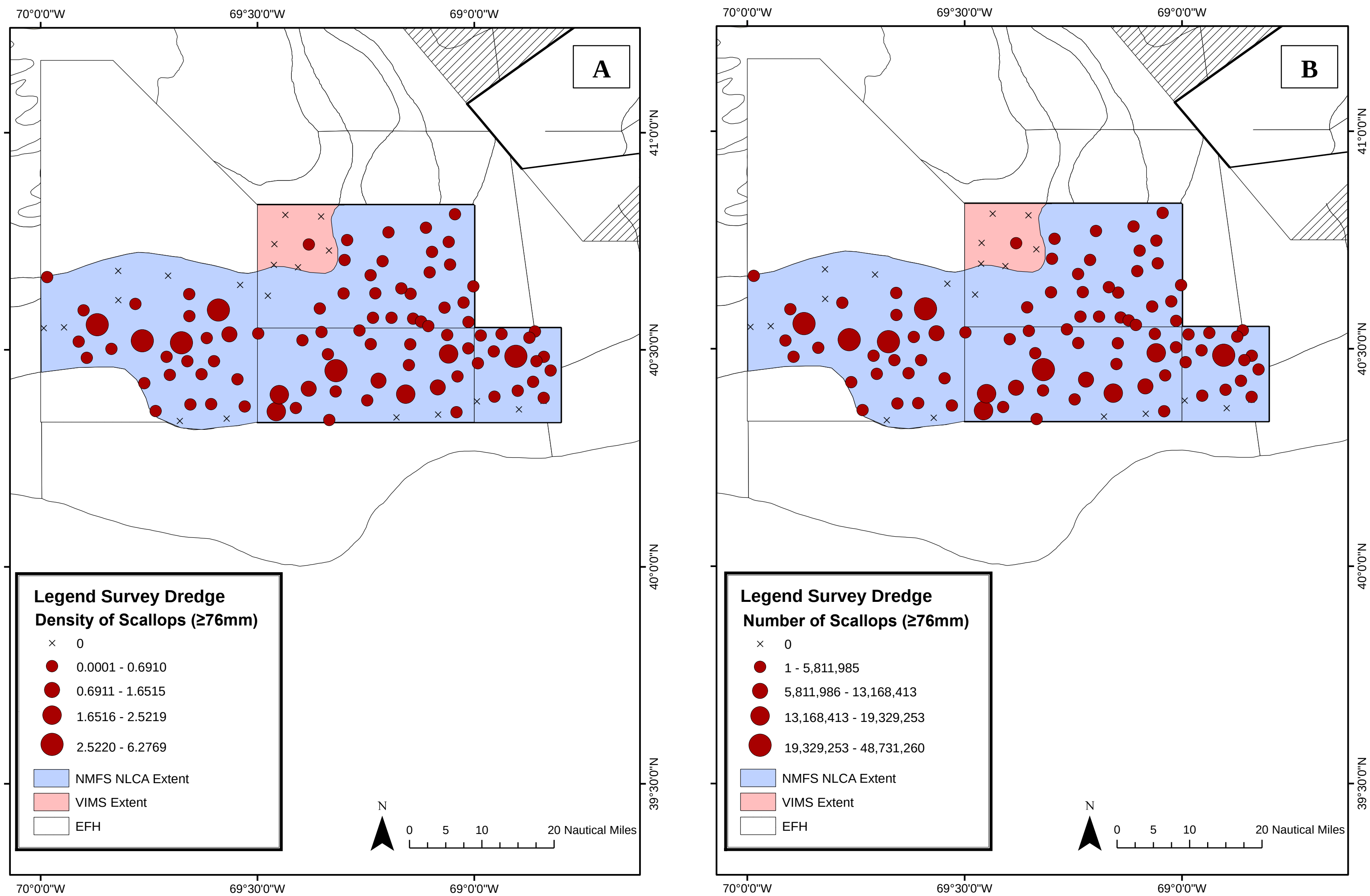


Figure 10. Density (A) and number (B) of scallops greater than 75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Nantucket Lightship Access Area and surrounds during May-June 2016.

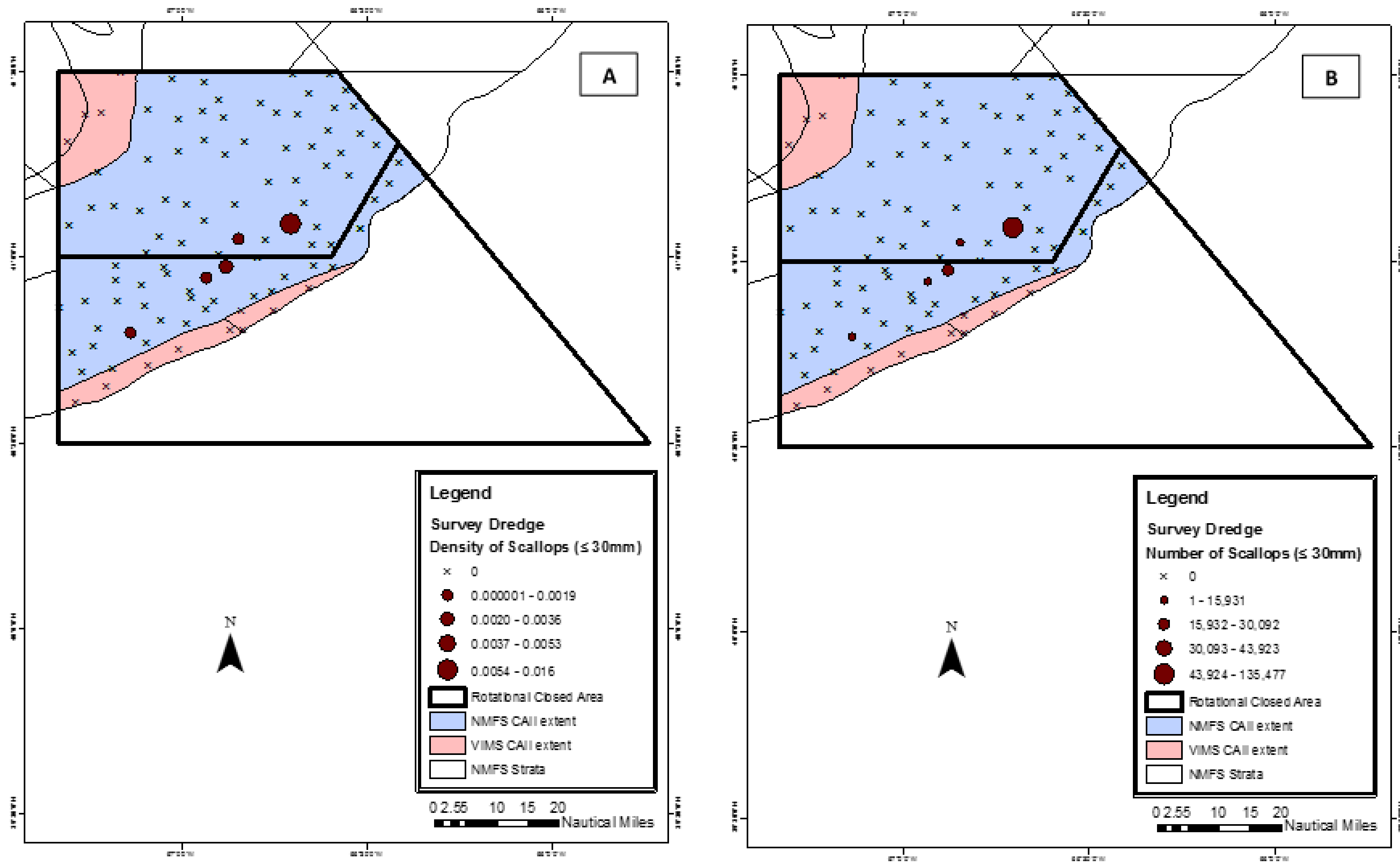


Figure 11. Density (A) and number (B) of scallops 0-30mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Closed Area II Access Area and southern Extension closure during May-June 2016.

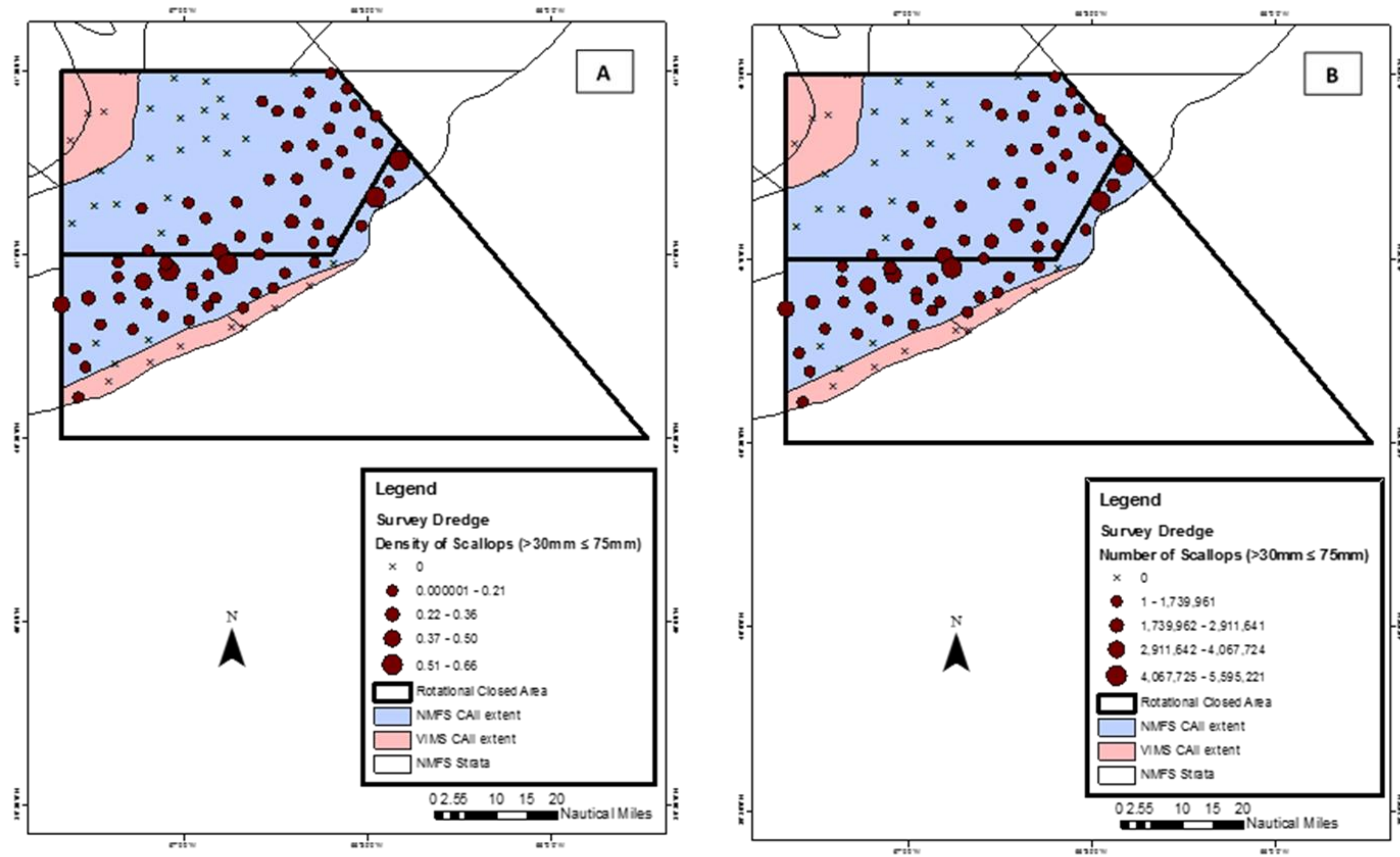


Figure 12. Density (A) and number (B) of scallops 31-75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Closed Area II Access Area and southern Extension closure during May-June 2016.

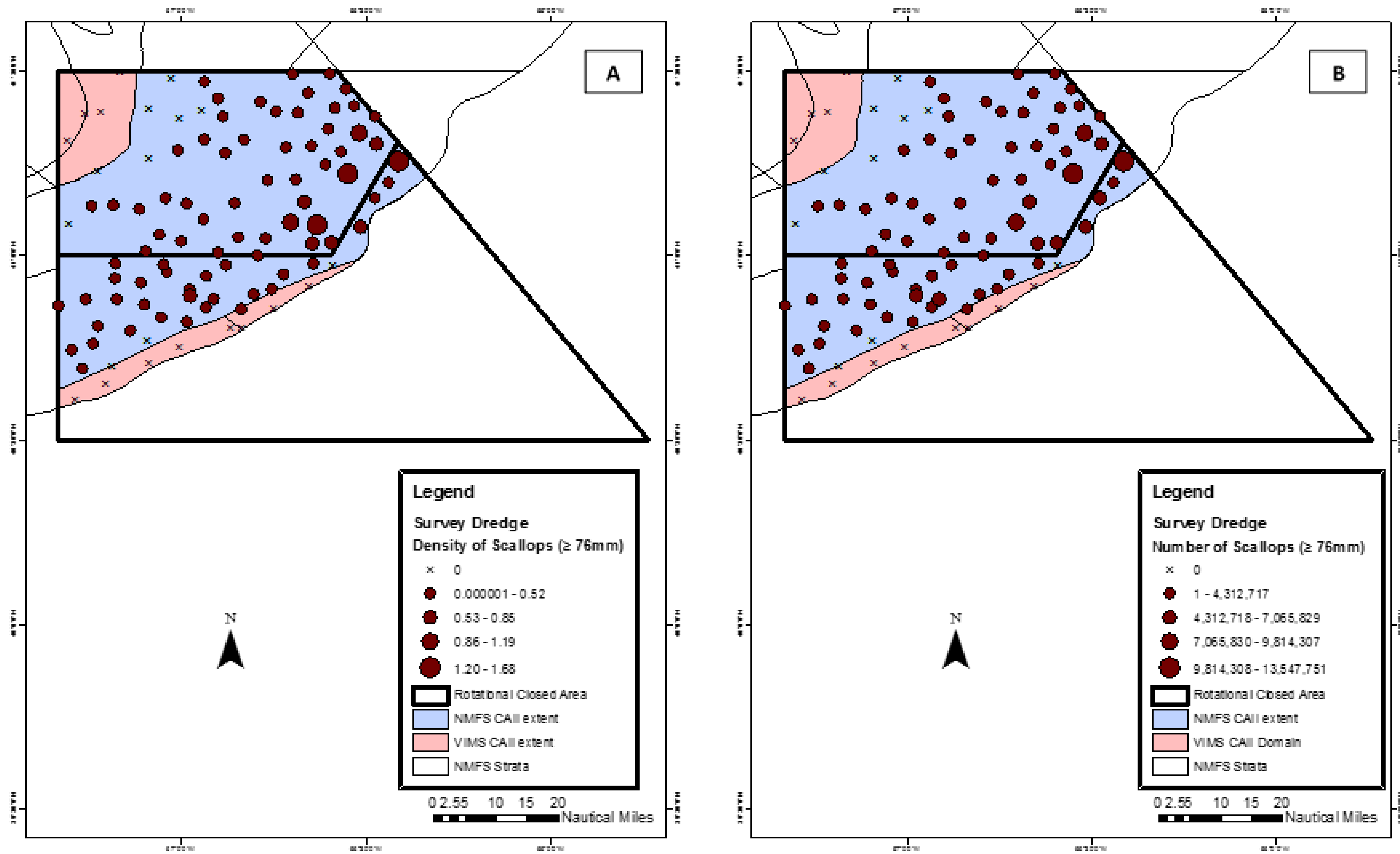


Figure 13. Density (A) and number (B) of scallops greater than 75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Closed Area II Access Area and southern Extension closure during May-June 2016.

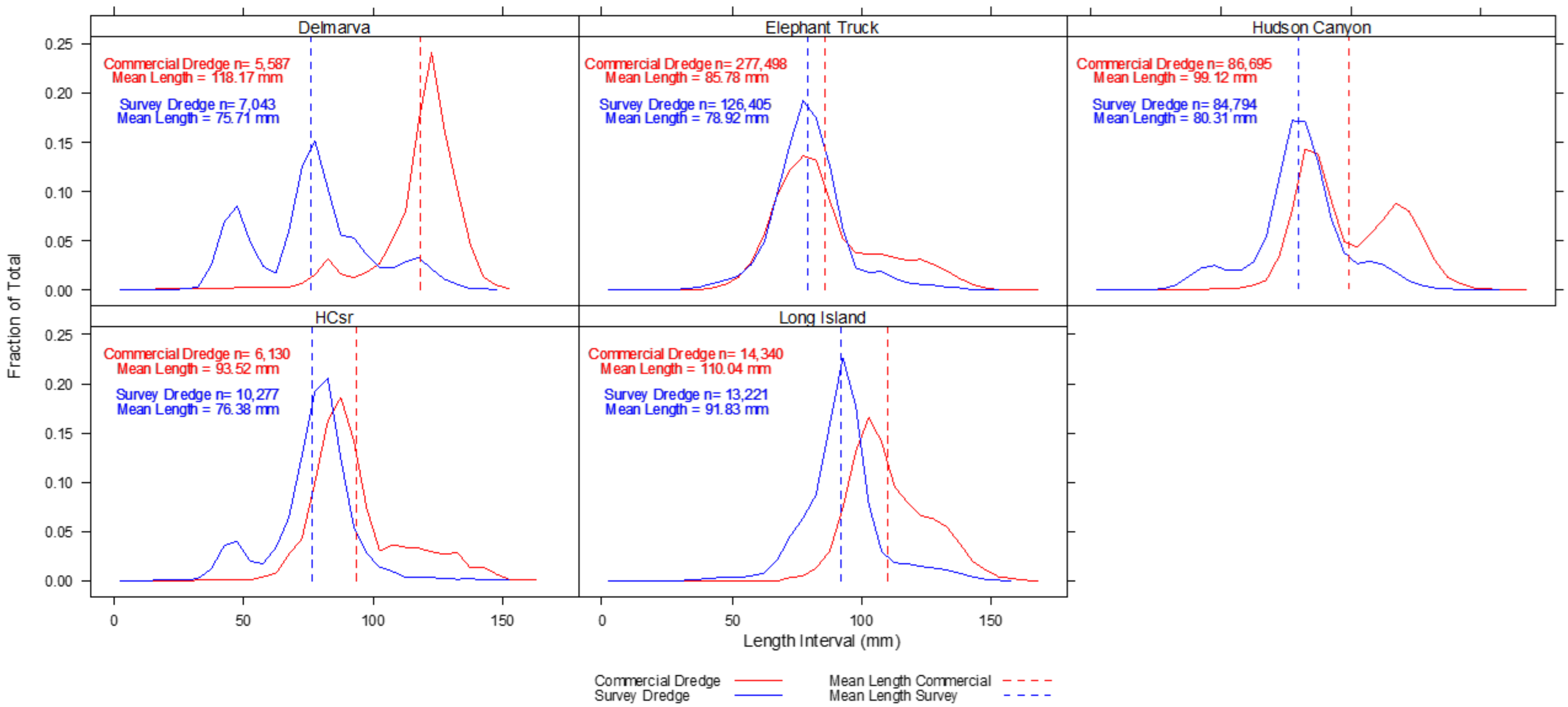


Figure 14. Length frequency of scallops captured in the survey and commercial dredges during the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource area for May-June 2016 by region. Number of scallops measured and mean length by gear are also included.

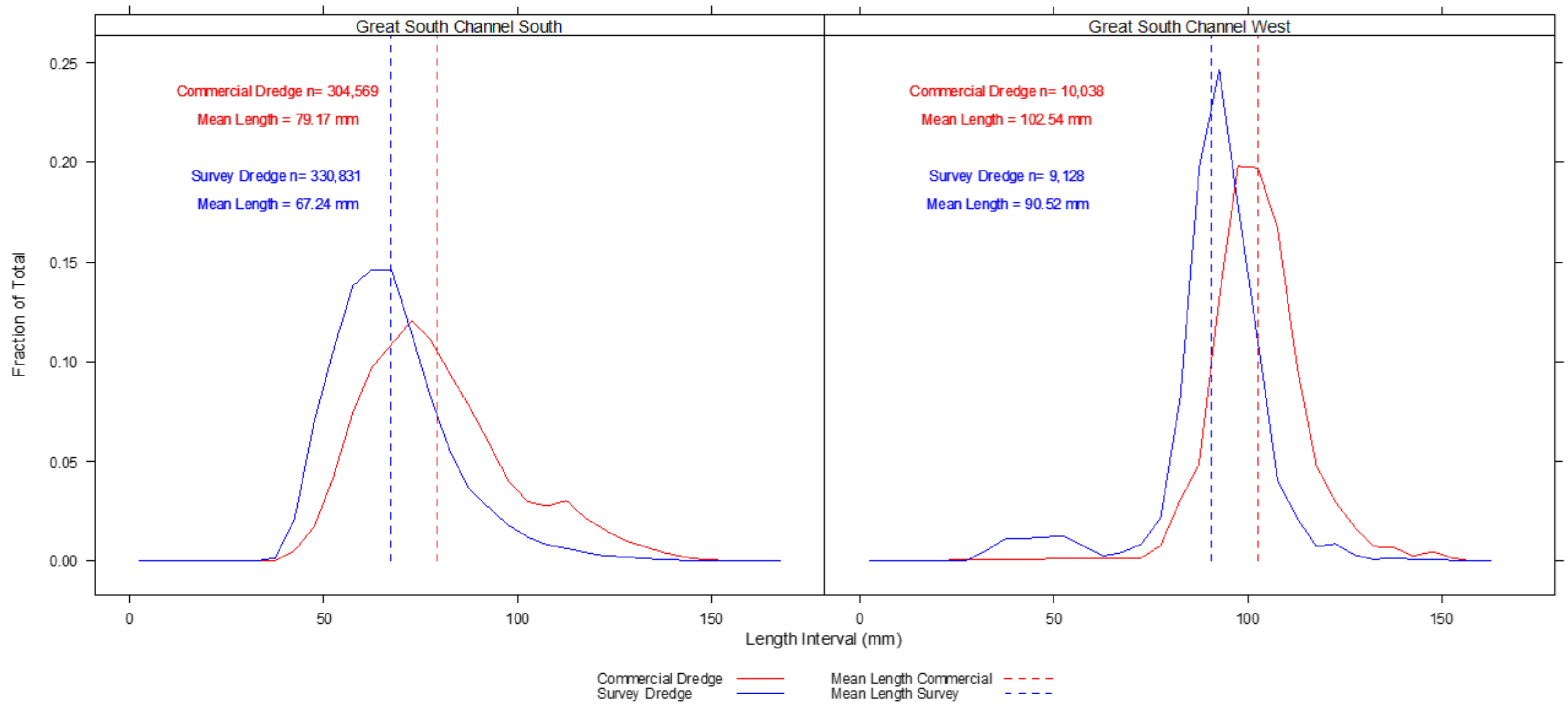


Figure 15. Length frequency of scallops captured in the survey and commercial dredges during the VIMS/Industry cooperative survey of the Nantucket Lightship Access Area and surrounds for May-June 2016 by region. Number of scallops measured and mean length by gear are also included.

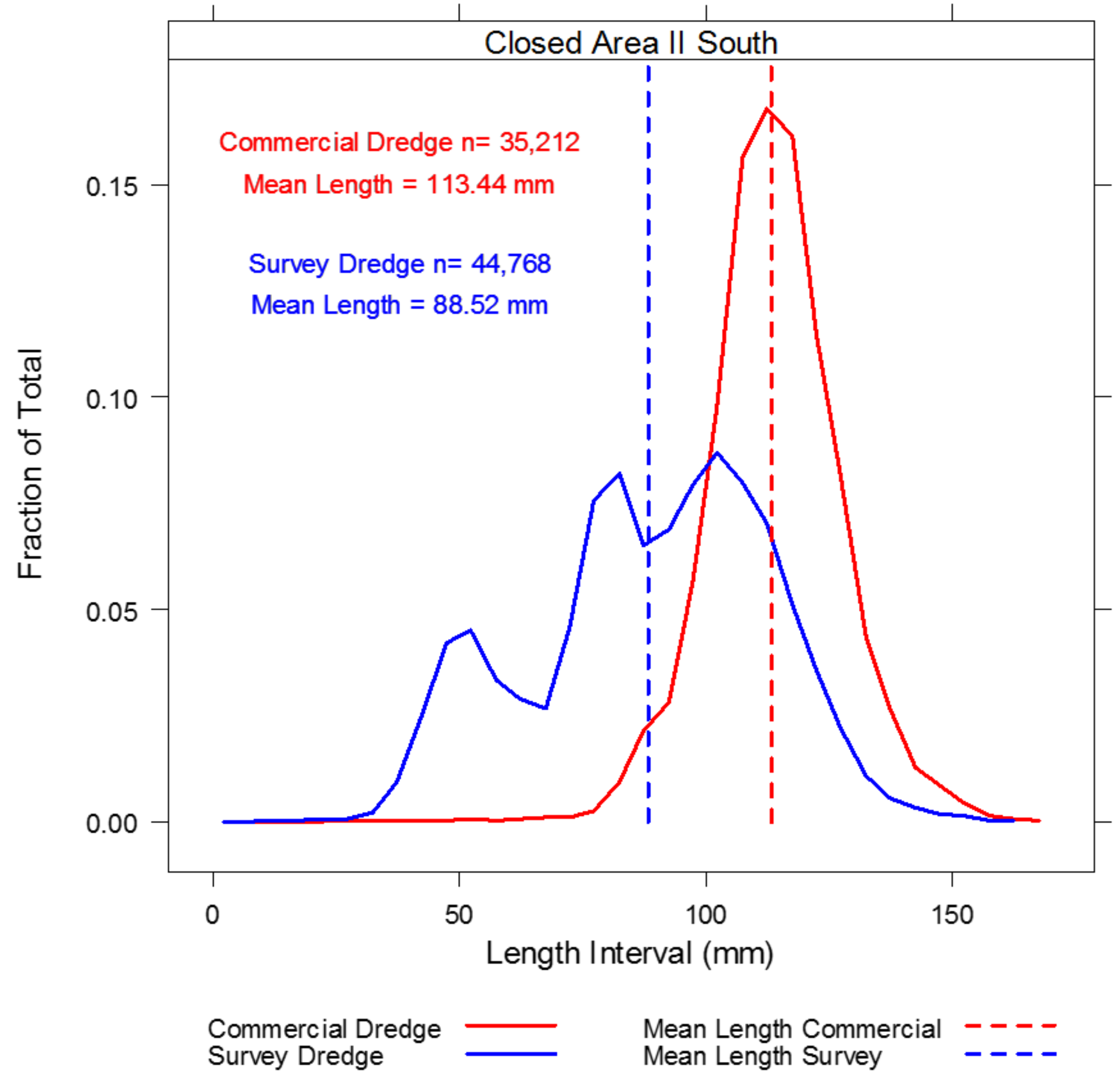


Figure 16. Length frequency of scallops captured in the survey and commercial dredges during the VIMS/Industry cooperative survey of the Closed Area II Access Area and southern Extension closure for May-June 2016 by region. Number of scallops measured and mean length by gear are also included.

Figure 17. Image of a scallop adductor meat infected with the parasitic nematode.

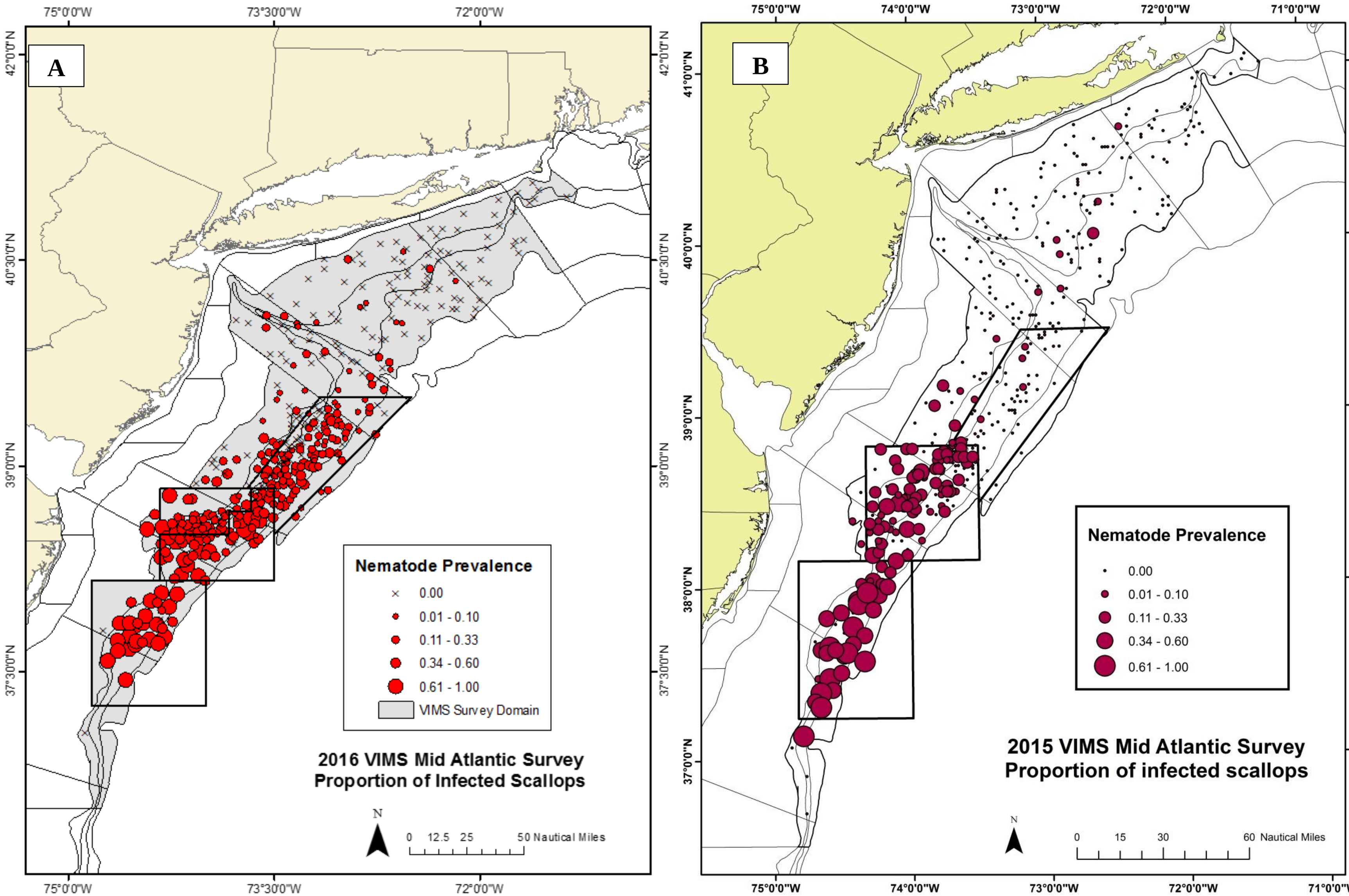


Figure 18. Nematode prevalence as documented during the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource area for May-June 2016 (A) and 2015 (B).

