ABSTRACT

Title of Thesis: GROWTH OF EASTERN OYSTER, *CRASSOSTREA VIRGINICA*, IN CHESAPEAKE BAY

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Marine, Estuarine, and Environmental Science (MEES)

I applied modern techniques of modal analysis to track size modes in Eastern oyster, *Crassostrea virginica*, populations longitudinally through time, from which I inferred age-classes to establish size-at-age relationships for individual oyster bars and across Maryland's Chesapeake Bay. Average shell lengths of putative age-0 through age-5 oysters range from 22.93 (±6.67, n=194) mm to 84.46 (±8.27, n=4) mm. Growth rates declined with age-class from a mean of 28.97mm/yr to –0.85mm/yr, and the maximum and minimum individual growth rates were 0.78 and 53.0 mm/yr, respectively. I estimated von Bertalanffy growth parameters across all sites as L_∞=90.85mm, k=0.55, and t_o=-0.51. Two processes likely account for the small asymptotic length: size-selective mortality, both natural and fishery-related, and underlying Dermo infections in the population. On average, I estimated oysters take 3 years to reach a marketable size within Chesapeake Bay. As an alternative to modal length frequency analysis, annuli in chondrophore sections of known-age oysters in Chesapeake were examined. It was determined that annuli formation was unrelated to chronological age.

GROWTH OF EASTERN OYSTER, *CRASSOSTREA VIRGINICA*, IN CHESAPEAKE BAY

by

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INTRODUCTION

The Eastern oyster *Crassostrea virginica* (Gmelin 1791) is distributed in estuaries and coastal areas of the western Atlantic and the Gulf of Mexico, ranging almost 8000 kilometers from Brazil to Canada (Newball and Carriker 1983; Andrews 1991). The Eastern oyster once supported a multi-million dollar industry in North America, however, fishery landings have declined by more than 90% over the last 40 years in most estuaries (Mackenzie 1996). Likewise, the Chesapeake Bay eastern oyster population declined dramatically during the last century. Prevailing explanations for the decline include high rates of fishing mortality (Rothschild et al. 1994; Jordan et al. 2002; Jordan and Coakley 2004), habitat degradation (Mackenzie 1983), poor recruitment (Krantz and Meritt 1977), and two salinity-related parasitic diseases, *Haplosporidium nelsoni* (MSX) and *Perkinsus marinus* (Dermo) (Ford and Tripp 1996). In the Chesapeake Bay, present estimates of rates of fishing mortality operating in the Chesapeake Bay fisheries, indicate that oyster removals in Chesapeake Bay are to be too high to be sustainable (Jordan et al. 2002; Jordan and Coakley 2004).

Oysters create a complex matrix of structured habitat, not unlike coral reefs, important to many fish and invertebrate species, which enhance estuarine biodiversity (Wells 1961; Breitburg 1992). Oyster reefs are known to play an important role in benthic-pelagic coupling and the movement of energy within the ecosystem (Ulanowicz and Tuttle 1992; Lenihan and Peterson 1998). The decline in oyster abundance has dramatically affected the Chesapeake Bay ecosystem causing reduced water filtration capacity and a shift from a benthic to a pelagic-dominated ecosystem (Baird and

Ulanowicz 1989). The decreased capability of the oyster population to remove suspended particles, such as phytoplankton, from the water column reduces its ability to mitigate many of the effects of nutrient enrichment (Newell 1988). Additionally, there is an associated reduction in the filtering capacity of the fouling invertebrate populations (barnacles, anemone, etc.), which make extensive use of the physical reef structure. The combined effects of removal of live oysters, shell material from the reefs, and the mechanical damage to the reef structure from fishing gear contribute to degradation of habitat structure. Thus, the loss of oysters and the associated structured habitat has cascading negative consequences on the biodiversity of the estuarine ecosystem. Declines in oysters also have negative effects on the economic and ecological value of the oyster fishery, and fisheries targeting transient mobile species that rely on the structured habitat to supply forage or refuge.

A dominant force impacting population dynamics of oysters in Chesapeake Bay and along the east coast, are the presence of two parasitic diseases, MSX and Dermo. These parasites are widespread and known to cause high levels of mortality in adult oysters (Jordan et al. 2002). The observed low levels of spat settlement (young-of-the-year oysters) observed throughout the bay in recent years (Krantz and Meritt 1977), and the subsequent low levels of recruitment, could be linked to the parasitic disease Dermo which is known to cause reduced total fecundity in infected oysters (Kennedy 1995).

The eastern oyster is a dioecious alternate hermaphrodite. In the James River, Virginia, 90% of the oysters less than 35mm were shown to be male (Andrews 1979). The proportion of females in each size class increases with total shell length. As a result, larger individuals tend to be predominantly female (Galstoff 1964). Eastern oysters

spawn externally and the larvae produced remain planktonic for up to three weeks (Nelson 1909). Despite the knowledge of where the larvae set in Chesapeake Bay, the spatial link between the origin of parental stock and the location of settling recruits remains unknown.

The peak of larval oyster settlement in Chesapeake Bay occurs in July and August. Howeer, patterns of larval settlement vary interannually in Chesapeake Bay, and both salinity and temperature are believed to influence larval settlement behavior. Although larval settlement occurs at temperatures as low as 16.9 ^{o}C (Loosanoff and Engle 1940), the most favorable temperature is thought to be 19 - 24 ^{o}C (Ryder 1995). Additional factors that have been suggested to affect larvae settlement behavior are food supply, light, substrate, and the presence of chemical cues from live oysters (Lutz et al. 1970). The presence of chemical cues from live oysters indicates that the substratum is suitable for settlement and is a mechanism that contributes to the complex reef building behavior observed. The integrity of this complex reef structure is believed to support enhanced survival and growth of young oysters.

The role of temperature (Menzel 1955; Loosanoff 1958; Feng 1965), and salinity in determining the distribution and growth of the eastern oyster in Chesapeake Bay is well established. While Eastern oysters are found in areas where the temperature can range from -2 - 36 ^{o}C (Butler 1954; Galstoff 1964), rates of temperature change can greatly influence the actual tolerance levels within that range for adult oysters (Fingerman and Fairbanks 1957). Rates of shell growth decrease with decreasing water temperature, until shell growth ceases at ~ 5^{o}C (Ingle and Dawson 1952; Galstoff 1964).

In Chesapeake Bay, oyster stocks are thought to experience large interannual variations in length of growing seasons, dependent on the salinity. In Chesapeake Bay, oysters occur from salinity 5 – 30. Shell growth increases with increasing salinity (Loosanoff 1953a, 1958, 1965; Shaw 1966). The optimum salinity range is approximately 14 - 28 (Galstoff 1964). In the upper reaches of Chesapeake Bay, and its tributaries with salinities less than 5, oysters can establish reefs but mortality on these reefs due to excessive freshwater runoff is common (Galstoff 1964; Haven et al. 1976). The increased presence of oyster predators at higher salinities is another indirect effect of salinity on oyster distribution (Gunter 1955).

OBJECTIVES

Despite the extensive research that has been conducted on the eastern oyster, estimates of fundamental processes that drive stock production, namely recruitment and growth under natural conditions, are lacking. Improving the understanding of the Eastern oyster stock-recruitment relationship remains a major challenge. However, there are techniques available to produce estimates of individual oyster growth and hence production. Three approaches to estimated growth can be recognized: tracking individuals as they grow through time, separating modes in length-frequencies to infer growth, or establishing the length-age relationship based on known age markers. For example, several different groups of individual oysters, of various unknown ages, were followed in trays in Milford, Connecticut, and changes in shell length from 7.7mm - 37.2mm were recorded over a 7-month growing season (Loosanoff and Nomejko 1949). Shaw (1966) and Freise (1996) also followed the growth of individuals in the Chesapeake

Bay. While these methods are desirable as researchers can easily identify individuals, experiments have shown that oysters have increased growth rates and survival if elevated off the bottom (Shaw 1962 a,b, 1963, 1969; Baab et al. 1973; April and Mauer 1976). While the average growth of single-year classes of oysters transplanted from other regions, as well as those produced in hatcheries have been followed (Paynter unpublished), they are not representative of natural bars with multi-year classes present. Thus, despite past studies, estimates of growth of oysters under natural conditions are not available.

Inferential techniques based on length-frequency data collected bay-wide on natural oyster bars provide a means to estimate growth rates at a large spatial scale. Extended time series of length-frequency data would also permit examination of potential interannual variations in growth. To capture the potential variability in shell length at age and growth rates, one requires data at a large spatial scale. Although an inferential length-structured analysis of growth is typically considered less accurate than direct aging methods, length is with a proxy for many biological and fishery-related processes for oysters such as fecundity, maturity, natural mortality, predation, distribution, and selectivity of the fishery better than age alone. This makes shell length an important metric to describe processes for Chesapeake Bay oysters, and length-frequency data is readily available through fishery-independent surveys.

Known-age markers called annuli (latin:rings) in scales and otoliths have long been used to establish a length-at-age relationship for many finfish species (Lai et al. 1996). Similarly, annuli within the microstructure of bivalve shells have been used to establish the age-at-length relationship for species such as hard clam, *Mercenaria*

mercenaria, in the Chesapeake Bay (Fritz and Haven 1983), freshwater mussel, *Elliptio complanata*, in Ontario, Canada (Veinott and Cornett 1996), fan mussel *Pinna nobilis* in the Mediterranean Sea (Richardson et al. 1999), as well as the European flat oyster, Ostrea edulis (Richardson et al. 1993). Importantly, the utility of shell microstructure for ageing eastern oyster has yet to be developed. Structural differences in external shell morphology are the result of numerous environmental factors which may include salinity, temperature, current velocity, turbidity, calcium concentrations, density, dissolved oxygen concentrations, and rates of growth which may determine shell thickness (Kennedy et al. 1996). Archaeologists have identified and used annuli in the chondrophore of eastern oyster shells to examine the season of harvest, although it has not been used to establish the age-at-length relationship for the Eastern oyster (Kent 1988). This is likely due to the difficulty in addressing the highly variable macro- and micro structure within oyster shell. Oyster morphology is highly variable and elaborate techniques are required to age individuals based upon the optical properties of sectioned shells (Kent 1988).

Obtaining estimates for individual oyster growth remains an important challenge to describing oyster population dynamics in Chesapeake Bay. In the first Chapter, I explore longitudinal applications of modal size decomposition analysis to length-frequency data for the eastern oyster in Chesapeake Bay. Through use of this technique I describe the growth of eastern oysters by inferring length-at-age across the Maryland portion of Chesapeake Bay and develop regional and site-specific length-at-age relationships. The validation of these length-based techniques can be achieved through the use of known-age oysters. In the second Chapter, I examine the use of the annuli in

the microstructure of the oyster chondrophore (hinge) as a known-age marker for determination of the length-at-age relationship. Additionally, these data are used to validate the inferred length-at-age relationship as determined through the length-based modal analysis. These growth analyses provide one step forward towards improving the current understanding of demographics of eastern oyster under natural condition in Chesapeake Bay. The final chapter ties together the contribution of these two analyses towards the understanding of eastern oyster growth in Chesapeake Bay. It also provides recommendations for future work that builds off the knowledge base established through this project.

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CHAPTER ONE:

GROWTH OF EASTERN OYSTER

(*CRASSOSTREA VIRGINICA*) IN CHESAPEAKE BAY:

LONGITUDINAL APPLICATION OF MODAL SIZE

DECOMPOSITION ANALYSIS

INTRODUCTION

The Eastern oyster *Crassostrea virginica* (*Gmelin* 1791) is distributed in estuaries and coastal areas in the Western Atlantic and the Gulf of Mexico, ranging almost 8000 kilometers from Brazil to Canada (Newball and Carriker 1983; Andrews 1991). The Chesapeake Bay has supported substantial populations of eastern oyster, but abundances have declined dramatically during the last century. This decline is believed to have resulted from the combination of high rates of fishing mortality (Rothschild et al. 1994; Jordan et al. 2002; Jordan and Coakley 2004), habitat degradation (Mackenzie 1983), poor recruitment (Krantz and Meritt 1977), and two salinity-related parasitic diseases, *Haplosporidium nelsoni* (MSX) and *Perkinsus marinus* (Dermo) (Ford and Tripp 1996). The decline in oyster abundance has affected the Chesapeake Bay ecosystem causing reduced filtration capacity and a shift from a benthic to a pelagic-dominated ecosystem (Baird and Ulanowicz 1989). The recent low levels of abundance have focused management efforts on the restoration of oyster stocks to sustainable levels. Moreover, the Chesapeake Bay Program (CBP 2000) commitment to increase native oyster populations ten-fold by the year 2010 has precipitated a need to assess the status of the oyster stocks in Chesapeake Bay.

Oyster growth and recruitment remain poorly understood processes. Rothschild et al. (1994) combined site-specific estimates of oyster growth in the field, a von Bertalanffy growth model and a spawning stock biomass per recruit model (SSBR) to assess oyster population status in the Chesapeake Bay. However, the studies used to estimate maximum size and growth rates were small-scale, site-specific, and based on

observed growth of oyster in off-bottom culture. The restricted geographic coverage and artificial culture conditions of these studies mean that the derived growth estimates may not reflect the true variability in growth rates for oysters *in situ* throughout the bay. The lack of reliable estimates of oyster vital rates in the field under natural conditions limits the application of traditional population dynamics models. Obtaining unbiased estimates of individual oyster growth, and understanding the associated uncertainty remains an important challenge to describing oyster population dynamics in Chesapeake Bay.

Growth estimates of cultured oysters are available (Shaw 1962a,b). Several studies report the growth of cultured oysters raised either suspended in floats, longlines, rafts, or submerged mesh trays. While these methods provide easy access to the study oysters for researchers, experiments have shown increased growth rates and survival of oysters if elevated off the bottom (Shaw 1962a, b, 1963, 1969; Baab et al. 1973; April and Mauer 1976). Growth rates of suspended oysters are likely not representative of those growing in the field. Oysters produced in hatcheries and then planted in the field may have growth rates that differ from wild oysters due to optimal nutrition in the hatchery, selection for fast growth through the rearing process, or single year class plantings with reduced competition. Additionally, growth rates estimated for oysters in the laboratory may be biased as a result of the feeding regimen used.

In the field, growth can be estimated by either tracking individuals as they grow through time, or separating modes in length-frequencies to infer growth, or establishing length-age relationship based on known age markers. The logistical difficulty of following individuals on a bay-wide scale and the lack of a known age marker for oysters requires the use of inferential techniques based on length-frequency data collected bay-

wide to obtain estimates of growth rates at a large spatial scale. Tracking modes from length-frequencies to infer growth can be based on data from a single sample (cross-sectional) or based on multiple samples thereby allowing individual cohorts to be tracked through time (longitudinal). Longitudinal approaches are preferred as they do not require the assumptions of (i) constant recruitment or (ii) that all cohorts observed have the same growth rates. Thus longitudinal approaches allow interannual differences in cohort growth to be examined (Chambers and Miller 1995).

Early techniques for modal analysis involved visual identification of either distinct modes of single year classes from length frequency plots, or inflection points from cumulative length-class frequencies (Cerrato 1980). Application of visually-based identification of modes is straightforward in fast growing species with conspicuous modes (Rothschild et. al. 1994). However, when growth is slow, or variation in size-at-age is high, the overlap among successive size modes increases and makes the application of visual techniques difficult. Moreover, size-based demarcation of age-classes becomes difficult as the maximum age increases because variation in size at age usually increases with age (Alverson and Carney 1975). Concerns over the visual identification of cohorts motivated the development of more rigorous, statistically-based approaches to modal analysis. Initially, these statistical approaches described the size distributions of the cohorts represented in the population as a suite of normal distributions (Hassleblad 1966). More recently, techniques have been developed that relax the normality assumption. Modern methods of modal analysis are considerably more flexible and permit a range of distributions such as lognormal and gamma distributions to be fit to individual modes (Haddon 2001), and allow the incorporation of biological information (Schnute and

Fournier 1980). Modal analysis of invertebrate length frequencies is widespread and examples include shrimp *Pandalus borealis* (Hansen and Aschan 2000) and the red sea urchin *Strongylocentrotus franciscanus* (Smith et al. 1998). In Chesapeake Bay, modal analysis has been applied to blue crabs comparing length-frequency histograms and predicted age based on lipofuscin, a biochemical age-marker, extracted from the crabs (Ju et al. 1999).

The application of modal analysis to estimate growth of eastern oyster in the field must account for environmental parameters that may influence observed growth. The role of temperature and salinity in determining the distribution and growth of the eastern oyster in Chesapeake Bay is well established (Menzel 1955, 1956; Loosanoff 1958; Feng 1965). While oysters are commonly found in areas where the temperature can range from -2 to 36 ^{o}C (Butler 1954; Galstoff 1964), rates of temperature change can greatly influence the actual tolerance levels within that range for adult oysters (Fingerman and Fairbanks 1957). Shell growth rates decrease with decreasing water temperature, until shell growth ceases at ~ 5^{o}C (Ingle and Dawson 1952; Galstoff 1964). In Chesapeake Bay, oysters occur from salinity 5 – 30. Shell growth in oysters is almost nonexistent below salinity 5: growth increases with increasing salinity (Loosanoff 1953a, 1958, 1965; Shaw 1966). The optimum salinity range is approximately 14 - 28 (Galstoff 1964). The low salinities (<5) common in the upper reaches of Chesapeake Bay, and its tributaries result in the establishment of reefs in the areas. However, subsequently mortality is high due to excessive freshwater runoff that is characteristics of these regions (Galstoff 1964; Haven et al. 1976). The increased presence of oyster predators at higher salinities is another indirect effect of salinity on oyster distribution (Gunter 1955).

In the Chesapeake Bay, disease can be an additional important factor regulating oyster growth. Several studies have been conducted to examine the effect of the parasitic protozoans, Dermo and MSX, on oyster growth rates. Dermo infection in oysters cultured in floating rafts in Chesapeake Bay was shown to retard shell growth at moderate and high salinities (Paynter and Burreson 1991). For oysters heavily infected with MSX, decreased feeding rates were observed, increasing the physiological stress on the oysters and causing a decrease in the condition of the tissue (Newell 1985). When oyster tissue condition decreases, the individual oyster is unable to allocate energy towards growth and reproduction (Ford and Figueras 1988; Freise 1996).

The factors that are known to affect oyster growth rates vary spatially. Jordan et al. (2002) have shown that there are important spatial differences in population structure of oysters within the Maryland portion of the Chesapeake Bay along a gradient of salinity. Similarly, Dittman (1998) documents regional differences in the environmental covariates through time that may cause large differences in growth rates associated with differences in location of individual cohorts. Individual oyster growth is also likely affected by regional productivity. These effects would most likely be coupled with oyster density. Density of oysters may affect shell growth by limiting food and therefore impact individual oyster morphology (Kent 1988). Areas that are extremely dynamic such as shifting sand bottoms can cause oyster shells to be very rounded in shape (Kent 1988), which could have an impact in a length-based analysis based on a single metric. It is, however, unknown if differences in growth rates and shell length due to environmental factors can be detected at a large spatial scale in the field.

Given the potential importance of spatial variation in productivity, temperature, salinity and disease prevalence, samples used to estimate growth must be broadly distributed spatially and temporally. Length-frequency data from fishery-independent surveys that cover a broad spatial and temporal domain are readily available for oysters in Chesapeake Bay. These data may provide an opportunity to apply modal analysis to assign age-classes, and hence infer growth rates. The Maryland Department of Natural Resources has collected length-frequency data for oysters since 1990. Although an inferential length-structured analysis of growth is typically considered the less accurate approach due to uncertainty in age determination, length describes many biological and fishery-related processes for oysters such as fecundity, maturity, natural mortality, predation, distribution, and selectivity of the fishery better than age alone. This makes shell length an important metric to describe demographic processes for oysters, and the inferential techniques used to establish size-at-age for oysters should prove quite informative.

The objectives of this study was to apply modern techniques of modal analysis and track size modes of presumptive year classes of eastern oyster on individual oyster bars in Chesapeake Bay and thereby develop reliable estimates of oyster growth under natural conditions. I used maximum likelihood approaches to estimate model parameters for the modal fits and their associated uncertainty using nonlinear optimization procedures (Fournier et al. 1990). By tracking size modes longitudinally, I inferred the length-at-age for up to six ages for individual year classes at each site. Subsequently, length-at-age estimates were analyzed to estimate growth at regional and bay-wide scales.

METHODS

In the Maryland portion of Chesapeake Bay, the Maryland Department of Natural Resources Fall oyster dredge survey has monitored the oyster population consistently since 1990. Sampling was conducted at sixty-four sites from 1990 – 1996. Over this period, one-bushel samples at each site were formed by compositing 1/5 bushel subsamples from 5 tows. Live oysters in the one-bushel sample were counted and the sizes tallied into 5 mm intervals. I compared the length frequency data in 5 mm intervals to 10 mm intervals, and determined the 5 mm size intervals (smallest interval available) provided a better description of modal structure (Figure 1). From 1997 – 2001, a subset of forty-three of the original sixty-four sites were sampled, and a one-bushel sample was composed of 1/2 bushel subsamples from 2 tows on each site. The mean number of live oysters per bushel sampled between the two sampling regimes were not significantly different based on a pooled two-sample t-test ($mean_{1990\text{-}1996}$=93.46, $mean_{1997\text{-}2001}$=85.97, t=0.71, df=10, p-value=0.4950). All assumption for the t-test were met, including equality of variance (F-value=4.12, p-value=0.121). I concluded that the change in sampling did not affect the numbers of oysters sampled. Thus I assumed that the change in sampling methodology did not bias the length-frequency data. The location of the sampling sites and geographic coordinates are shown in figure 2 and appendix I.

Potential environmental covariates of growth were based on Chesapeake Bay Program (CBP) water quality data. These data were used in the analysis because the oyster survey data provided only point estimates of temperature and salinity on the day of sampling. CBP water quality monitoring stations were scattered through the bay. Data

selected for these analyses were from twenty-two monitoring stations that were within 8 kilometers (straight-line) of the oyster dredge survey sites, and comprised biweekly or monthly records of bottom water temperature and salinity (Appendix VIII). For each oyster survey site, information on transplantation of natural or hatchery oysters from other sites (repletion) was also available.

MODAL ANALYSIS

Maximum –likelihood-based modal analysis of the oyster length-frequency data was conducted (Appendix II). The length-frequency distribution of oysters at a single site in a single year was modeled as a multimodal distribution with m modes. The probability of observing n oysters of length x_i can be represented as:

$$P\{x_i | n, p_1, p_2, ..., p_m\} = n! \prod_{j=1}^{m} \frac{p_i^{x_i}}{x_i!}$$

where p_m is the probability of observing x_i in the mth mode (Hastings and Peacock 1975). Each p_m can be defined by any probability density function (e.g. normal, lognormal, gamma, etc.). Taking expectations of each event, and expressing the result in log form to overcome numerical complexity in using the factorial operator, one may write:

$$LL\{x_i | n, p_1, p_2, ..., p_m\} = \sum_{i=1}^{m} [x_i Ln(p_i)]$$

I compared normal and lognormal probability density functions to define the p's. Normal probability density functions provided the best statistical fit for sample modal fits (Appendix III), therefore normal probability density functions were used to fit all the length-frequency data.

A variable number (m) of normal distributions with additive error were fit to the length-frequency data using 'Solver' in Microsoft Excel. The optimization algorithm varies the mean, variance and relative abundance of oysters in each modal distribution until the total likelihood for the entire length frequency fit is maximized. Akaike's Information Criterion (AIC) was used to test the goodness of fit of the maximum likelihood estimates to the length-frequency data based on differing numbers of m modes (Haddon 2001). The AIC statistic penalizes "goodness of fit" by the number of model parameters. Thus, the modal number that produced the smallest AIC was selected as the most likely representation of the data.

The modal analysis provided statistical estimates of the most likely number of modes present in the length frequency distribution together with the mean length, variance, and relative numbers of each mode for each site for each year in the entire 12-year time series. Any length-frequency sample that contained too few oysters (<5) or had hatchery or natural seed transplanted onto the site (repletion) were removed from the analyses. Based on the above criteria, 14 of the 64 sites were completely removed from the analyses.

I identified progressions of modal length classes across years at a single site. Based on these patterns, I assigned putative year classes and tracked sizes for subsequent age classes (age-0, age-1, age-2, age-3, age-4, and age-5) at each site. I discarded year-

class cohorts for which I was unable to identify an age-0 cohort, or that were characterized by equivocal frequency distributions, or which experienced repletion activities. Equivocal fits were defined as the failure of the optimization algorithm to identify any of the modes that could visually be identified in the length-frequency data.

The failure of the optimization algorithm to identify an interceding mode in a sample (age-class) from a single year for a year class that had prior and later age classes identified resulted in that year-class being removed from the analyses. Because putative age-classes and their associated growth rates were determined from the progression of these modal length classes across years, once the algorithm failed to identify the modal length class for a specific cohort, all latter modal fits for that specific cohort were not used in the analysis.

ANALYSIS OF LENGTH AT AGE-0

Analysis of length at inferred age-0 was conducted at three spatial resolutions:

1) The 50 sites were grouped into 23 spatial regions, based on proximity and location within river systems or water bodies, to attempt to identify any regional differences in putative age-0 mean shell lengths (Appendix VII).

2) Sites were grouped into larger spatial domains based on salinity regimes defined by Jordan et al. (2002). Accordingly, the sites were also grouped into three salinity regions: low (<12), moderate (12-13.99), and high (>14), based on the mean salinity recorded annually during the oyster dredge survey (Appendix VII).

3) The data from the 50 sites were pooled to provide mean shell length at age-0 aggregated across all sites.

I analyzed interannual variability in the mean length-at-age-0, across all sites using ANOVA ($\alpha = 0.05$, *Kenwood-Rogers ddfm*). ANOVA was used to test for site-specific differences in mean and variance in length at age-0, with year classes acting as replicates at each site. Experiment-wise error rate for all comparisons was controlled at 0.05 using Tukey's HSD (Tukey 1949a) method for all ANOVAs. ANOVA was also used to examine region-specific differences in mean length at age-0, with sites across all years as replicates. Residuals of the length-at-age data for salinity-based regions displayed normality, however inhomogeneity of variances was corrected by the use of multiple variance groupings. The assumptions of normality and homogeneity of variance for the spatially-based region residuals were met. In addition to the analyses which focused on the presumptive age-0 mean shell lengths, an important landmark in oyster life history, effort was taken to describe the means and distributions of shell lengths at latter age-classes (age-1, age2, age-3, age-4, age-5).

As site-specific salinity and the variance in salinity at a given site could potentially impact oyster length-at-age, regression analysis was used to identify relationships between mean shell length within age-class and the CBP site-specific mean salinity, maximum salinity, minimum salinity, and salinity variance (Appendix VIII). All assumptions were met, and subsequently the data were analyzed using regression. The same analyses were conducted using temperature and an additional ANOVA was used to examine the effect of degree-days on mean shell length within year-class. Because not all years and sites had water quality data collected for November and December, I removed those months from the analysis. For several years and months only monthly water temperatures were collected, therefore, I fit splines to the temperature data to allow two

bimonthly temperatures to be interpolated for use in the degree-day analysis. The oyster growing degree-days (GDD) for each year was calculated as the difference between the measured temperature (t) and 5^{o}C, the temperature below which shell growth does not occur, summing all bi-monthly observations for the year (Loosanoff and Nomejko 1949; Ingle and Dawson 1952).

$$GDD = \sum_{N} \left[t_i - 5^{o}\,\text{Celsius} \right]$$

ANALYSIS OF GROWTH

Growth was estimated in two ways. I calculated changes in size at putative-age for all sites and year classes. That allowed me to describe the distributions of growth rates for each year of growth (age(1-0), age(2-1), age(3-2), age(4-3), age(5-4)), and fit a regression model to examine if growth rates declined linearly with age, as would be expected. I also estimated growth by fitting a nonlinear von Bertalanffy (LVB) growth model with additive error structure (Galucci et. al. 1996) to the mean oyster length-at-age data at 29 sites. The model was only fit to those sites with at least 4 putative age-classes. The linear forms of LVB were not be used because of the difficulty in obtaining estimates of the precision of parameters, and an undefined error structure (Quinn and Deriso 1999). The equation for LVB is:

$$L_t = L_\infty (1\text{-}e^{-kt})$$

where L_t is the length at age (t), L_∞ is the asymptotic length, and k is the Brody growth coefficient (von Bertalanffy 1938). Parameter estimates from the von Bertalanffy growth model were compared across sites using ANOVA. Because of the intrinsic inverse relationship between L_∞ and k, a more uniform means of comparing growth curves across sites was needed. Examining a landmark along the growth curves, such as the age-at-entry to the fishery, provides this uniformity.

The age-at-entry to the fishery (76 mm shell length) was calculated for each site using site-specific growth curves. Differences in the age-at-entry to the fishery based on the spatially- and salinity-based regions were examined using ANOVA. The residuals met all assumptions of normality, however inhomogeneity of variances was corrected by the use of multiple variance groupings.

VALIDATION OF MODAL ANALYSIS

Hatchery produced oysters have been planted at a variety of sites throughout the bay as part of ongoing restoration efforts. Hatchery-reared oysters that had been planted on Bollingbroke Sands, Chest Neck, Spaniard Point, and Weems Upper oyster bars were sampled during June 2003 (Appendix IX). Divers using scuba gear collected 17 - 56 oysters from each of the four sites using 1/9 m^2 quadrat samples. Oyster shells were measured to the nearest mm. The length-at-age data for known-age oysters were then compared on a site-specific basis with the mean shell lengths for the same putative age-class at sites closest to those sampled.

RESULTS

Multimodal length frequency analysis resulted in both acceptable (Fig. 3) and equivocal fits (Fig. 4) fits to the observed data. One hundred and ninety-four year class cohorts were identified from the 50 sites sampled between 1991-2001 (1990, n=0; 1991, n=2; 1992, n=31; 1993, n=27; 1994, n=15; 1995, n=33; 1996, n=7; 1997, n=35; 1998, n=2; 1999, n=19; 2000, n=10; 2001, n=13; Appendix IV). Of the 600 possible year-site combinations of length-frequency samples for the 50 remaining sites, 53% (319) of the samples had acceptable modal fits and were retained for further analysis.

The modal length classes were interpreted as age classes based on longitudinal progression of length modes at individual sites, allowing putative ages to be assigned to length modes (Appendix IV; Appendix V). From 1991 – 2001, the average length of putative age-0 oysters in October was 22.93 (±6.67, n=194) mm (Fig. 5). The largest average length of age-0 oysters of 46.22 mm was observed at Bay North Mountain Point (BNMP – Fig. 2) in 1992. The smallest average length of age-0 oysters, 10.65 mm, was observed at Eastern Bay Parson's Island (EBPI – Fig. 2) in 1993. The average length of putative age-1 oysters in during that same time period was 50.80 (±6.16, n=130) mm (Fig. 5). The largest average length of age-1 oysters, 68.64 mm, was observed at Nanticoke River Wilson Shoal (NRWS – Fig. 2) in 1993. The smallest average length of age-1 oysters, 36.89 mm, was observed at Tangier Sound Great Rock (TSGR – Fig. 2) in 1994. The average length of putative age-2 oysters was 67.58 (±7.48, n=88) mm (Fig. 5). The largest average length of age-2 oysters, 82.98 mm, was observed at Patuxent River Broomes Island (PXBI – Fig. 2) in 1997. The smallest average length of age-2 oysters,

45.25 mm, was observed at Tangier Sound Piney Island (TSPI – Fig. 2) in 1995. The average length of putative age-3 oysters was 79.28 (±6.27, n=48) mm (Fig. 5). The largest average length of age-3 oysters of 101.88 mm was observed at Harris Creek Eagle Point (HCEP – Fig. 2) in 1995. The smallest average length of age-3 oysters, 69.45 mm, was observed at Fishing Bay Clay Island (FBCI – Fig. 2) in 1994. The average length of putative age-4 oysters was 85.37 (±10.62, n=23) mm (Fig. 5). The largest average length of age-4 oysters, 110.67 mm, was observed at Harris Creek Eagle Point (HCEP – Fig. 2) in 1996. The smallest average length of age-4 oysters, 69.19 mm, was observed at Little Choptank River Cason (LCCA – Fig. 2) in 2001. The average length of putative age-5 oysters was 84.46 (±8.27, n=4) mm (Fig. 5). The largest average length of age-5 oysters, 92.15 mm, was observed at Eastern Bay Hollicutt's Noose (EBHN – Fig. 2) in 2001. The smallest average length of age-5 oysters, 72.73 mm, was observed at Manokin River George's Bar (MAGE – Fig. 2) in 1997.

Figure 5 illustrates the high variability of mean oyster shell length at age-0 (CV=29.13%) across all sites. Variability in length at age was substantially lower for older ages (age-1 CV=12.17%, age-2 CV=11.07%, age-3 CV=7.90%, age-4 CV=12.44% and age-5 CV=9.79% respectively). The older age-classes also had smaller sample sizes. While the distributions of mean cohort shell lengths for the first three putative age-classes were quite distinct, the latter three age-classes showed a large degree of overlap (Fig. 5). Moreover, the distributions of mean shell lengths for the putative age-classes were approximately normally distributed, with the exception of age-5 which is likely due to sample size (age-1, kurtosis=0.73, skewness=0.84; age-1, kurtosis=0.22 , skewness=

0.53; age-2, kurtosis=-0.28, skewness=0.06; age-3, kurtosis=2.07, skewness=1.11; age-4, kurtosis=0.26, skewness=0.83; age-5, kurtosis=2.50, skewness=-1.34; Fig. 5).

Interannual variability significantly contributed to the variation in mean shell length for the age-0 putative age-class (df=10,183, F-value=9.11, p-value=<0.0001; Table 1). Analysis of variance suggests significant site-specific differences for age-0 (df=49,144, F-value=2.29, p-value=<0.0001; Table 2). However, the least-squares mean estimates of age-0 shell lengths at individual sites did not reveal strong, distinct groupings among sizes, showing rather a more continuous distribution of sizes (Table 2). Age-0 varied significantly at the water body level, also called spatially-based regions (df=17,151, F-value=2.51, p-value=0.0016; Table 3). However, least-squares mean estimates indicate that the difference results from one or two water bodies that had substantial larger estimated mean lengths at age-0 than the other sites: most sites were not statistically different from one another (Table 3). Salinity-based regions were significant determinants of age-0 shell length (df=2,17.7, F-value=5.19, p-value=0.0169; Table 4). Examination of least-squares mean estimates of age-0 shell lengths for salinity-based regions indicated the highest salinity region exhibited significantly different growth rates than the other two regions (Table 4). The interaction of year and site could not be tested due to a lack of degrees of freedom. No other interactions were significant.

Site-specific mean, maximum, minimum, and variance, in both salinity and temperature from the CBP water quality monitoring station data were not significant determinants of mean shell length-at-age (Table 5; Table 6). The analysis of variance using degree-days also did not yield significant results (F=0.22, p-value = 0.5744).

Age-specific growth rates, calculated longitudinally for single year classes cohorts declined linearly with increasing age-class (r^2=0.5730; Fig. 6). Growth rates declined with age class from a mean of 28.97mm/yr to –0.85mm/yr, and the minimum and maximum positive calculated growth rates were 0.78 and 53.0 mm/yr, respectively.

I examined the distribution of age-specific growth estimates based on differences in size-at putative age. The distributions of growths rates were approximately normal for each age interval (age(1-0), kurtosis=0.80, skewness=0.74; age(2-1), kurtosis=0.35 , skewness= 0.47; age(3-2), kurtosis=-0.51, skewness=-0.01; age(4-3), kurtosis=-0.05, skewness=0.19; age(5-4), kurtosis=-1.47, skewness=0.82; Fig. 7). There was also a broad range in the growth rates based on differences between putative age-classes for any given year of growth.

Modal analysis of length-frequency data provided parameter estimates for site-specific and bay-wide LVB growth models (Appendix VI). A nonlinear LVB growth model fit to mean length-at-age derived from tracking individual year classes provided a good description of growth (L_∞=90.85mm, k=0.55, t_o=-0.51; r^2=0.9047: Fig. 8). The model indicated that the average oyster attains a harvestable size (76mm shell length for Chesapeake Bay) in about 3 years. The estimate of asymptotic length (L_∞) in this model reflected size selective mortality, both natural and fishery-related, acting on the older year classes. Because of the low sample size for sixth age-class, the model was refit to reduced dataset including the first three, four or five age classes. All models produced similar results regardless of the number of age classes employed (L_∞=93.01mm, k=0.51, t_o=-0.56; L_∞=97.54mm, k=0.46, t_o=-0.58; L_∞=96.92mm, k=0.47, t_o=-0.57; for three, four and five age class models respectively).

Site-specific von Bertalanffy model parameters were estimated (Table 7; Appendix VI). ANOVA indicated that L_∞ and k differed significantly among a few spatial regions, although most of the spatial regions were not significantly different from one another based on least squared mean differences (Table 8; Table 9). Salinity-based regions were significant determinants of the shell length at age t_o (Table 8).

Analysis of variance suggests salinity-based regions were significant determinants of age-at-entry to the fishery (df=2, 24.6, F-value=5.92, p-value=<0.0080; Table 10, Table 11). Spatially-based regions were not significant determinants of age-at-entry to the oyster fishery (df=16,12, F-value=1.33, p-value=0.3106).

There were no sites from the Magothy River or the Severn River in the length-based modal analysis to be compared with known-age oysters from Chest Neck or Weems Upper oyster bars. However, oyster shell lengths for age-2 oysters at Chest Neck oyster bar in the Magothy River (n=56, mean=55.91$\pm$8.55mm) and Weems Upper in the Severn River (n=37, mean=62.67$\pm$10.73mm) was lower than the single observation of a putative age-2 oyster at a nearby Bay North Mountain Point site (n=1, length=74.33mm). These mean shell lengths were similar to the average putative age-2 shell lengths (n=88, mean=67.58$\pm$7.48mm) At Bollingbroke Sand in the Upper Choptank River the mean shell lengths (n=34, mean=74.91$\pm$1.98mm) were similar to those from modal analysis (n=11, mean=67.82$\pm$6.31mm). At Spaniard Point oyster bar in the Chester River, the hatchery planted age-5 oysters (n=19, mean=114.90$\pm$13.98mm) were larger than age-5 oysters identified in the length-based modal analyses (n=4, mean=84.46$\pm$8.27mm).

The size distributions of age-2 oysters from the modal analysis were similar to those of oysters with known age-2 oysters (Figure 9). However, the size distributions of

age-5 oysters from the modal analysis were much smaller than the known age-5 oysters (Figure 10).

DISCUSSION

I was able to apply modal analyses to longitudinal samples of eastern oyster from Chesapeake Bay successfully to estimate size-at-age and growth in the field. The average shell lengths of putative age-0 through age-5 oysters range from 22.93 (±6.67, n=194) mm to 84.46 (±8.27, n=4) mm. Growth rates declined with age-class from a mean of 28.97mm/yr to –0.85mm/yr, and the maximum and minimum observed growth rates were 0.78 and 53.0 mm/yr, respectively. The negative mean growth rate for the fifth year of growth is not statistically different from zero, and is an artifact of size selective mortality from both parasitic diseases and fishing mortality removing the older age-classes. While some organisms may exhibit negative growth, due to the retention of the hard structure of the oyster shell, negative growth rates are biologically impossible.

The estimates of size-at-age developed herein were biologically reasonable and similar to those derived from other approaches. My estimates of the size of age-2 oysters developed from a modal analysis overlapped the observed sizes of known age-2 oysters collected from not-take reserve areas within the Chesapeake Bay. In contrast, my estimates of the sizes of age-5 oysters were smaller than those of known age-5 oysters from no-take reserve areas. This later observation further implicates the role of fishery removals in the impacting the size structure of the oyster population in Chesapeake Bay. Further evidence in support of my estimates can be derived from field studies. Seed oysters suspended in trays in the Tred Avon River a sub-estuary of the Chesapeake Bay, showed age-0 oysters grew from an average of 25.5mm to 55.2mm (n=102; 29.7mm/season) from May to December (Shaw 1966). In their second year, oysters grew from an average size of 57.8mm to 80.1mm (n=100; 22.3mm/season) from April to

December (Shaw 1966). Shaw and Merill (1966) reported that oyster settling on navigation buoys in lower Chesapeake Bay averaged 25 to 35mm at the end of their first growing season (age-0), 70 to 80 mm at the end of the second year (age-1), and 80 to 95 mm at the end of the third (age-2). In trays in the York River, another sub-estuary of the Chesapeake Bay, *C. virginica* were found to grow to 64.6mm in 18 months (Barber and Mann 1991). Paynter and DiMichele (1990), who followed two groups of cultchless, hatchery-produced spat in trays in Chesapeake Bay, reported that oysters grew 8 - 10mm/month from July to October (32 -40mm/first season). Outside of Chesapeake Bay, Loosanoff and Nomenjko (1949) reported growth for a variety of age-classes ranging from 7.7 - 37.2 mm over seven months in Milford Harbor, Connecticut. As expected, oyster growth rates reported in studies of oysters growing in trays and on navigational buoys are slightly higher than those inferred from the length-based analyses of oysters under natural conditions.

The results of the modal analyses indicated significant interannual variability in the size of age-0 oysters. Ignoring 1991 estimates, which likely reflect low sample size (n=2), two statistically different groups size of age-0 oysters resulting from different year classes were identified. The timing of spawning is one mechanism that can introduce variation to the length-at-age relationship. In particular, the timing of spawning is related to temperature and salinity and thus varies throughout the bay among years (Loosanoff and Engle 1940, Lutz et al. 1970, Ryder 1995). As the timing in spawning varies interannually, the more easily observed timing of peak oyster larvae settlement events vary within a 5 month period, from late May to early October typically with single or double peaks in magnitude in July to early October (Beaven 1955; Shaw 1969;

Kennedy 1980; Kennedy et al. 1996). As salinity and temperature vary among oyster bars and survey sites throughout the bay at any given time, the spawning may not necessarily be synchronous across oyster bars.

Examination of least-squares mean estimates of age-0 shell length among sites and among spatially-based regions reveals that the statistically significant differences may be driven by the small sample sizes for Bay North Mountain Point (BNMP) and two sites in the Chester River. These three sites were characterized by substantial larger oysters at age-0 than the other sites. These sites were characterized also by some of the lowest salinity levels. In contrast the age-0 mean shell lengths in the highest salinity-based region were significantly smaller than the other regions. The higher prevalence of the parasitic disease MSX in the highest salinity region, when compared to the moderate and low salinity regions, may be responsible for smaller age-0 shell lengths in the highest salinity region. While MSX is known to cause high levels of mortality in adult oysters, spat are susceptible to infection and mortality from this parasite, particularly when infection pressure is high (Mhyre 1973; Andrews 1984a). Andrews (1964, 1983) observed that MSX disappeared from James River seed beds after freshet events when the salinity dropped below 10. In Delaware Bay, a similar pattern of reduced or zero prevalence of MSX in low salinity water was observed (Haskin and Ford 1982). The spatial and temporal dynamics of the disease processes, and associated mortality, have impacts on the length-frequency distributions that are difficult to quantify, and may be another source of variability.

The estimates of von Bertalanffy (LVB) growth parameters (L_∞=90.85mm, k=0.55, t_o=-0.51) provide important insights into the ecology and exploitation of oysters

in Chesapeake Bay. Two previous studies, both of which were conducted in Chesapeake Bay, have estimated von Bertalanffy growth parameters for eastern oysters. Rothschild et al. (1994) conducted a meta analysis of previous growth studies of Eastern oyster, and reported von Bertalanffy model parameters of L_∞=150mm and k=0.28 /yr. Thus, Rothschild et al.'s results imply oysters grow more slowly and attain a larger asymptotic size than my results indicate. However, Rothschild et al.'s (op. cit.) findings also imply that legal size (76 mm) is attained in approximately three years, similar to my own findings. This suggests that the difference between my results and those of Rothschild et al. (op. cit.) reflect differences in asymptotic size between the two studies rather than in recruitment to the fishery. Mann et al. (2003) also fit an oscillating von Bertalanffy growth model to length-frequency data.

My estimate of asymptotic length and that of Mann et al. (2003) was smaller than expected. Two processes likely account for the small asymptotic length: size-selective mortality, both natural and fishery-related, acting on the older year classes, and underlying Dermo infections in the population. The parasitic disease Dermo is prevalent in the Chesapeake Bay oyster population, and individual growth is decreased in those heavily infected (Paynter and Burreson 1991). While there are no other extensive growth studies with which to compare, it is possible that there has been an actual depression in the average growth rates of oysters after the introduction of the parasitic disease. Evidence has been found in pre-colonial middens and in historical writings that suggest oysters grew larger and formed more extensive reefs than they do under present condition of habitat destruction through harvest mechanisms and disease (Kennedy 1996). Goode (1884) reported live oysters as large as 230mm shell length. Under present conditions of

widespread infection with the parasitic disease Dermo, which is know to reduce fecundity, it would seem even more important to Management Agencies to conserve the larger, more fecund oysters to maintain the reproductive capability of the population as well as the ecological benefits of the physical reef structure (Kennedy et al. 1995). In addition, the eastern oyster is a dioecious alternate hermaphrodite causing larger individuals to be predominantly female (Galstoff 1964). As such, conservation of spawning stock biomass is extremely important to maintain the reproductive capacity of the population.

There are several possible shortcomings to my analyses. Bias could have unknowingly been introduced through the determination of year classes. While the techniques used were believed to be quite conservative, it is possible that bias was introduced at the point of determining age-0 modes or while following length modes through time. Another concern in the analyses was the binning in 5 mm length classes when the oyster dredge survey was conducted. All subsequent analyses are based on these data. It is possible the 5 mm incremental length-classes do not provide sufficient resolution to detect significant differences in mean age-0 shell lengths by site and spatially-based regions, and age-at-entry to the fishery by spatially-based region. In latter year classes,

These results should suggest that collecting measurements of oyster shell lengths to the nearest mm could reveal differences in growth, that were undetectable under less refined data collection methods. One consequence of the coarser resolution of the data used here is the difficulty in estimating fishing mortality rates baywide or on individual reefs. For the red sea urchin, *Strongylocentrus franciscanus*, the application of modal

analysis was conducted similarly with modal fitting using maximum likelihoods, but extended these data to the estimation of total mortality (Z) and natural mortality in unfished populations (Smith at al. 1998). Eastern oyster populations are spatially distributed, as is fishing mortality. This requires spatial management of fishing effort to protect regional spawning stock biomass. Site-specific length frequency data could provide the means to estimate regional and site-specific fishing mortality, as natural mortality based on shell box counts.

While the length-based modal analyses provided putative length at age-class and growth rates, they need to be validated against know-age oysters. The differences in estimated and known age-5 oyster lengths is likely due to fishing mortality, which was absent on the hatchery plantings. It has also been suggested that hatchery-reared oysters grow faster than wild oysters, however, this has not been scientifically determined. The similarity in length-at age for the age-2 known-age oysters and those inferred from modal analyses indicate growth rates may be similar, at least in the earlier age-classes. Inaccurate age data can distort the ability of scientists and managers to understand oyster population dynamics. This may lead to inappropriate fishery management, therefore, it is extremely important that the accuracy of these age estimates be validated. Growth is the fundamental process that translates newly settled oysters to the reproductive and fishable stock. It drives stock production, and it is hoped that through better understanding of these vital processes informed management decision can be made to restore the native eastern oyster to sustainable levels in the Chesapeake Bay.

The approaches utilized here to analyze growth in eastern oyster may be broadly applicable to other shellfish and invertebrate fisheries. The application of these

techniques to invertebrate species is often necessary due to the lack of a know-age marker or difficulty in aging these species. Time series of size composition data from fishery-independent surveys are often readily available**.** Some examples of studies of invertebrate fisheries have employed modal analysis techniques. Hansen and Aschan (2000) utilized modal analyses of carapace length-frequency in shrimp, *Pandalus borealis*, from waters north of the Svalbard Archipeligo. This study revealed differences in regional growth and age at first maturity. Similarly, Smith et al. (1998) estimated age-at-length, growth and mortality of red sea urchin using maximum likelihood-based modal analyses of length frequencies. More recently, Martell et al. (2000) combined modal analysis of shrimp and an age-structured assessment model to estimate growth and mortality rates in shrimp, *Pandalus jordani*. Von Bertalanffy models have been developed for a wide range of other shellfish populations. Brey (1996) analyzed size-frequency data from the cockle, *Cardium edule,* over one year in Kiel Bay. Brey (op. cit.) estimated the von Bertalanffy parameters for cockle of L_∞=90.85mm and k=0.55/yr. Estimates of growth parameters for the pearl oyster, *Pinctada inmbricata*, in the Caribbean were L_∞=84mm and k=0.94/yr (Urban 2000). Abalone estimates of L_∞ and k were 160mm and 0.33/yr, respectively (Shepherd and Avalos-Borja 1997). Information of inferred length-at-age from such analyses is extremely informative with respect to fishery and biological processes affecting invertebrates.

In summary, the application of length-based modal analysis and von Bertalanffy models allowed the effects of both the environment and the fishery on growth in eastern oyster. My results suggest size-selective mortality resulting from two parasitic diseases MSX and Dermo, and from fishery-related mortality act in parallel to limit maximum

sizes in oysters. Spatial salinity-based differences in growth parameters were apparent. Geographic variability in infection intensity of Dermo (Calvo et al. 1996), density, or any combination of environmental factors such as temperature and dissolved oxygen could be responsible for variability in growth rates by region. Age-at-entry to the fishery was significantly larger in the in the high and moderate salinity-based regions, than the lower salinity region. These results provide a foundation from which more inclusive population dynamic models can be developed to aid in the assessment of population status of oyster in the Chesapeake Bay.

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Table 1. Least-squares mean estimates of age-0 shell lengths for individual years averaged across sites ranked by size. The sample size for each year is given as N. Years that are followed by the same letter are not significantly different at $\alpha = 0.05$.

Year	N	Estimate (mm)
1990	0	0
1999c	19	16.25±1.28
1993c	27	17.65±1.08
1996bc	7	20.37±2.12
1994b	15	22.27±1.44
2001b	13	22.38±1.55
1998b	2	23.10±3.95
2000b	10	24.39±1.77
1992b	31	24.92±1.01
1997b	35	25.22±0.95
1995b	33	26.13±0.97
1991a	2	39.19±3.96
sum=	**194**	

Table 2. Least-squares mean estimates of age-0 shell lengths for individual sites ranked by size. The sample size for each site is given as N. Years that are followed by the same letter are not significantly different at $\alpha = 0.05$.

Site	N	Estimate (mm)	Site	N	Estimate (mm)
TSOW (a)	6	17.87±2.36	NRWS (ab)	4	21.74±2.89
TSPI (a)	6	17.94±2.36	WRES (ab)	2	22.72±4.09
TADM (ab)	2	18.43±4.09	PSMA (ab)	7	22.91±2.18
WRMV (ab)	1	19.25±5.79	WSBU (ab)	2	22.95±4.09
FBCI (a)	5	19.29±2.59	SMCC (ab)	7	23.65±2.19
TSSS (a)	6	19.41±2.36	CRRO (ab)	3	24.18±3.34
HRNO (a)	6	19.61±2.36	PXBI (ab)	2	24.23±4.09
EBPI (a)	7	19.62±2.19	CRTW (ab)	5	24.86±2.59
TSBC (ab)	7	19.62±2.19	CROS (ab)	2	26.34±4.09
FBGC (a)	4	19.69±2.89	EBBU (ab)	1	26.49±5.79
PRLC (ab)	1	20.07±5.78	CRLI (ab)	3	26.53±3.34
MAGE (a)	5	20.22±2.59	MRBI (ab)	4	26.57±2.89
LCRP (ab)	7	20.23±2.59	PRRP (ab)	2	27.18±4.09
PSGU (ab)	2	20.25±4.09	EBWG (ab)	3	27.25±3.34
PRCH (ab)	4	20.32±2.89	MESR (ab)	5	27.55±2.59
NRMG (a)	5	20.33±2.59	MRLP (ab)	2	27.88±4.09
MADP (ab)	5	20.40±2.59	MRAS (ab)	2	28.28±4.09
LCCA (ab)	5	20.49±2.59	EBHN (ab)	2	30.91±4.09
HOHO (a)	8	20.57±2.05	WSHI (ab)	3	31.40±3.34
TSGR (ab)	2	20.62±4.09	CHBR (ab)	1	31.53±5.78
BCDN (ab)	4	20.89±2.59	HCEP (ab)	4	31.62±2.89
TSTE (ab)	5	21.02±2.59	POSH (ab)	2	32.23±4.09
SMPA (a)	8	21.12±2.04	CRCP (ab)	2	34.06±4.09
MRTU (ab)	5	21.39±2.59	CRSH (ab)	2	37.27±4.09
HRWI (ab)	5	21.51±2.59	BNMP (b)	2	46.22±5.79

Table 3. Least-squares mean estimates of mean length of age-0 shells in different spatial regions ranked by size. The sample size for each spatial region is given as N. Years that are followed by the same letter are not significantly different at $\alpha = 0.05$.

Spatial Region	N	Estimate (mm)
Tangier Sound (a)	20	19.21±0.67
Fishing Bay (a)	9	19.47±2.44
Manokin River (a)	10	20.32±1.76
Honga River (a)	11	20.47±1.68
Broad Creek (ab)	4	20.89±3.42
Nanticoke River (a)	9	20.95±1.63
Potomac River (ab)	7	22.24±1.63
Pocomoke Sound (ab)	2	22.32±1.97
Eastern Bay (ab)	13	23.65±2.03
Patuxent River (ab)	2	24.23±7.26
Little Choptank River (ab)	12	24.32±1.61
Miles River (ab)	13	25.04±1.36
Middle East Shore (ab)	5	27.55±2.10
Chester River (b)	2	27.72±1.77
Choptank River (ab)	17	31.53±5.89
Harris Creek (ab)	4	31.62±3.41
Bay North (b)	2	46.22±5.89
sum=	**142**	

Table 4. Least-squares mean estimates of age-0 shell lengths for salinity-based regions lengths. Salinity region low (salinity<12), region moderate (salinity12-13.99), and region high (salinity>14) based on Jordan et al. (2002). The sample size for each salinity region is given as N.

Salinity Region	N	Estimate (mm)
High (b)	109	21.55±0.58
Moderate(a)	77	23.98±0.69
Low (b)	8	30.54±4.18

Table 5. Regression results examining sources of variability, based on salinity, with respect to mean shell length at 22 water quality monitoring stations from 1991-2001.

Source of Variation	*dF*	*F*	*P* Value
Mean Salinity			
Age(0) Length	1,21	0.01	0.9266
Age(1) Length	1,19	0.91	0.3509
Age(2) Length	1,18	0	0.9829
Age(3) Length	1,14	0.44	0.5191
Age(4) Length	1,7	0.24	0.6372
Maximum Salinity			
Age(1) Length	1,21	2.02	0.1703
Age(2) Length	1,19	1.59	0.2229
Age(3) Length	1,14	2.13	0.1665
Age(4) Length	1,7	0.22	0.6553
Minimum Salinity			
Age(1) Length	1,21	0.86	0.3935
Age(2) Length	1,19	2.64	0.1222
Age(3) Length	1,14	0.16	0.6932
Age(4) Length	1,7	0.77	0.3387
Salinity Variance			
Age(1) Length	1,21	1.65	0.2087
Age(2) Length	1,19	2.51	0.9573
Age(3) Length	1,14	0.38	0.5492
Age(4) Length	1,7	0.58	0.4287

Table 6 Regression results examining sources of variability, based on temperature, with respect to mean shell length at 22 water quality monitoring stations from 1991-2001.

Source of Variation	*dF*	*F*	*P* Value
Mean Temperature			
Age(0) Length	1,21	0.01	0.9266
Age(1) Length	1,19	1.03	0.3422
Age(2) Length	1,18	2.88	0.1408
Age(3) Length	1,14	1.65	0.2331
Age(4) Length	1,7	0.54	0.4846
Maximum Temperature			
Age(0) Length	1,21	1.86	0.21
Age(1) Length	1,19	0.01	0.9221
Age(2) Length	1,18	1.85	0.195
Age(3) Length	1,14	0.76	0.3862
Age(4) Length	1,7	0.36	0.591
Minimum Temperature			
Age(0) Length	1,21	0.28	0.7616
Age(1) Length	1,19	2.1	0.1843
Age(2) Length	1,18	3.81	0.0766
Age(3) Length	1,14	2.94	0.1287
Age(4) Length	1,7	0.79	0.3974
Salinity Temperature			
Age(0) Length	1,21	0.59	0.3688
Age(1) Length	1,19	1.22	0.2769
Age(2) Length	1,18	0.02	0.8552
Age(3) Length	1,14	4.02	0.0621
Age(4) Length	1,7	0.77	0.4257

Table 7. Ludwig von Bertalanffy growth model parameters from o 23 spatial regions and the 3 salinity-based regions similar to those used in Jordan et al. (2002). Salinity region low (salinity<12), region moderate (salinity12-13.99), and region high (salinity>14).

Site	Bar Name	Spatial Region	Salinity Region	L_∞	k	t_o
BCDN	Deep Neck	Broad Creek	moderate	85.52	0.573	-0.43
BNMP	Mountain Point	Bay North	low	88.62	0.492	-1.502
CHBR	Buoy Rock	Chester River	low	83.39	0.881	-0.526
CRLI	Lighthouse	Choptank River	moderate	92.67	0.519	-0.642
CRRO	Royston	Choptank River	moderate	91.43	0.52	-0.593
CRSH	Sandy Hill	Choptank River	low	121.432	0.281	-1.343
CRTW	Tilghman Wharf	Choptank River	moderate	87.28	0.573	-0.565
EBHN	Hollicutts Noose	Eastern Bay	high	106.49	0.393	-0.852
FBCI	Clay Island	Fishing Bay	high	80.47	0.542	-0.516
FBGC	Goose Creek	Fishing Bay	high	106.86	0.542	-0.312
HCEP	Eagle Point	Harris Creek	moderate	152.15	0.261	-0.913
HRNO	Normans	Honga River	high	90.69	0.513	-0.473
HRWI	Windmill	Honga River	high	88.68	0.546	-0.498
LCCA	Cason	Little Choptank River	moderate	76.98	0.65	-0.477
LCRP	Ragged Point	Little Choptank River	high	91.12	0.429	-0.799
MAGE	Georges Bar	Manokin River	high	77.48	0.779	-0.378
MESR	Stone Rock	Middle East Shore	high	98.61	0.384	-0.842
MRBI	Bruffs Island	Miles River	moderate	83.26	0.794	-0.48
MRLP	Long Point	Miles River	moderate	88.83	0.68	-0.552
MRTU	Turtle Back	Miles River	moderate	90.81	0.538	-0.509
NRMG	Middle Ground	Nanticoke River	high	100.99	0.631	-0.351
PRRP	Ragged Point	Potomac River	moderate	148.97	0.237	-0.831
PSGU	Gunby	Pocomoke Sound	high	98.55	0.399	-0.577
PSMA	Marumsco	Pocomoke Sound	high	80.47	0.6	-0.559
PXBI	Broomes Island	Patuxent River	moderate	102.99	0.539	-0.472
TSOW	Old Womans Leg	Tangier Sound	high	116.02	0.346	-0.521
TSPI	Piney Island	Tangier Sound	high	115.21	0.252	-0.709
TSSS	Sharkfin Shoal	Tangier Sound	moderate	95.64	0.49	-0.466
TSTE	Turtle Egg Island	Tangier Sound	high	140.86	0.23	-0.826
			mean	**99.4**	**0.504**	**-0.638**
			SEM	**3.742**	**0.031**	**0.05**

Table 8. One-way analysis of variance results examining von Bertalanffy growth model parameters, with respect to spatial and salinity-based regions.

Source of Variation	*dF*	*F*	*P* Value
Spatial Region			
$L\infty$	16,26	2.78	**0.0397**
k	16,26	2.68	**0.0447**
t_o	16,26	1.91	0.1297
Salinity Region			
$L\infty$	2,26	0.01	0.99
k	2,26	0.54	0.5882
t_o	2,26	8.14	**0.0018**

Table 9. Results of the least-squared mean differences for the Ludwig von Bertalanffy growth model parameters by spatial region. Means that are followed by the same letter, within that column, are not significantly different at $\alpha = 0.05$. Experiment-wise error rate was controlled at 0.05 using Tukey's HSD.

Spatial Region	$L\infty$	k	t_o
Potomac River	148.97 a	0.237 c	-0.831 a
Harris Creek	152.15 a	0.261 c	-0.913 a
Tangier Sound	116.93 b	0.329 c	-0.631 a
Middle East Shore	98.61 c	0.384 c	-0.842 a
Eastern Bay	106.49 bc	0.393 c	-0.852 a
Choptank River	98.20 c	0.473 c	-0.786 a
Bay North	88.62 c	0.492 bc	-1.502 a
Pocomoke Sound	89.51 c	0.499 b	-0.568 a
Honga River	89.69 c	0.530 b	-0.486 a
Patuxent River	102.99 c	0.539 b	-0.472 a
Little Choptank River	84.05 c	0.540 b	-0.638 a
Fishing Bay	93.67 c	0.542 b	-0.414 a
Broad Creek	85.52 c	0.573 b	-0.43 a
Nanticoke River	100.99 c	0.631 b	-0.351 a
Miles River	87.63 c	0.671 b	-0.514 a
Manokin River	77.48 c	0.779 b	-0.378 a
Chester River	83.39 c	0.881a	-0.526 a

Table 10. Estimated age-at-entry to the oyster fishery (76mm shell length) is given in years

Site	Bar Name	Spatial Region	Salinity Region	Age-at-Entry
BCDN	Deep Neck	Broad Creek	moderate	3.4
BNMP	Mountain Point	Bay North	low	2.46
CHBR	Buoy Rock	Chester River	low	2.22
CRLI	Lighthouse	Choptank River	moderate	2.66
CRRO	Royston	Choptank River	moderate	2.83
CRSH	Sandy Hill	Choptank River	low	2.16
CRTW	Tilghman Wharf	Choptank River	moderate	3.01
EBHN	Hollicutts Noose	Eastern Bay	high	2.33
FBCI	Clay Island	Fishing Bay	high	4.82
FBGC	Goose Creek	Fishing Bay	high	1.98
HCEP	Eagle Point	Harris Creek	moderate	1.74
HRNO	Normans	Honga River	high	3.08
HRWI	Windmill	Honga River	high	3.06
LCCA	Cason	Little Choptank River	moderate	6.24
LCRP	Ragged Point	Little Choptank River	high	3.39
MAGE	Georges Bar	Manokin River	high	4.7
MESR	Stone Rock	Middle East Shore	high	2.99
MRBI	Bruffs Island	Miles River	moderate	2.59
MRLP	Long Point	Miles River	moderate	2.29
MRTU	Turtle Back	Miles River	moderate	2.86
NRMG	Middle Ground	Nanticoke River	high	1.85
PRRP	Ragged Point	Potomac River	moderate	2.18
PSGU	Gunby	Pocomoke Sound	high	3.12
PSMA	Marumsco	Pocomoke Sound	high	4.26
PXBI	Broomes Island	Patuxent River	moderate	2.01
TSOW	Old Womans Leg	Tangier Sound	high	2.56
TSPI	Piney Island	Tangier Sound	high	3.57
TSSS	Sharkfin Shoal	Tangier Sound	moderate	2.76
TSTE	Turtle Egg Island	Tangier Sound	high	2.55
			mean	**2.95**
			SEM	**0.185**

Table 11. Least-squares mean estimates of age at entry into the fishery in different salinity-based regions. The sample size for each salinity-based region is given as N. Years that are followed by the same letter are not significantly different at $\alpha = 0.05$.

Salinity Region	N	Estimate (mm)
High (a)	14	3.16±0.277
Moderate(a)	12	2.88±0.298
Low (b)	3	2.28±0.092

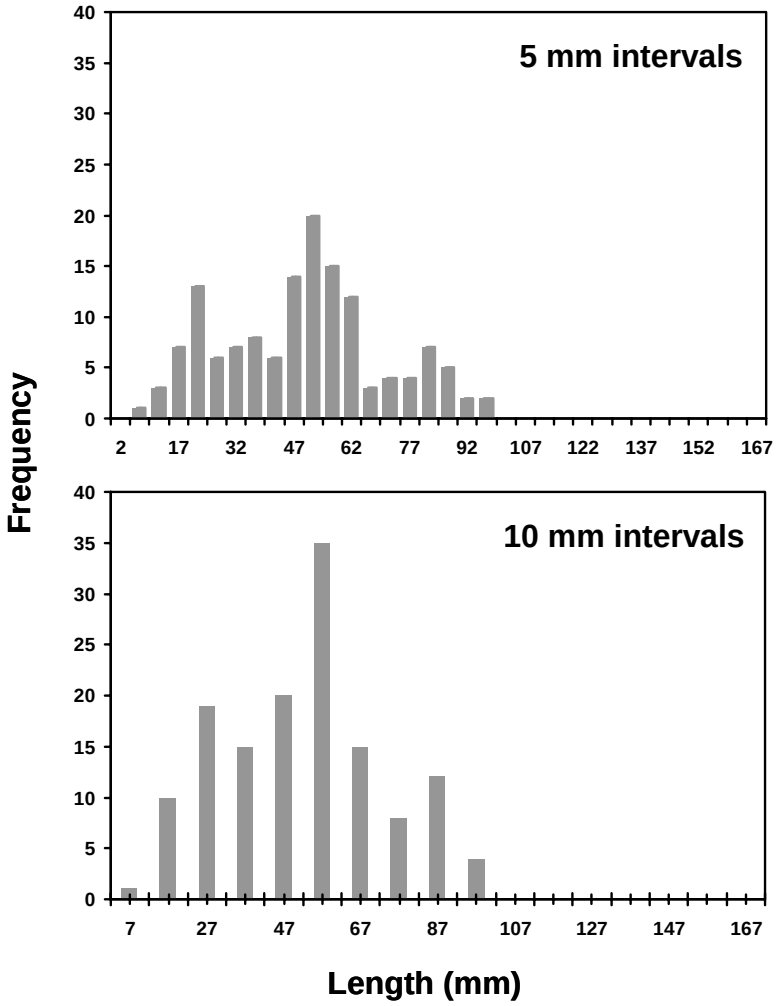

Figure 1. Comparison of length-frequency distributions from Tangier Sound Old Woman's Leg (TSOW) in 2000 binned at 5mm and 10mm size intervals.

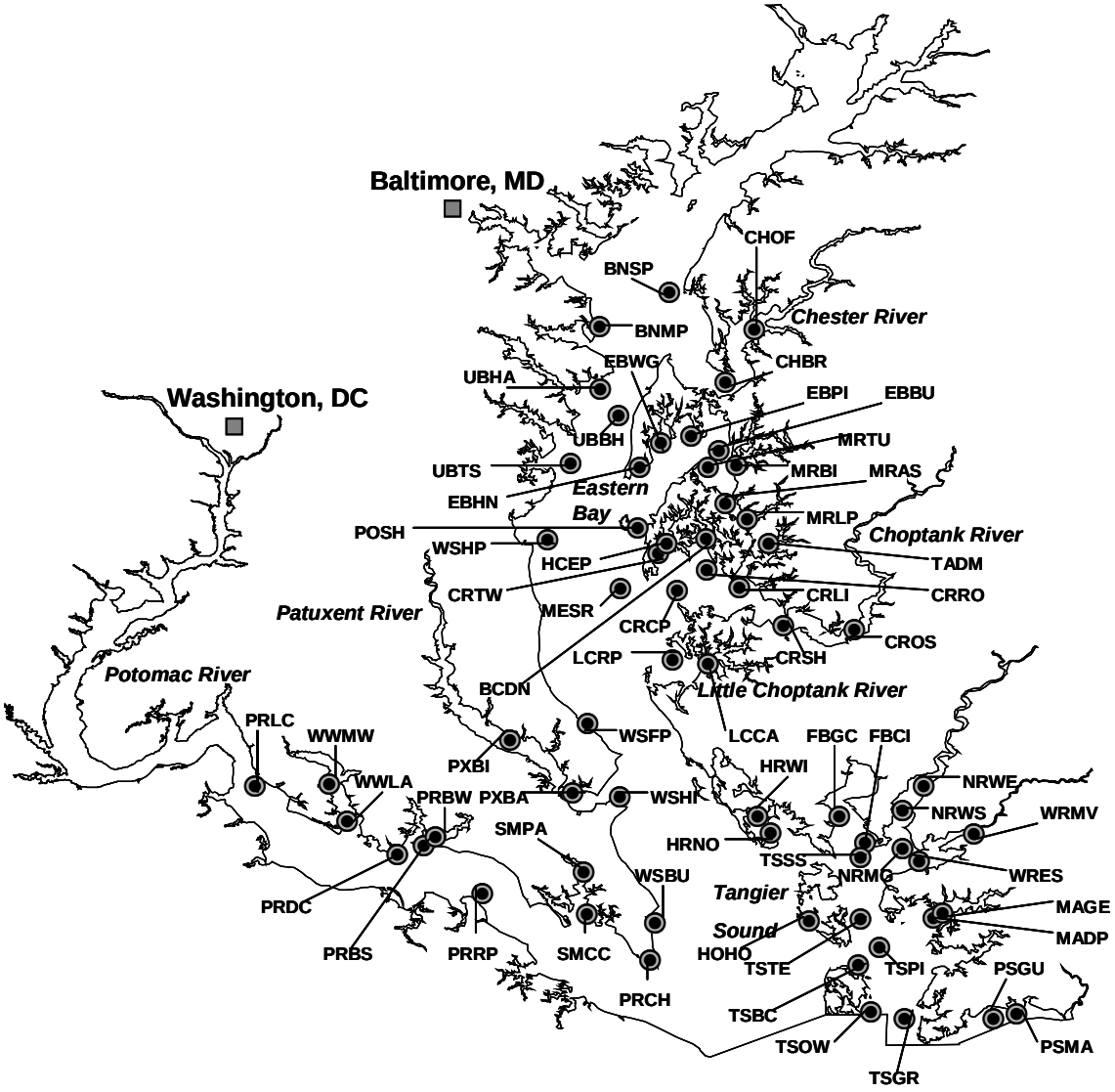

Figure 2. Map of the Sixty-Four Maryland Department of Natural Resources annual oyster dredge survey sites in Chesapeake Bay sampled from 1990-present.