An Assessment of Sea Scallop Abundance and Distribution in the Mid-Atlantic Bight, Nantucket Lightship Closed Area and Closed Area II

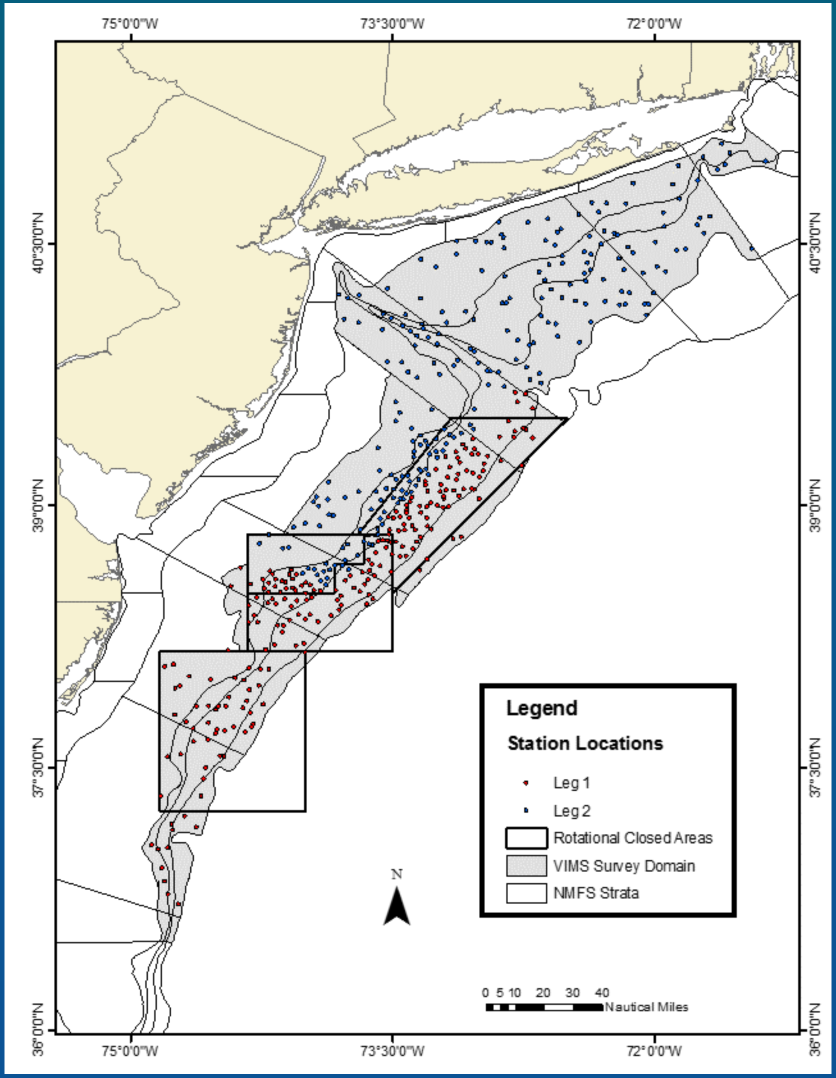
David B. Rudders
Sally Roman
Hunter Tipton

Virginia Institute of Marine Science

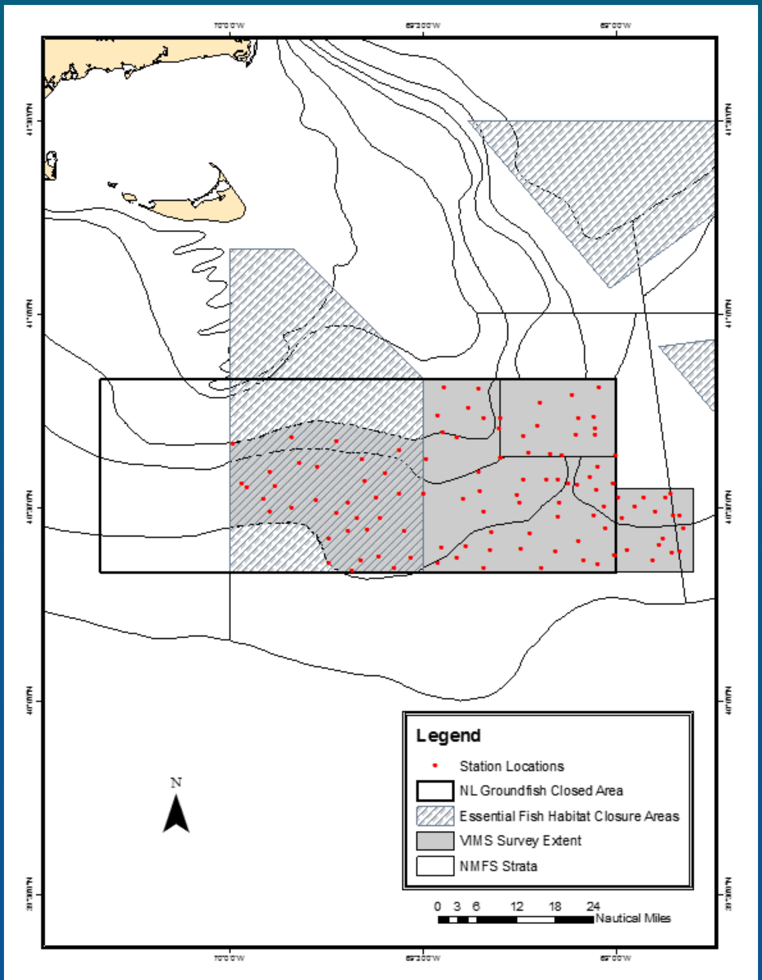
Sea Scallop Plan Development Team
Falmouth, MA
August 30-31, 2016

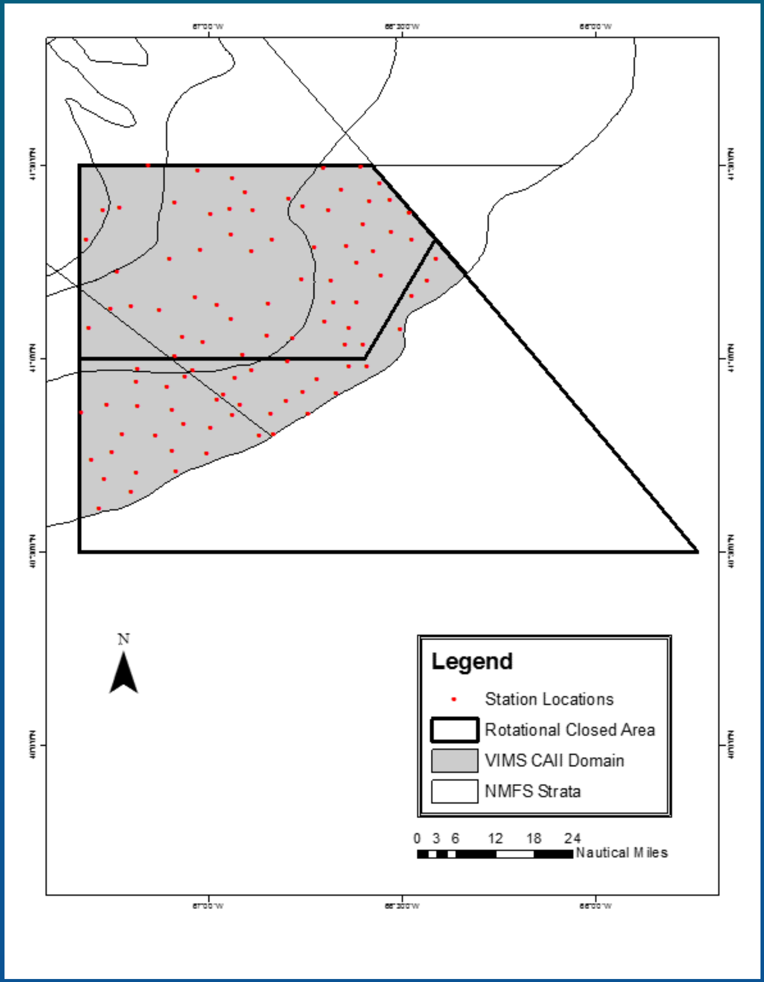
Preliminary – PDT use only.

2016 VIMS-Industry Cooperative Surveys
Mid-Atlantic Bight



2016 VIMS-Industry Cooperative Surveys
NLCA and CA II





2016 VIMS-Industry Cooperative Surveys
Primary Project Objectives

- **Assess the abundance and distribution of scallops in the Mid-Atlantic Bight, NLCA and CAII.**
  - **Mid-Atlantic Bight (Block Island to VA/NC)**
    - **2015 SAMS Area**
    - **2015 SAMS Extended Area**
  - **NLCA and surrounds**
    - **2015 SAMS Area**
    - **2015 SAMS Extended Area**
  - **CA II and surrounds**
    - **2015 SAMS Area**
    - **2015 SAMS Extended Area**

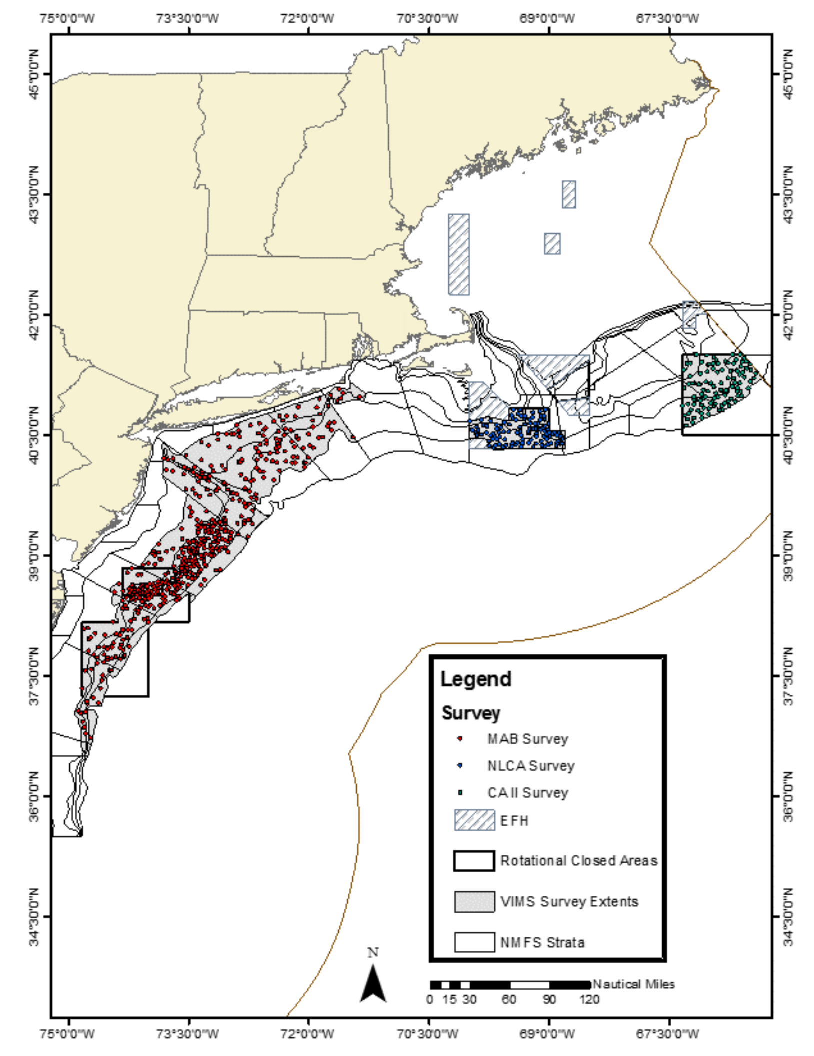
- **Estimate exploitable biomass.**
  - **Biomass of scallops available for capture with 4 inch ring commercial dredge.**

2016 VIMS-Industry Cooperative Surveys
Secondary Project Objectives

- **Gear performance**
  - **Estimate size selectivity and relative performance of 4.0 ring turtle CFTDD.**
- **Scallop Biology & Product Quality**
  - **Spatially and temporally explicit shell height:meat weight relationships.**
  - **Assess metrics associated with product quality.**
  - **Examine the incidence and pathology of the shell disease observed in survey areas.**
  - **Investigate the spatial distribution including incidence and intensity of the parasitic nematode observed in scallop meats.**

- **Finfish Bycatch**
  - **Obtain a snapshot of finfish bycatch rates and species assemblages in the surveyed areas from the commercial dredge.**
- **Scallop Predators**
  - **Quantify the species composition, spatial extent and abundance of scallop predators (crabs and starfish).**
- **Additional Sample Requests**
  - **Jonah crabs, scallops for gray meat analysis, hake sp., and *Astarte***

2016 VIMS-Industry Cooperative Surveys



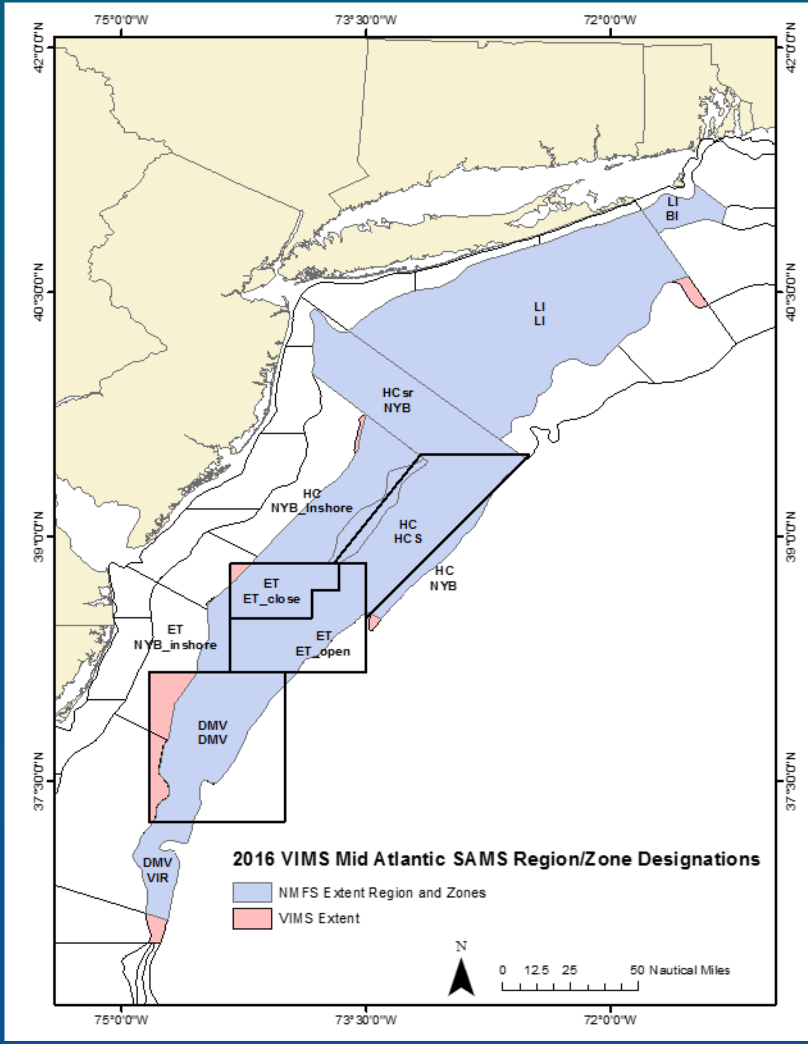
- **Sampling design**
  - Stratified random design
    - NMFS shellfish strata plus
      - Allocation
        - Area, prior year catch data (biomass, number) or modified proportional allocation (CA II and NLCA)
- **Vessels**
  - MAB Survey: 2 vessels with 1 new to the survey
    - Carolina Capes II (veteran), Sea Hawk (new)
  - NLCA Survey: Celtic (veteran)
  - NLCA Survey: KATE (veteran)
- **Data acquisition system**
  - Electronic boards (1mm res.)
  - Custom front end to Access DB
  - Integrated with Marel scale
  - Automated recording of wheel house data
- **All other protocols remained the same (see scallop survey peer review materials for details)**

2016 VIMS-Industry Cooperative Surveys
Analytical Framework

- Area swept per tow
  - Navigational info
  - Tilt sensor
- Catch weight per tow (stratified means and variances)
  - Length frequencies
  - Length-weight relationship (for this analysis regional SARC 59).
  - Selectivity (Yochum and DuPaul, 2008)
- Efficiency (constant)
  - Values from SARC 2014
    - 65%Commercial Dredge
    - 40% NMFS Survey Dredge
- Exploitable Biomass
  - Selectivity curve applied to catch for both the survey and commercial dredges (Yochum and DuPaul, 2008)
- Sub-Area (constant)
  - Dependent upon the spatial extent of the survey domain
    - 2015 NMFS SAMS regions and zones
    - 2016 SAMS VIMS extended

$$TotalBiomass = \sum_j \left(\frac{\left(\frac{CatchWtperTowinSubarea_j}{AreaSweptperTow} \right)}{Efficiency} \right) SubArea_j$$

2016 VIMS-Industry Cooperative Surveys
SAMS Regions/Zones

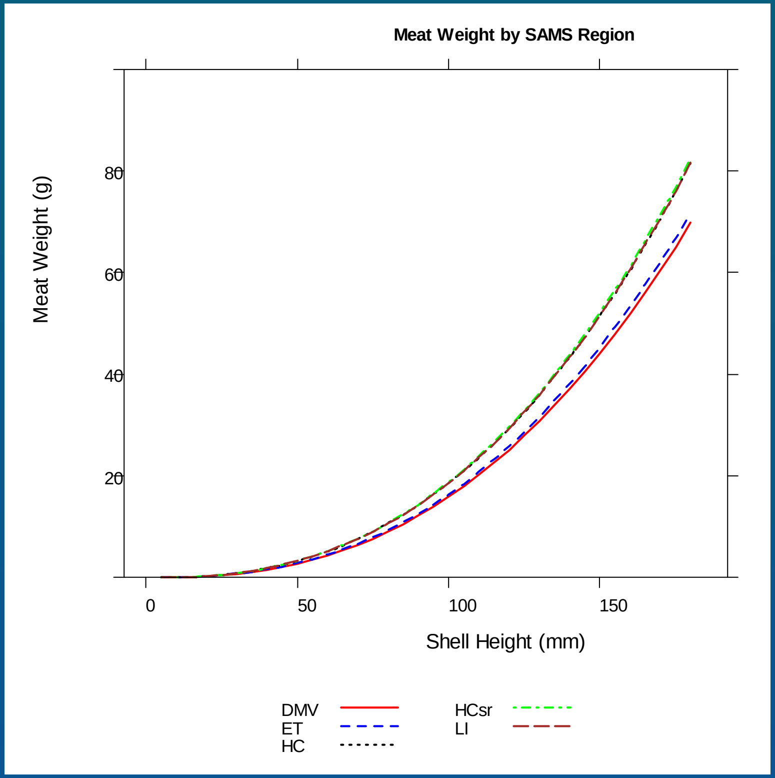


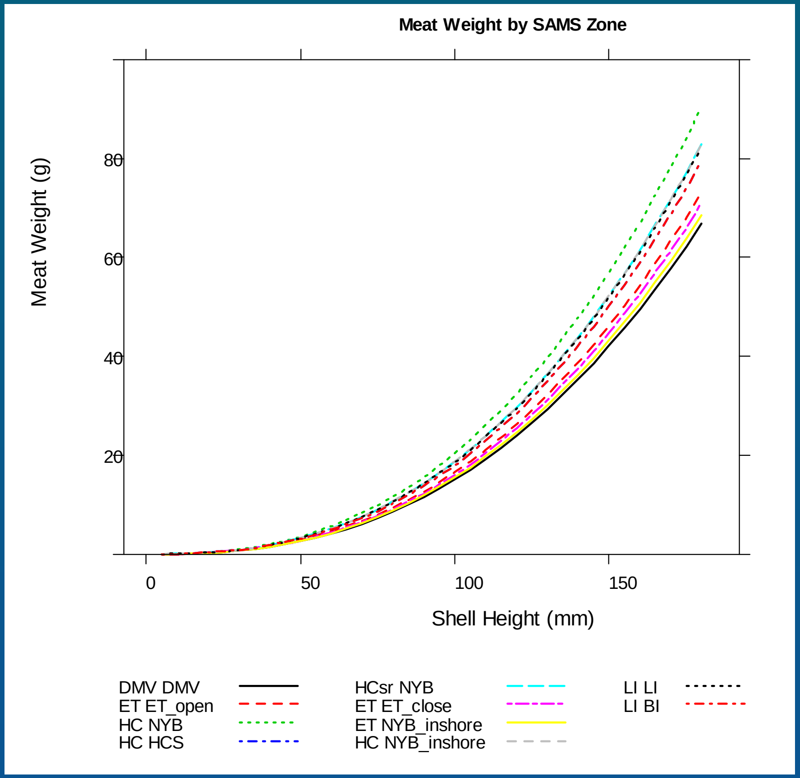
- The projection model (SAMS) examines the resource on a variety of spatial scales.
  - region, zone
- The VIMS surveys included some areas outside of the NMFS area specification.
- Biomass estimates will be presented in the context of the VIMS expanded areas.

2016 VIMS-Industry Cooperative Surveys
SH:MW Relationship

- SH:MW samples were taken from all stations that had scallops (15/station):
  - MAB Survey: ~5000
  - NLCA and CA II Surveys: ~ 1,000/survey
- The objective is to construct a model to predict meat weight based on a suite of potential covariates (i.e. shell height, depth, SAMS area, sex, disease…).
- Average depth was calculated for each tow from tilt sensor
- A GLMM was used to fit model (Gamma distribution, log link, random effect at the station level) with R v 3.3.1 Package lme4.

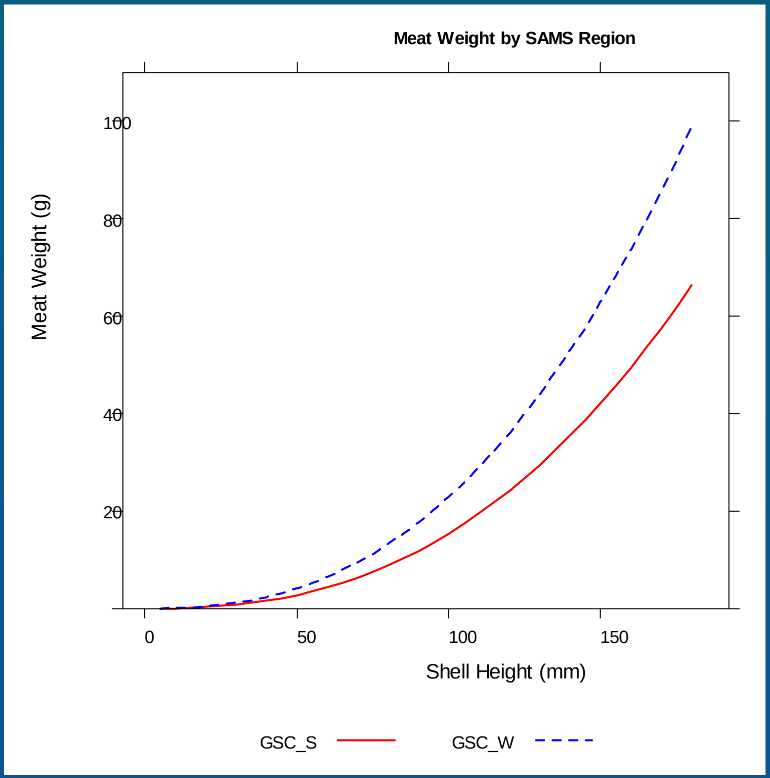
2016 VIMS-Industry Cooperative MAB Survey
SH:MW Results

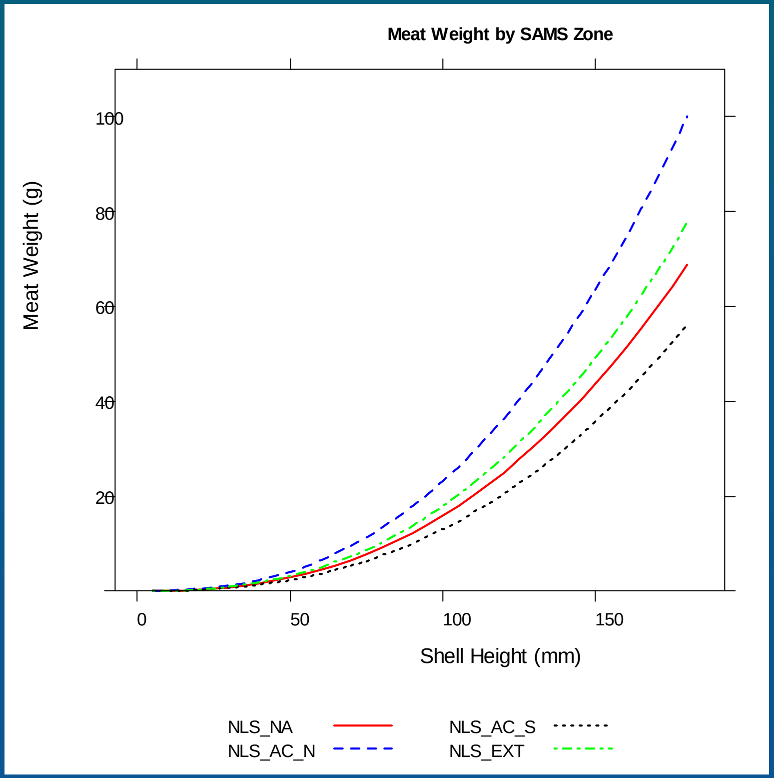




- **MAB SAMS Areas**
  - **Significantly different relationships between SAMS Regions and Zone.**
  - **Likely a function of average depths for each of subarea, as well as the temporal spread of the sampling**

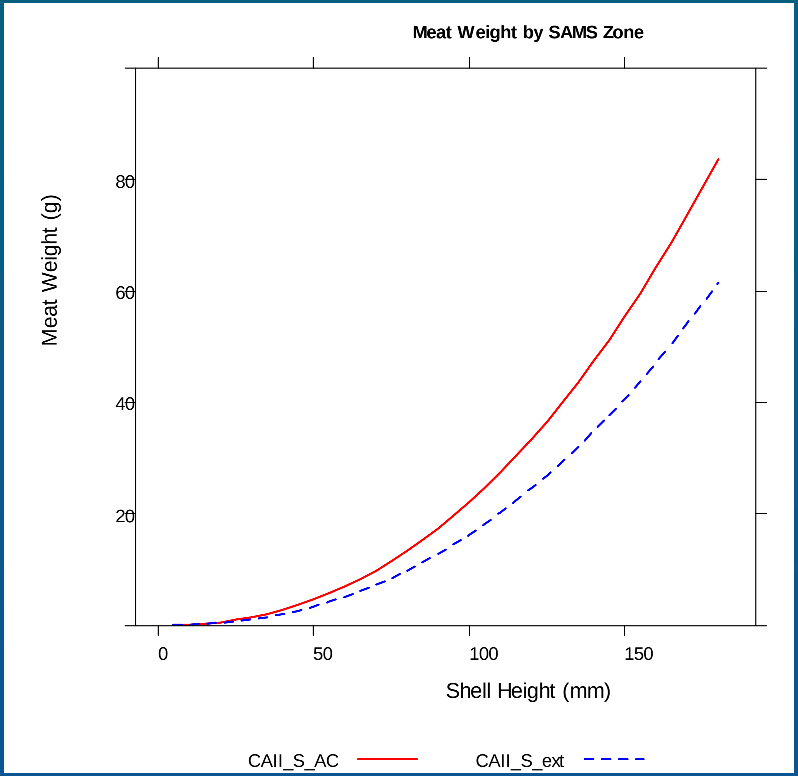
2016 VIMS-Industry Cooperative NLCA Survey
SH:MW Results





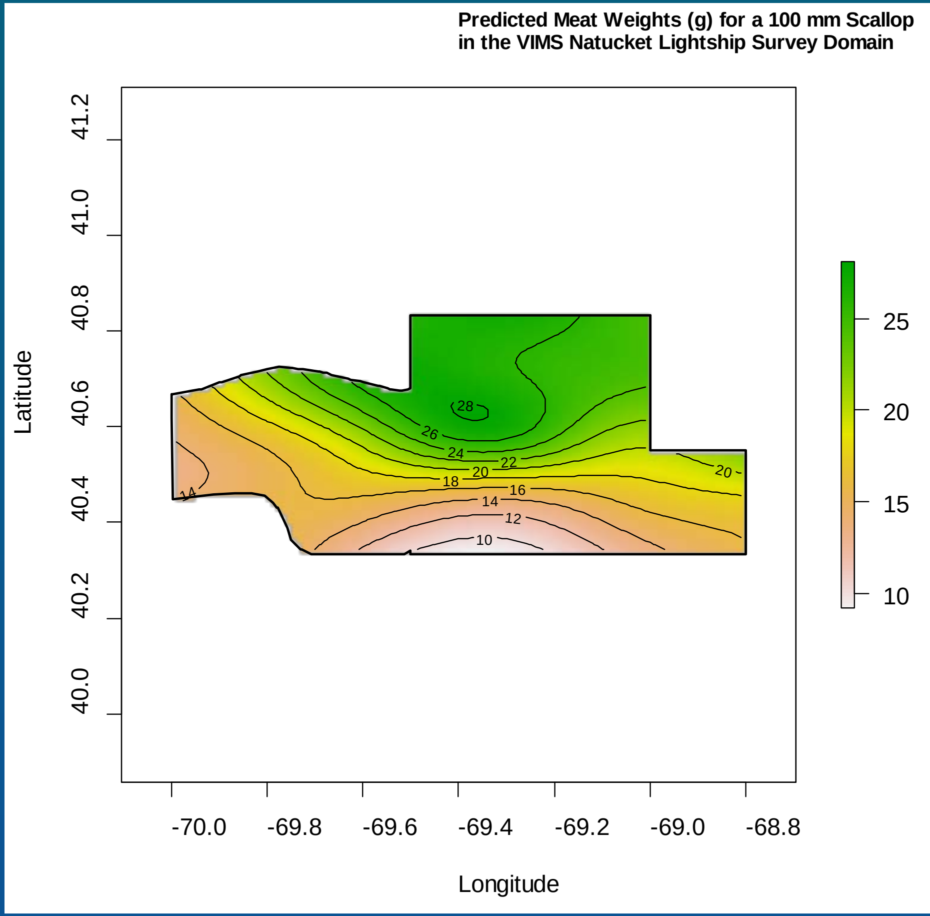
- **NLCA SAMS Areas**
  - **Significantly different relationships between SAMS Regions and Zones.**
  - **Likely a function of average depths for each of subarea, as well as the density of scallops and temporal spread of the sampling**

2016 VIMS-Industry Cooperative CA II Survey
SH:MW Results



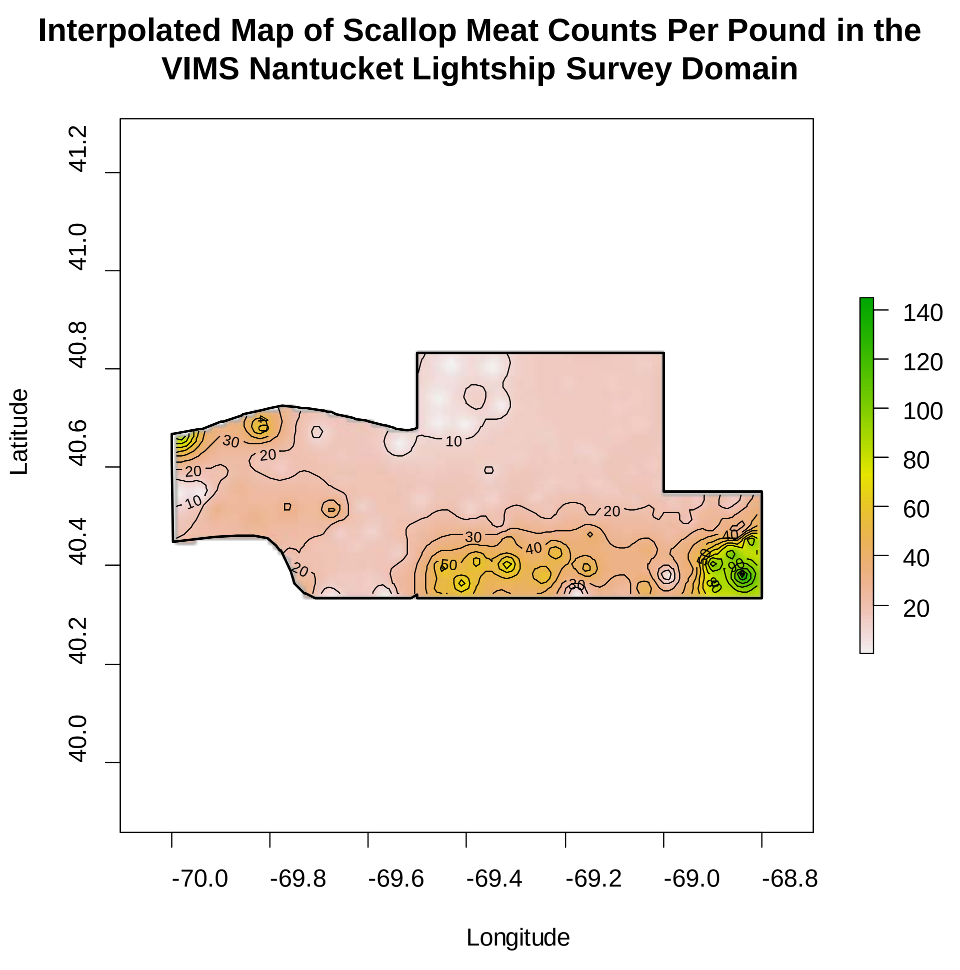
- **CA II SAMS Areas**
  - **Significantly different relationships between SAMS Zones.**
  - **Likely a function of average depths for each of subarea, as well as the temporal spread of the sampling**

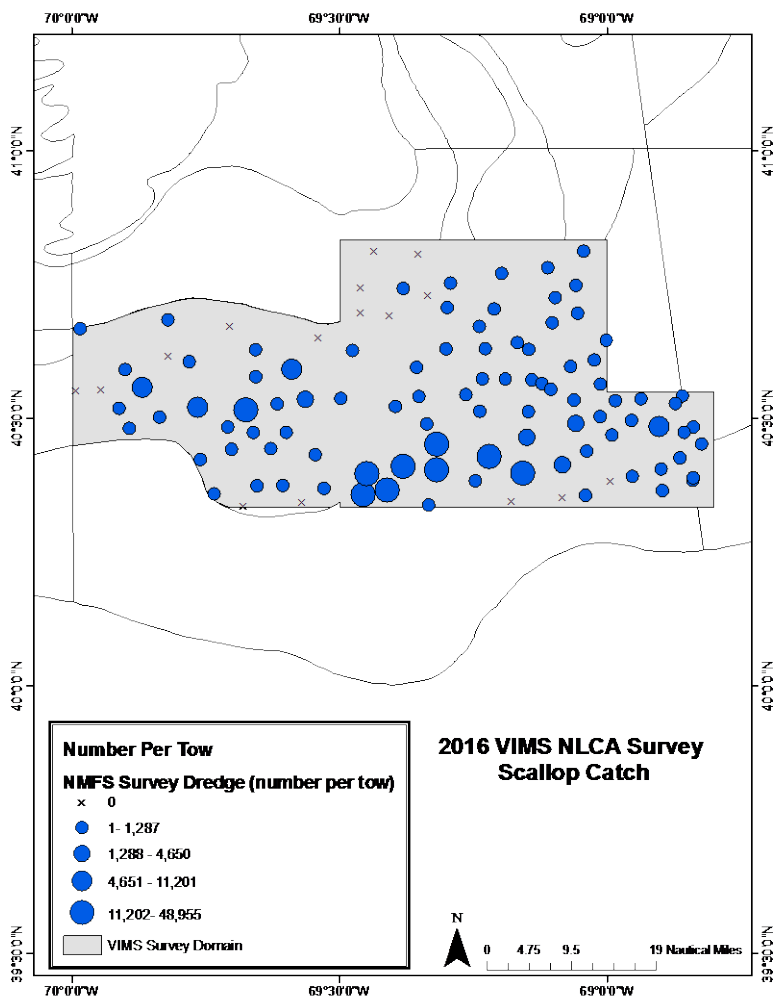
2015 VIMS-Industry Cooperative Surveys
SH:MW Results – NLCA Survey



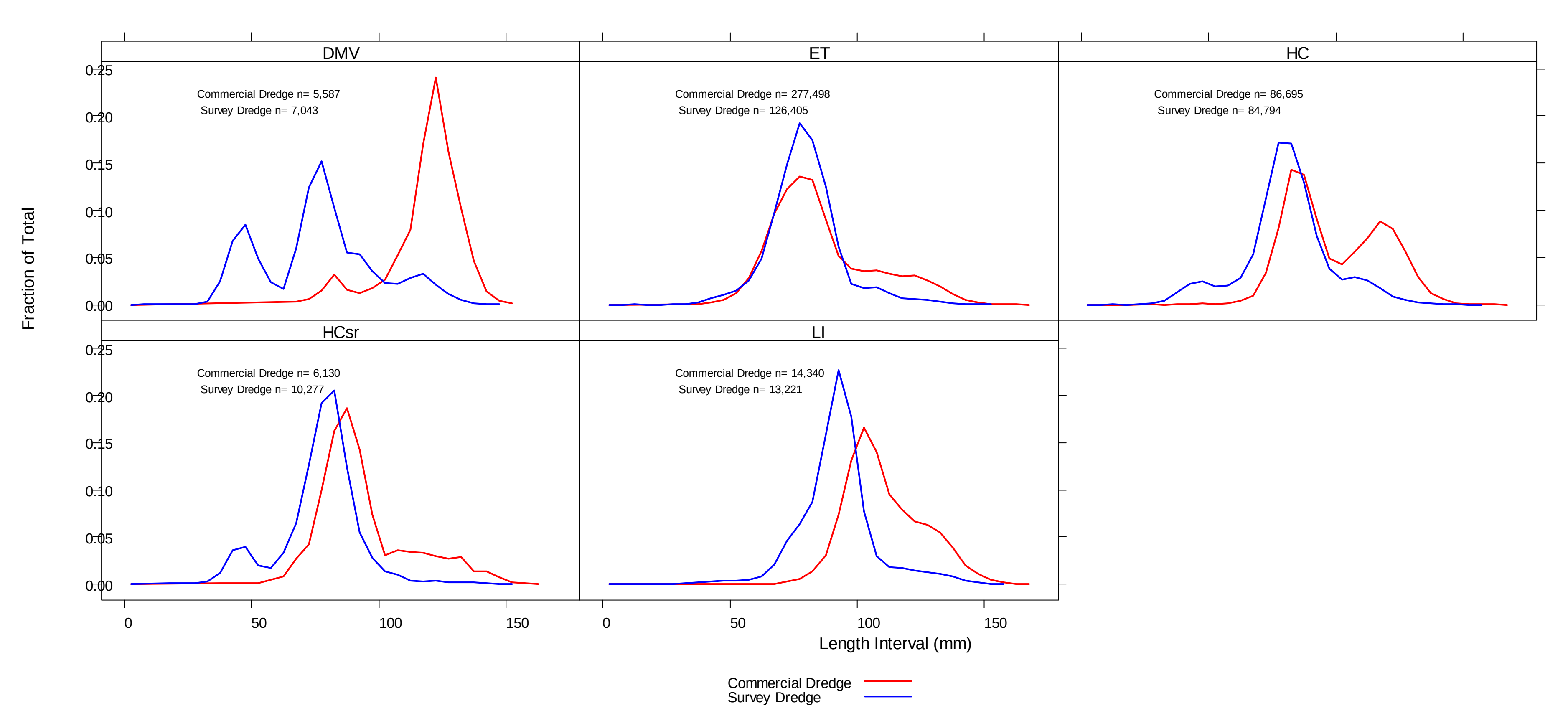
- Contour plot of meat weights predicted from a GAMM for a 100 mm scallop in the NLCA survey area.
- Gradient of meat weights was observed in the survey area.
  - Small meats observed in the south in deeper water with high densities of scallops .
- Biomass of an area is a dynamic process that has significant spatial and temporal components that warrant consideration in the specification process.
- SARC 59 estimates one subarea coefficient for the NLCA.