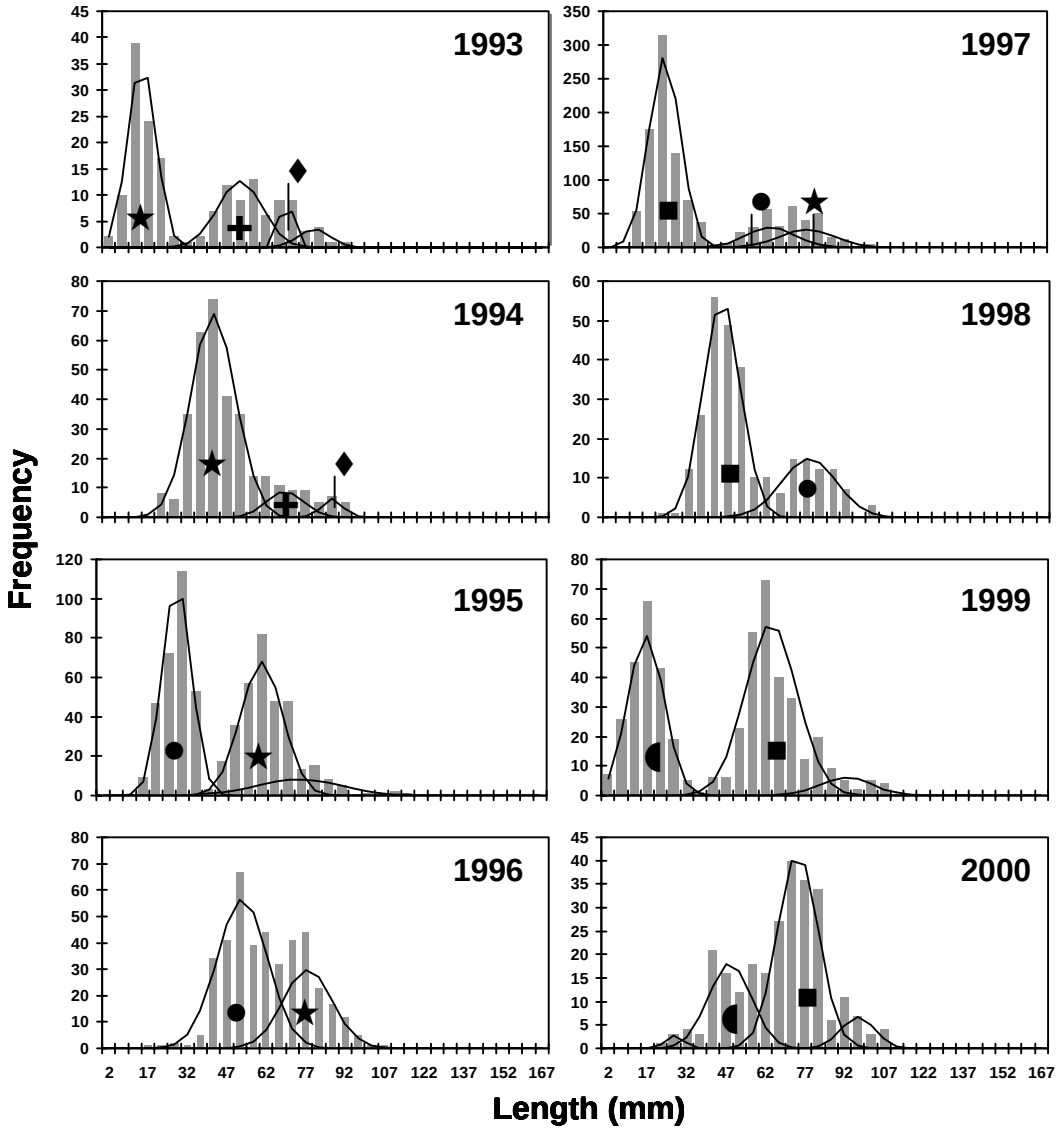

Figure 3. Broad Creek Deep Neck (BCDN) observed length frequency data (columns) from 1993 to 2000 and best maximum likelihood model fit (lines) based on AIC. Modes with the same symbols belong to the same cohort tracked longitudinally.

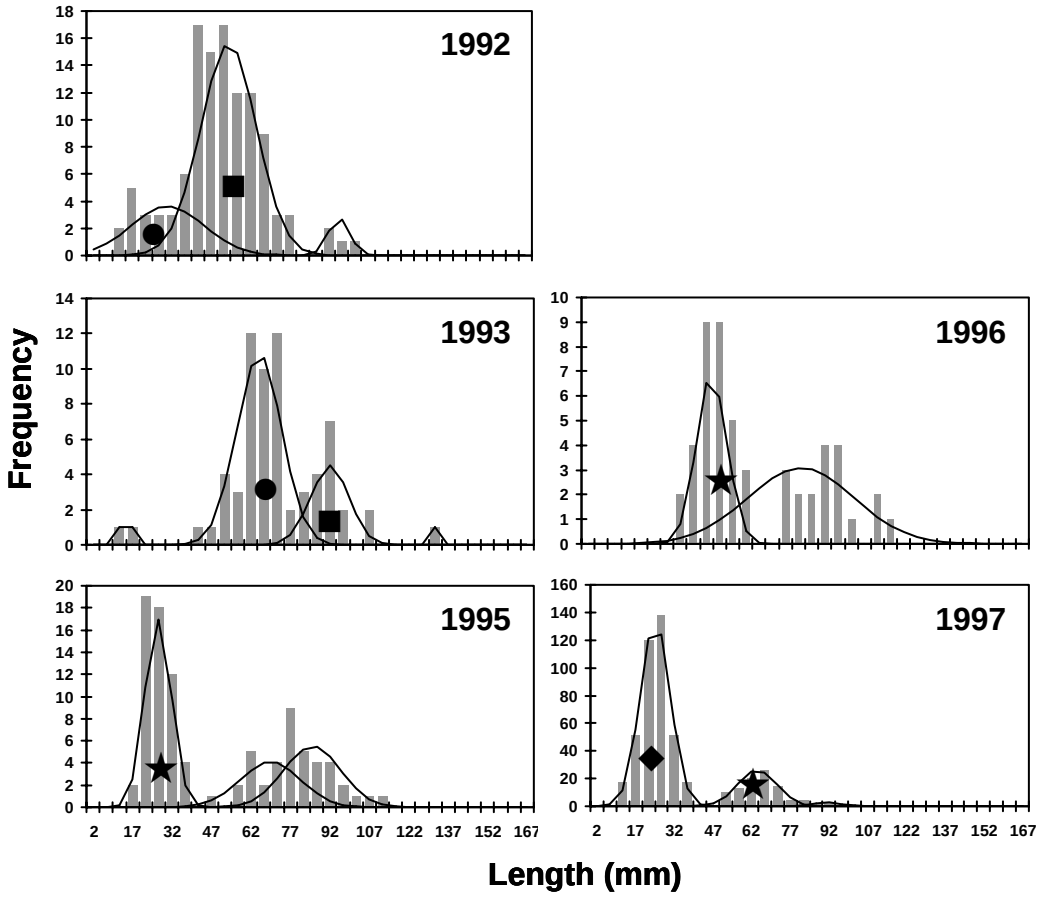

Figure 4. Eastern Bay Wild Ground (EBWG) observed length frequency data (columns) and best maximum likelihood model fit (lines) based on AIC. The second mode in 1996 is an equivocal fit and was not used in the analyses. Modes with the same symbols belong to the same cohort tracked longitudinally.

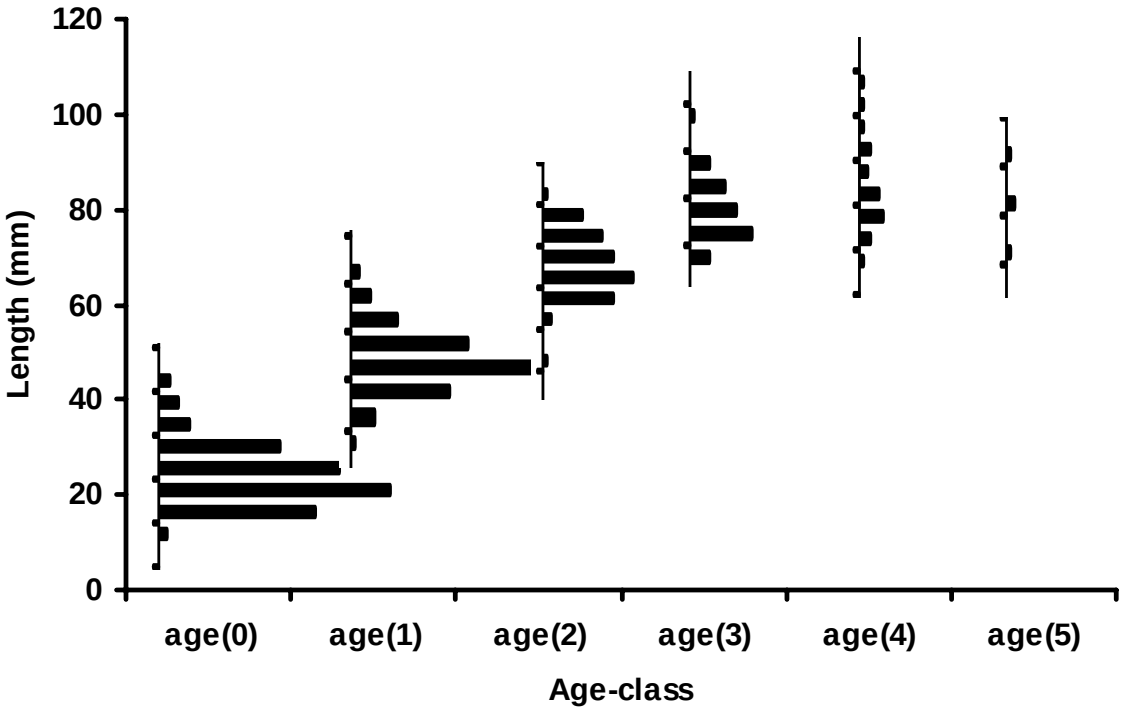

Figure 5. Distribution of cohort mean shell lengths for each age-class calculated from the multimodal length-frequency analysis at 50 sites in Chesapeake Bay from 1990-2001.

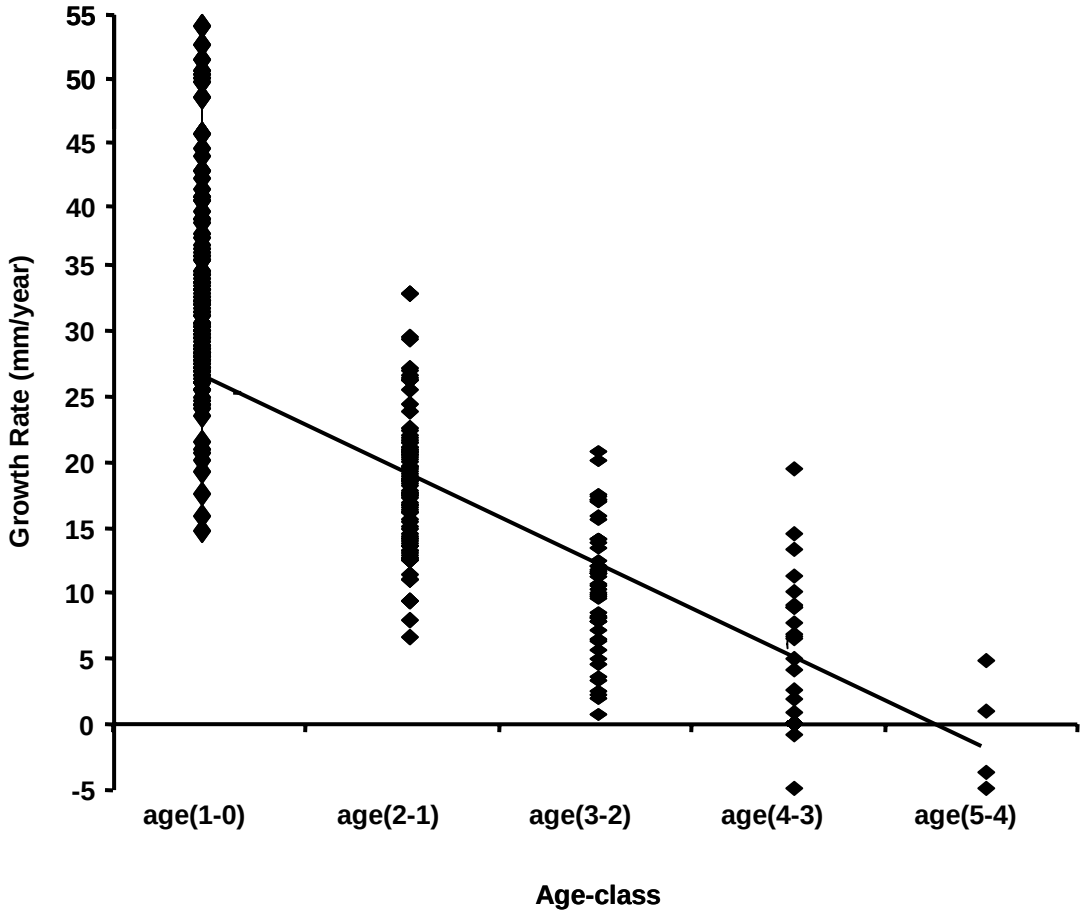

Figure 6. Linear decline in oyster growth rates, by year-of-growth calculated as the changes in size at putative age for each cohort followed longitudinally, across 50 sites from 1990-2001.

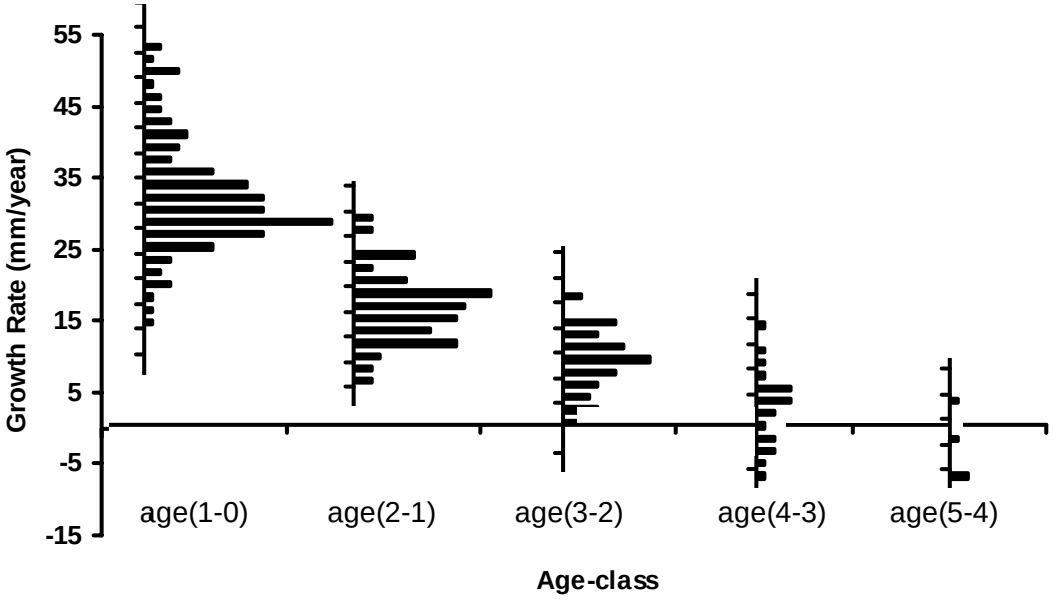

Figure 7. Distribution of cohort mean growth rates calculated from the multimodal length-frequency analysis conducted at 50 sites from 1990-2001.

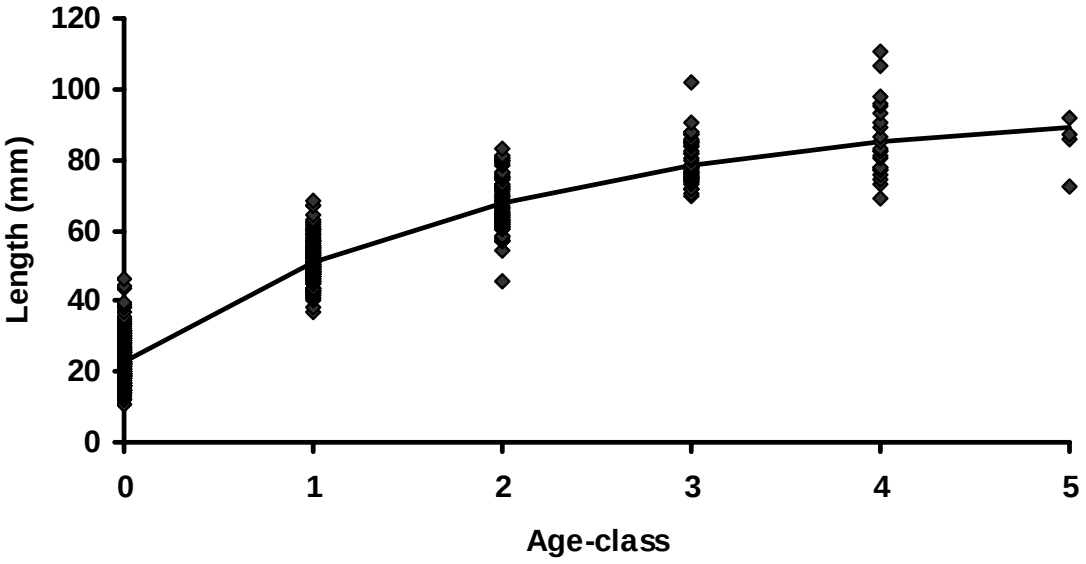

Figure 8. Nonlinear Von Bertalanffy growth model (solid line), fit to observed oyster length aggregated across 50 sites from 1990-2001. Model parameters are L_∞=90.85mm, k=0.55, t_o=-0.51.

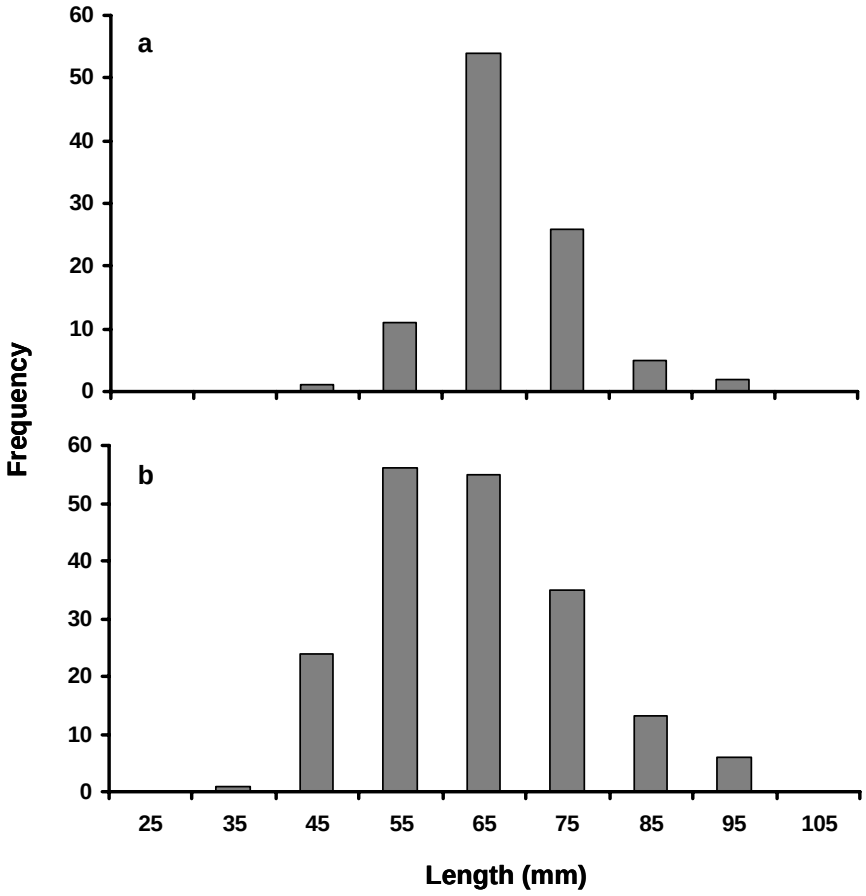

Figure 9. Comparison of size distributions of oysters from a) modal analysis (n=88) with b) known-age oysters (n=190) for age-2. Note a) denotes mean cohort shell length, while b) denotes individual shell length.

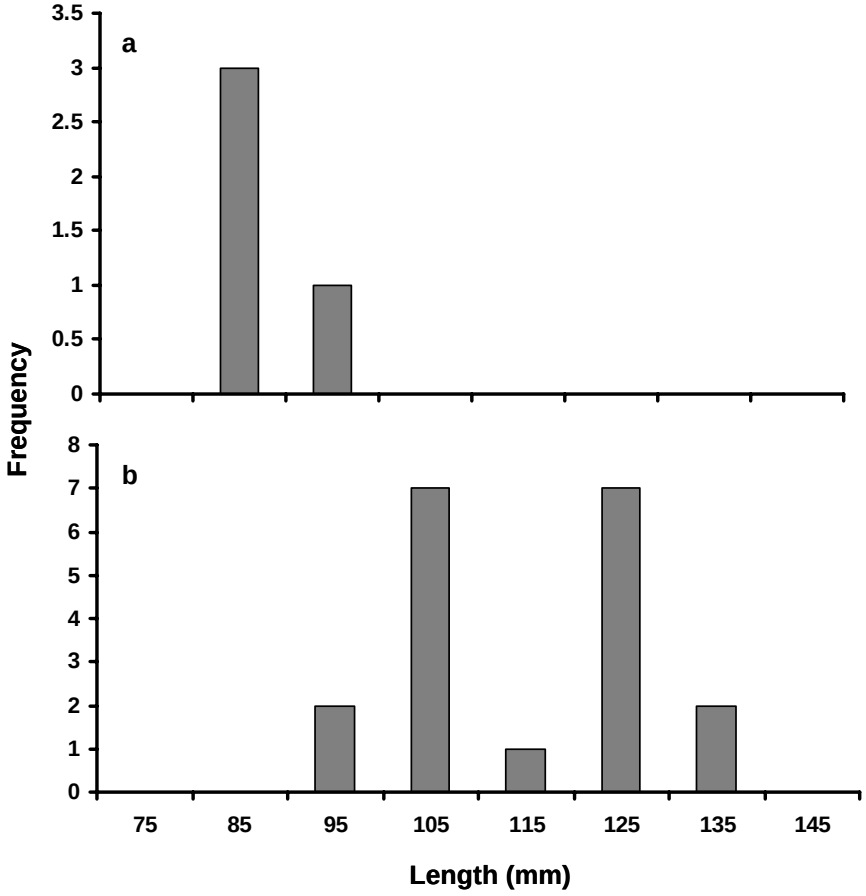

Figure 10. Comparison of size distributions of oysters from a) modal analysis (n=4) with b) known-age oysters (n=19) for age-5. Note a) denotes mean cohort shell length, while b) denotes individual shell length.

CHAPTER TWO:

EVALUATING ANNULI OF CHONDROPHORE SECTIONS AS A BASIS FOR AGE DETERMINATION IN EASTERN OYSTER (*CRASSOSTREA VIRGINICA*)

INTRODUCTION

The Chesapeake Bay has supported substantial populations of eastern oyster *Crassostrea virginica* (Gmelin 1791), but abundances have declined dramatically during the last century as a result of high rates of fishing mortality (Rothschild et al. 1994; Jordan et al. 2002; Jordan and Coakley 2004), habitat degradation (Mackenzie 1983), poor recruitment (Krantz and Meritt 1977), and two salinity-related parasitic diseases, *Haplosporidium nelsoni* (MSX) and *Perkinsus marinus* (Dermo) (Ford and Tripp 1996). The observed low levels of abundance have focused management efforts on the restoration of oyster stocks to sustainable levels. The Chesapeake Bay Program (CBP 2000) commitment to increase native oyster populations ten-fold by the year 2010 has precipitated a need to assess the status of the oyster stocks in Chesapeake Bay. The lack of a recognized method to age oysters has precluded the application of traditional population dynamics models and limited the development of reliable estimates of growth in the field. As a result, the most recent efforts to estimate *in situ* growth have employed modal analysis of samples from a fishery-independent survey (Chapter 2). Were a validated and reliable method available to directly age oysters sampled from the field, it would be possible to confirm the growth rates estimated using modal analysis.

The examination of the microstructures in the chondrophore (hinge) of the oyster may provide known age markers with which to establish a length-at-age relationship. Annuli (latin: rings) have be examined in the microstructure of otoliths and scales of finfish to determine the age of individuals and establish age-at-length relationships (Lai et al. 1996). In some bivalve species, it has been shown that annuli form at an annual rate

(Lutz and Rhoads 1977). Similarly, these shell microstructures have been used to establish the age-at-length relationship for the hard clam, *Mercenaria mercenaria*, in the Chesapeake Bay, the wedge clam, *Rangia cuneata,* in Delaware Bay, and the freshwater mussel, *Elliptio complanata*, in Ontario, Canada (Fritz and Haven 1983; Fritz et al. 1990; Veinott and Cornett 1996 respectively). Annuli have also been observed and described in the chondrophore surface of oyster shells (Lutz and Rhodes 1977; Kent 1988; Carriker 1996). Kent (op. cit.) and Herbert and Steponaitis (1998) have identified and used annuli in the chondrophore of eastern oyster shells to examine the season of harvest. Richardson et al. (1993) have interpreted annuli in European flat oysters, *Ostrea edulis*, to establish the age-at-length relationship and develop growth models. Oyster morphology is highly variable and elaborate techniques are required to age individuals based upon the optical properties of sectioned shells (Kent 1988). Because many environmental stressors can result in differences in shell micro and macro structure (Palmer and Carriker 1979; Seed 1980), any methodology to age individual oysters must be validated. The most rigorous groundtruthing requires comparison of chondrophore- estimated and actual ages of known-age specimens.

Hatchery produced oysters have been planted at a variety of sites throughout the bay. They are single age-classes and may not be comparable to the typically multi-year class oyster bars throughout the bay. Although hatchery planted oysters cannot be aged to the month due to the combination of spawning groups within the hatchery, a limited spawning window of a few weeks.

Here I examine the utility of chrondrophore sections as a basis of ageing eastern oyster in Chesapeake Bay by comparing age estimates derived using this method with the

actual age of known-age specimens. If chrondrophore-based aging proves reliable, the method could be used to validate the results of the modal analysis presented in the previous chapter.

METHODS

Samples of hatchery-reared oysters that had been planted on Bollingbroke Sands, Chest Neck, Spaniard Point, and Weems Upper oyster bars were sampled during June 2003 (Appendix IX). Sampling was conducted by divers using scuba gear. Divers collected 17 - 56 oysters from each of the four sites using 1/9 m^2 quadrat samples. Oyster shells were measured to the nearest mm. Ten oysters were randomly selected from these samples for examination of possible annular structures within the chondrophore. Based on known planting date, Bollingbroke Sands, Chest Neck, and Weems Upper oysters were age-2, while Spaniard Points oyster were age-5.

In the laboratory, oysters were shucked and the shells cleaned. Two cuts were made into the oyster shell using a metallurgical wet saw. The first is a rough cut along the length of the left valve, about ½ inch below the hinge (anterior region) to remove the bulk of the shell. Then multiple thin cross-sections of the hinge (c. 1-3mm thick) were cut along the chondrophore between the bourolettes along the ventral surface of the left valve. Multiple cross-sections were taken because they were brittle and prone to breakage during processing. The "reading side" of the cross-section was sanded on multiple grades of fine sand paper to remove any scratches from the sintered diamond saw blade used. The sections were then polished to a translucent state using alumina powder and a polishing cloth so that annular structures could be resolved by their optical properties under high magnification using reflective light. Annuli are formed by deposits of proteinaceous sheets called conchiolin (Carriker 1996). When the water temperature drops or dissolved oxygen is low, anaerobic processes inhibit the deposition of calcium

and dark protein layers form (Lutz and Rhodes 1977). Chalky irregular patches that as seen in appendix XI are normal parts of some shells, but the cause of these deposits are unknown (Galstoff 1964; Palmer and Carriker 1979). Ignoring these chalky deposits, any dark lines which extended from the tip of the umbo and parallel on either side of the abductor muscle scar were counted as annuli. Transmitted light was tested but did not increase clarification the structures. To enhance the color of the organic bands, the sections were lightly burned under an alcohol lamp, and then mounted in plastic (Crystal Bond) on petrographic slides.

The sections were randomly assigned numbers and read under double-blind conditions. The number of annuli was estimated for each mounted section on three separate occasions using reflected light under high magnification. Digital images of the chondrophore cross-sections are provided with the resulting counts of annular structures in Appendix XI and XII. The hinges were not interpreted using the digital pictures, but were instead interpreted directly from slides.

The known-ages of each sample were only reveled three readings were complete. ANOVA techniques did not detect any differences among estimated ages among sample locations, and thus samples from different locations were pooled based on known age. A one-sample t-test was ($\alpha = 0.05$) was used to examine if the residuals of known and predicted age were significantly different from 0 for age-2 and age-5. I also calculated the average percentage error for each known age class, defined as

$$APE = 100 \cdot \tfrac{1}{N} \sum_{N} \frac{(age_i - age)}{age}$$

where age_i is the estimated age of the i^{th} of N fish aged (Campana 2001). To assess whether chondrophore sections could be used as a basis for ageing, despite possible bias, estimated-age was regressed against known-age, and the regression line was tested against an expectation that the relationship should be 1:1 (intercept=0, slope=1; $\alpha = 0.05$).

RESULTS

The oysters collected from all the sites were measured (Appendix X). The distribution of estimated ages of oysters known to be age two was wide (0-8 years; n=30) and not well-defined (Fig. 1). The distribution was approximately normal (skewness=0.169, kurtosis=0.329). The mode of the distribution of estimated ages for these oysters was 4, and the mean was 3.67 $\pm$ 1.83 (mean $\pm$ SD) (Fig.1). The measurements of central tendency for the distribution differed from 2, the known age. The difference between the true and estimated age of known age-2 oysters were significantly different than 0, based on a one-sample t-test (t=4.055, p-value=0.003). The APE for known age-2 oysters was 83.3%

The distribution of estimated ages for oysters of known age-5 was wide (range of estimated ages 1-10) and not well-defined (Fig. 2). The modes of the distribution of estimated ages of known age-5 oysters were 4 and 7. The mean of the distribution was as 5.40 $\pm$ 2.76. The residuals of the known and predicted age-3 oysters were significantly different than 0, based on a one-sample t-test (t=2.739, p-value=0.0229). The APE for known age-5 oysters was 8%.

Estimated-age was regressed against known-age across all sites (Figure 3). The resulting regression equation was

$$\text{estimated age} = 2.51 + 0.578 * \text{known age}$$

(n=38 F-value=5.19, p-value=0.0285; R^2=0.1201). Although the regression was significant, the slope and intercept of the regression were significantly different and one and zero (df=2,38, F-value=9.78, p-value=0.0004), values expected from the 1:1 line that would indicate a reliable ageing structure.

There was no clear relationship between size and estimated age (Fig. 4). There did not appear to be a relationship between annular structure and known age observed in the age-2 or age-5 oysters (Fig. 4a and b). The data appeared to be almost random in nature. There was large variation in shell macro- and microstructure even within samples of oysters of the age-class (Appendix XI).

DISCUSSION

The identification of an age-marker for oysters, from which an age-length key can be developed, has the potential to reveal growth pattern with important implications to the way in the fishery is managed for sustainability. Knowledge of oyster demographics could be used incorporate spatial differences in growth and survival into the mainstream management of fishing effort.

My comparison of the size distribution of known age oysters with the sizes estimated for these age classes from the modal analysis (Table 1; Chapter 2) suggests the modal analysis may be reliable. For oysters of known age 2, the putative length-at-age inferred from the modal analysis corresponds well with the known length-at age from these four oyster bars. In contrast, the size of known age 5 oysters were larger than that estimated from the modal analysis. This is as expected for two reasons. The known age 5 oysters were sampled from an oyster sanctuary and thus these oysters had not been subjected to the strong size-dependent mortality imposed by a fishery. Based on a von Bertalanffy growth model (Chapter 2), oysters recruit to the fishery at age-3. Thus the age-5 oysters in non sanctuary areas would have experienced two years of exploitation. The low size for L_∞ in the von Bertalanffy model for oysters based on a fishery-independent survey is further indication of the impact of the fishery on the sizes of older oysters. An additional possible reason for the discrepancy between the size of age-5 oysters estimated by a modal analysis (Chapter 2) and sampled from the hatchery planting is that it is believed that hatchery reared oysters are selected for fast growth. Thus, even in the absence of fishery selectivity, one might expect the size of hatchery-

derived age-5 oysters to be greater than naturally produced age-5 oysters. However, a more extensive examination of oysters of known-age with respect to these modal analysis results is needed to further validating these methods.

Based on my initial examination of chondrophore sections of eastern oyster, annuli in chondrophore cross-sections do not appear to be promising structures for future ageing, as chronological and estimated age were not in agreement. This, however, was not as comprehensive an examination as validation of these methods may have warranted. The sample sizes in this examination of a potential known-age marker were quite low and did not cover the spectrum of age-classes available. Larger sample sizes and multiple experienced readers may provide more reliable results for the aging analyses. While these results are not promising, they may be other potential markers within the oyster shell that may warrant some examination. Few studies have focused on developing known-age markers for oysters, despite the importance to understanding the demographics of the population, therefore it does warrant future effort. Despite the rigorous statistical techniques used in the modal analysis, inherent uncertainty will remain if independent verification of oyster age-at-length is not available.

Analysis of isotopic signatures within otolith annuli has been successfully applied to document seasonal growth in teleost fishes (Gao et al. 2001). Differential amounts of the O^{18} isotope are seasonally incorporated into the calcified otolith during cooler water temperatures during annulus formation. Veinott and Cornett (op. cit) applied these techniques to opaque bands in shells of the freshwater mussel, *Elliptio complanata*, in Ontario, Canada to verify annular structures. It has also been applied in the sea scallop,

Placopecten magellanicus (Krantz 1984). Verification of suspected annular structures through isotopic analysis may warrant further exploration.

Richardson (op. cit.) recommends the use of acetate peels of umbo growth lines to interpret annuli, while others suggest heavy metal deposits in the shell as potential known-age markers. Whichever techniques are applied to microstructural analysis in oysters, care must be taken to verify the structures observed are indeed produced annular.

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Table 1. The mean shell length (mm), range in length, and age-class for oysters from four hatchery plantings.

Site	Age Class	Mean length (mm)	Range (mm)
Spaniard Point	Age(5)	114.9	48.4
Bolingbroke Sands	Age(2)	74.9	50.3
Weems Upper	Age(2)	62.7	43.6
Chest Neck	Age(2)	55.9	33.2

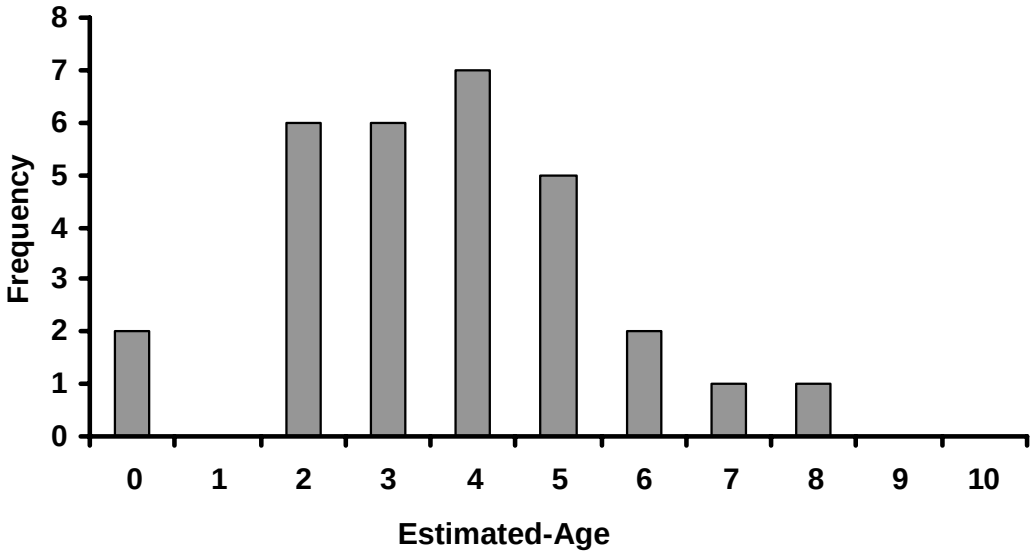

Figure 1. Distribution of estimated ages for known age-2 oysters from Bollingbroke Sands, Weems Upper, and Chest Neck oyster bars.

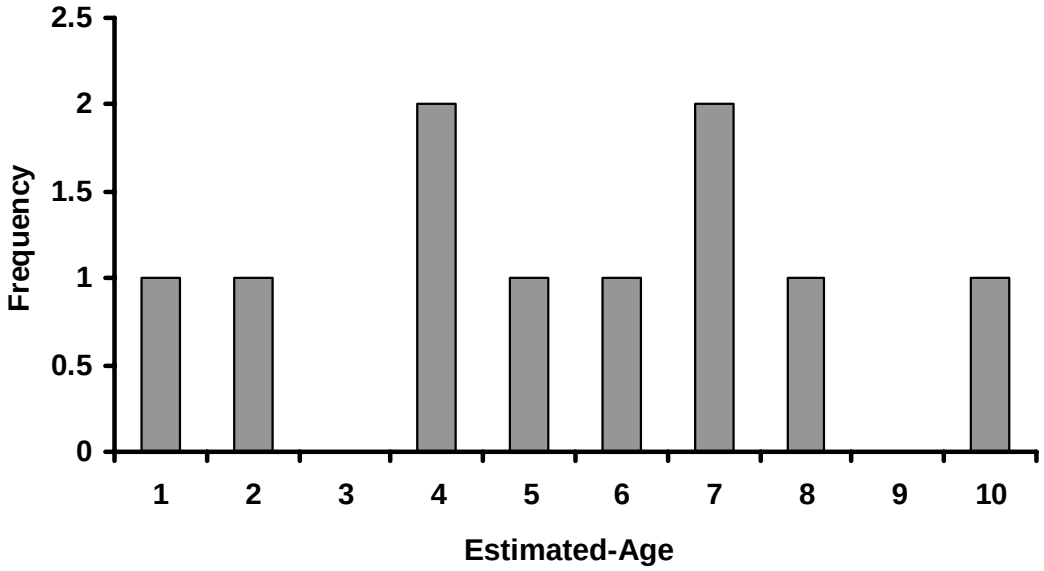

Figure 2. Distribution of estimated ages for known age-5 oysters from Spaniard Point oyster bar.

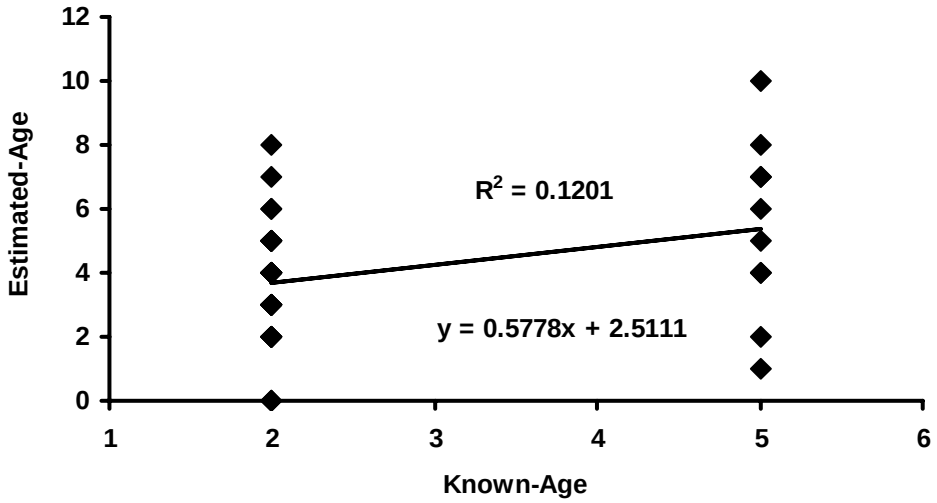

Figure 3. Linear regression of estimated-age on known age pooled across all sites.

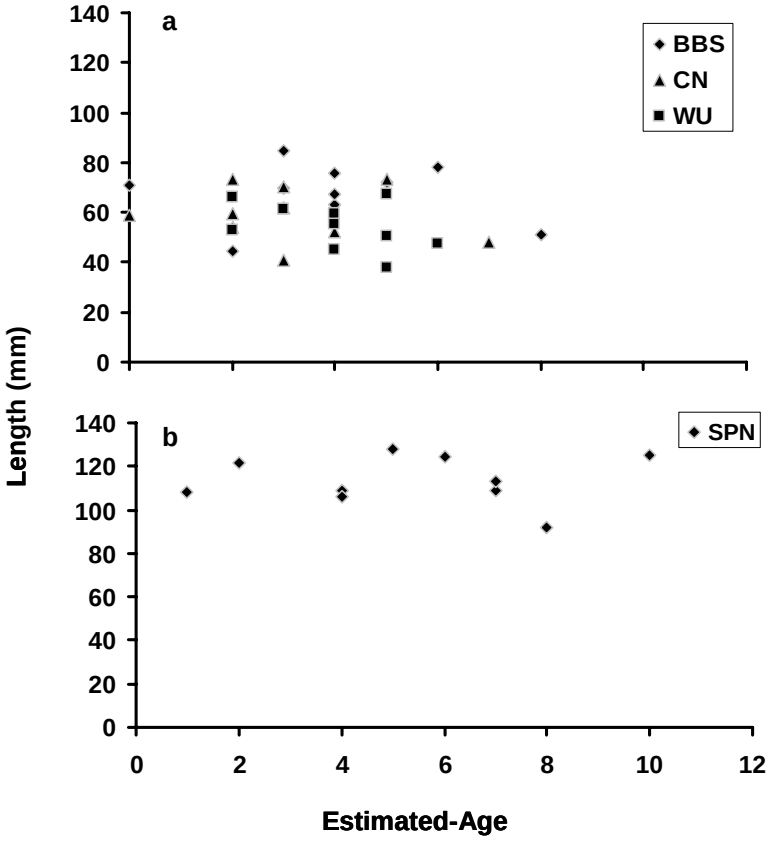

Figure 4. Sizes and estimated ages of a) known age-2 oysters collected from Bollingbroke Sands (BBS), Chest Neck (CN), and Weems Upper (WU), and; b) known age-5 oyster from Spaniards Point.

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CHAPTER 4

THESIS CONCLUSIONS

Obtaining estimates for individual oyster growth remains an important challenge to describing oyster population dynamics in Chesapeake Bay. I applied longitudinal techniques of modal size decomposition analysis to length-frequency data for the *Crassostrea virginica* in Chesapeake Bay. Growth of oysters was inferred as length-at-age across the Maryland portion of Chesapeake Bay, and regional as well as site specific length-at-age relationships were established. The utility of these techniques for examining eastern oyster growth has been demonstrated.

Annuli in the microstructure of the oyster chondrophore (hinge) does not appear to be valid as a known-age marker for determination of the length-at-age relationship. However, the length of known-age oyster from hatchery plantings have been shown to be useful in validating the inferred length-at-age relationship as determined through the length-based modal analysis.

Because of the difficulty of obtaining estimates of vital processes such as growth and recruitment, oyster management has not typically been based on traditional fishery population dynamics models. It has also not been managed spatially to control the spatially distributed fishing mortality rates on aggregations of oysters, and habitat degradation issues that occur from the mechanical action of harvesting. Improved information on the population dynamics of eastern oysters is critical to developing management strategies and evaluating their success.

Appendix I. Coordinates and location of 64 oyster bars surveyed by the Maryland Department of Natural Resources annual fall oyster dredge survey. The four letter site name is based on the oyster bar name and region of the bay or river system in which it is located. Latitude and longitude are in degrees and minutes.

Site	Region	Bar Name	Latitude	Longitude
BCDN	Broad Creek	Deep Neck	384417	761433
BNMP	Bay North	Mountain Point	390509	762502
BNSP	Bay North	Swan Point	390827	761810
CHBR	Chester River	Buoy Rock	385938	761242
CHOF	Chester River	Old Field	390448	760952
CRCP	Choptank River	Cooks Point	383909	761725
CRLI	Choptank River	Lighthouse	383927	761122
CROS	Choptank River	Oyster Shell Point	383518	760001
CRRO	Choptank River	Royston	384115	761430
CRSH	Choptank River	Sandy Hill	383539	760700
CRTW	Choptank River	Tilghman Wharf	384247	761915
EBBU	Eastern Bay	Bugby	385255	761320
EBHN	Eastern Bay	Hollicutts Noose	385114	762106
EBPI	Eastern Bay	Parsons Island	385420	761602
EBWG	Eastern Bay	Wild Ground	385339	761900
FBCI	Fishing Bay	Clay Island	381422	755902
FBGC	Fishing Bay	Goose Creek	381702	760130
HCEP	Harris Creek	Eagle Point	384345	761824
HOHO	Holland Straits	Holland Straits	380644	760430
HRNO	Honga River	Normans	381519	760815
HRWI	Honga River	Windmill	381659	760932
LCCA	Little Choptank River	Cason	383159	761421
LCRP	Little Choptank River	Ragged Point	383218	761750
MADP	Manokin River	Drum Point	380705	755215
MAGE	Manokin River	Georges Bar	380727	755124
MESR	Middle East Shore	Stone Rock	383920	762259
MRAS	Miles River	Ashcraft	384741	761241
MRBI	Miles River	Bruffs Island	385129	761135
MRLP	Miles River	Long Point	384613	761032
MRTU	Miles River	Turtle Back	385119	761421
NRMG	Nanticoke River	Middle Ground	381345	755519
NRWE	Nanticoke River	Wetipiquin	381959	755315
NRWS	Nanticoke River	Wilson Shoal	381735	755518
POSH	Poplar Island	Shell Hill	384523	762119
PRBS	Potomac River	Blue Sow	381404	764215
PRBW	Potomac River	Black Walnut	381454	764105
PRCH	Potomac River	Cornfield Harbor	380253	762001
PRDC	Potomac River	Dukehart Channel	381315	764451
PRLC	Potomac River	Lower Cedar Point	381959	765850

Appendix I. Continued.

Site	Region	Bar Name	Latitude	Longitude
PRRP	Potomac River	Ragged Point	380922	763633
PSGU	Pocomoke Sound	Gunby	375706	754626
PSMA	Pocomoke Sound	Marumsco	375733	754409
PXBA	Patuxent River	Back Of Island	381914	762739
PXBI	Patuxent River	Broomes Island	382428	763351
SMCC	St. Marys River	Chickencock	380723	762613
SMPA	St. Marys River	Pagan	381130	762635
TADM	Tred Avon River	Double Mills	384347	760825
TSBC	Tangier Sound	Back Cove	380225	755939
TSGR	Tangier Sound	Great Rock	375706	755505
TSOW	Tangier Sound	Old Womans Leg	375747	755823
TSPI	Tangier Sound	Piney Island	380409	755734
TSSS	Tangier Sound	Sharkfin Shoal	381256	755929
TSTE	Tangier Sound	Turtle Egg Island	380654	755928
UBBH	Upper Bay	Brick House	385620	762308
UBHA	Upper Bay	Hacketts	385859	762500
UBTS	Upper Bay	Three Sisters	385138	762750
WRES	Wicomico River	Evans Shoal	381231	755341
WRMV	Wicomico River	Mt. Vernon Wharf	381515	754820
WSBU	Western Shore	Butler	380632	761937
WSFP	Western Shore	Flag Pond	382606	762609
WSHI	Western Shore	Hog Island	381854	762301
WSHP	Western Shore	Holland Point	384407	763008
WWLA	Wicomico River	Lancaster	381635	764945
WWMW	Wicomico River	Mills West	382009	765129

Appendix II. Length-frequency data from 64 Sites within the Maryland portion of the Chesapeake Bay, collected by the Maryland Department of Natural Resources annual fall oyster dredge survey. (NOTE: nd denotes that no data were collected)

Bay North Mountain Point (BNMP): Data from 1990 and 1991 were not used in subsequent analyses because an Age-0 cohort was not identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
BNMP	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
BNMP	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
BNMP	**12**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
BNMP	**17**	0	0	0	1	0	0	0	0	nd	nd	nd	nd
BNMP	**22**	0	0	5	1	0	0	0	0	nd	nd	nd	nd
BNMP	**27**	0	0	3	1	0	0	0	1	nd	nd	nd	nd
BNMP	**32**	0	0	20	1	0	0	0	0	nd	nd	nd	nd
BNMP	**37**	0	0	70	2	0	0	0	0	nd	nd	nd	nd
BNMP	**42**	0	0	135	1	0	0	0	0	nd	nd	nd	nd
BNMP	**47**	0	0	156	6	1	0	0	0	nd	nd	nd	nd
BNMP	**52**	0	0	103	24	3	3	0	0	nd	nd	nd	nd
BNMP	**57**	0	0	54	51	6	1	1	0	nd	nd	nd	nd
BNMP	**62**	0	0	17	65	25	4	6	0	nd	nd	nd	nd
BNMP	**67**	0	0	7	36	31	5	10	2	nd	nd	nd	nd
BNMP	**72**	4	0	1	31	64	28	19	0	nd	nd	nd	nd
BNMP	**77**	8	1	2	13	45	24	15	10	nd	nd	nd	nd
BNMP	**82**	16	0	3	1	33	26	13	9	nd	nd	nd	nd
BNMP	**87**	15	6	1	4	21	16	9	6	nd	nd	nd	nd
BNMP	**92**	8	11	1	2	11	4	8	9	nd	nd	nd	nd
BNMP	**97**	8	7	4	1	1	5	6	6	nd	nd	nd	nd
BNMP	**102**	2	7	2	2	1	1	6	1	nd	nd	nd	nd
BNMP	**107**	1	5	5	0	0	1	1	3	nd	nd	nd	nd
BNMP	**112**	1	2	4	1	0	0	0	0	nd	nd	nd	nd
BNMP	**117**	1	2	1	2	0	0	1	0	nd	nd	nd	nd
BNMP	**122**	0	1	2	0	0	0	0	0	nd	nd	nd	nd
BNMP	**127**	0	1	1	0	0	0	0	0	nd	nd	nd	nd
BNMP	**132**	0	0	1	0	0	0	0	0	nd	nd	nd	nd
BNMP	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
BNMP	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
BNMP	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
BNMP	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
BNMP	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
BNMP	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
BNMP	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Broad Creek Deep Neck (BCDN). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1992 were not used because the length-frequency distributions were difficult to interpret, and data from 2001 were not used because the Solver would not converge on a solution. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
BCDN	**2**	0	0	0	2	0	0	0	0	0	7	0	0
BCDN	**7**	0	0	1	10	0	0	0	0	0	26	0	1
BCDN	**12**	0	0	3	39	0	0	0	53	0	45	0	0
BCDN	**17**	0	0	9	24	0	9	1	175	0	66	0	0
BCDN	**22**	0	0	14	17	8	47	1	315	1	43	1	4
BCDN	**27**	0	0	10	2	6	72	2	140	1	19	3	3
BCDN	**32**	1	1	13	1	35	114	1	70	12	5	4	2
BCDN	**37**	0	10	9	2	63	53	5	37	26	1	3	3
BCDN	**42**	3	9	22	7	74	3	34	3	56	6	21	2
BCDN	**47**	3	12	16	12	41	17	41	6	49	6	16	5
BCDN	**52**	4	21	12	9	35	36	67	22	38	23	12	21
BCDN	**57**	2	8	16	13	14	57	39	31	10	55	18	8
BCDN	**62**	1	5	4	6	14	82	44	57	10	73	16	20
BCDN	**67**	2	4	5	9	11	48	32	33	6	40	27	17
BCDN	**72**	2	1	5	9	9	48	41	62	15	33	40	21
BCDN	**77**	1	0	6	3	9	13	44	40	15	12	36	18
BCDN	**82**	1	0	2	4	5	15	23	50	12	20	34	12
BCDN	**87**	3	1	0	1	7	8	17	15	12	9	6	3
BCDN	**92**	0	1	0	1	5	5	12	12	7	5	11	2
BCDN	**97**	0	0	0	0	0	0	5	1	0	2	7	2
BCDN	**102**	0	1	0	0	0	1	1	4	3	5	3	3
BCDN	**107**	0	0	0	0	0	1	1	2	0	4	4	0
BCDN	**112**	0	0	0	0	0	2	0	0	0	0	0	1
BCDN	**117**	0	0	0	0	0	1	0	0	0	0	0	1
BCDN	**122**	0	0	0	0	0	0	0	0	0	0	0	0
BCDN	**127**	0	0	0	0	0	0	0	0	0	0	0	0
BCDN	**132**	0	0	0	0	0	0	0	0	0	0	0	0
BCDN	**137**	0	0	0	0	0	0	0	0	0	0	0	0
BCDN	**142**	0	0	0	0	0	0	0	0	0	0	0	0
BCDN	**147**	0	0	0	0	0	0	0	0	0	0	0	0
BCDN	**152**	0	0	0	0	0	0	0	0	0	0	0	0
BCDN	**157**	0	0	0	0	0	0	0	0	0	0	0	0
BCDN	**162**	0	0	0	0	0	0	0	0	0	0	0	0
BCDN	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Bay North Swan Point (BNSP). No data were used in subsequent analyses because the site was repleted in 1990, 1991, 1992, 1994, 1995, 1996, 1997, and 1998. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
BNSP	**2**	0	0	0	0	0	0	0	0	0	0	0	0
BNSP	**7**	0	0	0	0	0	0	0	0	0	0	0	0
BNSP	**12**	0	0	0	0	0	0	0	0	0	0	0	0
BNSP	**17**	0	0	0	0	0	0	0	0	0	0	0	0
BNSP	**22**	0	0	2	0	0	0	0	0	0	0	0	0
BNSP	**27**	0	0	0	0	0	0	0	0	0	0	0	0
BNSP	**32**	0	0	13	2	0	0	0	0	1	1	0	0
BNSP	**37**	0	0	22	3	0	0	0	0	10	0	0	0
BNSP	**42**	0	0	50	0	0	0	0	0	15	0	0	0
BNSP	**47**	0	0	72	3	0	0	0	0	23	1	0	0
BNSP	**52**	0	0	52	5	0	0	0	0	27	7	0	0
BNSP	**57**	0	0	35	14	0	0	0	0	11	15	1	0
BNSP	**62**	0	0	21	16	1	0	0	0	9	22	0	0
BNSP	**67**	2	0	8	26	6	2	0	0	4	25	1	2
BNSP	**72**	3	5	4	30	22	2	1	0	1	32	0	5
BNSP	**77**	5	5	0	10	18	4	1	0	5	22	2	4
BNSP	**82**	6	11	4	6	26	14	5	1	5	10	4	13
BNSP	**87**	7	10	4	6	20	10	4	2	6	4	3	11
BNSP	**92**	7	8	7	1	5	15	9	1	4	9	3	7
BNSP	**97**	7	3	7	1	1	9	9	3	0	9	6	12
BNSP	**102**	6	4	11	2	2	2	7	6	3	6	2	10
BNSP	**107**	5	2	9	1	2	1	3	6	1	4	2	2
BNSP	**112**	2	3	6	4	0	3	6	4	2	2	5	3
BNSP	**117**	1	1	4	5	1	3	1	0	2	3	5	0
BNSP	**122**	2	1	3	2	0	0	2	0	2	0	2	3
BNSP	**127**	1	0	0	1	0	0	0	1	0	0	1	0
BNSP	**132**	0	1	1	0	0	0	0	0	1	0	1	0
BNSP	**137**	0	0	1	0	0	0	1	0	0	0	0	0
BNSP	**142**	0	0	1	0	0	0	0	0	0	0	0	0
BNSP	**147**	0	0	0	0	0	0	0	0	0	0	0	0
BNSP	**152**	0	0	0	0	0	0	0	0	2	0	0	0
BNSP	**157**	0	0	0	0	0	0	0	0	0	0	0	0
BNSP	**162**	0	0	0	0	0	0	0	0	0	0	0	0
BNSP	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Chester River Buoy Rock (CHBR). Data from 1990 to 1996 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CHBR	**2**	0	0	0	0	0	0	0	0	0	0	0	0
CHBR	**7**	0	0	0	0	0	0	0	0	0	0	0	0
CHBR	**12**	0	0	0	0	0	0	0	0	0	0	0	0
CHBR	**17**	0	0	0	0	0	0	0	0	0	0	0	0
CHBR	**22**	0	0	0	0	0	0	0	1	0	0	0	1
CHBR	**27**	0	0	0	0	0	0	0	2	0	0	0	1
CHBR	**32**	0	0	0	0	0	0	0	2	0	0	0	0
CHBR	**37**	0	1	0	0	0	0	0	3	4	0	0	0
CHBR	**42**	0	1	0	0	0	0	1	0	5	1	0	0
CHBR	**47**	0	2	0	0	0	0	1	0	16	0	1	1
CHBR	**52**	0	9	0	0	0	0	2	1	23	2	3	2
CHBR	**57**	0	15	0	0	0	0	0	1	20	3	0	2
CHBR	**62**	2	20	0	0	0	0	0	3	23	5	6	9
CHBR	**67**	3	16	0	0	0	0	0	5	21	14	12	9
CHBR	**72**	3	11	2	0	0	0	0	3	16	14	19	15
CHBR	**77**	11	8	4	0	2	2	0	6	16	22	17	12
CHBR	**82**	11	22	3	0	3	3	1	0	9	24	23	14
CHBR	**87**	13	10	6	2	0	1	0	2	6	10	25	13
CHBR	**92**	18	18	11	1	3	2	0	3	6	12	18	7
CHBR	**97**	8	13	7	5	4	0	4	1	2	13	10	2
CHBR	**102**	10	13	7	0	2	1	3	2	6	5	3	3
CHBR	**107**	10	10	10	4	8	1	0	3	0	3	3	0
CHBR	**112**	4	8	6	4	5	3	2	1	0	2	1	0
CHBR	**117**	3	5	3	4	4	1	3	2	0	3	0	1
CHBR	**122**	3	3	7	1	1	3	1	3	1	1	2	0
CHBR	**127**	3	3	2	0	6	0	1	1	1	2	0	0
CHBR	**132**	1	0	2	3	0	0	0	1	0	0	0	0
CHBR	**137**	1	0	0	0	0	0	0	1	1	0	0	0
CHBR	**142**	1	0	2	0	0	0	0	0	0	2	0	0
CHBR	**147**	0	0	1	0	0	0	0	0	0	0	0	0
CHBR	**152**	0	0	0	1	1	0	0	1	0	0	0	0
CHBR	**157**	0	0	0	0	0	0	0	0	0	0	0	0
CHBR	**162**	0	0	0	0	0	0	0	0	0	0	0	0
CHBR	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Chester River Old Field (CHOF). No data were used in subsequent analyses because the site was repleted in 1990, 1991, 1992, 1993, 1995, 1997, 1998, and 2000. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CHOF	2	0	0	0	0	0	0	0	0	0	0	0	0
CHOF	7	0	0	0	0	0	0	0	0	0	0	0	0
CHOF	12	0	0	0	0	0	0	0	1	0	0	0	0
CHOF	17	0	0	0	0	0	0	0	0	0	0	0	0
CHOF	22	0	0	0	0	0	0	0	1	0	0	0	0
CHOF	27	0	0	0	1	0	0	0	0	0	0	0	0
CHOF	32	0	1	0	0	0	0	0	1	0	0	1	0
CHOF	37	0	2	3	0	0	1	0	10	0	0	6	0
CHOF	42	0	5	8	0	0	2	1	24	3	1	6	0
CHOF	47	0	10	14	1	1	5	2	31	3	0	6	0
CHOF	52	5	25	12	4	4	7	5	43	6	2	8	1
CHOF	57	3	22	15	9	4	11	19	39	15	2	10	0
CHOF	62	10	20	9	11	16	17	19	29	27	19	16	3
CHOF	67	7	18	6	20	16	15	33	9	26	22	20	6
CHOF	72	9	16	8	24	26	27	36	17	27	40	32	12
CHOF	77	9	9	9	20	18	11	17	17	22	45	31	10
CHOF	82	14	13	7	28	16	19	18	20	14	37	27	14
CHOF	87	17	12	12	13	14	12	7	13	6	17	22	9
CHOF	92	15	7	7	9	11	17	9	19	6	11	11	13
CHOF	97	9	8	7	4	8	3	1	7	3	5	5	5
CHOF	102	5	3	3	3	2	5	2	4	5	9	0	5
CHOF	107	3	3	2	0	2	2	1	2	4	6	3	1
CHOF	112	1	7	8	1	0	1	1	1	2	2	0	4
CHOF	117	1	2	9	0	0	0	2	3	1	2	0	5
CHOF	122	2	1	1	0	0	0	0	0	2	0	1	2
CHOF	127	1	2	2	0	0	0	0	0	0	0	0	2
CHOF	132	1	0	2	0	0	0	0	0	0	0	1	0
CHOF	137	0	0	1	0	0	0	0	0	0	0	0	0
CHOF	142	1	0	0	0	0	0	0	0	0	0	1	0
CHOF	147	0	1	1	0	0	0	0	0	0	0	0	0
CHOF	152	0	0	0	0	0	0	0	0	0	0	0	0
CHOF	157	0	0	0	0	0	0	0	0	0	0	0	0
CHOF	162	0	0	0	0	0	0	0	0	0	0	0	0
CHOF	167	0	0	0	0	0	0	0	0	0	0	0	0