2015 VIMS-Industry Cooperative Surveys
NLCA Survey



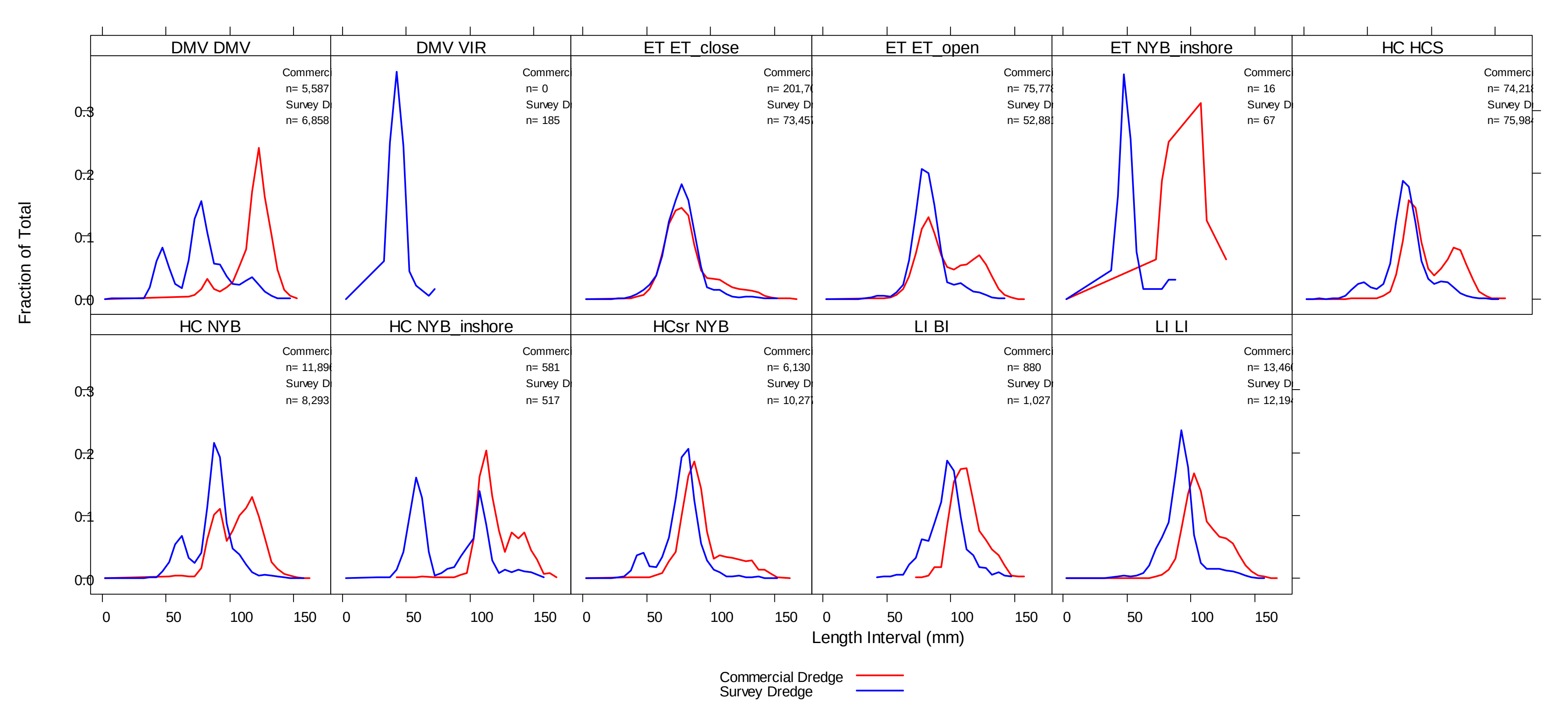


2016 VIMS-Industry Cooperative MAB Survey
Length Frequency- SAMS Region



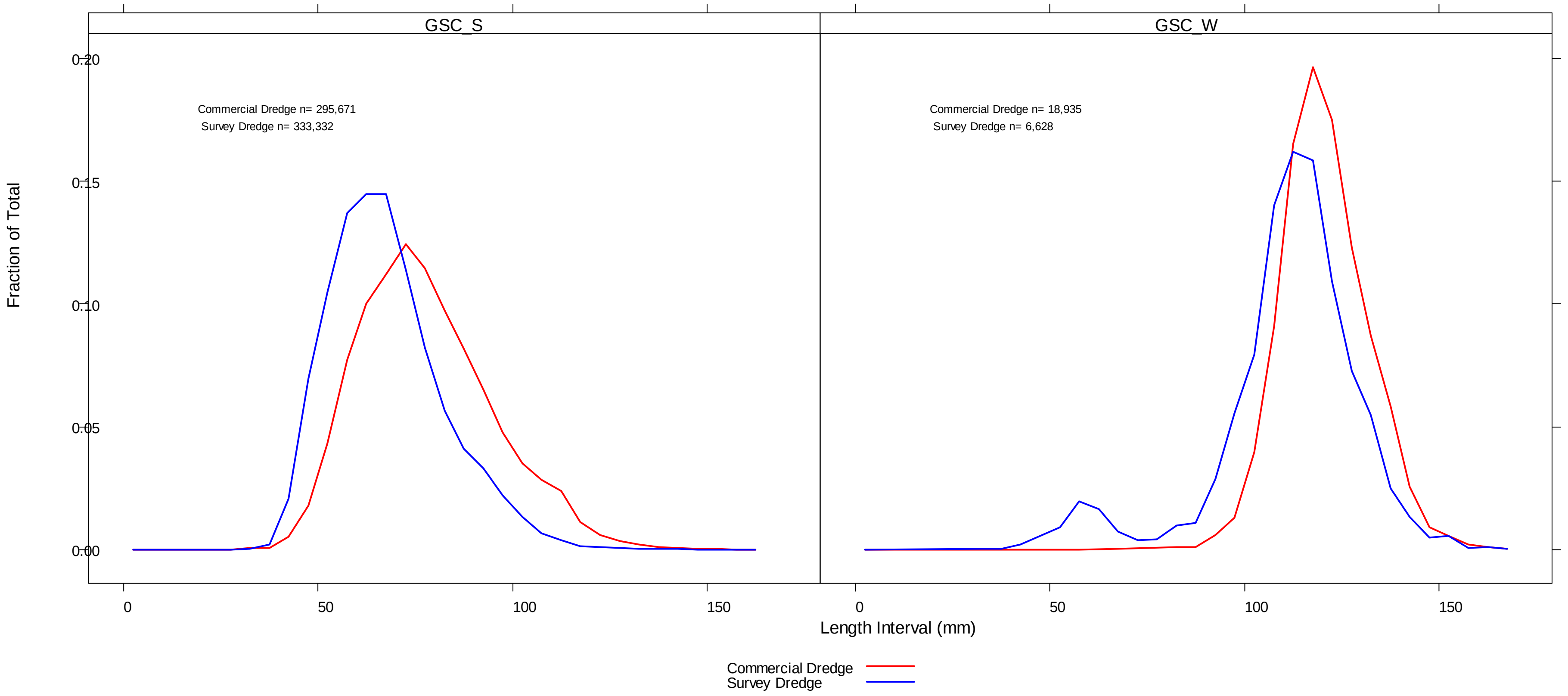
2016 VIMS-Industry Cooperative MAB Survey

Length Frequency- SAMS Zone



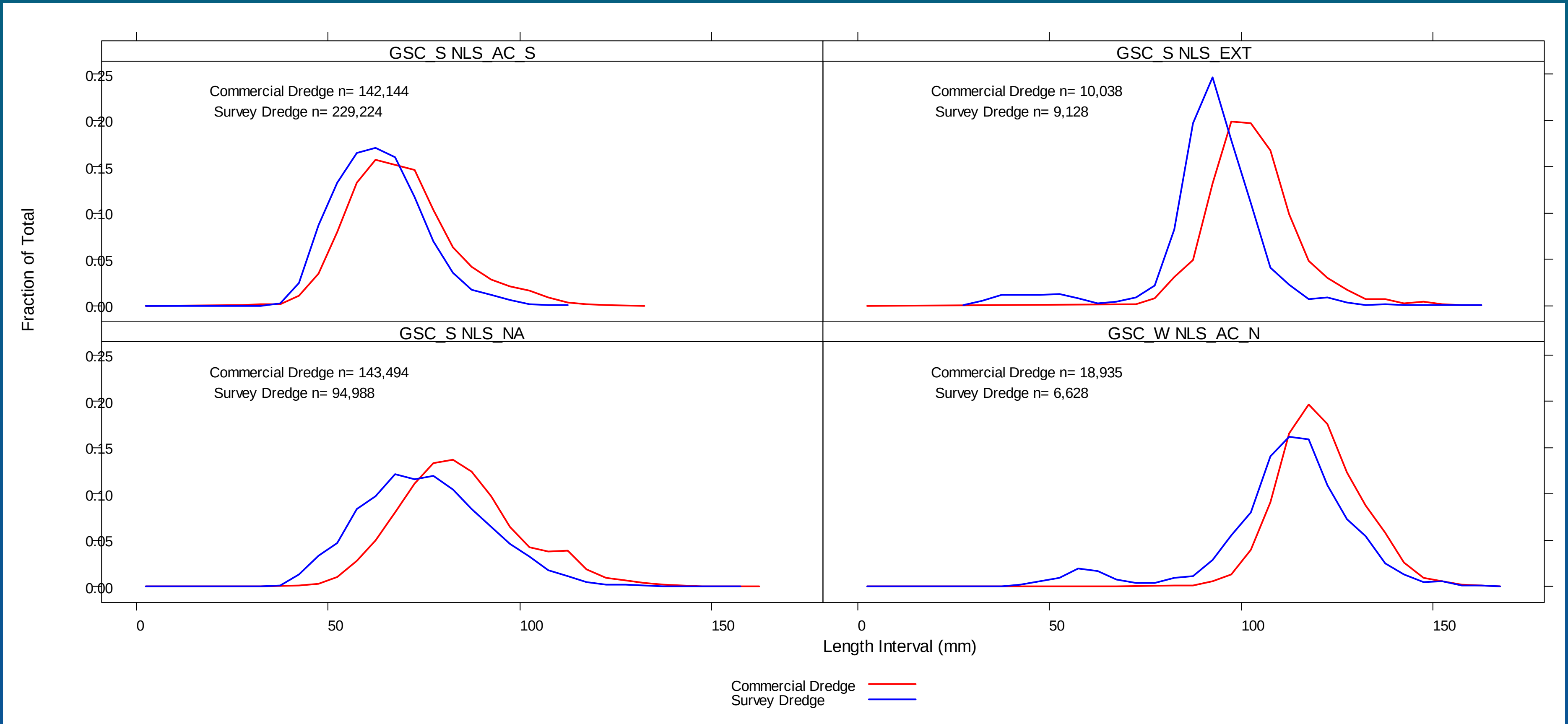
2016 VIMS-Industry Cooperative NLCA Survey

Length Frequency- SAMS Region

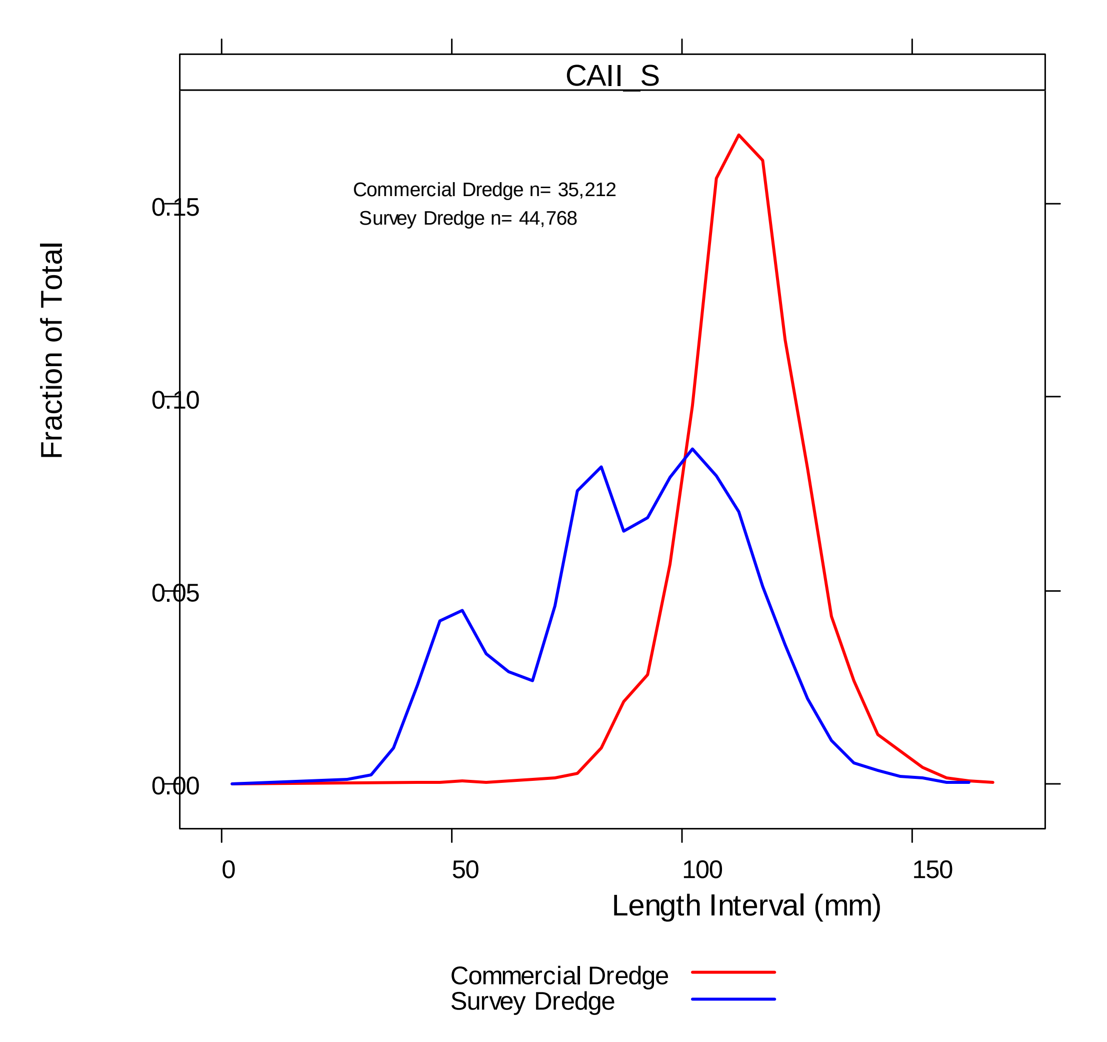


2016 VIMS-Industry Cooperative NLCA Survey

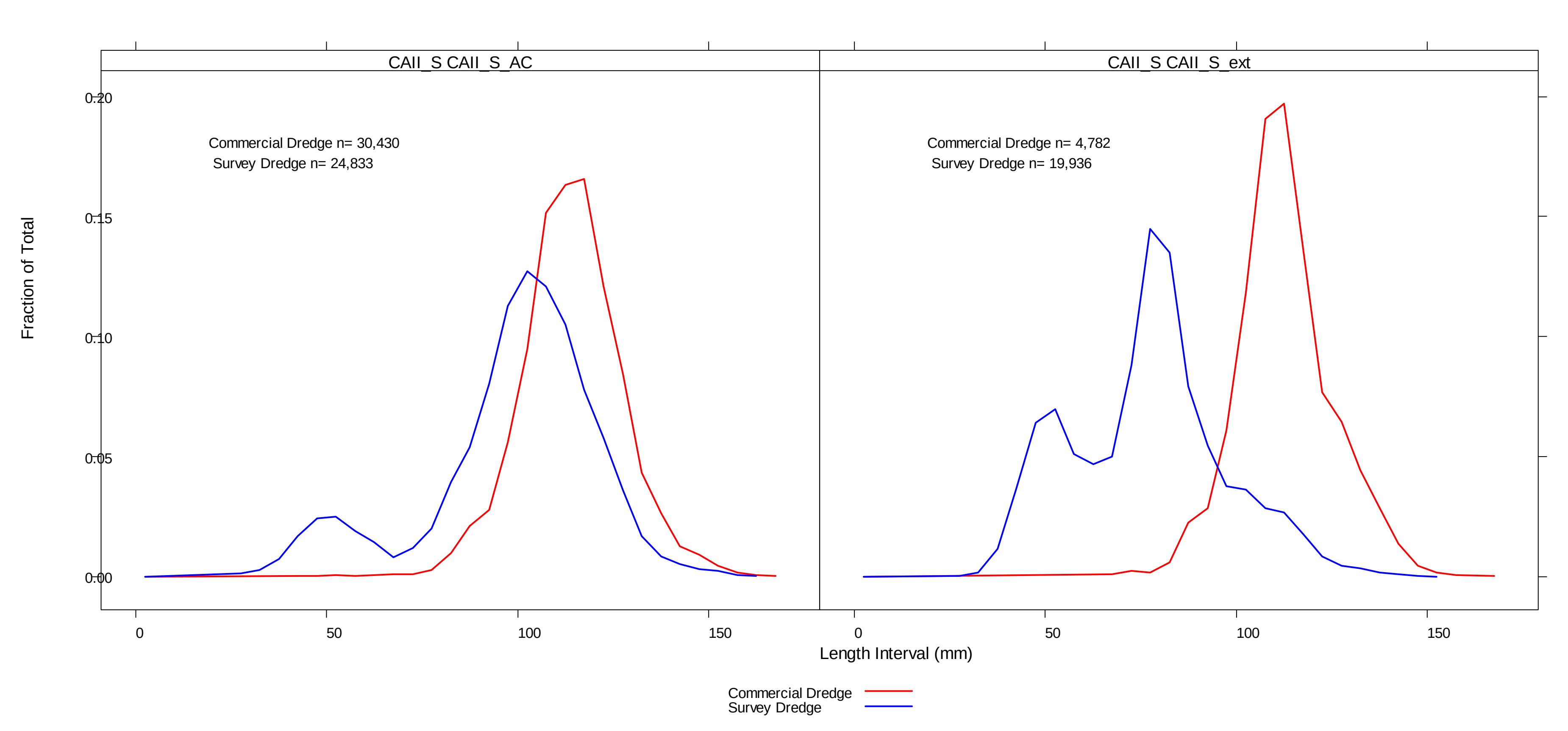
Length Frequency- SAMS Zone



2016 VIMS-Industry Cooperative CA II Survey
Length Frequency- SAMS Region

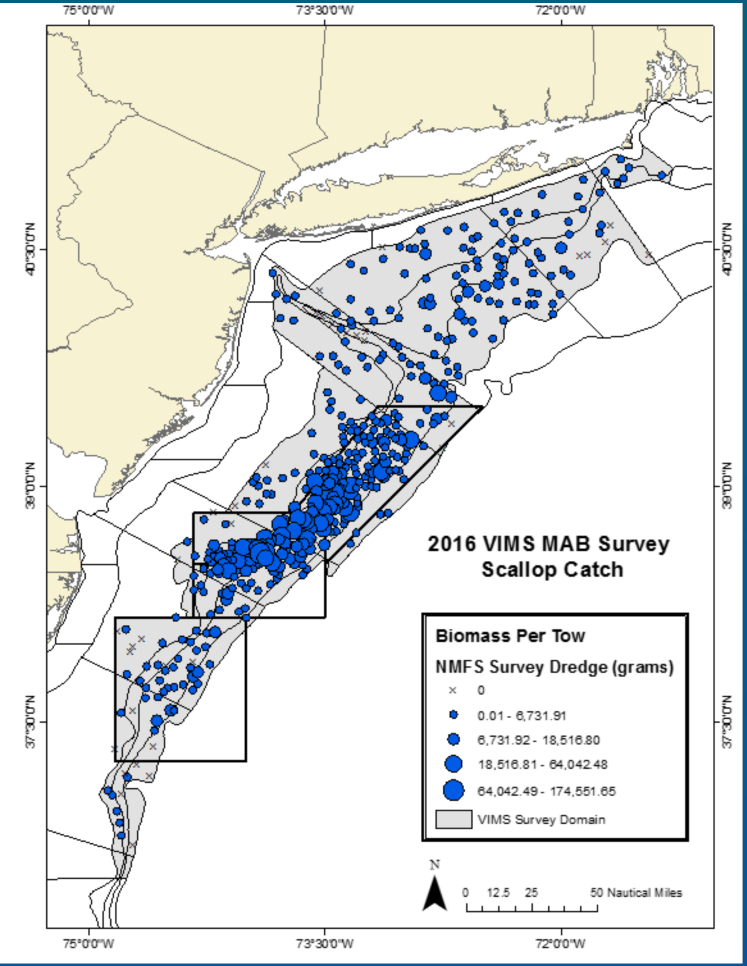


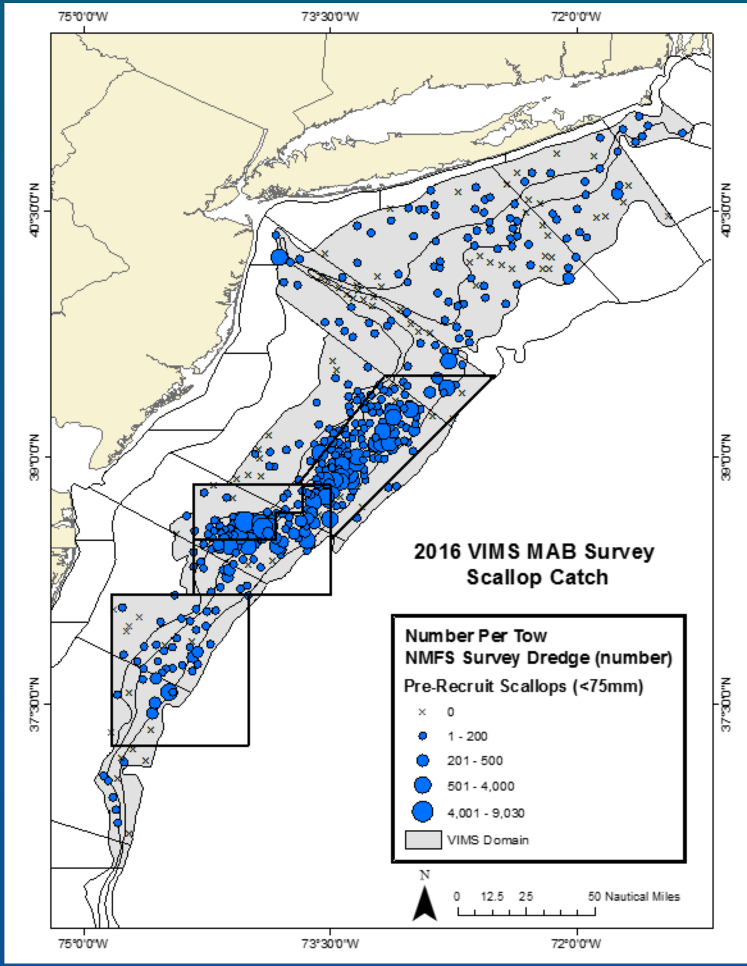
2016 VIMS-Industry Cooperative CA II Survey
Length Frequency- SAMS Zone



2016 VIMS-Industry Cooperative MAB Survey

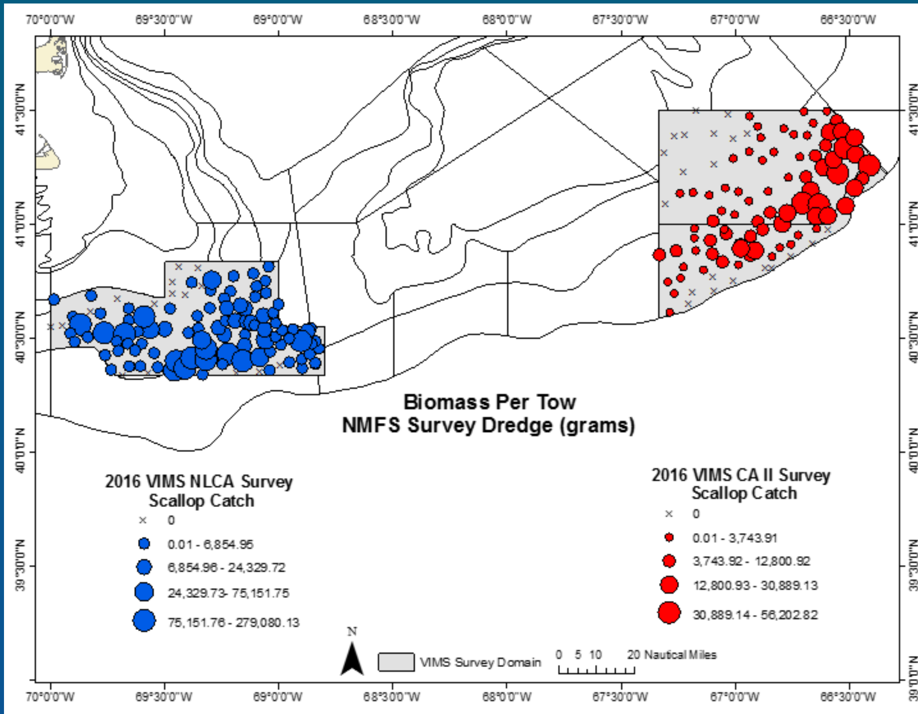
Scallop Distribution

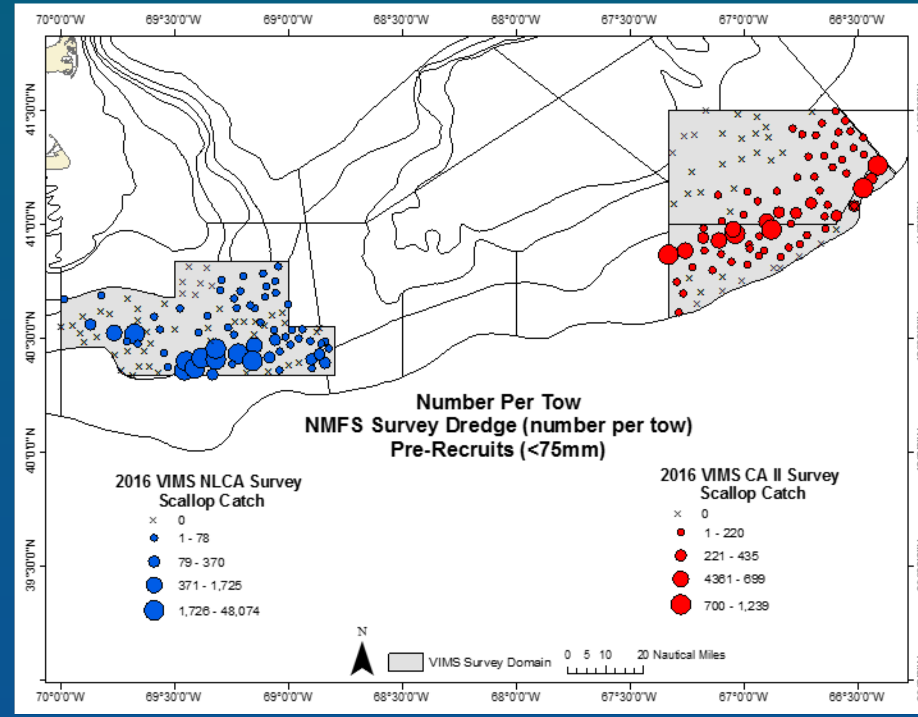




2016 VIMS-Industry Cooperative NLCA & CA II Surveys

Scallop Distribution





2016 VIMS-Industry Cooperative Surveys
Total Biomass - Region

Survey	SAMS Region	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV	4,125.96	434.32	0.07	11.24	394,116,594.99
	ET	22,485.56	1,023.28	0.70	10.47	2,035,382,047.86
	HC	17,115.44	722.81	0.33	12.07	1,395,865,849.41
	HCsr	4,937.67	917.70	0.17	10.42	492,190,000.77
	LI	16,202.76	742.02	0.07	17.41	922,179,496.32
NLCA	GSC_S	58,706.81	5,353.98	2.56	8.62	6,723,574,032.92
	GSC_W	3,571.57	298.14	0.12	30.06	118,974,287.52
	VIMS_45	5.41	2.00	0.00	30.20	179,063.89
CA II	CAII_S	18,229.87	994.76	0.26	15.83	1,160,535,650.77

2016 VIMS-Industry Cooperative Surveys
Total Biomass – Region/Zone

Survey	SAMS Region Zone	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV DMV	4,031.45	397.25	0.09	11.49	375,179,508.77
	DMV VIR	16.77	1.79	0.01	2.24	7,471,138.85
	ET ET_close	10,975.09	855.54	1.06	9.83	1,015,942,940.96
	ET ET_open	11,324.17	450.02	0.48	11.37	989,468,483.68
	ET NYB_inshore	61.55	0.41	0.01	3.39	19,618,868.30
	HC HCS	13,812.14	633.46	0.44	11.78	1,170,351,530.61
	HC NYB	2,603.36	339.48	0.18	14.46	180,727,689.59
	HC NYB_inshore	665.22	73.62	0.01	16.58	40,129,837.46
	HCsr NYB	4,937.66	917.75	0.17	10.42	492,176,971.18
	LI BI	1,508.47	83.34	0.10	20.41	73,974,647.90
	LI LI	14,713.37	736.31	0.07	17.16	848,918,181.20
NLCA	GSC_S NLS_AC_S	22,657.69	2,344.53	7.48	7.04	3,217,822,591.33
	GSC_S NLS_EXT	1,696.60	509.55	0.31	17.49	100,240,930.77
	GSC_S NLS_NA	25,801.89	3,970.65	1.38	11.58	2,230,524,250.16
	GSC_W NLS_AC_N	3,571.57	298.14	0.12	30.06	118,974,287.52
	VIMS_45	5.41	2.00	0.00	30.20	179,063.89
CA II	CAII_S CAII_S_AC	13,875.77	866.06	0.26	20.23	477,721,662.76
	CAII_S CAII_S_ext	4,963.42	427.42	0.25	10.34	688,469,033.23

2016 VIMS-Industry Cooperative Surveys

Exploitable Biomass Survey - Region

Survey	SAMS Region	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV	1,469.98	157.07	0.07	21.79	70,117,637.93
	ET	6,587.21	241.11	0.70	15.95	390,650,676.93
	HC	5,785.78	253.78	0.07	18.60	300,577,220.62
	HCsr	1,363.84	144.69	0.03	15.98	74,358,084.86
	LI	7,301.62	312.27	0.07	22.34	321,313,419.67
NLCA	GSC_S	9,721.64	1,004.46	2.56	16.16	595,200,859.59
	GSC_W	2,782.11	212.06	0.09	33.72	81,548,737.32
	VIMS_45	3.62	1.34	0.001	32.55	111,077.97
CAII	CAII_S	10,186.87	592.36	0.26	23.80	420,696,521.70

2016 VIMS-Industry Cooperative Surveys
Exploitable Biomass Survey – Region/Zone

Survey	SAMS Region Zone	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV DMV	1,440.98	145.99	0.09	21.81	68,868,929.86
	DMV VIR	0.18	0.03	0.00	3.71	47,855.93
	ET ET_close	3,159.04	197.06	1.06	15.59	183,249,825.64
	ET ET_open	3,415.01	131.55	0.10	16.32	203,522,665.83
	ET NYB_inshore	3.45	0.05	0.00	9.23	383,992.95
	HC HCS	4,422.69	229.24	0.09	18.28	239,014,768.09
	HC NYB	959.68	98.96	0.05	19.90	48,270,214.98
	HC NYB_inshore	405.64	39.40	0.00	30.80	13,169,425.83
	HCsr NYB	1,363.19	144.63	0.03	15.98	74,324,998.92
	LI BI	799.24	39.25	0.04	25.04	31,933,585.39
	LI LI	6,515.49	309.41	0.07	22.05	289,852,478.73
NLCA	GSC_S NLS_AC_S	1,741.46	185.82	7.48	11.03	157,851,406.44
	GSC_S NLS_EXT	681.89	180.23	0.11	20.79	32,824,672.28
	GSC_S NLS_NA	6,509.38	929.39	0.21	19.13	340,146,590.83
	GSC_W NLS_AC_N	2,782.11	212.06	0.09	33.72	81,548,737.32
	VIMS_45 VIMS_45	3.62	1.34	0.00	32.55	111,077.97
CA II	CAII_S CAII_S_AC	8,997.18	520.28	0.13	25.51	347,640,879.00
	CAII_S CAII_S_ext	1,720.24	152.22	0.25	18.13	92,805,506.65

2016 VIMS-Industry Cooperative Surveys

Exploitable Biomass - Commercial by Region

Survey	SAMS Region	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV	2,520.01	500.68	0.02	32.78	78,783,082.93
	ET	12,431.27	927.26	0.55	23.75	502,606,892.42
	HC	10,885.20	1,868.13	0.06	26.82	403,258,055.37
	HCsr	1,219.18	149.83	0.01	26.16	40,744,069.92
	LI	7,183.71	531.89	0.03	31.31	224,762,172.76
NLCA	GSC_S	8,756.97	1,910.63	0.80	21.38	407,904,423.34
	GSC_W	3,463.90	323.75	0.13	36.61	93,837,894.39
	VIMS_45	1.36	0.82	0.00	46.91	29,038.49
CAII	CAII_S	6,574.37	668.20	0.07	28.92	221,450,176.26

2016 VIMS-Industry Cooperative Surveys

Exploitable Biomass - Commercial by Region/Zone

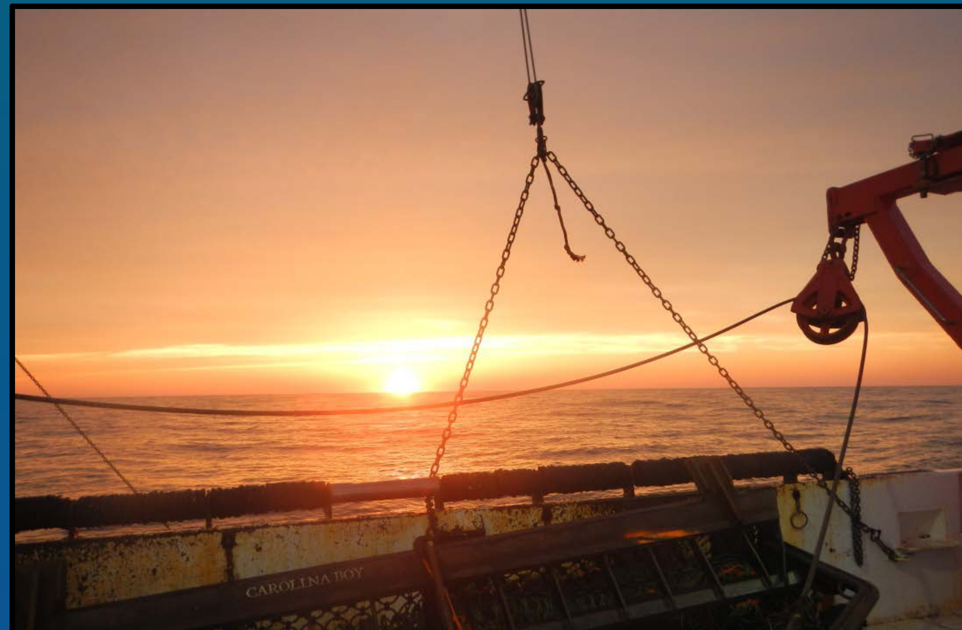
Survey	SAMS Region_Zone	Total Biomass (mt)	SE Biomass (mt)	Density (scal/m^2)	Avg MW (g)	Total #
MAB	DMV DMV	2,488.60	490.24	0.02	32.78	77,805,762.73
	DMV VIR	0.00	0.00	0.00	0.00	0.00
	ET ET_close	6,740.28	929.89	1.04	22.67	283,002,777.88
	ET ET_open	6,119.70	478.98	0.24	25.27	234,758,902.35
	ET NYB_inshore	3.11	1.09	0.00	26.20	118,684.81
	HC HCS	6,645.94	1,143.73	0.15	26.48	255,826,265.84
	HC NYB	3,700.39	1,433.83	0.09	27.47	134,610,305.82
	HC NYB_inshore	526.10	73.59	0.01	41.32	12,731,296.67
	HCsr NYB	1,219.10	149.82	0.04	26.16	40,742,725.13
	LI BI	522.31	31.63	0.03	32.86	15,906,955.82
	LI LI	6,665.26	530.08	0.03	31.20	208,962,219.62
NLCA	GSC_S NLS_AC_S	960.14	289.76	1.62	15.15	63,359,444.84
	GSC_S NLS_EXT	516.61	216.69	0.06	25.78	20,020,927.73
	GSC_S NLS_NA	6,774.37	1,819.28	0.18	22.94	295,157,372.01
	GSC_W NLS_AC_N	3,463.90	323.75	0.10	36.61	93,837,894.39
	VIMS_45 VIMS_45	1.36	0.82	0.00	46.91	29,038.49
CAII	CAII_S CAII_S_AC	6,149.25	609.17	0.10	29.29	138,811,858.69
	CAII_S CAII_S_ext	775.98	113.03	0.02	26.52	9,745,384.04

2016 VIMS-Industry Cooperative Surveys
Summary

- <u>The good</u>
  - Biomass in the MAB closed areas and traditional NLCA and CA II access areas appear to be strong.
- <u>Causes of concern</u>
  - General lack of strong recruiting year class across all surveyed areas.
  - How to handle the age 4 scallops in the southern portion of the NLS if growth is a not realized. This may result in a limited contribution in terms of yield to the fishery.
  - Continued and expanded presence of a nematode parasite observed in the scallop meats which may limit effort in south portions of the resource (DMV and parts of ET).