Choptank River Cooks Point (CRCP). No data were used in subsequent analyses because the site was repleted in 1990, there were too few oysters to clearly distinguish cohorts from 1990 to 1994, 1996, 1997, and a Age-0 cohort could not be identified in 1990 and 2000. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CRCP	**2**	0	0	0	0	0	0	0	0	0	0	0	0
CRCP	**7**	0	0	0	0	0	0	0	0	0	0	0	0
CRCP	**12**	0	0	0	0	0	0	0	0	0	1	0	0
CRCP	**17**	0	0	0	0	0	0	0	0	0	0	1	1
CRCP	**22**	0	0	0	0	0	2	0	0	0	0	1	1
CRCP	**27**	0	1	2	0	1	5	0	0	0	0	1	1
CRCP	**32**	0	0	0	0	1	3	0	0	0	0	2	3
CRCP	**37**	0	1	0	0	0	4	0	0	0	0	2	1
CRCP	**42**	1	1	1	0	0	1	0	0	0	0	2	1
CRCP	**47**	0	4	1	0	0	0	0	0	2	0	5	3
CRCP	**52**	1	6	1	0	1	0	0	0	4	1	3	1
CRCP	**57**	0	1	0	0	1	0	0	0	6	4	1	3
CRCP	**62**	1	1	1	0	1	1	0	0	6	2	3	4
CRCP	**67**	1	4	1	0	0	1	0	0	3	2	1	3
CRCP	**72**	5	1	2	0	0	1	0	0	0	7	1	1
CRCP	**77**	2	3	1	0	0	2	1	1	1	3	0	2
CRCP	**82**	3	3	1	0	0	0	0	1	6	8	0	0
CRCP	**87**	3	2	1	0	0	0	0	2	2	4	0	0
CRCP	**92**	0	5	0	0	0	0	1	0	8	5	0	0
CRCP	**97**	0	1	1	0	0	1	0	0	1	5	0	0
CRCP	**102**	0	4	0	0	0	0	1	2	2	0	0	0
CRCP	**107**	0	4	0	0	0	0	0	0	0	1	0	0
CRCP	**112**	0	0	0	0	0	0	0	0	0	0	0	0
CRCP	**117**	0	0	0	0	0	0	0	0	1	2	0	0
CRCP	**122**	0	0	0	0	0	0	0	0	1	1	0	0
CRCP	**127**	0	0	0	0	0	0	0	0	0	1	0	0
CRCP	**132**	0	0	0	0	0	0	0	0	0	1	0	0
CRCP	**137**	0	0	0	0	0	0	0	0	0	0	0	0
CRCP	**142**	0	0	0	0	0	0	0	0	0	0	0	0
CRCP	**147**	0	0	0	0	0	0	0	0	0	0	0	0
CRCP	**152**	0	0	0	0	0	0	0	0	0	0	0	0
CRCP	**157**	0	0	0	0	0	0	0	0	0	0	0	0
CRCP	**162**	0	0	0	0	0	0	0	0	0	0	0	0
CRCP	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Choptank River Lighthouse (CRLI). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 2000 and 2001 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CRLI	**2**	0	0	0	0	0	0	0	0	1	0	0	0
CRLI	**7**	0	0	2	0	0	0	0	0	0	0	0	0
CRLI	**12**	0	0	3	0	0	0	0	16	0	0	0	0
CRLI	**17**	0	0	6	0	0	1	0	16	2	1	0	0
CRLI	**22**	0	0	4	0	0	1	0	109	2	0	1	0
CRLI	**27**	0	0	8	0	0	1	1	62	0	0	0	0
CRLI	**32**	0	1	4	0	0	2	0	47	0	0	1	0
CRLI	**37**	0	2	8	0	0	1	0	32	0	0	0	0
CRLI	**42**	0	4	11	1	1	0	2	1	5	0	0	0
CRLI	**47**	1	9	18	5	3	1	3	0	21	1	2	1
CRLI	**52**	1	6	7	5	1	0	5	0	32	4	1	1
CRLI	**57**	0	7	5	5	4	2	4	1	28	5	2	1
CRLI	**62**	0	6	2	1	3	10	4	4	22	14	2	2
CRLI	**67**	2	4	2	4	2	8	3	4	10	20	2	3
CRLI	**72**	5	0	1	2	4	4	5	6	9	42	11	3
CRLI	**77**	6	0	0	0	5	8	5	4	4	24	8	3
CRLI	**82**	5	2	0	2	3	9	6	5	4	26	23	3
CRLI	**87**	7	2	1	0	2	6	5	1	4	5	16	8
CRLI	**92**	9	7	6	0	1	2	5	7	10	10	15	16
CRLI	**97**	9	0	2	0	1	3	5	2	5	2	13	6
CRLI	**102**	7	4	3	0	3	0	5	0	1	4	5	5
CRLI	**107**	2	5	1	0	1	3	2	1	1	2	6	7
CRLI	**112**	1	0	1	0	1	0	0	1	1	4	5	2
CRLI	**117**	1	0	0	0	0	0	0	3	5	0	6	1
CRLI	**122**	1	1	0	0	0	0	1	0	2	0	0	2
CRLI	**127**	0	0	0	0	0	0	2	0	0	0	0	0
CRLI	**132**	0	2	0	0	0	0	0	0	1	0	0	0
CRLI	**137**	1	0	0	0	0	0	0	0	0	0	0	0
CRLI	**142**	0	0	0	0	0	0	0	0	0	0	1	0
CRLI	**147**	0	0	0	0	0	0	0	0	0	0	0	0
CRLI	**152**	0	0	0	0	0	0	0	0	1	0	0	0
CRLI	**157**	0	0	0	0	0	0	0	0	0	0	0	0
CRLI	**162**	0	0	0	0	0	0	0	0	0	0	0	0
CRLI	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Choptank River Oyster Shell Point (CROS). Data from 1990 and 1991 were not used in subsequent analyses because an Age-0 cohort could not be identified, and data from 1995 to 1999 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CROS	**2**	0	0	0	0	0	0	0	0	0	0	0	0
CROS	**7**	0	0	1	0	0	0	0	0	0	0	0	0
CROS	**12**	0	0	6	0	0	0	0	0	0	0	0	0
CROS	**17**	0	0	4	0	0	0	0	2	0	0	0	1
CROS	**22**	0	0	4	0	0	0	0	1	0	0	0	0
CROS	**27**	0	2	2	0	0	0	0	0	0	0	1	0
CROS	**32**	0	2	16	1	1	0	0	1	1	0	2	0
CROS	**37**	0	11	16	3	2	1	2	0	0	0	2	0
CROS	**42**	2	19	30	16	2	0	0	0	5	0	2	0
CROS	**47**	3	34	33	8	5	0	0	2	4	0	2	1
CROS	**52**	13	27	23	15	6	1	1	3	3	3	0	3
CROS	**57**	12	20	27	16	20	7	0	2	2	2	0	2
CROS	**62**	23	30	17	29	16	8	3	5	5	6	1	1
CROS	**67**	27	28	22	20	24	12	4	5	2	8	1	4
CROS	**72**	42	25	26	21	49	16	15	11	2	14	11	4
CROS	**77**	38	47	26	12	17	15	17	6	2	10	9	13
CROS	**82**	26	40	16	20	26	21	14	12	7	12	11	9
CROS	**87**	15	15	14	4	13	8	6	5	6	10	4	7
CROS	**92**	8	11	5	8	12	5	10	6	6	13	11	8
CROS	**97**	2	1	5	1	4	0	8	7	4	6	3	5
CROS	**102**	2	4	2	2	1	1	2	0	3	8	3	5
CROS	**107**	1	1	3	0	1	0	0	1	0	4	4	0
CROS	**112**	1	0	1	0	0	0	0	1	2	3	2	3
CROS	**117**	1	0	0	0	0	0	0	1	0	3	1	1
CROS	**122**	0	0	0	0	0	0	0	0	0	3	0	0
CROS	**127**	0	0	0	0	0	0	0	0	0	1	0	0
CROS	**132**	0	0	0	0	0	0	0	0	0	0	0	0
CROS	**137**	0	0	0	0	0	0	0	0	0	0	0	0
CROS	**142**	0	0	0	0	0	0	0	0	0	0	0	0
CROS	**147**	0	0	0	0	0	0	0	0	0	0	0	0
CROS	**152**	0	0	0	0	0	0	0	0	0	0	0	0
CROS	**157**	0	0	0	0	0	0	0	0	0	0	0	0
CROS	**162**	0	0	0	0	0	0	0	0	0	0	0	0
CROS	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Choptank River Royston (CRRO). Data from 1990 to 1995 were not used in subsequent analyses because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CRRO	**2**	0	0	0	0	0	0	0	0	0	0	0	0
CRRO	**7**	0	0	2	0	0	0	0	0	0	5	0	0
CRRO	**12**	0	0	1	7	0	0	0	0	0	8	0	0
CRRO	**17**	0	0	10	1	0	2	0	26	0	12	0	0
CRRO	**22**	0	0	10	2	0	2	0	39	1	8	0	0
CRRO	**27**	0	0	15	1	0	2	0	92	0	3	0	0
CRRO	**32**	1	0	32	3	0	1	0	79	2	1	0	3
CRRO	**37**	0	7	32	2	1	3	1	53	8	0	2	0
CRRO	**42**	1	18	35	9	3	0	2	0	25	0	4	0
CRRO	**47**	0	21	15	10	3	0	4	0	34	0	7	1
CRRO	**52**	3	16	15	9	10	3	8	3	47	4	9	9
CRRO	**57**	0	10	5	4	6	6	2	1	26	15	5	4
CRRO	**62**	4	7	5	9	16	8	7	4	17	22	6	7
CRRO	**67**	3	8	2	2	9	8	9	6	5	19	6	4
CRRO	**72**	14	4	4	3	14	3	5	9	13	20	18	9
CRRO	**77**	13	5	4	4	5	13	8	10	14	14	18	9
CRRO	**82**	12	10	1	2	6	10	14	12	15	10	10	10
CRRO	**87**	5	2	2	0	2	8	6	8	3	3	12	11
CRRO	**92**	13	12	2	3	2	3	8	14	4	4	6	7
CRRO	**97**	4	4	3	1	1	3	6	6	6	4	4	2
CRRO	**102**	2	4	0	0	0	0	5	10	5	8	7	1
CRRO	**107**	1	0	1	0	0	1	0	5	3	3	5	0
CRRO	**112**	1	0	0	0	0	1	1	2	3	5	2	1
CRRO	**117**	1	0	0	0	0	0	0	0	3	1	2	0
CRRO	**122**	1	0	0	0	0	0	0	0	0	1	1	0
CRRO	**127**	1	0	0	0	0	0	1	0	0	1	0	0
CRRO	**132**	0	0	0	0	0	0	0	0	0	0	0	0
CRRO	**137**	0	0	0	0	0	0	0	0	0	0	1	0
CRRO	**142**	0	0	0	0	0	0	0	0	0	0	0	0
CRRO	**147**	0	0	0	0	0	0	0	0	0	0	0	0
CRRO	**152**	0	0	0	0	0	0	0	0	0	0	0	0
CRRO	**157**	0	0	0	0	0	0	0	0	0	0	0	0
CRRO	**162**	0	0	0	0	0	0	0	0	0	0	0	0
CRRO	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Choptank River Sandy Hill (CRSH). Data from 1990 and 1991 were not used in subsequent analyses because the site was repleted, and data from 1996 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CRSH	**2**	0	0	0	0	0	0	0	0	0	0	0	0
CRSH	**7**	0	0	0	0	0	0	0	0	0	0	0	0
CRSH	**12**	0	0	0	0	0	0	0	0	0	2	0	0
CRSH	**17**	0	0	2	0	0	0	0	7	0	1	0	0
CRSH	**22**	0	0	0	0	0	1	0	12	0	1	0	0
CRSH	**27**	0	0	2	0	0	0	0	7	0	0	0	0
CRSH	**32**	0	0	10	0	0	1	0	22	0	0	0	0
CRSH	**37**	0	1	26	0	0	2	1	29	0	0	0	1
CRSH	**42**	0	1	26	2	1	0	0	0	0	0	0	0
CRSH	**47**	0	7	29	3	0	0	2	0	4	0	0	0
CRSH	**52**	6	3	11	12	1	0	1	0	8	0	1	0
CRSH	**57**	4	2	10	17	2	1	2	0	14	6	0	0
CRSH	**62**	8	1	4	23	3	1	2	0	17	17	0	1
CRSH	**67**	11	1	2	4	4	3	0	0	8	29	2	1
CRSH	**72**	13	1	2	7	11	10	4	1	19	26	6	0
CRSH	**77**	9	1	1	1	13	9	5	3	3	22	10	3
CRSH	**82**	7	2	4	2	12	14	2	2	6	20	19	2
CRSH	**87**	13	3	4	1	1	6	2	3	3	10	20	5
CRSH	**92**	11	0	1	4	6	7	7	4	2	5	18	11
CRSH	**97**	9	3	1	0	2	10	7	4	0	3	16	12
CRSH	**102**	10	6	2	1	2	6	9	4	0	2	8	5
CRSH	**107**	4	1	6	0	2	1	5	5	1	4	3	6
CRSH	**112**	3	1	1	0	1	1	7	2	0	2	5	1
CRSH	**117**	3	1	1	0	0	0	1	2	4	2	1	2
CRSH	**122**	3	0	1	0	0	0	0	1	1	2	3	0
CRSH	**127**	1	1	0	0	0	0	0	0	0	0	2	0
CRSH	**132**	0	0	0	0	0	0	0	1	0	0	1	0
CRSH	**137**	0	0	0	0	0	0	0	0	0	0	0	0
CRSH	**142**	0	0	0	0	0	0	0	0	1	0	1	0
CRSH	**147**	0	0	0	0	0	0	0	0	0	0	0	0
CRSH	**152**	0	0	0	0	0	0	0	0	0	0	0	0
CRSH	**157**	0	0	0	0	0	0	0	0	0	0	0	0
CRSH	**162**	0	0	0	0	0	0	0	0	0	0	0	0
CRSH	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Choptank River Tilghman Wharf (CRTW). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CRTW	**2**	0	0	0	0	0	0	0	0	0	3	0	0
CRTW	**7**	0	0	0	5	0	0	0	0	0	6	0	0
CRTW	**12**	0	0	1	27	0	0	0	0	0	10	0	0
CRTW	**17**	0	0	9	15	0	2	0	87	0	15	0	0
CRTW	**22**	0	0	13	8	1	6	0	210	0	10	0	1
CRTW	**27**	0	0	26	2	1	12	0	105	0	4	0	0
CRTW	**32**	0	7	59	2	9	27	0	53	1	1	1	0
CRTW	**37**	0	20	48	10	24	17	2	17	10	0	0	0
CRTW	**42**	2	36	47	19	56	1	3	0	30	4	4	1
CRTW	**47**	6	25	30	25	34	5	7	0	56	5	7	0
CRTW	**52**	3	18	25	26	42	13	17	4	67	14	4	4
CRTW	**57**	6	10	14	12	31	21	18	2	25	29	5	4
CRTW	**62**	5	3	7	14	24	48	23	11	14	48	11	19
CRTW	**67**	8	3	3	9	24	62	30	14	7	63	28	14
CRTW	**72**	12	4	4	2	29	39	31	19	4	41	42	22
CRTW	**77**	16	10	5	2	17	22	57	16	12	26	30	13
CRTW	**82**	21	19	5	2	17	24	54	22	11	21	34	28
CRTW	**87**	9	8	4	1	8	10	39	13	20	7	16	9
CRTW	**92**	16	5	3	2	2	6	29	14	24	15	15	9
CRTW	**97**	9	3	3	0	2	3	7	6	12	3	4	7
CRTW	**102**	4	4	3	0	1	3	2	2	11	7	2	4
CRTW	**107**	2	6	0	1	0	0	2	3	9	2	1	2
CRTW	**112**	0	5	1	0	0	0	3	0	3	4	1	0
CRTW	**117**	3	2	1	1	0	0	0	0	3	2	2	0
CRTW	**122**	0	0	0	0	0	0	0	0	2	1	0	0
CRTW	**127**	0	0	0	0	0	0	0	0	1	1	0	0
CRTW	**132**	0	0	0	0	0	0	0	1	0	1	0	0
CRTW	**137**	0	0	0	0	0	0	0	0	0	0	0	0
CRTW	**142**	0	0	0	0	0	0	0	0	0	0	0	0
CRTW	**147**	0	0	0	0	0	0	0	0	0	0	0	0
CRTW	**152**	0	0	0	0	0	0	0	0	0	0	0	0
CRTW	**157**	0	0	0	0	0	0	0	0	0	0	0	0
CRTW	**162**	0	0	0	0	0	0	0	0	0	0	0	0
CRTW	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Eastern Bay Bugby (EBBU). Data from 1990 to 1996 were not used in subsequent analyses because a Age-0 cohort could not be identified and the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
EBBU	**2**	0	0	0	0	0	0	0	0	0	0	0	0
EBBU	**7**	0	0	0	1	0	0	0	0	0	1	0	0
EBBU	**12**	0	0	1	0	0	1	0	0	0	1	0	0
EBBU	**17**	0	0	0	0	0	0	0	62	0	2	0	0
EBBU	**22**	0	0	0	0	0	1	0	437	0	1	3	0
EBBU	**27**	0	0	0	1	0	2	0	312	0	1	0	1
EBBU	**32**	0	0	2	0	0	4	0	313	1	0	0	2
EBBU	**37**	1	0	3	0	0	2	0	63	3	1	2	0
EBBU	**42**	0	0	11	0	0	0	0	0	9	5	0	2
EBBU	**47**	0	2	10	3	1	0	4	0	17	2	2	2
EBBU	**52**	1	3	23	1	2	2	4	1	40	6	0	1
EBBU	**57**	1	4	22	0	1	0	2	0	31	2	2	3
EBBU	**62**	2	2	15	3	1	2	2	2	32	19	2	5
EBBU	**67**	2	0	4	5	4	2	1	1	17	17	5	2
EBBU	**72**	1	1	10	6	11	6	1	5	20	24	17	1
EBBU	**77**	5	1	0	2	7	8	0	4	7	40	29	6
EBBU	**82**	5	3	4	9	11	8	1	9	5	41	25	4
EBBU	**87**	1	0	0	3	5	7	2	3	7	21	21	7
EBBU	**92**	1	1	0	2	9	4	1	1	3	19	18	13
EBBU	**97**	7	1	4	2	2	2	0	3	0	10	12	9
EBBU	**102**	2	0	1	0	3	8	5	5	1	0	9	8
EBBU	**107**	2	0	2	0	1	2	1	7	2	0	5	3
EBBU	**112**	2	0	4	0	0	2	1	1	1	1	6	4
EBBU	**117**	0	0	0	2	0	2	1	2	0	0	0	0
EBBU	**122**	0	0	0	1	0	0	1	1	1	0	2	1
EBBU	**127**	0	0	0	0	0	0	0	0	0	1	1	0
EBBU	**132**	1	0	0	0	0	0	0	0	0	0	0	0
EBBU	**137**	0	0	0	0	0	0	0	0	0	0	0	0
EBBU	**142**	1	0	0	0	0	0	0	0	0	0	0	0
EBBU	**147**	0	0	0	0	0	0	0	0	0	0	0	0
EBBU	**152**	0	0	0	0	0	0	0	0	0	0	0	0
EBBU	**157**	0	0	0	0	0	0	0	0	0	0	0	0
EBBU	**162**	0	0	0	0	0	0	0	0	0	0	0	0
EBBU	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Eastern Bay Hollicutts Noose (EBHN). Data from 1990 to 1994 were not used in subsequent analyses because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
EBHN	2	0	0	0	0	0	0	0	0	0	1	0	0
EBHN	7	0	0	0	0	0	0	0	0	0	0	0	0
EBHN	12	0	0	1	0	0	0	0	0	0	0	0	0
EBHN	17	0	0	0	0	0	0	0	0	0	1	0	0
EBHN	22	0	0	0	0	0	0	0	14	0	4	2	0
EBHN	27	0	0	0	0	0	2	0	9	0	0	0	1
EBHN	32	0	0	0	1	0	4	1	12	0	1	0	0
EBHN	37	0	0	0	0	0	1	0	21	0	1	0	0
EBHN	42	0	1	2	0	0	0	2	0	1	5	3	1
EBHN	47	0	1	3	0	1	0	3	0	6	10	6	2
EBHN	52	0	1	4	0	0	0	10	0	10	2	11	5
EBHN	57	0	5	5	2	1	0	3	0	8	3	4	6
EBHN	62	4	2	5	2	3	2	7	5	6	8	3	2
EBHN	67	5	6	3	2	3	3	2	8	5	10	5	4
EBHN	72	5	6	7	13	2	10	0	16	1	15	6	9
EBHN	77	11	4	6	10	7	5	6	6	7	13	2	5
EBHN	82	21	11	15	13	3	12	9	9	4	8	8	6
EBHN	87	9	8	6	12	5	5	8	4	6	0	4	6
EBHN	92	6	5	5	12	13	2	5	4	6	5	3	2
EBHN	97	8	5	4	7	9	3	6	4	1	2	2	2
EBHN	102	5	4	2	2	10	3	3	1	3	2	4	3
EBHN	107	6	4	3	1	5	2	0	3	1	1	0	2
EBHN	112	0	4	3	4	4	2	0	0	2	1	0	0
EBHN	117	4	1	0	1	1	0	1	0	0	0	2	0
EBHN	122	3	1	2	1	0	0	0	0	0	0	0	0
EBHN	127	3	0	0	0	0	0	0	0	0	0	0	0
EBHN	132	0	1	0	0	1	0	0	0	0	0	0	0
EBHN	137	0	0	0	0	0	0	0	0	0	0	0	0
EBHN	142	2	0	1	0	0	0	0	0	0	0	0	0
EBHN	147	0	0	0	0	0	0	0	0	0	0	0	0
EBHN	152	0	0	0	0	0	0	0	0	0	0	0	0
EBHN	157	0	0	0	0	0	0	0	0	0	0	0	0
EBHN	162	0	0	0	0	0	0	0	0	0	0	0	0
EBHN	167	0	0	0	0	0	0	0	0	0	0	0	0

Eastern Bay Parsons Island (EBPI). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
EBPI	**2**	0	0	0	0	0	0	0	0	0	4	0	0
EBPI	**7**	0	0	3	2	0	0	0	0	0	15	0	0
EBPI	**12**	0	0	4	1	0	0	0	0	0	25	1	0
EBPI	**17**	0	0	7	1	0	2	0	2	0	37	3	1
EBPI	**22**	0	0	4	0	0	11	0	3	0	24	0	2
EBPI	**27**	0	0	0	0	0	20	0	4	0	10	0	1
EBPI	**32**	0	0	1	0	0	10	0	9	3	3	2	1
EBPI	**37**	0	0	7	0	3	9	2	8	2	0	4	2
EBPI	**42**	1	0	9	3	1	0	7	0	23	0	8	0
EBPI	**47**	0	1	14	5	3	1	6	0	21	1	3	2
EBPI	**52**	1	1	22	6	1	1	3	1	41	1	6	2
EBPI	**57**	1	3	16	8	0	3	5	0	23	0	10	2
EBPI	**62**	0	5	6	13	4	2	1	1	43	1	15	2
EBPI	**67**	1	4	5	13	5	3	2	1	16	0	12	4
EBPI	**72**	9	5	2	9	7	2	3	1	17	1	21	7
EBPI	**77**	5	1	6	8	6	2	1	0	15	0	20	3
EBPI	**82**	6	8	2	6	9	1	10	1	11	3	23	7
EBPI	**87**	6	3	2	2	8	6	2	1	3	0	13	3
EBPI	**92**	6	10	6	2	7	6	7	0	3	1	9	5
EBPI	**97**	7	8	1	3	4	4	4	0	0	1	4	4
EBPI	**102**	10	5	3	8	2	1	1	0	1	0	2	6
EBPI	**107**	14	3	0	4	0	1	0	0	0	0	4	0
EBPI	**112**	3	2	1	2	1	0	1	0	0	1	0	3
EBPI	**117**	4	1	1	0	0	1	1	0	0	0	1	1
EBPI	**122**	2	1	0	0	2	0	0	0	0	0	0	1
EBPI	**127**	1	0	0	0	0	0	0	0	0	0	0	0
EBPI	**132**	0	0	0	0	0	0	0	0	0	0	0	0
EBPI	**137**	0	0	0	0	0	0	0	0	0	0	0	0
EBPI	**142**	0	0	0	0	0	1	0	0	0	0	0	0
EBPI	**147**	0	0	0	0	0	0	0	0	0	0	0	0
EBPI	**152**	0	0	0	0	0	0	0	0	0	0	0	0
EBPI	**157**	0	0	0	0	0	0	0	0	0	0	0	0
EBPI	**162**	0	0	0	0	0	0	0	0	0	0	0	0
EBPI	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Eastern Bay Wild Ground (EBWG). Data from 1990 and 1991 were not used in subsequent analyses because an Age-0 cohort could not be identified, and data from 1994 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
EBWG	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
EBWG	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
EBWG	**12**	0	0	2	1	0	0	0	17	nd	nd	nd	nd
EBWG	**17**	0	0	5	1	0	2	0	52	nd	nd	nd	nd
EBWG	**22**	0	0	3	0	0	19	0	120	nd	nd	nd	nd
EBWG	**27**	0	0	3	0	0	18	0	138	nd	nd	nd	nd
EBWG	**32**	0	0	3	0	0	12	0	52	nd	nd	nd	nd
EBWG	**37**	0	0	6	0	1	4	2	17	nd	nd	nd	nd
EBWG	**42**	0	5	17	1	12	0	4	1	nd	nd	nd	nd
EBWG	**47**	2	8	15	1	5	1	9	1	nd	nd	nd	nd
EBWG	**52**	3	13	17	4	11	0	9	10	nd	nd	nd	nd
EBWG	**57**	2	9	12	3	4	2	5	13	nd	nd	nd	nd
EBWG	**62**	3	12	12	12	9	5	3	20	nd	nd	nd	nd
EBWG	**67**	7	10	9	10	9	2	0	26	nd	nd	nd	nd
EBWG	**72**	5	4	3	12	12	4	0	14	nd	nd	nd	nd
EBWG	**77**	3	9	3	2	7	9	3	4	nd	nd	nd	nd
EBWG	**82**	9	8	0	3	13	5	2	4	nd	nd	nd	nd
EBWG	**87**	6	11	0	4	5	4	2	2	nd	nd	nd	nd
EBWG	**92**	6	5	2	7	10	4	4	3	nd	nd	nd	nd
EBWG	**97**	2	7	1	2	6	2	4	1	nd	nd	nd	nd
EBWG	**102**	2	9	1	0	4	1	1	1	nd	nd	nd	nd
EBWG	**107**	6	4	0	2	2	1	0	0	nd	nd	nd	nd
EBWG	**112**	0	3	0	0	2	1	2	0	nd	nd	nd	nd
EBWG	**117**	1	1	0	0	0	0	1	0	nd	nd	nd	nd
EBWG	**122**	4	3	0	0	2	0	0	0	nd	nd	nd	nd
EBWG	**127**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
EBWG	**132**	0	1	0	1	0	0	0	0	nd	nd	nd	nd
EBWG	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
EBWG	**142**	0	1	0	0	0	0	0	0	nd	nd	nd	nd
EBWG	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
EBWG	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
EBWG	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
EBWG	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
EBWG	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Fishing Bay Clay Island (FBCI). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
FBCI	**2**	0	0	0	1	0	0	0	0	nd	nd	nd	nd
FBCI	**7**	0	0	0	5	0	2	0	0	nd	nd	nd	nd
FBCI	**12**	0	0	2	19	4	0	0	5	nd	nd	nd	nd
FBCI	**17**	0	0	7	18	9	2	1	6	nd	nd	nd	nd
FBCI	**22**	0	0	25	10	12	6	0	5	nd	nd	nd	nd
FBCI	**27**	0	0	10	5	4	1	0	4	nd	nd	nd	nd
FBCI	**32**	0	0	6	5	2	0	0	0	nd	nd	nd	nd
FBCI	**37**	0	1	13	7	2	4	0	0	nd	nd	nd	nd
FBCI	**42**	0	0	29	30	10	8	1	0	nd	nd	nd	nd
FBCI	**47**	1	2	19	33	29	7	1	1	nd	nd	nd	nd
FBCI	**52**	3	3	7	33	24	9	5	2	nd	nd	nd	nd
FBCI	**57**	6	8	4	16	25	10	4	1	nd	nd	nd	nd
FBCI	**62**	4	8	3	14	30	8	3	3	nd	nd	nd	nd
FBCI	**67**	5	6	2	13	36	15	7	4	nd	nd	nd	nd
FBCI	**72**	8	7	3	7	45	16	4	3	nd	nd	nd	nd
FBCI	**77**	7	5	1	1	15	17	13	5	nd	nd	nd	nd
FBCI	**82**	1	8	1	1	14	34	4	5	nd	nd	nd	nd
FBCI	**87**	2	10	0	0	5	10	7	6	nd	nd	nd	nd
FBCI	**92**	0	4	0	0	4	14	3	7	nd	nd	nd	nd
FBCI	**97**	0	5	0	0	0	8	7	3	nd	nd	nd	nd
FBCI	**102**	0	1	0	0	3	5	6	2	nd	nd	nd	nd
FBCI	**107**	0	1	0	0	0	1	3	1	nd	nd	nd	nd
FBCI	**112**	0	0	0	0	0	1	1	0	nd	nd	nd	nd
FBCI	**117**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
FBCI	**122**	0	0	0	0	0	1	1	0	nd	nd	nd	nd
FBCI	**127**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
FBCI	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
FBCI	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
FBCI	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
FBCI	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
FBCI	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
FBCI	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
FBCI	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
FBCI	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Fishing Bay Goose Creek (FBGC). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1997 and 1998 were not used because the length-frequency distributions were difficult to interpret, and data from 1999 to 2001 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
FBGC	2	0	0	0	0	0	0	0	0	0	0	0	0
FBGC	7	0	0	0	0	0	0	0	0	0	0	0	0
FBGC	12	0	0	4	8	2	0	0	1	0	0	0	0
FBGC	17	0	0	11	12	4	1	0	2	0	0	0	0
FBGC	22	0	0	12	17	7	0	0	0	0	0	0	0
FBGC	27	0	0	9	4	10	1	0	2	0	0	0	0
FBGC	32	0	0	3	5	3	0	0	0	0	0	0	0
FBGC	37	0	0	6	4	3	1	0	0	0	0	0	0
FBGC	42	0	0	5	13	8	4	0	0	0	0	0	0
FBGC	47	5	1	1	25	13	4	1	1	0	1	0	0
FBGC	52	10	3	2	10	15	10	1	0	0	0	0	0
FBGC	57	3	8	3	12	29	2	3	2	1	0	1	0
FBGC	62	9	9	2	9	27	11	4	0	4	1	0	0
FBGC	67	8	9	1	8	15	17	1	1	1	0	1	0
FBGC	72	11	18	2	3	44	24	4	2	5	0	1	0
FBGC	77	8	15	1	0	15	19	6	2	1	1	3	1
FBGC	82	8	10	5	1	9	23	8	5	4	5	2	0
FBGC	87	1	14	3	0	2	8	4	5	5	0	3	0
FBGC	92	5	6	0	0	1	9	9	6	8	2	3	0
FBGC	97	1	4	1	0	1	6	6	6	4	1	2	1
FBGC	102	1	3	3	0	0	3	3	8	12	1	3	1
FBGC	107	0	1	0	0	0	0	1	3	2	2	2	0
FBGC	112	0	0	0	0	0	2	3	1	3	3	0	0
FBGC	117	0	0	0	0	0	2	2	0	0	0	1	0
FBGC	122	0	0	0	0	0	0	0	0	1	0	2	0
FBGC	127	0	0	0	0	0	0	0	0	1	0	0	0
FBGC	132	0	0	0	0	0	0	0	0	1	1	0	1
FBGC	137	0	0	0	0	0	0	0	0	0	0	1	0
FBGC	142	0	0	0	0	0	0	0	0	0	0	0	0
FBGC	147	0	0	0	0	0	0	0	0	0	0	0	0
FBGC	152	0	0	0	0	0	0	0	0	0	0	0	0
FBGC	157	0	0	0	0	0	0	0	0	0	0	0	0
FBGC	162	0	0	0	0	0	0	0	0	0	0	0	0
FBGC	167	0	0	0	0	0	0	0	0	0	0	0	0

Harris Creek Eagle Point (HCEP). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
HCEP	**2**	0	0	0	0	0	0	0	1	nd	nd	nd	nd
HCEP	**7**	0	0	0	2	0	0	0	0	nd	nd	nd	nd
HCEP	**12**	0	0	1	3	0	0	0	0	nd	nd	nd	nd
HCEP	**17**	0	0	2	1	0	0	0	8	nd	nd	nd	nd
HCEP	**22**	0	0	2	5	0	8	0	17	nd	nd	nd	nd
HCEP	**27**	0	0	4	3	0	9	0	50	nd	nd	nd	nd
HCEP	**32**	0	0	9	3	0	22	0	67	nd	nd	nd	nd
HCEP	**37**	0	1	13	0	1	23	0	25	nd	nd	nd	nd
HCEP	**42**	0	3	24	2	7	1	3	0	nd	nd	nd	nd
HCEP	**47**	0	5	30	3	8	1	4	1	nd	nd	nd	nd
HCEP	**52**	2	14	14	4	6	1	4	1	nd	nd	nd	nd
HCEP	**57**	0	7	7	3	7	2	9	1	nd	nd	nd	nd
HCEP	**62**	2	3	4	14	7	8	14	4	nd	nd	nd	nd
HCEP	**67**	1	2	7	12	7	6	14	2	nd	nd	nd	nd
HCEP	**72**	0	3	3	12	11	13	15	12	nd	nd	nd	nd
HCEP	**77**	2	0	3	3	11	10	10	11	nd	nd	nd	nd
HCEP	**82**	6	3	1	3	18	17	12	16	nd	nd	nd	nd
HCEP	**87**	0	2	2	1	14	10	12	12	nd	nd	nd	nd
HCEP	**92**	6	1	2	4	9	14	10	8	nd	nd	nd	nd
HCEP	**97**	6	2	0	0	7	5	7	10	nd	nd	nd	nd
HCEP	**102**	1	0	0	0	2	14	8	10	nd	nd	nd	nd
HCEP	**107**	2	1	0	0	1	8	4	3	nd	nd	nd	nd
HCEP	**112**	3	1	2	0	0	3	8	4	nd	nd	nd	nd
HCEP	**117**	0	0	0	0	0	0	4	1	nd	nd	nd	nd
HCEP	**122**	1	0	0	0	0	2	1	1	nd	nd	nd	nd
HCEP	**127**	0	0	0	0	0	0	1	1	nd	nd	nd	nd
HCEP	**132**	1	0	0	0	0	0	0	2	nd	nd	nd	nd
HCEP	**137**	1	0	0	0	0	0	0	0	nd	nd	nd	nd
HCEP	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HCEP	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HCEP	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HCEP	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HCEP	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HCEP	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Holland Straits Holland Straits (HOHO). Data from 1990 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1998 and 2000 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
HOHO	**2**	0	0	0	0	0	0	0	0	0	7	0	0
HOHO	**7**	0	0	1	37	0	3	1	0	0	19	0	10
HOHO	**12**	0	0	4	8	0	2	1	1	0	34	2	50
HOHO	**17**	0	0	19	12	3	6	3	1	0	49	3	59
HOHO	**22**	0	0	20	6	4	6	3	3	0	32	4	52
HOHO	**27**	0	0	8	3	3	8	2	3	0	14	4	41
HOHO	**32**	0	1	16	12	4	9	1	2	0	4	4	31
HOHO	**37**	0	6	4	26	12	3	3	1	2	0	0	30
HOHO	**42**	2	10	9	49	24	5	5	1	0	0	2	2
HOHO	**47**	5	33	4	52	25	2	5	0	2	2	3	5
HOHO	**52**	4	27	10	12	40	2	2	1	0	1	5	1
HOHO	**57**	19	13	6	17	23	12	3	1	4	1	1	2
HOHO	**62**	10	6	4	10	37	14	4	4	2	1	4	2
HOHO	**67**	18	6	4	5	27	24	2	2	4	4	1	0
HOHO	**72**	5	5	1	3	18	30	5	6	14	1	2	2
HOHO	**77**	12	5	0	3	3	24	13	9	13	1	0	1
HOHO	**82**	6	6	0	1	4	12	5	14	14	3	1	1
HOHO	**87**	1	2	0	1	0	7	5	6	14	3	1	1
HOHO	**92**	0	3	0	0	0	4	9	20	20	7	0	1
HOHO	**97**	2	2	0	1	1	0	5	12	10	4	0	1
HOHO	**102**	0	2	0	0	0	1	2	10	9	1	1	0
HOHO	**107**	0	0	0	0	0	0	1	12	5	5	2	0
HOHO	**112**	0	0	0	0	0	0	1	6	4	5	0	0
HOHO	**117**	0	0	0	0	0	0	0	0	3	0	0	0
HOHO	**122**	0	0	0	0	0	0	0	0	0	0	0	0
HOHO	**127**	0	0	0	0	0	0	0	0	0	1	0	0
HOHO	**132**	0	0	0	0	0	0	0	0	1	0	0	0
HOHO	**137**	0	0	0	0	0	0	0	0	0	0	0	0
HOHO	**142**	0	0	0	0	0	0	0	0	0	1	0	0
HOHO	**147**	0	0	0	0	0	0	0	0	0	0	0	0
HOHO	**152**	0	0	0	0	0	0	0	0	0	0	0	0
HOHO	**157**	0	0	0	0	0	0	0	0	0	0	0	0
HOHO	**162**	0	0	0	0	0	0	0	0	0	0	0	0
HOHO	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Honga River Normans (HRNO). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1996 and 1997 were not used because the length-frequency distributions were difficult to interpret, and data from 1998 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
HRNO	**2**	0	0	0	0	0	0	0	0	0	1	0	0
HRNO	**7**	0	0	0	1	1	1	0	1	0	5	0	0
HRNO	**12**	0	0	7	7	1	1	0	1	0	7	0	2
HRNO	**17**	0	0	16	8	7	7	0	1	0	10	0	8
HRNO	**22**	0	0	17	11	3	3	0	3	0	6	0	8
HRNO	**27**	0	0	17	7	3	3	0	0	0	3	0	9
HRNO	**32**	2	0	20	6	5	5	0	2	0	1	0	2
HRNO	**37**	1	2	19	12	10	10	0	0	0	0	2	1
HRNO	**42**	1	2	28	12	19	19	2	0	1	0	3	1
HRNO	**47**	7	3	30	9	23	23	1	0	1	0	1	1
HRNO	**52**	10	9	19	5	24	24	2	1	0	0	7	3
HRNO	**57**	7	7	6	3	15	15	0	1	0	0	8	1
HRNO	**62**	16	5	9	3	8	8	2	0	2	0	8	1
HRNO	**67**	13	9	1	1	9	9	1	3	0	1	9	2
HRNO	**72**	11	6	2	2	11	11	2	2	1	2	2	1
HRNO	**77**	3	1	0	0	3	3	4	2	2	1	0	1
HRNO	**82**	5	4	0	0	6	6	4	6	2	0	0	0
HRNO	**87**	0	3	1	0	1	1	2	2	1	2	0	1
HRNO	**92**	0	1	2	0	0	0	5	5	3	1	2	0
HRNO	**97**	0	1	0	0	0	0	0	1	3	6	3	1
HRNO	**102**	0	0	0	0	0	0	2	1	3	5	2	0
HRNO	**107**	0	0	0	0	0	0	0	0	3	0	1	0
HRNO	**112**	0	0	0	0	0	0	0	0	0	2	2	0
HRNO	**117**	0	0	0	0	0	0	0	0	0	0	1	2
HRNO	**122**	0	0	0	0	0	0	0	1	0	0	0	0
HRNO	**127**	0	0	0	0	0	0	0	0	0	0	0	0
HRNO	**132**	0	0	0	0	0	0	0	0	0	1	0	0
HRNO	**137**	0	0	0	0	0	0	0	0	0	0	0	0
HRNO	**142**	0	0	0	0	0	0	0	0	0	0	0	1
HRNO	**147**	0	0	0	0	0	0	0	0	0	0	0	1
HRNO	**152**	0	0	0	0	0	0	0	0	0	0	0	0
HRNO	**157**	0	0	0	0	0	0	0	0	0	1	0	0
HRNO	**162**	0	0	0	0	0	0	0	0	0	0	0	0
HRNO	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Honga River Windmill (HRWI). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
HRWI	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**7**	0	0	0	0	0	2	0	0	nd	nd	nd	nd
HRWI	**12**	0	0	12	1	3	0	0	0	nd	nd	nd	nd
HRWI	**17**	0	0	14	4	5	1	0	2	nd	nd	nd	nd
HRWI	**22**	0	0	16	6	5	6	1	2	nd	nd	nd	nd
HRWI	**27**	0	0	9	7	3	2	1	0	nd	nd	nd	nd
HRWI	**32**	1	0	6	7	6	3	0	1	nd	nd	nd	nd
HRWI	**37**	3	5	20	7	6	4	1	0	nd	nd	nd	nd
HRWI	**42**	3	7	22	10	15	6	3	1	nd	nd	nd	nd
HRWI	**47**	7	16	26	7	17	11	2	1	nd	nd	nd	nd
HRWI	**52**	15	24	9	5	23	14	6	1	nd	nd	nd	nd
HRWI	**57**	13	19	12	4	15	20	6	3	nd	nd	nd	nd
HRWI	**62**	23	11	5	4	10	27	2	5	nd	nd	nd	nd
HRWI	**67**	11	7	4	1	4	15	10	5	nd	nd	nd	nd
HRWI	**72**	7	6	2	0	4	22	7	9	nd	nd	nd	nd
HRWI	**77**	1	4	2	2	2	12	5	5	nd	nd	nd	nd
HRWI	**82**	4	1	0	1	1	3	6	10	nd	nd	nd	nd
HRWI	**87**	2	2	1	0	0	1	3	2	nd	nd	nd	nd
HRWI	**92**	0	2	2	0	2	3	5	2	nd	nd	nd	nd
HRWI	**97**	0	0	0	0	1	0	1	1	nd	nd	nd	nd
HRWI	**102**	0	1	1	0	0	0	2	4	nd	nd	nd	nd
HRWI	**107**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**112**	0	0	0	0	0	0	1	0	nd	nd	nd	nd
HRWI	**117**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**122**	0	0	0	0	0	1	0	0	nd	nd	nd	nd
HRWI	**127**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
HRWI	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Little Choptank River Cason (LCCA). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
LCCA	**2**	0	0	0	0	0	0	0	0	0	2	0	0
LCCA	**7**	0	0	1	0	0	1	0	0	0	7	0	0
LCCA	**12**	0	0	16	4	0	1	0	0	0	11	1	1
LCCA	**17**	0	0	16	14	6	6	0	146	0	16	1	0
LCCA	**22**	0	0	7	17	7	3	2	108	1	11	1	0
LCCA	**27**	0	0	8	3	9	12	0	55	1	5	2	0
LCCA	**32**	0	3	15	5	9	14	3	55	3	1	3	1
LCCA	**37**	0	12	9	14	16	13	2	19	3	0	5	1
LCCA	**42**	0	28	12	12	27	8	1	0	8	0	11	2
LCCA	**47**	0	49	8	6	38	9	10	4	12	2	9	3
LCCA	**52**	2	43	5	6	43	7	8	4	13	10	8	4
LCCA	**57**	4	32	8	5	28	26	11	15	10	13	5	10
LCCA	**62**	8	12	1	4	12	38	25	11	10	22	9	11
LCCA	**67**	6	6	5	4	11	48	27	19	13	18	13	5
LCCA	**72**	2	4	3	0	12	51	34	23	8	23	18	10
LCCA	**77**	3	4	0	0	0	40	30	25	19	18	22	9
LCCA	**82**	3	3	1	0	3	17	29	24	24	14	13	2
LCCA	**87**	4	2	3	0	0	13	13	13	12	4	9	7
LCCA	**92**	2	3	0	0	1	3	10	16	16	11	12	6
LCCA	**97**	3	1	0	0	0	1	2	3	5	6	4	0
LCCA	**102**	0	0	0	0	0	0	3	4	5	4	9	3
LCCA	**107**	0	0	0	0	0	0	0	2	1	0	1	2
LCCA	**112**	0	0	0	0	0	0	0	1	1	0	0	0
LCCA	**117**	0	0	0	0	0	0	0	0	0	0	1	1
LCCA	**122**	0	0	0	0	0	0	0	0	0	0	0	0
LCCA	**127**	0	0	0	0	0	0	0	0	0	0	0	0
LCCA	**132**	0	0	0	0	0	0	0	0	0	0	0	0
LCCA	**137**	0	0	0	0	0	0	0	0	0	0	0	0
LCCA	**142**	0	0	0	0	0	0	0	0	0	0	0	0
LCCA	**147**	0	0	0	0	0	0	0	0	0	0	0	0
LCCA	**152**	0	0	0	0	0	0	0	0	0	0	0	0
LCCA	**157**	0	0	0	0	0	0	0	0	0	0	0	0
LCCA	**162**	0	0	0	0	0	0	0	0	0	0	0	0
LCCA	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Little Choptank River Ragged Point (LCRP). Data from 1990 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1997 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
LCRP	**2**	0	0	0	0	0	0	0	0	0	2	0	0
LCRP	**7**	0	0	0	0	0	0	0	0	0	5	0	0
LCRP	**12**	0	0	3	0	0	2	0	0	0	9	0	0
LCRP	**17**	0	0	8	3	0	3	0	0	0	13	1	4
LCRP	**22**	0	0	31	5	1	5	0	0	0	9	1	1
LCRP	**27**	0	0	35	3	0	8	0	0	0	4	0	0
LCRP	**32**	0	6	57	1	0	5	0	1	0	1	4	0
LCRP	**37**	1	15	52	8	6	2	1	1	4	0	6	1
LCRP	**42**	6	15	33	13	12	0	5	0	8	0	17	2
LCRP	**47**	8	5	17	9	9	6	7	0	14	2	18	0
LCRP	**52**	23	6	6	3	13	9	11	0	13	1	17	4
LCRP	**57**	31	7	2	2	10	12	8	1	10	11	6	6
LCRP	**62**	20	10	2	1	6	13	4	2	6	17	8	3
LCRP	**67**	29	13	3	0	5	26	8	2	2	26	13	8
LCRP	**72**	15	12	5	0	4	18	13	7	2	20	12	5
LCRP	**77**	7	5	3	0	0	14	6	5	11	5	10	5
LCRP	**82**	4	3	2	1	0	3	21	5	12	6	6	3
LCRP	**87**	2	1	0	0	0	3	5	1	11	5	8	3
LCRP	**92**	6	2	0	0	0	0	7	1	12	11	7	2
LCRP	**97**	4	1	0	0	0	1	0	1	12	3	2	1
LCRP	**102**	0	0	0	0	0	0	2	0	12	5	2	0
LCRP	**107**	2	0	0	0	0	0	0	0	2	3	0	0
LCRP	**112**	2	0	0	0	0	0	0	0	3	1	1	0
LCRP	**117**	0	0	0	0	0	0	0	0	1	0	0	1
LCRP	**122**	1	0	0	0	0	0	0	0	1	1	0	0
LCRP	**127**	0	0	0	0	0	0	0	0	1	0	1	0
LCRP	**132**	0	0	0	0	0	0	0	0	0	0	0	0
LCRP	**137**	0	0	0	0	0	0	0	0	0	0	0	0
LCRP	**142**	0	0	0	0	0	0	0	0	0	0	0	0
LCRP	**147**	0	0	0	0	0	0	0	0	0	0	0	0
LCRP	**152**	0	0	0	0	0	0	0	0	0	0	0	0
LCRP	**157**	0	0	0	0	0	0	0	0	0	0	0	0
LCRP	**162**	0	0	0	0	0	0	0	0	0	0	0	0
LCRP	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Manokin River Drum Point (MADP). Data from 1990 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1991 and 1995 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
MADP	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**7**	0	0	10	2	0	0	1	0	nd	nd	nd	nd
MADP	**12**	0	0	32	10	1	2	0	2	nd	nd	nd	nd
MADP	**17**	0	0	35	7	4	1	3	5	nd	nd	nd	nd
MADP	**22**	0	0	58	15	3	1	2	4	nd	nd	nd	nd
MADP	**27**	0	1	29	11	5	3	4	4	nd	nd	nd	nd
MADP	**32**	0	1	17	13	1	4	0	2	nd	nd	nd	nd
MADP	**37**	0	3	7	20	4	3	0	0	nd	nd	nd	nd
MADP	**42**	0	5	10	39	25	3	0	0	nd	nd	nd	nd
MADP	**47**	0	7	7	32	32	4	0	0	nd	nd	nd	nd
MADP	**52**	0	8	10	14	44	7	0	0	nd	nd	nd	nd
MADP	**57**	0	5	1	11	32	3	1	3	nd	nd	nd	nd
MADP	**62**	0	3	4	4	34	9	1	2	nd	nd	nd	nd
MADP	**67**	0	4	4	1	25	6	3	3	nd	nd	nd	nd
MADP	**72**	4	5	0	2	27	9	2	2	nd	nd	nd	nd
MADP	**77**	8	4	0	0	7	5	4	4	nd	nd	nd	nd
MADP	**82**	16	1	4	0	5	0	9	7	nd	nd	nd	nd
MADP	**87**	15	0	0	0	0	2	5	4	nd	nd	nd	nd
MADP	**92**	8	0	0	0	0	5	2	4	nd	nd	nd	nd
MADP	**97**	8	2	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**102**	2	0	0	0	0	0	1	4	nd	nd	nd	nd
MADP	**107**	1	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**112**	1	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**117**	1	0	0	0	0	0	0	1	nd	nd	nd	nd
MADP	**122**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**127**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MADP	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Manokin River Georges Bar (MAGE). Data from 1990 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 2000 and 2001 were not used because the length-frequency distributions were difficult to interpret, and data from 1991 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
MAGE	2	0	0	0	0	0	0	0	0	0	2	0	0
MAGE	7	0	0	0	2	0	0	0	0	0	6	0	0
MAGE	12	0	0	2	2	0	2	0	2	1	11	1	0
MAGE	17	0	0	2	3	0	1	0	4	2	16	0	0
MAGE	22	0	0	7	6	2	2	0	1	0	10	1	1
MAGE	27	0	0	7	3	2	0	0	1	0	4	0	0
MAGE	32	0	0	17	4	3	0	1	0	2	1	4	0
MAGE	37	0	0	11	0	4	0	0	0	1	0	1	0
MAGE	42	4	2	2	4	5	2	0	1	5	0	2	0
MAGE	47	0	0	8	3	9	4	1	0	8	4	5	0
MAGE	52	3	0	3	3	11	0	0	0	13	4	1	4
MAGE	57	3	2	1	3	8	3	0	1	6	2	6	5
MAGE	62	5	1	0	2	5	3	3	3	2	5	5	3
MAGE	67	3	0	0	0	2	4	7	8	1	4	0	6
MAGE	72	4	2	0	0	3	7	7	18	4	12	1	2
MAGE	77	5	5	0	0	2	4	10	9	3	3	0	4
MAGE	82	2	2	2	0	1	6	11	5	1	4	2	1
MAGE	87	0	0	0	0	0	1	5	3	4	4	0	2
MAGE	92	1	2	0	0	1	2	7	2	6	0	1	1
MAGE	97	1	0	0	0	0	0	3	3	4	2	1	2
MAGE	102	1	0	0	0	0	0	4	1	1	2	0	0
MAGE	107	0	1	0	0	0	0	1	0	1	0	0	0
MAGE	112	0	0	0	0	0	0	0	0	0	0	0	0
MAGE	117	0	0	0	0	0	0	1	0	2	0	0	0
MAGE	122	0	0	0	0	0	0	0	0	0	0	0	0
MAGE	127	0	0	0	0	0	0	1	0	0	0	0	0
MAGE	132	0	0	0	0	0	0	0	0	0	0	0	0
MAGE	137	0	0	0	0	0	0	0	0	0	0	0	0
MAGE	142	0	0	0	0	0	0	0	0	0	0	0	0
MAGE	147	0	0	0	0	0	0	0	0	0	0	0	0
MAGE	152	0	0	0	0	0	0	0	0	0	0	0	0
MAGE	157	0	0	0	0	0	0	0	0	0	0	0	0
MAGE	162	0	0	0	0	0	0	0	0	0	0	0	0
MAGE	167	0	0	0	0	0	0	0	0	0	0	0	0

Middle Eastern Shore Stone Rock (MESR). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
MESR	**2**	0	0	0	0	0	0	0	0	0	0	0	0
MESR	**7**	0	0	1	0	0	0	0	0	0	0	0	0
MESR	**12**	0	0	3	0	0	3	0	1	0	0	0	0
MESR	**17**	0	0	8	0	0	5	0	2	0	1	2	0
MESR	**22**	0	0	18	0	1	2	0	2	0	1	7	2
MESR	**27**	0	0	46	0	2	4	1	3	0	1	9	0
MESR	**32**	0	0	66	0	1	1	3	5	1	0	12	0
MESR	**37**	0	2	46	4	0	4	10	5	2	1	4	5
MESR	**42**	3	7	32	7	3	2	30	0	3	0	0	15
MESR	**47**	1	5	16	25	2	9	34	1	9	2	2	25
MESR	**52**	6	4	15	31	9	7	27	4	12	0	0	25
MESR	**57**	4	4	5	8	7	4	12	7	5	1	2	7
MESR	**62**	27	10	2	11	16	3	5	10	2	5	3	5
MESR	**67**	40	28	3	7	11	9	3	16	8	8	0	1
MESR	**72**	52	39	3	4	24	17	6	10	12	14	3	4
MESR	**77**	46	55	3	1	2	7	4	0	13	18	4	5
MESR	**82**	42	43	0	1	5	9	3	4	12	18	1	1
MESR	**87**	24	22	3	0	3	5	9	2	4	11	3	0
MESR	**92**	14	13	2	0	2	1	4	2	6	9	2	2
MESR	**97**	7	6	0	0	0	1	4	2	1	7	3	0
MESR	**102**	2	2	0	0	0	1	2	0	0	0	2	0
MESR	**107**	2	0	0	0	0	0	1	0	0	2	1	0
MESR	**112**	0	2	0	0	0	0	0	0	0	2	0	0
MESR	**117**	0	0	0	0	0	0	0	0	0	0	0	0
MESR	**122**	0	0	0	0	0	0	0	0	0	1	0	0
MESR	**127**	0	0	0	0	0	0	0	0	0	0	0	0
MESR	**132**	0	0	0	0	0	0	0	0	0	0	0	0
MESR	**137**	0	0	0	0	0	0	1	0	0	0	0	0
MESR	**142**	0	0	0	0	0	0	0	0	0	0	0	0
MESR	**147**	0	0	0	0	0	0	0	0	0	0	0	0
MESR	**152**	0	0	0	0	0	0	0	0	0	0	0	0
MESR	**157**	0	0	0	0	0	0	0	0	0	0	0	0
MESR	**162**	0	0	0	0	0	0	0	0	0	0	0	0
MESR	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Miles River Ashcraft (MRAS). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1992 to 1994 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
MRAS	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MRAS	**7**	0	0	0	0	0	1	0	1	nd	nd	nd	nd
MRAS	**12**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MRAS	**17**	0	0	0	0	0	5	1	33	nd	nd	nd	nd
MRAS	**22**	0	0	0	0	0	14	0	133	nd	nd	nd	nd
MRAS	**27**	0	0	0	0	0	17	0	266	nd	nd	nd	nd
MRAS	**32**	0	0	0	0	0	16	0	300	nd	nd	nd	nd
MRAS	**37**	0	1	0	0	0	7	1	166	nd	nd	nd	nd
MRAS	**42**	0	0	1	0	0	0	1	0	nd	nd	nd	nd
MRAS	**47**	0	0	1	0	0	0	7	0	nd	nd	nd	nd
MRAS	**52**	0	1	2	0	0	0	10	1	nd	nd	nd	nd
MRAS	**57**	1	0	1	0	0	0	2	1	nd	nd	nd	nd
MRAS	**62**	2	0	5	0	0	0	8	2	nd	nd	nd	nd
MRAS	**67**	2	0	0	0	0	0	4	11	nd	nd	nd	nd
MRAS	**72**	11	2	2	2	1	0	2	21	nd	nd	nd	nd
MRAS	**77**	8	0	1	2	0	0	1	8	nd	nd	nd	nd
MRAS	**82**	9	4	3	1	4	1	1	6	nd	nd	nd	nd
MRAS	**87**	8	8	1	0	1	0	0	3	nd	nd	nd	nd
MRAS	**92**	12	3	4	1	6	0	0	4	nd	nd	nd	nd
MRAS	**97**	9	3	2	1	5	2	0	2	nd	nd	nd	nd
MRAS	**102**	9	6	0	1	8	3	1	0	nd	nd	nd	nd
MRAS	**107**	10	8	4	1	3	0	0	1	nd	nd	nd	nd
MRAS	**112**	1	5	2	2	1	0	1	0	nd	nd	nd	nd
MRAS	**117**	4	6	1	1	3	0	0	0	nd	nd	nd	nd
MRAS	**122**	3	2	2	3	2	0	0	0	nd	nd	nd	nd
MRAS	**127**	2	2	2	2	2	1	1	0	nd	nd	nd	nd
MRAS	**132**	0	1	0	0	0	0	0	0	nd	nd	nd	nd
MRAS	**137**	1	1	0	1	0	0	0	1	nd	nd	nd	nd
MRAS	**142**	0	1	0	1	1	0	0	0	nd	nd	nd	nd
MRAS	**147**	0	0	1	0	0	0	0	0	nd	nd	nd	nd
MRAS	**152**	0	1	0	0	0	0	0	0	nd	nd	nd	nd
MRAS	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MRAS	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
MRAS	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Miles River Bruffs Island (MRBI). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1993 and 1994 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
MRBI	**2**	0	0	0	0	0	0	0	0	0	0	0	0
MRBI	**7**	0	0	0	0	0	0	0	0	0	1	0	0
MRBI	**12**	0	0	0	0	0	0	0	0	0	1	3	0
MRBI	**17**	0	0	1	0	0	0	0	26	0	2	2	0
MRBI	**22**	0	0	1	0	0	1	0	53	0	1	3	1
MRBI	**27**	0	0	5	0	0	6	0	185	0	0	1	1
MRBI	**32**	0	0	1	0	0	5	0	265	0	0	1	3
MRBI	**37**	0	1	0	0	0	3	0	212	3	0	1	1
MRBI	**42**	0	1	0	0	0	0	0	0	8	0	7	2
MRBI	**47**	0	0	2	0	0	0	0	0	22	2	6	4
MRBI	**52**	2	1	0	1	0	0	2	0	42	8	5	4
MRBI	**57**	2	2	1	1	1	0	6	0	35	11	2	3
MRBI	**62**	1	3	1	0	0	0	2	3	28	31	13	7
MRBI	**67**	4	1	0	0	1	0	0	3	13	42	23	6
MRBI	**72**	2	1	0	1	2	0	1	4	9	54	26	6
MRBI	**77**	3	3	0	0	0	0	0	8	4	50	29	7
MRBI	**82**	4	1	0	1	0	1	0	3	3	20	27	13
MRBI	**87**	8	1	0	0	0	1	0	3	0	9	23	6
MRBI	**92**	7	0	2	4	0	0	1	1	0	10	12	7
MRBI	**97**	7	1	1	0	1	0	1	0	0	5	3	3
MRBI	**102**	8	2	0	0	0	0	0	0	2	4	2	10
MRBI	**107**	5	2	0	0	1	1	0	0	0	2	1	2
MRBI	**112**	6	3	0	2	1	0	1	0	0	4	0	3
MRBI	**117**	4	7	0	3	0	0	1	2	0	2	0	1
MRBI	**122**	7	5	1	2	0	0	1	1	0	0	0	1
MRBI	**127**	1	2	1	0	1	0	0	0	0	0	0	0
MRBI	**132**	2	3	1	1	0	0	0	0	0	0	0	0
MRBI	**137**	0	2	1	0	0	1	0	0	0	0	0	0
MRBI	**142**	0	0	0	1	0	0	1	0	0	0	0	0
MRBI	**147**	0	1	0	0	0	0	0	1	0	0	0	0
MRBI	**152**	1	1	0	0	0	0	0	0	0	0	0	0
MRBI	**157**	0	0	0	0	0	0	0	0	0	0	0	0
MRBI	**162**	0	0	0	0	0	0	0	0	0	0	0	0
MRBI	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Miles River Long Point (MRLP). Data from 1990 to 1994 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
MRLP	2	0	0	0	0	0	0	0	0	0	0	0	0
MRLP	7	0	0	0	1	0	0	0	0	0	0	0	0
MRLP	12	0	0	0	0	0	0	0	0	0	0	0	0
MRLP	17	0	0	0	0	0	3	0	2	0	0	0	0
MRLP	22	0	0	0	0	0	12	0	2	0	1	0	0
MRLP	27	0	0	1	0	0	18	0	5	0	0	0	0
MRLP	32	0	0	0	0	0	12	0	2	1	1	0	0
MRLP	37	0	0	0	0	0	20	0	1	3	1	0	0
MRLP	42	0	0	0	0	0	0	1	0	8	6	0	0
MRLP	47	0	0	0	0	0	0	3	1	24	12	1	0
MRLP	52	0	0	1	1	0	0	11	0	40	32	1	1
MRLP	57	0	0	4	1	0	0	12	1	26	57	2	0
MRLP	62	0	0	4	0	0	0	8	3	41	63	4	2
MRLP	67	0	0	4	4	0	0	6	7	14	55	5	0
MRLP	72	1	0	0	4	0	0	6	18	12	55	12	2
MRLP	77	2	0	0	2	0	0	2	14	11	33	16	8
MRLP	82	4	1	0	3	2	1	2	15	21	26	19	6
MRLP	87	4	0	0	2	2	1	1	7	14	17	18	9
MRLP	92	5	1	0	2	3	3	0	8	12	8	14	14
MRLP	97	6	1	0	2	5	3	1	2	8	2	7	6
MRLP	102	9	4	2	2	4	1	1	2	4	2	7	10
MRLP	107	8	3	2	1	2	1	1	3	2	1	5	4
MRLP	112	5	4	3	1	2	3	0	0	2	0	3	2
MRLP	117	6	5	0	2	0	0	0	0	0	0	0	0
MRLP	122	2	3	0	0	1	0	4	1	3	0	0	2
MRLP	127	4	3	0	1	0	0	2	0	3	0	0	1
MRLP	132	2	0	0	1	0	0	0	0	0	0	0	2
MRLP	137	3	0	0	0	1	0	1	0	0	0	1	0
MRLP	142	0	0	0	0	0	0	0	0	0	0	0	0
MRLP	147	0	0	0	0	0	0	0	0	0	0	0	0
MRLP	152	1	0	0	0	0	0	0	0	0	0	0	0
MRLP	157	0	0	0	0	0	0	0	0	0	0	0	0
MRLP	162	0	0	0	0	0	0	0	0	0	0	0	0
MRLP	167	0	0	0	0	0	0	0	0	0	0	0	0

Miles River Turtle Back (MRTU). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1994 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
MRTU	**2**	0	0	0	0	0	0	0	0	0	0	0	0
MRTU	**7**	0	0	2	0	0	3	0	0	0	2	0	0
MRTU	**12**	0	0	4	0	0	19	0	0	0	3	1	2
MRTU	**17**	0	0	7	0	0	35	0	225	0	4	0	5
MRTU	**22**	0	0	2	0	0	63	0	449	0	3	2	8
MRTU	**27**	0	0	0	1	0	44	0	314	0	1	1	13
MRTU	**32**	0	0	0	1	0	23	2	314	0	0	1	17
MRTU	**37**	1	0	8	3	0	7	13	45	5	1	3	6
MRTU	**42**	5	0	15	8	0	0	38	0	15	0	4	6
MRTU	**47**	2	2	24	20	0	0	34	3	23	6	13	6
MRTU	**52**	6	5	16	22	2	2	17	18	46	14	9	7
MRTU	**57**	11	2	18	19	1	1	13	18	34	15	4	5
MRTU	**62**	8	3	9	40	4	3	7	29	39	30	4	2
MRTU	**67**	8	5	10	14	4	3	2	13	10	41	10	5
MRTU	**72**	4	2	6	19	4	6	2	19	16	56	13	11
MRTU	**77**	9	2	1	8	3	8	1	3	11	25	11	7
MRTU	**82**	9	7	2	5	6	2	4	2	9	37	29	18
MRTU	**87**	8	3	2	1	6	3	2	3	4	14	22	4
MRTU	**92**	2	6	2	5	1	1	7	5	4	8	14	9
MRTU	**97**	1	0	2	2	0	1	2	1	2	6	14	3
MRTU	**102**	2	4	3	1	3	2	4	0	0	3	8	1
MRTU	**107**	1	5	1	0	0	0	0	0	0	1	3	1
MRTU	**112**	0	2	1	1	0	0	1	1	1	0	2	1
MRTU	**117**	0	1	0	0	0	0	0	1	0	0	0	0
MRTU	**122**	0	0	0	1	0	0	0	0	0	0	0	0
MRTU	**127**	0	0	1	0	0	0	0	0	0	0	0	0
MRTU	**132**	1	0	1	0	0	0	0	0	0	0	0	0
MRTU	**137**	0	0	0	0	1	0	0	0	0	0	0	0
MRTU	**142**	0	0	0	0	0	0	0	0	0	0	0	0
MRTU	**147**	0	0	0	0	0	0	0	0	0	0	0	0
MRTU	**152**	0	0	0	0	0	0	0	0	0	0	0	0
MRTU	**157**	0	0	0	0	0	0	0	0	0	0	0	0
MRTU	**162**	0	0	0	0	0	0	0	0	0	0	0	0
MRTU	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Nanticoke River Middle Ground (NRMG). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NRMG	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRMG	**7**	0	0	0	2	0	0	0	0	nd	nd	nd	nd
NRMG	**12**	0	0	6	7	3	0	0	3	nd	nd	nd	nd
NRMG	**17**	0	0	21	3	5	0	1	15	nd	nd	nd	nd
NRMG	**22**	0	0	21	1	5	0	3	6	nd	nd	nd	nd
NRMG	**27**	0	0	9	1	11	0	1	0	nd	nd	nd	nd
NRMG	**32**	0	0	21	0	2	2	1	3	nd	nd	nd	nd
NRMG	**37**	0	0	12	0	2	1	0	0	nd	nd	nd	nd
NRMG	**42**	0	1	6	14	9	1	1	2	nd	nd	nd	nd
NRMG	**47**	0	9	3	15	8	2	0	1	nd	nd	nd	nd
NRMG	**52**	3	9	7	17	15	9	2	0	nd	nd	nd	nd
NRMG	**57**	3	11	4	14	15	11	0	1	nd	nd	nd	nd
NRMG	**62**	0	3	8	8	20	14	7	5	nd	nd	nd	nd
NRMG	**67**	2	7	3	5	17	13	4	2	nd	nd	nd	nd
NRMG	**72**	1	7	4	5	14	13	5	2	nd	nd	nd	nd
NRMG	**77**	4	4	5	4	13	13	5	2	nd	nd	nd	nd
NRMG	**82**	1	7	2	1	17	13	11	13	nd	nd	nd	nd
NRMG	**87**	0	4	0	0	8	5	6	3	nd	nd	nd	nd
NRMG	**92**	1	0	2	0	6	6	4	11	nd	nd	nd	nd
NRMG	**97**	0	1	0	0	2	7	0	4	nd	nd	nd	nd
NRMG	**102**	0	0	1	0	1	2	2	2	nd	nd	nd	nd
NRMG	**107**	0	1	0	0	1	0	6	3	nd	nd	nd	nd
NRMG	**112**	0	0	0	1	2	0	0	0	nd	nd	nd	nd
NRMG	**117**	0	0	0	0	0	0	0	1	nd	nd	nd	nd
NRMG	**122**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRMG	**127**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRMG	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRMG	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRMG	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRMG	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRMG	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRMG	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRMG	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRMG	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Nanticoke River Wetipiquin (NRWE). No data were used in subsequent analyses because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NRWE	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRWE	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRWE	**12**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRWE	**17**	0	0	3	0	2	0	0	0	nd	nd	nd	nd
NRWE	**22**	0	0	1	1	1	1	0	0	nd	nd	nd	nd
NRWE	**27**	0	0	1	0	0	0	0	0	nd	nd	nd	nd
NRWE	**32**	0	0	5	0	1	0	0	0	nd	nd	nd	nd
NRWE	**37**	0	0	5	1	0	0	0	0	nd	nd	nd	nd
NRWE	**42**	3	0	19	3	0	1	1	0	nd	nd	nd	nd
NRWE	**47**	4	9	36	8	0	1	0	0	nd	nd	nd	nd
NRWE	**52**	11	12	24	15	4	3	0	0	nd	nd	nd	nd
NRWE	**57**	8	34	16	14	3	1	6	0	nd	nd	nd	nd
NRWE	**62**	16	35	13	25	10	4	3	0	nd	nd	nd	nd
NRWE	**67**	15	34	17	26	8	2	6	3	nd	nd	nd	nd
NRWE	**72**	23	19	21	24	17	4	4	7	nd	nd	nd	nd
NRWE	**77**	14	13	18	28	19	2	6	5	nd	nd	nd	nd
NRWE	**82**	22	13	7	15	21	7	9	11	nd	nd	nd	nd
NRWE	**87**	7	5	12	3	11	5	11	4	nd	nd	nd	nd
NRWE	**92**	10	7	7	5	13	9	10	13	nd	nd	nd	nd
NRWE	**97**	2	4	10	4	4	4	5	5	nd	nd	nd	nd
NRWE	**102**	7	5	5	8	1	7	4	5	nd	nd	nd	nd
NRWE	**107**	1	2	0	2	0	4	3	0	nd	nd	nd	nd
NRWE	**112**	2	1	0	3	3	3	1	3	nd	nd	nd	nd
NRWE	**117**	2	2	0	1	1	4	2	1	nd	nd	nd	nd
NRWE	**122**	0	2	0	2	2	2	1	2	nd	nd	nd	nd
NRWE	**127**	0	0	0	0	0	1	0	0	nd	nd	nd	nd
NRWE	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRWE	**137**	0	0	0	0	1	0	0	1	nd	nd	nd	nd
NRWE	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRWE	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRWE	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRWE	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRWE	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
NRWE	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Nanticoke River Wilson Shoal (NRWS). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1992, 1996, and 1998 were not used because the site was repleted, and data from 1998 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NRWS	**2**	0	0	0	0	0	0	0	0	0	1	0	0
NRWS	**7**	0	0	0	0	0	0	0	0	0	0	0	0
NRWS	**12**	0	0	0	2	0	0	0	2	0	0	0	2
NRWS	**17**	0	0	2	1	4	0	0	8	0	0	3	5
NRWS	**22**	0	0	5	1	9	1	0	7	0	0	4	8
NRWS	**27**	0	0	9	2	8	0	0	3	0	0	3	13
NRWS	**32**	1	0	10	0	8	1	0	0	0	0	0	17
NRWS	**37**	2	0	7	0	2	0	0	1	0	0	0	6
NRWS	**42**	7	1	5	0	1	3	0	0	0	0	3	6
NRWS	**47**	12	1	3	1	3	1	0	2	1	0	0	6
NRWS	**52**	19	0	0	2	4	2	0	7	2	2	3	7
NRWS	**57**	19	0	1	8	4	14	0	10	2	2	1	5
NRWS	**62**	20	6	1	14	8	11	4	15	0	3	4	2
NRWS	**67**	18	8	0	11	7	23	7	10	4	3	1	5
NRWS	**72**	25	6	3	5	7	18	7	12	1	14	4	11
NRWS	**77**	11	15	7	11	17	6	11	11	3	7	3	7
NRWS	**82**	12	10	5	5	16	21	6	7	1	12	0	18
NRWS	**87**	4	10	1	6	11	5	7	8	2	6	2	4
NRWS	**92**	3	7	2	6	10	8	5	9	2	9	4	9
NRWS	**97**	3	6	3	3	1	2	4	4	0	3	2	3
NRWS	**102**	1	3	0	1	0	3	2	3	0	7	5	1
NRWS	**107**	2	1	1	3	0	3	0	1	0	1	1	1
NRWS	**112**	0	1	0	1	1	0	2	2	0	3	0	1
NRWS	**117**	0	1	1	0	0	0	1	2	1	0	0	0
NRWS	**122**	2	2	0	0	0	0	0	2	1	1	0	0
NRWS	**127**	0	0	0	0	1	0	0	0	0	1	0	0
NRWS	**132**	0	1	0	1	0	0	0	1	0	0	0	0
NRWS	**137**	0	0	0	0	0	0	0	1	1	0	0	0
NRWS	**142**	0	1	0	0	0	0	0	0	0	0	0	0
NRWS	**147**	0	0	0	0	0	0	0	0	0	0	0	0
NRWS	**152**	0	0	0	0	0	0	0	0	0	0	0	0
NRWS	**157**	0	0	0	0	0	0	0	0	0	0	0	0
NRWS	**162**	0	0	0	0	0	0	0	0	0	0	0	0
NRWS	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Poplar Island Shell Hill (POSH). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1992 to 1994 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
POSH	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
POSH	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
POSH	**12**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
POSH	**17**	0	0	0	0	0	1	0	0	nd	nd	nd	nd
POSH	**22**	0	0	0	0	0	1	0	0	nd	nd	nd	nd
POSH	**27**	0	0	0	0	0	2	0	6	nd	nd	nd	nd
POSH	**32**	0	0	0	0	0	5	0	4	nd	nd	nd	nd
POSH	**37**	0	0	3	0	0	6	0	9	nd	nd	nd	nd
POSH	**42**	0	0	2	0	0	0	0	0	nd	nd	nd	nd
POSH	**47**	0	0	5	1	0	0	2	0	nd	nd	nd	nd
POSH	**52**	1	2	0	0	0	0	1	0	nd	nd	nd	nd
POSH	**57**	0	2	0	2	2	0	4	0	nd	nd	nd	nd
POSH	**62**	1	6	1	0	1	0	3	0	nd	nd	nd	nd
POSH	**67**	2	2	1	0	1	0	0	0	nd	nd	nd	nd
POSH	**72**	5	4	3	2	0	2	1	2	nd	nd	nd	nd
POSH	**77**	7	1	0	5	0	3	2	1	nd	nd	nd	nd
POSH	**82**	8	3	0	4	1	0	2	2	nd	nd	nd	nd
POSH	**87**	8	3	1	2	0	5	2	2	nd	nd	nd	nd
POSH	**92**	7	3	1	2	0	1	4	2	nd	nd	nd	nd
POSH	**97**	6	4	1	0	0	0	0	1	nd	nd	nd	nd
POSH	**102**	3	10	0	0	0	1	2	2	nd	nd	nd	nd
POSH	**107**	0	4	2	0	0	0	1	2	nd	nd	nd	nd
POSH	**112**	0	1	0	0	1	1	0	0	nd	nd	nd	nd
POSH	**117**	2	2	0	0	0	0	1	0	nd	nd	nd	nd
POSH	**122**	0	2	1	0	0	0	0	0	nd	nd	nd	nd
POSH	**127**	0	0	0	1	0	0	0	0	nd	nd	nd	nd
POSH	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
POSH	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
POSH	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
POSH	**147**	1	0	0	0	0	0	0	0	nd	nd	nd	nd
POSH	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
POSH	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
POSH	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
POSH	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Potomac River Blue Sow (PRBS). No data were used in subsequent analyses because the length-frequency distributions were difficult to interpret and the site was repleted. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
PRBS	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**12**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**17**	0	0	0	1	0	2	0	0	nd	nd	nd	nd
PRBS	**22**	0	0	0	0	0	2	0	0	nd	nd	nd	nd
PRBS	**27**	0	0	0	0	0	0	0	1	nd	nd	nd	nd
PRBS	**32**	0	0	1	0	0	1	0	0	nd	nd	nd	nd
PRBS	**37**	0	0	4	0	0	2	0	2	nd	nd	nd	nd
PRBS	**42**	0	1	8	0	0	0	1	0	nd	nd	nd	nd
PRBS	**47**	0	1	13	2	0	0	2	1	nd	nd	nd	nd
PRBS	**52**	0	3	16	4	1	0	1	0	nd	nd	nd	nd
PRBS	**57**	0	2	10	10	3	0	0	1	nd	nd	nd	nd
PRBS	**62**	2	2	4	15	4	1	2	3	nd	nd	nd	nd
PRBS	**67**	5	1	4	10	6	2	1	1	nd	nd	nd	nd
PRBS	**72**	6	2	2	18	11	1	0	4	nd	nd	nd	nd
PRBS	**77**	5	6	1	8	24	6	2	2	nd	nd	nd	nd
PRBS	**82**	9	5	4	8	22	7	8	5	nd	nd	nd	nd
PRBS	**87**	5	0	5	6	7	5	8	7	nd	nd	nd	nd
PRBS	**92**	6	5	5	4	10	6	11	4	nd	nd	nd	nd
PRBS	**97**	3	4	2	1	4	6	7	3	nd	nd	nd	nd
PRBS	**102**	3	5	0	0	6	3	6	3	nd	nd	nd	nd
PRBS	**107**	1	2	0	0	0	1	0	1	nd	nd	nd	nd
PRBS	**112**	1	1	0	2	0	4	1	0	nd	nd	nd	nd
PRBS	**117**	0	1	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**122**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**127**	1	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**132**	0	1	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBS	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Potomac River Black Walnut (PRBW). No data were used in subsequent analyses because the length-frequency distributions were difficult to interpret and the site was repleted. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
PRBW	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**12**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**17**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**22**	0	0	0	1	0	0	0	2	nd	nd	nd	nd
PRBW	**27**	0	0	1	0	0	0	0	0	nd	nd	nd	nd
PRBW	**32**	0	0	1	0	0	0	1	0	nd	nd	nd	nd
PRBW	**37**	0	0	2	0	1	1	0	0	nd	nd	nd	nd
PRBW	**42**	0	1	2	1	1	0	0	0	nd	nd	nd	nd
PRBW	**47**	0	0	2	0	0	0	3	0	nd	nd	nd	nd
PRBW	**52**	0	0	0	4	0	0	4	1	nd	nd	nd	nd
PRBW	**57**	0	1	2	6	1	0	2	0	nd	nd	nd	nd
PRBW	**62**	0	2	0	12	6	3	0	2	nd	nd	nd	nd
PRBW	**67**	2	0	1	6	3	1	1	1	nd	nd	nd	nd
PRBW	**72**	2	1	0	6	14	8	5	1	nd	nd	nd	nd
PRBW	**77**	8	3	2	1	6	10	10	6	nd	nd	nd	nd
PRBW	**82**	9	5	4	4	5	8	6	8	nd	nd	nd	nd
PRBW	**87**	10	6	3	1	1	11	7	7	nd	nd	nd	nd
PRBW	**92**	11	3	0	3	3	7	5	11	nd	nd	nd	nd
PRBW	**97**	9	3	0	1	2	3	3	3	nd	nd	nd	nd
PRBW	**102**	6	8	1	2	1	0	1	4	nd	nd	nd	nd
PRBW	**107**	7	2	0	0	0	1	1	0	nd	nd	nd	nd
PRBW	**112**	2	0	1	1	0	1	1	1	nd	nd	nd	nd
PRBW	**117**	1	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**122**	1	1	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**127**	0	2	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRBW	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Potomac River Cornfield Harbor(PRCH). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1998 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
PRCH	**2**	0	0	0	0	0	0	0	0	0	1	0	0
PRCH	**7**	0	0	0	0	0	2	0	0	0	3	0	1
PRCH	**12**	0	0	0	2	0	5	0	0	0	5	0	7
PRCH	**17**	0	0	1	3	0	9	0	0	4	8	1	7
PRCH	**22**	0	0	1	9	0	17	0	0	2	5	0	11
PRCH	**27**	0	0	1	11	0	11	0	0	3	2	2	8
PRCH	**32**	1	1	3	4	0	5	0	3	1	1	1	1
PRCH	**37**	2	6	12	6	3	0	2	1	2	1	1	0
PRCH	**42**	7	5	9	12	7	0	6	1	0	1	2	0
PRCH	**47**	9	7	5	7	14	1	5	1	4	2	6	1
PRCH	**52**	9	14	6	1	12	4	10	2	3	0	2	0
PRCH	**57**	6	7	1	2	7	6	5	7	3	1	5	2
PRCH	**62**	11	6	0	3	6	9	5	18	2	1	0	3
PRCH	**67**	3	12	3	0	7	11	4	23	4	5	1	1
PRCH	**72**	9	8	4	0	7	8	8	34	5	1	2	0
PRCH	**77**	1	7	1	3	1	5	4	15	10	1	3	1
PRCH	**82**	4	5	3	0	3	6	4	9	10	1	1	1
PRCH	**87**	0	3	2	1	1	0	0	9	0	1	0	1
PRCH	**92**	0	1	2	1	0	2	1	6	4	0	1	0
PRCH	**97**	0	1	1	1	1	0	1	2	0	1	0	0
PRCH	**102**	1	1	0	1	0	0	0	2	0	0	0	0
PRCH	**107**	0	0	0	0	0	0	0	3	1	0	0	0
PRCH	**112**	0	0	0	0	0	0	0	1	0	0	0	0
PRCH	**117**	0	0	0	0	0	0	0	0	0	0	1	0
PRCH	**122**	0	0	0	0	0	0	0	0	0	0	0	0
PRCH	**127**	0	0	0	0	0	0	0	0	0	0	0	0
PRCH	**132**	0	0	0	0	0	0	0	0	0	0	0	0
PRCH	**137**	0	0	0	0	0	0	0	0	0	0	0	0
PRCH	**142**	0	0	0	0	0	0	0	0	0	0	0	0
PRCH	**147**	0	0	0	0	0	0	0	0	0	0	0	0
PRCH	**152**	0	0	0	0	0	0	0	0	0	0	0	0
PRCH	**157**	0	0	0	0	0	0	0	0	0	0	0	0
PRCH	**162**	0	0	0	0	0	0	0	0	0	0	0	0
PRCH	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Potomac River Dukehart Channel (PRDC). No data were used in subsequent analyses because the length-frequency distributions were difficult to interpret or there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
PRDC	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**12**	0	0	0	1	0	0	0	0	nd	nd	nd	nd
PRDC	**17**	0	0	0	0	0	1	0	0	nd	nd	nd	nd
PRDC	**22**	0	0	0	1	0	0	0	0	nd	nd	nd	nd
PRDC	**27**	0	0	0	1	0	0	0	0	nd	nd	nd	nd
PRDC	**32**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**37**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**42**	0	0	1	0	0	0	0	0	nd	nd	nd	nd
PRDC	**47**	0	0	2	0	0	0	0	0	nd	nd	nd	nd
PRDC	**52**	0	0	5	2	0	0	0	0	nd	nd	nd	nd
PRDC	**57**	0	0	6	0	0	0	0	0	nd	nd	nd	nd
PRDC	**62**	0	1	7	2	1	0	0	0	nd	nd	nd	nd
PRDC	**67**	1	0	1	3	3	1	0	0	nd	nd	nd	nd
PRDC	**72**	3	1	0	1	2	2	0	3	nd	nd	nd	nd
PRDC	**77**	4	1	1	0	1	4	2	0	nd	nd	nd	nd
PRDC	**82**	3	1	5	0	3	10	0	0	nd	nd	nd	nd
PRDC	**87**	5	1	2	2	1	4	2	1	nd	nd	nd	nd
PRDC	**92**	6	1	4	4	0	5	2	0	nd	nd	nd	nd
PRDC	**97**	6	6	4	1	0	6	3	3	nd	nd	nd	nd
PRDC	**102**	4	5	2	1	3	1	2	4	nd	nd	nd	nd
PRDC	**107**	4	2	2	1	0	1	1	2	nd	nd	nd	nd
PRDC	**112**	3	3	0	1	1	1	1	3	nd	nd	nd	nd
PRDC	**117**	0	1	0	1	0	0	1	0	nd	nd	nd	nd
PRDC	**122**	0	0	0	1	0	0	1	1	nd	nd	nd	nd
PRDC	**127**	0	0	1	0	0	0	0	0	nd	nd	nd	nd
PRDC	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**147**	0	1	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PRDC	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Potomac River Lower Cedar Point (PRLC). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1996 to 2001 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
PRLC	**2**	0	0	0	0	0	0	0	0	0	0	0	0
PRLC	**7**	0	0	0	0	0	0	0	0	0	0	0	0
PRLC	**12**	0	0	1	0	0	0	0	0	0	0	0	0
PRLC	**17**	0	0	2	0	0	0	0	0	0	0	0	0
PRLC	**22**	0	0	7	0	0	0	0	0	0	0	0	0
PRLC	**27**	0	0	0	0	0	0	0	0	0	0	0	0
PRLC	**32**	0	0	2	1	0	0	0	0	0	0	0	0
PRLC	**37**	0	1	2	4	0	0	0	0	0	0	0	0
PRLC	**42**	0	1	5	7	0	0	0	0	0	0	0	1
PRLC	**47**	0	0	11	10	1	0	0	0	0	0	0	0
PRLC	**52**	0	3	22	8	3	0	0	0	0	0	0	0
PRLC	**57**	0	0	17	9	11	2	0	0	0	0	0	0
PRLC	**62**	4	1	19	8	10	0	1	1	0	0	0	2
PRLC	**67**	2	1	15	18	20	3	1	2	1	1	0	0
PRLC	**72**	15	6	8	18	32	9	4	5	0	0	0	0
PRLC	**77**	25	2	5	10	17	13	7	3	1	1	1	1
PRLC	**82**	19	8	8	6	17	10	4	9	4	1	1	1
PRLC	**87**	22	9	5	3	12	2	6	1	5	3	2	1
PRLC	**92**	10	9	6	2	10	5	6	7	0	6	3	4
PRLC	**97**	5	9	7	0	2	2	6	0	1	7	3	2
PRLC	**102**	1	8	6	1	0	2	5	1	6	8	5	3
PRLC	**107**	1	0	2	0	0	0	3	1	3	4	4	1
PRLC	**112**	2	4	3	0	1	0	1	0	3	3	3	3
PRLC	**117**	0	1	0	0	0	0	0	0	0	2	0	3
PRLC	**122**	0	0	0	0	0	0	0	0	1	0	2	3
PRLC	**127**	0	0	0	0	0	0	0	0	1	0	0	2
PRLC	**132**	0	0	0	0	0	0	0	0	0	0	0	1
PRLC	**137**	0	0	0	0	0	0	0	0	0	0	0	0
PRLC	**142**	0	0	0	0	0	0	0	0	0	0	0	1
PRLC	**147**	0	0	0	0	0	0	0	0	0	0	0	0
PRLC	**152**	0	0	0	0	0	0	0	0	0	0	0	0
PRLC	**157**	0	0	0	0	0	0	0	0	0	0	0	0
PRLC	**162**	0	0	0	0	0	0	0	0	0	0	0	0
PRLC	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Potomac River Ragged Point (PRRP). Data from 1990 and 1991, and 1996-2001 were not used in subsequent analyses because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
PRRP	2	0	0	0	0	0	0	0	0	0	0	0	0
PRRP	7	0	0	0	0	0	0	0	0	0	0	0	0
PRRP	12	0	0	0	0	0	0	0	5	0	0	0	0
PRRP	17	0	0	0	0	0	1	0	16	0	0	0	0
PRRP	22	0	0	0	1	0	3	0	37	0	1	0	0
PRRP	27	0	0	0	0	0	5	0	27	0	0	1	0
PRRP	32	0	0	0	1	0	3	0	16	0	0	0	0
PRRP	37	0	0	0	0	0	7	0	5	0	0	0	0
PRRP	42	0	0	2	0	0	0	0	1	0	0	0	0
PRRP	47	0	0	0	0	0	0	3	3	1	1	1	0
PRRP	52	0	0	0	0	1	0	1	2	0	1	1	0
PRRP	57	0	4	0	0	0	0	6	5	0	1	0	0
PRRP	62	0	1	0	0	1	0	2	4	1	2	0	0
PRRP	67	2	0	4	0	0	0	0	5	2	3	1	0
PRRP	72	3	5	1	3	0	0	0	19	2	2	0	0
PRRP	77	3	3	2	0	0	0	0	12	1	3	1	0
PRRP	82	2	1	4	1	3	2	0	21	2	3	2	2
PRRP	87	1	2	4	5	0	1	1	17	6	2	1	0
PRRP	92	1	0	3	4	1	0	1	18	3	3	1	0
PRRP	97	0	2	3	1	0	4	2	5	1	1	1	0
PRRP	102	0	1	2	3	6	1	0	8	0	3	1	0
PRRP	107	3	0	3	1	1	1	0	1	0	1	0	0
PRRP	112	1	1	0	3	0	0	0	0	2	2	0	0
PRRP	117	1	0	4	0	0	1	0	1	1	0	1	0
PRRP	122	1	0	0	2	0	0	0	0	0	0	0	0
PRRP	127	0	0	0	0	0	1	0	0	0	0	0	0
PRRP	132	0	0	0	1	0	0	0	0	0	0	0	0
PRRP	137	0	0	0	0	0	0	0	0	0	0	0	0
PRRP	142	0	0	0	0	0	0	0	0	0	0	0	0
PRRP	147	0	0	0	0	0	0	0	0	0	0	0	0
PRRP	152	0	0	0	0	0	0	0	0	0	0	0	0
PRRP	157	0	0	0	0	0	0	0	0	0	0	0	0
PRRP	162	0	0	0	0	0	0	0	0	0	0	0	0
PRRP	167	0	0	0	0	0	0	0	0	0	0	0	0

Pocomoke Sound Gunby (PSGU). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1996 were not used because the length-frequency distributions were difficult to interpret, and data from 1997 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
PSGU	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**7**	0	0	0	2	0	0	3	0	nd	nd	nd	nd
PSGU	**12**	0	0	3	5	0	0	1	0	nd	nd	nd	nd
PSGU	**17**	0	0	46	18	1	0	0	0	nd	nd	nd	nd
PSGU	**22**	0	0	61	16	4	3	1	0	nd	nd	nd	nd
PSGU	**27**	0	0	32	14	2	1	2	0	nd	nd	nd	nd
PSGU	**32**	1	2	8	19	0	0	2	0	nd	nd	nd	nd
PSGU	**37**	0	2	15	8	1	1	0	0	nd	nd	nd	nd
PSGU	**42**	1	4	13	39	3	0	0	0	nd	nd	nd	nd
PSGU	**47**	3	4	19	38	18	2	1	1	nd	nd	nd	nd
PSGU	**52**	0	5	11	29	38	1	2	2	nd	nd	nd	nd
PSGU	**57**	2	3	9	10	27	1	2	3	nd	nd	nd	nd
PSGU	**62**	4	3	6	12	40	3	2	1	nd	nd	nd	nd
PSGU	**67**	8	3	1	5	22	3	3	0	nd	nd	nd	nd
PSGU	**72**	2	4	1	5	44	8	1	0	nd	nd	nd	nd
PSGU	**77**	5	0	1	2	10	7	2	3	nd	nd	nd	nd
PSGU	**82**	1	0	1	1	14	6	6	3	nd	nd	nd	nd
PSGU	**87**	0	0	2	0	6	2	1	2	nd	nd	nd	nd
PSGU	**92**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**97**	0	0	0	0	0	0	0	1	nd	nd	nd	nd
PSGU	**102**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**107**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**112**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**117**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**122**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**127**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PSGU	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Pocomoke Sound Marumsco (PSMA). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1997 and 2001 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
PSMA	**2**	0	0	0	0	0	0	0	0	0	1	0	0
PSMA	**7**	0	0	0	0	0	0	0	0	0	2	1	0
PSMA	**12**	0	0	0	6	0	0	0	0	9	6	5	0
PSMA	**17**	0	0	8	12	0	1	0	0	21	8	4	3
PSMA	**22**	0	0	7	18	0	2	0	0	20	5	7	0
PSMA	**27**	0	0	11	21	1	1	0	0	1	2	4	0
PSMA	**32**	0	0	6	3	0	1	0	1	5	2	5	1
PSMA	**37**	0	0	6	1	6	1	0	0	1	6	5	1
PSMA	**42**	0	4	5	5	1	0	0	1	4	13	9	0
PSMA	**47**	0	5	5	8	2	0	2	1	7	11	7	5
PSMA	**52**	1	4	9	11	7	1	2	4	8	18	12	4
PSMA	**57**	4	5	9	9	13	2	1	2	3	12	6	5
PSMA	**62**	8	4	7	6	14	3	3	0	1	7	19	11
PSMA	**67**	4	4	0	8	10	5	2	2	2	4	9	5
PSMA	**72**	5	4	1	9	9	10	3	2	7	9	3	10
PSMA	**77**	6	3	0	3	4	3	4	2	1	3	10	5
PSMA	**82**	4	1	0	0	3	3	8	0	3	7	2	9
PSMA	**87**	3	4	2	0	2	3	4	0	2	2	1	1
PSMA	**92**	0	1	1	0	0	2	2	4	2	0	3	1
PSMA	**97**	0	2	0	0	1	2	0	0	2	3	2	1
PSMA	**102**	0	1	0	0	1	0	0	0	0	0	0	1
PSMA	**107**	0	0	0	0	1	0	1	0	0	0	0	0
PSMA	**112**	0	0	0	0	0	0	0	0	0	1	0	0
PSMA	**117**	0	0	0	0	0	0	0	0	0	1	0	0
PSMA	**122**	0	0	0	0	0	0	0	0	0	0	0	1
PSMA	**127**	0	0	0	0	0	0	0	0	0	0	0	0
PSMA	**132**	0	0	0	0	0	0	0	0	0	0	0	0
PSMA	**137**	0	0	0	0	0	0	0	0	0	0	0	0
PSMA	**142**	0	0	0	0	0	0	0	0	0	0	0	0
PSMA	**147**	0	0	0	0	0	0	0	0	0	0	0	0
PSMA	**152**	0	0	0	0	0	0	0	0	0	0	0	0
PSMA	**157**	0	0	0	0	0	0	0	0	0	0	0	0
PSMA	**162**	0	0	0	0	0	0	0	0	0	0	0	0
PSMA	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Patuxent River Back of Island (PXBA). No data were used in subsequent analyses because the length-frequency distributions were difficult to interpret or there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
PXBA	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PXBA	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PXBA	**12**	0	0	0	0	0	1	0	0	nd	nd	nd	nd
PXBA	**17**	0	0	1	0	0	1	0	0	nd	nd	nd	nd
PXBA	**22**	0	0	0	0	0	3	0	0	nd	nd	nd	nd
PXBA	**27**	0	0	3	0	0	4	0	1	nd	nd	nd	nd
PXBA	**32**	0	0	1	0	1	4	0	1	nd	nd	nd	nd
PXBA	**37**	0	1	0	0	1	4	0	1	nd	nd	nd	nd
PXBA	**42**	0	0	11	0	1	0	0	0	nd	nd	nd	nd
PXBA	**47**	0	4	4	1	2	0	0	0	nd	nd	nd	nd
PXBA	**52**	0	6	1	2	1	1	2	0	nd	nd	nd	nd
PXBA	**57**	0	1	4	2	5	3	2	0	nd	nd	nd	nd
PXBA	**62**	2	4	1	4	6	4	2	0	nd	nd	nd	nd
PXBA	**67**	5	6	0	3	6	2	2	0	nd	nd	nd	nd
PXBA	**72**	6	10	0	1	9	2	2	2	nd	nd	nd	nd
PXBA	**77**	5	6	2	0	6	6	1	5	nd	nd	nd	nd
PXBA	**82**	9	7	2	0	3	3	3	9	nd	nd	nd	nd
PXBA	**87**	5	6	1	0	2	1	1	6	nd	nd	nd	nd
PXBA	**92**	6	5	0	0	0	5	4	12	nd	nd	nd	nd
PXBA	**97**	3	1	1	0	0	1	3	6	nd	nd	nd	nd
PXBA	**102**	3	2	0	0	0	1	4	2	nd	nd	nd	nd
PXBA	**107**	1	1	0	0	0	0	1	3	nd	nd	nd	nd
PXBA	**112**	1	0	0	0	0	0	4	0	nd	nd	nd	nd
PXBA	**117**	0	0	1	0	0	0	1	0	nd	nd	nd	nd
PXBA	**122**	0	0	0	0	0	0	1	0	nd	nd	nd	nd
PXBA	**127**	1	0	0	0	0	0	0	0	nd	nd	nd	nd
PXBA	**132**	0	1	0	0	0	0	0	0	nd	nd	nd	nd
PXBA	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PXBA	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PXBA	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PXBA	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PXBA	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PXBA	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
PXBA	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Patuxent River Bruffs Island (PXBI). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1992 to 1994, and 2001 were not used because the length-frequency distributions were difficult to interpret, and data from 1998 and 2000 were not used because the sites was repleted. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
PXBI	**2**	0	0	0	0	0	0	0	0	0	0	0	0
PXBI	**7**	0	0	0	0	0	1	0	0	0	1	0	0
PXBI	**12**	0	0	0	0	0	1	0	0	0	1	0	0
PXBI	**17**	0	0	0	0	0	2	0	0	0	3	0	1
PXBI	**22**	0	0	0	0	0	4	0	0	0	1	0	0
PXBI	**27**	0	0	0	0	0	11	0	0	1	1	0	0
PXBI	**32**	0	0	0	0	0	13	0	0	0	0	1	0
PXBI	**37**	0	0	0	0	0	26	1	0	0	0	5	0
PXBI	**42**	0	0	1	0	0	1	0	0	2	0	7	0
PXBI	**47**	1	0	0	0	0	0	4	0	0	0	8	0
PXBI	**52**	0	0	0	0	0	0	5	0	0	0	8	0
PXBI	**57**	0	0	0	0	0	0	6	1	0	0	5	1
PXBI	**62**	5	0	2	2	0	1	5	0	0	0	6	3
PXBI	**67**	4	0	4	1	1	0	0	2	0	0	0	0
PXBI	**72**	16	3	2	1	1	2	1	1	1	1	3	1
PXBI	**77**	19	1	1	0	0	7	1	6	2	3	4	1
PXBI	**82**	14	7	6	2	1	7	1	9	3	1	5	2
PXBI	**87**	11	11	3	2	0	3	2	1	4	3	3	1
PXBI	**92**	5	12	5	2	2	4	5	5	3	4	7	1
PXBI	**97**	9	9	2	0	0	2	4	3	3	2	1	0
PXBI	**102**	2	6	0	0	1	4	1	2	1	3	2	1
PXBI	**107**	2	3	5	1	0	0	2	4	7	5	4	0
PXBI	**112**	2	1	2	3	0	1	1	2	2	4	3	0
PXBI	**117**	1	1	1	0	2	1	0	3	2	6	3	0
PXBI	**122**	2	0	0	0	0	0	0	2	2	2	0	0
PXBI	**127**	0	0	0	0	0	0	0	1	1	3	0	0
PXBI	**132**	1	1	0	0	0	0	0	0	0	0	1	0
PXBI	**137**	0	0	0	0	0	0	0	0	1	2	1	0
PXBI	**142**	0	0	0	0	0	0	0	0	0	0	0	0
PXBI	**147**	0	0	0	0	0	0	0	0	0	0	0	0
PXBI	**152**	0	0	0	0	0	0	0	0	0	0	0	0
PXBI	**157**	0	0	0	0	0	0	0	0	0	0	0	0
PXBI	**162**	0	0	0	0	0	0	0	0	0	0	0	0
PXBI	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Saint Mary's River Chicken Cock (SMCC). Data from 1990 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1994 and 2000 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
SMCC	**2**	0	0	0	0	0	0	0	0	0	5	0	0
SMCC	**7**	0	0	0	0	0	3	0	1	0	16	1	0
SMCC	**12**	0	0	0	1	0	3	0	2	0	28	0	2
SMCC	**17**	0	0	5	4	0	8	0	5	1	41	1	2
SMCC	**22**	0	0	5	18	1	30	0	11	2	27	5	1
SMCC	**27**	1	0	1	13	0	25	0	5	3	12	6	4
SMCC	**32**	1	0	9	9	3	9	2	11	3	3	9	4
SMCC	**37**	0	6	10	6	3	0	5	1	2	0	8	4
SMCC	**42**	5	5	10	5	7	3	9	0	5	0	13	3
SMCC	**47**	10	13	19	11	9	8	13	3	10	0	8	2
SMCC	**52**	8	14	11	18	11	20	13	5	13	0	1	11
SMCC	**57**	19	10	13	13	20	25	7	13	11	0	1	11
SMCC	**62**	16	7	6	13	10	30	20	26	6	1	1	10
SMCC	**67**	23	10	6	6	20	16	18	43	15	4	0	6
SMCC	**72**	22	12	7	13	15	23	31	43	19	7	3	2
SMCC	**77**	12	11	4	7	12	32	26	33	32	2	0	0
SMCC	**82**	16	11	6	12	4	18	22	27	32	5	0	1
SMCC	**87**	9	9	6	3	1	2	16	11	21	3	0	1
SMCC	**92**	7	7	1	4	4	2	8	16	10	2	0	0
SMCC	**97**	3	3	3	0	0	0	3	3	0	0	0	0
SMCC	**102**	3	0	0	2	0	1	1	3	4	0	0	0
SMCC	**107**	0	0	0	0	1	1	2	1	0	0	0	0
SMCC	**112**	0	0	0	0	0	0	0	2	0	0	0	0
SMCC	**117**	0	0	0	0	0	0	0	1	0	0	0	0
SMCC	**122**	0	0	0	0	0	0	0	0	0	0	0	0
SMCC	**127**	0	0	0	0	0	0	0	0	0	0	0	0
SMCC	**132**	0	0	0	0	0	0	0	0	0	0	0	0
SMCC	**137**	0	0	0	0	0	0	0	0	0	0	0	0
SMCC	**142**	0	0	0	0	0	0	0	0	0	0	0	0
SMCC	**147**	0	0	0	0	0	0	0	0	0	0	0	0
SMCC	**152**	0	0	0	0	0	0	0	0	0	0	0	0
SMCC	**157**	0	0	0	0	0	0	0	0	0	0	0	0
SMCC	**162**	0	0	0	0	0	0	0	0	0	0	0	0
SMCC	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Saint Mary's River Pagan (SMPA). Data from 1990 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1995 and 1996 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
SMPA	**2**	0	0	0	0	0	0	0	0	0	4	0	0
SMPA	**7**	0	0	7	0	0	0	0	42	1	12	0	18
SMPA	**12**	0	0	12	4	3	4	0	293	0	20	5	44
SMPA	**17**	1	0	27	2	2	15	0	669	1	30	6	32
SMPA	**22**	0	2	16	5	2	16	1	460	1	19	16	18
SMPA	**27**	0	4	8	3	0	23	0	126	2	8	13	1
SMPA	**32**	0	25	18	5	6	27	4	84	12	3	10	6
SMPA	**37**	1	51	29	11	6	37	6	0	30	5	15	2
SMPA	**42**	5	44	50	22	16	73	14	0	32	15	11	6
SMPA	**47**	14	24	54	16	14	91	17	3	44	29	11	12
SMPA	**52**	21	14	54	30	15	72	10	2	26	56	26	13
SMPA	**57**	33	8	38	29	23	55	12	13	6	60	30	8
SMPA	**62**	33	6	19	29	21	55	16	38	4	102	53	7
SMPA	**67**	33	4	16	8	13	29	15	24	2	47	42	24
SMPA	**72**	32	8	4	13	16	36	26	43	5	37	40	25
SMPA	**77**	13	2	1	1	3	25	20	26	3	19	17	11
SMPA	**82**	8	3	0	1	5	10	15	34	4	15	14	9
SMPA	**87**	2	0	1	0	0	3	8	11	3	3	6	5
SMPA	**92**	0	0	0	0	0	1	3	13	0	4	2	2
SMPA	**97**	0	0	0	0	1	0	1	2	0	1	2	2
SMPA	**102**	0	0	0	0	0	0	1	5	0	1	1	0
SMPA	**107**	0	0	0	0	0	0	0	0	0	0	1	0
SMPA	**112**	0	0	0	0	0	0	0	0	0	1	0	0
SMPA	**117**	0	0	0	0	0	0	0	0	0	0	0	0
SMPA	**122**	0	0	0	0	0	0	0	0	0	0	0	0
SMPA	**127**	0	0	0	0	0	0	0	0	0	0	0	0
SMPA	**132**	0	0	0	0	0	0	0	0	0	0	0	0
SMPA	**137**	0	0	0	0	0	0	0	0	0	0	0	0
SMPA	**142**	0	0	0	0	0	0	0	0	0	0	0	0
SMPA	**147**	0	0	0	0	0	0	0	0	0	0	0	0
SMPA	**152**	0	0	0	0	0	0	0	0	0	0	0	0
SMPA	**157**	0	0	0	0	0	0	0	0	0	0	0	0
SMPA	**162**	0	0	0	0	0	0	0	0	0	0	0	0
SMPA	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Tred Avon River Double Mills (TADM). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1999 and 2000 were not used because the length-frequency distributions were difficult to interpret, and data from 1996 and 2001 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TADM	**2**	0	0	0	0	0	0	0	1	0	0	0	0
TADM	**7**	0	0	0	3	0	0	0	0	0	0	0	0
TADM	**12**	0	0	0	4	0	0	0	2	0	0	0	0
TADM	**17**	0	0	0	4	0	2	0	9	0	0	0	0
TADM	**22**	0	0	0	2	0	1	0	13	0	1	0	0
TADM	**27**	0	0	0	0	0	4	0	9	0	0	0	0
TADM	**32**	0	1	1	0	0	3	0	2	0	0	0	0
TADM	**37**	0	0	3	1	0	6	0	4	1	0	0	0
TADM	**42**	0	1	8	1	1	0	0	0	3	1	0	0
TADM	**47**	0	1	15	2	2	0	1	0	4	0	0	0
TADM	**52**	0	0	13	10	5	0	0	0	16	1	0	0
TADM	**57**	0	0	5	14	3	1	2	0	10	2	0	0
TADM	**62**	0	0	1	11	2	4	4	0	12	9	2	0
TADM	**67**	1	0	1	20	3	8	0	1	6	5	4	2
TADM	**72**	2	0	2	7	6	13	3	4	3	23	1	0
TADM	**77**	0	0	0	4	9	8	1	5	1	17	1	0
TADM	**82**	2	0	0	1	13	12	1	8	1	13	9	4
TADM	**87**	4	1	0	0	11	7	4	8	2	7	6	4
TADM	**92**	12	0	2	0	16	16	3	6	3	6	13	0
TADM	**97**	14	0	2	1	10	5	1	6	4	0	6	3
TADM	**102**	9	0	0	1	13	9	2	9	12	1	7	5
TADM	**107**	16	1	0	0	2	2	2	2	4	1	1	2
TADM	**112**	3	0	0	0	2	3	3	5	7	1	3	2
TADM	**117**	2	0	0	0	1	1	3	2	6	2	1	0
TADM	**122**	4	2	0	0	0	0	1	7	5	2	0	2
TADM	**127**	1	0	0	0	0	0	0	4	1	0	2	0
TADM	**132**	4	0	0	0	0	0	0	0	2	0	0	0
TADM	**137**	0	0	0	0	0	0	0	0	2	0	1	0
TADM	**142**	0	1	0	0	0	0	0	2	1	0	0	0
TADM	**147**	0	0	0	0	0	0	0	0	2	1	0	0
TADM	**152**	0	1	0	0	0	0	0	0	0	0	1	0
TADM	**157**	0	0	0	0	0	0	0	0	0	0	0	0
TADM	**162**	0	0	0	0	0	0	0	0	0	0	0	0
TADM	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Tangier Sound Back Cove (TSBC). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1993 were not used because the length-frequency distributions were difficult to interpret, and data from 1992 were not used because the Solver would not converge on a solution. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TSBC	**2**	0	0	0	0	0	0	0	0	0	19	0	0
TSBC	**7**	0	0	0	10	0	0	1	1	0	63	2	3
TSBC	**12**	0	0	65	30	7	19	7	3	0	109	5	58
TSBC	**17**	0	0	151	22	13	32	17	4	4	158	11	53
TSBC	**22**	0	0	367	25	15	61	24	8	2	104	23	40
TSBC	**27**	2	0	238	29	3	32	14	4	2	45	3	31
TSBC	**32**	5	0	108	39	5	23	7	1	3	12	10	20
TSBC	**37**	16	7	44	31	28	1	12	5	5	2	14	6
TSBC	**42**	27	19	4	63	52	13	29	12	3	2	39	12
TSBC	**47**	24	25	4	44	53	13	32	16	6	2	46	11
TSBC	**52**	38	16	0	23	51	14	23	16	6	7	42	10
TSBC	**57**	40	12	1	4	45	10	9	13	4	4	38	13
TSBC	**62**	63	11	0	3	25	20	12	9	6	3	21	18
TSBC	**67**	38	13	0	1	16	10	11	10	2	1	10	20
TSBC	**72**	30	13	1	0	17	16	8	7	13	4	7	18
TSBC	**77**	14	9	0	0	12	6	9	5	7	2	1	6
TSBC	**82**	7	4	0	0	2	2	3	6	5	7	0	11
TSBC	**87**	2	7	1	0	0	3	3	2	8	3	0	3
TSBC	**92**	1	1	1	0	2	0	1	5	7	5	1	4
TSBC	**97**	1	0	0	0	0	0	0	2	4	0	1	3
TSBC	**102**	1	1	0	0	0	0	1	1	0	0	1	0
TSBC	**107**	0	0	0	0	0	0	0	0	0	1	0	0
TSBC	**112**	0	0	0	0	0	0	0	0	0	3	0	0
TSBC	**117**	0	0	0	0	0	0	0	0	0	0	0	0
TSBC	**122**	0	0	0	0	0	0	0	0	0	0	0	0
TSBC	**127**	0	0	0	0	0	0	0	0	0	0	0	0
TSBC	**132**	0	0	0	0	0	0	0	0	0	0	0	0
TSBC	**137**	0	0	0	0	0	0	0	0	0	0	0	0
TSBC	**142**	0	0	0	0	0	0	0	0	0	0	0	0
TSBC	**147**	0	0	0	0	0	0	0	0	0	0	0	0
TSBC	**152**	0	0	0	0	0	0	0	0	0	0	0	0
TSBC	**157**	0	0	0	0	0	0	0	0	0	0	0	0
TSBC	**162**	0	0	0	0	0	0	0	0	0	0	0	0
TSBC	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Tangier Sound Great Rock (TSGR). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1995 to 1997 were not used because the length-frequency distributions were difficult to interpret or there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TSGR	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSGR	**7**	0	0	1	3	0	1	2	0	nd	nd	nd	nd
TSGR	**12**	0	0	3	14	0	1	1	0	nd	nd	nd	nd
TSGR	**17**	0	0	7	4	0	0	1	0	nd	nd	nd	nd
TSGR	**22**	0	0	16	6	3	0	1	0	nd	nd	nd	nd
TSGR	**27**	0	0	12	0	3	1	1	0	nd	nd	nd	nd
TSGR	**32**	0	2	7	3	6	0	1	0	nd	nd	nd	nd
TSGR	**37**	4	2	12	6	8	0	0	1	nd	nd	nd	nd
TSGR	**42**	14	10	27	4	10	1	0	0	nd	nd	nd	nd
TSGR	**47**	5	7	12	7	6	0	0	2	nd	nd	nd	nd
TSGR	**52**	5	6	7	15	9	6	0	5	nd	nd	nd	nd
TSGR	**57**	1	4	5	8	4	3	0	3	nd	nd	nd	nd
TSGR	**62**	2	1	3	6	5	3	2	2	nd	nd	nd	nd
TSGR	**67**	0	1	3	7	8	4	0	0	nd	nd	nd	nd
TSGR	**72**	0	0	0	2	10	6	3	0	nd	nd	nd	nd
TSGR	**77**	0	0	0	1	4	2	4	1	nd	nd	nd	nd
TSGR	**82**	0	0	0	2	1	1	1	3	nd	nd	nd	nd
TSGR	**87**	0	0	0	0	1	2	1	5	nd	nd	nd	nd
TSGR	**92**	0	0	0	0	3	3	3	6	nd	nd	nd	nd
TSGR	**97**	0	0	0	0	0	0	0	3	nd	nd	nd	nd
TSGR	**102**	0	0	0	0	1	0	1	2	nd	nd	nd	nd
TSGR	**107**	0	0	1	0	0	0	0	1	nd	nd	nd	nd
TSGR	**112**	0	0	0	0	0	0	0	3	nd	nd	nd	nd
TSGR	**117**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSGR	**122**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSGR	**127**	0	0	0	0	0	0	0	1	nd	nd	nd	nd
TSGR	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSGR	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSGR	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSGR	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSGR	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSGR	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSGR	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSGR	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Tangier Sound Old Womans Leg (TSOW). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, and data from 1992 and 1998 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TSOW	**2**	0	0	0	0	0	0	0	0	0	10	0	4
TSOW	**7**	0	0	0	2	0	0	0	1	0	35	1	25
TSOW	**12**	0	0	1	5	1	1	2	5	0	61	3	90
TSOW	**17**	0	0	1	5	0	0	5	3	2	89	7	105
TSOW	**22**	0	0	2	12	0	0	1	2	5	58	13	79
TSOW	**27**	2	0	2	5	2	0	2	0	0	25	6	25
TSOW	**32**	4	0	3	8	4	0	1	1	5	7	7	14
TSOW	**37**	24	2	0	19	5	0	0	0	1	0	8	6
TSOW	**42**	47	6	1	31	10	2	0	0	1	2	6	5
TSOW	**47**	32	8	0	53	10	0	0	1	0	4	14	7
TSOW	**52**	32	6	2	41	8	3	1	2	2	5	20	3
TSOW	**57**	28	4	1	11	8	5	0	1	1	6	15	6
TSOW	**62**	48	11	2	10	12	6	2	1	2	8	12	2
TSOW	**67**	34	3	0	1	7	9	3	1	4	4	3	5
TSOW	**72**	19	3	0	1	6	4	7	0	0	2	4	4
TSOW	**77**	14	5	0	3	7	1	7	1	0	2	4	1
TSOW	**82**	3	5	1	3	5	1	7	2	0	2	7	9
TSOW	**87**	4	3	1	0	0	1	6	3	2	0	5	1
TSOW	**92**	1	3	1	1	1	0	8	7	0	0	2	2
TSOW	**97**	0	1	1	0	0	0	1	6	0	0	2	1
TSOW	**102**	0	0	0	0	1	0	1	1	1	3	0	2
TSOW	**107**	0	1	0	0	0	0	1	2	0	1	0	0
TSOW	**112**	0	0	0	0	0	0	1	0	0	0	0	1
TSOW	**117**	0	0	0	0	0	0	0	0	0	0	0	0
TSOW	**122**	0	0	0	0	0	0	0	0	0	0	0	0
TSOW	**127**	0	0	0	0	0	0	0	0	0	0	0	0
TSOW	**132**	0	0	0	0	0	0	0	0	0	0	0	0
TSOW	**137**	0	0	0	0	0	0	0	0	0	0	0	0
TSOW	**142**	0	0	0	0	0	0	0	0	0	0	0	0
TSOW	**147**	0	0	0	0	0	0	0	0	0	0	0	0
TSOW	**152**	0	0	0	0	0	0	0	0	0	0	0	0
TSOW	**157**	0	0	0	0	0	0	0	0	0	0	0	0
TSOW	**162**	0	0	0	0	0	0	0	0	0	0	0	0
TSOW	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Tangier Sound Piney Island (TSPI). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1998, 1999, and 2000 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TSPI	**2**	0	0	0	0	0	0	1	0	0	0	0	0
TSPI	**7**	0	0	10	5	0	0	1	4	1	0	1	3
TSPI	**12**	0	0	34	9	0	2	5	11	1	4	2	27
TSPI	**17**	0	0	68	2	0	8	6	7	2	2	3	79
TSPI	**22**	0	0	120	4	0	6	2	5	2	0	12	44
TSPI	**27**	1	1	59	2	1	3	4	9	1	0	4	12
TSPI	**32**	7	0	43	7	9	1	4	5	4	0	5	4
TSPI	**37**	10	7	17	20	36	3	3	4	3	3	5	5
TSPI	**42**	20	10	15	61	29	8	3	0	1	5	6	18
TSPI	**47**	30	6	13	65	34	7	3	0	1	8	2	11
TSPI	**52**	28	5	5	49	24	10	3	2	1	25	6	12
TSPI	**57**	32	8	4	12	26	6	4	1	0	27	3	7
TSPI	**62**	29	9	4	6	42	14	4	1	0	64	4	10
TSPI	**67**	13	5	1	3	16	11	2	1	1	50	1	5
TSPI	**72**	19	10	3	2	25	14	4	4	0	48	2	4
TSPI	**77**	3	6	3	0	8	9	7	3	1	41	0	6
TSPI	**82**	1	1	1	0	2	13	4	0	1	29	0	9
TSPI	**87**	1	1	1	0	0	6	4	2	1	22	1	1
TSPI	**92**	0	0	0	0	1	4	3	3	1	5	1	2
TSPI	**97**	0	0	0	0	0	2	2	2	2	2	0	0
TSPI	**102**	0	0	0	0	0	1	2	3	1	1	1	0
TSPI	**107**	0	0	0	0	0	0	1	0	1	0	0	0
TSPI	**112**	0	0	0	0	0	0	0	2	0	2	0	0
TSPI	**117**	0	0	0	0	0	0	0	1	1	1	1	0
TSPI	**122**	0	0	0	0	0	0	0	0	1	0	1	0
TSPI	**127**	0	0	0	0	0	0	0	0	1	0	0	0
TSPI	**132**	0	0	0	0	0	0	0	0	0	0	0	0
TSPI	**137**	0	0	0	0	0	0	0	0	2	0	0	0
TSPI	**142**	0	0	0	0	0	0	0	0	0	0	0	0
TSPI	**147**	0	0	0	0	0	0	0	0	0	0	0	0
TSPI	**152**	0	0	0	0	0	0	0	0	0	0	0	0
TSPI	**157**	0	0	0	0	0	0	0	0	0	0	0	0
TSPI	**162**	0	0	0	0	0	0	0	0	0	0	0	0
TSPI	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Tangier Sound Sharkfin Shoal (TSSS). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1998 were not used because the length-frequency distributions were difficult to interpret, and data from 2000 and 2001 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TSSS	**2**	0	0	0	0	0	0	0	0	0	0	0	0
TSSS	**7**	0	0	1	4	0	0	0	0	0	1	0	0
TSSS	**12**	0	0	9	4	1	0	0	1	0	2	0	0
TSSS	**17**	0	0	22	8	5	2	0	3	0	3	0	0
TSSS	**22**	0	0	26	2	3	1	0	0	0	2	0	0
TSSS	**27**	0	0	23	1	1	2	0	2	0	1	0	0
TSSS	**32**	0	0	14	8	0	0	0	1	0	0	0	0
TSSS	**37**	1	2	6	14	2	1	0	0	0	0	0	0
TSSS	**42**	5	1	3	34	4	1	0	0	1	0	0	0
TSSS	**47**	5	12	2	24	12	1	1	0	0	0	0	0
TSSS	**52**	11	14	3	29	18	5	2	0	4	0	2	0
TSSS	**57**	8	21	0	25	24	2	0	1	5	0	0	2
TSSS	**62**	19	16	1	9	31	6	3	0	1	0	2	0
TSSS	**67**	16	15	1	1	27	7	4	2	2	1	1	2
TSSS	**72**	16	24	2	2	37	13	4	0	4	0	1	0
TSSS	**77**	9	15	2	0	21	9	6	3	0	0	2	2
TSSS	**82**	3	12	2	1	6	11	10	5	4	1	1	1
TSSS	**87**	2	7	1	0	4	6	8	10	2	1	2	0
TSSS	**92**	0	9	1	0	4	4	8	7	4	3	0	1
TSSS	**97**	0	2	1	0	0	3	8	8	5	3	0	0
TSSS	**102**	0	1	0	0	0	1	2	3	3	4	1	2
TSSS	**107**	0	0	0	0	0	1	4	1	1	2	0	0
TSSS	**112**	0	0	0	0	0	0	1	0	5	4	2	4
TSSS	**117**	0	0	0	0	0	0	0	0	1	1	0	1
TSSS	**122**	0	0	0	0	0	0	0	0	1	1	1	0
TSSS	**127**	0	0	0	0	0	0	0	0	1	0	1	0
TSSS	**132**	0	0	0	0	0	0	0	0	0	2	1	1
TSSS	**137**	0	0	0	0	0	0	0	0	1	0	0	1
TSSS	**142**	0	0	0	0	0	0	0	0	0	0	0	0
TSSS	**147**	0	0	0	0	0	0	0	0	0	0	0	0
TSSS	**152**	0	0	0	0	0	0	0	0	0	0	0	0
TSSS	**157**	0	0	0	0	0	0	0	0	0	0	0	0
TSSS	**162**	0	0	0	0	0	0	0	0	0	0	0	0
TSSS	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Tangier Sound Turtle Egg Island (TSTE). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TSTE	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**7**	0	0	0	8	0	0	2	0	nd	nd	nd	nd
TSTE	**12**	0	0	26	12	1	1	3	0	nd	nd	nd	nd
TSTE	**17**	0	0	104	8	9	1	10	0	nd	nd	nd	nd
TSTE	**22**	2	0	174	5	8	1	8	0	nd	nd	nd	nd
TSTE	**27**	2	0	193	7	11	2	5	1	nd	nd	nd	nd
TSTE	**32**	1	0	86	10	7	0	5	1	nd	nd	nd	nd
TSTE	**37**	4	4	33	38	17	2	3	1	nd	nd	nd	nd
TSTE	**42**	7	12	9	61	34	1	1	0	nd	nd	nd	nd
TSTE	**47**	13	18	6	52	28	6	5	0	nd	nd	nd	nd
TSTE	**52**	12	11	3	36	34	10	2	0	nd	nd	nd	nd
TSTE	**57**	13	13	3	18	38	10	2	0	nd	nd	nd	nd
TSTE	**62**	24	9	1	8	45	16	2	0	nd	nd	nd	nd
TSTE	**67**	27	4	0	3	35	19	6	0	nd	nd	nd	nd
TSTE	**72**	16	9	1	2	42	18	9	2	nd	nd	nd	nd
TSTE	**77**	17	9	0	1	19	9	6	5	nd	nd	nd	nd
TSTE	**82**	10	5	0	1	15	11	4	9	nd	nd	nd	nd
TSTE	**87**	0	3	0	1	3	4	5	6	nd	nd	nd	nd
TSTE	**92**	0	4	0	0	2	4	3	12	nd	nd	nd	nd
TSTE	**97**	0	3	0	0	2	1	1	6	nd	nd	nd	nd
TSTE	**102**	0	0	0	0	0	0	1	2	nd	nd	nd	nd
TSTE	**107**	0	0	0	0	0	0	2	3	nd	nd	nd	nd
TSTE	**112**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**117**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**122**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**127**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
TSTE	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Upper Bay Brick House (UBBH). No data were used in subsequent analyses because the length-frequency distributions were difficult to interpret or Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
UBBH	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBBH	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBBH	**12**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBBH	**17**	0	0	0	0	0	1	0	0	nd	nd	nd	nd
UBBH	**22**	0	0	0	0	0	1	0	0	nd	nd	nd	nd
UBBH	**27**	0	0	0	0	0	1	0	0	nd	nd	nd	nd
UBBH	**32**	0	0	0	0	0	2	0	0	nd	nd	nd	nd
UBBH	**37**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBBH	**42**	0	0	0	0	1	0	1	0	nd	nd	nd	nd
UBBH	**47**	3	0	0	1	0	0	3	0	nd	nd	nd	nd
UBBH	**52**	3	0	0	1	1	0	1	0	nd	nd	nd	nd
UBBH	**57**	0	4	0	1	1	0	4	0	nd	nd	nd	nd
UBBH	**62**	5	3	1	0	1	0	2	3	nd	nd	nd	nd
UBBH	**67**	1	1	0	3	0	5	3	4	nd	nd	nd	nd
UBBH	**72**	1	5	4	2	1	7	4	3	nd	nd	nd	nd
UBBH	**77**	5	7	3	7	1	5	4	7	nd	nd	nd	nd
UBBH	**82**	1	5	3	12	2	11	7	8	nd	nd	nd	nd
UBBH	**87**	4	10	1	10	5	8	9	8	nd	nd	nd	nd
UBBH	**92**	2	10	5	20	2	2	4	2	nd	nd	nd	nd
UBBH	**97**	3	2	0	13	0	3	5	2	nd	nd	nd	nd
UBBH	**102**	12	5	2	13	5	3	2	1	nd	nd	nd	nd
UBBH	**107**	7	6	1	4	0	3	2	0	nd	nd	nd	nd
UBBH	**112**	3	8	2	0	0	2	1	0	nd	nd	nd	nd
UBBH	**117**	2	1	1	5	2	0	0	3	nd	nd	nd	nd
UBBH	**122**	3	3	1	2	0	0	0	0	nd	nd	nd	nd
UBBH	**127**	1	1	0	2	2	0	0	0	nd	nd	nd	nd
UBBH	**132**	4	0	2	2	0	1	0	0	nd	nd	nd	nd
UBBH	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBBH	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBBH	**147**	0	0	0	1	0	0	0	0	nd	nd	nd	nd
UBBH	**152**	0	0	1	0	0	0	0	0	nd	nd	nd	nd
UBBH	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBBH	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBBH	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Upper Bay Hacketts (UBHA). No data were used in subsequent analyses because the length-frequency distributions were difficult to interpret or the site was repleted. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
UBHA	2	0	0	0	0	0	0	0	0	0	0	0	0
UBHA	7	0	0	0	0	0	0	0	0	0	0	0	0
UBHA	12	0	0	0	0	0	0	0	0	0	0	0	0
UBHA	17	0	0	0	0	0	0	0	0	0	0	0	0
UBHA	22	0	0	0	1	0	0	0	0	0	0	0	0
UBHA	27	0	0	0	1	0	0	0	0	0	0	1	0
UBHA	32	0	0	0	1	1	0	0	0	0	0	0	0
UBHA	37	0	1	0	0	0	0	0	0	0	0	0	0
UBHA	42	0	2	0	0	0	0	1	0	0	0	0	0
UBHA	47	0	11	1	1	2	0	0	3	0	0	1	0
UBHA	52	0	24	1	0	2	0	0	2	0	0	1	2
UBHA	57	0	24	1	0	2	3	3	1	0	0	1	0
UBHA	62	2	32	8	1	2	9	4	1	1	1	8	3
UBHA	67	6	32	14	1	1	16	10	0	2	2	18	1
UBHA	72	7	12	40	14	6	24	9	2	4	2	23	4
UBHA	77	8	9	13	22	5	21	19	2	5	5	30	4
UBHA	82	7	7	9	27	9	20	10	2	3	3	22	4
UBHA	87	10	8	4	20	4	14	5	6	4	2	4	2
UBHA	92	7	5	5	11	10	8	3	2	2	6	10	3
UBHA	97	7	4	1	4	4	6	0	4	2	4	4	3
UBHA	102	2	14	2	4	4	1	0	0	1	5	3	6
UBHA	107	1	2	1	1	0	1	2	1	2	4	1	3
UBHA	112	1	2	1	1	5	2	1	1	1	3	0	3
UBHA	117	0	3	0	1	0	0	0	0	0	0	0	1
UBHA	122	1	0	1	1	0	2	0	0	0	1	0	1
UBHA	127	1	0	0	1	0	0	0	0	0	0	1	0
UBHA	132	0	0	0	0	0	0	0	0	1	0	0	0
UBHA	137	0	0	0	0	0	0	0	0	0	0	0	0
UBHA	142	1	1	0	0	0	0	0	0	0	0	0	0
UBHA	147	0	0	0	0	0	0	0	0	0	0	0	0
UBHA	152	0	1	0	0	0	0	0	0	0	0	0	0
UBHA	157	0	0	0	0	0	0	0	0	0	0	0	0
UBHA	162	0	0	0	0	0	0	0	0	0	0	0	0
UBHA	167	0	0	0	0	0	0	0	0	0	0	0	0

Upper Bay Three Sisters (UBTS). No data were used in subsequent analyses because there were too few oysters to clearly distinguish cohorts or the site was repleted. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
UBTS	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**12**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**17**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**22**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**27**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**32**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**37**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**42**	0	2	1	0	0	0	1	0	nd	nd	nd	nd
UBTS	**47**	0	6	0	0	0	0	1	0	nd	nd	nd	nd
UBTS	**52**	0	14	1	0	0	0	1	0	nd	nd	nd	nd
UBTS	**57**	0	19	1	0	0	0	0	0	nd	nd	nd	nd
UBTS	**62**	1	11	5	1	0	0	0	0	nd	nd	nd	nd
UBTS	**67**	1	4	11	0	0	0	0	0	nd	nd	nd	nd
UBTS	**72**	1	2	19	3	0	0	0	0	nd	nd	nd	nd
UBTS	**77**	1	2	17	9	5	0	0	0	nd	nd	nd	nd
UBTS	**82**	7	3	11	7	6	0	0	1	nd	nd	nd	nd
UBTS	**87**	3	7	14	16	2	1	0	2	nd	nd	nd	nd
UBTS	**92**	5	4	9	6	8	2	3	0	nd	nd	nd	nd
UBTS	**97**	9	4	5	2	5	2	5	0	nd	nd	nd	nd
UBTS	**102**	7	6	5	5	1	1	0	0	nd	nd	nd	nd
UBTS	**107**	4	2	4	2	0	1	3	0	nd	nd	nd	nd
UBTS	**112**	1	2	2	2	0	0	0	2	nd	nd	nd	nd
UBTS	**117**	1	4	2	1	0	0	0	3	nd	nd	nd	nd
UBTS	**122**	0	0	1	0	0	0	0	1	nd	nd	nd	nd
UBTS	**127**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**132**	0	0	0	1	0	0	0	0	nd	nd	nd	nd
UBTS	**137**	0	1	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**162**	1	0	0	0	0	0	0	0	nd	nd	nd	nd
UBTS	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Wicomico River Evans Shoal (WRES). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1992 were not used because the site was repleted, and data from 1996 and 1997 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
WRES	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRES	**7**	0	0	0	0	0	0	0	1	nd	nd	nd	nd
WRES	**12**	0	0	0	1	2	0	0	0	nd	nd	nd	nd
WRES	**17**	0	0	4	4	3	2	0	1	nd	nd	nd	nd
WRES	**22**	0	0	9	1	6	0	0	3	nd	nd	nd	nd
WRES	**27**	0	0	12	1	6	0	0	0	nd	nd	nd	nd
WRES	**32**	0	0	3	0	10	1	1	0	nd	nd	nd	nd
WRES	**37**	0	0	1	0	3	0	0	1	nd	nd	nd	nd
WRES	**42**	0	2	3	0	2	1	1	0	nd	nd	nd	nd
WRES	**47**	0	0	0	0	2	1	0	6	nd	nd	nd	nd
WRES	**52**	0	1	0	4	4	5	0	5	nd	nd	nd	nd
WRES	**57**	2	1	3	1	7	5	0	3	nd	nd	nd	nd
WRES	**62**	3	2	2	8	12	9	0	7	nd	nd	nd	nd
WRES	**67**	6	4	2	2	9	9	0	4	nd	nd	nd	nd
WRES	**72**	8	3	0	5	14	14	1	4	nd	nd	nd	nd
WRES	**77**	5	0	0	2	5	6	3	4	nd	nd	nd	nd
WRES	**82**	4	4	1	2	9	13	2	2	nd	nd	nd	nd
WRES	**87**	3	1	1	0	13	5	1	7	nd	nd	nd	nd
WRES	**92**	5	3	0	1	13	6	4	5	nd	nd	nd	nd
WRES	**97**	2	5	1	0	5	0	3	2	nd	nd	nd	nd
WRES	**102**	2	2	1	0	1	4	1	5	nd	nd	nd	nd
WRES	**107**	0	1	0	0	2	4	0	0	nd	nd	nd	nd
WRES	**112**	0	1	0	0	3	0	0	3	nd	nd	nd	nd
WRES	**117**	0	0	0	0	0	0	1	0	nd	nd	nd	nd
WRES	**122**	0	0	0	0	0	0	0	1	nd	nd	nd	nd
WRES	**127**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRES	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRES	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRES	**142**	0	0	1	0	0	0	0	0	nd	nd	nd	nd
WRES	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRES	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRES	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRES	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRES	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Wicomico River Mt. Vernon Wharf (WRMV). Data from 1990 to 1992 were not used in subsequent analyses because a Age-0 cohort could not be identified. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
WRMV	**2**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRMV	**7**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRMV	**12**	0	0	0	1	0	0	0	0	nd	nd	nd	nd
WRMV	**17**	0	0	0	7	0	0	0	0	nd	nd	nd	nd
WRMV	**22**	0	0	0	8	0	0	0	0	nd	nd	nd	nd
WRMV	**27**	0	0	0	1	1	0	0	0	nd	nd	nd	nd
WRMV	**32**	1	0	0	4	1	1	0	0	nd	nd	nd	nd
WRMV	**37**	1	0	0	5	4	0	0	0	nd	nd	nd	nd
WRMV	**42**	0	0	0	5	5	0	0	0	nd	nd	nd	nd
WRMV	**47**	0	1	0	4	0	0	2	0	nd	nd	nd	nd
WRMV	**52**	4	0	0	6	1	17	1	0	nd	nd	nd	nd
WRMV	**57**	17	3	0	5	2	9	0	2	nd	nd	nd	nd
WRMV	**62**	17	6	5	4	1	22	3	2	nd	nd	nd	nd
WRMV	**67**	28	13	0	13	4	30	9	3	nd	nd	nd	nd
WRMV	**72**	58	24	15	9	3	10	16	8	nd	nd	nd	nd
WRMV	**77**	26	25	25	11	3	13	21	6	nd	nd	nd	nd
WRMV	**82**	8	21	15	17	9	10	27	16	nd	nd	nd	nd
WRMV	**87**	5	13	30	21	7	10	16	13	nd	nd	nd	nd
WRMV	**92**	5	5	45	21	14	8	12	11	nd	nd	nd	nd
WRMV	**97**	1	2	20	6	8	5	8	12	nd	nd	nd	nd
WRMV	**102**	1	3	15	5	6	2	9	8	nd	nd	nd	nd
WRMV	**107**	1	1	5	1	6	0	4	4	nd	nd	nd	nd
WRMV	**112**	1	0	0	3	0	5	1	0	nd	nd	nd	nd
WRMV	**117**	1	0	0	1	0	0	1	1	nd	nd	nd	nd
WRMV	**122**	0	0	0	0	2	0	1	0	nd	nd	nd	nd
WRMV	**127**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRMV	**132**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRMV	**137**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRMV	**142**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRMV	**147**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRMV	**152**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRMV	**157**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRMV	**162**	0	0	0	0	0	0	0	0	nd	nd	nd	nd
WRMV	**167**	0	0	0	0	0	0	0	0	nd	nd	nd	nd

Western Shore Butler (WSBU). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified, data from 1992 to 1998 were not used because the length-frequency distributions were difficult to interpret, and data from 2000 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
WSBU	**2**	0	0	0	0	0	0	0	0	0	0	0	0
WSBU	**7**	0	0	0	0	0	0	0	0	0	1	0	0
WSBU	**12**	0	0	0	0	0	2	0	0	0	1	0	0
WSBU	**17**	0	0	0	0	0	1	0	0	0	2	0	0
WSBU	**22**	0	0	3	1	0	4	0	0	0	1	0	6
WSBU	**27**	0	0	2	0	1	0	0	0	0	1	0	4
WSBU	**32**	0	1	3	1	0	0	1	5	0	0	1	15
WSBU	**37**	0	4	9	2	0	0	0	3	0	0	1	3
WSBU	**42**	0	2	19	1	0	0	2	0	0	2	0	0
WSBU	**47**	5	7	12	5	0	0	4	1	0	3	0	0
WSBU	**52**	13	14	7	4	2	0	10	1	1	2	1	2
WSBU	**57**	61	6	4	4	3	0	13	3	2	0	0	0
WSBU	**62**	64	9	2	3	2	4	11	3	2	0	3	1
WSBU	**67**	39	13	2	9	8	1	7	9	0	0	2	1
WSBU	**72**	22	17	3	3	5	3	6	5	4	2	2	1
WSBU	**77**	9	13	2	4	4	1	8	3	3	1	3	1
WSBU	**82**	5	19	4	3	4	0	7	8	5	2	1	2
WSBU	**87**	3	12	1	1	3	0	10	3	11	1	1	3
WSBU	**92**	0	6	0	1	1	0	4	0	5	8	1	1
WSBU	**97**	0	4	0	0	2	0	7	3	5	0	1	2
WSBU	**102**	3	1	1	0	0	0	5	4	2	1	2	2
WSBU	**107**	0	1	0	0	0	1	1	1	1	0	0	0
WSBU	**112**	0	0	0	0	0	0	1	1	0	0	0	0
WSBU	**117**	0	0	0	0	0	0	0	0	1	1	0	0
WSBU	**122**	0	0	0	0	0	0	0	0	0	0	0	0
WSBU	**127**	0	0	0	0	0	0	0	0	0	0	0	0
WSBU	**132**	0	0	0	0	0	0	0	0	0	0	0	0
WSBU	**137**	0	0	0	0	0	0	0	0	0	0	0	0
WSBU	**142**	0	0	0	0	0	0	0	0	0	0	0	0
WSBU	**147**	0	0	0	0	0	0	0	0	0	0	0	0
WSBU	**152**	0	0	0	0	0	0	0	0	0	0	0	0
WSBU	**157**	0	0	0	0	0	0	0	0	0	0	0	0
WSBU	**162**	0	0	0	0	0	0	0	0	0	0	0	0
WSBU	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Western Shore Flag Pond (WSFP). No data were used in subsequent analyses because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
WSFP	**2**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**7**	0	0	0	0	0	1	0	0	0	0	0	0
WSFP	**12**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**17**	0	0	0	1	0	0	0	0	0	0	2	0
WSFP	**22**	0	0	0	0	0	3	0	0	0	0	0	0
WSFP	**27**	0	0	0	5	0	2	0	1	0	0	1	0
WSFP	**32**	0	0	1	4	0	3	0	3	0	0	2	4
WSFP	**37**	1	0	0	3	0	2	0	3	0	0	0	1
WSFP	**42**	3	0	11	5	0	0	2	0	0	0	0	0
WSFP	**47**	4	3	4	1	1	1	0	0	0	0	0	1
WSFP	**52**	2	2	1	1	3	1	2	0	0	0	0	0
WSFP	**57**	6	6	4	1	2	1	2	0	0	0	0	2
WSFP	**62**	5	10	1	0	6	1	6	2	1	0	0	2
WSFP	**67**	9	10	0	0	5	1	2	3	2	1	0	0
WSFP	**72**	15	13	0	1	3	0	2	5	0	0	0	0
WSFP	**77**	10	9	2	0	2	4	2	4	0	0	0	0
WSFP	**82**	14	13	2	0	0	2	5	6	0	0	0	0
WSFP	**87**	4	8	1	0	0	2	2	2	0	0	0	0
WSFP	**92**	4	4	0	0	1	0	6	1	1	0	0	0
WSFP	**97**	2	4	1	0	0	0	1	2	0	0	0	0
WSFP	**102**	2	0	0	0	0	0	0	1	0	0	0	0
WSFP	**107**	0	2	0	0	0	0	0	1	0	0	0	0
WSFP	**112**	0	1	0	0	0	0	0	0	0	0	0	0
WSFP	**117**	0	0	1	0	0	0	0	1	0	0	0	0
WSFP	**122**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**127**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**132**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**137**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**142**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**147**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**152**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**157**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**162**	0	0	0	0	0	0	0	0	0	0	0	0
WSFP	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Western Shore Hog Island (WSHI). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified and data from 1992 to 1994 and 1998 to 2000 were not used because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
WSHI	**2**	0	0	0	0	0	0	0	0	0	0	0	0
WSHI	**7**	0	0	0	0	0	0	0	0	0	1	0	1
WSHI	**12**	0	0	0	0	0	0	0	0	0	1	0	1
WSHI	**17**	0	0	0	0	0	0	0	0	0	2	0	6
WSHI	**22**	0	0	0	0	0	1	0	0	3	1	0	7
WSHI	**27**	0	0	0	0	0	3	0	1	2	1	1	9
WSHI	**32**	0	1	3	0	0	2	0	0	0	0	0	5
WSHI	**37**	0	0	1	0	0	11	0	4	1	1	1	3
WSHI	**42**	0	0	7	1	0	0	0	0	0	2	1	2
WSHI	**47**	1	0	1	0	0	1	2	0	0	1	1	1
WSHI	**52**	6	0	0	0	2	0	2	0	0	1	2	1
WSHI	**57**	4	1	4	1	1	0	7	1	1	5	0	2
WSHI	**62**	24	1	1	1	2	0	4	1	1	0	23	5
WSHI	**67**	37	3	0	2	1	0	2	3	2	3	0	6
WSHI	**72**	53	4	0	3	6	1	4	10	3	1	2	2
WSHI	**77**	38	10	1	0	4	4	1	7	2	0	1	5
WSHI	**82**	12	9	1	0	0	5	0	12	1	0	2	2
WSHI	**87**	7	9	0	1	0	2	2	3	1	0	0	0
WSHI	**92**	3	5	1	0	0	1	1	3	3	2	0	1
WSHI	**97**	1	3	0	1	0	2	0	4	1	2	0	1
WSHI	**102**	0	1	0	0	0	1	2	3	0	0	0	1
WSHI	**107**	0	0	0	0	0	1	0	2	1	1	0	2
WSHI	**112**	0	0	0	0	0	0	0	2	0	0	1	1
WSHI	**117**	0	0	0	0	0	0	1	1	1	0	0	0
WSHI	**122**	0	0	0	0	0	0	0	0	0	0	0	0
WSHI	**127**	0	0	0	0	0	0	0	0	0	0	0	0
WSHI	**132**	0	0	0	0	0	0	0	0	0	0	0	0
WSHI	**137**	0	0	0	0	0	0	0	0	0	0	0	0
WSHI	**142**	0	0	0	0	0	0	0	0	0	0	0	0
WSHI	**147**	0	0	0	0	0	0	0	0	0	0	0	0
WSHI	**152**	0	0	0	0	0	0	0	0	0	0	0	0
WSHI	**157**	0	0	0	0	0	0	0	0	0	0	0	0
WSHI	**162**	0	0	0	0	0	0	0	0	0	0	0	0
WSHI	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Western Shore Holland Point (WSHP). No data were used in subsequent analyses because there were too few oysters to clearly distinguish cohorts. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
WSHP	**2**	0	0	0	0	0	0	0	0	0	0	0	0
WSHP	**7**	0	0	0	0	0	0	0	0	0	0	0	0
WSHP	**12**	0	0	0	0	0	0	0	0	0	0	0	0
WSHP	**17**	0	0	0	0	0	0	0	0	0	0	0	1
WSHP	**22**	0	0	0	0	0	0	0	0	0	0	0	0
WSHP	**27**	0	0	0	0	0	0	0	0	0	0	0	0
WSHP	**32**	0	0	0	0	0	0	0	0	0	0	0	0
WSHP	**37**	0	0	0	0	1	0	0	0	0	0	0	0
WSHP	**42**	0	0	0	0	0	0	0	0	0	0	0	0
WSHP	**47**	0	1	0	0	0	0	2	0	0	0	0	0
WSHP	**52**	2	0	0	0	1	0	0	0	0	0	1	0
WSHP	**57**	2	0	0	0	1	0	2	0	0	1	0	2
WSHP	**62**	7	0	0	0	0	0	0	0	0	1	0	3
WSHP	**67**	10	0	3	1	0	0	0	1	0	2	0	1
WSHP	**72**	7	1	2	5	0	0	0	1	0	8	0	1
WSHP	**77**	1	2	0	4	0	1	0	2	0	9	0	1
WSHP	**82**	11	5	4	9	8	1	0	1	4	3	1	0
WSHP	**87**	5	4	7	7	10	2	2	2	2	1	2	0
WSHP	**92**	14	4	5	12	7	5	2	1	1	2	1	3
WSHP	**97**	12	17	9	5	3	3	0	3	1	2	3	0
WSHP	**102**	8	12	5	8	8	1	2	0	3	4	4	2
WSHP	**107**	8	10	4	8	1	7	4	3	2	3	4	1
WSHP	**112**	5	9	5	2	2	2	3	3	5	0	7	1
WSHP	**117**	4	4	6	0	2	1	1	5	2	0	2	0
WSHP	**122**	4	4	2	3	0	0	0	5	0	0	0	0
WSHP	**127**	2	4	4	0	0	1	0	2	0	1	1	0
WSHP	**132**	2	3	2	1	0	0	0	0	2	0	0	0
WSHP	**137**	0	0	0	0	1	0	0	1	1	0	1	0
WSHP	**142**	0	0	1	0	2	0	0	0	0	0	0	0
WSHP	**147**	0	0	0	0	0	0	0	0	0	0	2	0
WSHP	**152**	0	0	0	0	0	0	0	0	0	0	1	0
WSHP	**157**	0	0	0	0	0	0	0	0	0	0	0	0
WSHP	**162**	0	0	0	0	0	0	0	0	0	0	0	0
WSHP	**167**	0	0	0	0	0	0	0	0	0	0	0	0

Wicomico River Lancaster (WWLA). No data were used in subsequent analyses because the length-frequency distributions were difficult to interpret or the site was repleted. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
WWLA	**2**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**7**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**12**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**17**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**22**	0	0	1	0	0	0	0	0	0	1	0	0
WWLA	**27**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**32**	0	1	0	0	0	0	0	1	0	0	0	0
WWLA	**37**	0	4	3	0	0	0	0	0	1	0	0	0
WWLA	**42**	0	13	5	3	0	0	0	0	0	0	0	0
WWLA	**47**	0	11	10	11	0	0	0	0	0	0	0	0
WWLA	**52**	0	21	19	8	2	0	0	3	6	0	0	0
WWLA	**57**	0	24	24	13	2	0	1	0	4	0	0	0
WWLA	**62**	1	10	34	31	7	0	0	0	23	9	1	0
WWLA	**67**	4	2	45	35	20	3	2	2	14	10	0	3
WWLA	**72**	6	6	48	41	24	21	10	6	12	15	6	2
WWLA	**77**	17	2	27	20	20	27	11	7	11	7	3	1
WWLA	**82**	19	1	15	12	15	20	18	8	6	29	5	3
WWLA	**87**	13	3	5	8	12	13	13	6	1	11	4	3
WWLA	**92**	9	2	4	5	5	5	12	3	2	7	5	4
WWLA	**97**	5	2	3	1	0	4	5	2	1	1	1	2
WWLA	**102**	1	4	1	0	0	1	5	4	3	3	2	3
WWLA	**107**	1	0	1	0	0	0	1	1	1	1	1	0
WWLA	**112**	1	1	1	1	0	0	0	0	1	0	0	0
WWLA	**117**	0	1	1	0	0	10	0	0	0	0	0	0
WWLA	**122**	1	1	0	0	0	0	1	1	0	0	0	0
WWLA	**127**	1	0	0	0	0	0	0	0	0	0	0	0
WWLA	**132**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**137**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**142**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**147**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**152**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**157**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**162**	0	0	0	0	0	0	0	0	0	0	0	0
WWLA	**167**	0	0	0	0	0	0	0	0	0	0	0	0

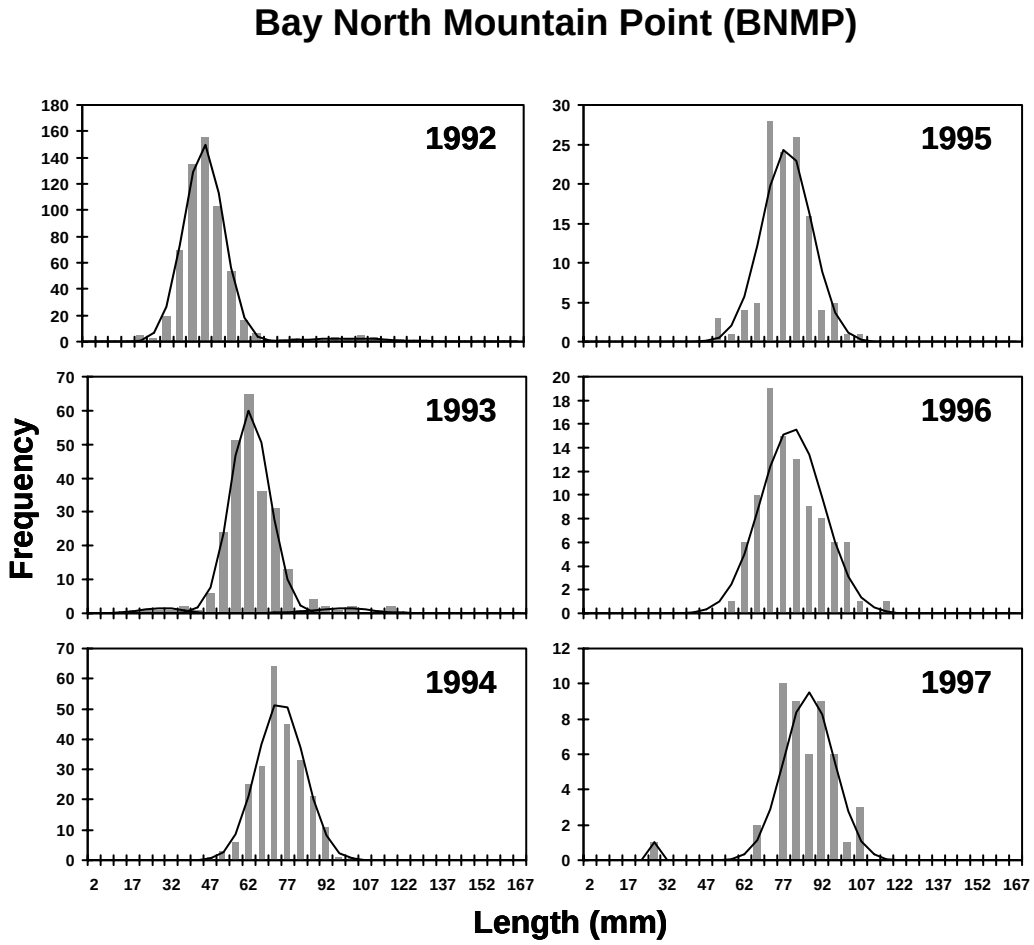
Wicomico River Mills West (WWMW). Data from 1990 and 1991 were not used in subsequent analyses because a Age-0 cohort could not be identified and data from 1997 to 2001 were not used because the length-frequency distributions were difficult to interpret. Class is the midpoint of the 5 mm length-class.