Acknowledgements

- The owners, captains and crews;
  - F/V *Carolina Capes II*
  - *F/V Sea Hawk*
  - F/V *K.A.T.E*
  - F/V *Celtic*
- Daniel Smith, Lee Rollins, Chase Long and Nick Cardoso
- Support from NMFS NEFSC: Dvora Hart, Russ Brown, Vic Nordahl.
- Funding through Sea Scallop RSA program.



A continued investigation into the emergence of a parasite in sea scallops

David B. Rudders
Robert Fisher
Jan McDowell
Sally Roman

Virginia Institute of Marine Science

Sea Scallop Plan Development Team
Falmouth, MA
August 30-31, 2016

Preliminary – PDT use only.

VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

Affected scallops

- Typical gross appearance and intensity of affected scallops.
- Reports from industry concerning infected scallops began in May of 2015 and have continued throughout 2016.
- Reports of infected scallops began in the DMV and have extended into the ET.

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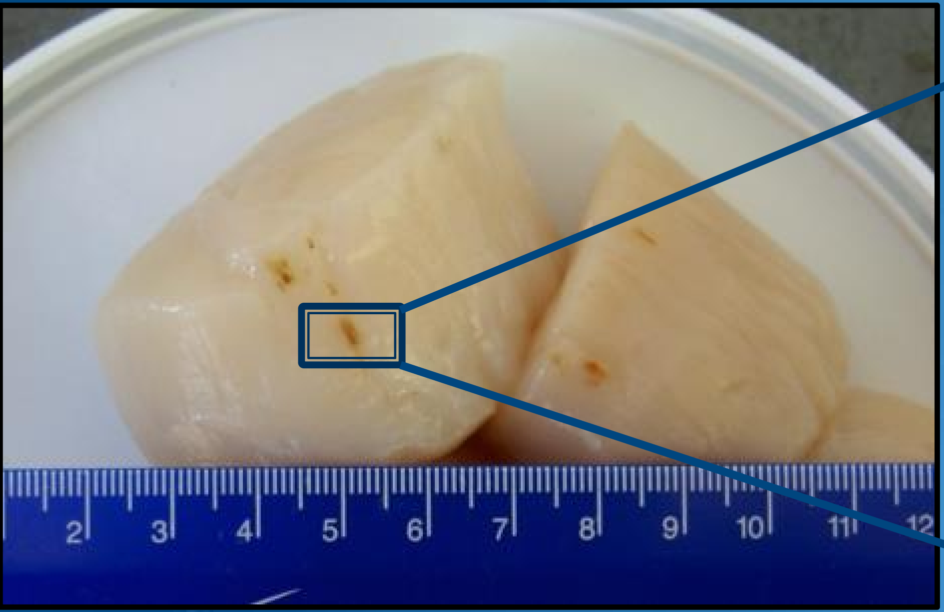
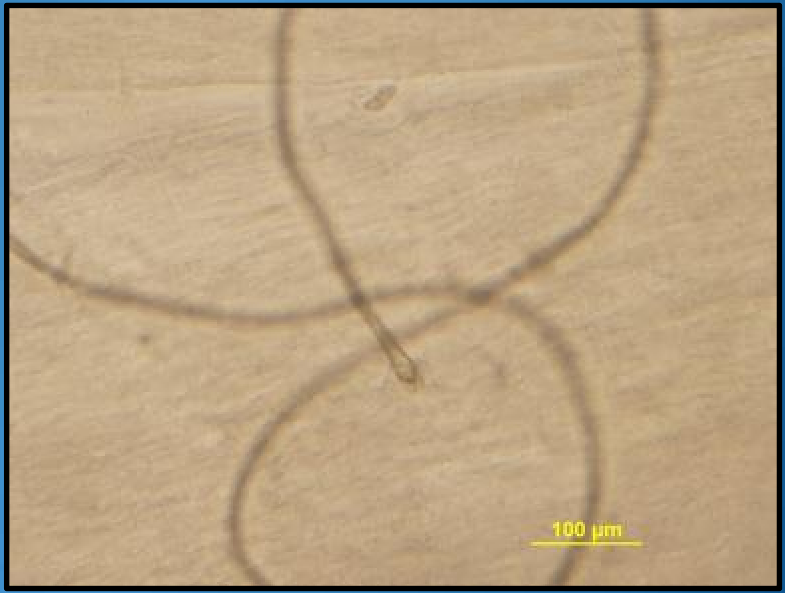
Appearance of affected scallops

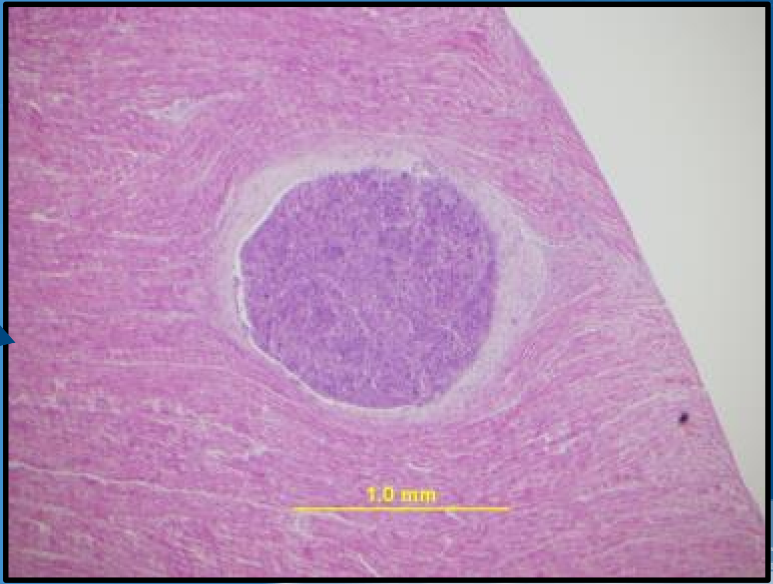
- Typical lesion size with number per scallop meat ranging from 1-6.
- The lesions presented on the exterior of the adductor muscle, typically opposite the sweet meat.
- Visible to the naked eye against the white meat. (~2-5mm)

Preliminary histology

Fresh squash mount







Histologically processed: pink=muscle, blue=hemocytes surrounding foreign object (host response)

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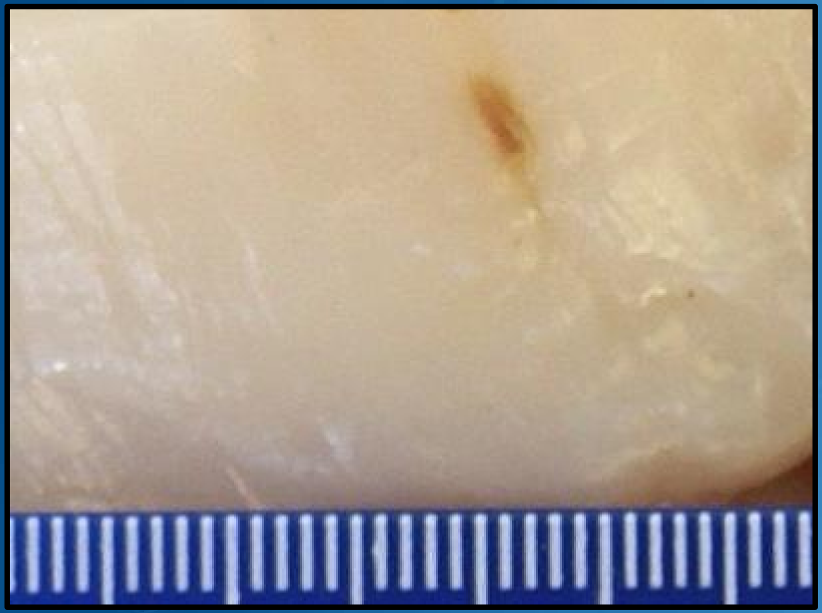
Preliminary histology



Fourth stage nematode larvae coiled within brownish lesion in sea scallop adductor muscle

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Preliminary identification

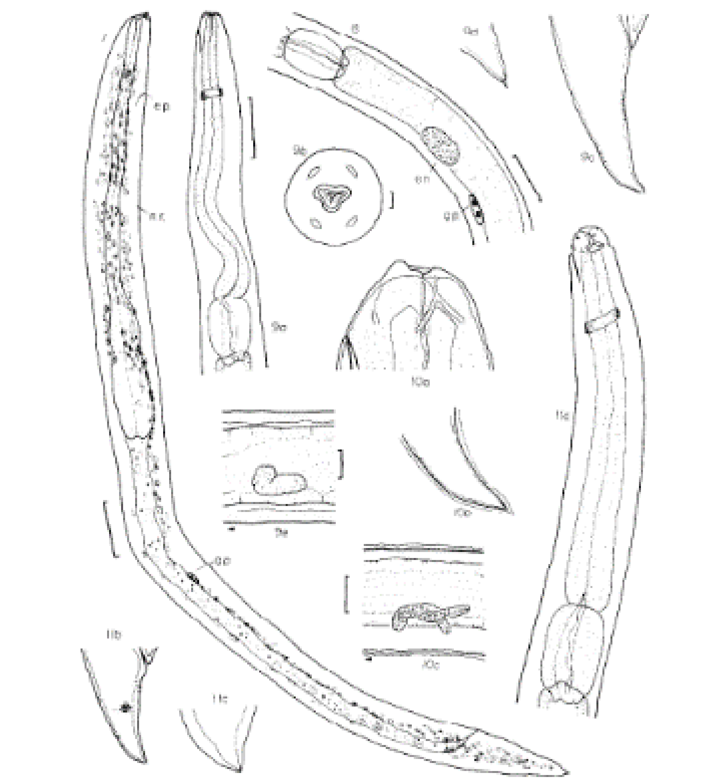


FIG. 7. Third stage larva from egg stained with aceto-orcein to show nuclei (Scale 0·02 mm): e.p., excretory pore; g.p., genital primordium; n.r., nerve ring.
FIG. 8. Lateral view of middle region of third stage larva from bivalve (*Melina ephippium*) infected 55 days previously (Scale 0·05 mm): e.n., excretory nucleus; g.p., genital primordium.
FIG. 9 (a–e). Third stage larva from bivalve (*Melina ephippium*) infected 86 days previously. (a) Oesophageal region (Scale 0·2 mm). (b) *En face* view (Scale 0·01 mm). (c) Tail showing no apparent phasmid (Scale as for FIG. 8). (d) Tip of tail showing mucron (Scale as for FIG. 7). (e) Latero-ventral view of middle region showing genital primordium. Arrow indicates anterior end (Scale 0·02 mm).
FIG. 10 (a–c). Third stage larva about to moult to fourth stage larva from bivalve (*Melina ephippium*) infected 115 days previously. (a) Head showing third stage cuticle with fourth stage lips forming below. (Scale as for FIG. 9e). (b) Tip of tail with third and fourth stage cuticles. (Scale as for FIG. 7). (c) Latero-ventral view of middle region showing genital primordium and third and fourth stage cuticles (Scale 0·05 mm).
FIG. 11 (a–c). Fourth stage larva from bivalve (*Melina ephippium*) infected 115 days previously. (a) Oesophageal region. (Scale as for FIG. 9a). (b) Tail showing phasmid. (Scale as for FIG. 10c). (c) Tip of tail showing no mucron. (Scale as for FIG. 7).

From Berry and Cannon, 1981

- Preliminary histology and molecular analysis has been completed on samples taken from the 2015 MAB survey.
- DNA results concluded that the sequences analyzed have a 99% identity with *Sulcascaris sulcata* .
- This species is cosmopolitan and has been identified in many genera of bivalve molluscs.
- Saucer scallop (Aus.), Calico scallop (US), Surf clams (US).
- Similar ephemeral observation of similar affected sea scallops was reported in May 2003.

Sulcascaris sulcata life cycle

- The life cycle of *Sulcascaris sulcata* involves two hosts.
- Adult nematodes attach to the esophagus of Loggerhead and Green sea turtles.
- Eggs pass through the GI tract and enter the benthos via the feces.
- Eggs are filtered by benthic molluscs and the larval stages (1-4) develop.
- Fourth stage larvae are ingested by turtles.

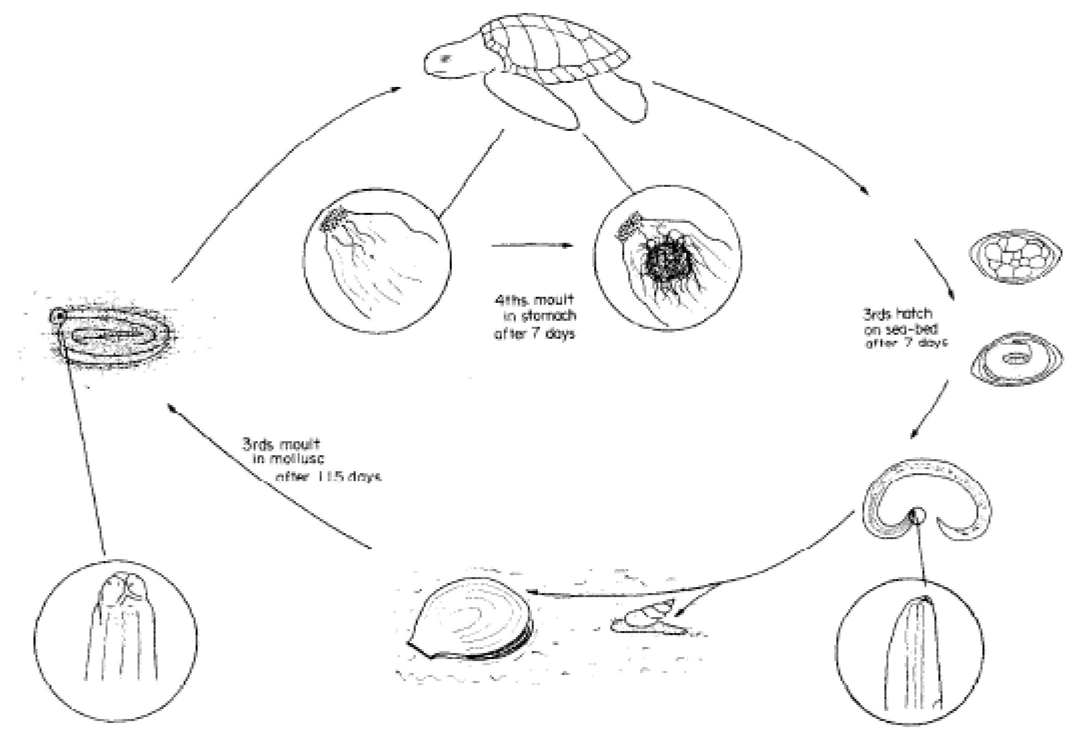
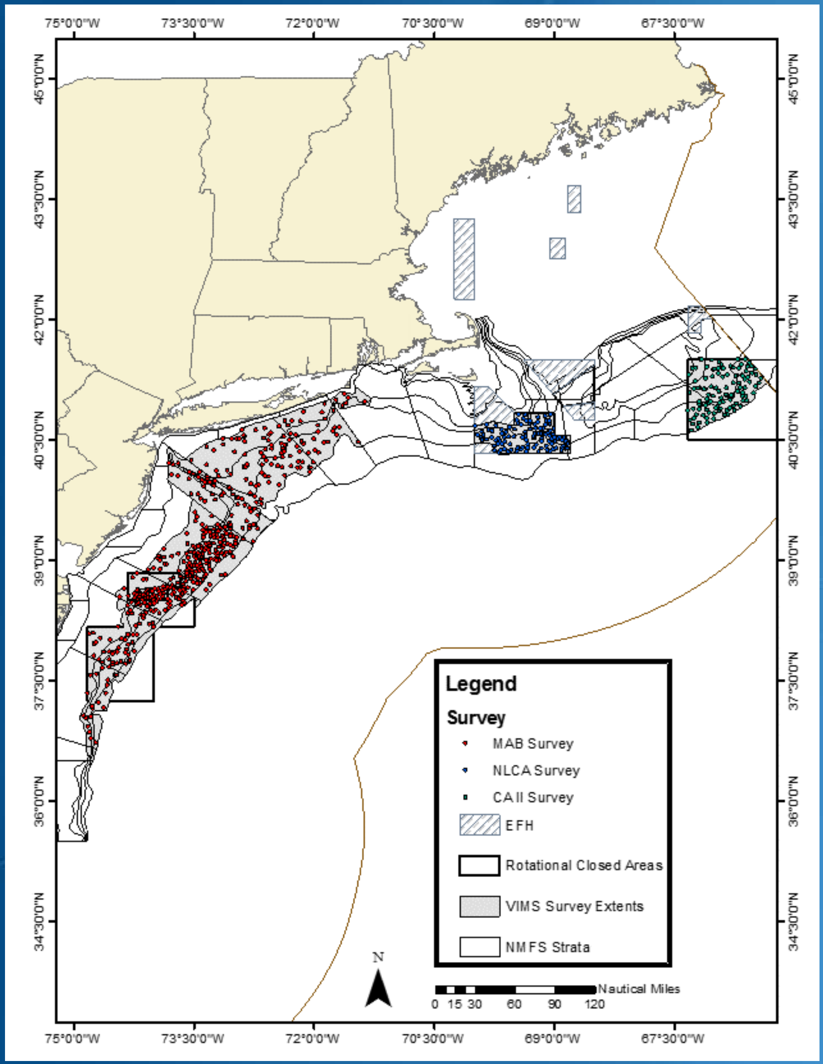


FIG. 16. Life history of *S. sulcata* in *C. caretta* and marine molluscs. Time intervals are minima found experimentally at 25° C.

From Berry and Cannon, 1981

Parasite surveillance



- For the 2016 surveys, VIMS continued an expanded biological sampling protocol to capture the spatial extent of the parasite as well as the prevalence and intensity of infected scallops.
- Sampled 15 animals at every station that had scallops .
  - Histological and genetic samples.
  - Gross observation of the number of nematodes present in an infected scallop.
  - Gross observation of the number of infected animals.

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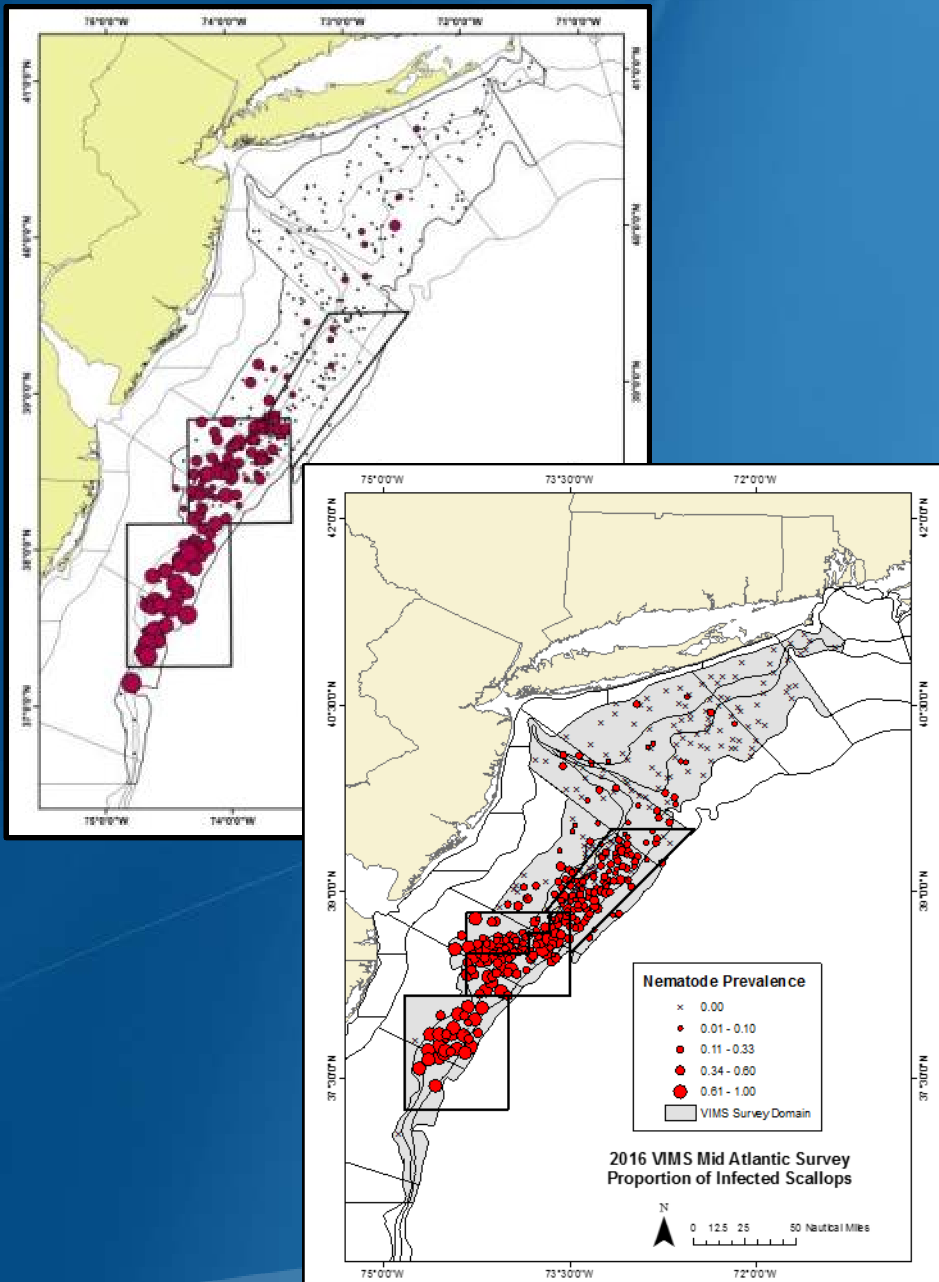
Nematode Prevalence



- Spatial distribution of the prevalence of the parasite in the sampled scallops.
- No infected scallops observed in the NLCA or the CA II survey areas.
- For each station with sampled scallops, a proportion of the sample that contained at least one nematode was calculated.
- Intensity appears to increase as a function if decreasing latitude.
- Prevalence appears to be increasing in the ET and Hudson Canyon compared to 2015.

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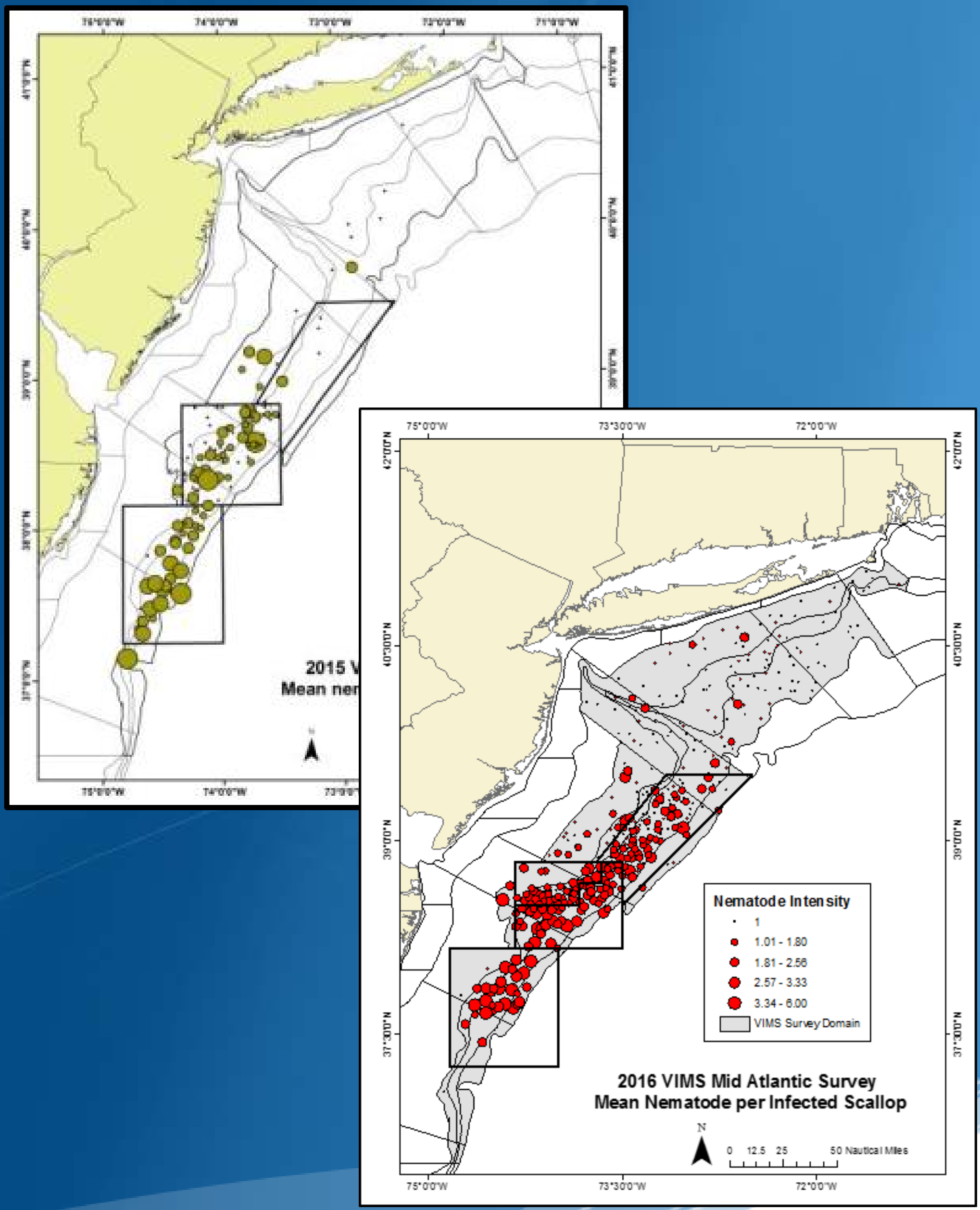
Nematode Intensity



- Spatial distribution of the intensity of the parasite in the sampled scallops.
- For each positive identification at a given station, the mean number of nematodes per scallop was calculated.
- Intensity appears to increase as a function if decreasing latitude.
- Intensity in northern areas is also increasing compared to 2015.

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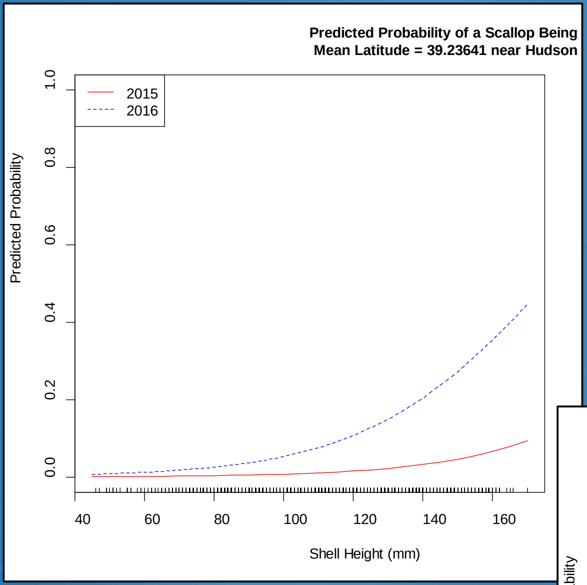
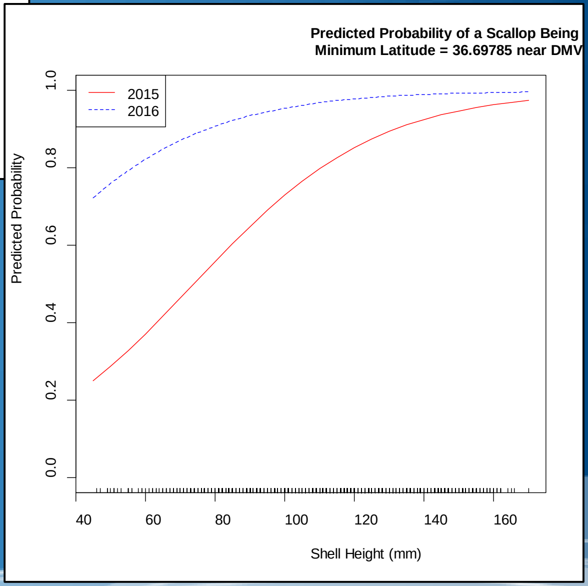
Logistic Regression for Nematode Presence

- Logistic regression was developed to predict the probability of a scallop being infected with nematodes.
- Significant predictor variables included year (2015 & 2016), latitude & shell height.
- The probability of a scallop being infected increased as a function of shell height and for 2016 and decreased as a function of latitude.
- Predictions are sensitive to the latitude value used.





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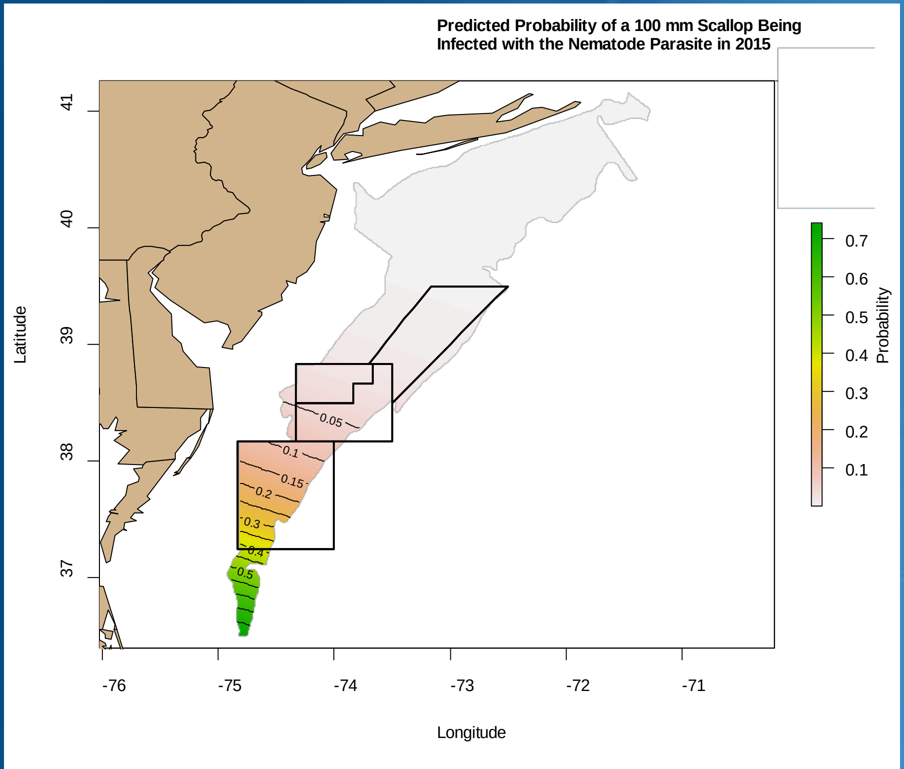
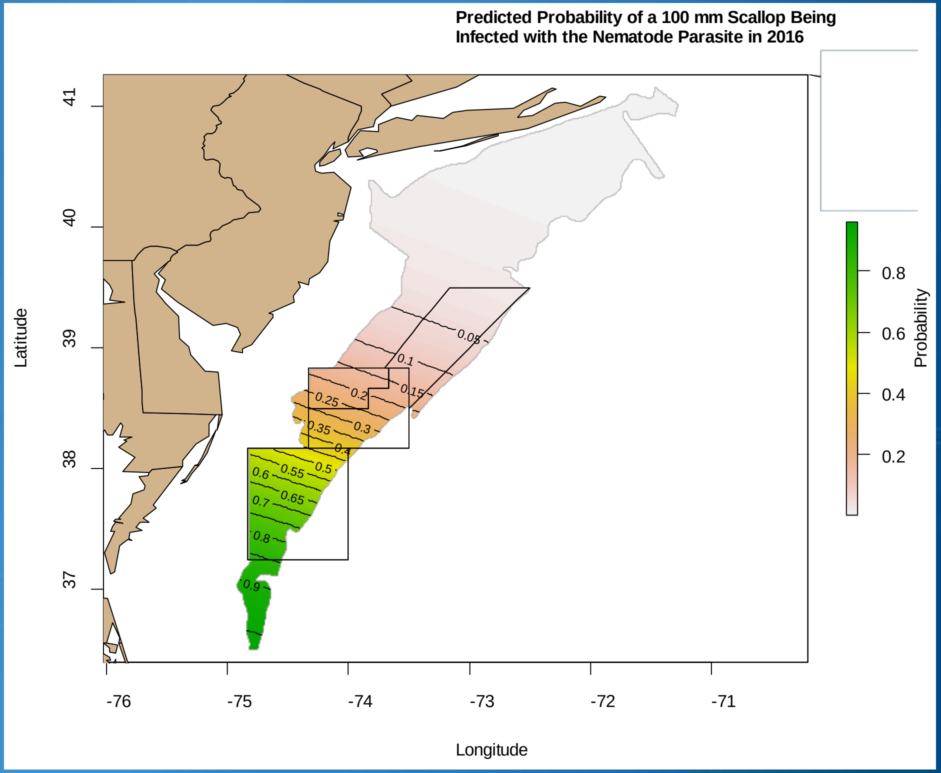
GAMM for Nematode Presence





- GAMM was developed to predict the probability of a scallop being infected with nematodes.
- Significant predictor variables included year (2015 & 2016), tensor product of latitude & longitude & shell height.

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Summary

- One parasite has been positively identified using taxonomic and genetic techniques.
- Data collected from the 2016 MAB survey will be analyzed using histology and molecular analysis to determine if more than one parasite is infecting animals and to understand the biology of the parasite and how it affects the host(s).
- Impact on fishery.
  - Clear overlap with the core of the current scallop biomass and the highest prevalence and intensity of the parasite.
  - In May of 2003, reports waned over time and there were no additional reported sightings until 2015.

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Results for the 2016 VIMS Industry Cooperative Surveys of the Mid-Atlantic, Nantucket Lightship Closed Area, and Closed Area II Resource Areas

Submitted to:
Sea Scallop Fishing Industry

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The Virginia Institute of Marine Science (VIMS) conducted high resolution sea scallop dredge surveys of the entire Mid-Atlantic (MAB) sea scallop resource area, the Nantucket Lightship (NLCA) access area and surrounds, and the CA II access area and Extension Closure to the south during May-June of 2016 (Figure 1). These surveys were funded by the Sea Scallop Research Set-Aside Program (RSA). Exploitable biomass for each survey is shown in Table 1 by spatially structured model (SAMS) region (Figure 2-4). SAMS regions take into account differences in recruitment, vital rates, and fishing effort. At the time of the surveys, exploitable biomass estimated from the survey dredge was 1,470 mt or 3.2 million pounds for the Delmarva (DMV) SAMS region, 6,587 mt or 14.5 million pounds for the Elephant Truck (ET) SAMS region and 7,302 mt or 16.1 million pounds in Long Island (LI) SAMS region in the MAB resource area. In the NLCA, the exploitable biomass in the southern region (GSC_S SAMS region in Table 1) was 10,531.55 mt or 23.2 million pounds. Exploitable biomass in the CAII survey domain was 10,187 mt or 22.4 million pounds.

The MAB survey was conducted aboard two commercial vessels: F/V *Carolina Capes II* and F/V *Sea Hawk* during May 2016. Each vessel completed one survey leg and approximately 225 stations in different regions of the survey area. The NLCA and CA II surveys were each conducted by a single commercial vessel in June of 2016. The F/V *Celtic* conducted the NLCA survey and completed 110 stations throughout the survey area. The F/V *K.A.T.E.* completed 100 stations throughout the CA II survey area. All surveys employed a stratified random survey design. All vessels towed a NMFS 8 foot survey dredge along with either a 14 foot Coonamessett Farm Turtle Deflector Dredge (CFTDD) equipped with a 10 inch diamond mesh twine top with a 1.76 hanging ratio (60 meshes, 34 rings) and 8.5 meshes on the side or a 14 foot or 15 foot New Bedford style commercial dredge. While the comparison of catches between the survey dredge and the commercial dredge is informative on a relative basis, for the purposes of this report, we present only the catch data from the commercial dredges during a 15 minute survey tow at 3.8 kts with a 3:1 scope in Table 2. This information is more applicable to what the industry is likely to encounter.

Catch data in tabular form is shown in Table 2. The density and number of scallops caught in three size classes (0-30mm, 31-75mm, and >75mm) in each tow is shown in Figures 5-13. In Figures 14-16, the shell height frequency distribution from the catches by the survey dredge and commercial dredges are shown for the different surveys and SAMS regions.

In addition to data on scallop abundance and biomass, we conducted a survey of meat quality during each survey. This includes documenting the presence and intensity of a parasitic nematode observed in the scallop meat. Infected scallops have rust colored lesions on the meats (Figure 17). Nematode infected scallops were observed only during the MAB survey. The typical number of nematodes observed per scallop meat ranged from 1-6 and nematodes were usually present on the exterior of the adductor muscle, typically opposite the sweet meat. The prevalence (% of sampled scallops sampled at a given station) of nematodes observed in the survey is shown in Figure 18. Intensity appears to increase as a function of decreasing latitude. Compared to 2015 observations, there appears to be an increase in the number of infected scallops sampled in the Hudson Canyon Access Area. VIMS will continue to investigate the nematode infection. This includes identifying the parasite, trying to understand the biology of the parasite and how it affects scallops, and the impact to the fishery.

Table 1. Exploitable biomass for scallops captured in the commercial and survey dredges during the VIMS/Industry cooperative surveys by survey, gear, and SAMS region during May-June 2016.

Survey	SAMS Region	Gear	Exploitable Biomass (mt)	95% CI Lower Bound	95% CI Upper Bound
MAB	DMV	COMM	2,520.01	1,538.68	3,501.33
	DMV	SURVEY	1,469.98	1,162.12	1,777.84
	ET	COMM	12,431.27	10,613.84	14,248.71
	ET	SURVEY	6,587.21	6,114.64	7,059.78
	HC	COMM	10,883.96	7,223.66	14,546.74
	HC	SURVEY	5,785.78	5,289.31	6,284.19
	HCsr	COMM	1,219.07	925.51	1,512.85
	HCsr	SURVEY	1,363.84	1,080.34	1,647.60
	LI	COMM	7,183.71	6,141.20	8,226.22
	LI	SURVEY	7,301.62	6,689.56	7,913.67
NLCA	GSC_S	COMM	10,877.03	7,356.89	14,397.18
	GSC_S	SURVEY	10,531.55	8,721.56	12,341.54
	GSC_W	COMM	512.80	91.14	934.45
	GSC_W	SURVEY	676.43	325.73	1,027.13
CA II	CAII_S	COMM	6,574.37	5,264.69	7,884.05
	CAII_S	SURVEY	10,186.87	9,025.85	11,347.90

Table 2. Catch data for the commercial dredges from the VIMS/Industry cooperative surveys completed during May-June 2016. Nematode prevalence (% of sampled scallops sampled at a given station infected with nematodes) is also provided for each station.

Survey	StationID	Latitude (degrees)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	Scallop (number)	Scallop (lbs)	Scallop (baskets)	Scallop Density	Nematode Prevalence
MAB	201602001	36	43.09	74	43.43	0	0.00	0.00	0.00	0
MAB	201602002	36	46.49	74	47.03	0	0.00	0.00	0.00	0
MAB	201602003	36	50.95	74	48.11	0	0.00	0.00	0.00	0
MAB	201602004	36	55.46	74	49.17	0	0.00	0.00	0.00	0
MAB	201602005	37	2.49	74	47.10	0	0.00	0.00	0.00	0
MAB	201602006	37	1.92	74	50.49	0	0.00	0.00	0.00	0
MAB	201602007	37	3.36	74	52.58	0	0.00	0.00	0.00	0
MAB	201602008	37	8.57	74	45.45	0	0.00	0.00	0.00	0
MAB	201602009	37	10.44	74	45.81	0	0.00	0.00	0.00	0
MAB	201602010	37	9.44	74	37.27	0	0.00	0.00	0.00	0
MAB	201602011	37	13.34	74	41.32	0	0.00	0.00	0.00	0
MAB	201602012	37	20.22	74	35.64	0	0.00	0.00	0.00	0
MAB	201602013	37	26.13	74	34.81	99	0.00	1.00	0.02	0.71
MAB	201602014	37	29.93	74	34.02	462	0.02	4.30	0.09	0
MAB	201602015	37	33.91	74	29.06	59	0.00	0.50	0.01	0
MAB	201602016	37	33.87	74	27.76	0	0.00	0.00	0.00	0
MAB	201602017	37	42.57	74	27.46	8	0.00	0.10	0.00	0.50
MAB	201602018	37	43.91	74	24.39	325	0.01	3.80	0.06	0.87
MAB	201602019	37	42.11	74	20.54	532	0.01	6.25	0.10	0.80
MAB	201602020	37	44.05	74	18.30	1	0.00	0.01	0.00	1.00
MAB	201602021	37	44.89	74	17.65	941	0.03	11.25	0.18	0.93
MAB	201602022	37	48.72	74	18.72	42	0.00	0.25	0.01	0.60
MAB	201602023	37	50.46	74	21.20	645	0.02	9.50	0.13	0.80
MAB	201602024	37	51.66	74	14.25	4	0.00	0.01	0.00	0.33
MAB	201602025	37	52.88	74	19.93	1	0.00	0.01	0.00	0
MAB	201602026	37	56.64	74	18.99	20	0.00	0.10	0.00	0.20
MAB	201602027	37	58.18	74	15.74	446	0.01	5.00	0.09	0.67
MAB	201602028	37	59.99	74	20.97	97	0.00	1.50	0.02	0.53
MAB	201602029	38	0.79	74	23.97	7	0.00	0.10	0.00	0.63
MAB	201602030	38	4.25	74	19.17	58	0.00	0.50	0.01	0.80
MAB	201602031	38	3.74	74	15.31	0	0.00	0.00	0.00	0
MAB	201602032	38	3.68	74	12.34	197	0.01	2.00	0.04	0.67
MAB	201602033	38	10.46	74	13.46	1,172	0.03	10.50	0.23	0.53
MAB	201602034	38	12.17	74	10.50	318	0.01	3.00	0.06	1.00

MAB	201602035	38	11.80	74	3.07	223	0.01	2.50	0.04	0.87
MAB	201602036	38	9.60	73	59.97	5	0.00	0.10	0.00	0.33
MAB	201602037	38	12.60	74	0.38	0	0.00	0.00	0.00	0
MAB	201602038	38	16.35	74	7.74	1	0.00	0.10	0.00	1.00
MAB	201602039	38	18.74	74	9.28	942	0.03	9.50	0.18	0.67
MAB	201602040	38	18.68	74	7.45	672	0.02	8.00	0.13	0.60
MAB	201602041	38	20.48	74	5.31	664	0.02	10.00	0.13	0.60
MAB	201602042	38	22.41	74	2.15	422	0.01	7.00	0.08	0.87
MAB	201602043	38	20.88	73	59.92	394	0.01	7.00	0.08	0.40
MAB	201602044	38	22.43	73	58.21	160	0.00	2.50	0.03	0.80
MAB	201602045	38	20.06	73	55.59	915	0.03	13.00	0.18	0.47
MAB	201602046	38	22.03	73	50.98	28	0.00	0.20	0.01	0.13
MAB	201602047	38	24.03	73	48.26	0	0.00	0.00	0.00	0
MAB	201602048	38	25.76	73	47.49	2	0.00	0.01	0.00	0
MAB	201602049	38	27.36	73	48.85	15	0.00	0.10	0.00	0.33
MAB	201602050	38	28.92	73	47.66	872	0.02	13.50	0.17	0.33
MAB	201602051	38	25.97	73	38.70	154	0.00	3.00	0.03	0.47
MAB	201602052	38	27.80	73	36.69	5	0.00	0.10	0.00	0.33
MAB	201602053	38	29.38	73	37.89	1	0.00	0.01	0.00	0.07
MAB	201602054	38	30.37	73	41.09	2	0.00	0.01	0.00	1.00
MAB	201602055	38	31.66	73	43.09	769	0.02	11.00	0.15	0.71
MAB	201602056	38	32.80	73	39.44	980	0.02	12.00	0.19	0.27
MAB	201602057	38	34.45	73	38.35	475	0.01	4.50	0.09	0.40
MAB	201602058	38	35.84	73	36.16	719	0.02	9.00	0.14	0.67
MAB	201602059	38	37.19	73	30.34	1,423	0.04	15.00	0.28	0.36
MAB	201602060	38	37.72	73	20.58	283	0.01	2.20	0.05	0.27
MAB	201602061	38	41.43	73	17.95	4	0.00	0.10	0.00	0.07
MAB	201602062	38	42.49	73	25.32	2	0.00	0.10	0.00	0.33
MAB	201602063	38	42.34	73	27.24	498	0.01	5.00	0.10	0.21
MAB	201602064	38	43.11	73	30.07	785	0.02	7.00	0.15	0.20
MAB	201602065	38	45.76	73	26.51	641	0.02	6.00	0.12	0.27
MAB	201602066	38	45.09	73	22.89	68	0.00	0.75	0.01	0.14
MAB	201602067	38	47.44	73	21.50	29	0.00	0.50	0.01	0.14
MAB	201602068	38	49.06	73	20.34	1,920	0.05	19.00	0.37	0.13
MAB	201602069	38	48.46	73	9.05	2,824	0.08	26.00	0.55	0.07
MAB	201602070	38	49.17	73	6.22	22	0.00	0.10	0.00	0.27
MAB	201602071	38	51.72	73	16.59	2	0.00	0.01	0.00	0.33
MAB	201602072	38	52.84	73	17.88	388	0.01	5.00	0.08	0.33
MAB	201602073	38	51.45	73	22.08	82	0.00	1.00	0.02	0.27
MAB	201602074	38	52.95	73	23.13	1,033	0.03	18.00	0.20	0.20
MAB	201602075	38	55.65	73	24.09	397	0.01	5.00	0.08	0.13

MAB	201602076	38	55.68	73	18.20	717	0.02	11.00	0.14	0.33
MAB	201602077	38	57.51	73	20.19	77	0.00	1.00	0.01	0.40
MAB	201602078	38	59.76	73	20.57	311	0.01	7.25	0.06	0.27
MAB	201602079	38	59.43	73	18.11	950	0.01	19.50	0.18	0.20
MAB	201602080	39	0.79	73	16.85	140	0.00	1.80	0.03	0.40
MAB	201602081	38	59.98	73	14.47	54	0.00	1.00	0.01	0.40
MAB	201602082	38	59.27	73	12.56	17	0.00	0.10	0.00	0.33
MAB	201602083	38	59.56	73	10.49	40	0.00	0.50	0.01	0.20
MAB	201602084	39	2.16	73	0.19	12	0.00	0.10	0.00	0.27
MAB	201602085	39	3.20	73	7.03	0	0.00	0.00	0.00	0
MAB	201602086	39	2.29	73	12.19	148	0.01	1.50	0.03	0.07
MAB	201602087	39	3.09	73	12.31	35	0.00	0.25	0.01	0.13
MAB	201602088	39	4.68	73	13.52	225	0.01	1.90	0.04	0.27
MAB	201602089	39	5.15	73	11.58	349	0.01	3.00	0.07	0.20
MAB	201602090	39	5.00	73	8.75	277	0.01	2.50	0.05	0.20
MAB	201602091	39	5.55	73	5.52	1,453	0.04	16.00	0.28	0.33
MAB	201602092	39	5.38	73	1.83	57	0.00	0.50	0.01	0.13
MAB	201602093	39	5.76	73	2.59	2	0.00	0.10	0.00	0
MAB	201602094	39	8.83	73	7.95	60	0.00	0.60	0.01	0.07
MAB	201602095	39	10.64	73	7.39	204	0.01	1.90	0.04	0.07
MAB	201602096	39	11.89	73	4.39	62	0.00	1.00	0.01	0.13
MAB	201602097	39	11.02	73	2.34	143	0.00	2.00	0.03	0.20
MAB	201602098	39	9.70	72	59.96	13	0.00	0.20	0.00	0
MAB	201602099	39	11.73	72	58.77	58	0.00	0.50	0.01	0.06
MAB	201602100	39	14.19	72	58.46	12	0.00	0.10	0.00	0.13
MAB	201602101	39	16.79	72	57.24	186	0.00	2.00	0.04	0.20
MAB	201602102	39	15.19	72	52.71	2,244	0.05	30.00	0.44	0.07
MAB	201602103	39	13.61	72	45.37	8	0.00	0.10	0.00	0.18
MAB	201602104	39	23.08	72	41.76	1	0.00	0.01	0.00	0
MAB	201602106	39	26.56	72	45.00	11	0.00	0.10	0.00	0
MAB	201602107	39	33.19	72	41.82	97	0.00	1.50	0.02	0.13
MAB	201602108	39	38.13	72	44.24	110	0.00	1.50	0.02	0
MAB	201602109	39	38.80	72	47.79	52	0.00	0.80	0.01	0.13
MAB	201602110	39	35.46	72	47.00	668	0.01	12.00	0.13	0.20
MAB	201602111	39	28.77	72	50.05	294	0.01	2.80	0.06	0.07
MAB	201602112	39	25.36	72	47.90	657	0.02	5.20	0.13	0.13
MAB	201602113	39	23.40	72	48.24	137	0.00	1.10	0.03	0.20
MAB	201602114	39	23.48	72	53.12	69	0.00	0.75	0.01	0.07
MAB	201602115	39	22.73	73	2.32	96	0.01	1.00	0.02	0.27
MAB	201602116	39	20.87	73	5.75	117	0.00	1.25	0.02	0.40
MAB	201602117	39	19.45	73	4.80	240	0.01	2.25	0.05	0.40

MAB	201602118	39	19.26	73	1.62	196	0.01	1.75	0.04	0.20
MAB	201602119	39	17.54	73	0.52	667	0.02	6.10	0.13	0.20
MAB	201602120	39	17.47	73	2.55	465	0.01	4.50	0.09	0.06
MAB	201602121	39	18.27	73	8.14	118	0.00	1.20	0.02	0.07
MAB	201602122	39	16.70	73	11.68	29	0.00	0.30	0.01	0
MAB	201602123	39	16.30	73	7.58	190	0.01	1.75	0.04	0.13
MAB	201602124	39	14.65	73	6.78	99	0.00	1.00	0.02	0.13
MAB	201602125	39	13.01	73	10.22	258	0.01	2.50	0.05	0.20
MAB	201602126	39	12.30	73	14.93	136	0.00	1.50	0.03	0.27
MAB	201602127	39	9.61	73	10.90	140	0.00	1.50	0.03	0.07
MAB	201602128	39	7.17	73	13.24	245	0.01	2.50	0.05	0.13
MAB	201602129	39	8.17	73	18.62	182	0.01	2.00	0.04	0.13
MAB	201602130	39	6.90	73	18.52	137	0.00	1.50	0.03	0.13
MAB	201602131	39	4.82	73	17.86	399	0.01	3.80	0.08	0
MAB	201602132	39	2.70	73	23.25	82	0.00	2.10	0.02	0
MAB	201602133	39	1.11	73	23.92	97	0.00	1.10	0.02	0.07
MAB	201602134	38	59.80	73	25.06	695	0.01	7.50	0.13	0.13
MAB	201602135	38	58.39	73	24.95	549	0.01	7.10	0.11	0.13
MAB	201602136	38	57.50	73	25.11	829	0.01	12.00	0.16	0.20
MAB	201602137	38	57.79	73	28.67	698	0.02	7.20	0.14	0.20
MAB	201602138	38	55.81	73	31.35	326	0.01	4.00	0.06	0
MAB	201602139	38	55.56	73	29.61	866	0.02	9.00	0.17	0.27
MAB	201602140	38	55.92	73	27.30	650	0.01	8.00	0.13	0.07
MAB	201602141	38	53.34	73	25.94	679	0.02	8.00	0.13	0.13
MAB	201602142	38	51.48	73	25.77	1,112	0.03	12.10	0.22	0.20
MAB	201602143	38	51.26	73	27.75	1,026	0.02	15.10	0.20	0.27
MAB	201602144	38	51.55	73	30.98	1,529	0.04	17.00	0.30	0.47
MAB	201602145	38	50.02	73	31.01	204	0.01	2.50	0.04	0.20
MAB	201602146	38	47.42	73	28.71	1,279	0.04	12.80	0.25	0.20
MAB	201602148	38	47.87	73	31.71	966	0.03	12.00	0.19	0.27
MAB	201602149	38	47.98	73	33.21	0	0.00	0.00	0.00	0
MAB	201602150	38	47.57	73	34.86	552	0.01	7.00	0.11	0.60
MAB	201602151	38	45.56	73	32.01	220	0.00	2.50	0.04	0.40
MAB	201602152	38	43.67	73	35.67	671	0.01	10.00	0.13	0.20
MAB	201602153	38	41.20	73	38.08	590	0.02	7.00	0.11	0.67
MAB	201602154	38	39.69	73	36.95	870	0.02	9.50	0.17	0.40
MAB	201602155	38	39.12	73	34.19	1,314	0.03	10.00	0.26	0.40
MAB	201602156	38	37.58	73	37.73	254	0.01	2.90	0.05	0.53
MAB	201602157	38	37.00	73	40.21	348	0.01	4.00	0.07	0.64
MAB	201602158	38	35.77	73	44.46	524	0.01	8.00	0.10	0.67
MAB	201602159	38	34.15	73	46.10	972	0.02	15.00	0.19	0.27

MAB	201602160	38	30.75	73	49.44	786	0.02	10.20	0.15	0.40
MAB	201602161	38	30.48	73	54.71	810	0.02	10.50	0.16	0.27
MAB	201602162	38	30.74	73	56.92	1,103	0.02	16.50	0.21	0.20
MAB	201602163	38	32.56	73	58.19	1,715	0.02	31.00	0.33	0.47
MAB	201602164	38	33.46	73	59.60	700	0.02	9.50	0.14	0.40
MAB	201602165	38	36.26	74	2.90	556	0.02	8.00	0.11	0.13
MAB	201602166	38	37.83	74	4.66	577	0.02	8.00	0.11	0.40
MAB	201602167	38	36.24	74	5.34	282	0.01	3.25	0.05	0.13
MAB	201602168	38	34.72	74	4.19	1,790	0.06	24.00	0.35	0.40
MAB	201602169	38	32.43	74	1.10	988	0.02	15.25	0.19	0.27
MAB	201602170	38	29.84	73	59.78	1,401	0.02	22.00	0.27	0.47
MAB	201602171	38	28.43	73	57.75	777	0.02	9.00	0.15	0.20
MAB	201602172	38	27.37	73	59.35	1,667	0.03	22.00	0.32	0.20
MAB	201602173	38	27.25	74	2.74	216	0.01	3.25	0.04	0.60
MAB	201602174	38	30.74	74	3.17	43	0.00	1.00	0.01	0.40
MAB	201602175	38	31.65	74	4.26	246	0.01	2.75	0.05	0.80
MAB	201602176	38	31.44	74	6.47	614	0.02	7.00	0.12	0.53
MAB	201602177	38	33.59	74	6.62	223	0.01	3.50	0.04	0.53
MAB	201602178	38	33.97	74	7.89	398	0.02	5.00	0.08	0.33
MAB	201602179	38	34.60	74	10.03	178	0.01	2.00	0.03	0.13
MAB	201602180	38	36.37	74	11.09	420	0.01	4.80	0.08	0.53
MAB	201602181	38	37.36	74	11.99	1,439	0.03	16.00	0.28	0.13
MAB	201602182	38	38.60	74	22.06	6	0.00	0.10	0.00	0.33
MAB	201602183	38	34.58	74	14.39	827	0.02	10.90	0.16	0.43
MAB	201602184	38	33.36	74	12.43	545	0.02	7.50	0.11	0.87
MAB	201602185	38	32.18	74	10.25	384	0.01	4.00	0.07	0.47
MAB	201602186	38	30.11	74	8.44	1,021	0.05	13.00	0.20	0.80
MAB	201602187	38	27.78	74	6.89	1,233	0.03	17.00	0.24	0.60
MAB	201602188	38	25.26	74	4.78	158	0.00	1.50	0.03	0.60
MAB	201602189	38	26.07	74	9.90	380	0.01	6.00	0.07	0.47
MAB	201602190	38	26.48	74	12.78	156	0.00	1.70	0.03	0.67
MAB	201602191	38	27.83	74	11.08	399	0.01	3.80	0.08	0.47
MAB	201602192	38	30.23	74	12.46	517	0.02	7.25	0.10	0.63
MAB	201602193	38	31.37	74	14.04	26	0.00	0.20	0.01	0.80
MAB	201602194	38	32.97	74	18.74	14	0.00	0.10	0.00	0.67
MAB	201602195	38	32.09	74	25.38	1	0.00	0.01	0.00	1.00
MAB	201602196	38	28.29	74	16.49	53	0.00	0.50	0.01	0.65
MAB	201602197	38	25.64	74	19.36	10	0.00	0.01	0.00	0.58
MAB	201602198	38	22.20	74	17.44	106	0.00	1.00	0.02	0.53
MAB	201602199	38	19.85	74	16.12	205	0.01	2.25	0.04	0.60
MAB	201602200	38	19.77	74	19.25	10	0.00	0.01	0.00	0.71

MAB	201602201	38	10.12	74	26.36	0	0.00	0.00	0.00	0
MAB	201602202	38	5.28	74	45.13	0	0.00	0.00	0.00	0
MAB	201602203	38	4.68	74	48.14	0	0.00	0.00	0.00	0
MAB	201602204	37	57.15	74	44.46	0	0.00	0.00	0.00	0
MAB	201602205	37	58.06	74	42.95	0	0.00	0.00	0.00	0
MAB	201602206	38	1.30	74	39.74	0	0.00	0.00	0.00	0
MAB	201602207	38	0.12	74	32.40	0	0.00	0.00	0.00	0.33
MAB	201602208	37	54.16	74	26.15	99	0.00	1.10	0.02	0.73
MAB	201602209	37	51.04	74	27.20	18	0.00	0.20	0.00	0.93
MAB	201602210	37	50.96	74	29.59	22	0.00	0.25	0.00	0.53
MAB	201602211	37	49.84	74	30.70	7	0.00	0.10	0.00	1.00
MAB	201602212	37	51.08	74	33.06	25	0.00	0.40	0.00	0.67
MAB	201602213	37	51.00	74	37.32	2	0.00	0.01	0.00	1.00
MAB	201602214	37	48.09	74	44.69	0	0.00	0.01	0.00	0
MAB	201602215	37	45.61	74	40.82	0	0.00	0.00	0.00	0
MAB	201602216	37	43.33	74	38.34	5	0.00	0.10	0.00	0.83
MAB	201602217	37	45.36	74	33.16	16	0.00	0.10	0.00	0.87
MAB	201602218	37	43.13	74	30.16	103	0.00	1.00	0.02	0.73
MAB	201602219	37	41.56	74	30.68	182	0.01	2.00	0.04	0.87
MAB	201602220	37	39.62	74	33.25	15	0.00	0.15	0.00	0.93
MAB	201602221	37	38.93	74	38.23	3	0.00	0.01	0.00	0.75
MAB	201602222	37	34.55	74	42.64	1	0.00	0.01	0.00	1.00
MAB	201602223	37	33.63	74	47.11	0	0.00	0.00	0.00	0
MAB	201602224	37	20.19	74	49.56	0	0.00	0.00	0.00	0
MAB	201603001	38	45.41	74	5.64	106	0.00	1.50	0.02	0.40
MAB	201603002	38	45.22	74	7.52	2	0.00	0.01	0.00	0.40
MAB	201603003	38	46.84	74	15.55	3	0.00	0.01	0.00	0.67
MAB	201603004	38	49.87	74	12.37	0	0.00	0.00	0.00	0
MAB	201603005	38	52.42	74	3.89	1	0.00	0.01	0.00	0
MAB	201603006	38	53.74	73	59.86	10	0.00	0.01	0.00	0.27
MAB	201603007	38	52.91	73	54.89	40	0.00	0.25	0.01	0.47
MAB	201603008	38	56.42	73	50.29	21	0.00	0.25	0.00	0.33
MAB	201603009	38	56.74	73	51.70	14	0.00	0.15	0.00	0
MAB	201603010	38	59.65	73	55.20	1	0.00	0.01	0.00	0
MAB	201603011	39	1.12	73	57.05	2	0.00	0.02	0.00	0
MAB	201603012	39	2.78	73	56.02	2	0.00	0.02	0.00	0
MAB	201603013	39	1.94	73	52.11	10	0.00	0.20	0.00	0.17
MAB	201603014	39	2.56	73	46.24	48	0.00	0.50	0.01	0.13
MAB	201603015	39	4.65	73	41.54	12	0.00	0.20	0.00	0
MAB	201603016	39	8.02	73	51.90	3	0.00	0.01	0.00	0
MAB	201603017	39	11.89	73	34.34	21	0.00	0.20	0.00	0.33

MAB	201603018	39	19.57	73	34.87	33	0.00	0.40	0.01	0.07
MAB	201603019	39	26.33	73	23.46	37	0.00	0.20	0.01	0
MAB	201603020	39	28.80	73	28.67	17	0.00	0.10	0.00	0.07
MAB	201603021	39	31.79	73	27.39	9	0.00	0.01	0.00	0.08
MAB	201603022	39	32.78	73	16.39	49	0.00	0.66	0.01	0.07
MAB	201603023	39	35.38	73	28.78	8	0.00	0.10	0.00	0
MAB	201603024	39	44.90	73	13.79	88	0.00	1.00	0.02	0
MAB	201603025	39	48.76	73	15.64	53	0.00	0.60	0.01	0.20
MAB	201603026	39	43.82	73	21.46	16	0.00	0.25	0.00	0.09
MAB	201603027	39	45.75	73	24.51	11	0.00	0.10	0.00	0
MAB	201603028	39	49.10	73	26.62	27	0.00	0.40	0.01	0
MAB	201603029	39	49.09	73	31.68	35	0.00	0.40	0.01	0
MAB	201603030	40	2.67	73	41.50	6	0.00	0.15	0.00	0
MAB	201603031	40	3.80	73	46.52	2	0.00	0.02	0.00	0
MAB	201603032	40	12.29	73	48.27	0	0.00	0.00	0.00	0
MAB	201603033	40	11.02	73	45.22	0	0.00	0.00	0.00	0
MAB	201603034	40	12.02	73	41.35	0	0.00	0.00	0.00	0
MAB	201603035	40	0.31	73	33.36	5	0.00	0.05	0.00	0.20
MAB	201603036	40	5.67	73	33.08	7	0.00	0.05	0.00	0.14
MAB	201603037	40	4.22	73	30.24	0	0.00	0.00	0.00	0
MAB	201603038	40	1.55	73	26.54	3	0.00	0.03	0.00	0
MAB	201603039	39	59.72	73	23.72	3	0.00	0.03	0.00	0
MAB	201603040	39	58.17	73	21.53	0	0.00	0.00	0.00	0
MAB	201603041	39	54.76	73	22.16	44	0.00	0.50	0.01	0
MAB	201603042	39	55.29	73	14.58	1	0.00	0.01	0.00	0
MAB	201603043	39	58.70	73	14.06	52	0.00	0.90	0.01	0
MAB	201603044	39	57.60	73	17.54	0	0.00	0.00	0.00	0
MAB	201603045	40	0.74	73	19.41	100	0.00	1.20	0.02	0.07
MAB	201603046	40	2.18	73	19.88	57	0.00	0.80	0.01	0.07
MAB	201603047	40	5.35	73	25.40	77	0.00	1.00	0.02	0.20
MAB	201603048	40	14.36	73	31.63	1	0.00	0.01	0.00	0
MAB	201603049	40	10.94	73	20.20	26	0.00	0.20	0.01	0
MAB	201603050	40	6.27	73	12.79	42	0.00	0.25	0.01	0
MAB	201603051	40	2.62	73	11.32	79	0.00	1.00	0.02	0.07
MAB	201603052	40	3.68	73	1.95	111	0.00	1.50	0.02	0
MAB	201603053	40	6.54	73	4.79	99	0.00	1.00	0.02	0
MAB	201603054	40	9.40	72	52.27	52	0.00	0.75	0.01	0.07
MAB	201603055	40	9.33	72	50.84	90	0.00	1.00	0.02	0
MAB	201603056	40	11.06	72	49.64	62	0.00	0.80	0.01	0.07
MAB	201603057	40	18.52	72	51.33	111	0.00	1.25	0.02	0
MAB	201603058	40	20.51	72	59.22	110	0.00	1.25	0.02	0