SITE	CLASS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
WWMW	**2**	0	0	0	0	0	0	0	0	0	0	0	0
WWMW	**7**	0	0	0	0	0	0	0	0	0	0	0	0
WWMW	**12**	0	0	7	0	0	0	0	0	0	0	0	0
WWMW	**17**	0	0	30	0	0	0	0	0	0	0	0	0
WWMW	**22**	0	0	24	0	0	0	0	0	0	0	0	0
WWMW	**27**	0	0	14	0	0	0	0	0	0	0	0	0
WWMW	**32**	0	0	13	7	0	0	0	1	0	0	0	0
WWMW	**37**	0	0	35	24	0	0	0	0	0	0	0	0
WWMW	**42**	0	0	39	20	10	0	0	1	0	0	1	0
WWMW	**47**	2	0	29	50	20	2	0	1	0	0	0	0
WWMW	**52**	1	0	23	66	36	2	0	4	1	0	0	0
WWMW	**57**	2	1	7	72	39	9	0	2	0	0	0	0
WWMW	**62**	2	1	2	50	48	17	7	0	0	0	1	0
WWMW	**67**	18	0	4	19	52	23	4	2	1	1	1	1
WWMW	**72**	32	4	3	7	55	53	19	2	2	4	0	2
WWMW	**77**	40	7	5	6	31	36	31	2	6	1	3	4
WWMW	**82**	20	8	7	5	19	28	36	0	10	3	1	3
WWMW	**87**	9	9	6	7	10	16	11	0	18	4	7	2
WWMW	**92**	2	16	8	7	5	10	9	4	19	7	2	5
WWMW	**97**	2	10	0	3	2	2	1	0	3	8	4	6
WWMW	**102**	2	6	3	0	4	2	1	0	3	4	7	3
WWMW	**107**	0	6	2	1	1	0	0	0	0	3	2	3
WWMW	**112**	0	0	0	0	0	0	0	0	1	1	0	3
WWMW	**117**	0	1	1	0	0	0	0	0	0	1	0	0
WWMW	**122**	0	0	1	0	0	0	0	0	0	0	0	0
WWMW	**127**	0	1	0	0	0	0	0	0	0	0	0	0
WWMW	**132**	0	0	0	0	0	0	0	0	0	0	0	0
WWMW	**137**	0	0	0	0	0	0	0	0	0	0	0	0
WWMW	**142**	0	0	0	0	0	0	0	0	0	0	0	0
WWMW	**147**	0	0	0	0	0	0	0	0	0	0	0	0
WWMW	**152**	0	0	0	0	0	0	0	0	0	0	0	0
WWMW	**157**	0	0	0	0	0	0	0	0	0	0	0	0
WWMW	**162**	0	0	0	0	0	0	0	0	0	0	0	0
WWMW	**167**	0	0	0	0	0	0	0	0	0	0	0	0

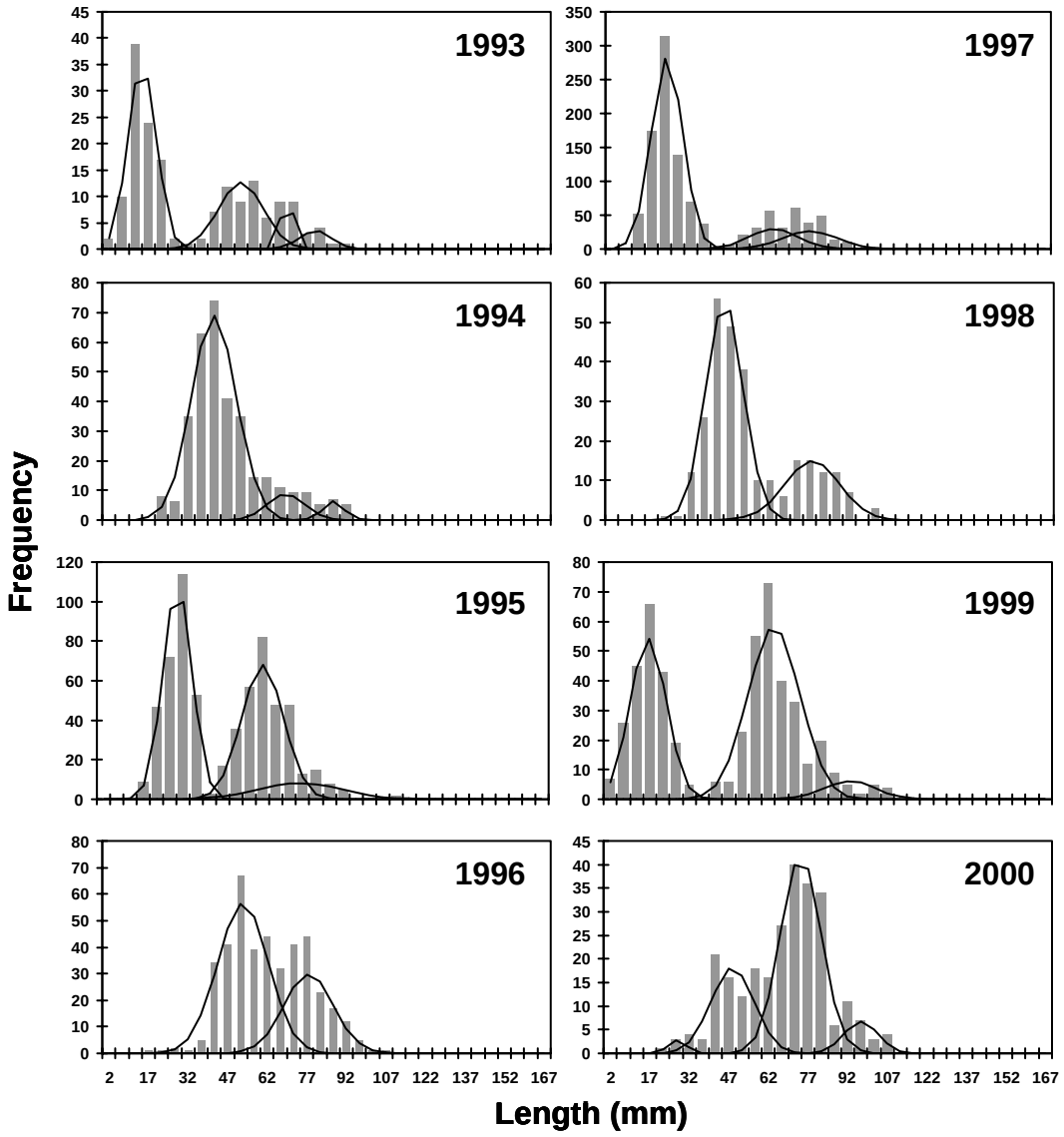
Appendix III. Comparison of normal and lognormal maximum log-likelihoods to observed length-frequency data at Little Choptank River Ragged Point (LCRP) based on the goodness of fit statistic Akaike's Information Criterion (AIC).

LCRP	Normal Likelihood	Lognormal Likelihood
2001	264.53	289.72
2000	758.49	757.62
1999	892.58	891.17
1998	753.04	752.65
1997	123.38	182.33
1996	486.97	487.61

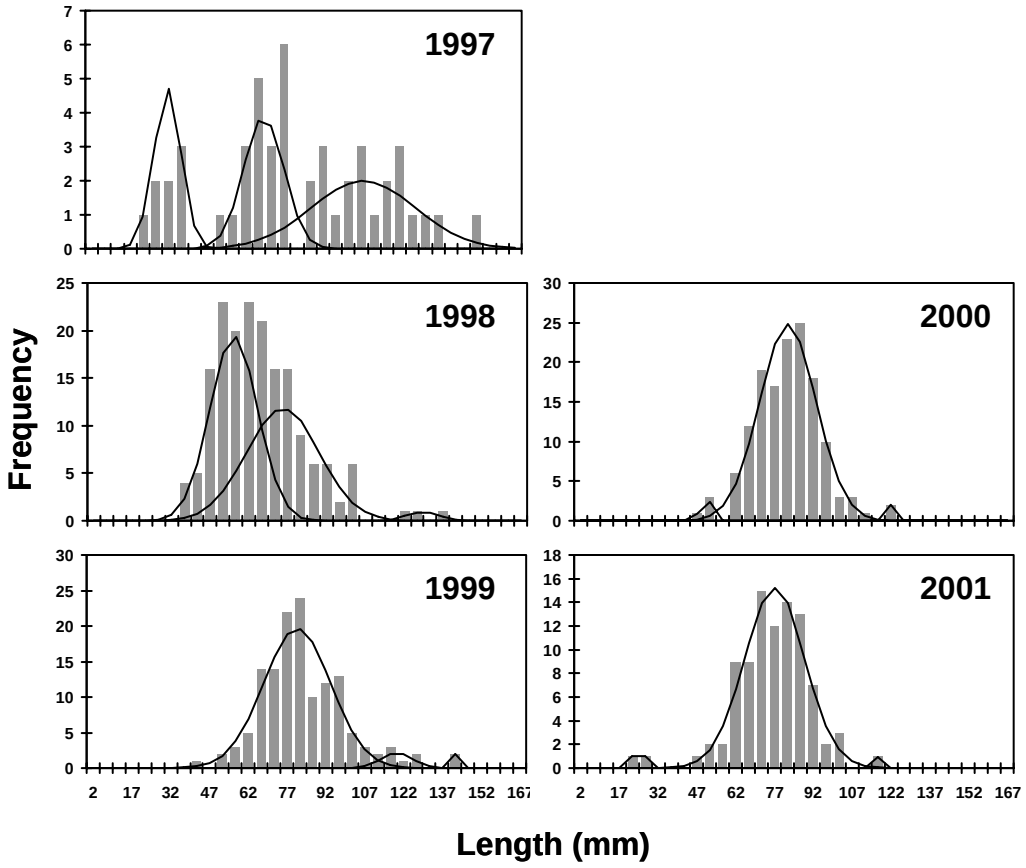
Appendix IV. The best maximum likelihood model fits (lines) to the observed length-frequency data (bars) based on Akaike's Information Criterion (AIC).



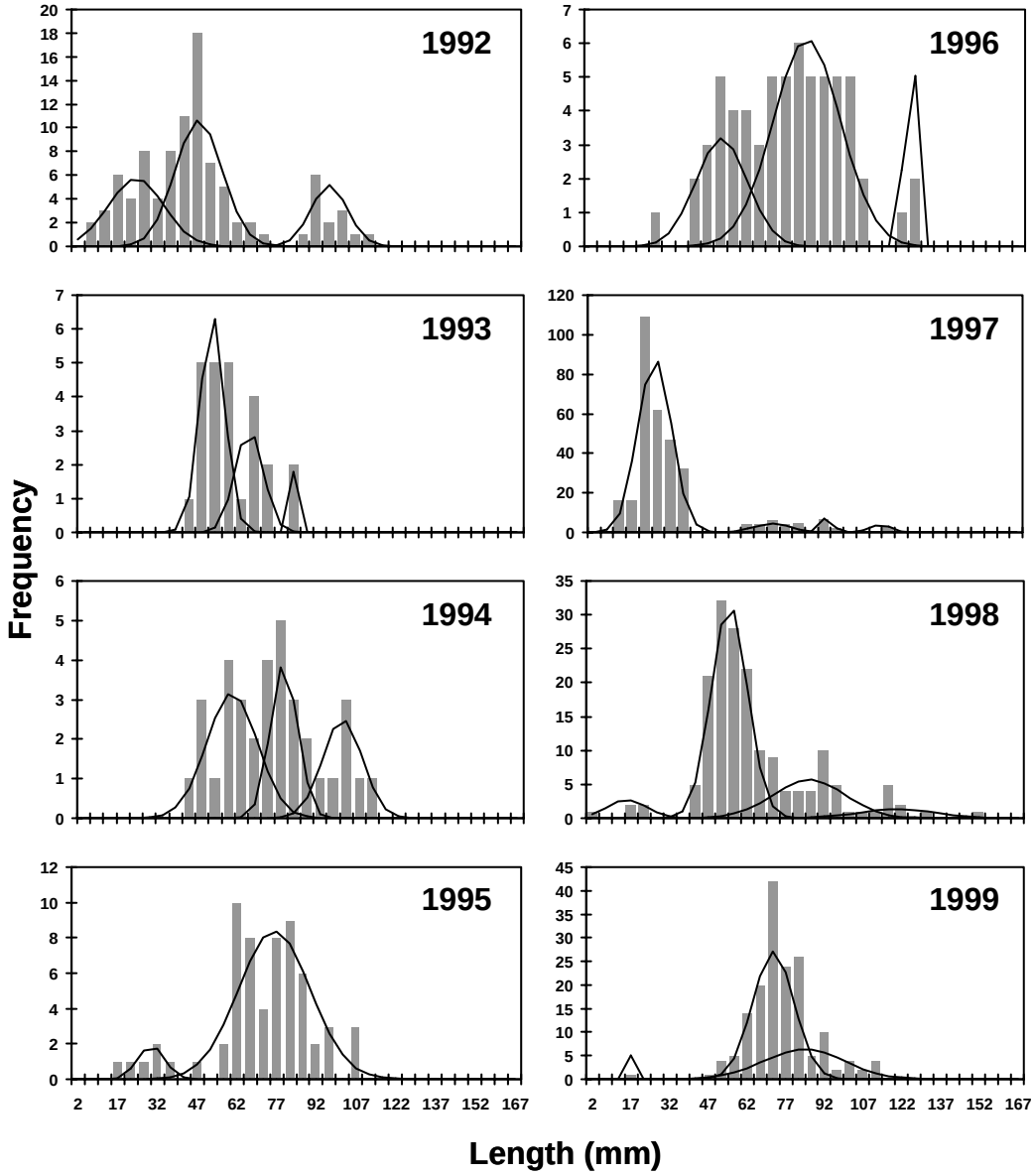
Broad Creek Deep Neck (BCDN)



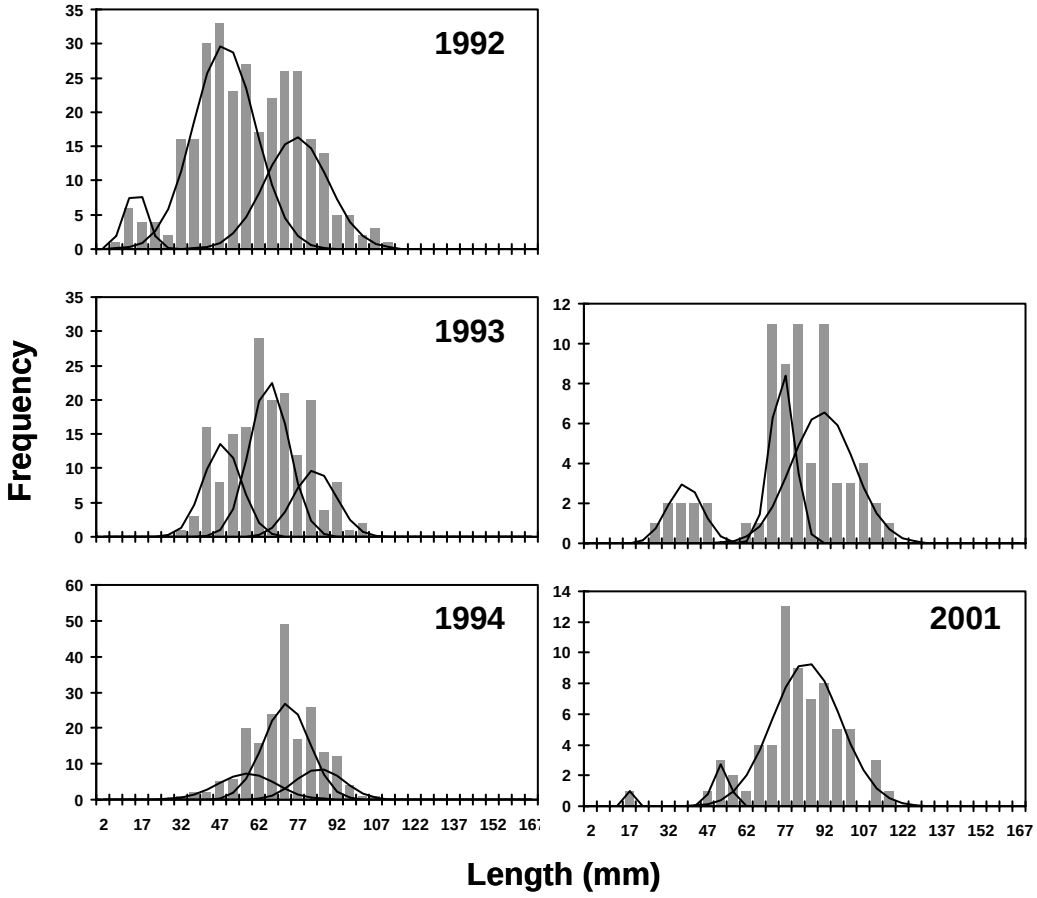
Chester River Buoy Rock (CHBR)



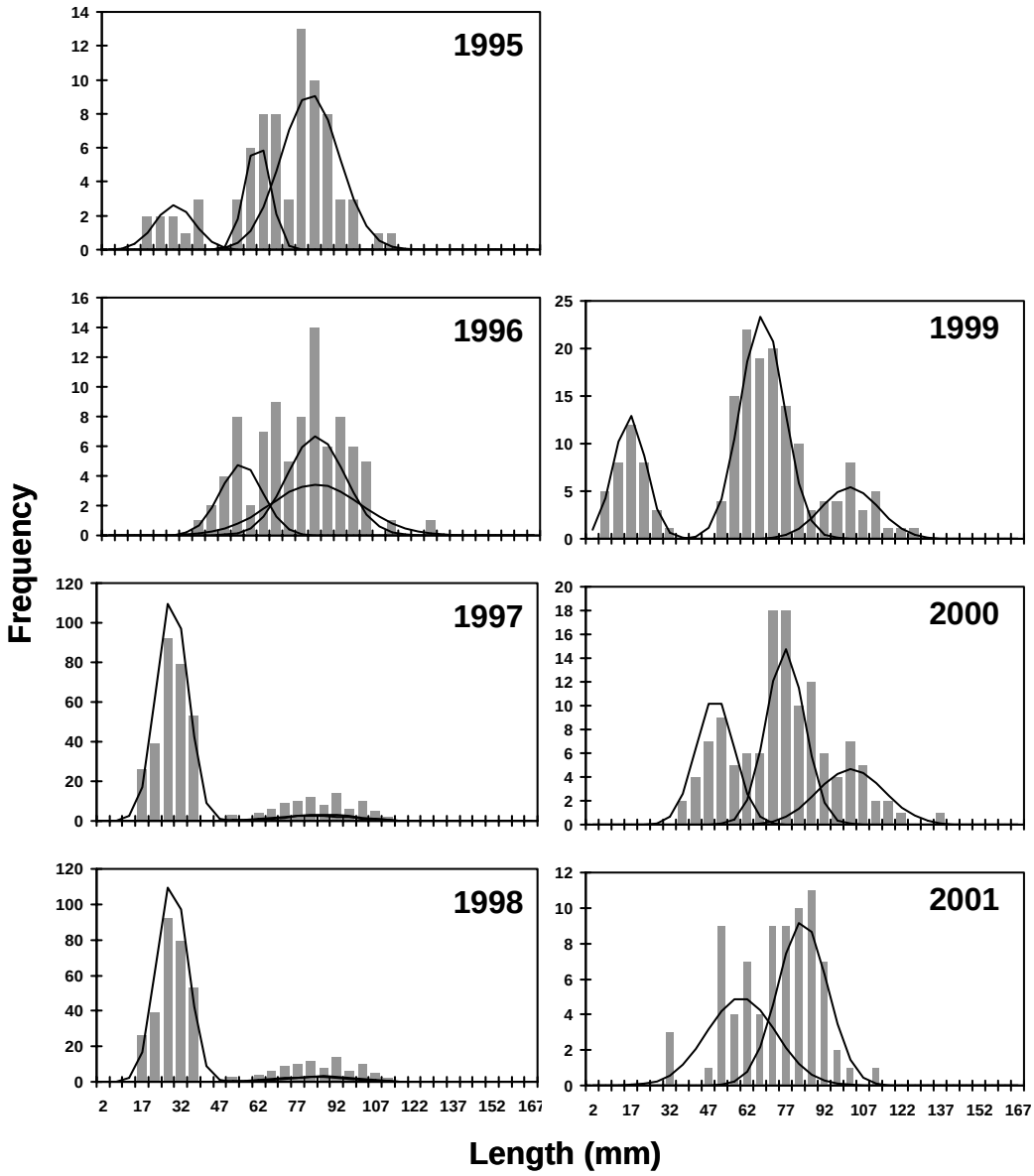
Choptank River Lighthouse (CRLI)



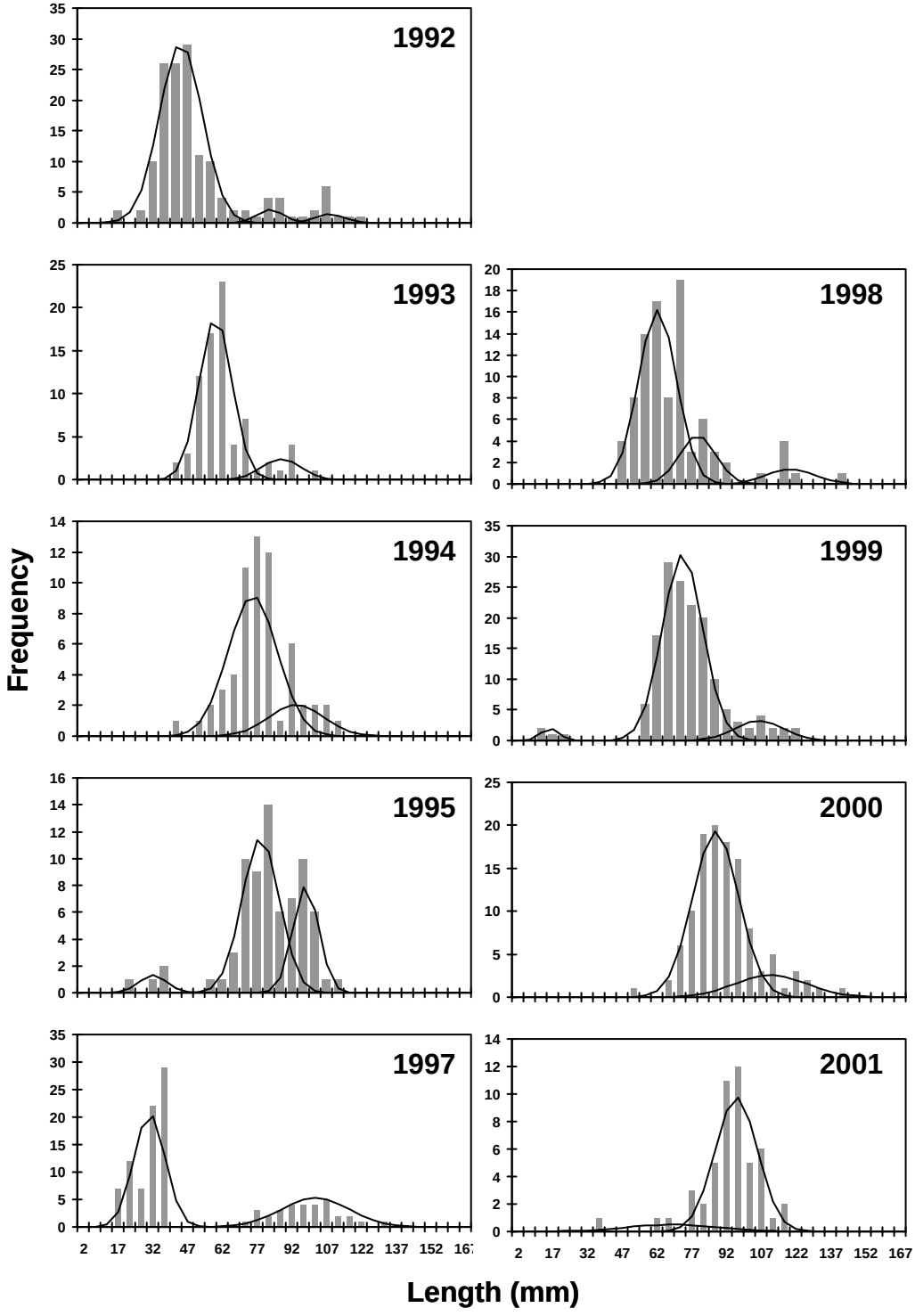
Choptank River Oyster Shell Point (CROS)



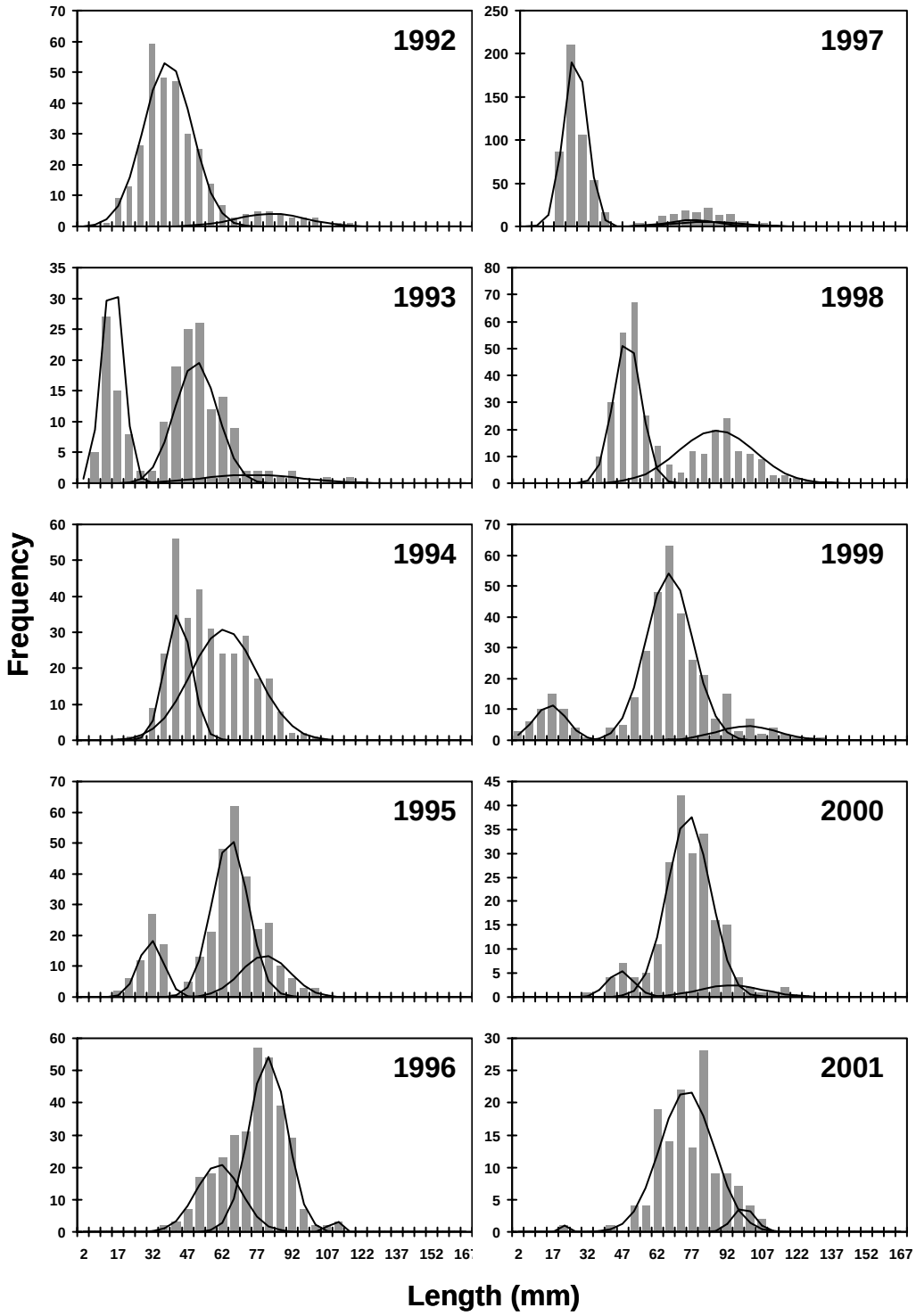
Choptank River Royston (CRRO)



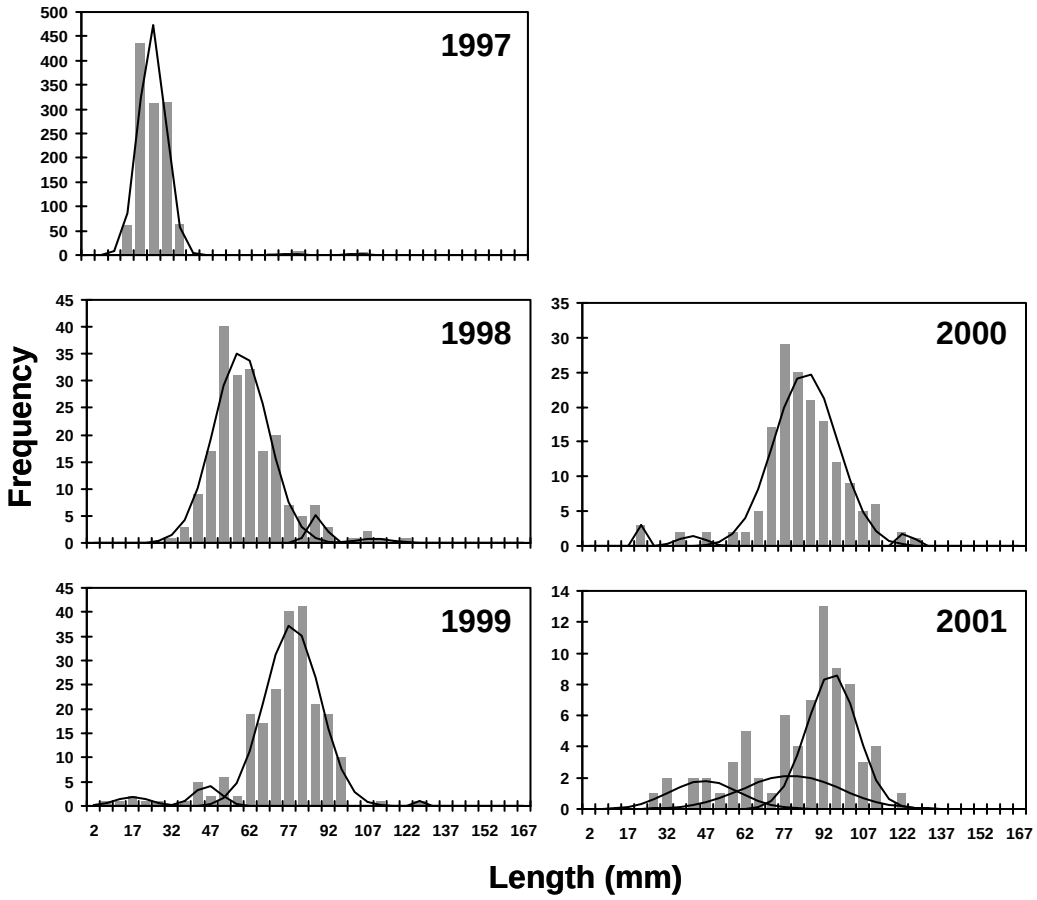
Choptank River Sandy Hill (CRSH)



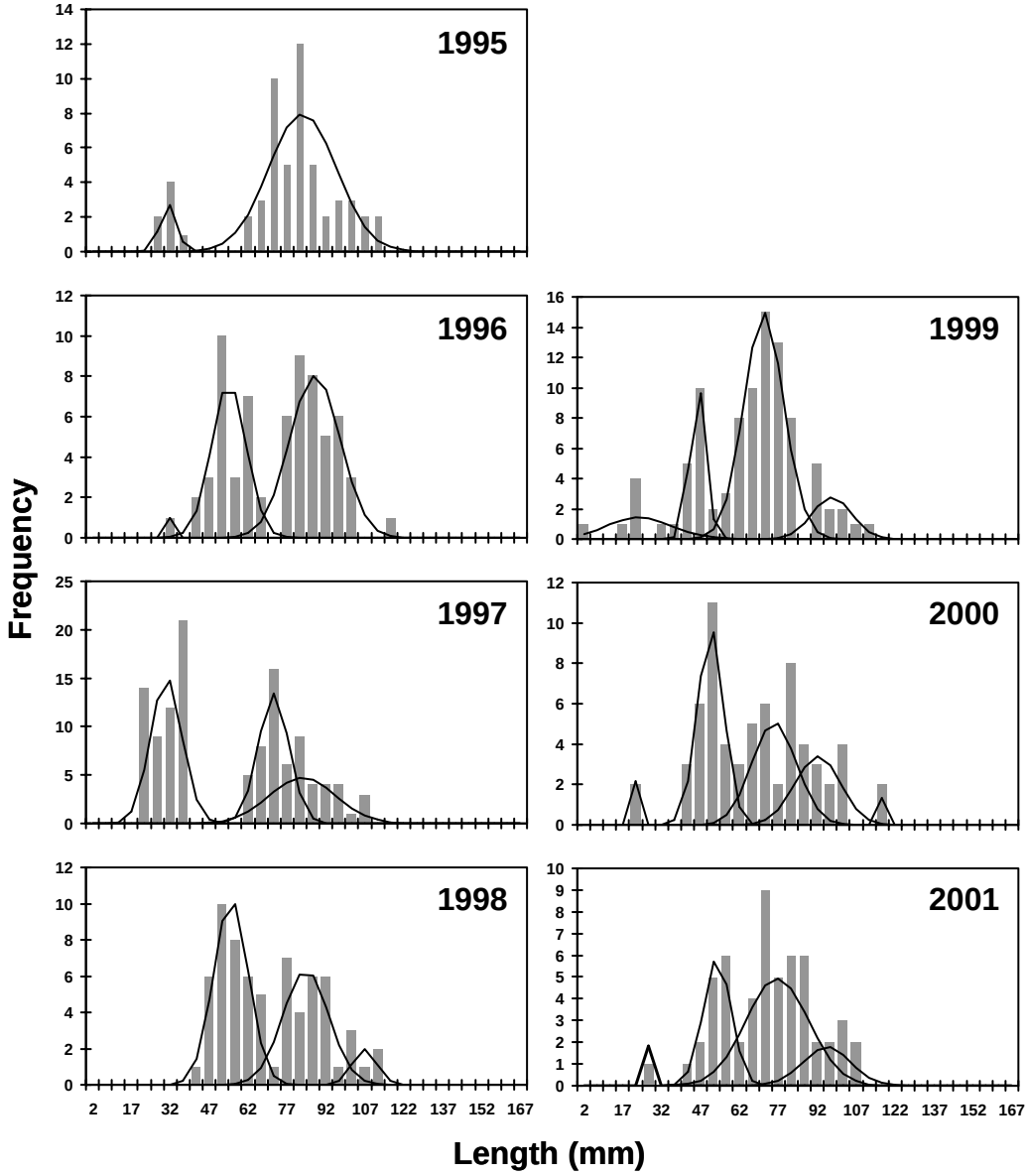
Choptank River Tilghman Wharf (CRTW)



Eastern Bay Bugby (EBBU)



Eastern Bay Hollicutts Noose (EBHN)



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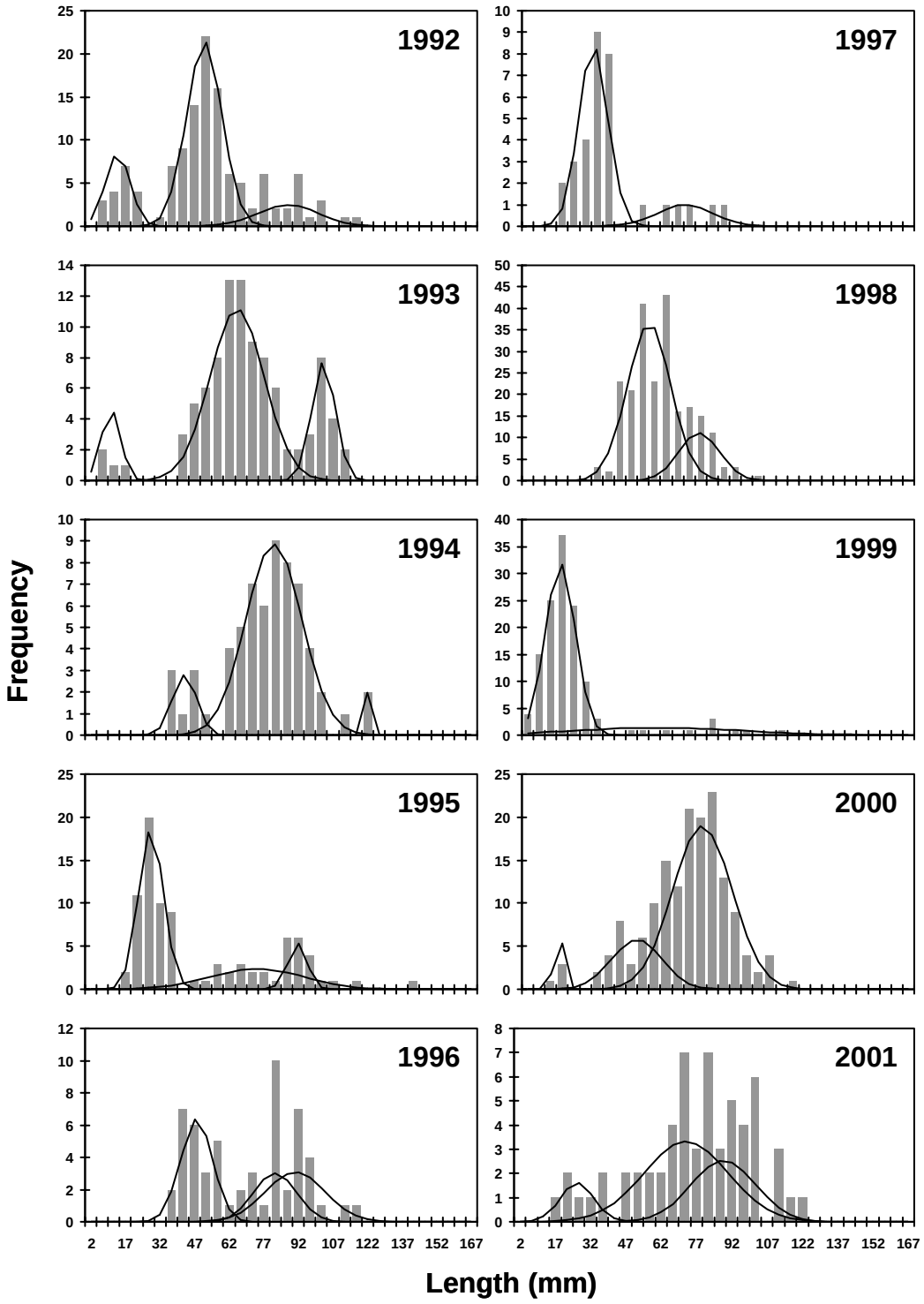
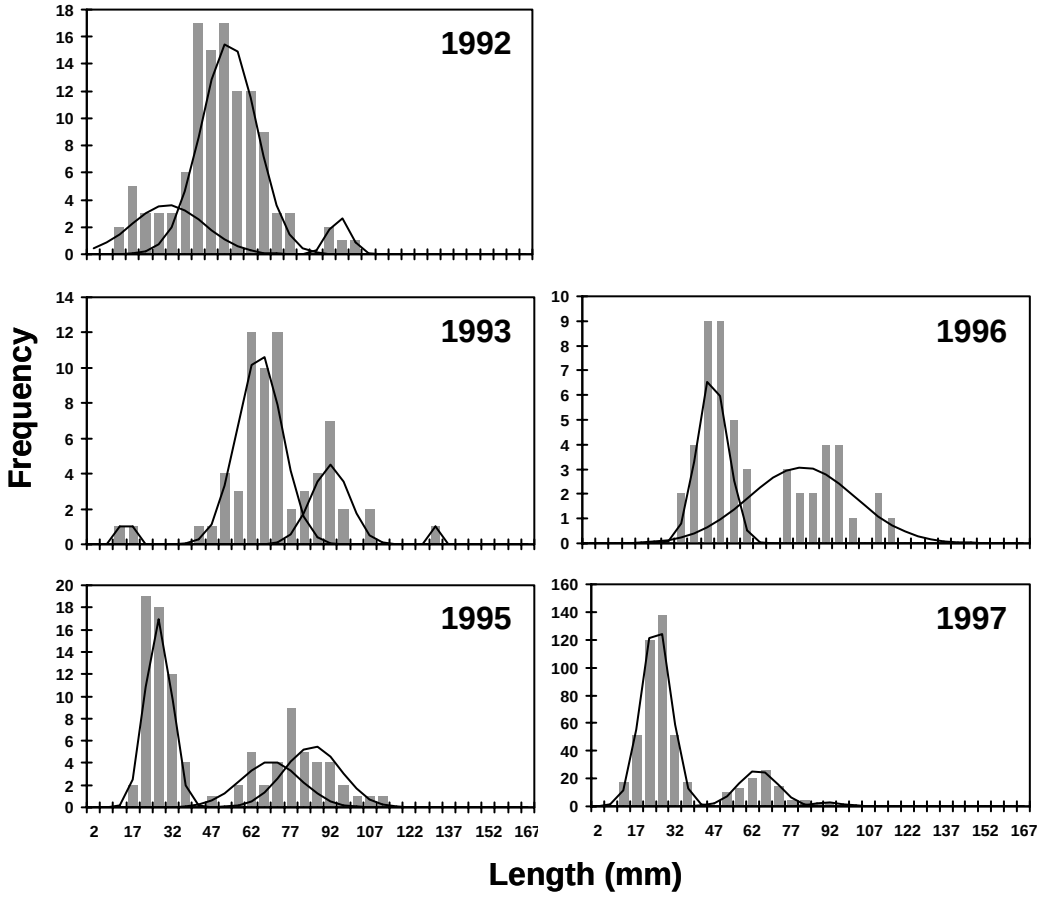
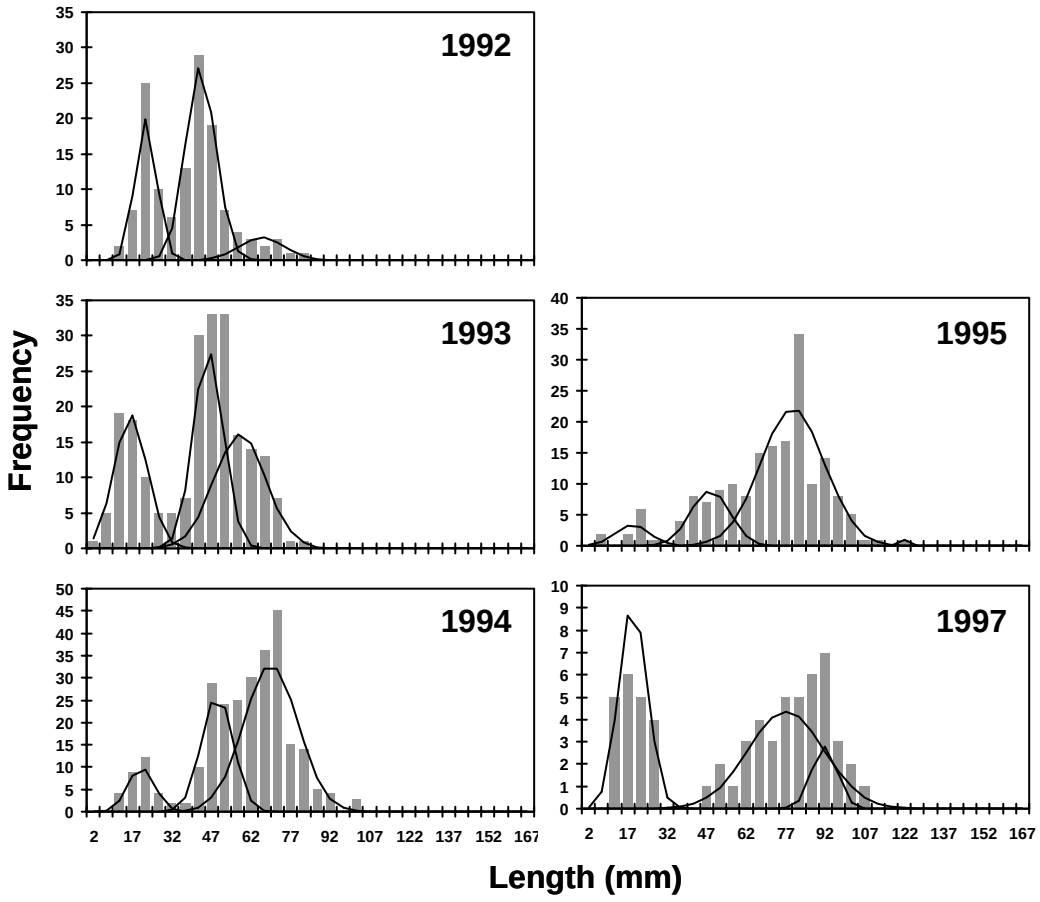


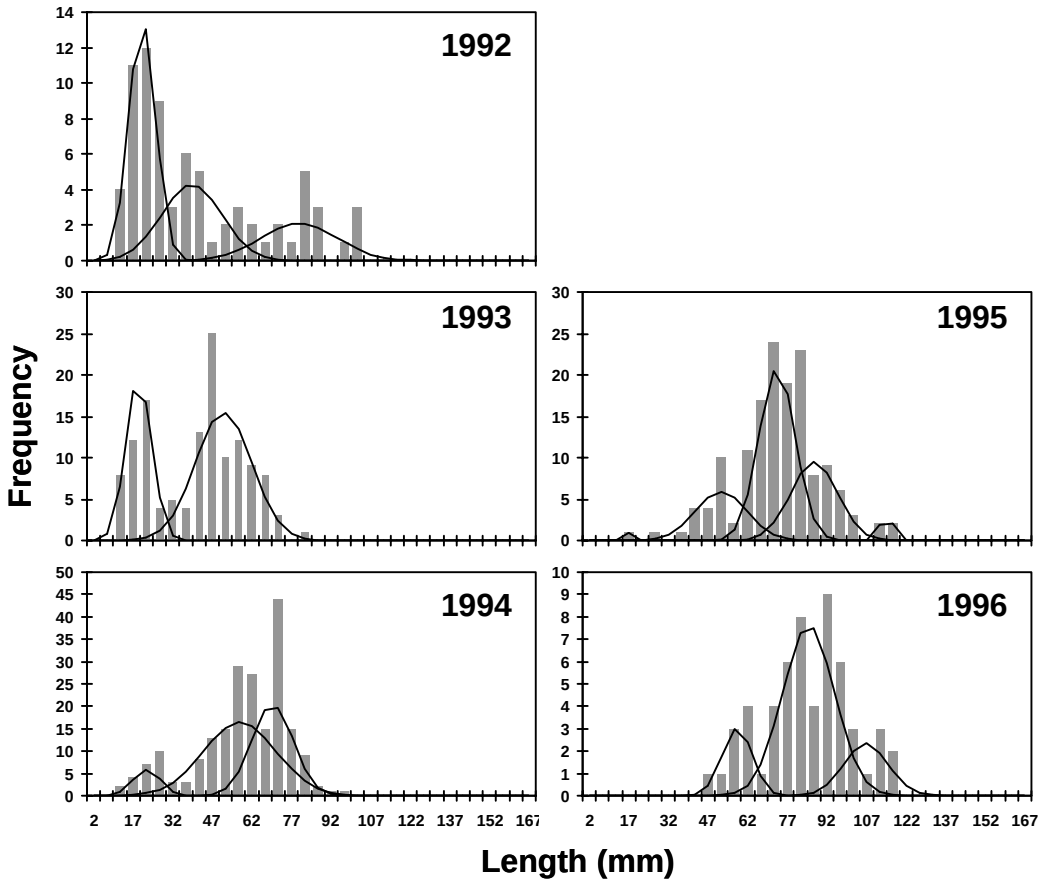
Eastern Bay Wild Ground (EBWG)



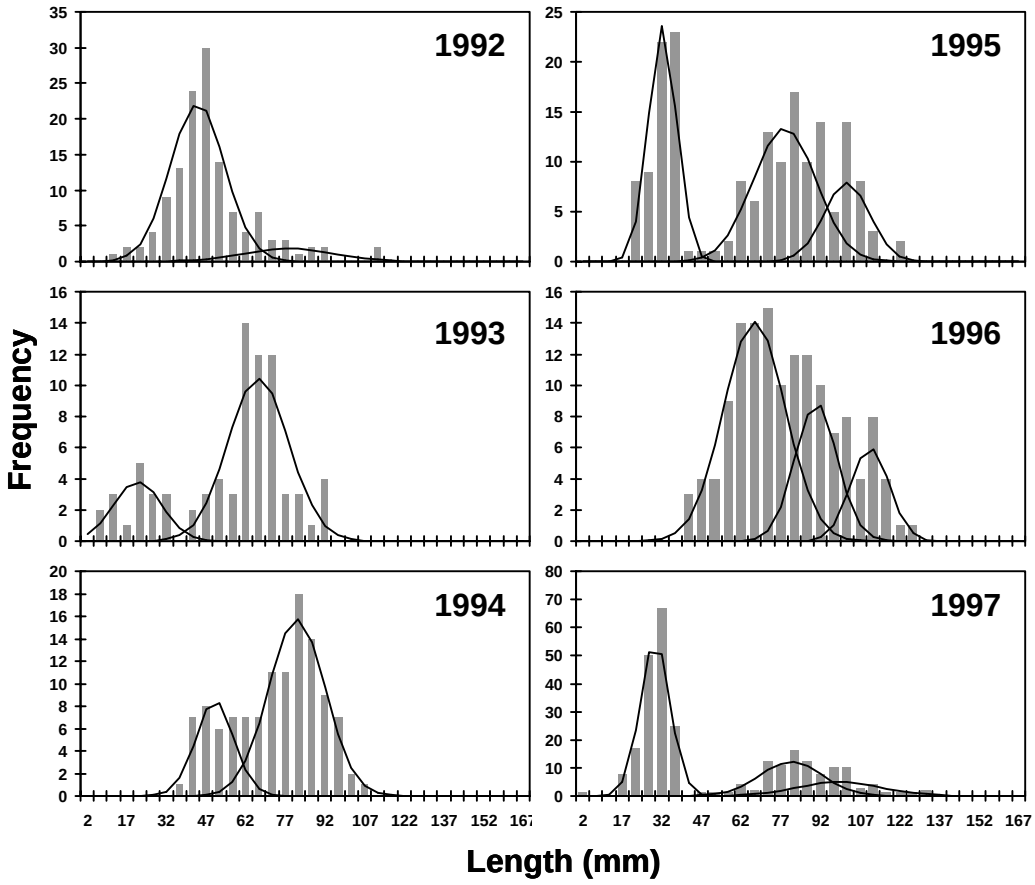
Fishing Bay Clay Island (FBCI)



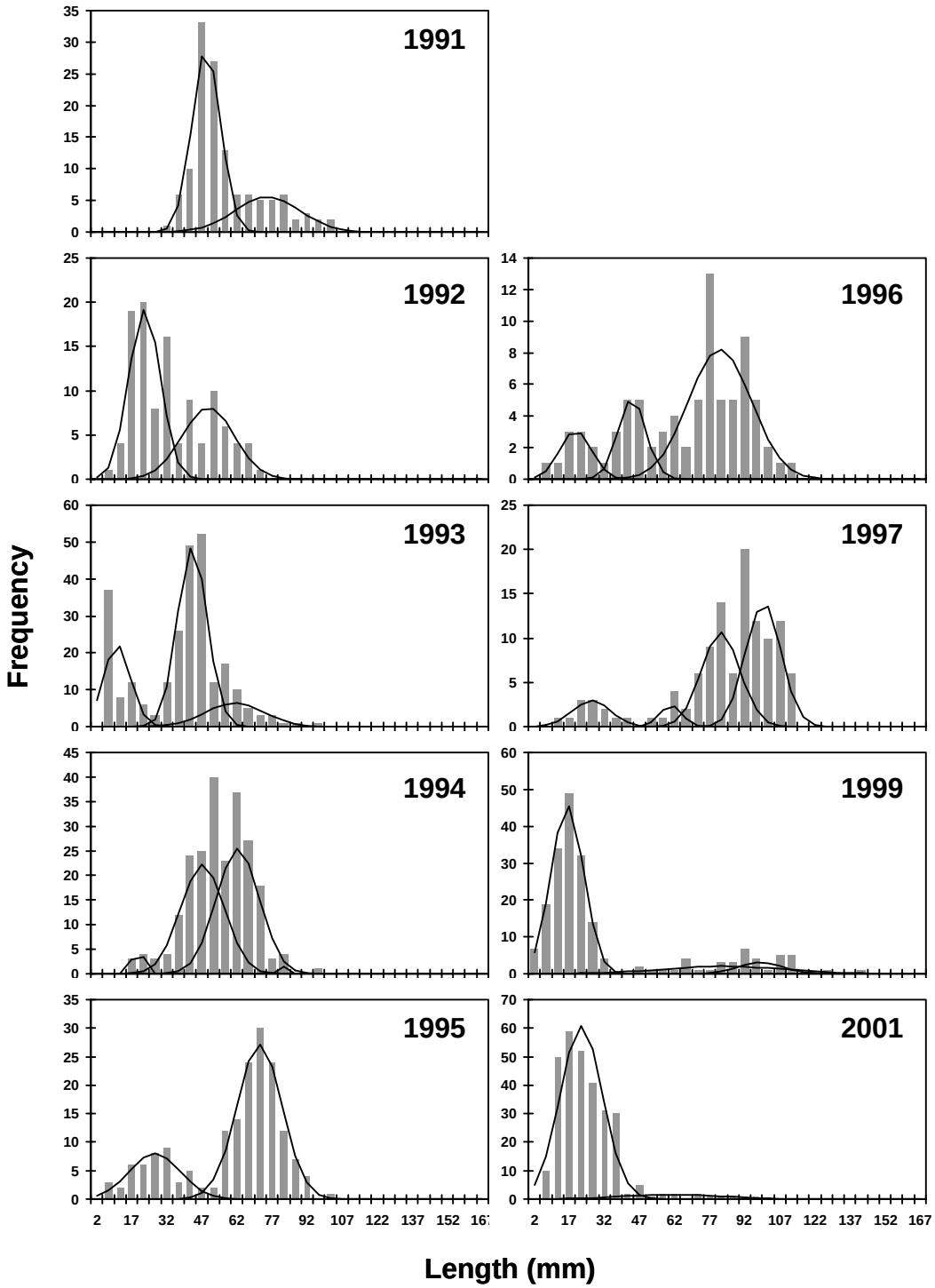
Fishing Bay Goose Creek (FBGC)



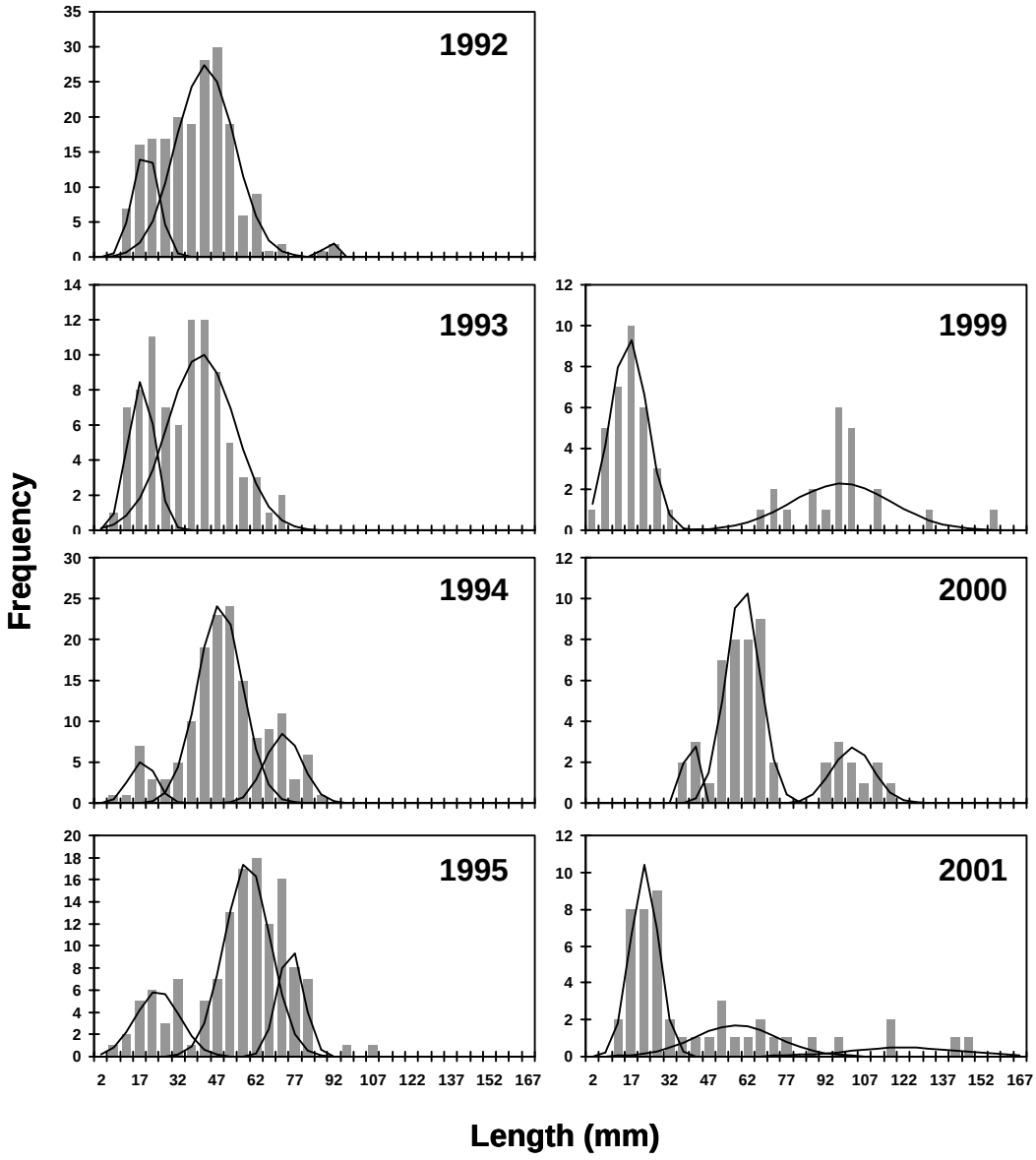
Harris Creek Eagle Point (HCEP)



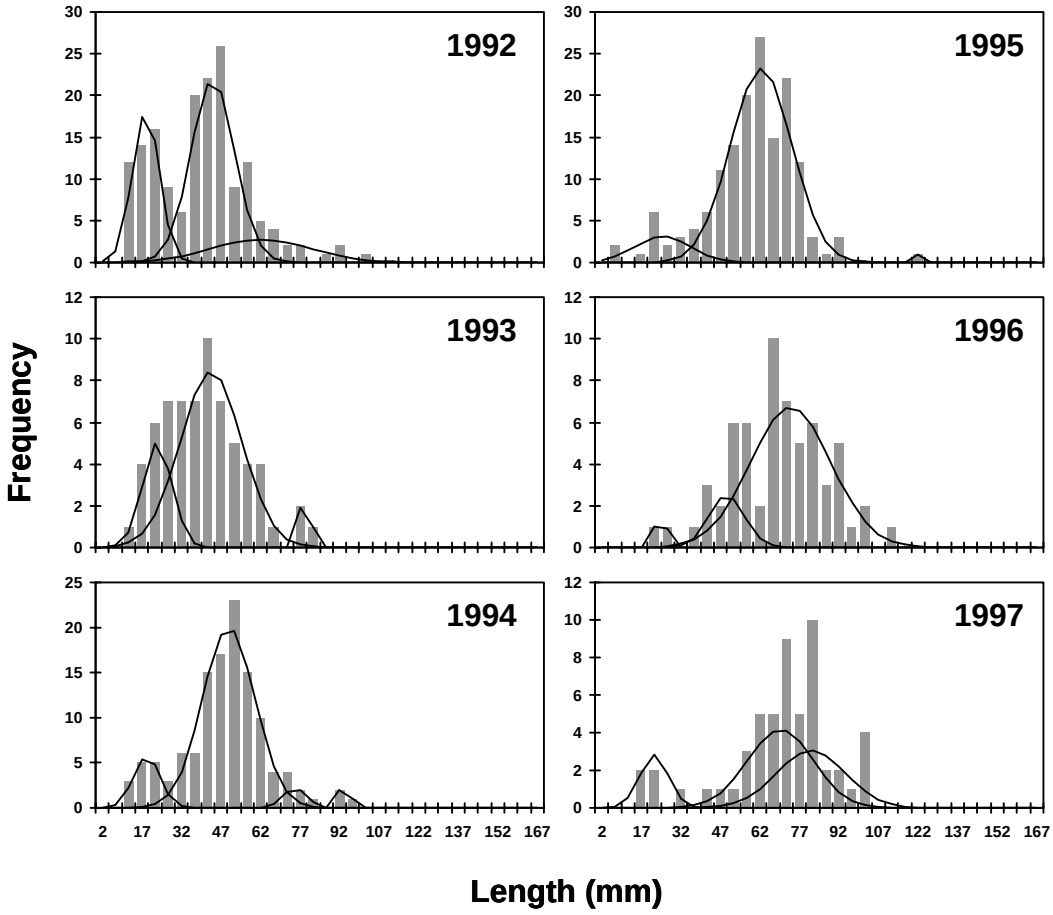
Holland Straits Holland Straits (HOHO)



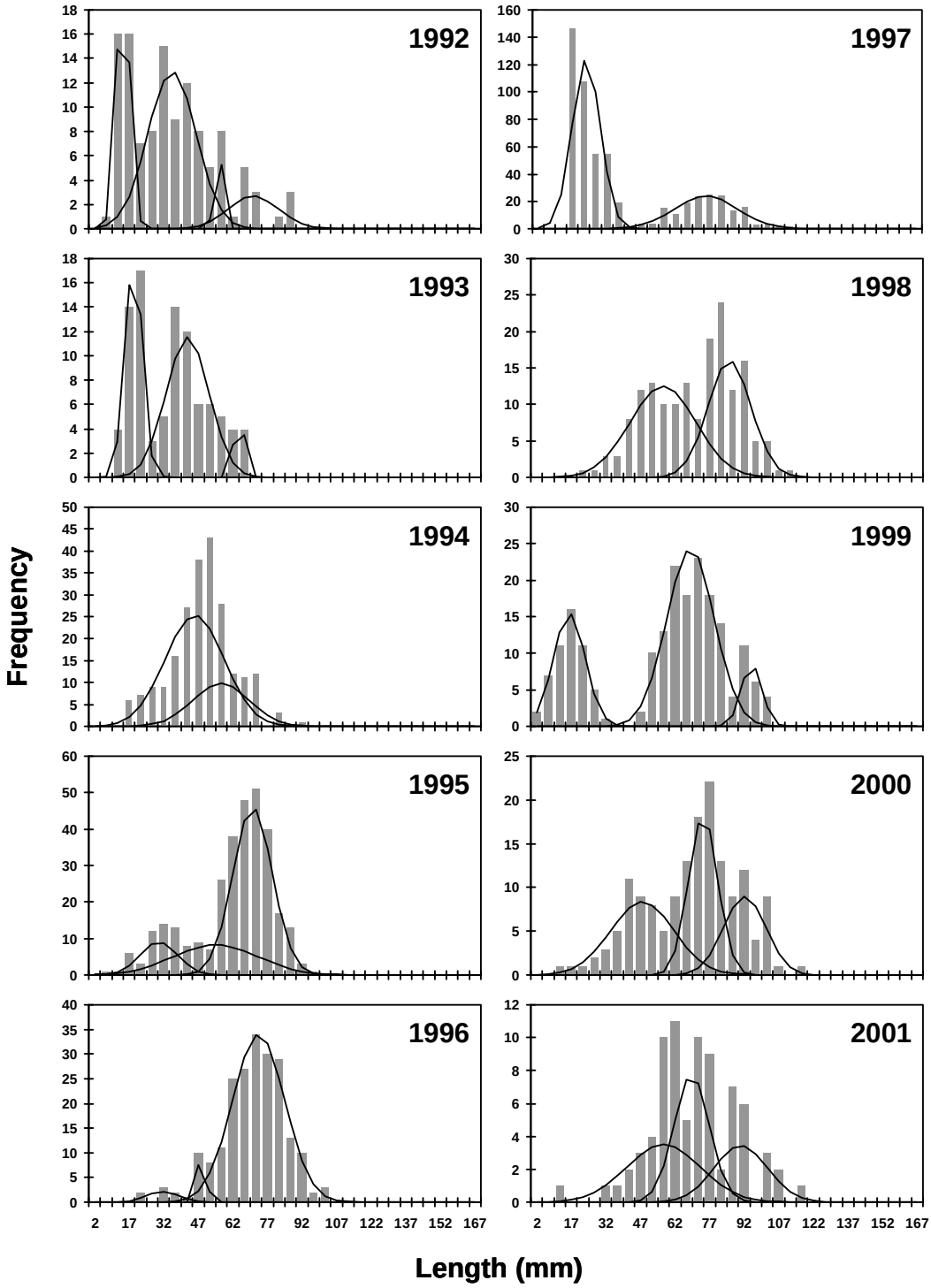
Honga River Normans (HRNO)