MAB	201603059	40	21.70	73	14.95	22	0.00	0.25	0.00	0
MAB	201603060	40	24.39	73	20.10	0	0.00	0.00	0.00	0
MAB	201603061	40	26.06	73	7.90	7	0.00	0.01	0.00	0
MAB	201603062	40	30.71	73	7.83	2	0.00	0.01	0.00	0
MAB	201603063	40	30.70	73	1.35	0	0.00	0.00	0.00	0
MAB	201603064	40	30.24	72	57.50	10	0.00	0.10	0.00	0.20
MAB	201603065	40	30.17	72	55.90	32	0.00	0.20	0.01	0
MAB	201603066	40	28.26	72	51.55	511	0.01	4.90	0.11	0
MAB	201603068	40	32.88	72	52.46	24	0.00	0.20	0.01	0
MAB	201603069	40	37.23	72	53.39	0	0.00	0.00	0.00	0
MAB	201603070	40	37.03	72	43.36	9	0.00	0.01	0.00	0
MAB	201603071	40	30.81	72	37.31	29	0.00	0.20	0.01	0
MAB	201603072	40	29.25	72	33.99	26	0.00	0.20	0.01	0
MAB	201603073	40	33.64	72	33.37	17	0.00	0.10	0.00	0.07
MAB	201603074	40	34.80	72	32.08	34	0.00	0.25	0.01	0
MAB	201603075	40	38.33	72	36.56	73	0.00	1.00	0.01	0
MAB	201603076	40	39.75	72	25.97	50	0.00	0.50	0.01	0
MAB	201603077	40	43.83	72	21.49	8	0.00	0.10	0.00	0
MAB	201603078	40	40.57	72	18.98	8	0.00	0.10	0.00	0
MAB	201603079	40	43.63	72	16.32	7	0.00	0.10	0.00	0
MAB	201603080	40	43.48	72	9.79	8	0.00	0.10	0.00	0
MAB	201603081	40	50.51	72	7.24	6	0.00	0.10	0.00	0
MAB	201603082	40	50.09	71	53.65	39	0.00	0.50	0.01	0
MAB	201603083	40	56.49	71	51.70	2	0.00	0.02	0.00	0
MAB	201603084	40	59.50	71	43.27	130	0.00	1.25	0.03	0
MAB	201603085	41	4.05	71	36.80	86	0.00	1.00	0.02	0
MAB	201603086	41	0.90	71	34.06	117	0.00	1.25	0.03	0
MAB	201603087	40	58.00	71	21.79	100	0.00	1.00	0.02	0
MAB	201603088	40	56.87	71	35.74	51	0.00	0.60	0.01	0
MAB	201603089	40	55.08	71	38.32	140	0.00	1.40	0.03	0
MAB	201603090	40	51.45	71	45.00	187	0.01	2.25	0.04	0
MAB	201603091	40	45.25	71	51.32	43	0.00	0.40	0.01	0
MAB	201603092	40	40.44	71	56.79	181	0.00	1.75	0.04	0
MAB	201603093	40	35.66	71	56.58	218	0.01	3.00	0.05	0
MAB	201603094	40	33.32	71	42.94	3	0.00	0.01	0.00	0
MAB	201603095	40	36.17	71	45.19	146	0.01	2.00	0.03	0
MAB	201603096	40	38.66	71	44.29	11	0.00	0.10	0.00	0
MAB	201603097	40	39.15	71	40.88	1	0.00	0.01	0.00	0
MAB	201603098	40	28.04	71	26.52	0	0.00	0.00	0.00	0
MAB	201603099	40	27.91	71	49.30	0	0.00	0.00	0.00	0
MAB	201603100	40	27.42	71	52.22	0	0.00	0.00	0.00	0

MAB	201603101	40	30.29	71	59.65	104	0.00	1.33	0.02	0
MAB	201603102	40	26.67	72	7.27	25	0.00	0.33	0.01	0
MAB	201603103	40	28.57	72	8.96	42	0.00	0.50	0.01	0
MAB	201603105	40	33.26	72	13.67	76	0.00	1.00	0.01	0
MAB	201603106	40	34.01	72	17.14	30	0.00	0.35	0.01	0
MAB	201603107	40	32.29	72	22.36	8	0.00	0.01	0.00	0
MAB	201603108	40	29.54	72	18.19	57	0.00	1.00	0.01	0
MAB	201603109	40	26.93	72	24.04	23	0.00	0.10	0.01	0
MAB	201603110	40	26.04	72	21.77	31	0.00	0.25	0.01	0.13
MAB	201603111	40	24.66	72	12.15	56	0.00	1.00	0.01	0
MAB	201603112	40	20.77	72	10.42	119	0.00	1.50	0.03	0.07
MAB	201603113	40	19.73	72	3.81	30	0.00	0.25	0.01	0
MAB	201603114	40	21.89	71	58.98	2	0.00	0.01	0.00	0
MAB	201603115	40	20.18	71	56.07	11	0.00	0.10	0.00	0
MAB	201603116	40	12.80	72	0.18	36	0.00	0.25	0.01	0
MAB	201603117	40	12.85	72	8.48	21	0.00	0.20	0.00	0
MAB	201603118	40	13.32	72	11.13	66	0.00	1.00	0.01	0
MAB	201603119	40	17.49	72	17.47	95	0.00	1.33	0.02	0
MAB	201603120	40	16.91	72	23.40	890	0.02	11.75	0.18	0
MAB	201603121	40	19.58	72	23.98	234	0.01	3.00	0.05	0
MAB	201603122	40	20.67	72	21.86	374	0.01	4.00	0.07	0
MAB	201603123	40	23.23	72	22.99	67	0.00	0.80	0.01	0
MAB	201603124	40	25.51	72	31.54	21	0.00	0.33	0.00	0
MAB	201603125	40	23.01	72	31.55	53	0.00	0.80	0.01	0
MAB	201603126	40	22.60	72	36.09	87	0.00	0.90	0.02	0
MAB	201603127	40	20.06	72	39.55	177	0.00	2.00	0.03	0
MAB	201603128	40	17.17	72	37.56	126	0.00	1.50	0.02	0
MAB	201603129	40	14.09	72	35.38	79	0.00	1.00	0.02	0
MAB	201603130	40	11.03	72	38.57	97	0.00	1.33	0.02	0
MAB	201603131	40	11.21	72	31.66	43	0.00	0.66	0.01	0
MAB	201603132	40	15.75	72	28.84	972	0.02	9.50	0.22	0
MAB	201603133	40	10.12	72	27.06	20	0.00	0.15	0.00	0
MAB	201603134	40	9.05	72	23.67	13	0.00	0.20	0.00	0
MAB	201603135	40	9.98	72	16.90	35	0.00	0.40	0.01	0
MAB	201603136	40	8.77	72	11.96	1	0.00	0.01	0.00	0
MAB	201603137	40	8.88	72	9.93	16	0.00	0.10	0.00	0
MAB	201603139	40	8.93	72	1.95	90	0.00	1.00	0.02	0
MAB	201603140	40	5.26	72	2.76	7	0.00	0.01	0.00	0
MAB	201603141	40	2.87	72	21.65	103	0.00	1.10	0.02	0
MAB	201603142	39	55.90	72	25.68	35	0.00	0.25	0.01	0
MAB	201603143	39	57.93	72	33.15	207	0.01	2.00	0.04	0

MAB	201603144	40	2.21	72	33.83	334	0.01	3.25	0.07	0.07
MAB	201603145	40	2.67	72	36.41	66	0.00	1.00	0.01	0.07
MAB	201603146	40	4.96	72	38.82	473	0.01	4.75	0.10	0
MAB	201603147	39	59.89	72	50.44	197	0.01	2.50	0.04	0
MAB	201603148	39	56.60	72	46.89	84	0.00	1.33	0.02	0
MAB	201603149	39	55.72	72	41.43	31	0.00	0.50	0.01	0
MAB	201603150	39	54.93	72	42.95	54	0.00	1.00	0.01	0
MAB	201603151	39	49.91	72	47.37	63	0.00	1.00	0.01	0
MAB	201603152	39	52.71	73	1.72	166	0.01	2.50	0.03	0
MAB	201603153	39	53.74	73	3.20	30	0.00	0.80	0.01	0
MAB	201603154	39	49.78	73	7.58	53	0.00	0.66	0.01	0.13
MAB	201603155	39	47.98	73	8.88	44	0.00	0.66	0.01	0
MAB	201603156	39	48.77	73	0.42	10	0.00	0.10	0.00	0
MAB	201603158	39	45.93	72	56.18	21	0.00	0.50	0.00	0
MAB	201603159	39	45.57	72	53.51	1	0.00	0.01	0.00	0
MAB	201603160	39	47.34	72	43.87	47	0.00	0.75	0.01	0.13
MAB	201603161	39	45.14	72	39.40	70	0.00	0.90	0.02	0.20
MAB	201603162	39	41.95	72	38.89	15	0.00	0.10	0.00	0.07
MAB	201603163	39	43.03	72	42.63	38	0.00	0.40	0.01	0
MAB	201603164	39	40.76	72	51.47	478	0.01	5.50	0.10	0
MAB	201603165	39	41.35	72	56.87	34	0.00	0.50	0.01	0.07
MAB	201603166	39	33.03	73	1.71	90	0.00	1.20	0.02	0.07
MAB	201603167	39	27.52	73	3.20	152	0.00	2.10	0.04	0.07
MAB	201603168	39	26.01	73	2.03	428	0.01	6.00	0.09	0.07
MAB	201603169	39	24.70	73	6.22	288	0.01	3.00	0.06	0.13
MAB	201603170	39	23.35	73	8.84	62	0.00	0.90	0.01	0
MAB	201603171	39	24.19	73	10.33	40	0.00	0.50	0.01	0
MAB	201603172	39	26.05	73	12.13	69	0.00	0.90	0.01	0
MAB	201603173	39	22.72	73	14.79	229	0.01	2.50	0.05	0.07
MAB	201603174	39	22.12	73	18.57	176	0.01	1.75	0.04	0
MAB	201603175	39	23.95	73	20.14	23	0.00	0.33	0.01	0.13
MAB	201603176	39	22.05	73	22.93	35	0.00	0.33	0.01	0
MAB	201603177	39	20.70	73	20.38	56	0.00	0.75	0.01	0
MAB	201603178	39	20.47	73	17.69	201	0.01	2.00	0.04	0
MAB	201603179	39	21.08	73	11.38	52	0.00	0.80	0.01	0
MAB	201603180	39	18.67	73	12.58	6	0.00	0.07	0.00	0.14
MAB	201603181	39	18.39	73	14.84	36	0.00	0.50	0.01	0
MAB	201603182	39	16.41	73	14.52	100	0.00	1.00	0.02	0.20
MAB	201603183	39	17.44	73	17.13	58	0.00	0.50	0.01	0
MAB	201603184	39	18.39	73	22.58	91	0.00	1.00	0.02	0
MAB	201603185	39	16.56	73	22.61	38	0.00	0.50	0.01	0

MAB	201603187	39	11.71	73	20.26	119	0.00	1.10	0.02	0
MAB	201603188	39	12.37	73	18.33	275	0.01	2.50	0.06	0
MAB	201603189	39	10.48	73	17.52	78	0.00	1.00	0.01	0
MAB	201603190	39	8.78	73	20.90	241	0.01	3.50	0.05	0
MAB	201603191	39	10.23	73	24.64	111	0.00	1.50	0.02	0
MAB	201603192	39	9.88	73	26.58	42	0.00	0.50	0.01	0.07
MAB	201603193	39	10.36	73	30.28	82	0.00	1.00	0.02	0.13
MAB	201603194	39	8.86	73	28.67	69	0.00	0.90	0.01	0.13
MAB	201603195	39	8.12	73	23.97	302	0.01	3.01	0.06	0
MAB	201603196	39	6.70	73	21.83	201	0.01	2.00	0.05	0.07
MAB	201603197	39	4.48	73	23.49	155	0.01	1.80	0.03	0.27
MAB	201603198	39	3.92	73	25.01	207	0.01	2.10	0.04	0.33
MAB	201603199	39	4.98	73	26.63	663	0.01	7.10	0.14	0.07
MAB	201603200	39	5.47	73	29.43	216	0.01	2.00	0.04	0.20
MAB	201603201	39	5.70	73	32.00	43	0.00	0.50	0.01	0.27
MAB	201603202	39	4.65	73	35.43	87	0.00	0.90	0.02	0.20
MAB	201603203	39	1.63	73	33.81	593	0.01	7.50	0.13	0.27
MAB	201603204	39	2.48	73	29.60	259	0.01	2.75	0.06	0.13
MAB	201603206	39	2.03	73	26.15	472	0.01	5.50	0.11	0
MAB	201603207	39	0.78	73	27.95	483	0.01	5.50	0.10	0
MAB	201603208	38	57.70	73	32.78	173	0.01	1.80	0.03	0.40
MAB	201603209	38	58.46	73	37.18	153	0.00	1.60	0.03	0.13
MAB	201603210	38	55.34	73	34.07	73	0.00	0.90	0.02	0.20
MAB	201603211	38	53.32	73	33.47	612	0.02	6.00	0.12	0.07
MAB	201603212	38	51.71	73	34.97	333	0.01	3.00	0.07	0
MAB	201603213	38	51.54	73	41.01	140	0.00	1.50	0.03	0
MAB	201603214	38	50.00	73	34.80	251	0.01	4.00	0.05	0
MAB	201603215	38	46.37	73	36.76	94	0.00	1.00	0.02	0.13
MAB	201603216	38	46.64	73	37.98	1,948	0.04	19.00	0.41	0.07
MAB	201603217	38	47.51	73	39.78	1,280	0.03	11.00	0.24	0.07
MAB	201603218	38	46.62	73	45.30	770	0.02	6.50	0.17	0.07
MAB	201603219	38	45.36	73	46.92	2,023	0.05	19.00	0.44	0.33
MAB	201603220	38	42.74	73	41.96	2,336	0.06	21.00	0.50	0.33
MAB	201603221	38	41.03	73	46.09	2,996	0.08	27.00	0.62	0.20
MAB	201603222	38	37.98	73	44.99	436	0.01	4.50	0.09	0.27
MAB	201603223	38	39.23	73	47.15	453	0.01	4.10	0.09	0.07
MAB	201603224	38	39.39	73	49.68	1,868	0.05	19.00	0.39	0.07
MAB	201603225	38	39.91	73	52.69	4,776	0.12	53.50	1.00	0.13
MAB	201603226	38	37.81	73	51.44	1,079	0.03	11.00	0.24	0.13
MAB	201603227	38	37.27	73	53.57	980	0.02	8.75	0.24	0
MAB	201603228	38	38.06	73	56.74	891	0.02	12.00	0.22	0.13

MAB	201603229	38	38.31	73	58.74	293	0.01	3.25	0.07	0.47
MAB	201603230	38	36.56	74	0.75	3,923	0.05	90.00	0.90	0.13
MAB	201603231	38	36.09	73	55.78	1,968	0.03	40.25	0.43	0.13
MAB	201603232	38	34.95	73	52.41	2,406	0.03	42.50	0.51	0.27
MAB	201603233	38	34.03	73	54.54	5,226	0.07	86.00	1.20	0
MAB	201603234	38	32.60	73	52.79	668	0.01	8.00	0.14	0.40
NLCA	201604001	40	39.98	69	59.27	0	0.00	0.00	0.00	0
NLCA	201604002	40	40.93	69	50.12	1	0.00	0.01	0.00	0
NLCA	201604003	40	40.28	69	43.24	3	0.00	0.01	0.00	0
NLCA	201604004	40	38.95	69	33.44	0	0.00	0.00	0.00	0
NLCA	201604005	40	37.51	69	29.33	1	0.00	0.01	0.00	0
NLCA	201604006	40	40.90	69	24.52	0	0.00	0.00	0.00	0
NLCA	201604007	40	41.77	69	26.81	0	0.00	0.00	0.00	0
NLCA	201604008	40	44.30	69	27.58	0	0.00	0.00	0.00	0
NLCA	201604009	40	48.68	69	26.66	0	0.00	0.00	0.00	0
NLCA	201604010	40	48.46	69	21.14	0	0.00	0.00	0.00	0
NLCA	201604011	40	45.41	69	22.83	4	0.00	0.01	0.00	0
NLCA	201604012	40	43.87	69	20.50	0	0.00	0.00	0.00	0
NLCA	201604013	40	42.31	69	17.94	119	0.01	1.40	0.02	0
NLCA	201604014	40	43.84	69	17.84	1,207	0.04	13.25	0.22	0
NLCA	201604016	40	46.34	69	11.73	94	0.00	1.10	0.02	0
NLCA	201604017	40	42.68	69	12.03	98	0.00	1.10	0.02	0
NLCA	201604018	40	41.04	69	14.21	160	0.01	2.00	0.03	0
NLCA	201604019	40	38.46	69	13.56	339	0.01	4.00	0.06	0
NLCA	201604020	40	37.68	69	17.75	57	0.00	0.80	0.01	0
NLCA	201604021	40	35.61	69	21.28	158	0.01	2.33	0.03	0
NLCA	201604022	40	32.45	69	21.05	318	0.01	4.00	0.06	0
NLCA	201604023	40	31.26	69	23.59	82	0.00	1.00	0.02	0
NLCA	201604024	40	32.15	69	29.78	686	0.03	9.00	0.14	0
NLCA	201604025	40	32.12	69	33.62	2,401	0.06	30.00	0.47	0
NLCA	201604026	40	31.60	69	37.04	16	0.00	0.33	0.00	0
NLCA	201604027	40	34.08	69	38.94	117	0.00	1.33	0.02	0
NLCA	201604028	40	35.37	69	35.73	10,649	0.31	119.00	2.13	0
NLCA	201604029	40	37.59	69	39.30	12	0.00	0.33	0.00	0
NLCA	201604030	40	36.30	69	46.13	7	0.00	0.10	0.00	0
NLCA	201604031	40	36.91	69	48.94	1	0.00	0.01	0.00	0
NLCA	201604032	40	35.48	69	53.69	0	0.00	0.00	0.00	0
NLCA	201604033	40	33.68	69	57.97	0	0.00	0.00	0.00	0
NLCA	201604034	40	33.15	69	57.08	0	0.00	0.00	0.00	0
NLCA	201604035	40	33.37	69	52.74	5,648	0.10	78.00	1.09	0
NLCA	201604036	40	31.40	69	54.62	0	0.00	0.00	0.00	0

NLCA	201604037	40	29.37	69	53.68	0	0.00	0.00	0.00	0
NLCA	201604038	40	30.01	69	50.31	0	0.00	0.00	0.00	0
NLCA	201604039	40	31.18	69	46.49	6,207	0.10	87.00	1.22	0
NLCA	201604040	40	30.84	69	41.36	5,750	0.07	120.00	1.18	0
NLCA	201604041	40	29.15	69	43.22	4	0.00	0.01	0.00	0
NLCA	201604042	40	28.30	69	40.12	28	0.00	0.25	0.01	0
NLCA	201604043	40	28.34	69	36.48	35	0.00	0.50	0.01	0
NLCA	201604044	40	26.35	69	32.66	163	0.01	1.90	0.03	0
NLCA	201604045	40	26.53	69	38.55	54	0.00	0.80	0.01	0
NLCA	201604046	40	26.45	69	41.51	3	0.00	0.01	0.00	0
NLCA	201604047	40	25.28	69	44.53	1	0.00	0.01	0.00	0
NLCA	201604048	40	21.43	69	44.37	0	0.00	0.00	0.00	0
NLCA	201604049	40	20.16	69	40.80	0	0.00	0.00	0.00	0
NLCA	201604050	40	21.90	69	39.49	1	0.00	0.01	0.00	0
NLCA	201604051	40	22.44	69	36.81	1	0.00	0.01	0.00	0
NLCA	201604052	40	20.54	69	34.28	0	0.00	0.00	0.00	0
NLCA	201604053	40	22.11	69	31.76	3	0.00	0.03	0.00	0
NLCA	201604054	40	21.41	69	27.58	404	0.00	8.50	0.08	0
NLCA	201604055	40	23.70	69	26.88	797	0.01	19.00	0.17	0
NLCA	201604056	40	22.21	69	24.61	189	0.00	8.50	0.04	0
NLCA	201604057	40	24.07	69	23.29	1,775	0.02	42.00	0.34	0
NLCA	201604058	40	20.60	69	20.36	0	0.00	0.00	0.00	0
NLCA	201604059	40	23.50	69	19.42	2,184	0.02	60.00	0.42	0
NLCA	201604060	40	26.28	69	19.24	4,456	0.07	73.00	0.86	0
NLCA	201604061	40	29.26	69	20.44	2,631	0.08	34.00	0.50	0
NLCA	201604062	40	30.73	69	14.87	1,921	0.06	22.00	0.38	0
NLCA	201604063	40	32.05	69	15.29	1,609	0.06	24.50	0.31	0
NLCA	201604064	40	34.39	69	14.18	986	0.04	11.00	0.19	0
NLCA	201604066	40	34.35	69	10.77	1,962	0.07	23.00	0.39	0
NLCA	201604067	40	34.30	69	8.81	299	0.01	3.50	0.06	0
NLCA	201604068	40	33.81	69	7.27	213	0.01	2.40	0.04	0
NLCA	201604069	40	33.48	69	5.91	93	0.00	1.10	0.02	0
NLCA	201604070	40	30.79	69	8.74	0	0.00	0.00	0.00	0
NLCA	201604071	40	28.58	69	8.91	70	0.00	1.00	0.01	0
NLCA	201604072	40	25.94	69	13.17	972	0.01	24.25	0.19	0
NLCA	201604073	40	23.58	69	14.65	0	0.00	0.01	0.00	0
NLCA	201604074	40	20.70	69	11.47	0	0.00	0.00	0.00	0
NLCA	201604075	40	23.19	69	9.38	0	0.00	0.01	0.00	0
NLCA	201604076	40	24.81	69	5.63	3	0.00	0.01	0.00	0
NLCA	201604077	40	21.88	69	4.93	1	0.00	0.01	0.00	0
NLCA	201604078	40	21.15	69	2.65	0	0.00	0.00	0.00	0

NLCA	201604079	40	22.52	69	0.23	0	0.00	0.00	0.00	0
NLCA	201604080	40	23.44	68	58.09	0	0.00	0.01	0.00	0
NLCA	201604081	40	21.81	68	54.28	0	0.00	0.00	0.00	0
NLCA	201604082	40	22.96	68	51.21	0	0.00	0.00	0.00	0
NLCA	201604083	40	23.21	68	50.04	0	0.00	0.00	0.00	0
NLCA	201604084	40	24.15	68	53.31	1	0.00	0.01	0.00	0
NLCA	201604085	40	25.16	68	52.60	0	0.00	0.00	0.00	0
NLCA	201604086	40	26.84	68	49.49	0	0.00	0.00	0.00	0
NLCA	201604087	40	28.76	68	50.11	4	0.00	0.05	0.00	0
NLCA	201604088	40	28.87	68	51.12	2	0.00	0.04	0.00	0
NLCA	201604089	40	32.13	68	51.46	32	0.00	0.50	0.01	0
NLCA	201604090	40	31.51	68	52.30	361	0.01	4.50	0.07	0
NLCA	201604091	40	29.43	68	53.89	4,405	0.10	46.00	0.84	0
NLCA	201604092	40	31.57	68	55.70	309	0.01	4.50	0.06	0
NLCA	201604093	40	30.20	68	57.00	139	0.00	1.50	0.03	0
NLCA	201604094	40	28.27	68	59.00	13	0.00	0.10	0.00	0
NLCA	201604095	40	26.75	69	1.55	6	0.00	0.08	0.00	0
NLCA	201604096	40	28.71	69	3.39	2,776	0.06	26.00	0.53	0
NLCA	201604097	40	30.06	69	1.71	66	0.00	1.00	0.01	0
NLCA	201604098	40	31.46	68	59.50	144	0.01	1.75	0.03	0
NLCA	201604099	40	33.72	69	0.40	97	0.00	1.10	0.02	0
NLCA	201604100	40	32.73	69	2.94	1,213	0.04	13.50	0.22	0
NLCA	201604101	40	34.80	69	3.90	873	0.03	10.00	0.17	0
NLCA	201604102	40	36.39	69	2.76	782	0.03	9.00	0.16	0
NLCA	201604103	40	38.10	69	0.04	100	0.00	1.00	0.02	0
NLCA	201604105	40	42.26	69	3.13	339	0.01	4.25	0.07	0
NLCA	201604106	40	44.14	69	3.37	255	0.01	3.00	0.05	0
NLCA	201604108	40	48.66	69	2.60	468	0.02	6.50	0.09	0
NLCA	201604109	40	47.37	69	6.62	97	0.00	1.50	0.02	0
NLCA	201604110	40	43.91	69	5.73	585	0.02	7.00	0.11	0
NLCA	201604111	40	41.30	69	6.11	257	0.01	3.25	0.05	0
NLCA	201604112	40	38.12	69	8.30	569	0.02	7.25	0.11	0
NLCA	201604113	40	38.26	69	10.02	790	0.03	8.25	0.16	0
CA II	201605001	41	18.39	67	18.80	0	0.00	0.00	0.00	0
CA II	201605003	41	22.99	67	16.10	0	0.00	0.00	0.00	0
CA II	201605004	41	23.43	67	13.52	0	0.00	0.00	0.00	0
CA II	201605008	41	29.88	67	9.19	0	0.00	0.00	0.00	0
CA II	201605009	41	29.20	67	1.53	0	0.00	0.00	0.00	0
CA II	201605010	41	24.22	67	5.01	0	0.00	0.00	0.00	0
CA II	201605012	41	22.47	66	59.46	0	0.00	0.00	0.00	0
CA II	201605013	41	23.28	66	56.61	1	0.00	1.00	0.00	0

CA II	201605014	41	27.95	66	56.22	0	0.00	0.00	0.00	0
CA II	201605015	41	25.79	66	54.22	8	0.00	0.08	0.00	0
CA II	201605016	41	22.99	66	53.00	29	0.00	0.50	0.01	0
CA II	201605017	41	19.27	66	56.40	41	0.00	0.75	0.01	0
CA II	201605018	41	16.58	66	53.24	52	0.00	0.80	0.01	0
CA II	201605019	41	18.40	66	50.08	75	0.00	1.10	0.01	0
CA II	201605020	41	24.79	66	47.53	95	0.00	1.75	0.02	0
CA II	201605021	41	23.53	66	45.20	137	0.01	2.00	0.03	0
CA II	201605022	41	23.09	66	41.31	118	0.00	1.66	0.02	0
CA II	201605023	41	26.10	66	39.39	131	0.01	2.00	0.03	0
CA II	201605024	41	29.45	66	42.07	40	0.00	0.60	0.01	0
CA II	201605025	41	29.72	66	36.37	159	0.01	2.00	0.03	0
CA II	201605026	41	27.20	66	33.43	425	0.01	5.25	0.08	0
CA II	201605027	41	24.39	66	34.88	576	0.02	6.00	0.11	0
CA II	201605028	41	24.62	66	31.87	679	0.02	8.00	0.13	0
CA II	201605029	41	20.77	66	35.87	598	0.02	6.25	0.12	0
CA II	201605031	41	17.32	66	43.54	200	0.01	2.00	0.04	0
CA II	201605033	41	17.44	66	38.51	474	0.02	4.50	0.09	0
CA II	201605034	41	14.89	66	36.86	994	0.03	9.80	0.18	0
CA II	201605035	41	12.78	66	33.18	2,501	0.06	25.00	0.49	0
CA II	201605036	41	16.57	66	34.36	1,658	0.05	15.00	0.30	0
CA II	201605037	41	19.56	66	31.50	2,062	0.05	19.00	0.40	0
CA II	201605038	41	22.63	66	28.90	452	0.01	5.00	0.09	0
CA II	201605039	41	18.36	66	28.42	1,271	0.03	17.50	0.24	0
CA II	201605040	41	15.56	66	24.64	21	0.00	0.20	0.00	0
CA II	201605041	41	11.99	66	26.11	0	0.00	0.00	0.00	0
CA II	201605042	41	9.60	66	28.49	0	0.00	0.00	0.00	0
CA II	201605043	41	4.49	66	30.28	0	0.00	0.00	0.00	0
CA II	201605044	41	8.64	66	36.86	890	0.03	8.50	0.18	0
CA II	201605045	41	12.10	66	41.00	409	0.01	4.85	0.09	0
CA II	201605046	41	12.19	66	45.40	143	0.01	2.00	0.03	0
CA II	201605047	41	8.78	66	40.43	1,088	0.03	12.00	0.21	0
CA II	201605048	41	5.74	66	41.98	2,969	0.09	33.00	0.57	0
CA II	201605049	41	4.72	66	38.21	824	0.02	8.00	0.16	0
CA II	201605050	41	2.20	66	38.65	319	0.01	4.00	0.06	0
CA II	201605051	41	2.17	66	36.02	2	0.00	0.02	0.00	0
CA II	201605052	40	58.71	66	35.28	0	0.00	0.00	0.00	0
CA II	201605053	40	58.86	66	38.11	1	0.00	0.01	0.00	0
CA II	201605055	40	54.52	66	40.02	0	0.00	0.00	0.00	0
CA II	201605056	40	56.87	66	43.06	3	0.00	0.10	0.00	0
CA II	201605057	40	54.80	66	45.32	1	0.00	0.01	0.00	0

CA II	201605058	40	51.35	66	44.50	0	0.00	0.00	0.00	0
CA II	201605059	40	53.40	66	47.78	5	0.00	0.10	0.00	0
CA II	201605060	40	51.48	66	50.21	0	0.00	0.00	0.00	0
CA II	201605061	40	48.32	66	49.74	0	0.00	0.00	0.00	0
CA II	201605062	40	48.10	66	51.96	0	0.00	0.00	0.00	0
CA II	201605063	40	51.28	66	56.16	55	0.00	0.60	0.01	0
CA II	201605064	40	52.79	66	54.88	192	0.00	2.25	0.03	0
CA II	201605065	40	54.35	66	57.43	195	0.01	1.75	0.04	0
CA II	201605066	40	53.64	66	58.55	514	0.01	6.00	0.10	0
CA II	201605067	40	51.97	67	5.37	203	0.01	2.20	0.04	0
CA II	201605068	40	49.94	67	3.63	104	0.00	1.00	0.02	0
CA II	201605069	40	49.28	66	59.58	1	0.00	0.01	0.00	0
CA II	201605070	40	45.32	67	0.08	0	0.00	0.00	0.00	0
CA II	201605071	40	42.42	67	4.89	0	0.00	0.00	0.00	0
CA II	201605072	40	45.75	67	5.49	0	0.00	0.00	0.00	0
CA II	201605073	40	47.95	67	8.01	1	0.00	0.01	0.00	0
CA II	201605074	40	42.27	67	10.99	0	0.00	0.00	0.00	0
CA II	201605075	40	39.25	67	11.85	0	0.00	0.00	0.00	0
CA II	201605076	40	36.67	67	16.85	0	0.00	0.00	0.00	0
CA II	201605077	40	41.35	67	15.92	0	0.00	0.00	0.00	0
CA II	201605078	40	44.22	67	17.87	0	0.00	0.00	0.00	0
CA II	201605079	40	45.53	67	14.76	1	0.00	0.01	0.00	0
CA II	201605080	40	48.31	67	13.12	23	0.00	0.15	0.00	0
CA II	201605081	40	51.54	67	19.47	193	0.01	2.00	0.04	0
CA II	201605082	40	52.83	67	15.52	165	0.00	2.00	0.03	0
CA II	201605083	40	52.58	67	10.73	128	0.00	1.50	0.03	0
CA II	201605084	40	55.50	67	6.25	109	0.00	1.20	0.02	0
CA II	201605086	40	56.36	67	10.90	112	0.00	1.33	0.02	0
CA II	201605087	40	58.36	67	10.71	97	0.00	1.25	0.02	0
CA II	201605088	40	57.23	67	3.49	189	0.01	2.10	0.04	0
CA II	201605089	40	58.19	67	2.24	58	0.00	0.80	0.01	0
CA II	201605090	41	0.30	67	5.05	194	0.01	2.20	0.04	0
CA II	201605091	41	3.36	67	3.85	152	0.01	2.20	0.03	0
CA II	201605092	41	2.48	67	0.64	287	0.01	3.00	0.06	0
CA II	201605093	41	0.67	66	54.62	369	0.01	4.85	0.08	0
CA II	201605094	40	57.07	66	55.74	187	0.00	2.00	0.04	0
CA II	201605095	40	58.19	66	53.14	153	0.00	1.50	0.03	0
CA II	201605098	40	59.58	66	47.70	679	0.02	6.00	0.13	0
CA II	201605100	41	3.19	66	46.86	763	0.02	7.25	0.15	0
CA II	201605102	41	3.47	66	50.83	490	0.02	5.00	0.09	0
CA II	201605103	41	8.60	66	50.59	119	0.00	1.40	0.02	0

CA II	201605105	41	6.11	66	56.35	95	0.00	1.10	0.02	0
CA II	201605106	41	8.30	66	58.51	131	0.01	1.60	0.02	0
CA II	201605107	41	9.51	67	1.97	78	0.00	1.00	0.02	0
CA II	201605109	41	7.42	67	7.45	73	0.00	0.90	0.01	0
CA II	201605111	41	8.16	67	11.86	37	0.00	0.40	0.01	0
CA II	201605112	41	7.77	67	14.94	10	0.00	0.10	0.00	0
CA II	201605113	41	4.83	67	18.34	10	0.00	0.10	0.00	0
CA II	201605114	41	13.49	67	14.06	1	0.00	0.01	0.00	0
CA II	201605115	41	15.53	67	5.92	2	0.00	0.01	0.00	0
CA II	201605116	41	16.92	67	1.03	8	0.00	0.15	0.00	0

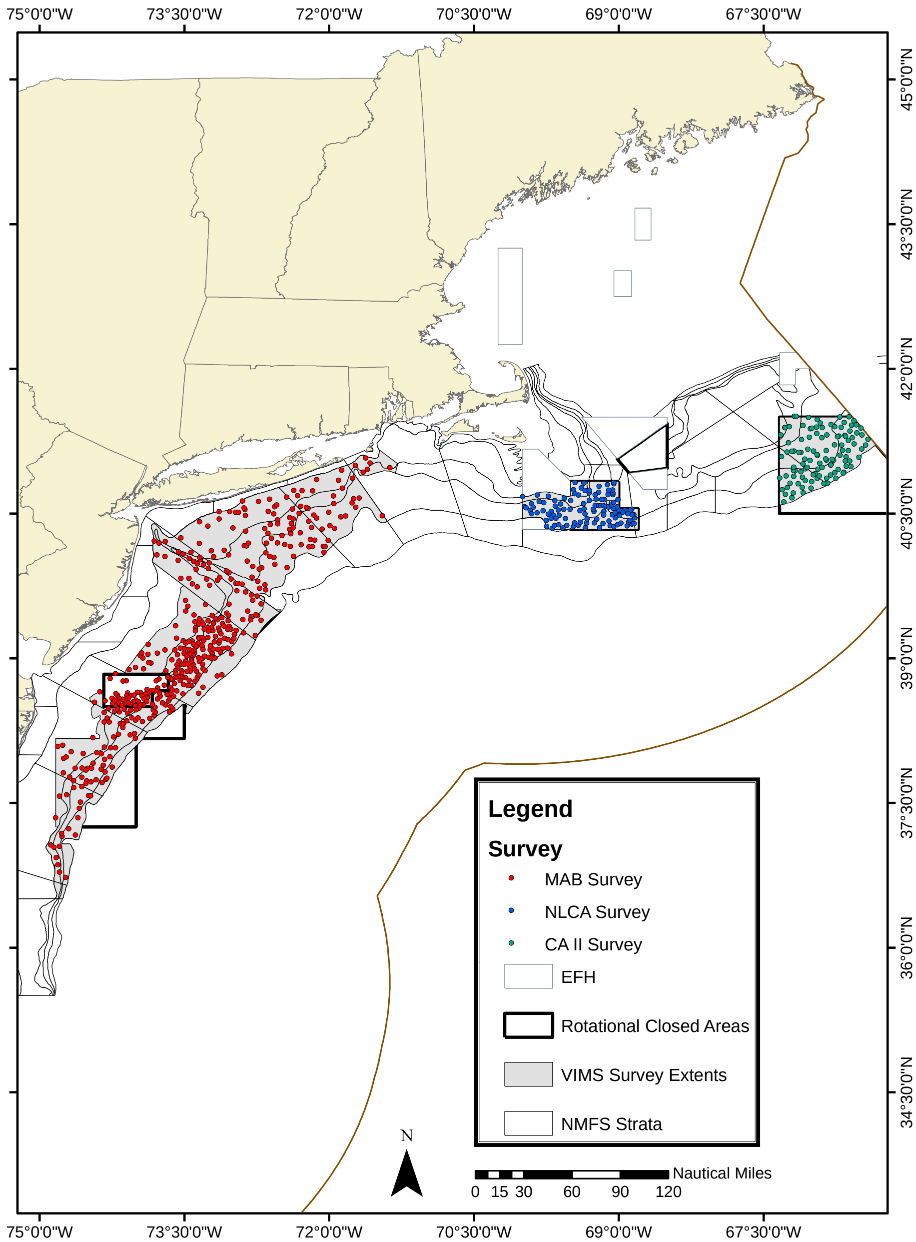


Figure 1. Survey domains with station locations for the VIMS/Industry cooperative surveys of the Mid-Atlantic sea scallop resource area, Nantucket Lightship Closed Area, and Closed Area II completed during May-June 2016.