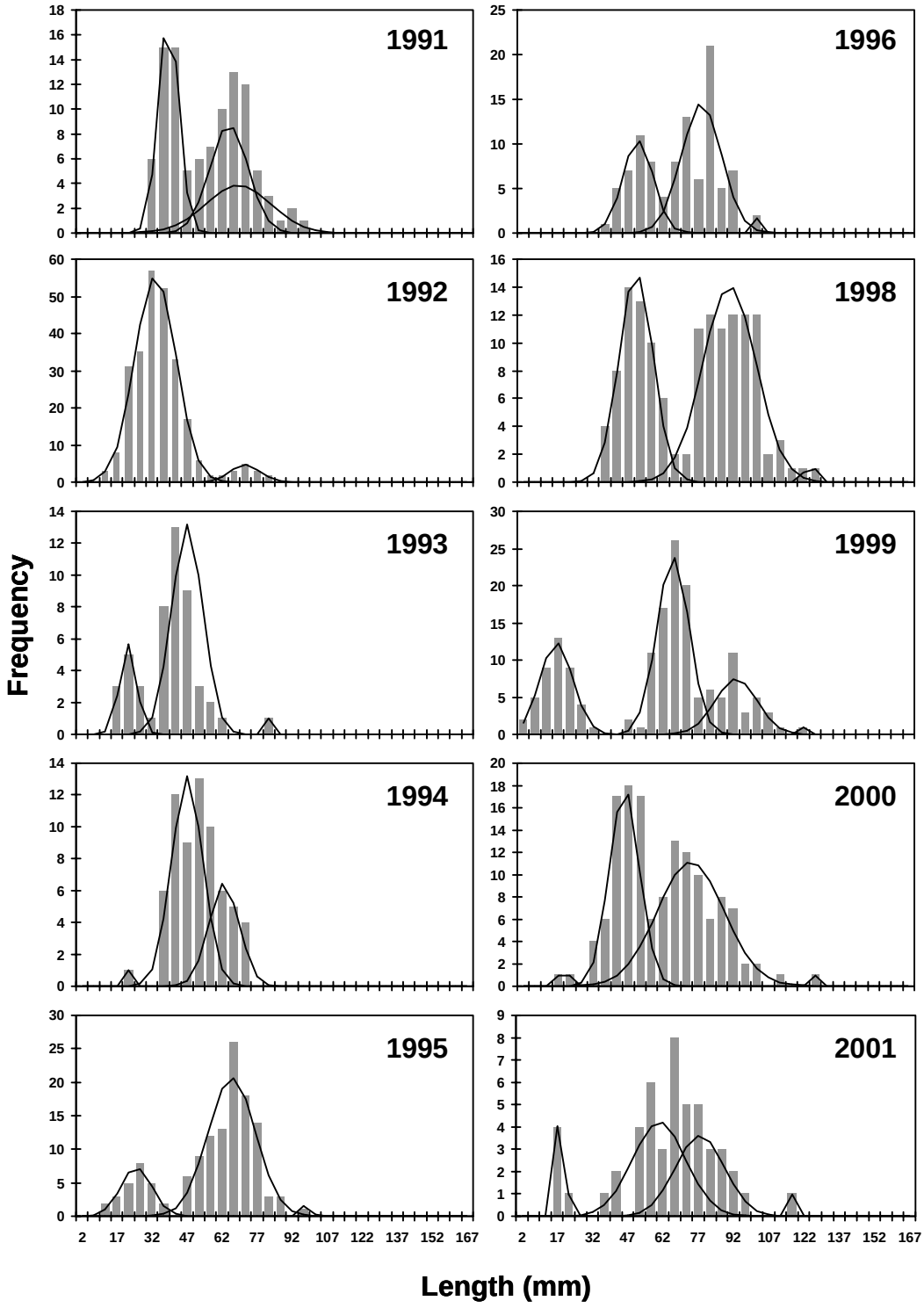
Honga River Windmill (HRWI)



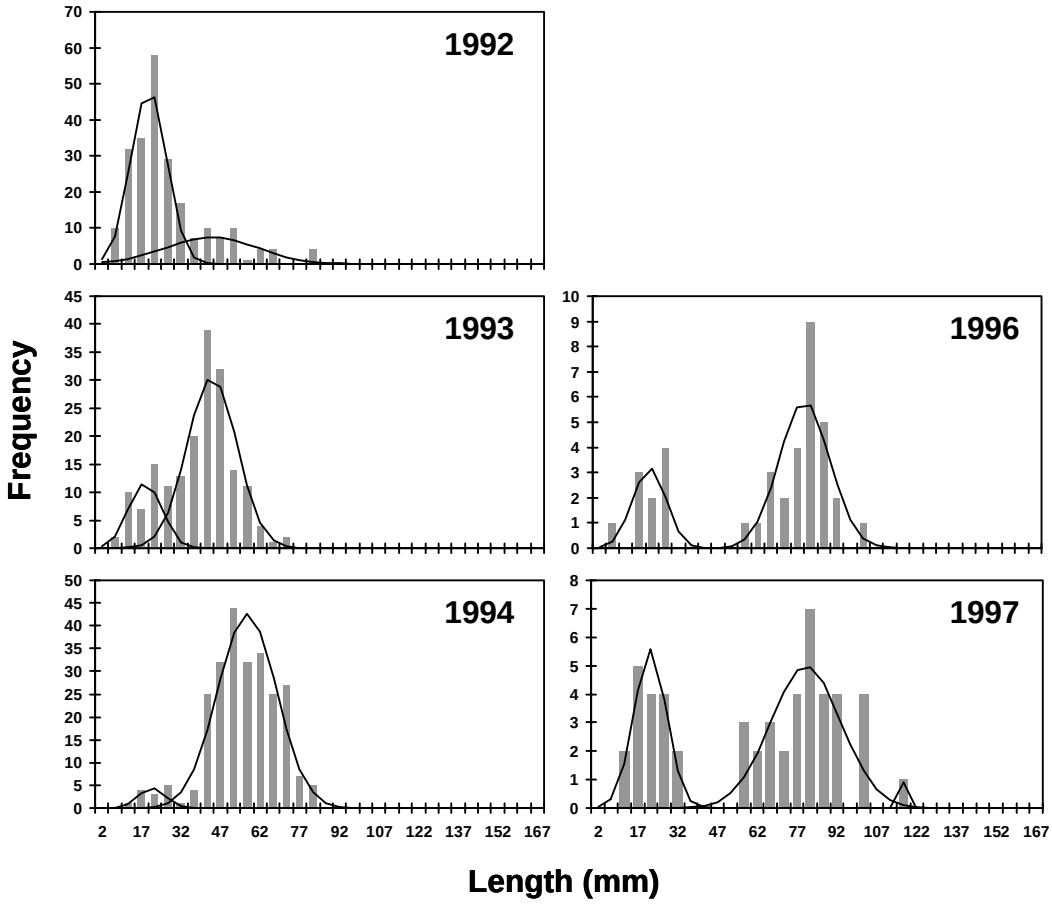
Little Choptank Cason (LCCA)



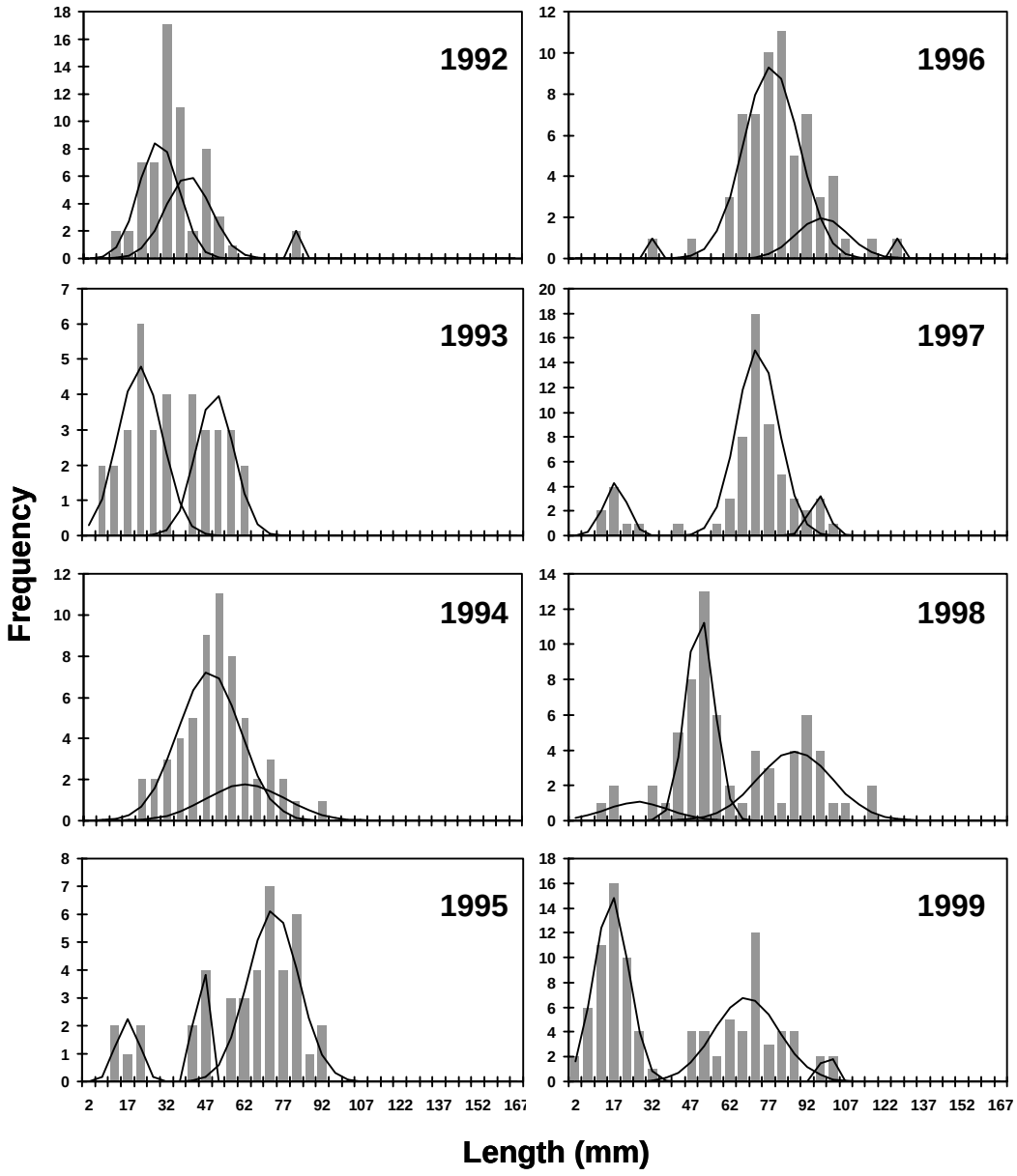
Little Choptank Ragged Point (LCRP)



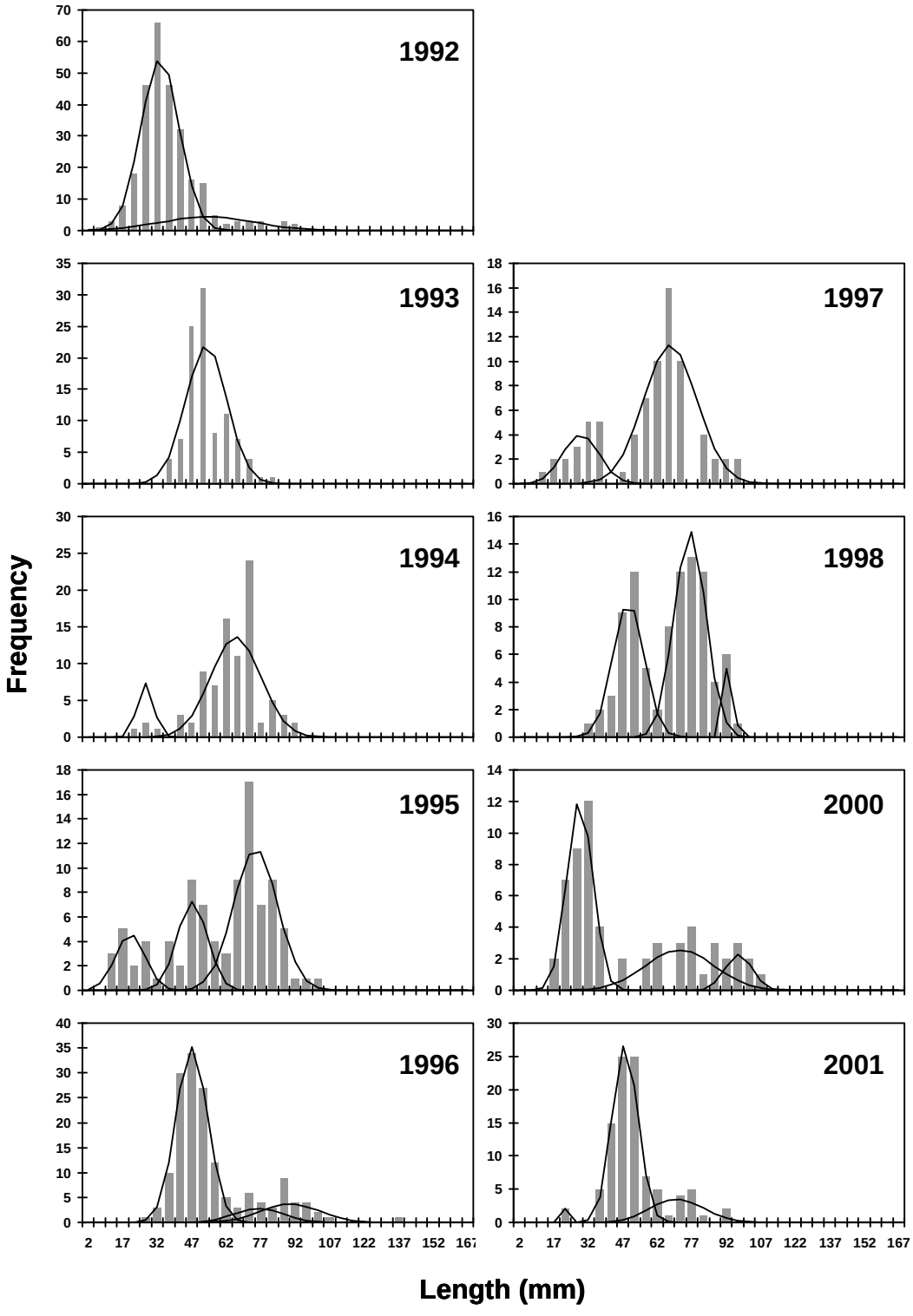
Manokin River Drum Point (MADP)



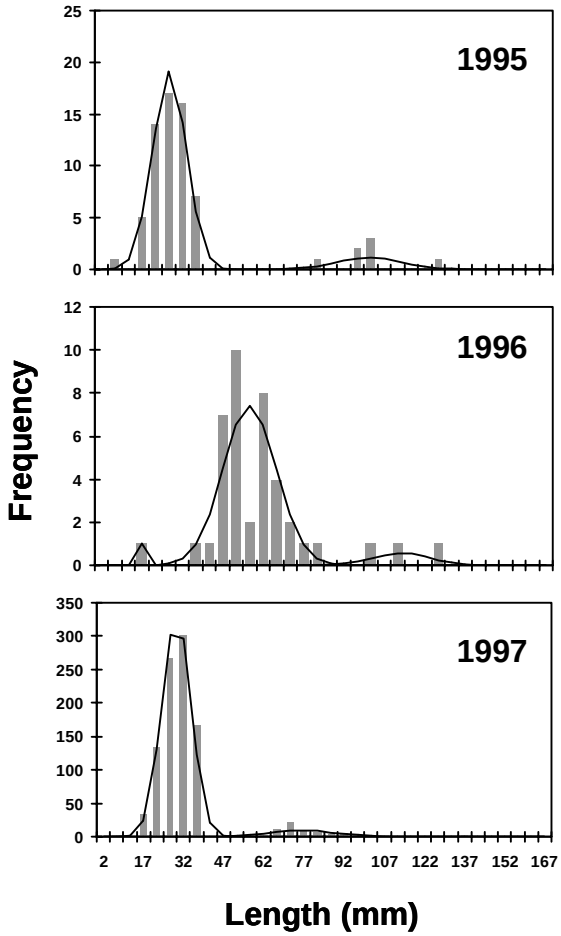
Manokin River Georges Bar (MAGE)



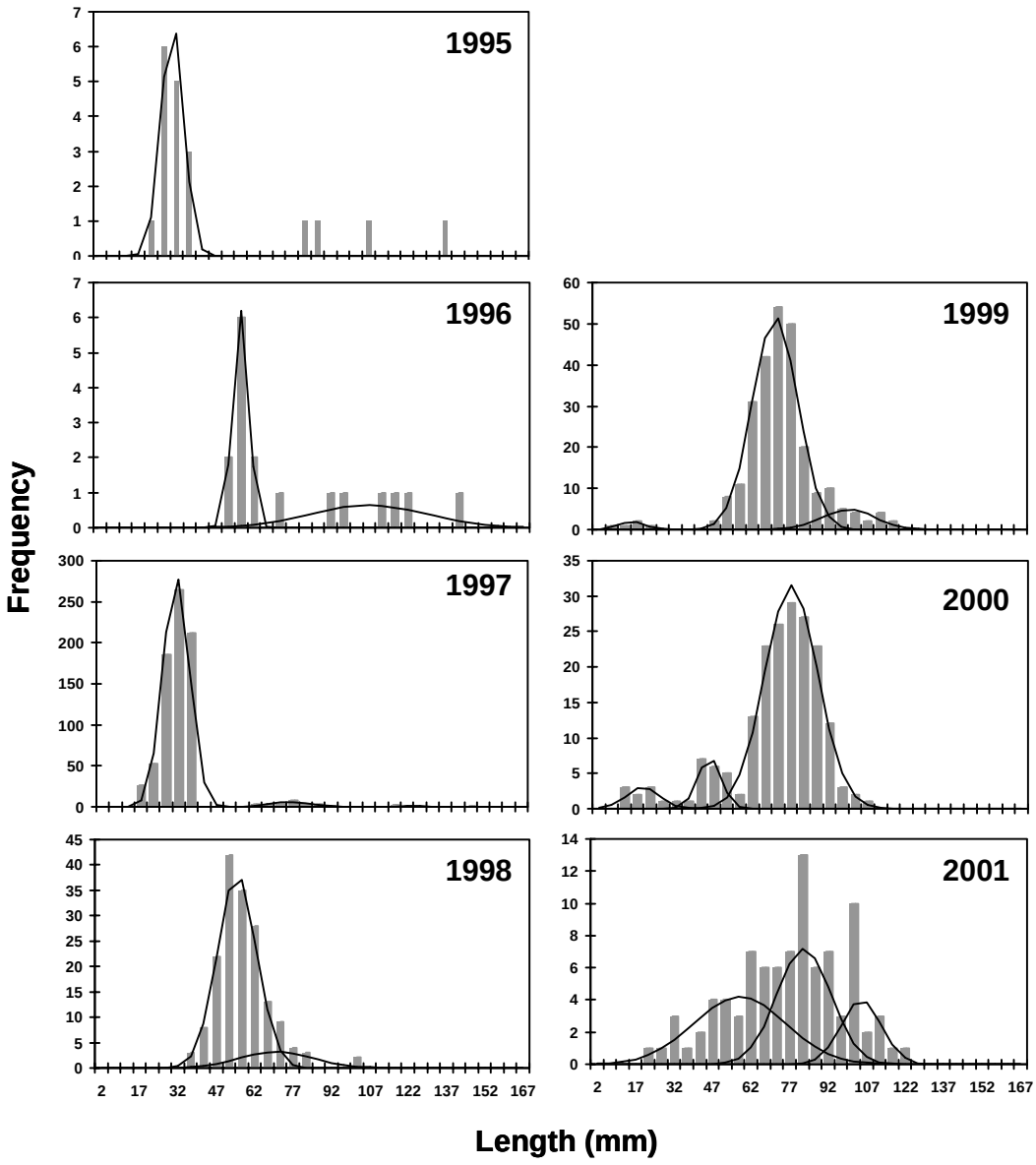
Middle Eastern Shore Stone Rock (MESR)



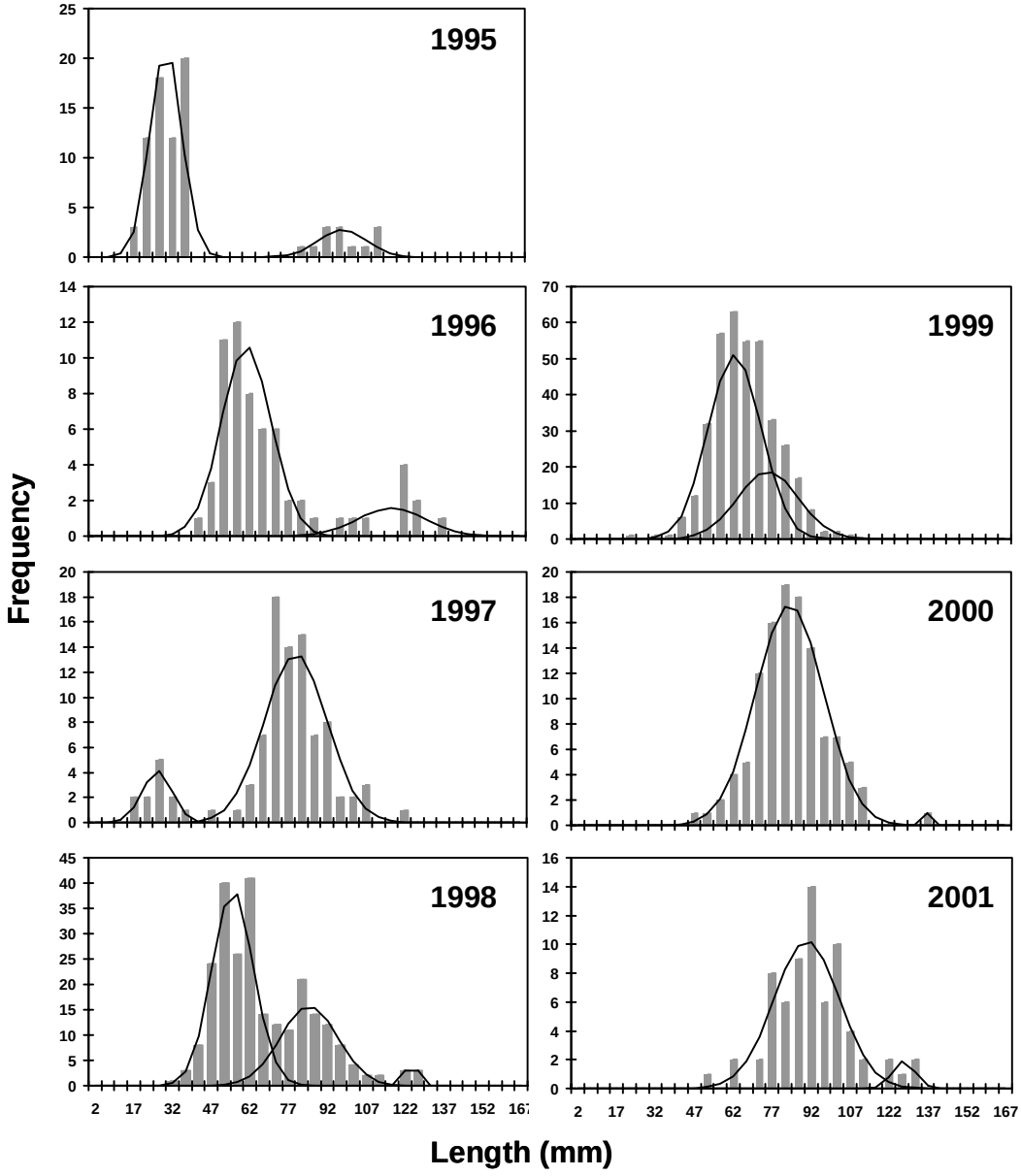
Miles River Ashcraft (MRAS)



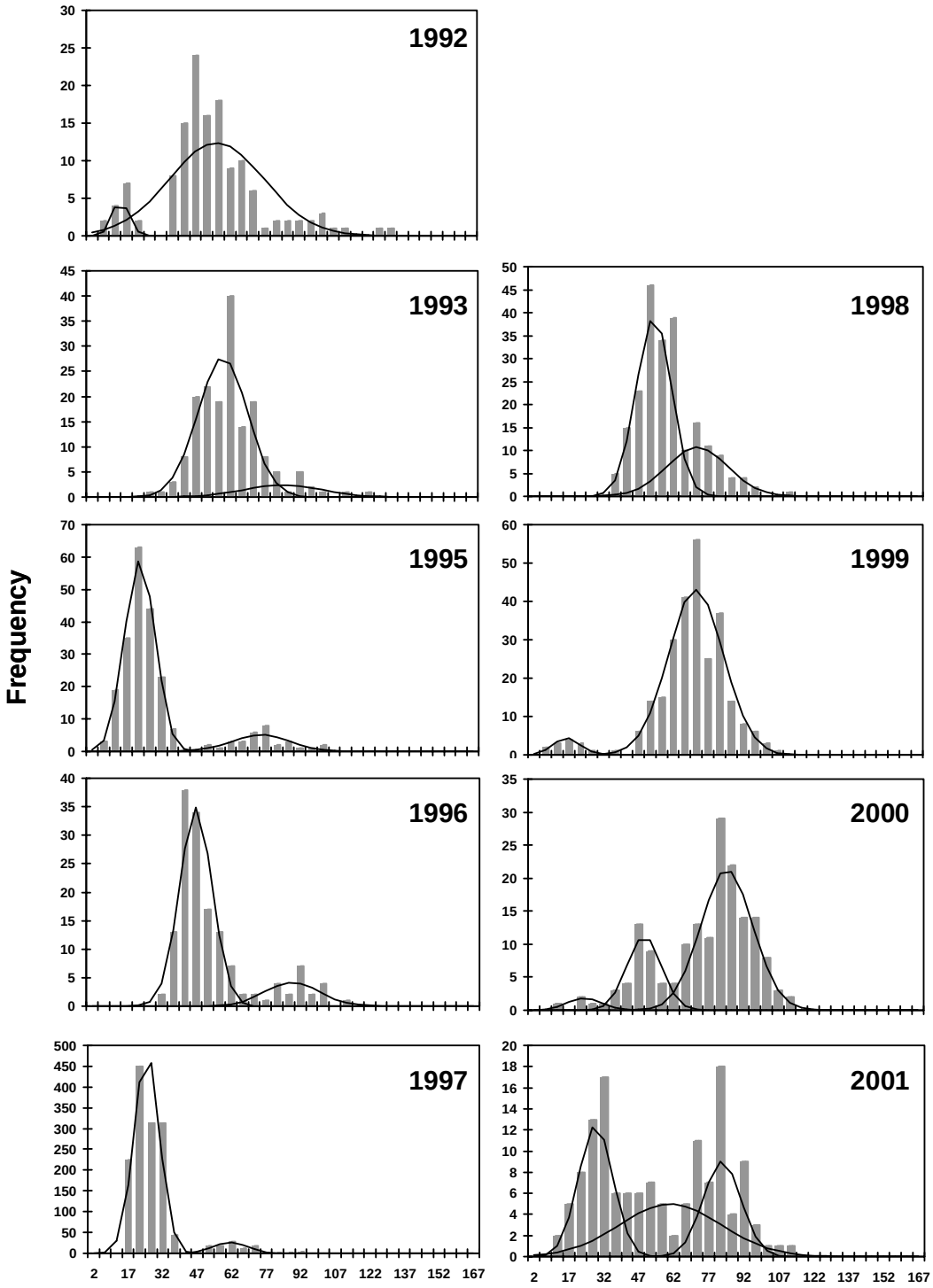
Miles River Bruffs Island (MRBI)



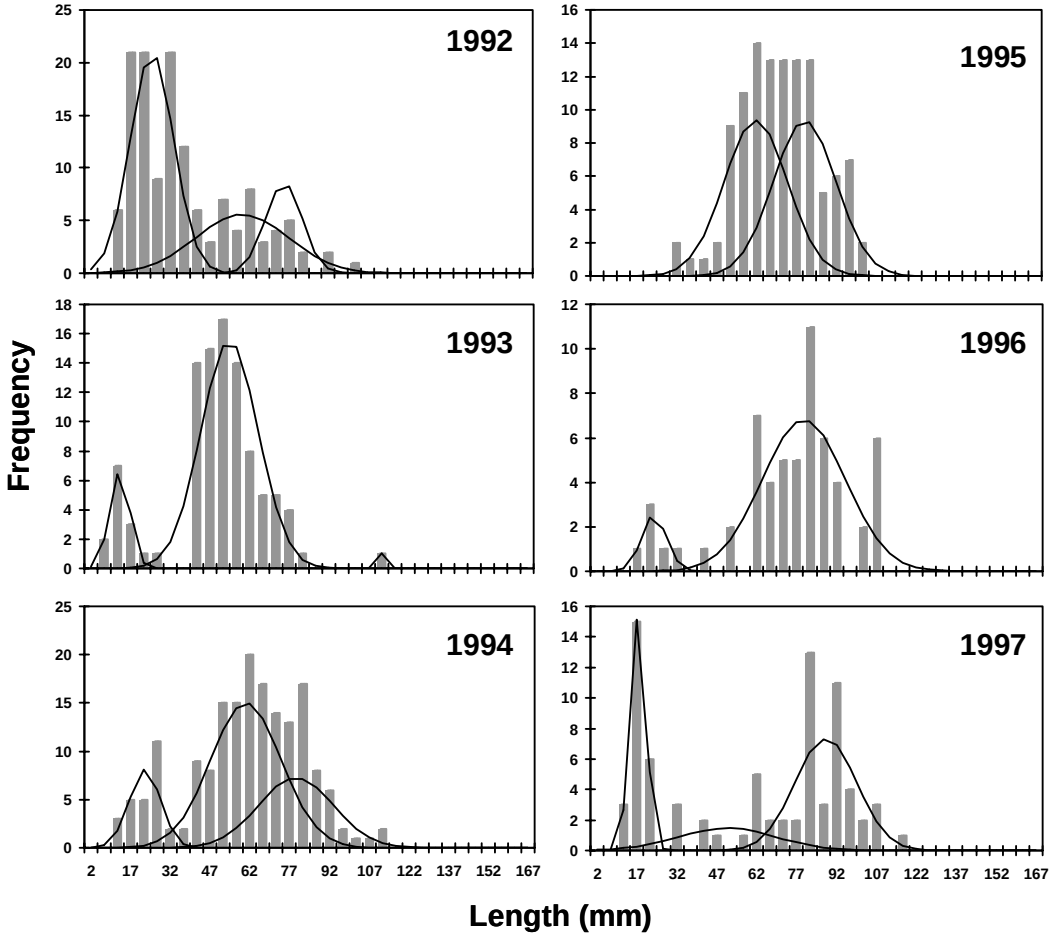
Miles River Long Point (MRLP)



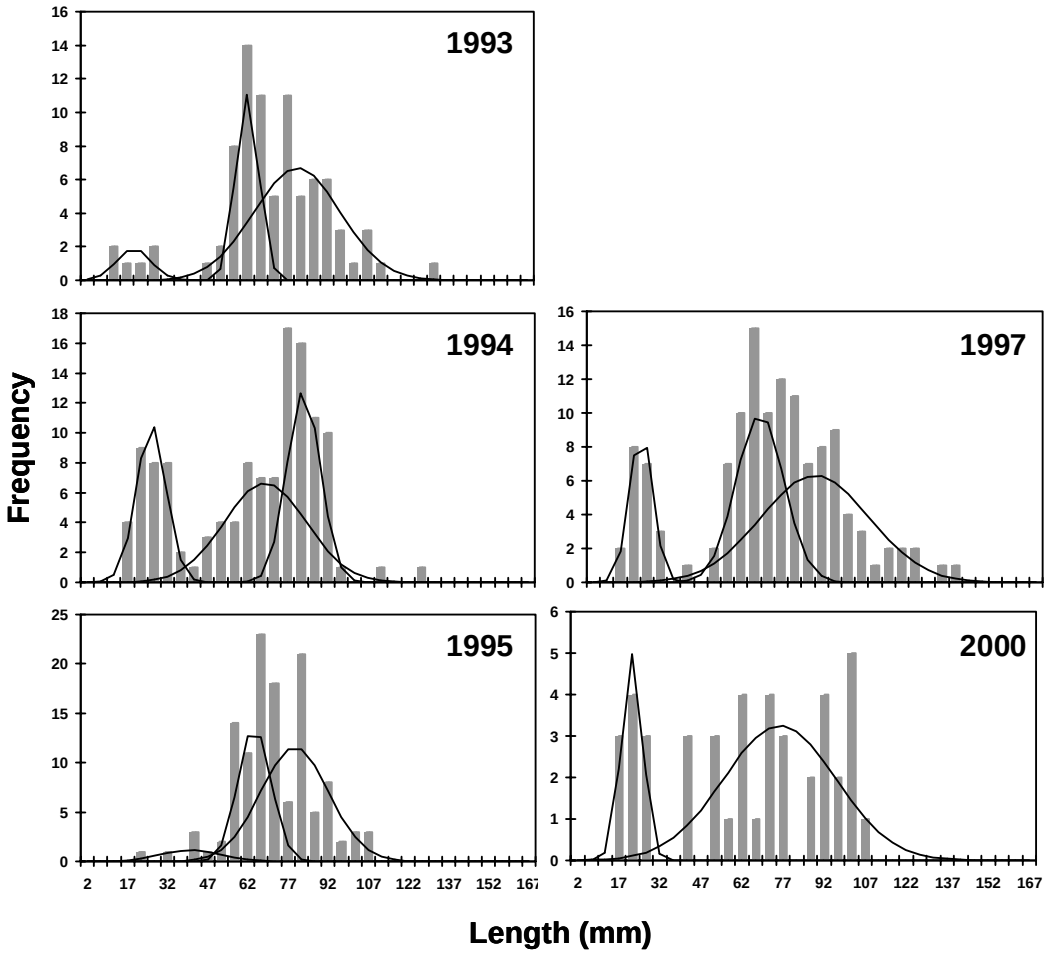
Miles River Turtleback (MRTU)



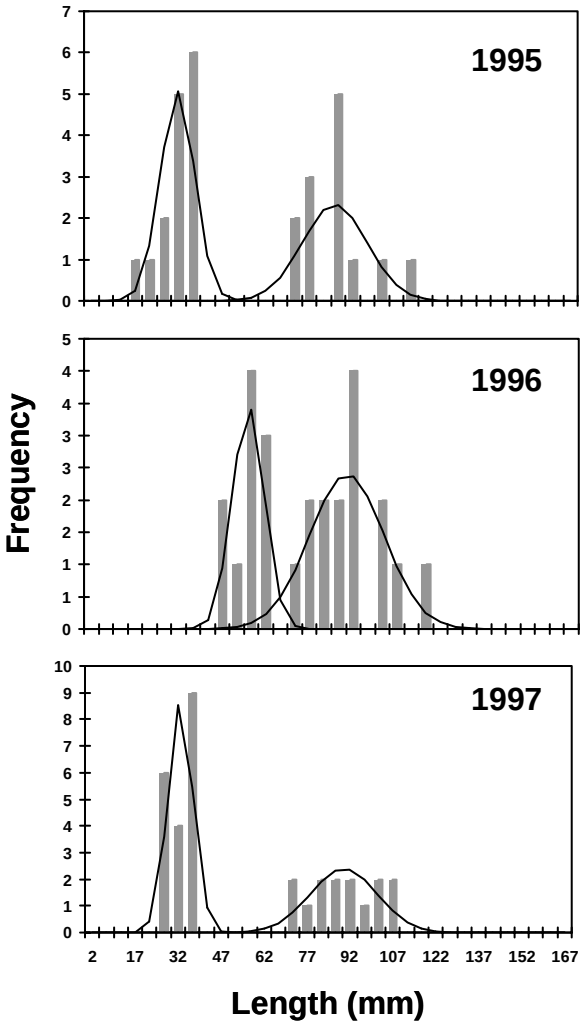
Nanticoke River Middleground (NRMG)



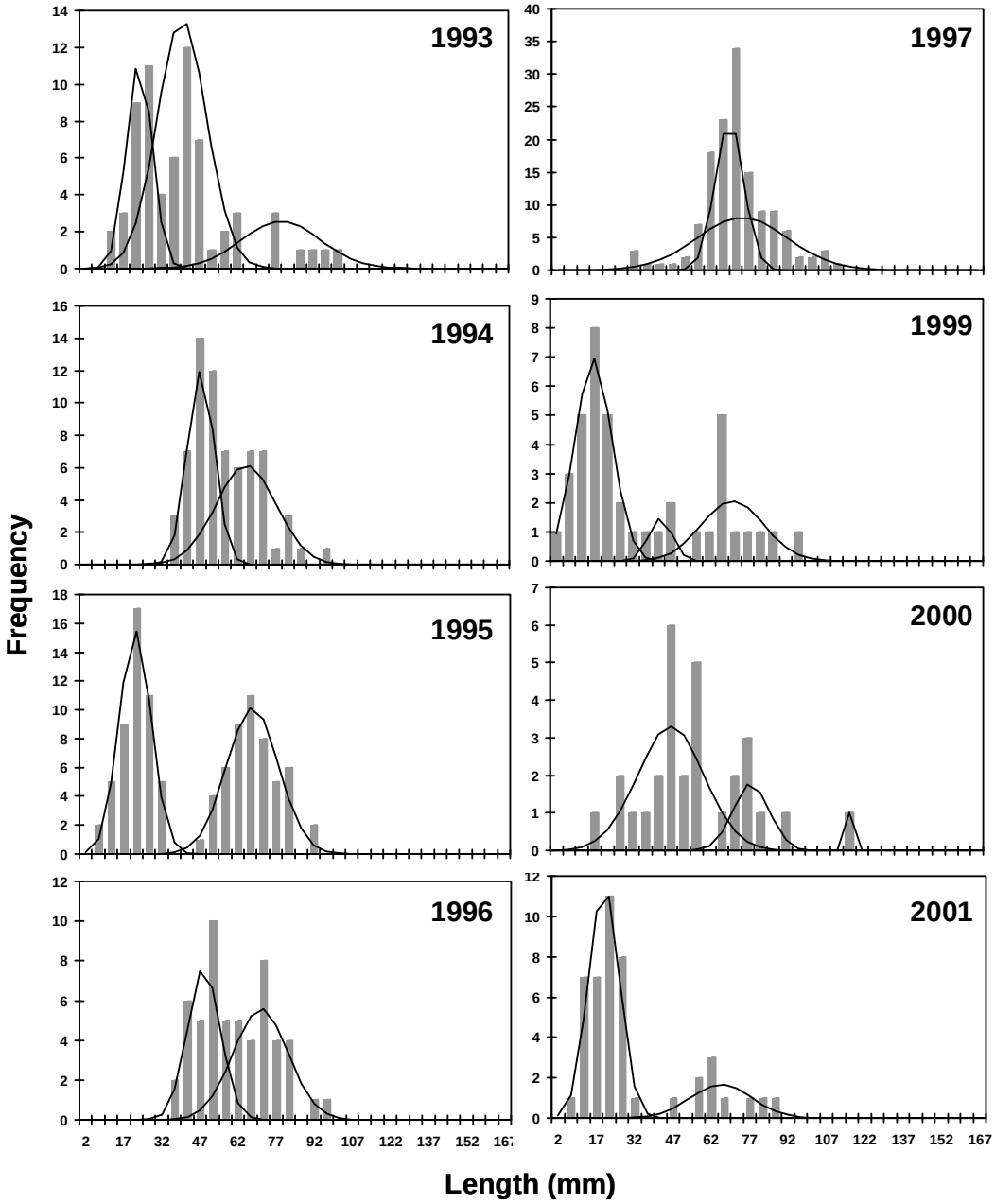
Nanticoke River Wilson Shoal (NRWS)



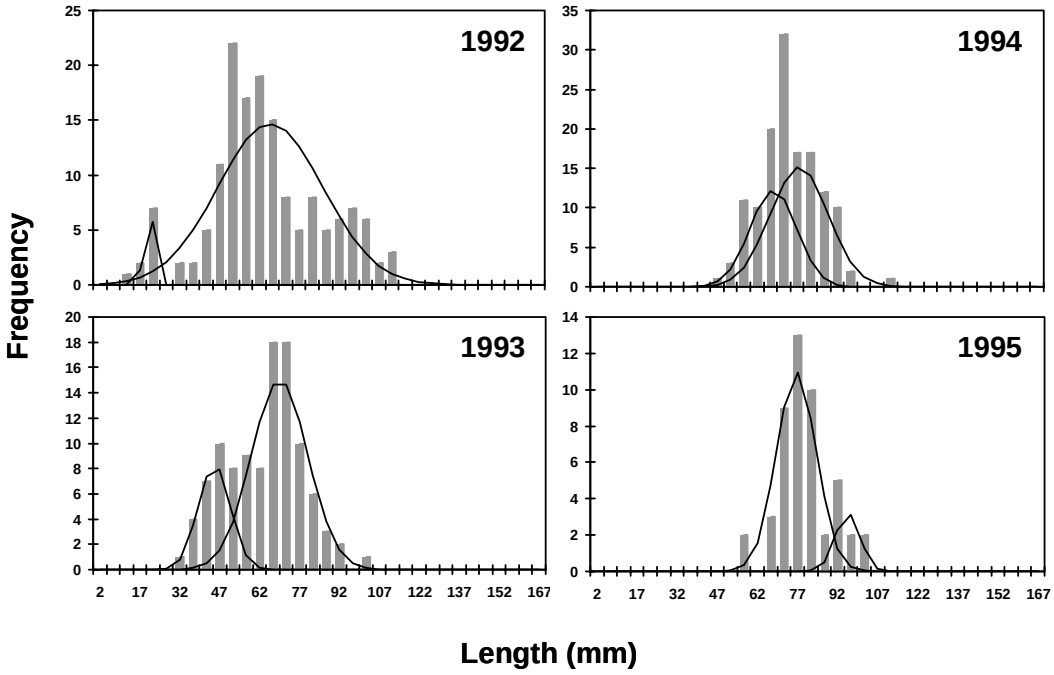
Poplar Island Shell Hill (POSH)



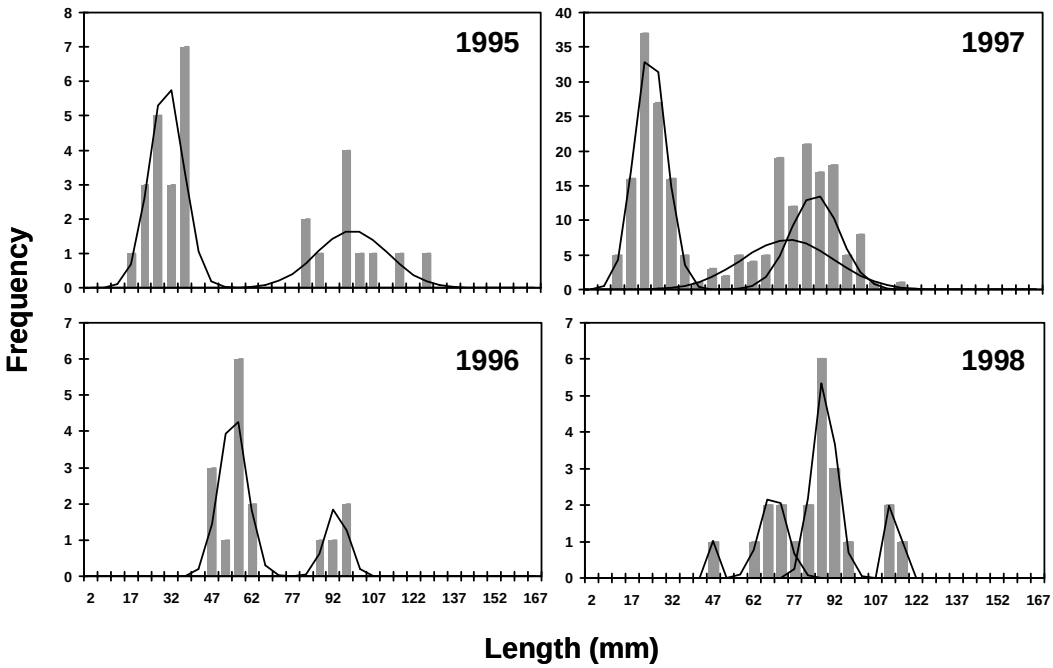
Potomac River Cornfield Harbor (PRCH)



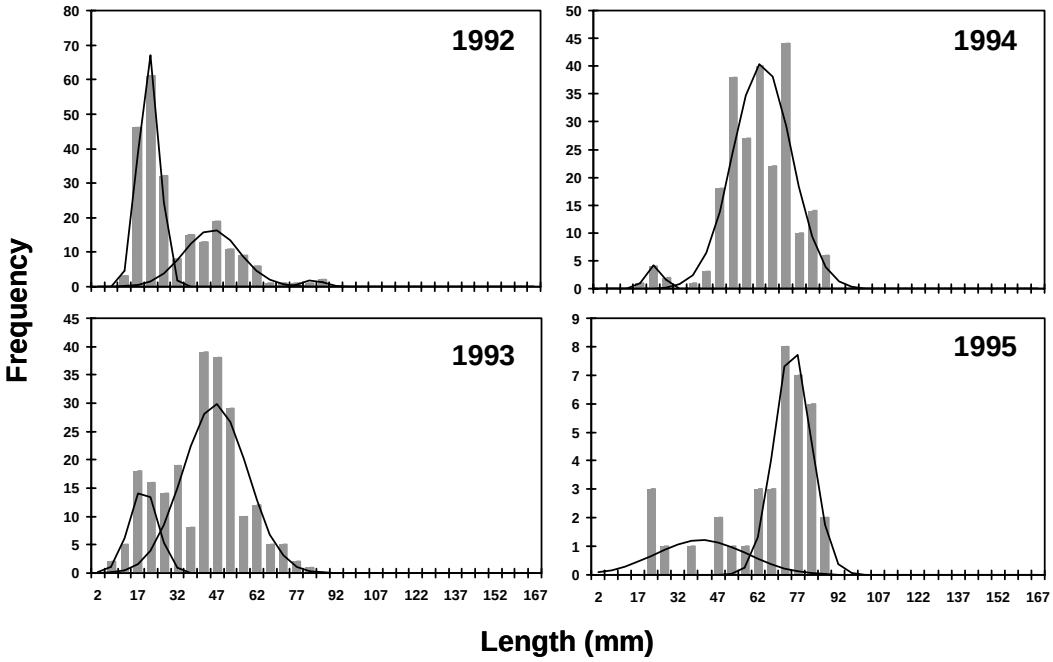
Potomac River Lower Cedar Point (PRLC)



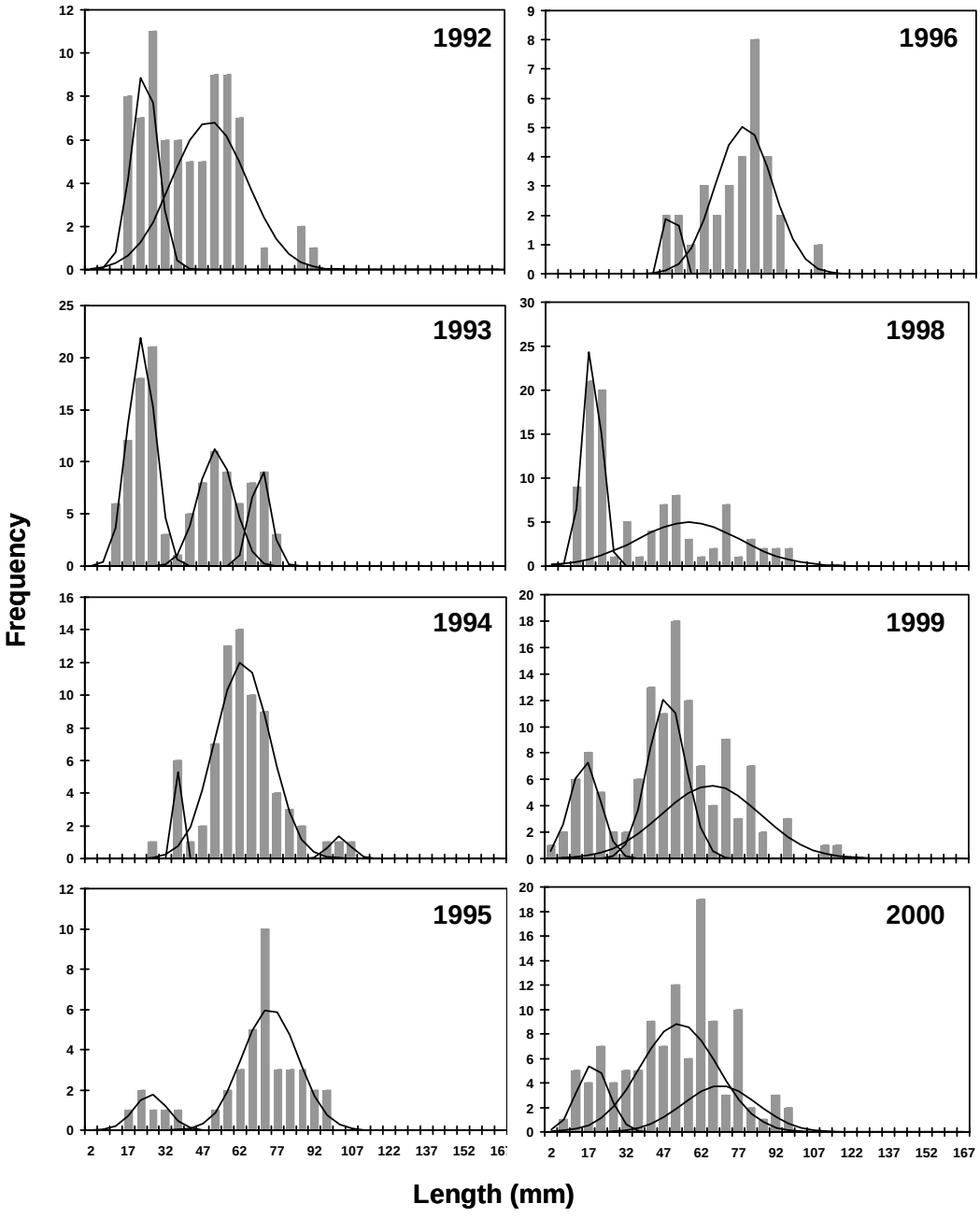
Potomac River Ragged Point (PRRP)



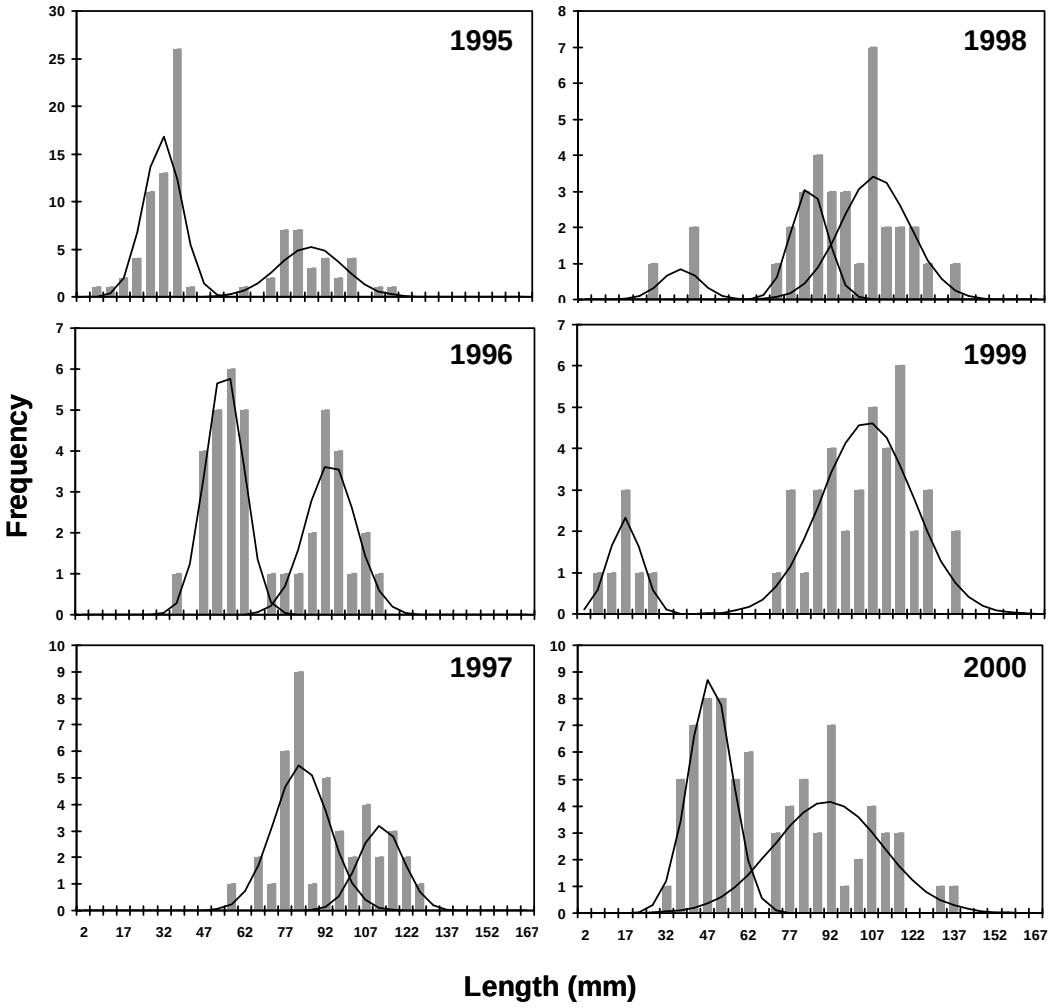
Pocomoke Sound Gunby (PSGU)



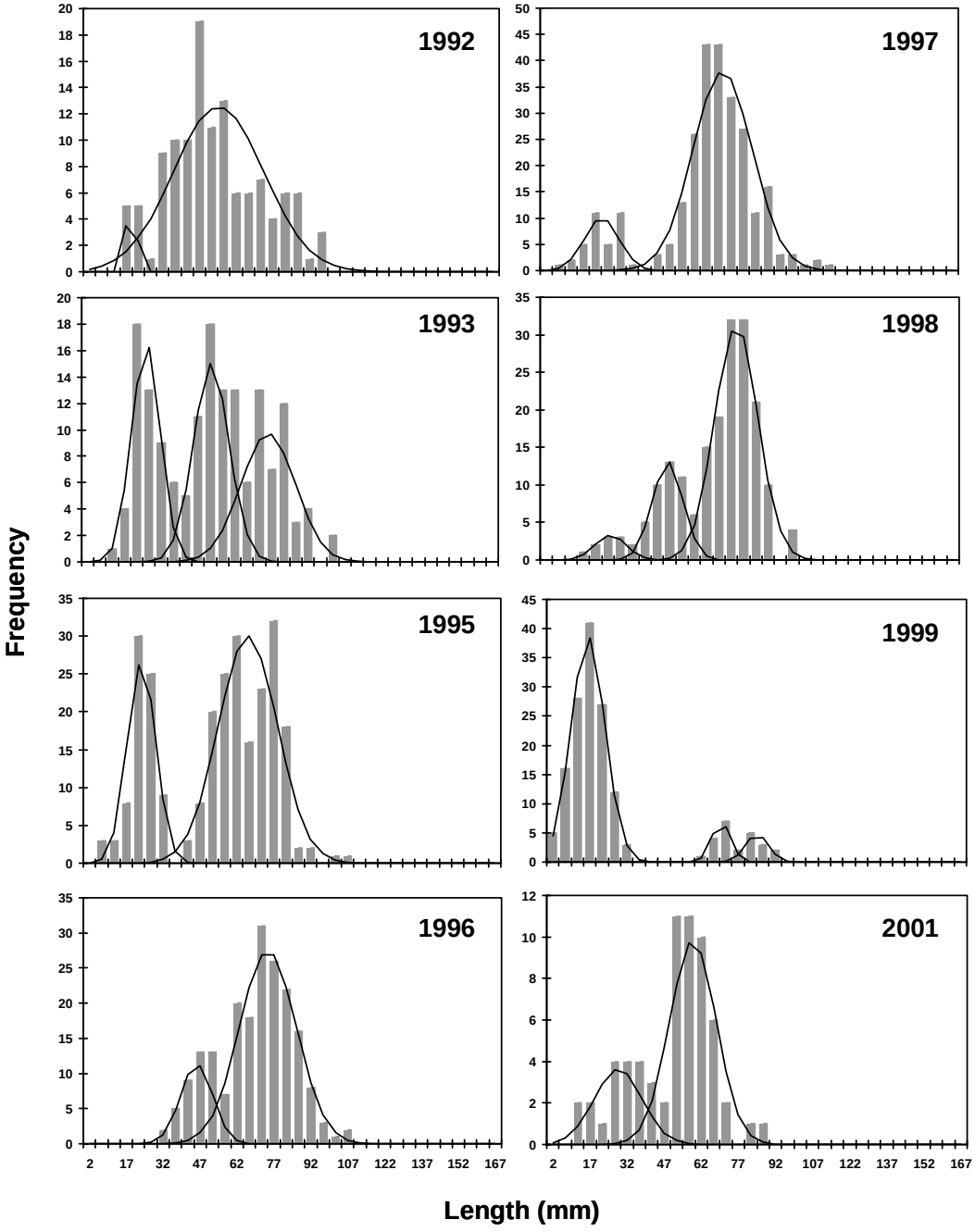
Pocomoke Sound Marumsco (PSMA)



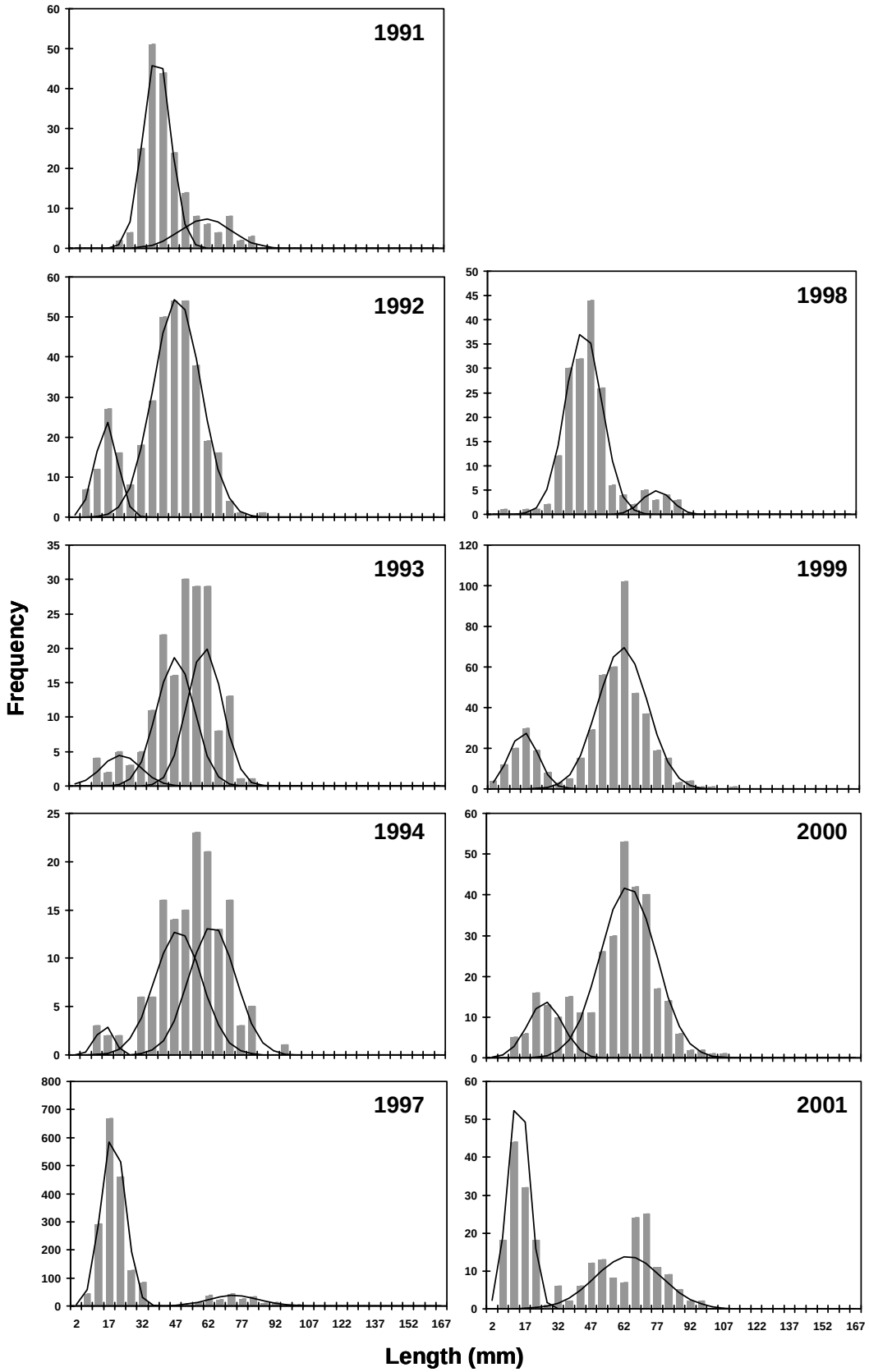
Patuxent River Broomes Island (PXBI)



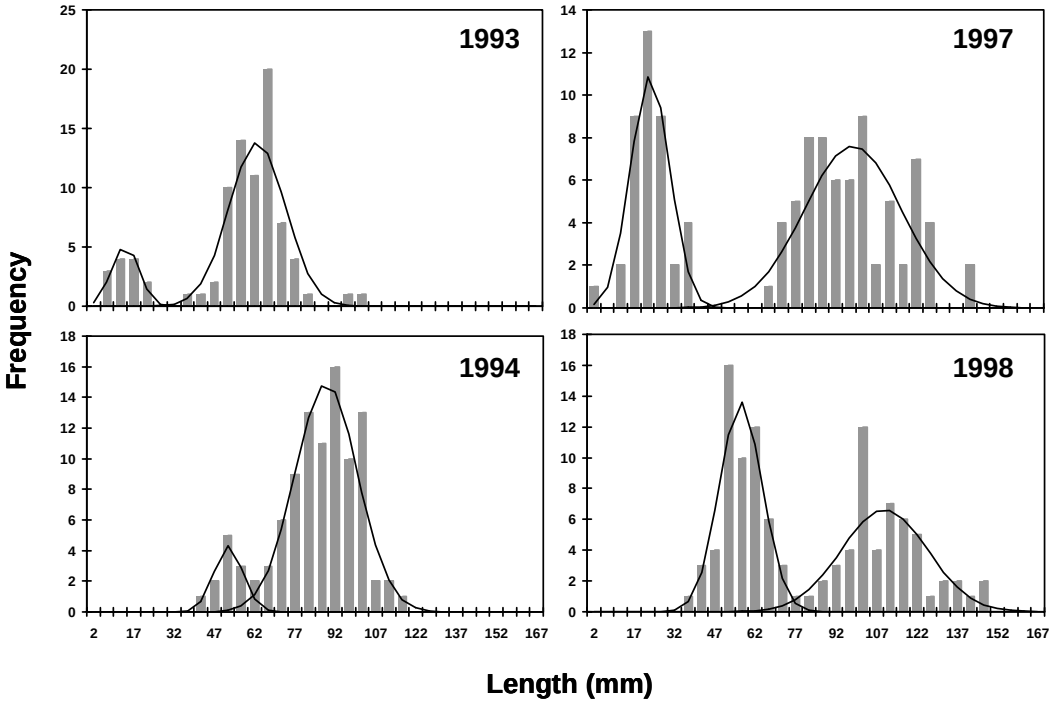
Saint Mary's River Chickencock (SMCC)



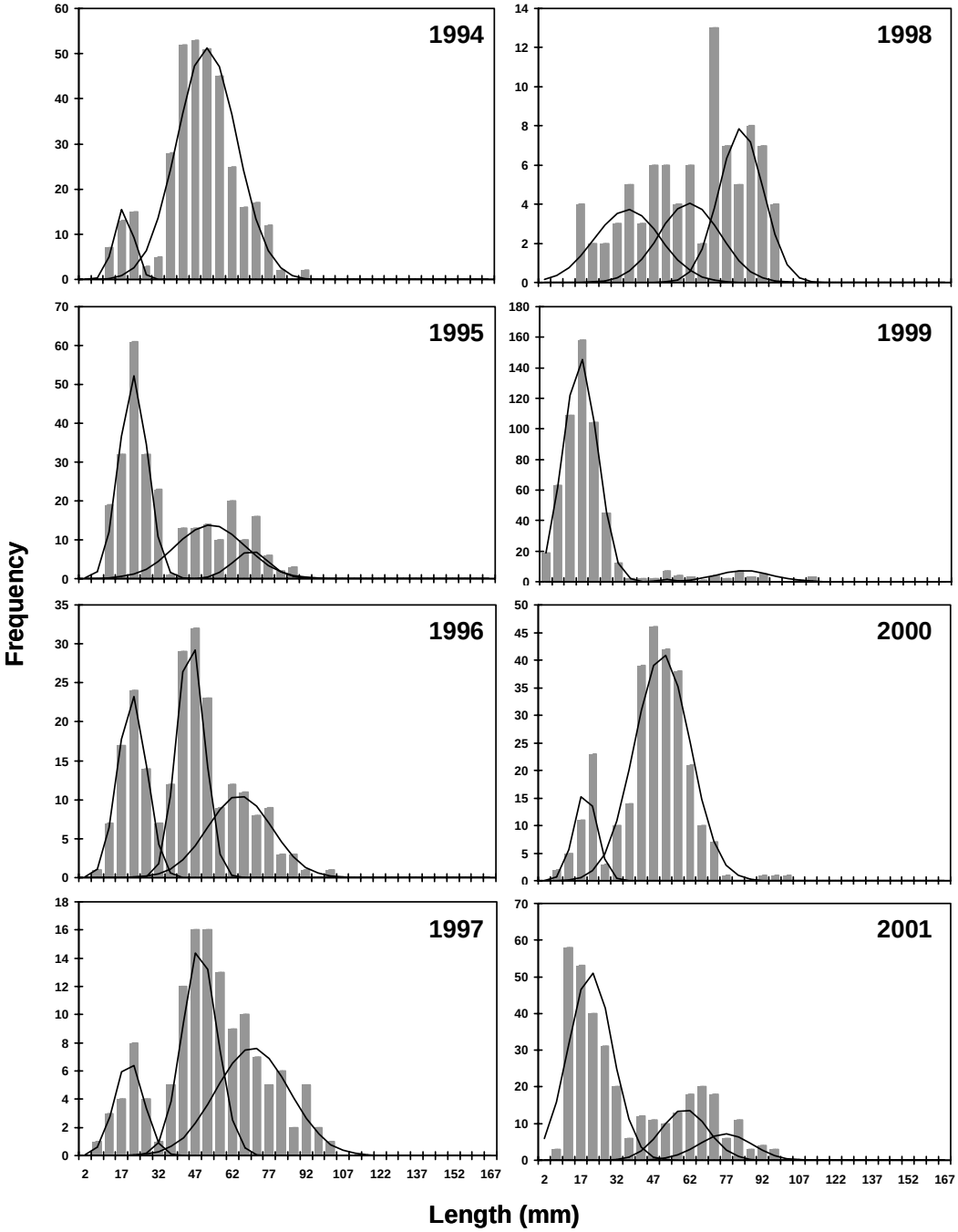
Saint Mary's River Pagan (SMPA)



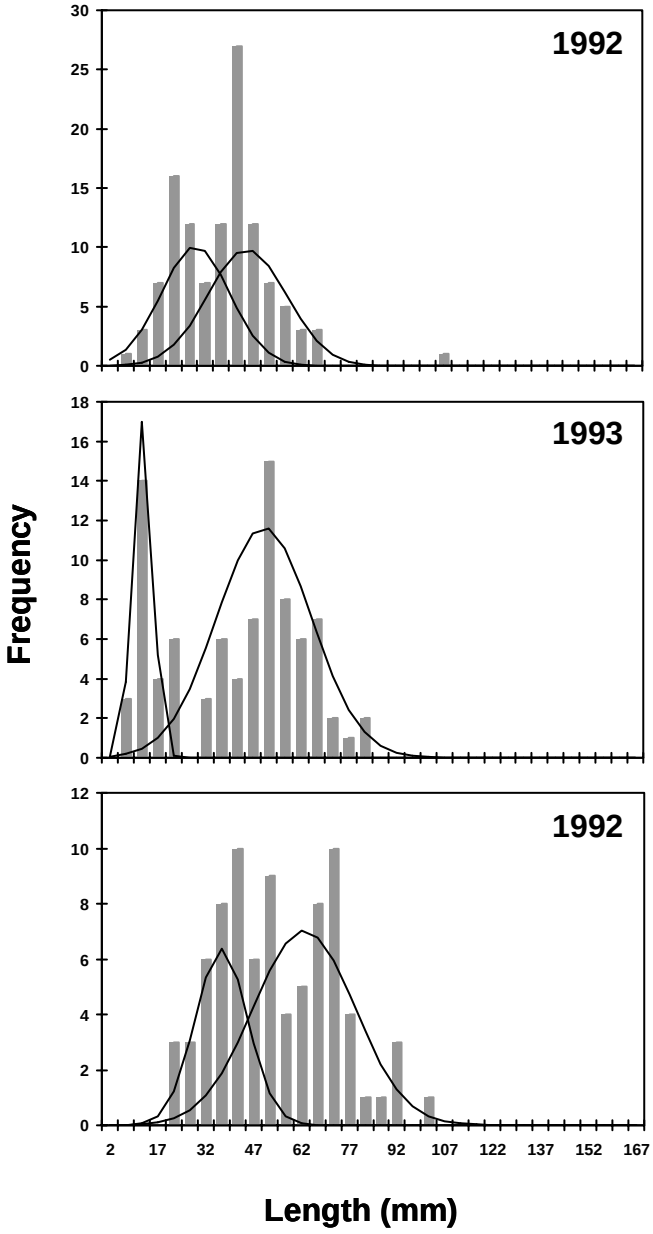
Tred Avon River Double Mills (TADM)



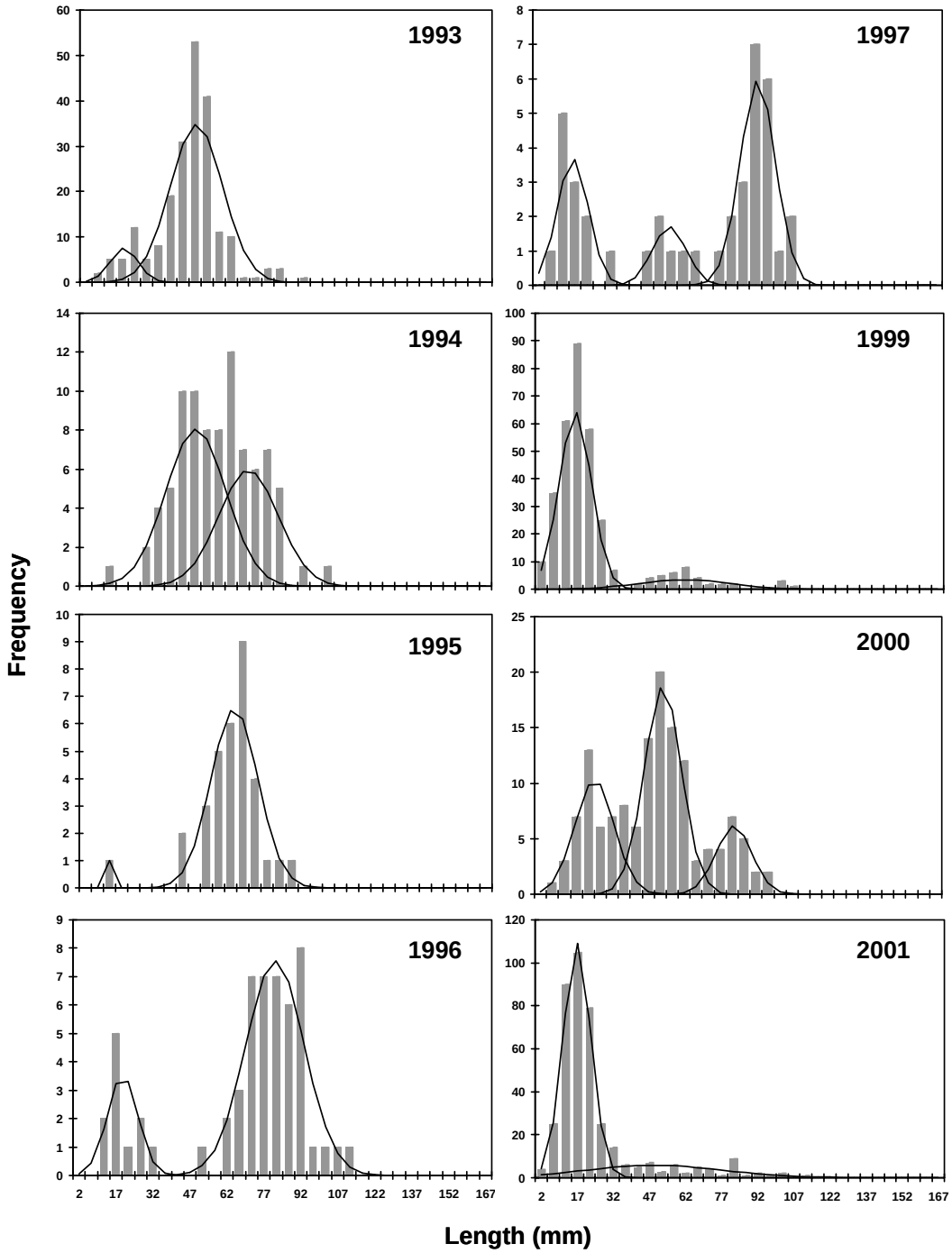
Tangier Sound Back Cove (TSBC)



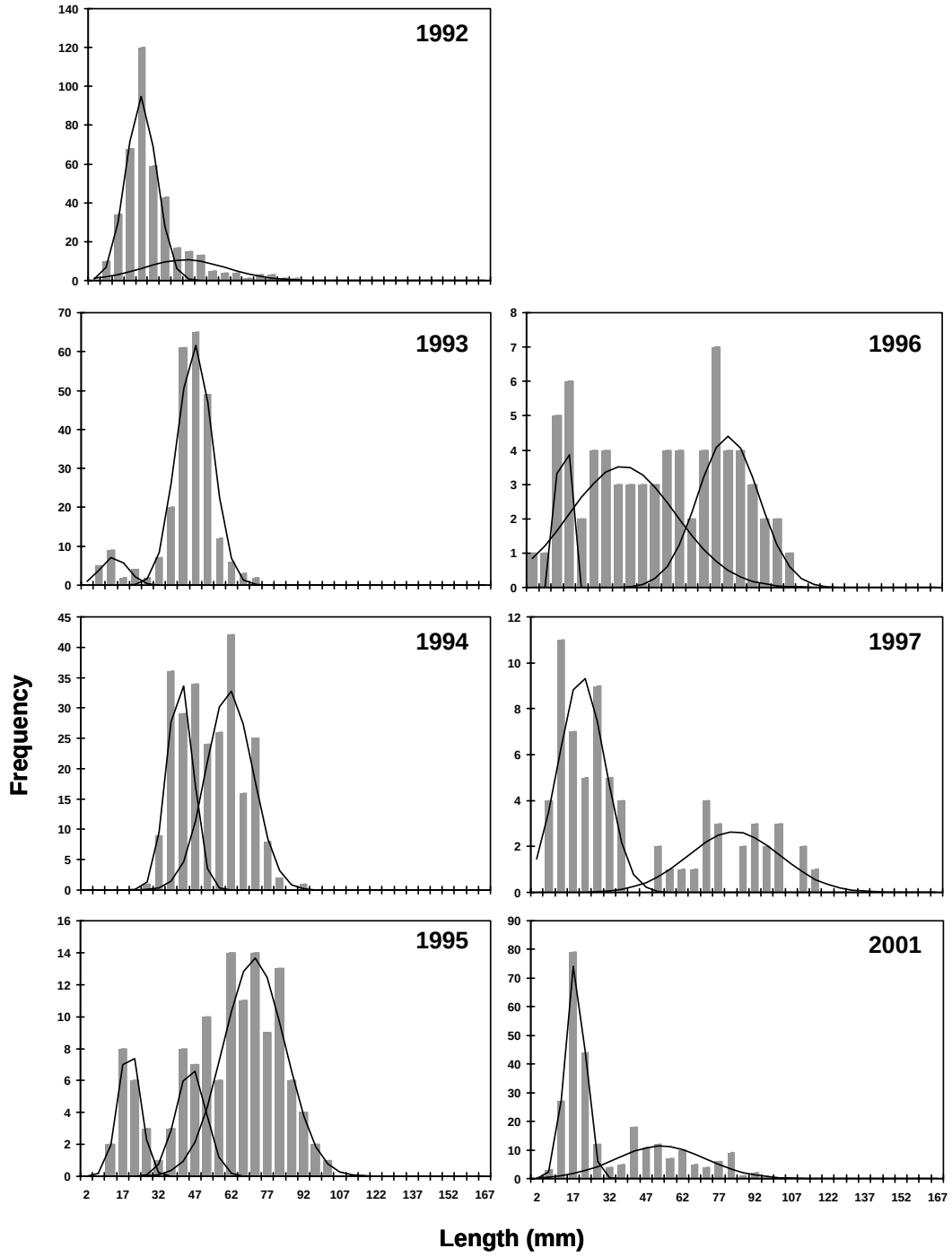
Tangier Sound Great Rock (TSGR)



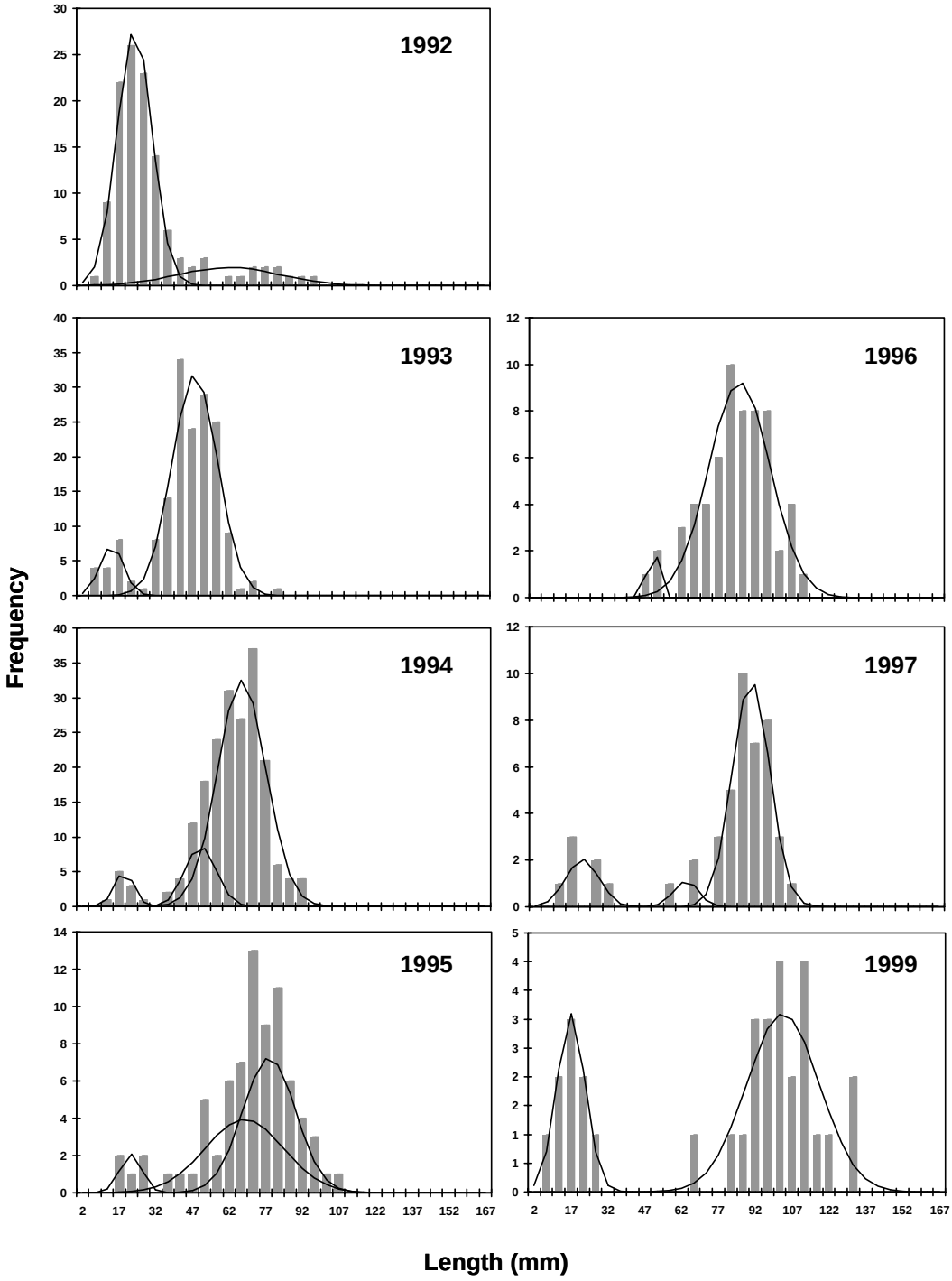
Tangier Sound Old Woman's Leg (TSOW)



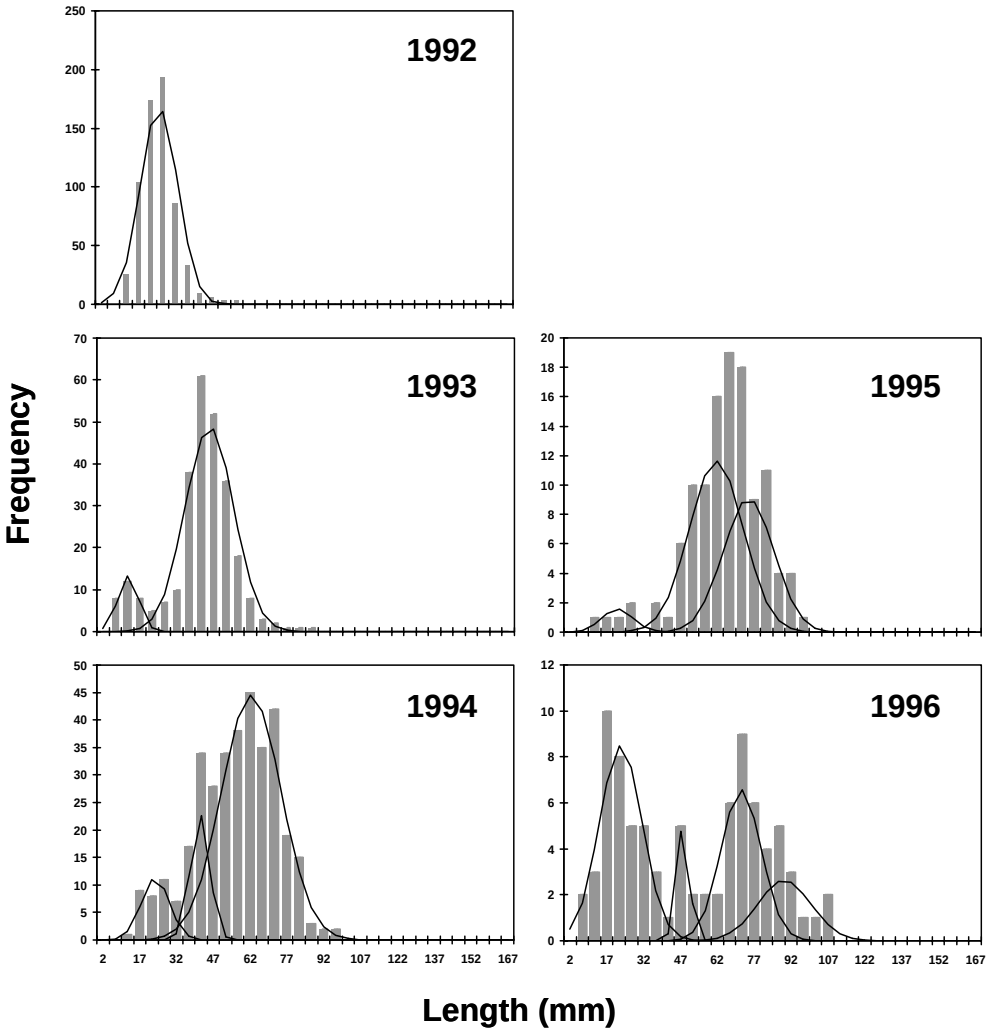
Tangier Sound Piney Island (TSPI)



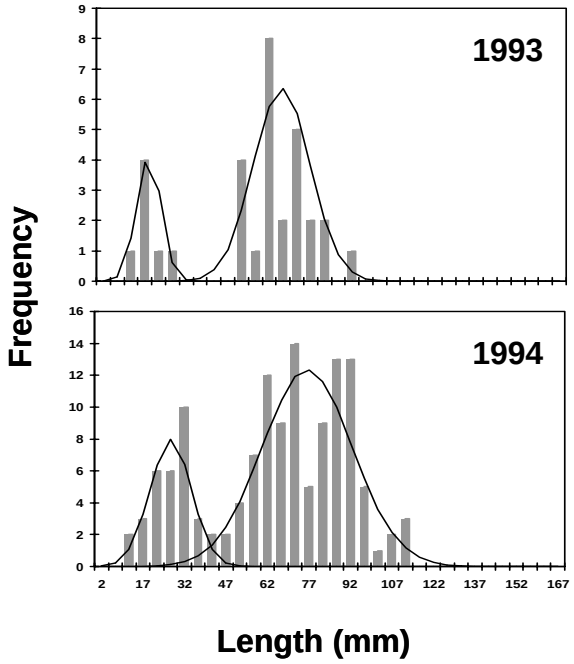
Tangier Sound Sharkfin Shoal (TSSS)



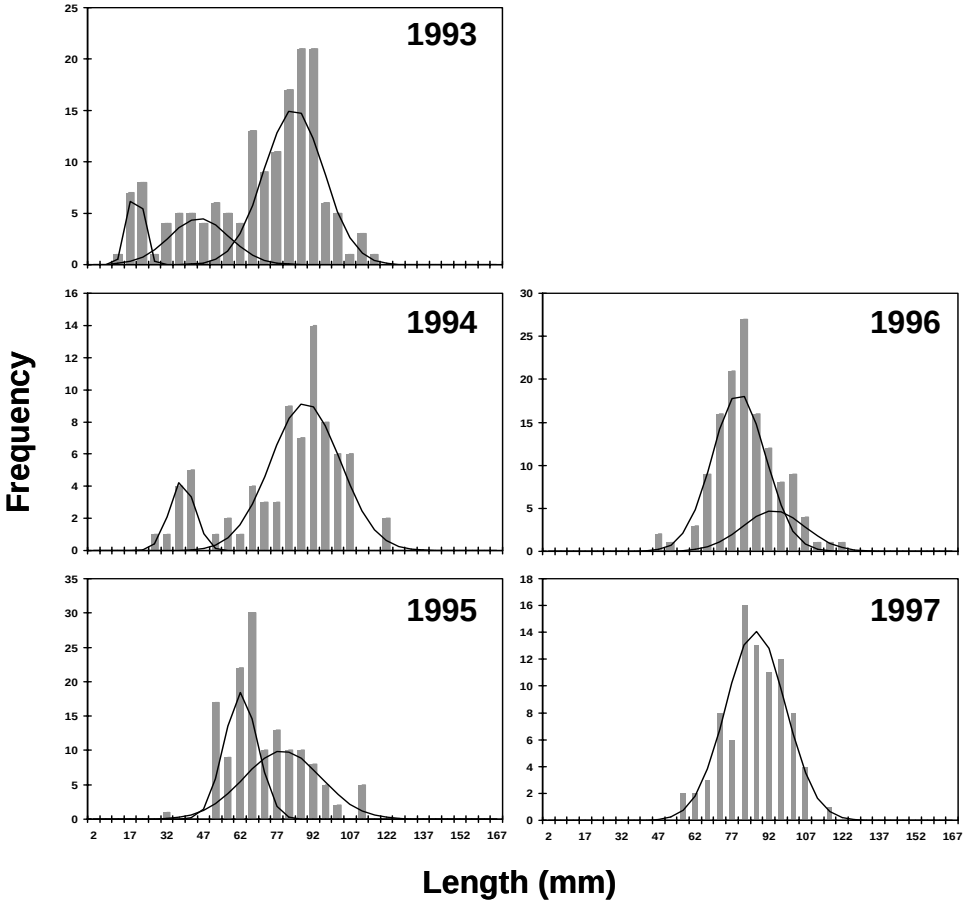
Tangier Sound Turtle Egg Island (TSTE)



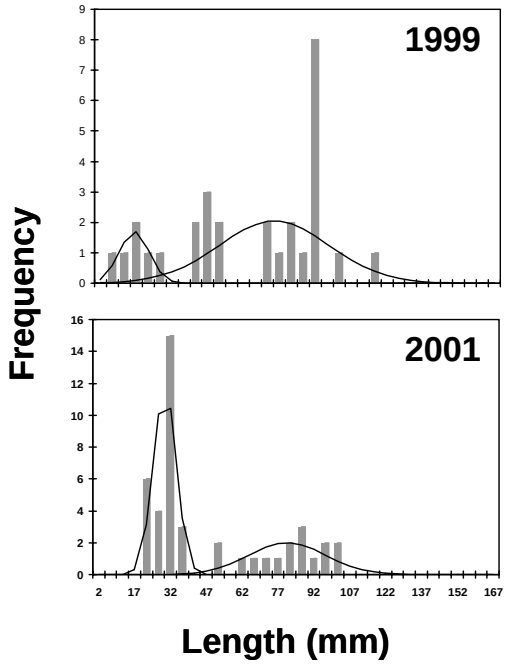
Wicomico River Evans Shoal (WRES)



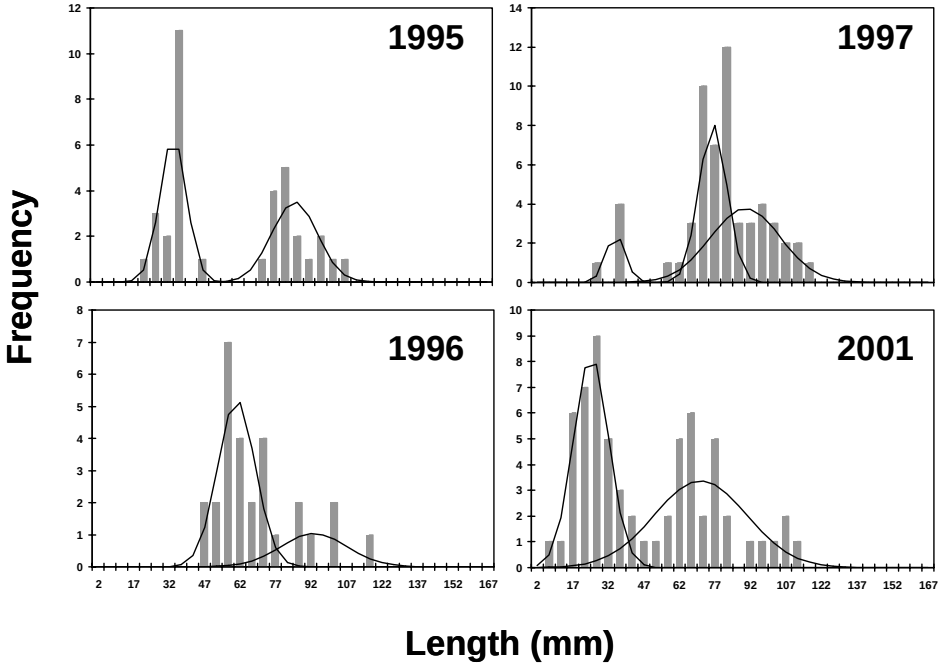
Wicomico River Mount Vernon Wharf (WRMV)



Western Shore Butlers (WSBU)



Western Shore Hog Island (WSHI)



Appendix V. Mean shell length (mm) within year-class followed though time, as determined through log likelihood modal fitting techniques, with "Year" indicating the year when the cohort was first identified and "Cohort" identifying individual cohorts within each site.

Bar Name	Site	Year	Cohort	Year(0)	Year(1)	Year(2)	Year(3)	Year(4)	Year(5)
Deep Neck	BCDN	1993	1	14.646	41.895	61.826	77.793	77.225	
Deep Neck	BCDN	1993	2		52.119	69.02	75.895		
Deep Neck	BCDN	1995	3	29.735	52.871	63.436	78.009		
Deep Neck	BCDN	1997	4	22.779	44.781	64.094	74.262		
Deep Neck	BCDN	1999	5	16.423					
Mountain Point	BNMP	1992	1	46.222	62.492	74.335	78.356	80.263	86.89
Buoy Rock	CHBR	1997	2	31.534	56.032	80.903	82.167	77.02	
Cook's Point	CRCP	1995	1	30.994					
Cook's Point	CRCP	2000	2	37.118					
Lighthouse	CRLI	1992	2	24.105	50.947	58.412	76.222	85.309	86.056
Lighthouse	CRLI	1995	4	29.791	52.411	71.51	86.056		
Lighthouse	CRLI	1997	5	25.708	55.173	72.259			
Oyster Shell Point	CROS	1992	1	14.537	47.781	57.31			
Oyster Shell Point	CROS	2000	4	38.147	52.363				
Royston	CRRO	1995	1	27.541	53.434				
Royston	CRRO	1997	2	28.648	50.021	67.786	76.753	83.416	
Royston	CRRO	1999	3	16.368					
Sandy Hill	CRSH	1992	1	44.028	59.032	75.04	77.47		
Sandy Hill	CRSH	1997	2	30.506	62.158	72.982	87.292	96.197	
Tilghman Wharf	CRTW	1992	1	38.389	50.623	62.785	80.36		
Tilghman Wharf	CRTW	1993	2	14.587	42.947	65.343	81.628	82.408	
Tilghman Wharf	CRTW	1995	3	31.203	60.39	75.287			
Tilghman Wharf	CRTW	1997	4	23.851	49.12	67.275	75.627	74.707	
Tilghman Wharf	CRTW	1999	5	15.769	46.238				
Bugby	EBBU	1997	1	26.492	58.618	78.264	85.095	95.093	
Holicutts Noose	EBHN	1995	1	31.258	54.531	71.834	84.29	97.551	92.155
Holicutts Noose	EBHN	1997	2	30.57	55.388	71.472	74.432		
Holicutts Noose	EBHN	1999	3		50.819	76.567			
Parson's Island	EBPI	1992	1	13.609					
Parson's Island	EBPI	1993	2	10.654	42.611				
Parson's Island	EBPI	1995	3	25.146	47.821				
Parson's Island	EBPI	1997	4	30.509	54.602				
Parson's Island	EBPI	1999	5	16.152					
Parson's Island	EBPI	2000	6	14.908					
Parson's Island	EBPI	2001	7	26.333					
Wild Ground	EBWG	1992	1	30.419					
Wild Ground	EBWG	1992	2		53.681	65.163			
Wild Ground	EBWG	1995	3	26.7	48.92	64.202			
Wild Ground	EBWG	1997	4	24.645					

Appendix V. continued.

Bar Name	Site	Year	Cohort	Year(0)	Year(1)	Year(2)	Year(3)	Year(4)	Year(5)
Clay Island	FBCI	1992	1	22.063	45.769				
Clay Island	FBCI	1992	2		42.821	57.809	69.453		
Clay Island	FBCI	1993	3	16.291	49.185				
Clay Island	FBCI	1994	4	20.244	48.28				
Clay Island	FBCI	1995	5	18.865					
Clay Island	FBCI	1997	6	18.993					
Goose Creek	FBGC	1992	1	20.432	51.304	69.788	87.12	106.633	
Goose Creek	FBGC	1993	2	19.16	57.462	73.127	85.069		
Goose Creek	FBGC	1994	3	22.147	52.05	58.041			
Goose Creek	FBGC	1995	4	17.015					
Eagle Point	HCEP	1992	1	43.774	66.832	81.338	101.882	110.677	
Eagle Point	HCEP	1993	2	21.156	50.21	78.358	90.374		
Eagle Point	HCEP	1995	3	32.131	67.033	80.774			
Eagle Point	HCEP	1997	4	29.41					
Holland Straits	HOHO	1991	1		48.824				
Holland Straits	HOHO	1992	2	22.569	42.975	62.334			
Holland Straits	HOHO	1992	3		49.569	61.005			
Holland Straits	HOHO	1993	4	10.724	47.263				
Holland Straits	HOHO	1994	5	19.609					
Holland Straits	HOHO	1995	6	26.915	43.831	60.339			
Holland Straits	HOHO	1996	7	19.718					
Holland Straits	HOHO	1997	8	26.672					
Holland Straits	HOHO	1999	9	16.152					
Holland Straits	HOHO	2001	10	22.203					
Normans	HRNO	1992	1	19.377	40.865	72.59	75.268		
Normans	HRNO	1992	2		42.362				
Normans	HRNO	1993	3	17.731	48.012	58.575			
Normans	HRNO	1994	4	18.234					
Normans	HRNO	1995	5	24.082					
Normans	HRNO	1999	6	16.072	60.14				
Normans	HRNO	2001	7	22.146					
Windmill	HRWI	1992	1	18.603	43.267	75.062			
Windmill	HRWI	1993	2	22.828	49.95	62.473	73.666	81.347	
Windmill	HRWI	1994	3	18.963					
Windmill	HRWI	1995	4	25.312	49.444	69.825			
Windmill	HRWI	1997	5	21.859					
Cason	LCCA	1992	1	14.373	42.342	56.752	70.572	73.146	
Cason	LCCA	1993	2	19.057	45.411	54.502			
Cason	LCCA	1995	3	29.913					
Cason	LCCA	1997	4	22.955	56.803	68.693	74.195	69.187	
Cason	LCCA	1999	5	16.195	47.853	57.049			

Appendix V. continued.

Bar Name	Site	Year	Cohort	Year(0)	Year(1)	Year(2)	Year(3)	Year(4)	Year(5)
Ragged Point	LCRP	1991	1	39.022					
Ragged Point	LCRP	1992	2	33.436	43.723	62.777			
Ragged Point	LCRP	1993	3	21.746	47.03	66.169	78.322		
Ragged Point	LCRP	1995	4	25.276	51.05				
Ragged Point	LCRP	1997	5	34.5	50.249	66.064	73.709	77.78	
Ragged Point	LCRP	1999	6	16.273	45.288	60.403			
Ragged Point	LCRP	2001	7	19.127					
Drum Point	MADP	1992	1	19.842	43.738	57.049			
Drum Point	MADP	1993	2	18.541					
Drum Point	MADP	1994	3	20.95					
Drum Point	MADP	1996	4	20.995					
Drum Point	MADP	1997	5	21.691					
George's Bar	MAGE	1992	1	28.618	50.624	62.421	73.136	78.091	72.729
George's Bar	MAGE	1993	2	21.844	48.202				
George's Bar	MAGE	1995	3	16.999					
George's Bar	MAGE	1997	4	17.627	50.438	68.441			
George's Bar	MAGE	1999	5	16.049					
Stone Rock	MESR	1992	1	33.311	53.364	66.146	74.803		
Stone Rock	MESR	1994	2	26.962	47.228				
Stone Rock	MESR	1995	3	20.336	47.025	67.636	76.249		
Stone Rock	MESR	1997	4	28.815	49.459				
Stone Rock	MESR	2000	5	28.334	47.958				
Ashcraft	MRAS	1995	1	27.167	56.982				
Ashcraft	MRAS	1997	2	29.385					
Bruff's Island	MRBI	1992	1	25.667					
Bruff's Island	MRBI	1995	2	30.331	56.969	75.577			
Bruff's Island	MRBI	1997	3	30.941	55.171	70.989	77.149		
Bruff's Island	MRBI	2000	4	19.327	57.667				
Long Point	MRLP	1995	1	29.615	60.87	79.848	84.9	75.571	
Long Point	MRLP	1997	2	26.157	55.358	62.746	83.932	90.337	
Turtleback	MRTU	1992	1	14.444	58.708				
Turtleback	MRTU	1995	2	22.74	46.835	61.469	71.779		
Turtleback	MRTU	1997	3	25.164	53.64	72.378	84.919	82.697	
Turtleback	MRTU	1999	4	16.18	49.427	60.586			
Turtleback	MRTU	2001	5	28.424					
Middleground	NRMG	1992	1	25.094	54.427	79.438			
Middleground	NRMG	1993	2	12.945	60.609	80.215			
Middleground	NRMG	1994	3	22.492	61.695	79.701	88.007		
Middleground	NRMG	1996	4	23.504	50.76				

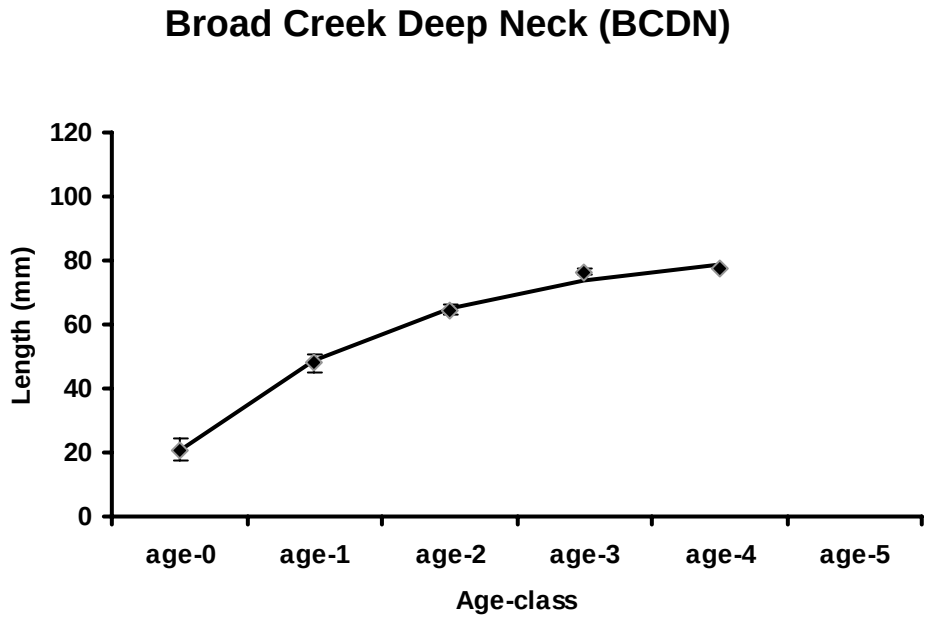
Appendix V. continued.

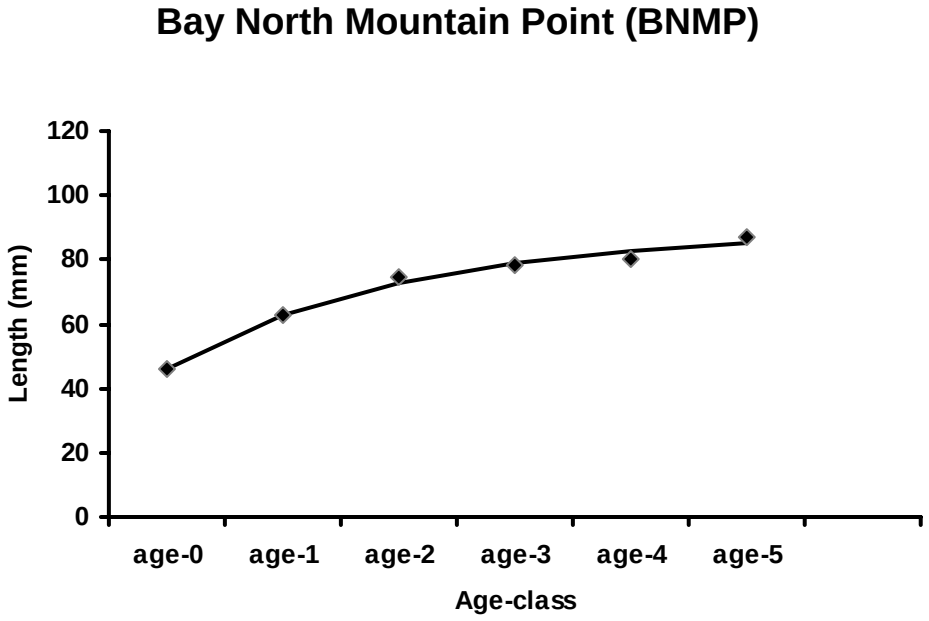
Bar Name	Site	Year	Cohort	Year(0)	Year(1)	Year(2)	Year(3)	Year(4)	Year(5)
Middleground	NRMG	1997	5	17.595					
Wilson Shoal	NRWS	1993	2	19.416	68.635	79.526			
Wilson Shoal	NRWS	1994	3	25.919	64.437				
Wilson Shoal	NRWS	1997	4	19.704					
Wilson Shoal	NRWS	2000	5	21.905					
Shell Hill	POSH	1995	1	31.667	55.9				
Shell Hill	POSH	1997	2	32.789					
Cornfield Harbor	PRCH	1993	1	23.237	47.506				
Cornfield Harbor	PRCH	1993	2		40.204	65.494			
Cornfield Harbor	PRCH	1995	3	21.584	48.487	69.525			
Cornfield Harbor	PRCH	1999	4	16.48	46.872				
Cornfield Harbor	PRCH	2001	5	19.987					
Lower Cedar Point	PRLC	1992	1	20.067	45.006	68.105	76.609		
Ragged Point	PRRP	1995	1	30.158	54.917	75.058	88.022		
Ragged Point	PRRP	1997	2	24.198	46.169				
Gunby	PSGU	1992	1	21.255	46.226	63.126	75.031		
Gunby	PSGU	1993	3	19.234					
Marumsco	PSMA	1992	1	23.717	52.479				
Marumsco	PSMA	1993	2	22.332	63.167	74.144	77.969		
Marumsco	PSMA	1994	3	35.738					
Marumsco	PSMA	1995	4	26.073	49.424				
Marumsco	PSMA	1998	5	18.178	48.513	69.414			
Marumsco	PSMA	1999	6	15.776	53.041				
Marumsco	PSMA	2000	8	18.583					
Broome Island	PXBI	1995	1	31.492	54.683	82.981	83.795		
Broome Island	PXBI	1999	2	16.971	48.045				
Chickencock	SMCC	1991	1		49.797				
Chickencock	SMCC	1992	2	19.372	52.389				
Chickencock	SMCC	1993	3	25.766					
Chickencock	SMCC	1995	4	23.245	45.516				
Chickencock	SMCC	1997	5	24.436	51.218				
Chickencock	SMCC	1998	6	28.02					
Chickencock	SMCC	1999	7	16.31					
Chickencock	SMCC	2001	8	28.373					
Pagan	SMPA	1991	1	39.366	48.389	60.77			
Pagan	SMPA	1992	2	16.389	47.523	64.19			
Pagan	SMPA	1993	3	22.845	48.807				
Pagan	SMPA	1994	4	15.459					
Pagan	SMPA	1997	5	18.749	43.802	61.251			
Pagan	SMPA	1999	6	15.878					

Appendix V. continued.

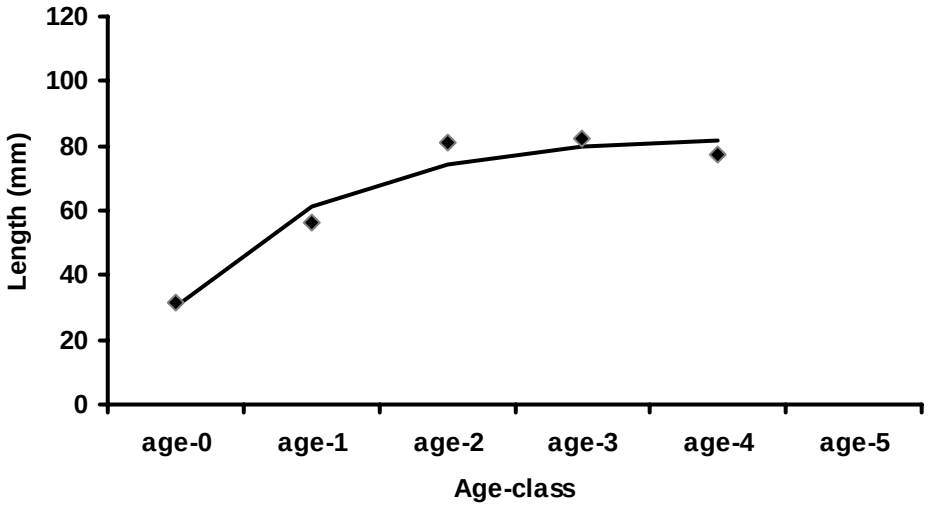
Bar Name	Site	Year	Cohort	Year(0)	Year(1)	Year(2)	Year(3)	Year(4)	Year(5)
Pagan	SMPA	2000	7	26.082					
Pagan	SMPA	2001	8	14.225					
Double Mills	TADM	1993	1	13.892	52.308				
Double Mills	TADM	1997	2	22.967	56.649				
Back Cove	TSBC	1994	1	17.964	53.253	65.055			
Back Cove	TSBC	1995	2	21.817	45.114	70.198			
Back Cove	TSBC	1996	3	21.317	48.658	61.832			
Back Cove	TSBC	1997	4	20.002					
Back Cove	TSBC	1999	5	16.253	50.661	76.524			
Back Cove	TSBC	2000	6	18.943	59.828				
Back Cove	TSBC	2001	7	21.01					
Great Rock	TSGR	1992	1	28.958	50.372	62.796			
Great Rock	TSGR	1993	2	12.281	36.889				
Old Woman's Leg	TSOW	1993	1	17.778	47.491	63.563	81.553	92.909	
Old Woman's Leg	TSOW	1996	2	19.715	56.155				
Old Woman's Leg	TSOW	1997	3	16.045					
Old Woman's Leg	TSOW	1999	4	16.217					
Old Woman's Leg	TSOW	2000	5	20.566					
Old Woman's Leg	TSOW	2001	6	16.899					
Piney Island	TSPI	1992	1	21.832	46.609	61.076	71.511		
Piney Island	TSPI	1993	2	13.224	40.598	45.255			
Piney Island	TSPI	1995	3	19.698					
Piney Island	TSPI	1996	4	14.606					
Piney Island	TSPI	1997	5	20.53					
Piney Island	TSPI	2001	6	17.803					
Sharkfin Shoal	TSSS	1992	1	23.388	48.136	67.387	78.41		
Sharkfin Shoal	TSSS	1993	2	14.019	50.435	68.276			
Sharkfin Shoal	TSSS	1994	3	18.976	49.746	63.719			
Sharkfin Shoal	TSSS	1995	4	21.832					
Sharkfin Shoal	TSSS	1997	5	21.273					
Sharkfin Shoal	TSSS	1999	6	16.981					
Turtle Egg Island	TSTE	1992	1	25.365	45.334	62.451	74.736	89.345	
Turtle Egg Island	TSTE	1993	2	12.301	41.559	61.586	71.704		
Turtle Egg Island	TSTE	1994	3	23.407					
Turtle Egg Island	TSTE	1995	4	21.332	48.096				
Turtle Egg Island	TSTE	1996	5	22.701					
Evan's Shoal	WRES	1993	1	18.419					
Evan's Shoal	WRES	1994	2	27.014					
Evan's Shoal	WRMV	1992	1	19.248	38.252	62.358	79.823	86.709	
Butler	WSBU	1999	1	16.221					
Butler	WSBU	2001	2	29.668					
Hog Island	WSHI	1995	1	34.499	60.436	76.175			
Hog Island	WSHI	1997	2	34.997					
Hog Island	WSHI	2001	3	24.701					

Appendix VI. Growth curves and Ludwig von Bertalanffy growth models (solid lines) fit to observed mean shell lengths (diamonds) by putative age-class. Error bars are the standard error of the mean. No error bar indicates a single observation.

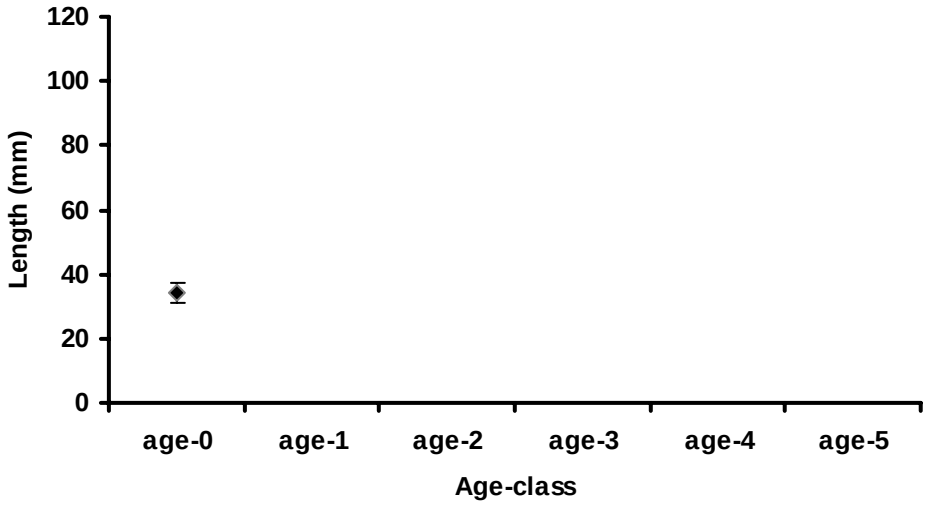




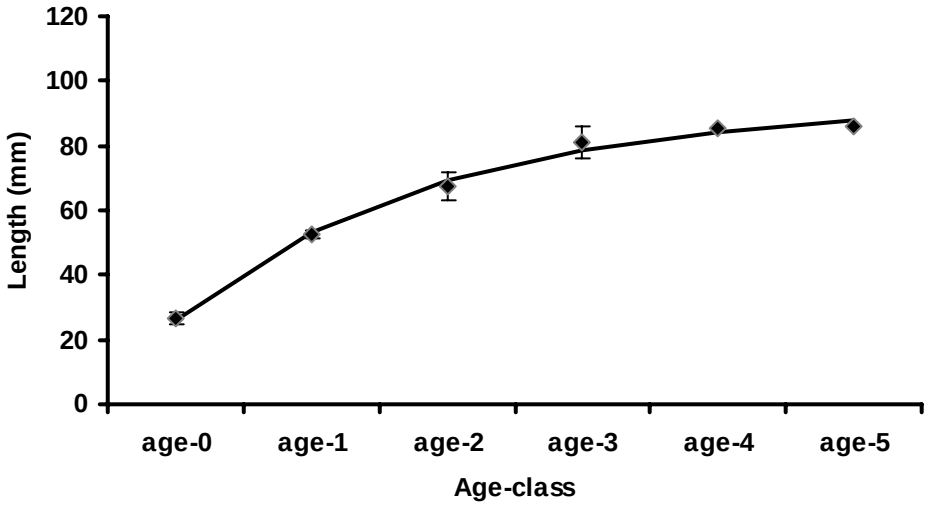
Chester River Buoy Rock (CHBR)



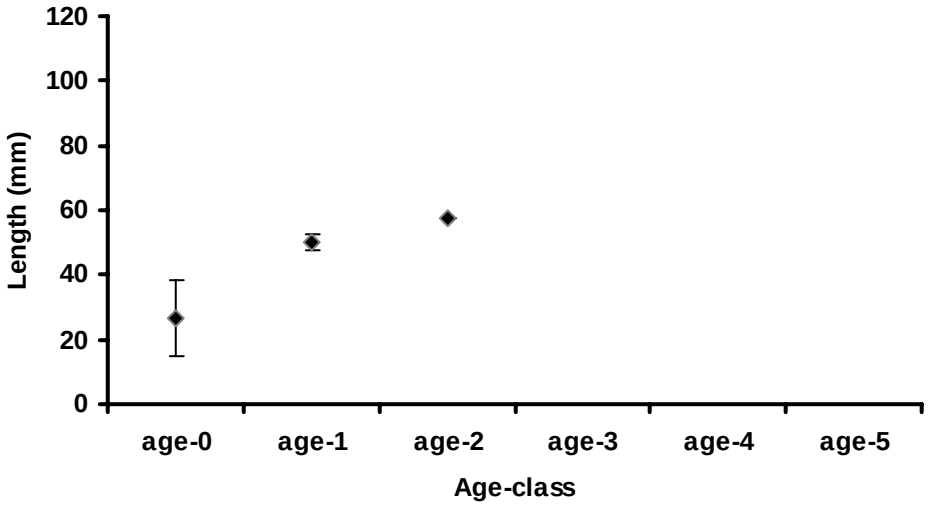
Choptank River Cooks Point (CRCP)



Choptank River Lighthouse (CRLI)

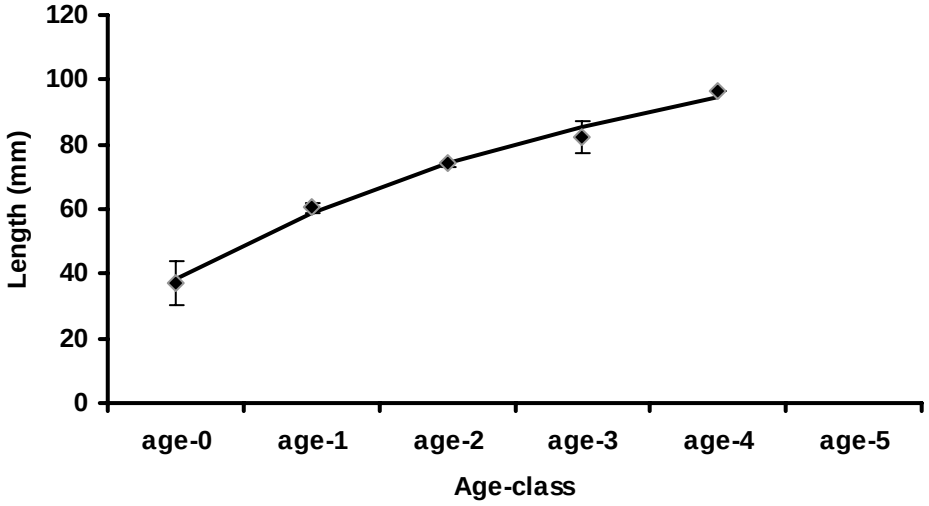


Choptank River Oyster Shell Point (CROS)

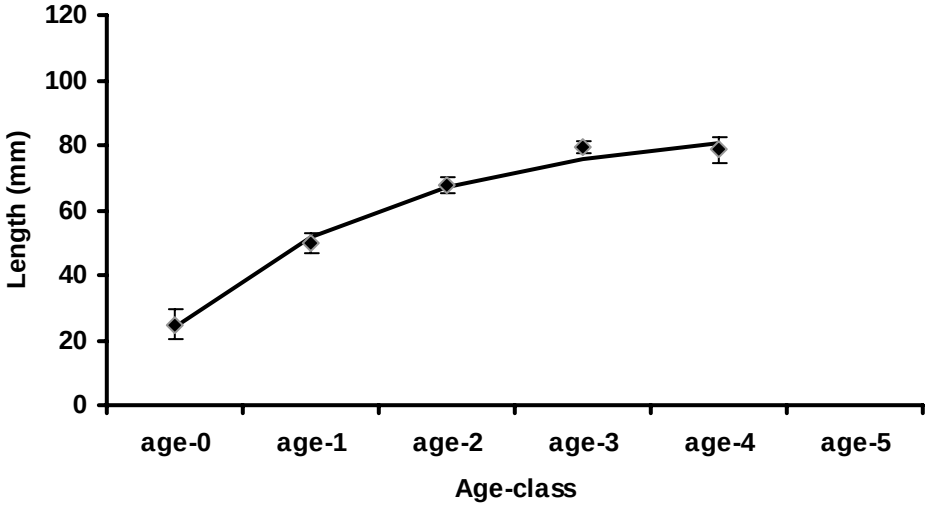


Choptank River Royston (CRRO)

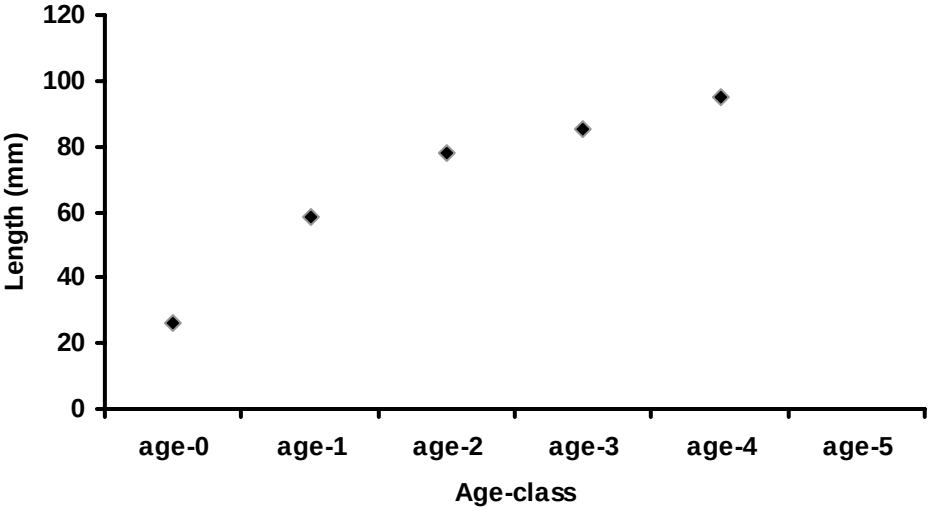
Choptank River Sandy Hill (CRSH)



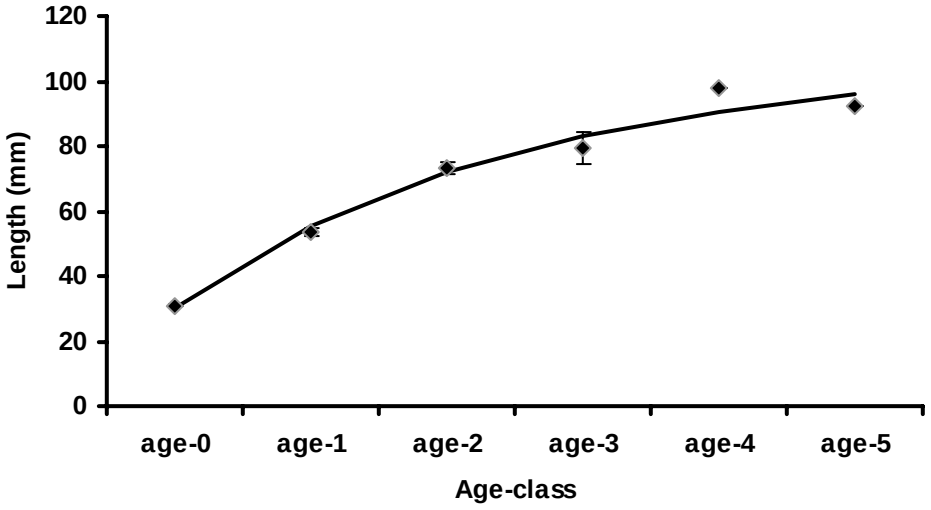
Choptank River Tilghman Wharf (CRTW)



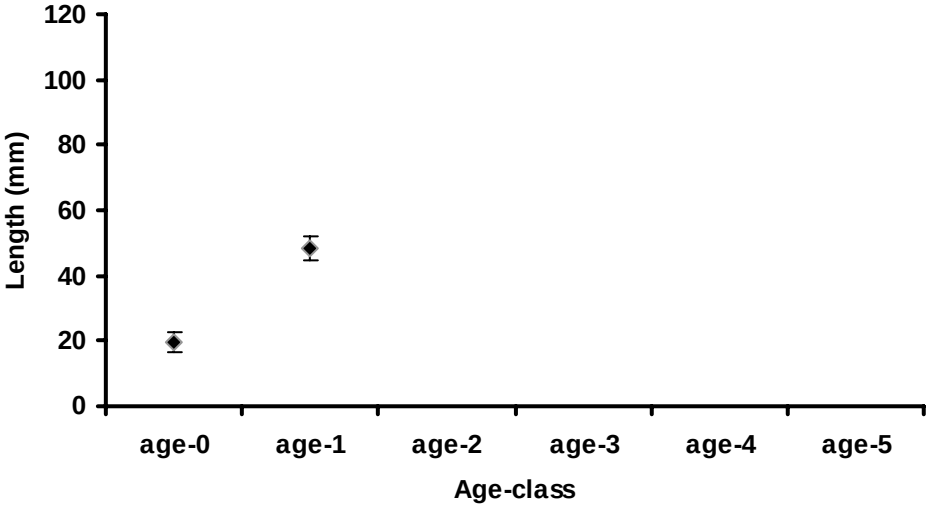
Eastern Bay Bugby (EBBU)



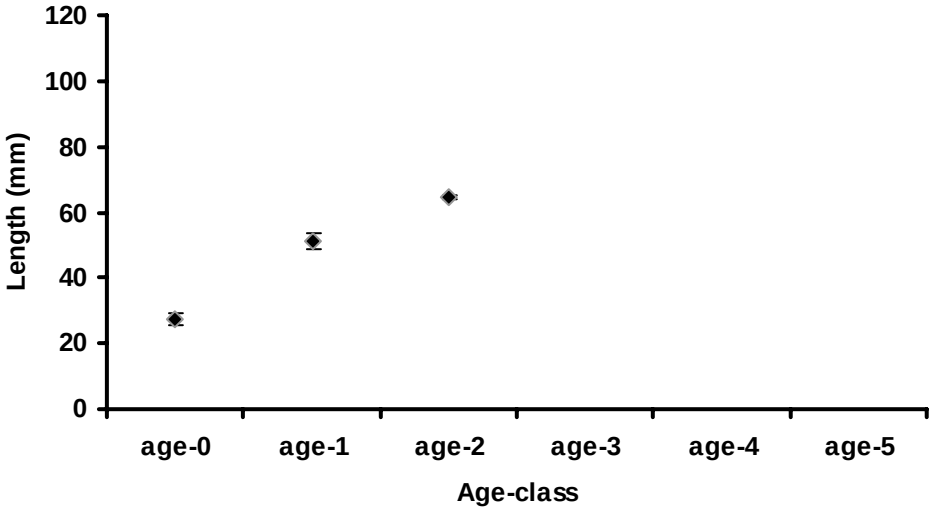
Eastern Bay Hollicutts Noose (EBHN)



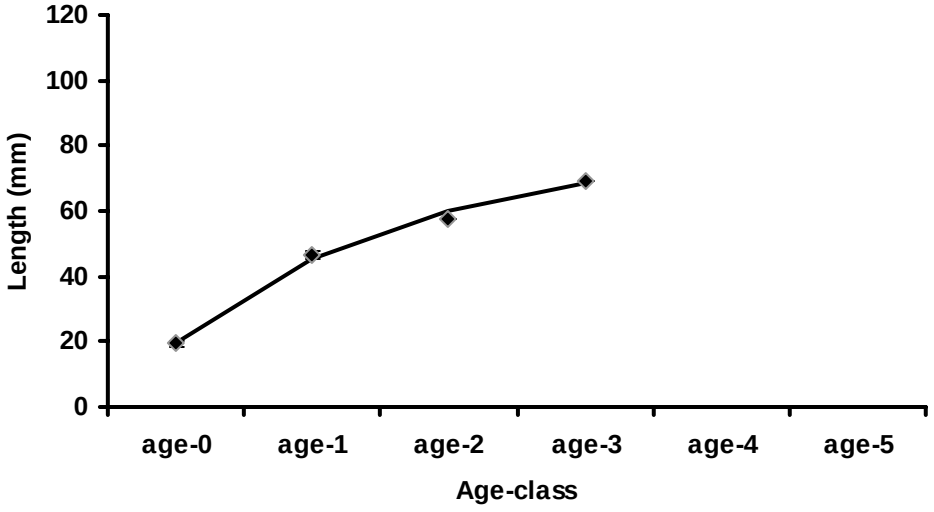
Eastern Bay Parsons Islands (EBPI)



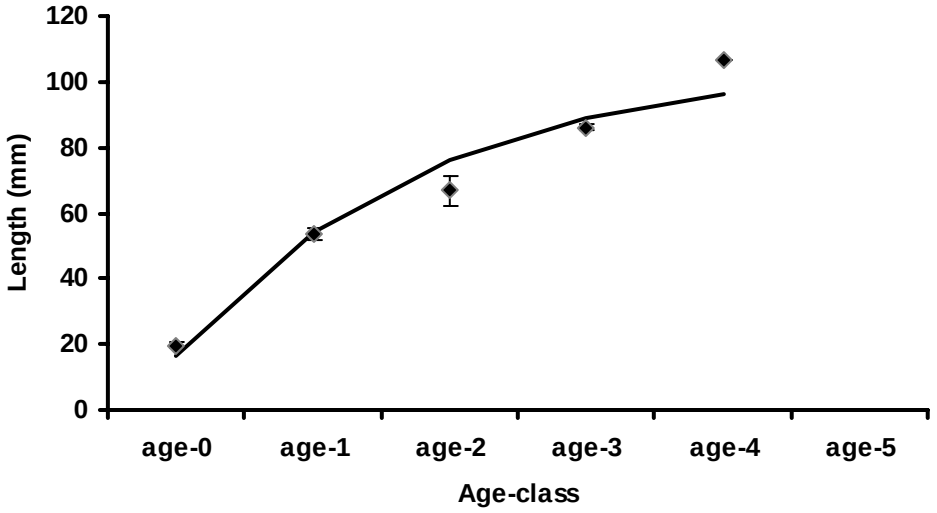
Eastern Bay Wild Ground (EBWG)



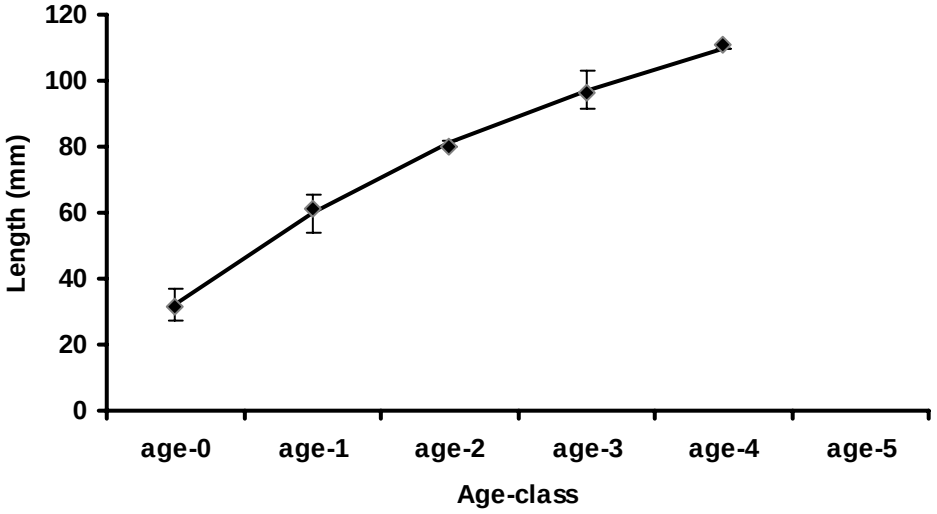
Fishing Bay Clay Island (FBCI)



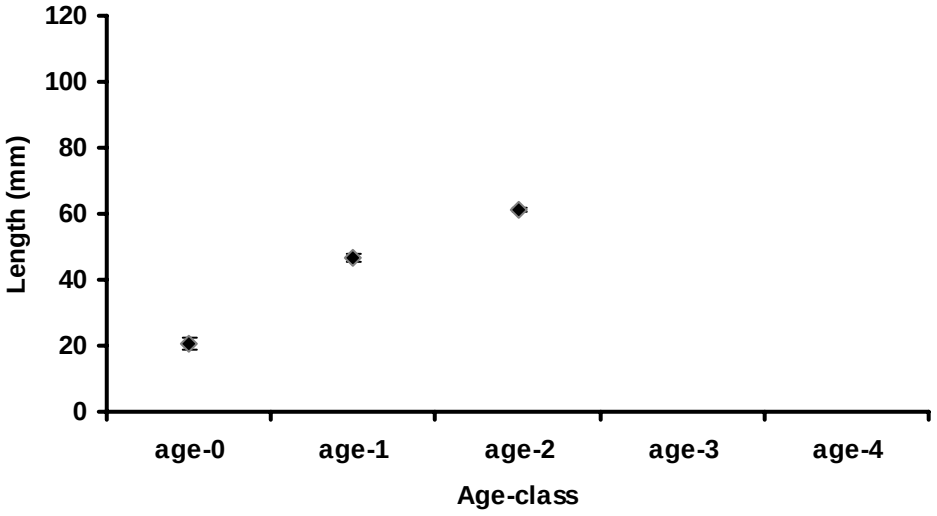
Fishing Bay Goose Creek (FBGC)



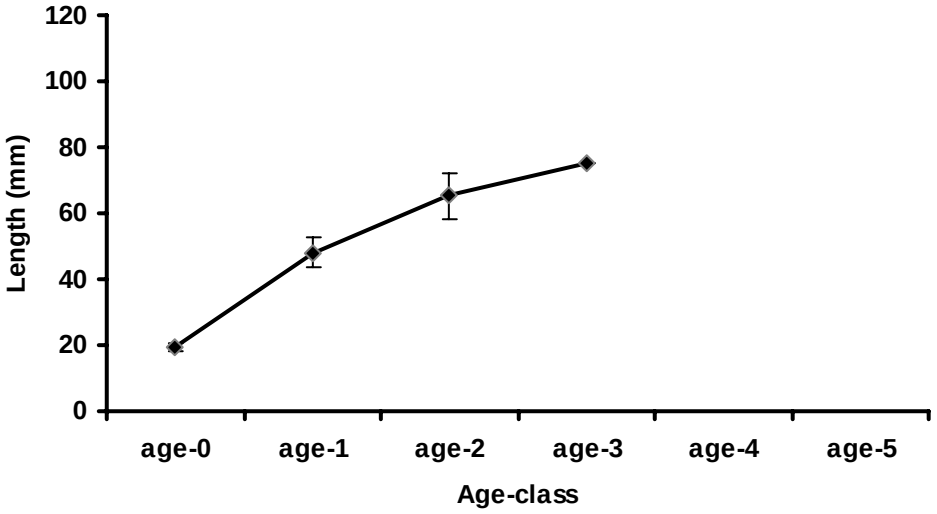
Harris Creek Eagle Point (HCEP)



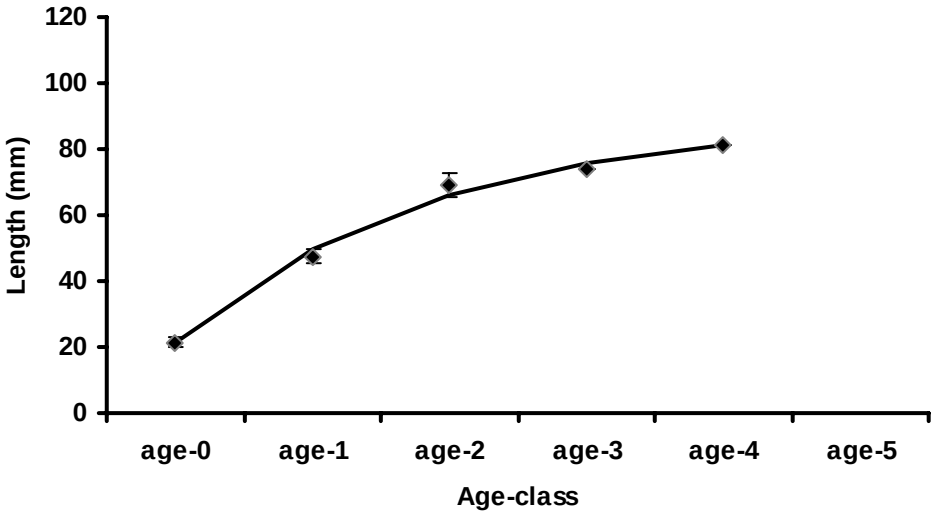
Holland Straits Holland Straits (HOHO)



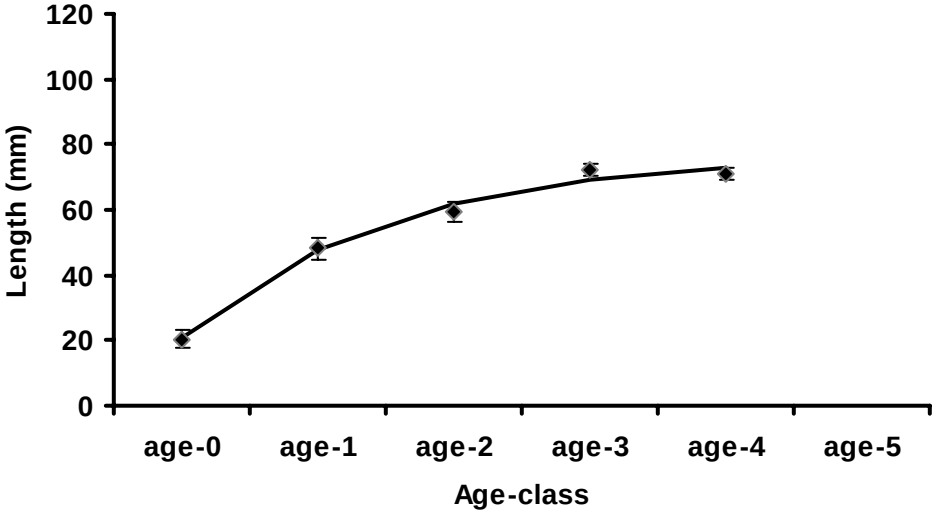
Honga River Normans (HRNO)



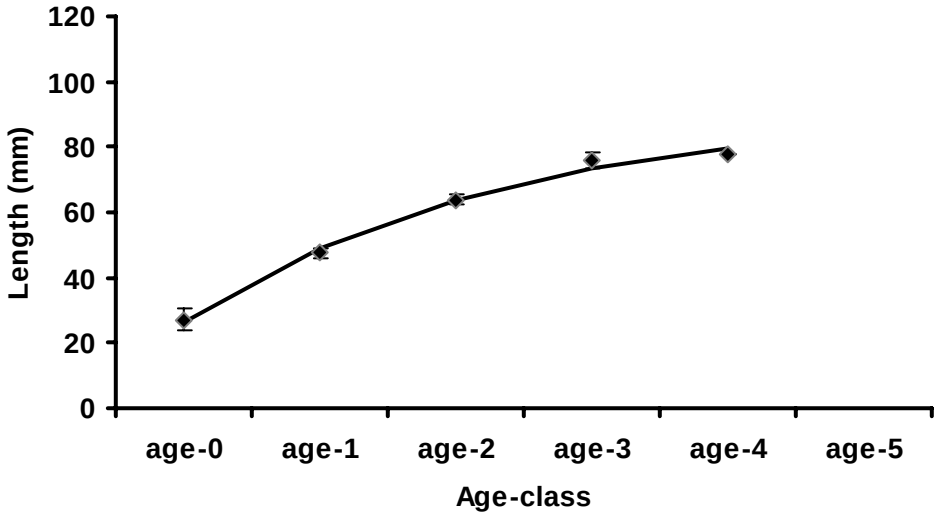
Honga River Windmill (HRWI)



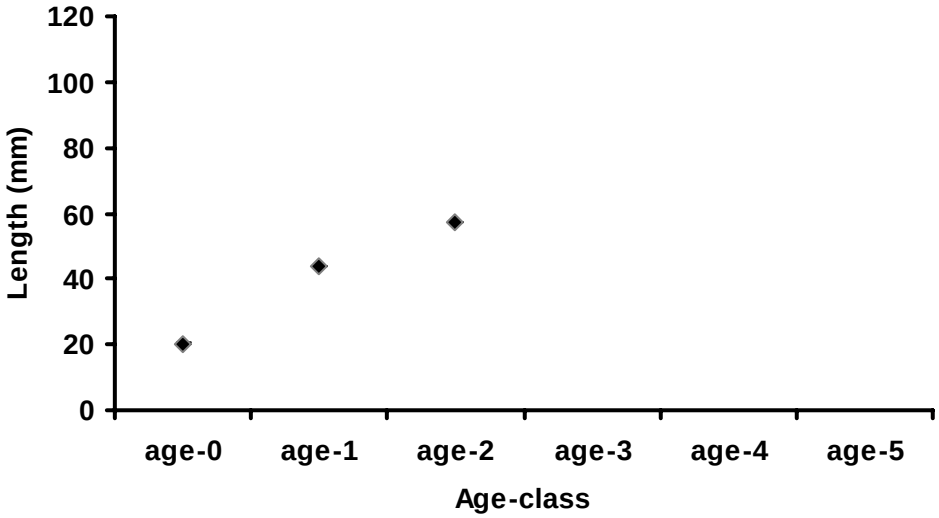
Little Choptank Cason (LCCA)