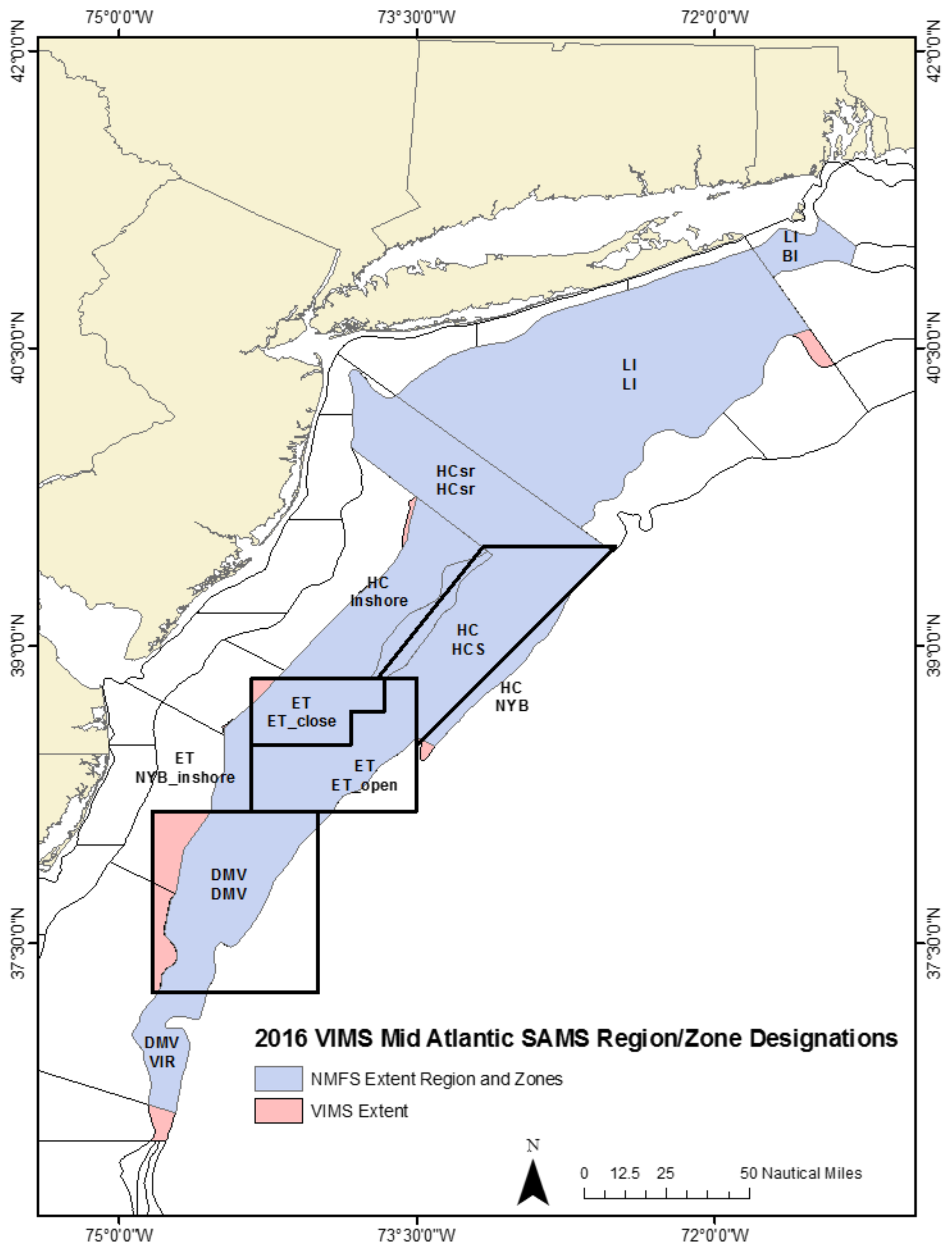


Figure 2. SAMS regions and zones used to calculate biomass estimates for the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource during May-June 2016.

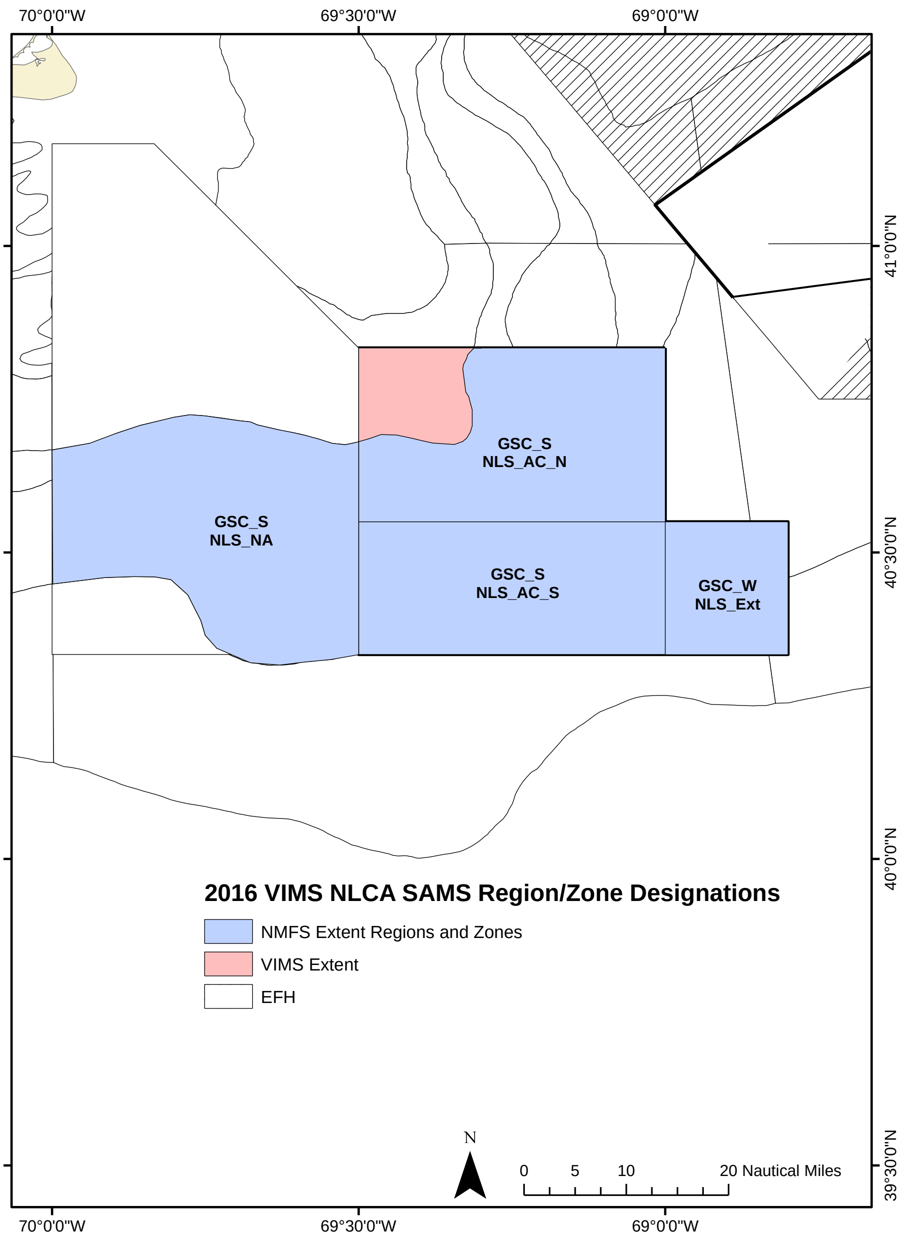


Figure 3. SAMS regions and zones used to calculate biomass estimates for the VIMS/Industry cooperative survey of the Nantucket Lightship access area and surrounds resource during May-June 2016.

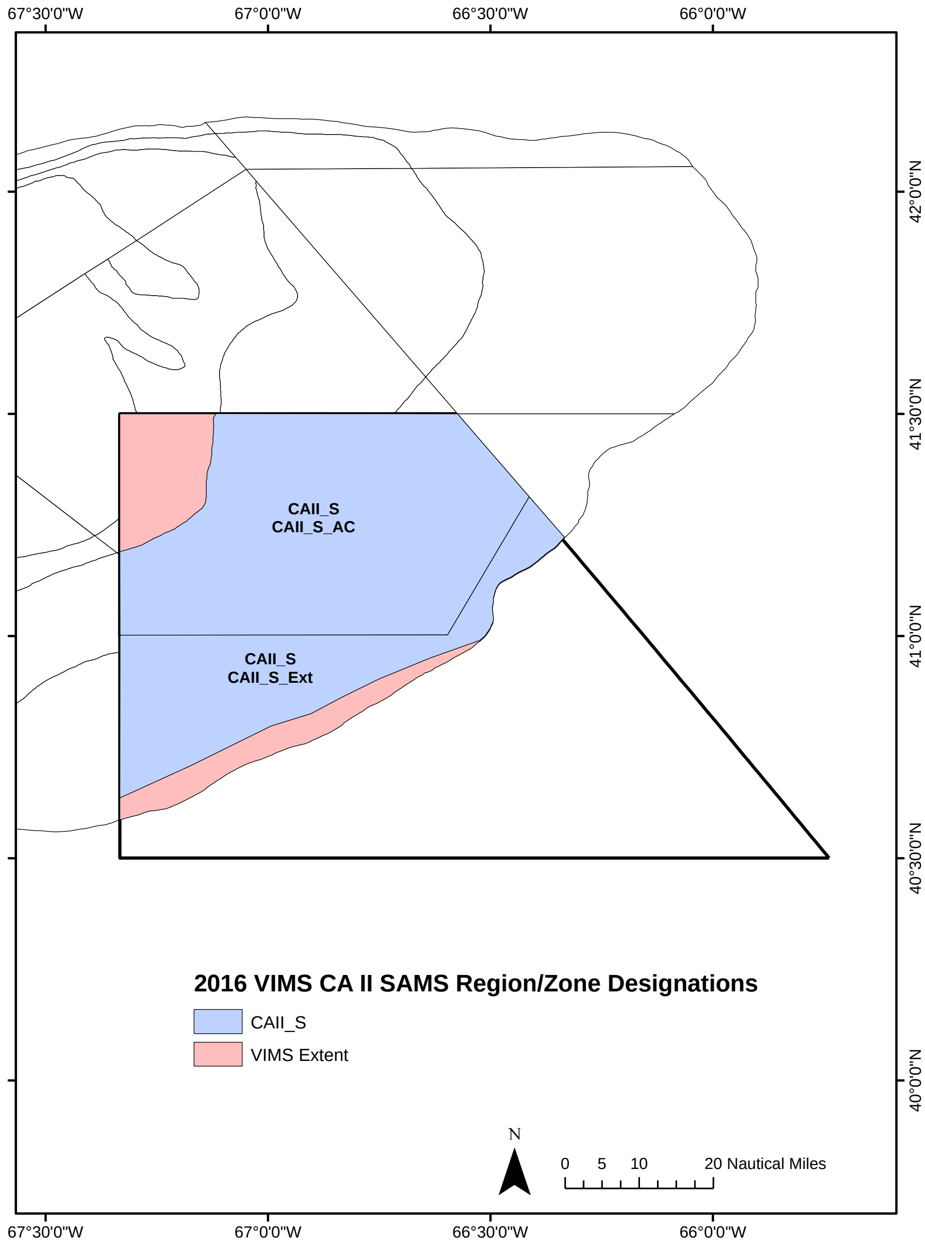


Figure 4. SAMS regions and zones used to calculate biomass estimates for the VIMS/Industry cooperative survey of the Closed Area II access area and southern Extension closure during May-June 2016.

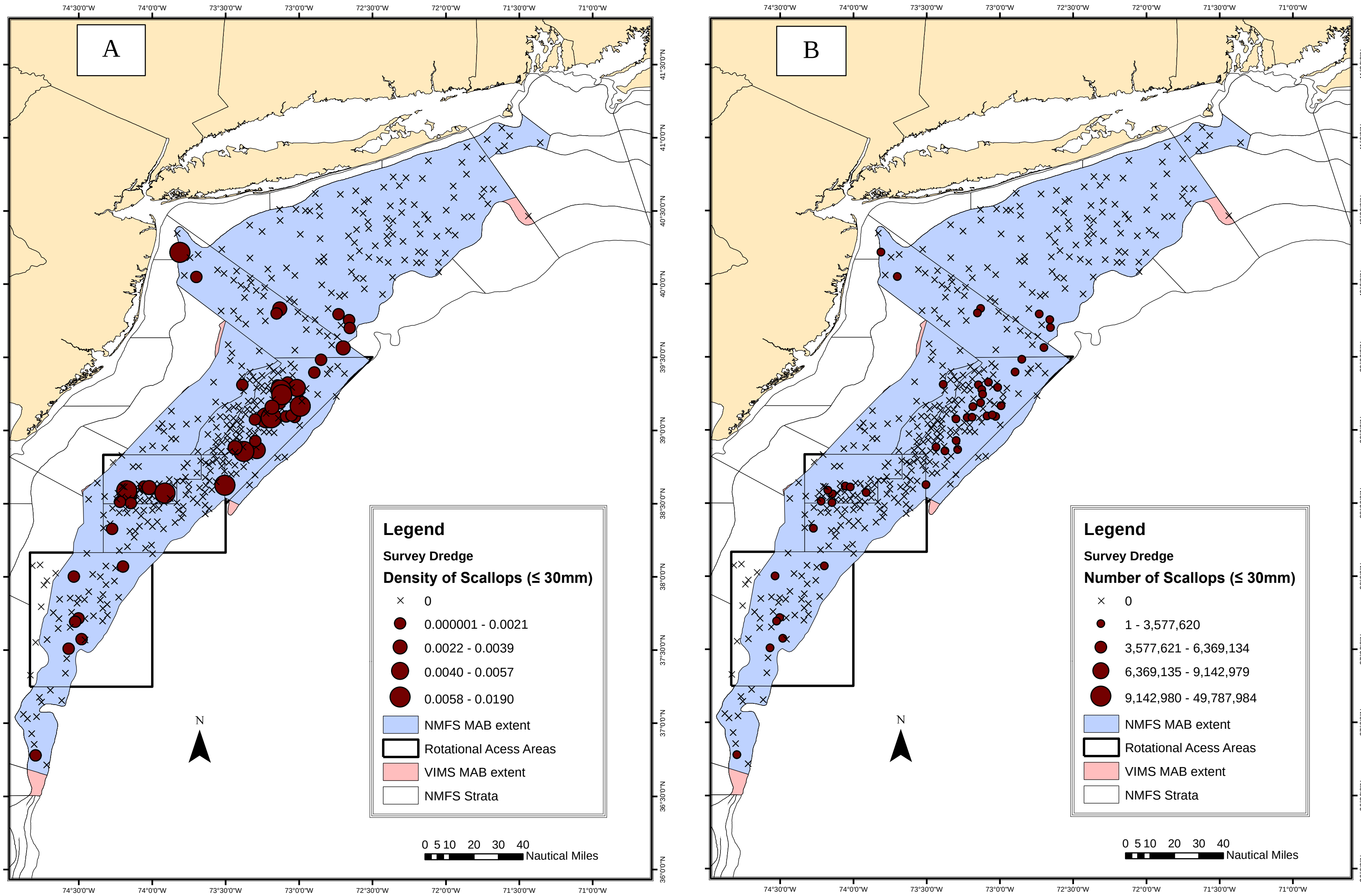


Figure 5. Density (A) and number (B) of scallops 0-30mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource during May-June 2016.

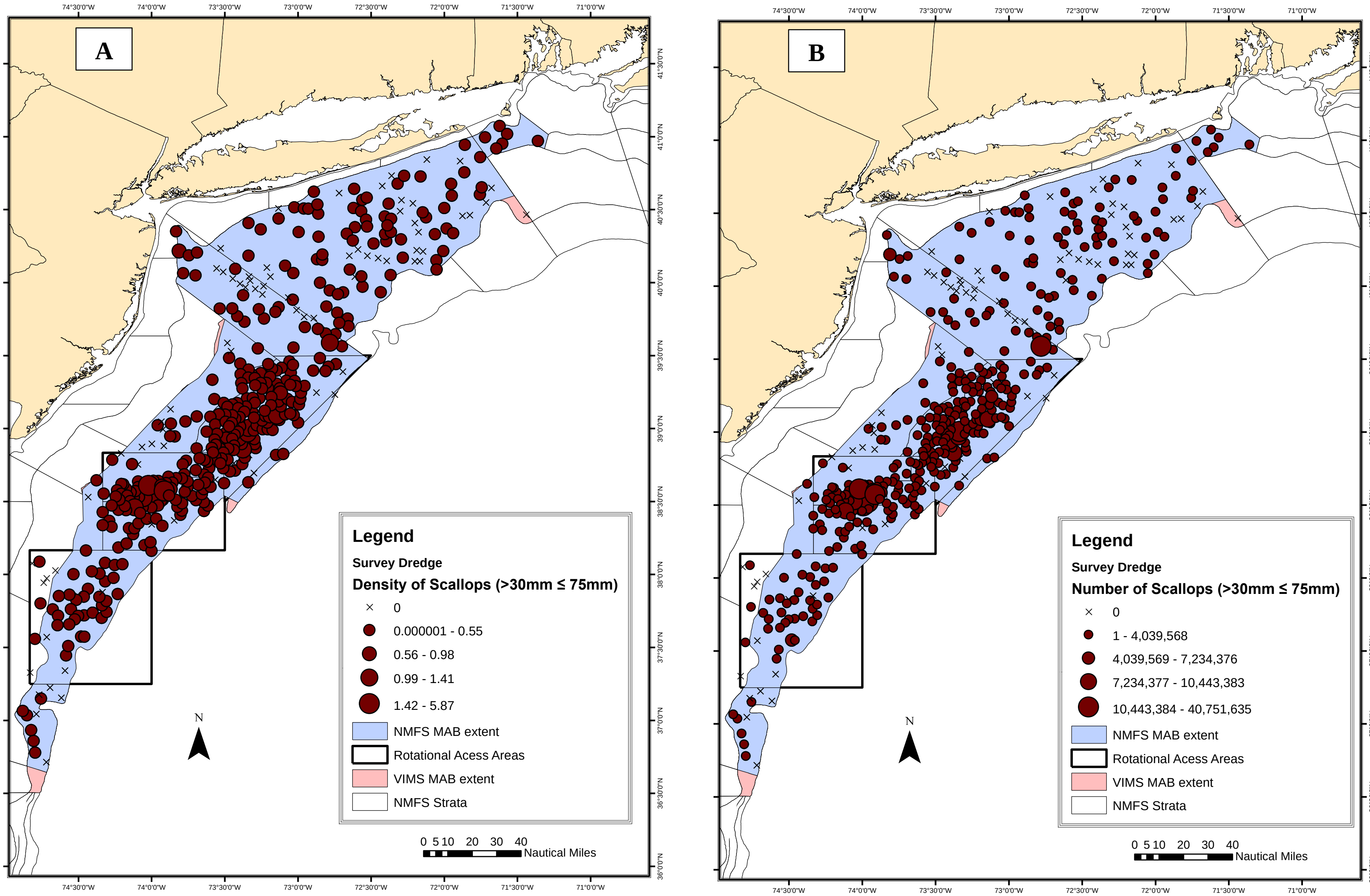


Figure 6. Density (A) and number (B) of scallops 31-75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource during May-June 2016.

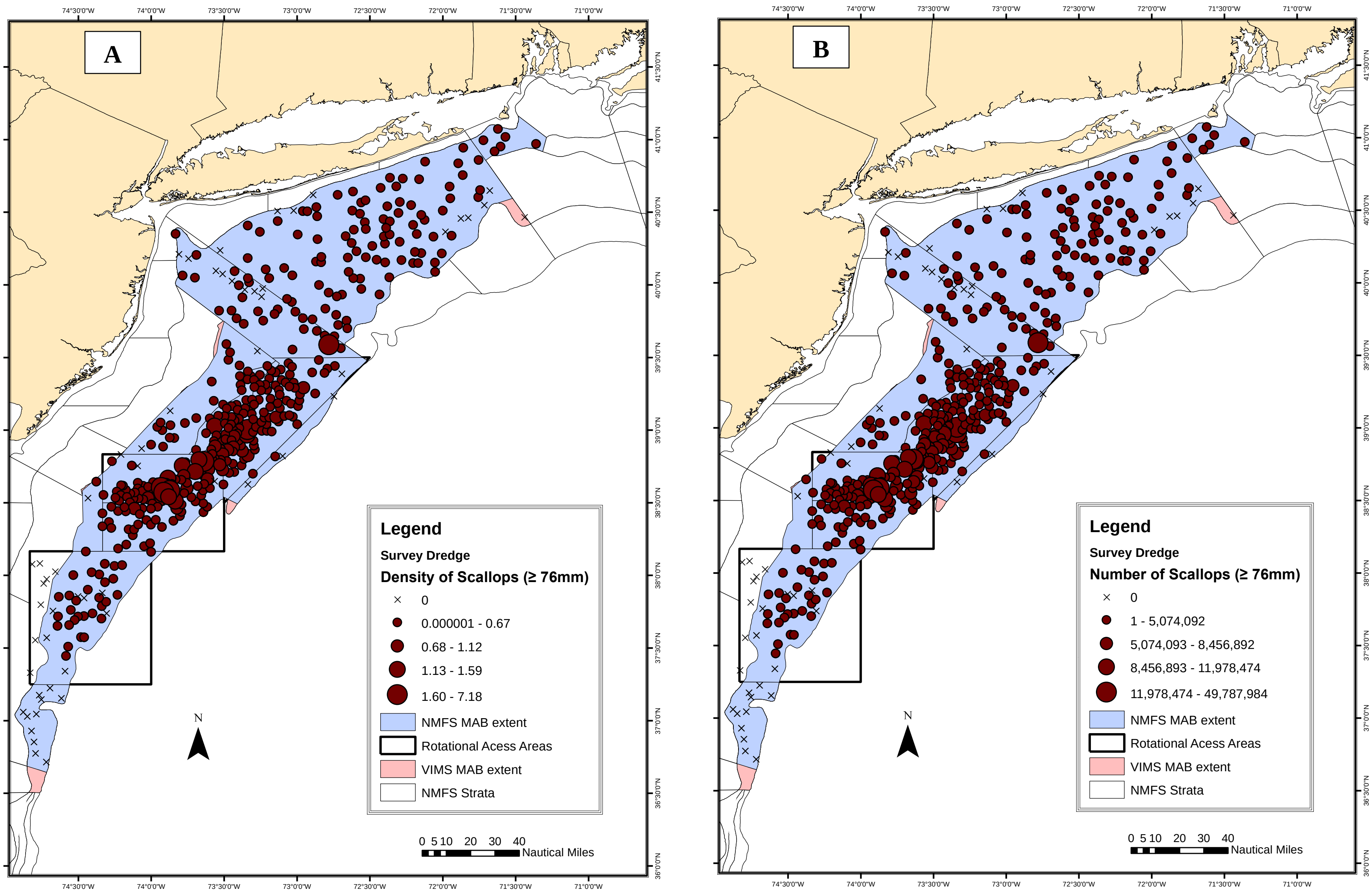
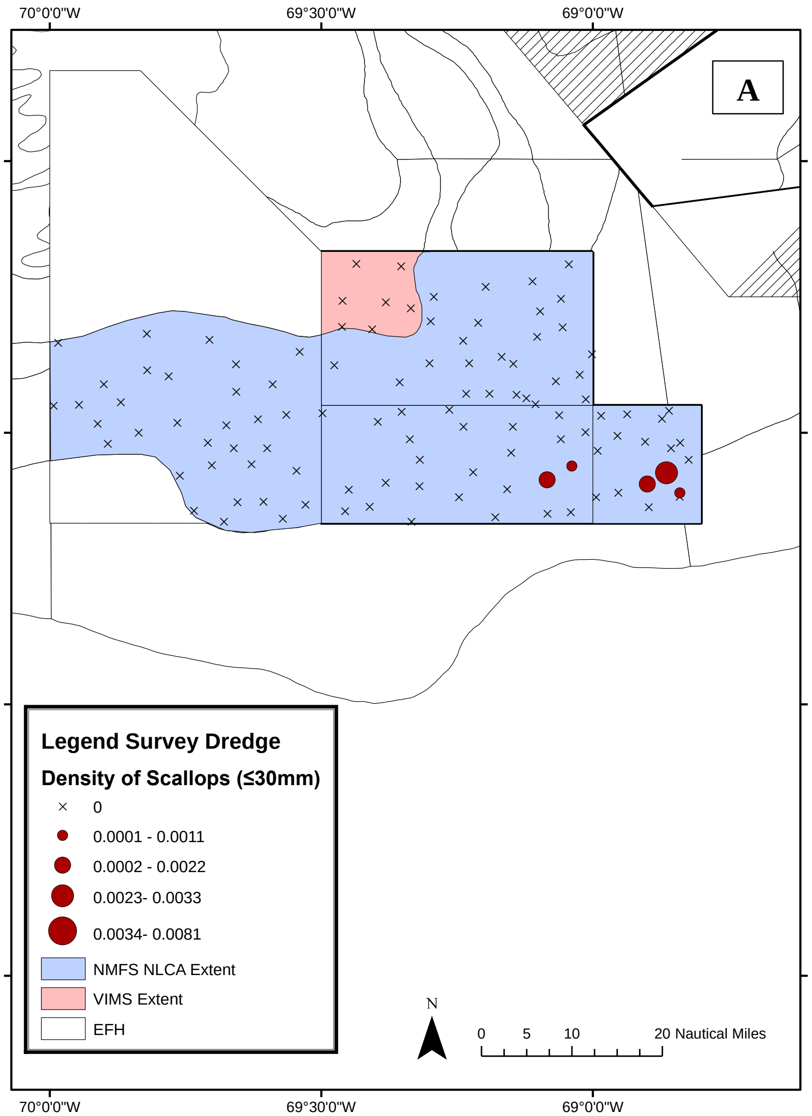


Figure 7. Density (A) and number (B) of scallops greater than 75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource during May-June 2016.



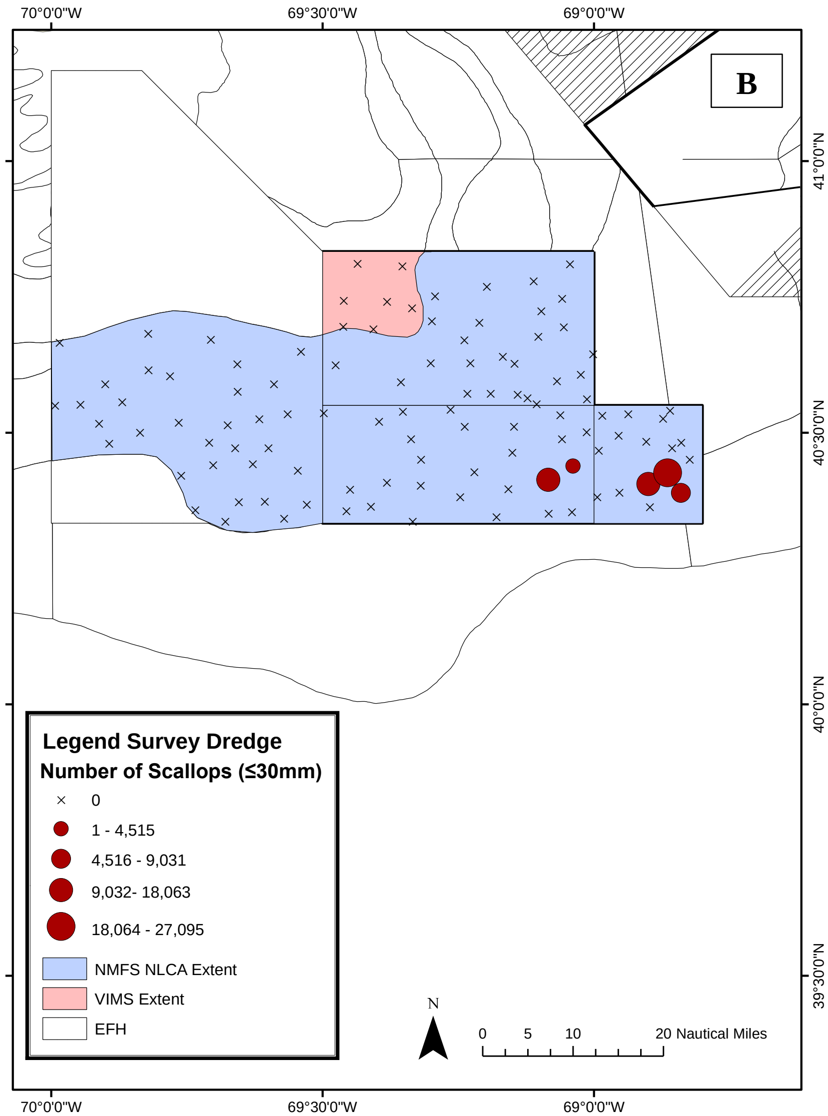


Figure 8. Density (A) and number (B) of scallops 0-30mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Nantucket Lightship Access Area and surrounds during May-June 2016.

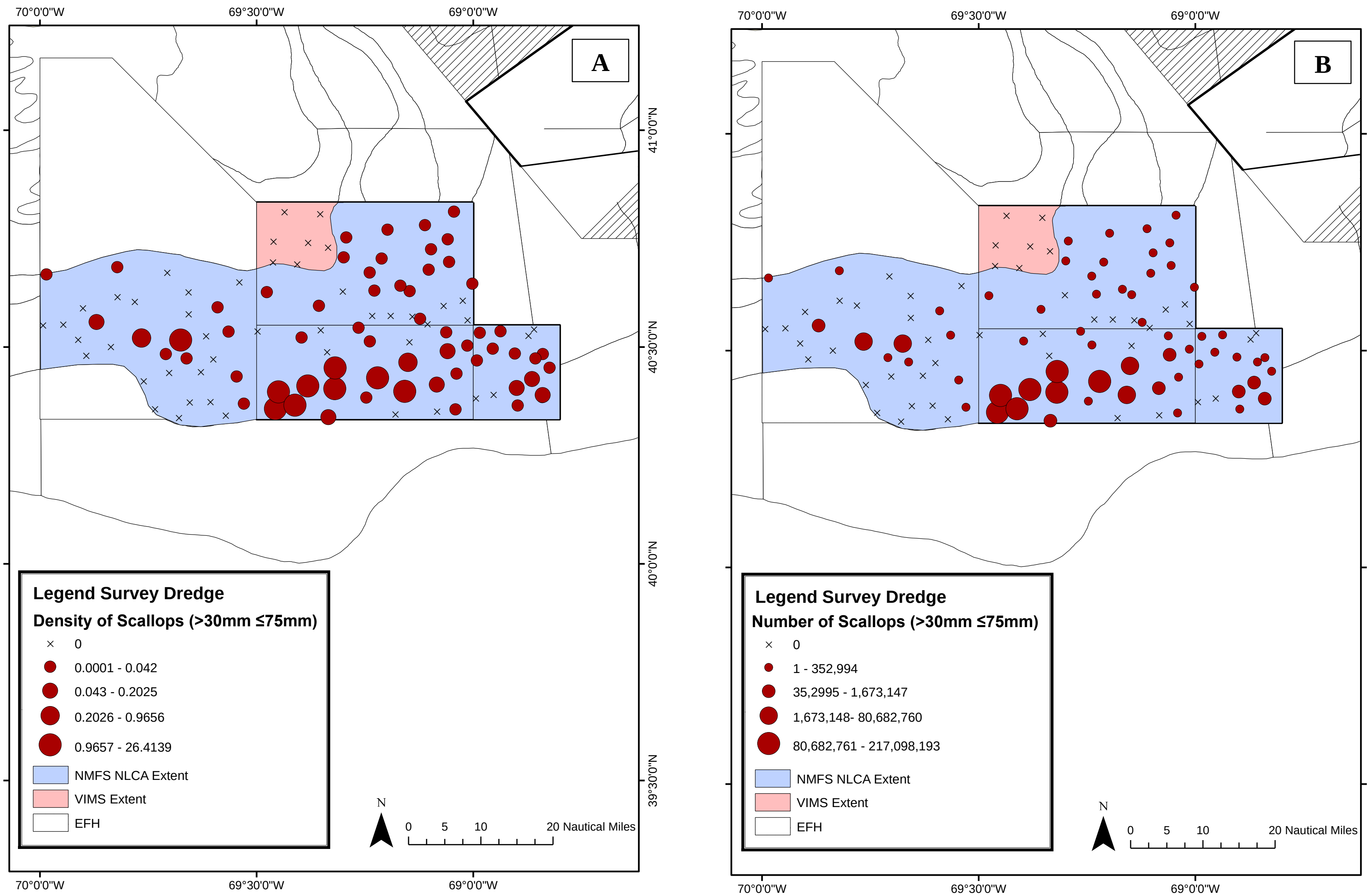


Figure 9. Density (A) and number (B) of scallops 31-75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Nantucket Lightship Access Area and surrounds during May-June 2016.

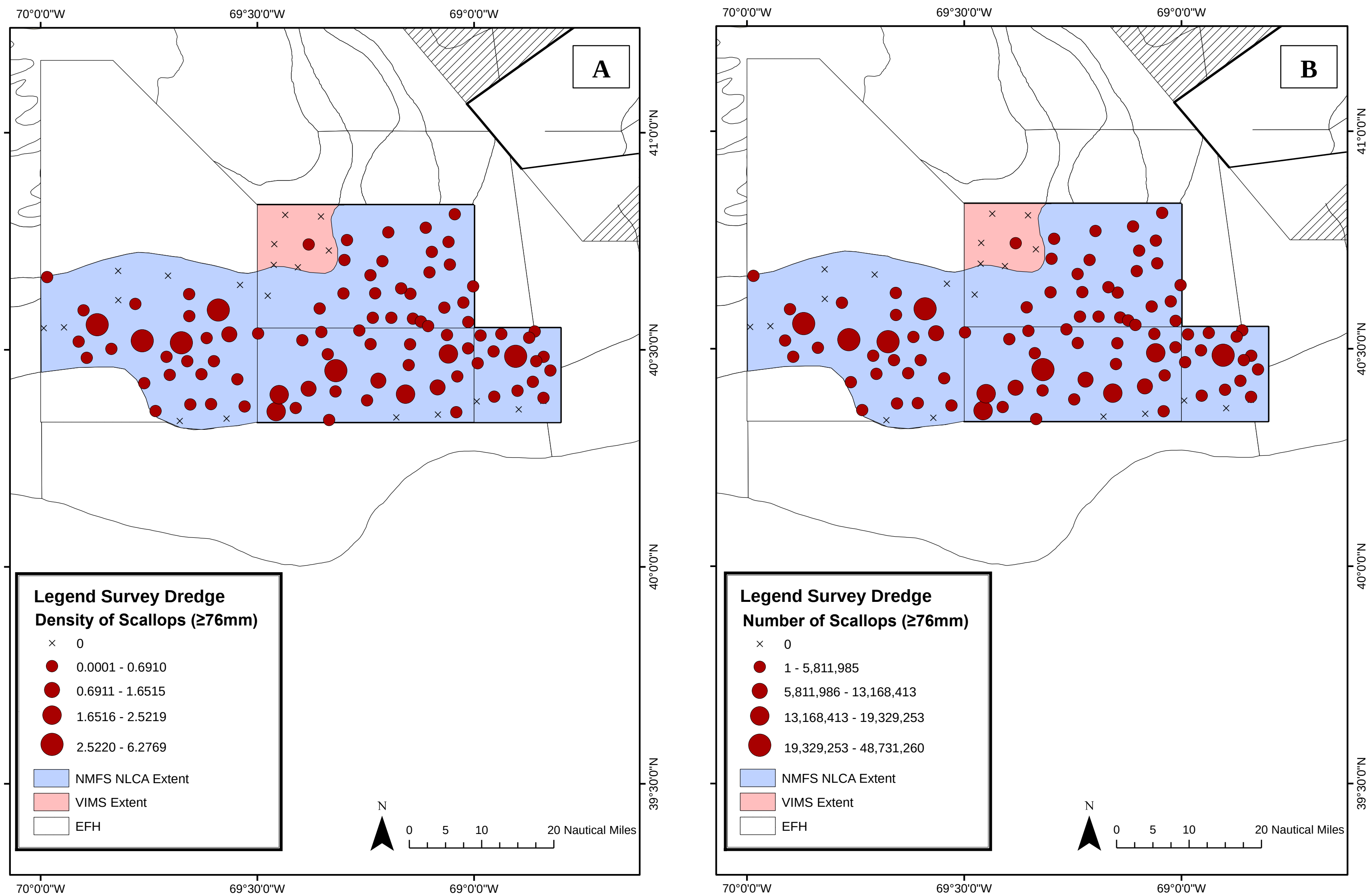


Figure 10. Density (A) and number (B) of scallops greater than 75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Nantucket Lightship Access Area and surrounds during May-June 2016.

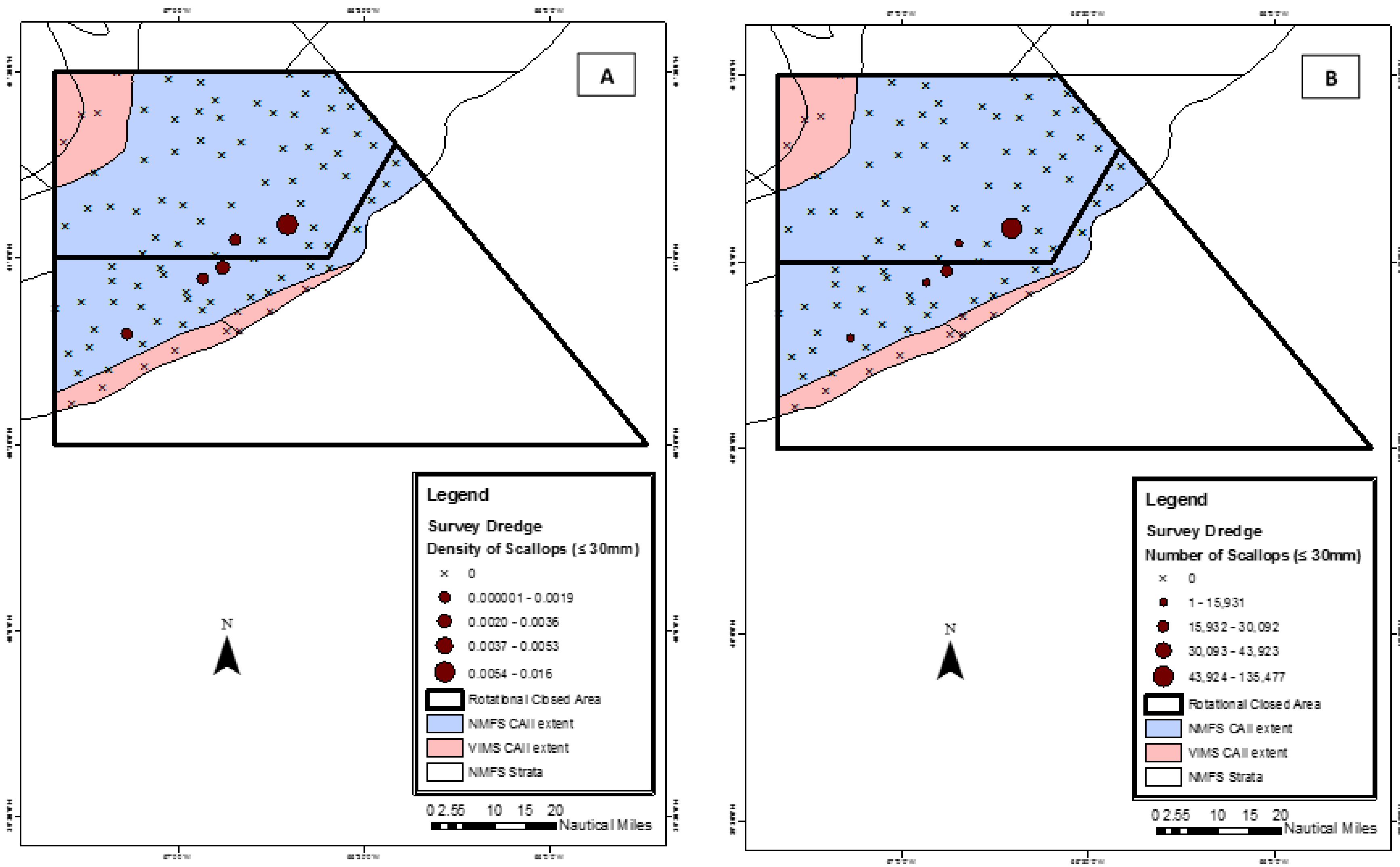


Figure 11. Density (A) and number (B) of scallops 0-30mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Closed Area II Access Area and southern Extension closure during May-June 2016.

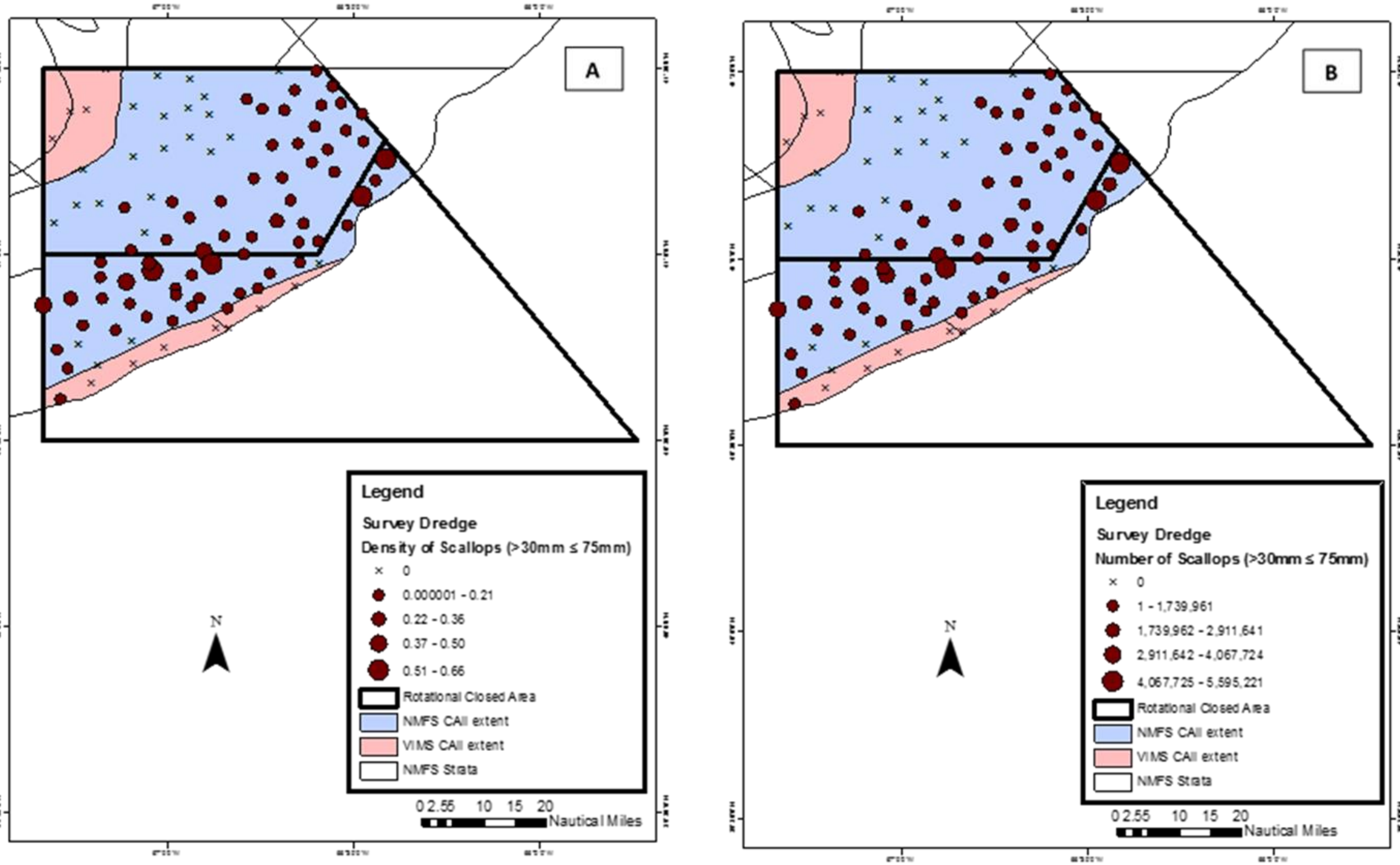


Figure 12. Density (A) and number (B) of scallops 31-75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Closed Area II Access Area and southern Extension closure during May-June 2016.

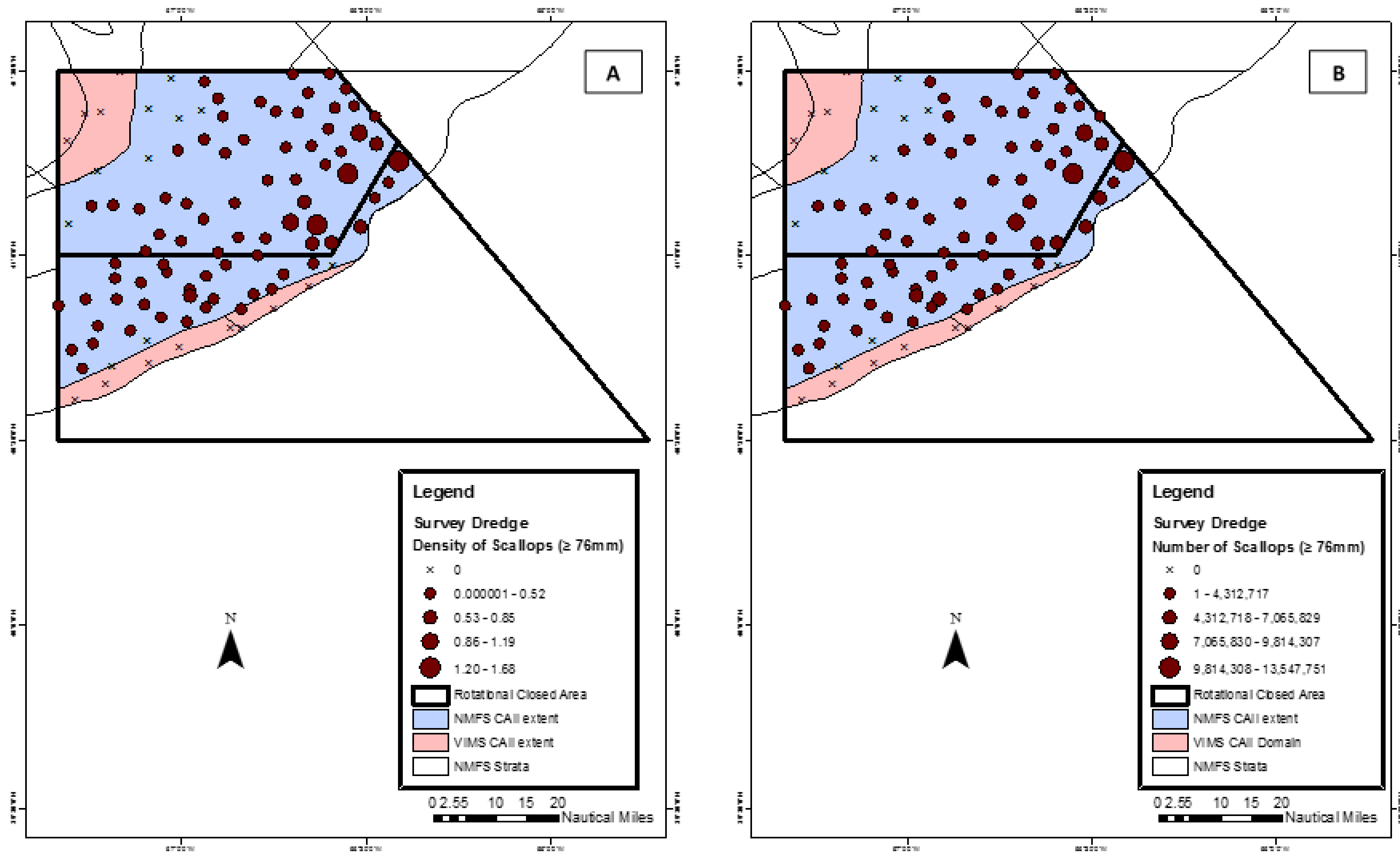


Figure 13. Density (A) and number (B) of scallops greater than 75mm per m^2 caught in the NMFS survey dredge during the VIMS/Industry cooperative survey of the Closed Area II Access Area and southern Extension closure during May-June 2016.

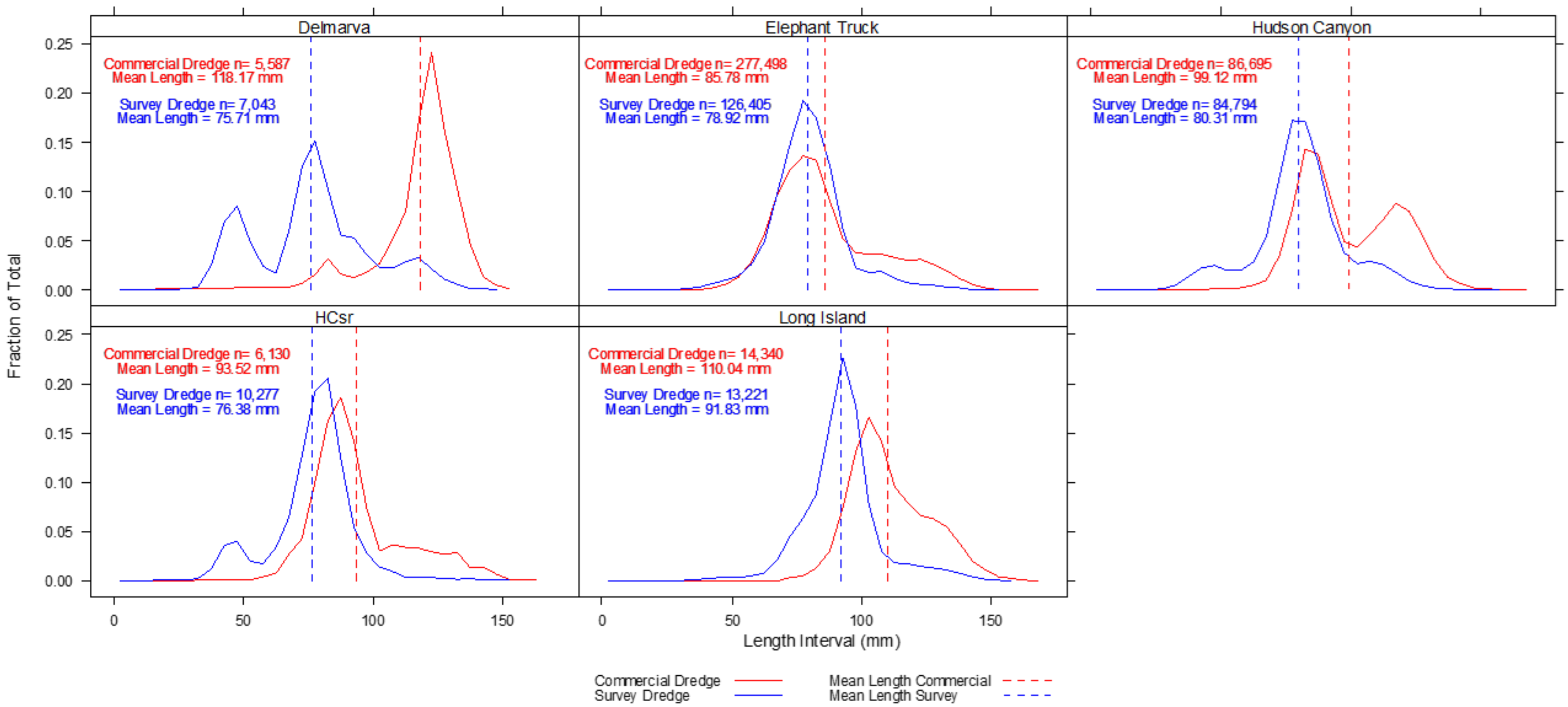


Figure 14. Length frequency of scallops captured in the survey and commercial dredges during the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource area for May-June 2016 by region. Number of scallops measured and mean length by gear are also included.

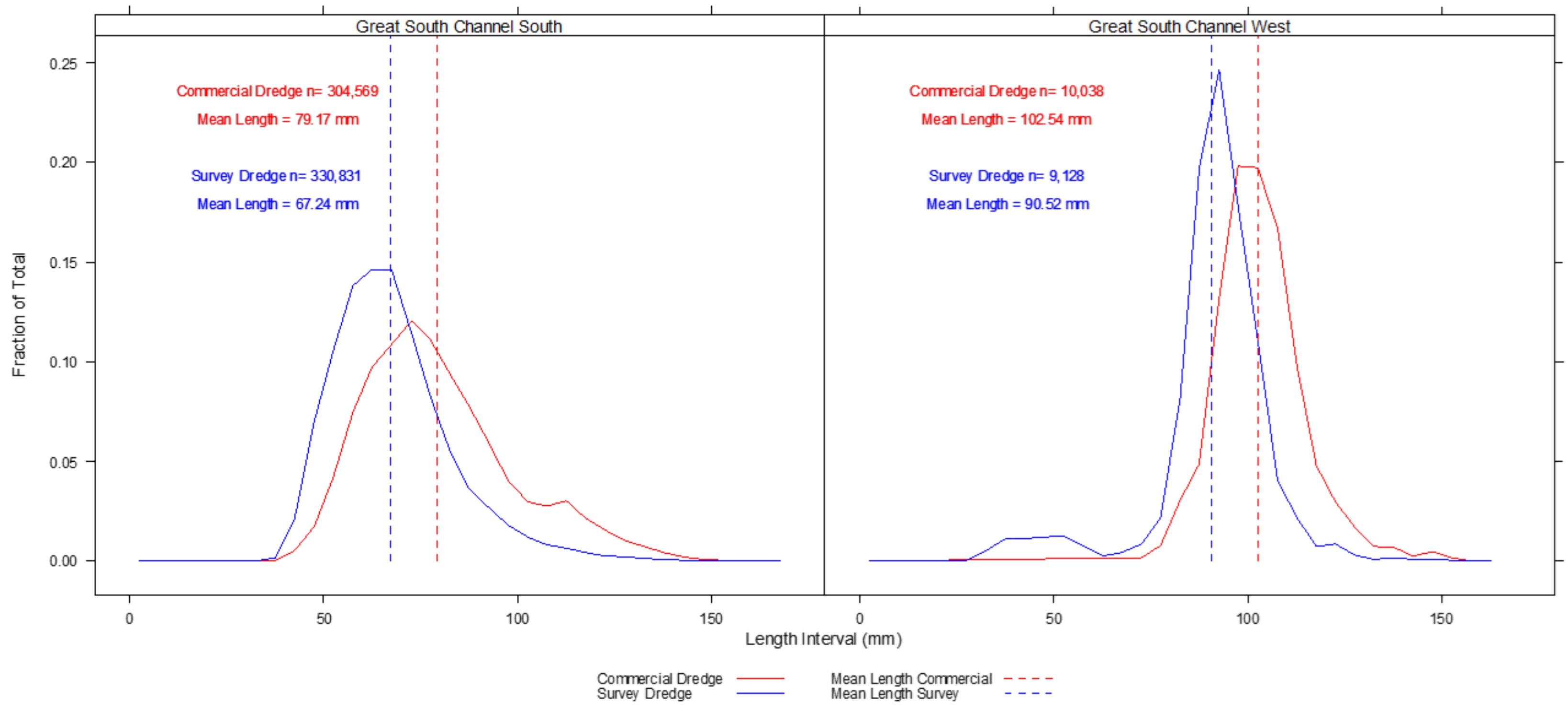


Figure 15. Length frequency of scallops captured in the survey and commercial dredges during the VIMS/Industry cooperative survey of the Nantucket Lightship Access Area and surrounds for May-June 2016 by region. Number of scallops measured and mean length by gear are also included.

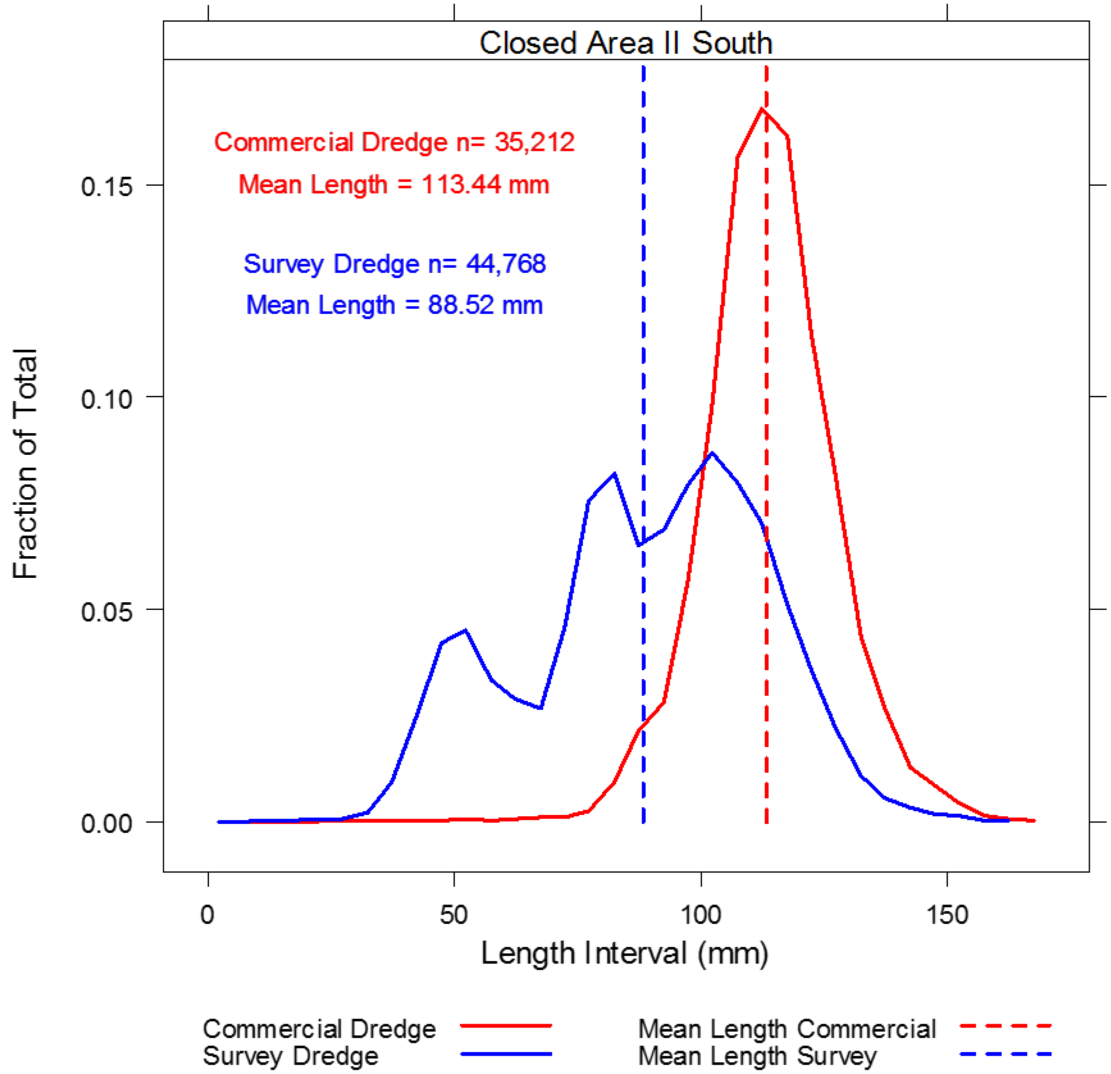
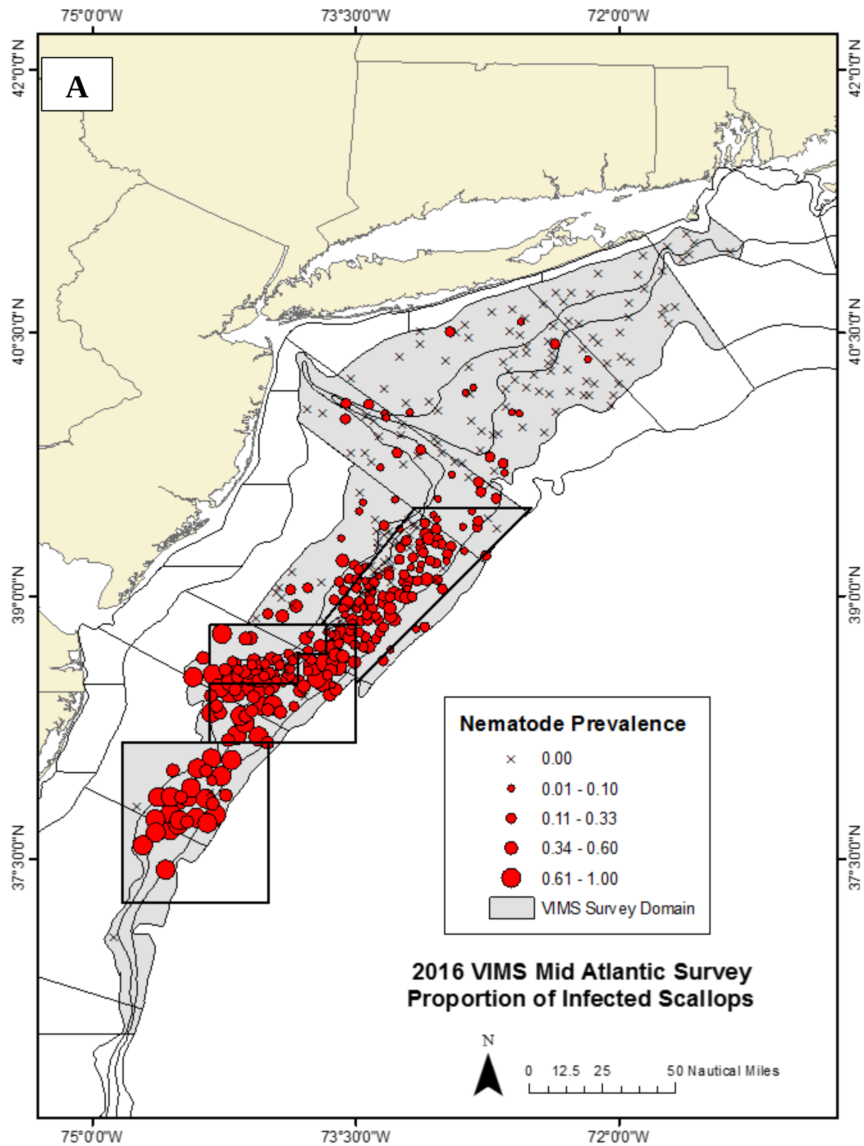


Figure 16. Length frequency of scallops captured in the survey and commercial dredges during the VIMS/Industry cooperative survey of the Closed Area II Access Area and southern Extension closure for May-June 2016 by region. Number of scallops measured and mean length by gear are also included.

Figure 17. Image of a scallop adductor meat infected with the parasitic nematode.



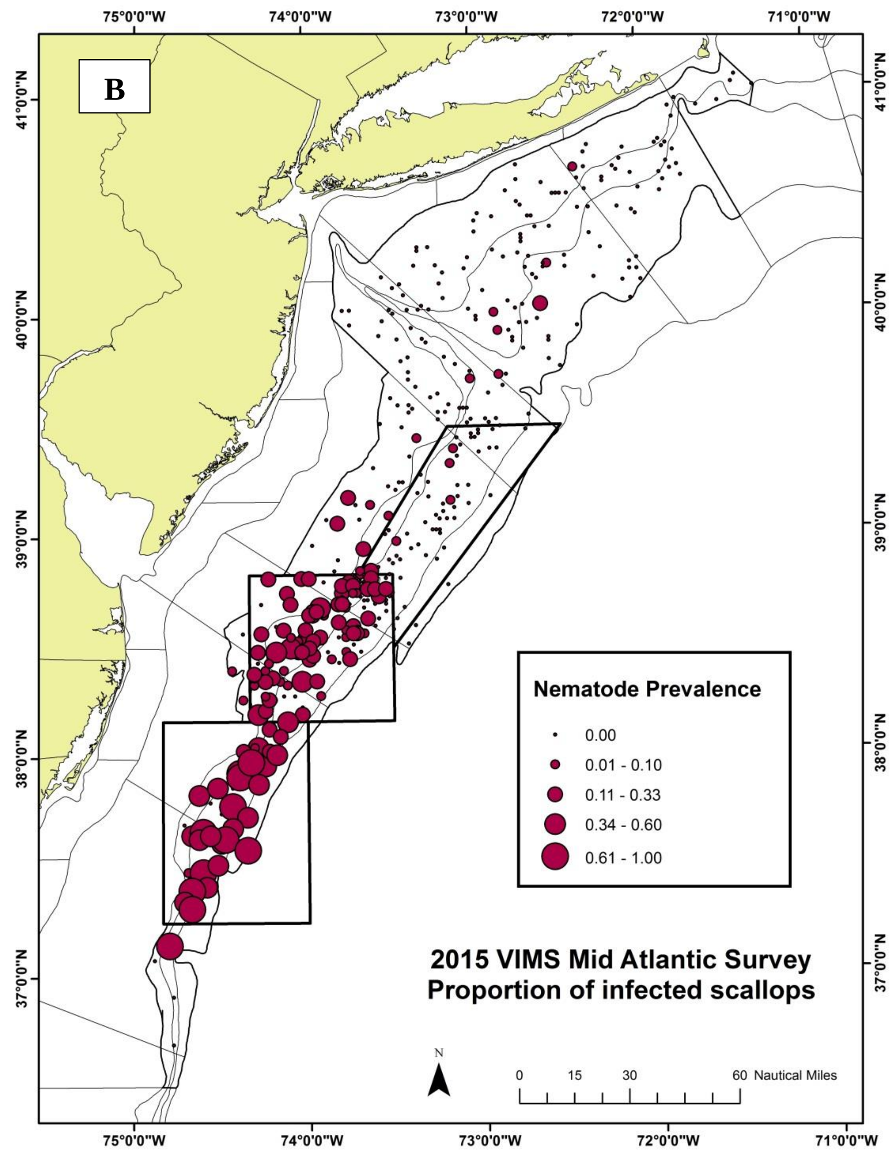


Figure 18. Nematode prevalence as documented during the VIMS/Industry cooperative survey of the Mid-Atlantic sea scallop resource area for May-June 2016 (A) and 2015 (B).