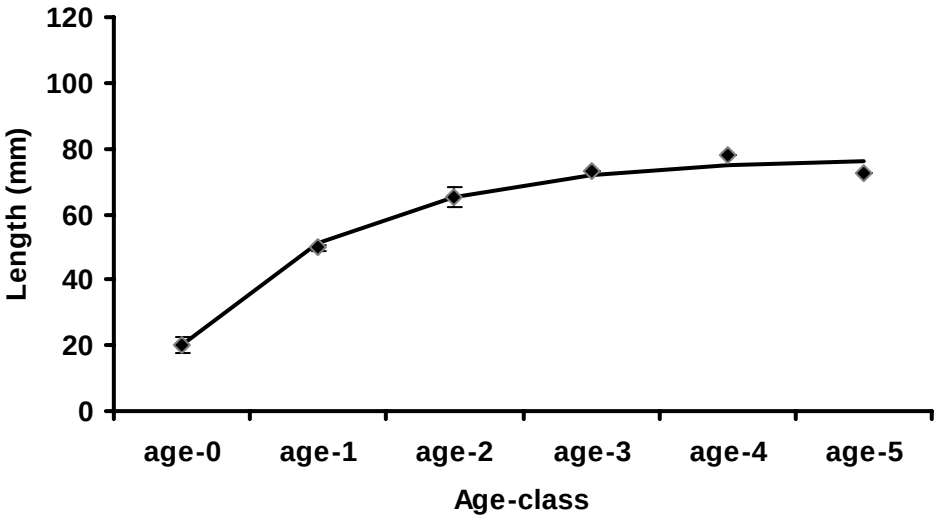
Little Choptank Ragged Point (LCRP)



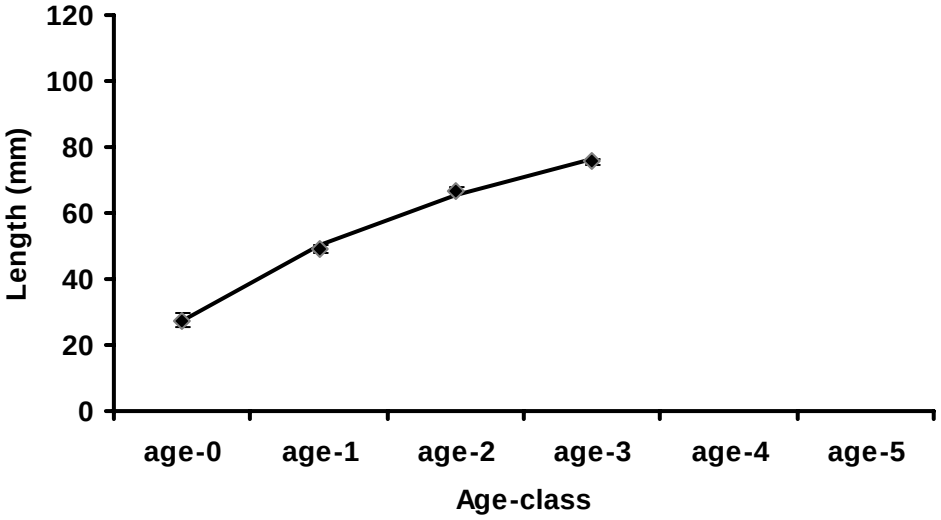
Manokin River Drum Point (MADP)



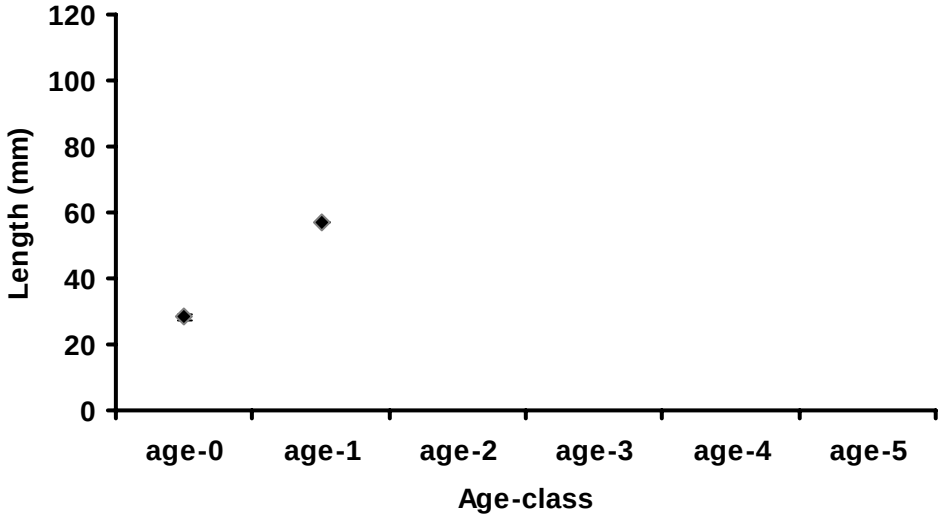
Manokin River Georges Bar (MAGE)



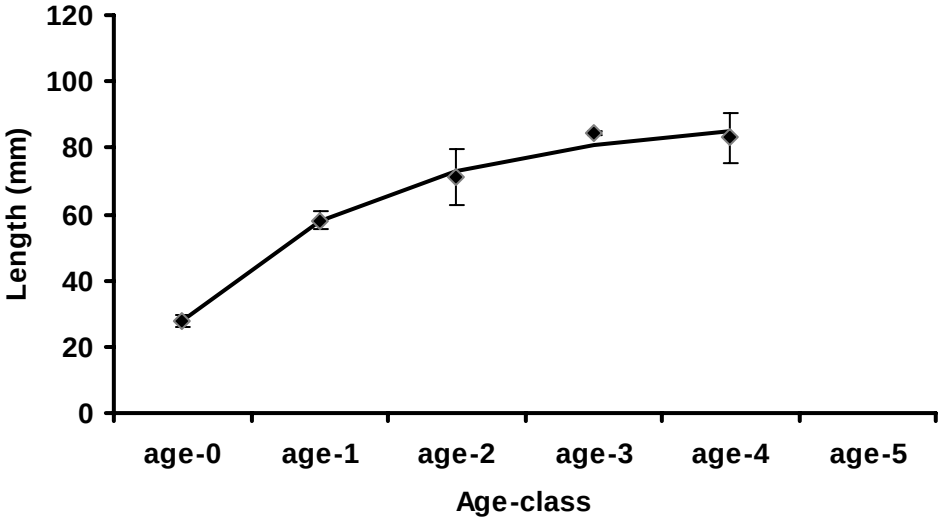
Middle Eastern Shore Stone Rock (MESR)



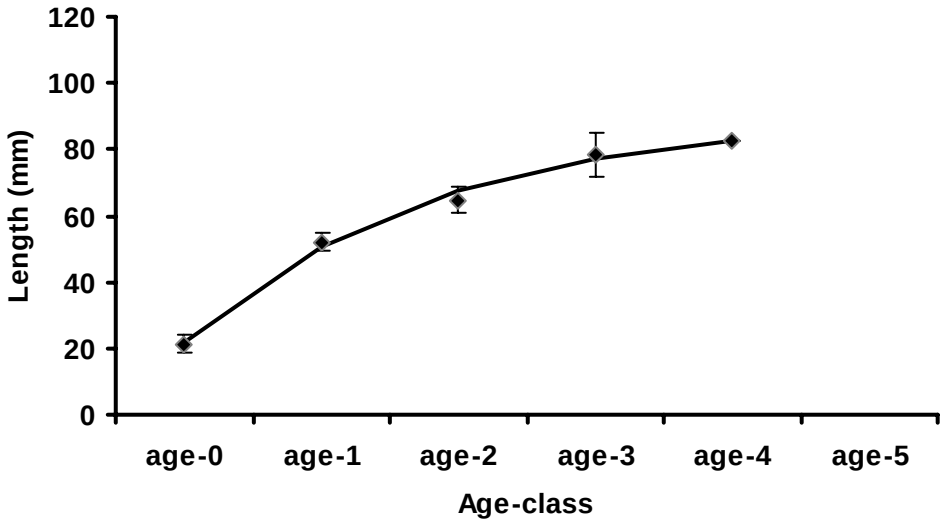
Miles River Ashcraft (MRAS)



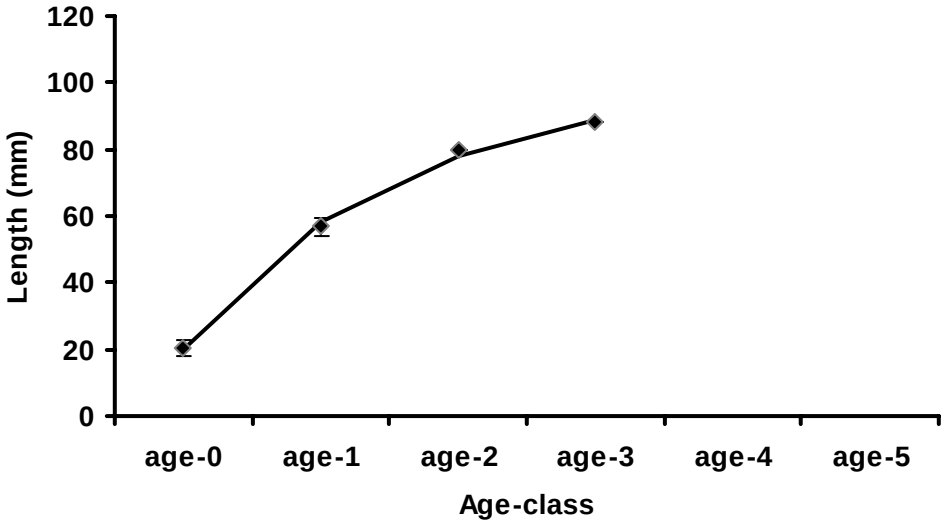
Miles River Long Point (MRLP)

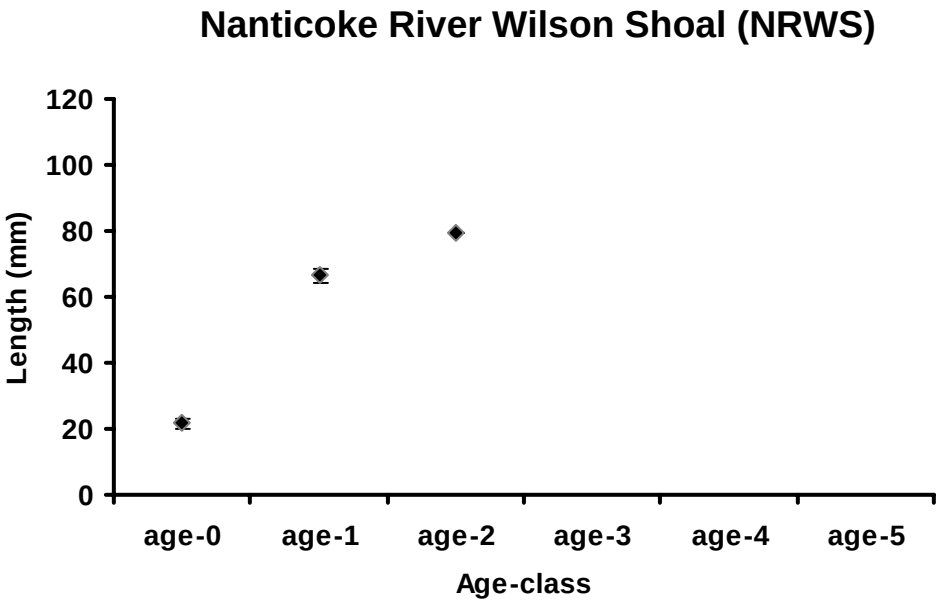


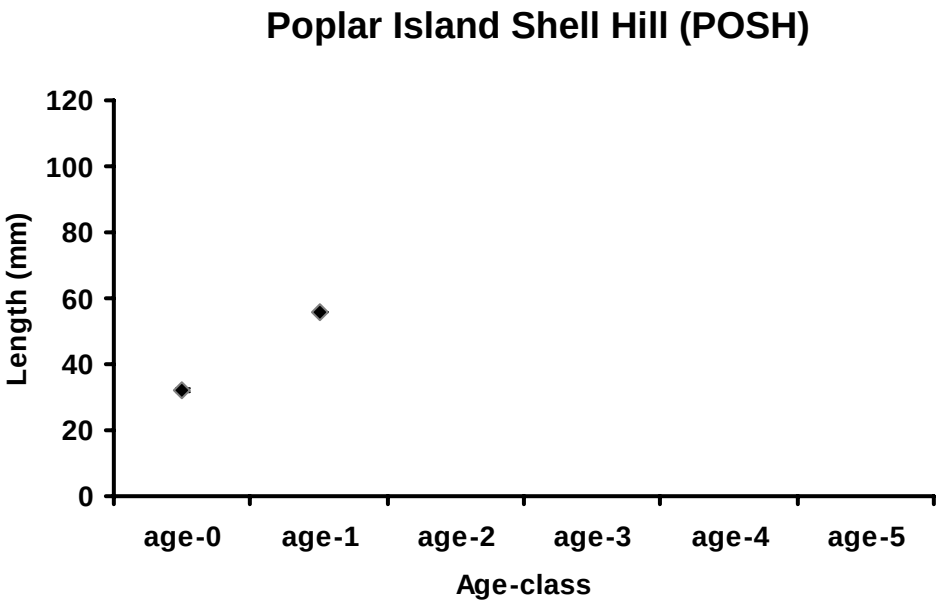
Miles River Turtleback (MRTU)



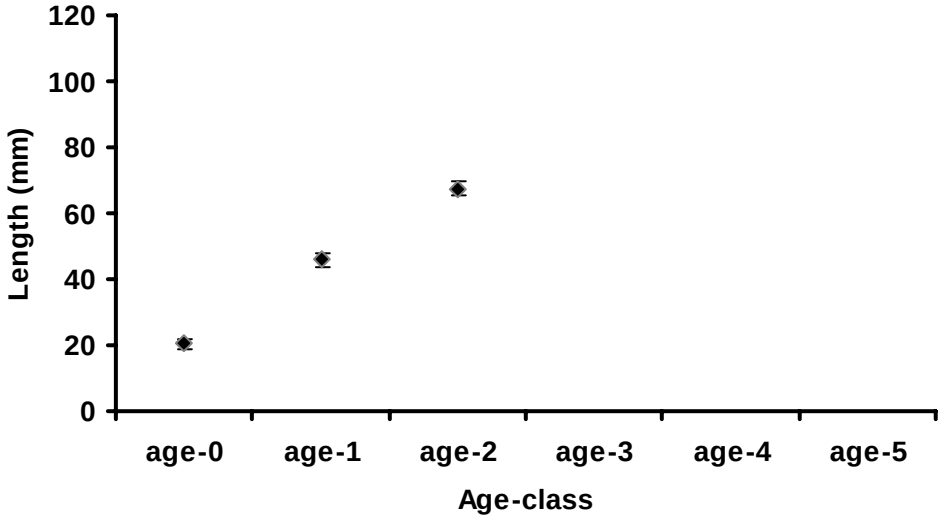
Nanticoke River Middleground (NRMG)



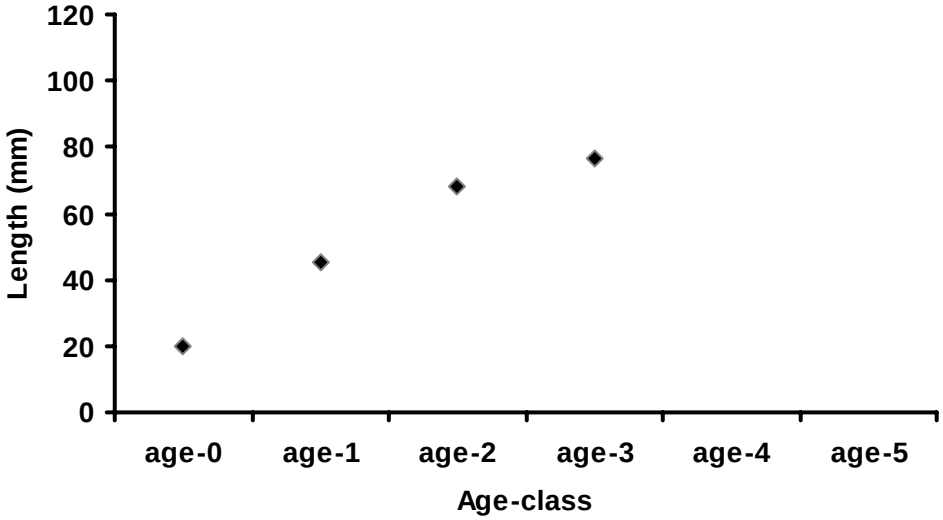

Nanticoke River Wilson Shoal (NRWS)
120
100
80
60
40
20
0
Length (mm)
age-0
age-1
age-2
age-3
age-4
age-5
Age-class


Poplar Island Shell Hill (POSH)
120
100
80
60
40
20
0
Length (mm)
age-0
age-1
age-2
age-3
age-4
age-5
Age-class

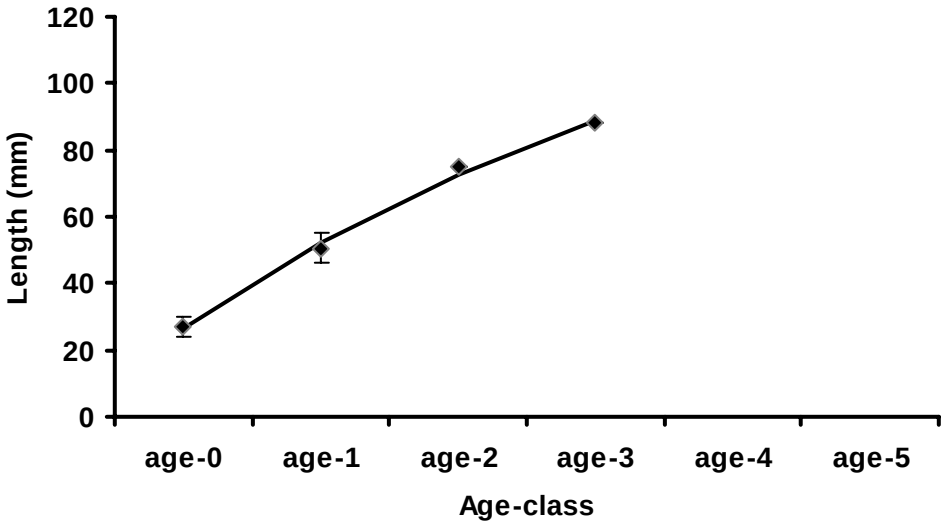
Potomac River Cornfield Harbor (PRCH)



Potomac River Lower Cedar Point (PRLC)

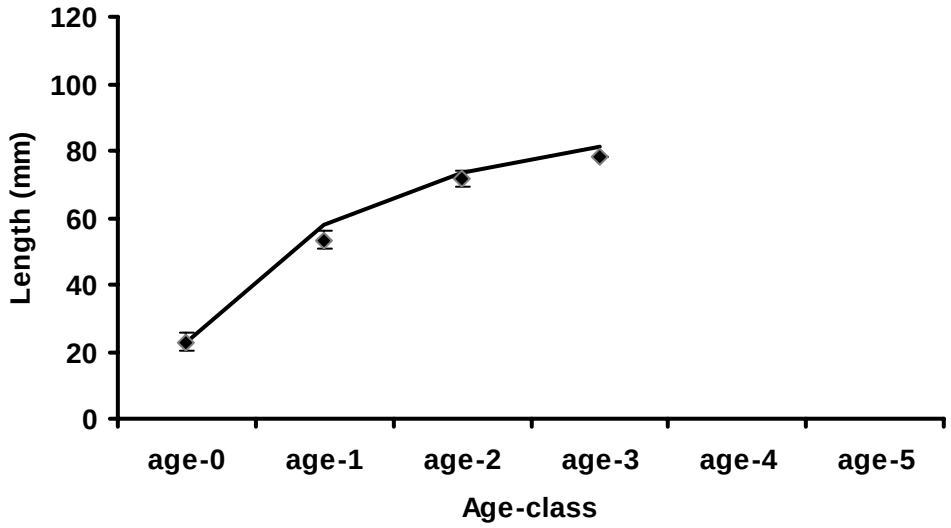


Potomac River Ragged Point (PRRP)

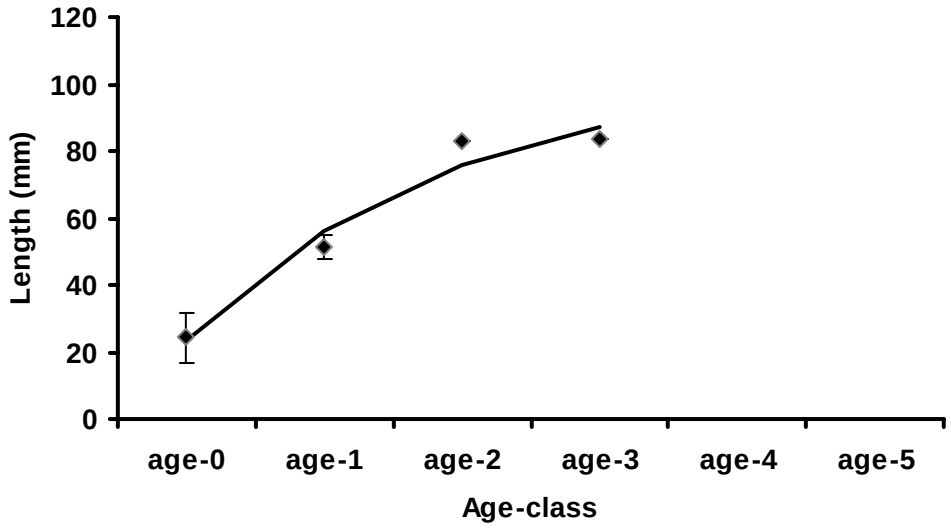


Pocomoke Sound Gunby (PSGU)

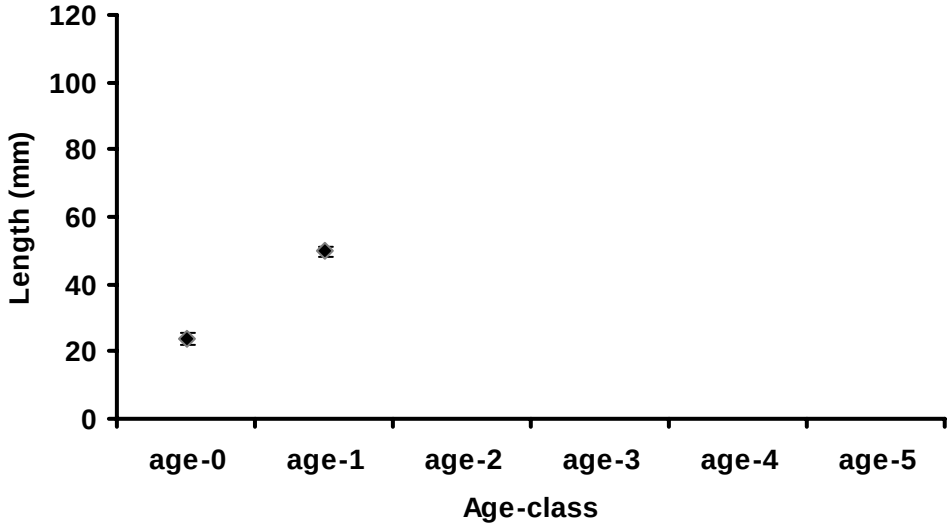
Pocomoke Sound Marumsco (PSMA)



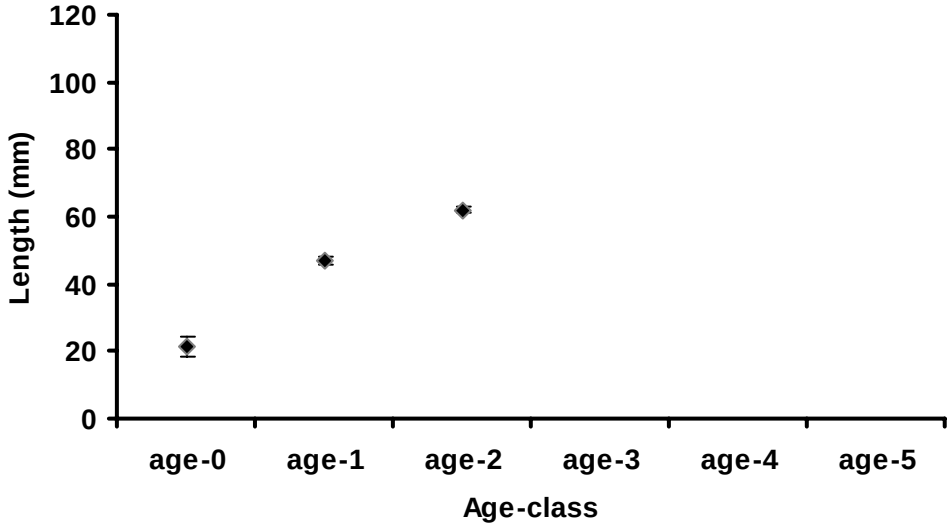
Patuxent River Broomes Island (PSMA)



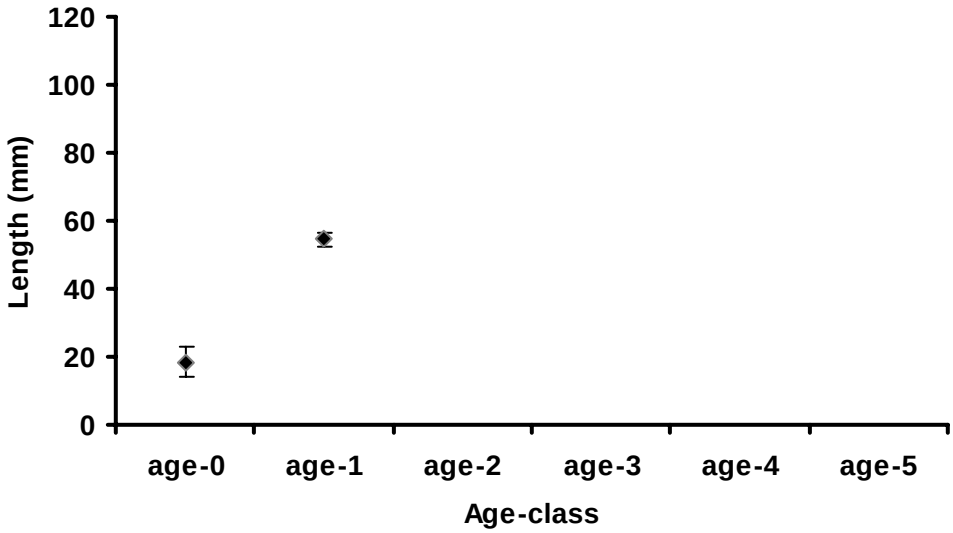
Saint Mary's River Chicken Cock (SMCC)



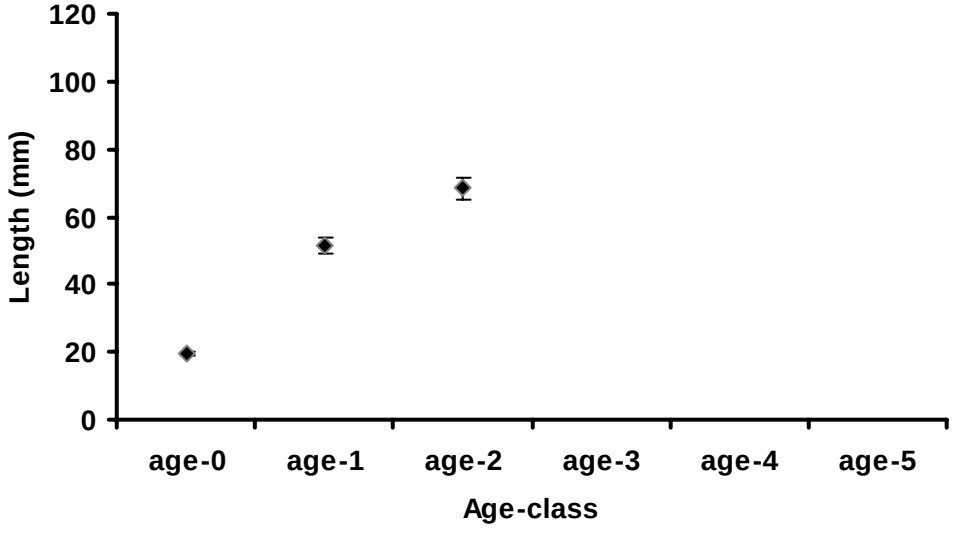
Saint Mary's River Pagan (SMPA)



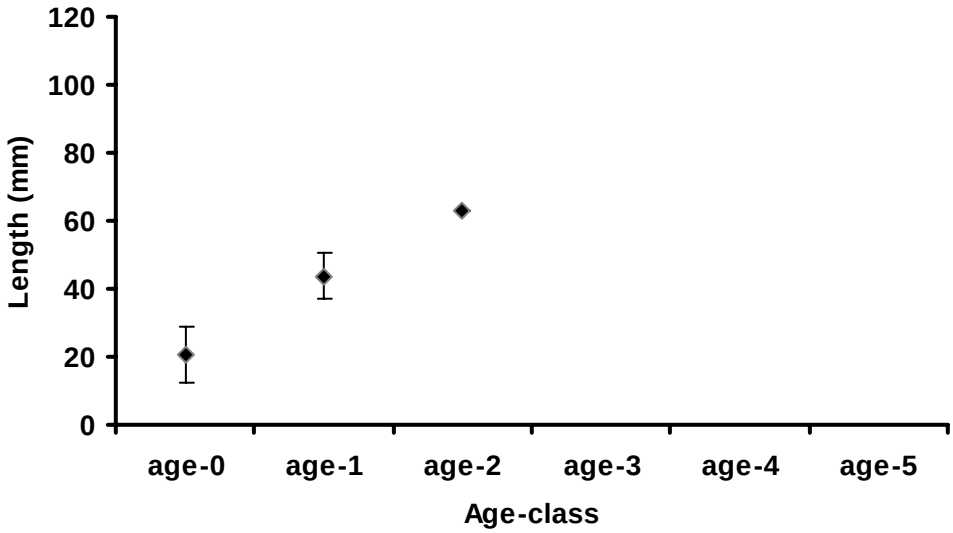
Tred Avon River Double Mills (TADM)



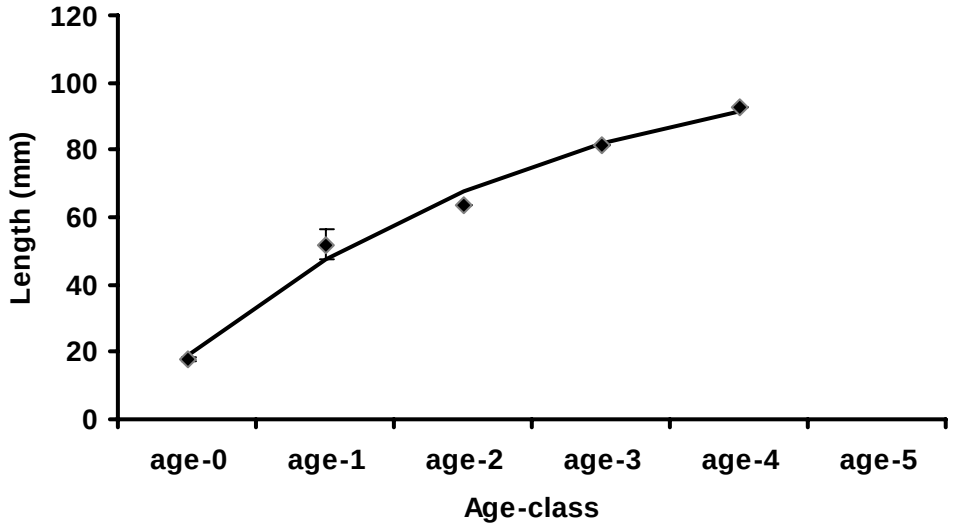
Tangier Sound Back Cove (TSBC)



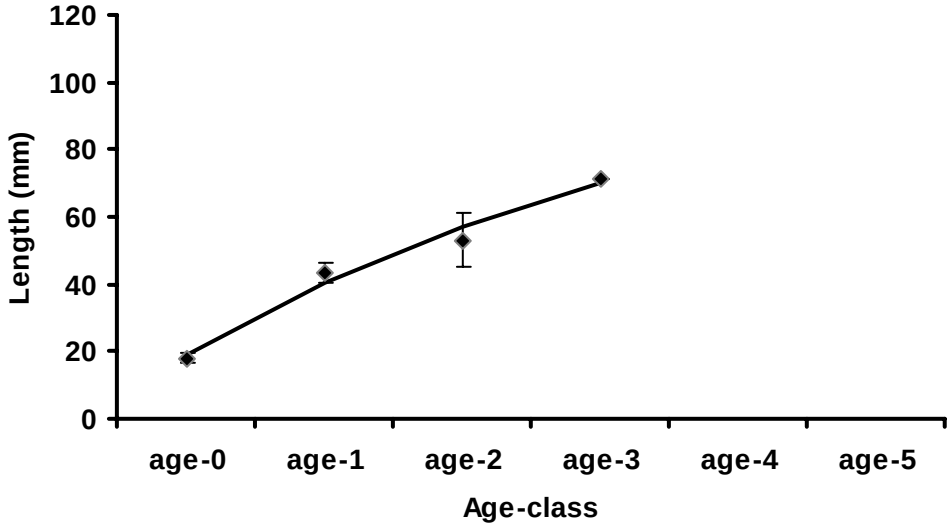
Tangier Sound Great Rock (TSGR)



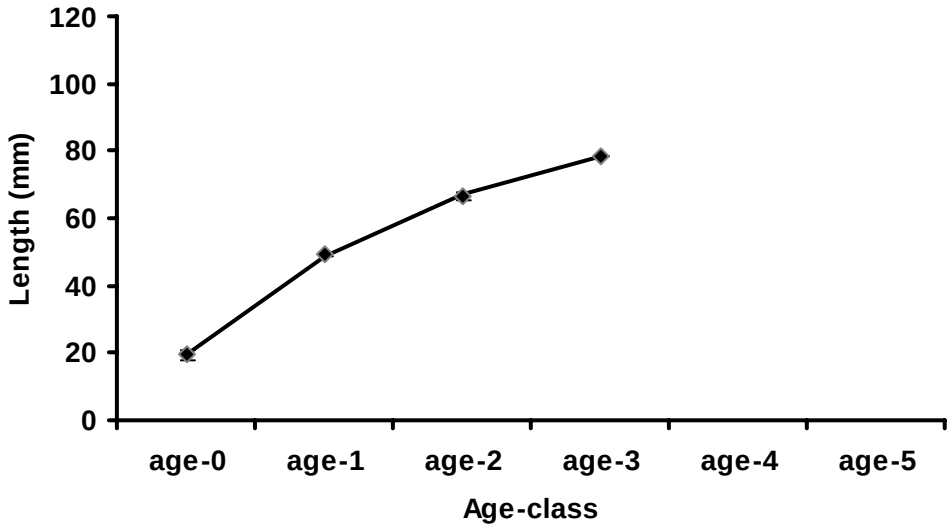
Tangier Sound Old Womans Leg (TSOW)



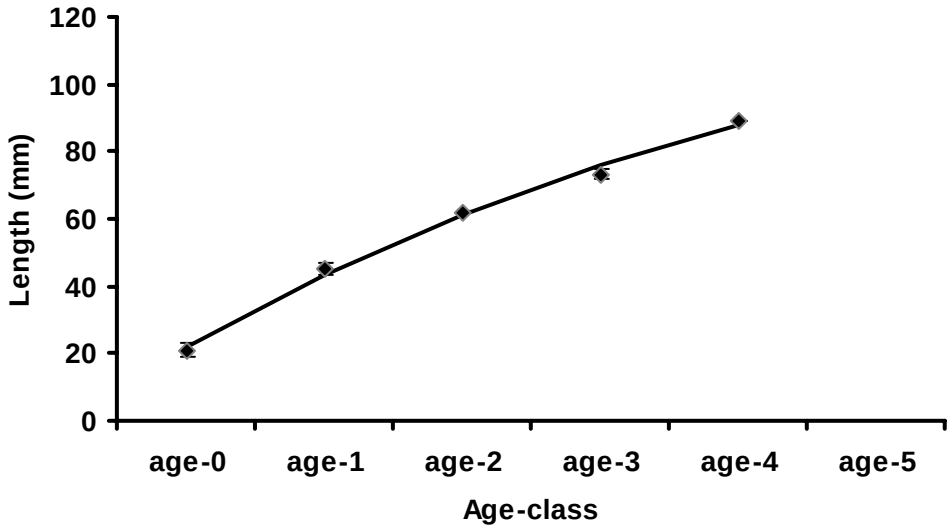
Tangier Sound Piney Island (TSPI)



Tangier Sound Sharkfin Shoal (TSSS)



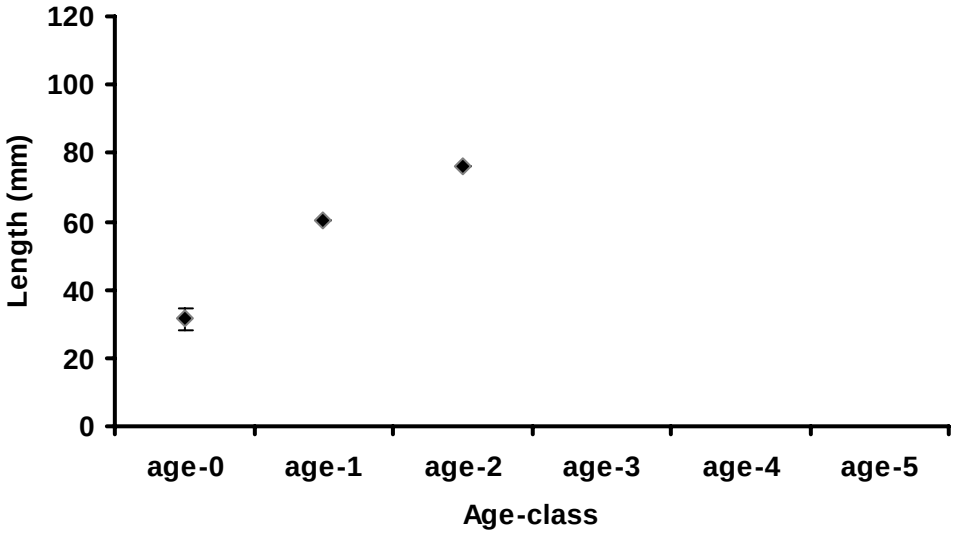
Tangier Sound Turtle Egg Island (TSTE)



Wicomico River Evans Shoal (WRES)

Wicomico River Butler (WRBU)

Western Shore Hog Island (WSHI)



Appendix VII. The breakdown of the 50 dredge surveys sites into 23 spatial regions, and the 3 salinity-based regions similar to those used in Jordan et al. (2002). Salinity region 3 (<12ppt), region 1 (12-13.99ppt), and region 2 (>14ppt) were all based on the mean salinity recorded annually during the fall oyster dredge survey.

Site	Mean Salinity	Spatial	Salinity
BCDN	13.33	0	1
BNMP	10.71	1	3
CHBR	10.80	2	3
CRCP	13.74	3	1
CRLI	12.69	3	1
CROS	9.93	3	3
CRRO	13.20	3	1
CRSH	11.64	3	3
CRTW	13.72	3	1
EBBU	13.86	4	1
EBHN	14.17	4	2
EBPI	13.48	4	1
EBWG	12.81	4	1
FBCI	14.51	5	2
FBGC	14.88	5	2
HCEP	12.78	6	1
HOHO	16.00	7	2
HRNO	16.00	8	2
HRWI	14.75	8	2
LCCA	13.74	9	1
LCRP	14.24	9	2
MADP	14.86	10	2
MAGE	16.28	10	2
MESR	14.48	11	2
MRAS	12.58	12	1
MRBI	13.28	12	1
MRLP	12.79	12	1
MRTU	13.31	12	1
NRMG	14.20	13	2
NRWS	12.12	13	1
POSH	13.69	14	1
PRCH	14.25	15	2
PRLC	9.23	15	3
PRRP	13.67	15	1
PSGU	16.76	16	2
PSMA	16.84	16	2
PXBI	13.26	17	1
SMCC	13.36	18	1
SMPA	15.10	18	2

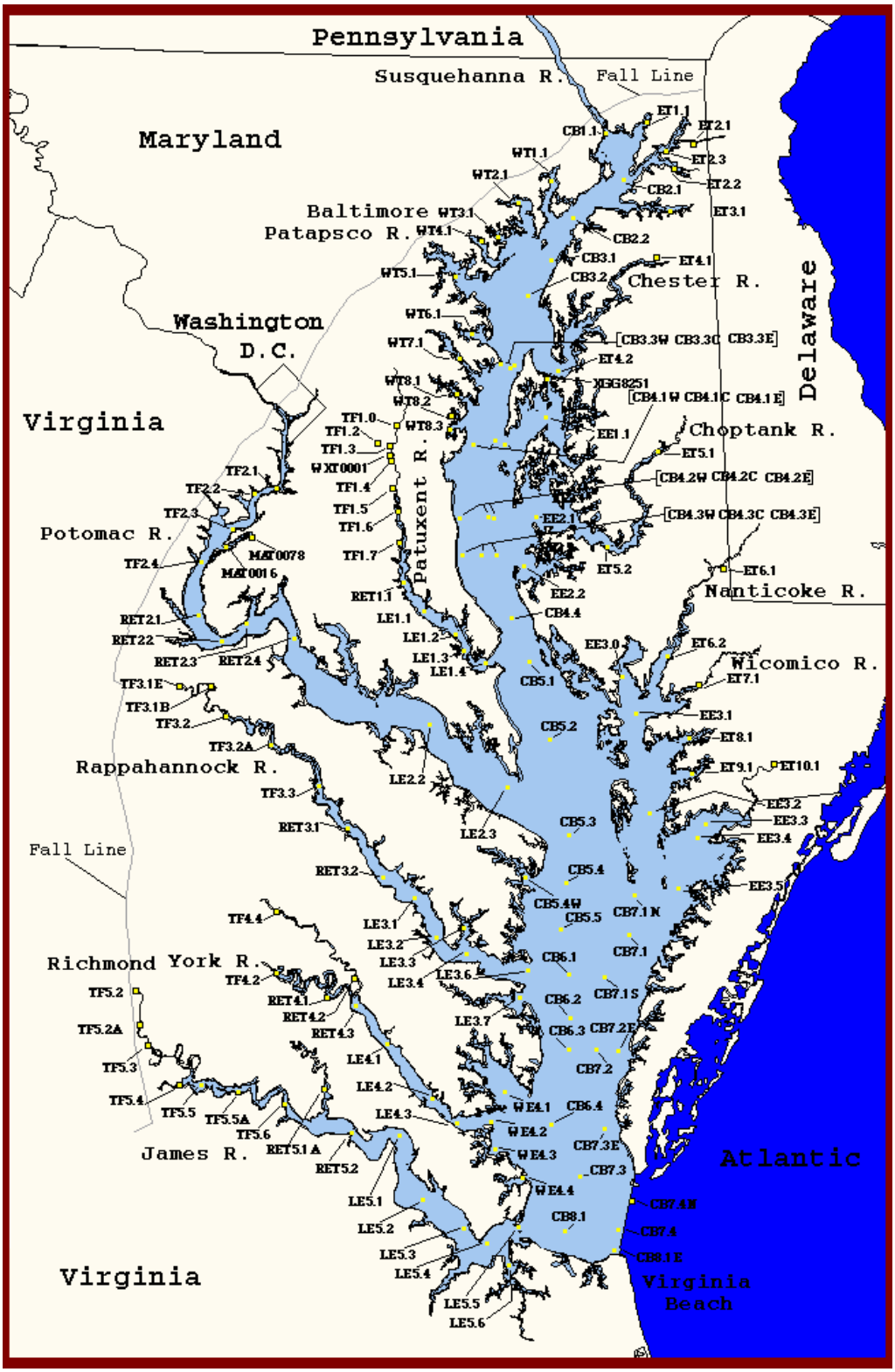
Appendix VII. Continued.

Site	Mean Salinity	Spatial	Salinity
TADM	12.22	19	1
TSBC	17.36	20	2
TSGR	17.25	20	2
TSOW	17.98	20	2
TSPI	17.06	20	2
TSSS	13.77	20	1
TSTE	16.00	20	2
WRES	13.16	21	1
WRMV	7.79	21	3
WSBU	15.58	22	2
WSHI	15.00	22	2

Appendix VIII. The pairs of 22 Chesapeake Bay water quality monitoring stations (1990-2001) with oyster dredge survey sites, the distance between sites in kilometers, and a map of the sites (Chesapeake Bay Program).

WQ Station	Oyster Survey Site	Distance (km)
ET4.2	CHBR	0.44
EE2.1	CRCP	1.41
ET5.2	CROS	5.07
EE1.1	EBBU	2.31
CB4.1E	EBHN	4.44
EE1.1	EBPI	2.92
EE3.1	FBCI	4.45
EE3.0	FBGC	0.84
EE2.2	LCRP	0.74
ET8.1	MADP	5.63
ET8.1	MAGE	3.94
CB4.2E	MESR	1.98
EE1.1	MRTU	3.30
ET6.2	NRWE	0.40
LE2.3	PRCH	3.30
RET2.4	PRLC	2.96
LE2.2	PRRP	2.62
EE3.3	PSGU	1.32
LE1.1	PXBI	3.75
EE3.1	TSSS	2.30
EE3.1	TSTE	9.32
ET7.1	WRMV	1.93
CB5.2	WSBU	9.30
CB5.1W	WSHI	1.55

Chesapeake Bay Program Water Quality Monitoring Sites



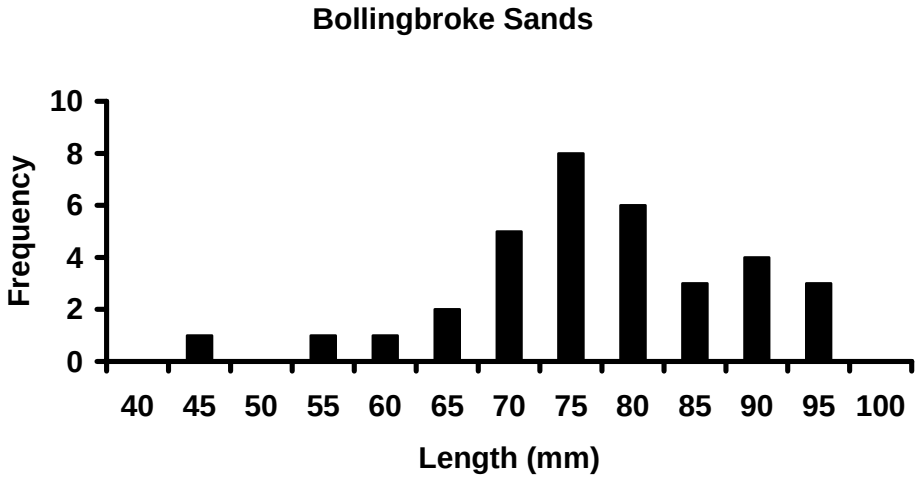
Appendix IX. Hatchery reared oysters from four sites with their associated spawning, settlement, and planting in the field dates, as well as identification within groups later combined into batches prior to planting.

Site	River	Planted	Group	Batch	Spawned	Settlement
Bolingbroke Sands	Choptank	7/6/01	2A	6	4/25-26/01	5/16,21/01
Bolingbroke Sands	Choptank	7/6/01	2A	7	4/26/01	5/16,21/01
Bolingbroke Sands	Choptank	7/6/01	2A	9	5/1/01	5/19,21/01
Bolingbroke Sands	Choptank	7/6/01	2A	10	5/11/01	5/19,21/01
Bolingbroke Sands	Choptank	7/6/01	5A	4	4/11-12/01	4/20/01
Bolingbroke Sands	Choptank	7/6/01	5A	5	4/17-18/01	4/30/01, 5/1,3,4/01
Bolingbroke Sands	Choptank	7/16/01	6A	14	5/7/01	5/24/01
Bolingbroke Sands	Choptank	7/16/01	6A	15	5/8/01	5/24/01
Bolingbroke Sands	Choptank	7/5/01	8A	1	3/26/01	4/10/01
Bolingbroke Sands	Choptank	7/5/01	9A	2	4/4-5/01	4/17/01
Bolingbroke Sands	Choptank	7/5/01	9A	4	4/11-12/01	4/20/01
Bolingbroke Sands	Choptank	8/15/01	4B	22	5/30/01	6/14,17/01
Bolingbroke Sands	Choptank	8/15/01	4B	23	5/31/01	6/14,17/01
Bolingbroke Sands	Choptank	8/15/01	4B	24	6/1/01	6/14,17/01
Bolingbroke Sands	Choptank	7/16/01	7B	6	4/25-26/01	5/16,21/01
Bolingbroke Sands	Choptank	7/16/01	7B	7	4/26/01	5/16,21/01
Bolingbroke Sands	Choptank	7/6/01	9B	6	4/25-26/01	5/16,21/01
Bolingbroke Sands	Choptank	7/6/01	9B	7	4/26/01	5/16,21/01
Bolingbroke Sands	Choptank	7/16/01	10B	11	5/2/01	5/18,21/01
Bolingbroke Sands	Choptank	7/16/01	10B	12	5/2/01	5/18,21/01
Bolingbroke Sands	Choptank	7/16/01	10B	13	5/4/01	5/18,21/01
Chest Neck	Magothy	9/8/01	4D	31	6/18/01	7/9,17/2001
Chest Neck	Magothy	9/8/01	4D	32	6/18/01	7/9,17/2001
Chest Neck	Magothy	9/8/01	4D	33	6/21/01	7/9,17/2001
Chest Neck	Magothy	9/8/01	4D	34	6/22/01	7/9,17/2001
Chest Neck	Magothy	9/8/01	6D	31	6/18/01	7/12,17/2001
Chest Neck	Magothy	9/8/01	6D	32	6/18/01	7/12,17/2001
Chest Neck	Magothy	9/8/01	6D	33	6/21/01	7/12,17/2001
Chest Neck	Magothy	9/8/01	6D	34	6/22/01	7/12,17/2001
Spaniard Point	Chester	10/14/98	OST1A	8	6/24-25/98	7/6/98
Spaniard Point	Chester	10/14/98	RST1B	15	7/1/98	7/17/98
Weems Upper	Severn	9/8/01	4D	31	6/18/01	7/9,17/2001
Weems Upper	Severn	9/8/01	4D	32	6/18/01	7/9,17/2001
Weems Upper	Severn	9/8/01	4D	33	6/21/01	7/9,17/2001
Weems Upper	Severn	9/8/01	4D	34	6/22/01	7/9,17/2001
Weems Upper	Severn	9/8/01	6D	31	6/18/01	7/12,17/2001
Weems Upper	Severn	9/8/01	6D	32	6/18/01	7/12,17/2001
Weems Upper	Severn	9/8/01	6D	33	6/21/01	7/12,17/2001
Weems Upper	Severn	9/8/01	6D	34	6/22/01	7/12,17/2001

Appendix X. Individual oyster shell length (mm) and length-frequency distribution.

Bollingbroke Sands (Known Age-2)

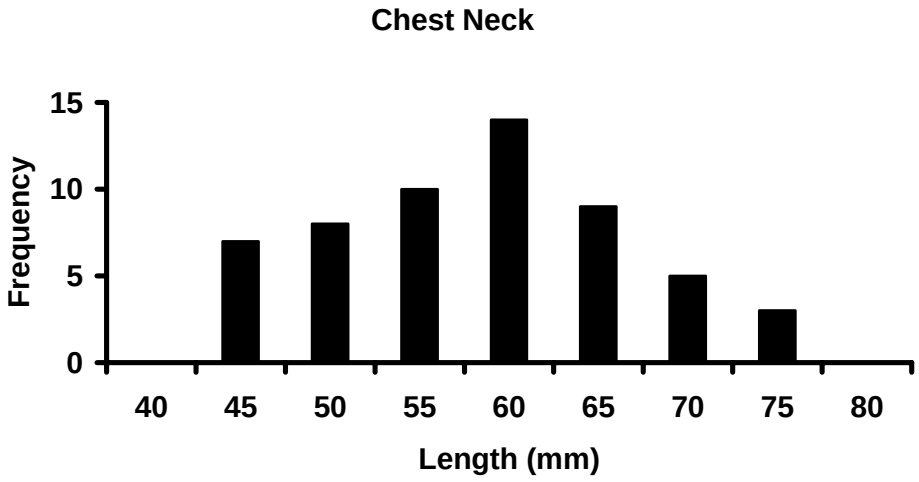
Oyster	Length	Oyster	Length
1	69.9	**18**	72.6
2	75.8	**19**	69.3
3	78.2	**20**	67
4	70.8	**21**	71.5
5	84.8	**22**	88.5
6	62.9	**23**	73.9
7	44.6	**24**	78
8	67.3	**25**	72.1
9	72	**26**	75
10	50.9	**27**	88.5
11	68	**28**	73.2
12	58.4	**29**	81.4
13	75.3	**30**	93.5
14	84.5	**31**	94.9
15	85.5	**32**	78.1
16	62.4	**33**	89.3
17	75.5	**34**	93.4



Appendix X. Continued.

Chest Neck (Known Age-2)

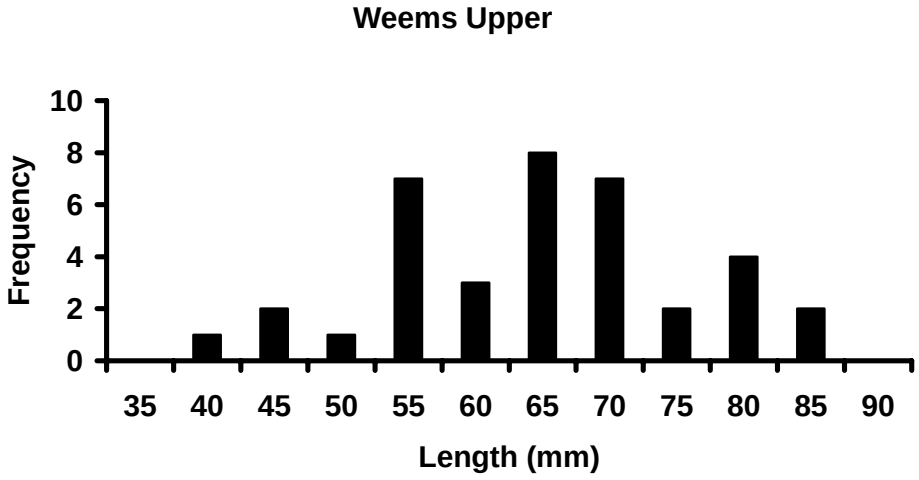
Oyster	Length	Oyster	Length
1	59	**29**	55.7
2	59.5	**30**	41.5
3	52	**31**	55.5
4	40.9	**32**	62.6
5	53.8	**33**	54.8
6	70.2	**34**	48.2
7	73.4	**35**	54.9
8	73.2	**36**	54.1
9	47.8	**37**	54.1
10	61.8	**38**	52.6
11	61.9	**39**	60.8
12	67.1	**40**	66.9
13	50	**41**	63
14	43.3	**42**	57.5
15	58.7	**43**	48.9
16	40.4	**44**	41.8
17	42.3	**45**	53.3
18	55.8	**46**	56.9
19	50.4	**47**	55.8
20	48.6	**48**	59.5
21	62.3	**49**	60
22	60.4	**50**	62.2
23	69.5	**51**	46.9
24	58.9	**52**	65
25	40.2	**53**	52
26	47.7	**54**	68.1
27	48.2	**55**	55.6
28	68.5	**56**	57



Appendix X. Continued.

Weems Upper (Known Age-2)

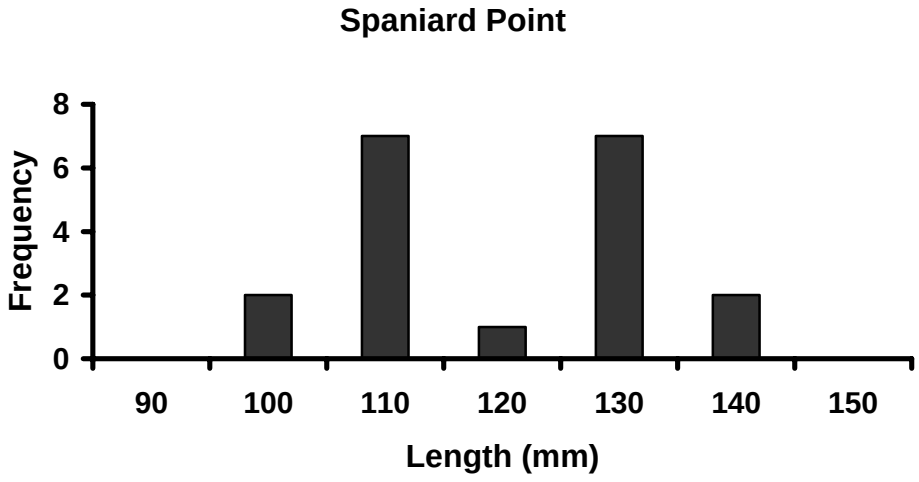
Oyster	Length	Oyster	Length
1	37.7	**20**	60
2	67.3	**21**	75.7
3	61.4	**22**	77.6
4	55	**23**	62.4
5	47.3	**24**	52.3
6	44.8	**25**	65.5
7	50.4	**26**	63.2
8	52.6	**27**	77.3
9	66.2	**28**	61.4
10	59.7	**29**	65
11	64.5	**30**	69.5
12	72.8	**31**	54.9
13	68	**32**	53.7
14	81.3	**33**	73
15	76.8	**34**	68.9
16	80.3	**35**	65
17	44.8	**36**	70
18	51.2	**37**	64.8
19	56.6		



Appendix X. Continued.

Spaniard Point (Known Age-5)

Oyster	Length
1	92.2
2	109.1
3	128.2
4	108.5
5	121.4
6	106.3
7	108.8
8	125.4
9	124.4
10	113.1
11	123.3
12	90.8
13	100.5
14	100.4
15	129.2
16	139.2
17	122.5
18	133.1
19	106



Appendix XI. Digital pictures of the cross-sectioned shell chondrophore used in the aging analyses.

Bollingbroke Sands (BBS)

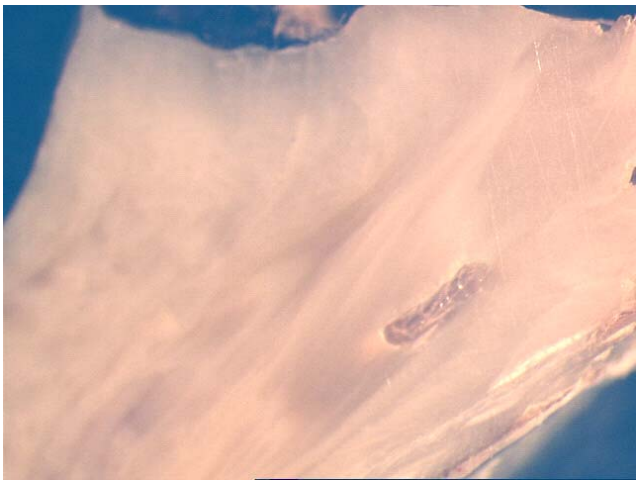
BBS-1

Known Age = 2 years, Estimated Age = 3 years

BBS-2

Known Age = 2 years, Estimated Age = 4 years

Bollingbroke Sands (BBS)



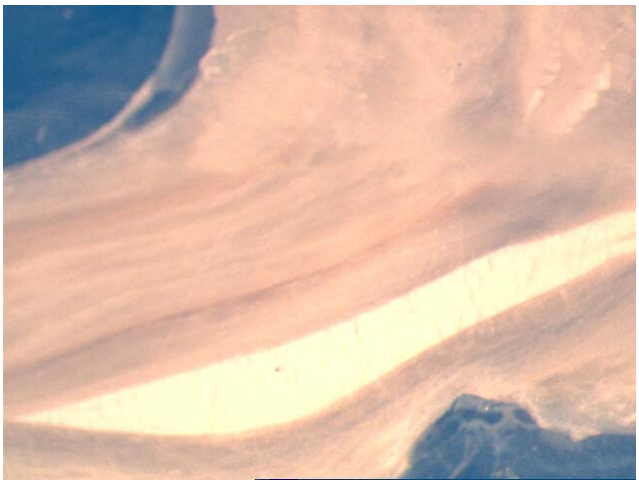
BBS-3

Known Age = 2 years, Estimated Age = 6 years

BBS-4

Known Age = 2 years, Estimated Age = 0 years

Bollingbroke Sands (BBS)



BBS-5

Known Age = 2 years, Estimated Age = 3 years

BBS-6

Known Age = 2 years, Estimated Age = 4 years

Bollingbroke Sands (BBS)

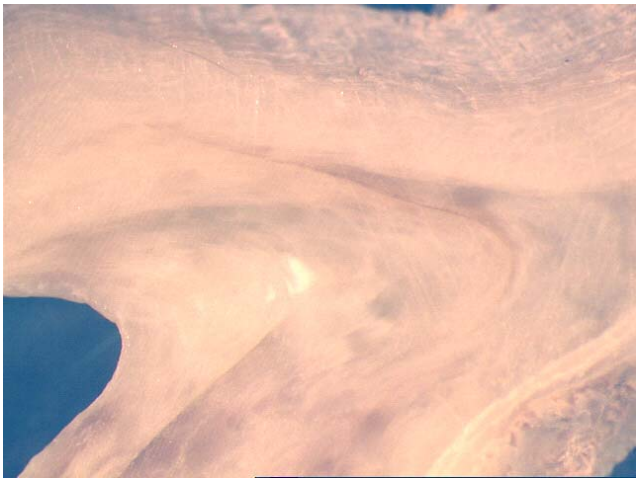
BBS-7

Known Age = 2 years, Estimated Age = 2 years

BBS-8

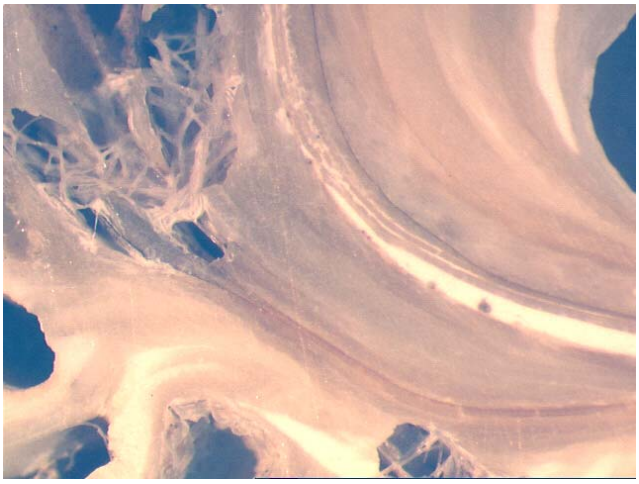
Known Age = 2 years, Estimated Age = 4 years

Bollingbroke Sands (BBS)



BBS-9

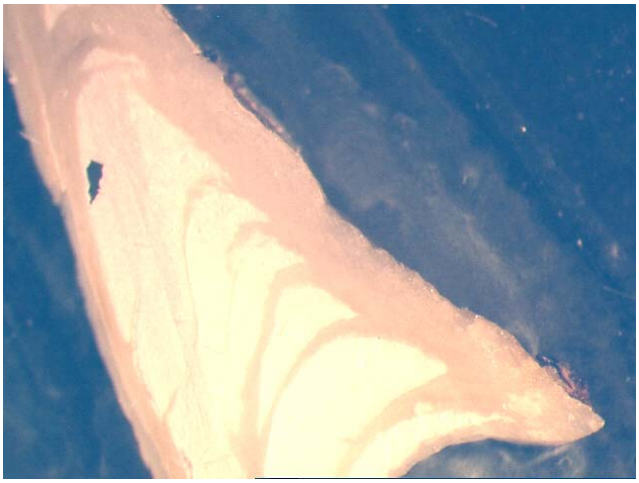
Known Age = 2 years, Estimated Age = 5 years



BBS-10

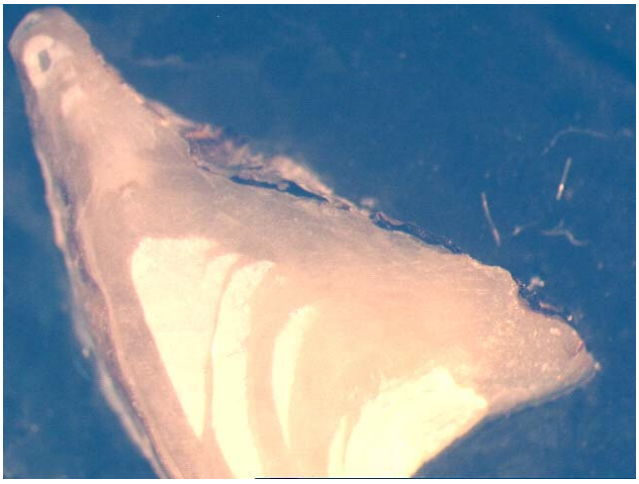
Known Age = 2 years, Estimated Age = 8 years

Chest Neck (CN)



CN-1

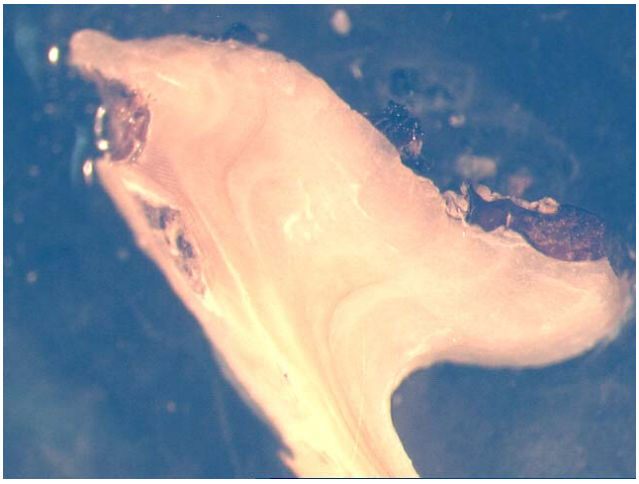
Known Age = 2 years, Estimated Age = 0 years



CN-2

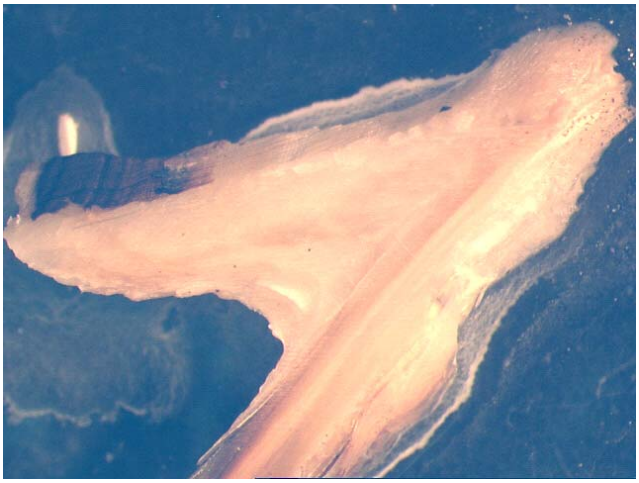
Known Age = 2 years, Estimated Age = 2 years

Chest Neck (CN)



CN-3

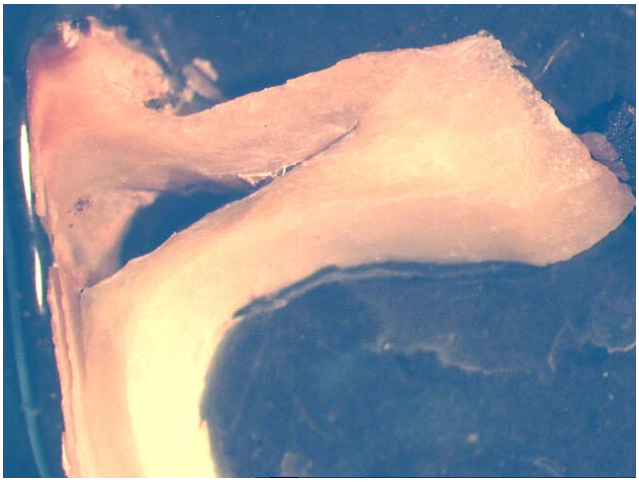
Known Age = 2 years, Estimated Age = 4 years



CN-4

Known Age = 2 years, Estimated Age = 3 years

Chest Neck (CN)



CN-5

Known Age = 2 years, Estimated Age = 2 years

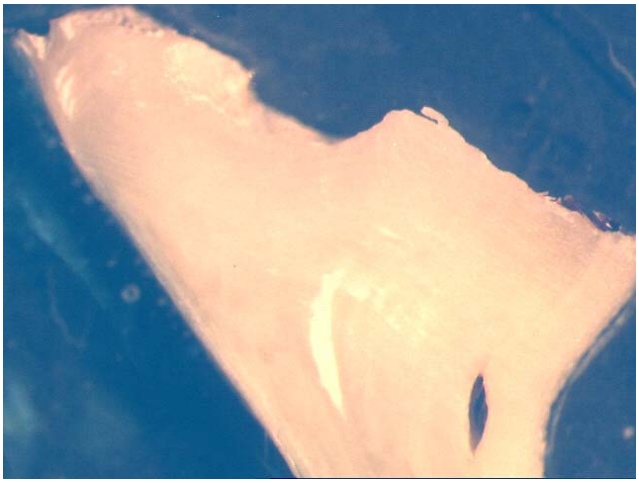
CN-6

Known Age = 2 years, Estimated Age = 3 years

Chest Neck (CN)

CN-7

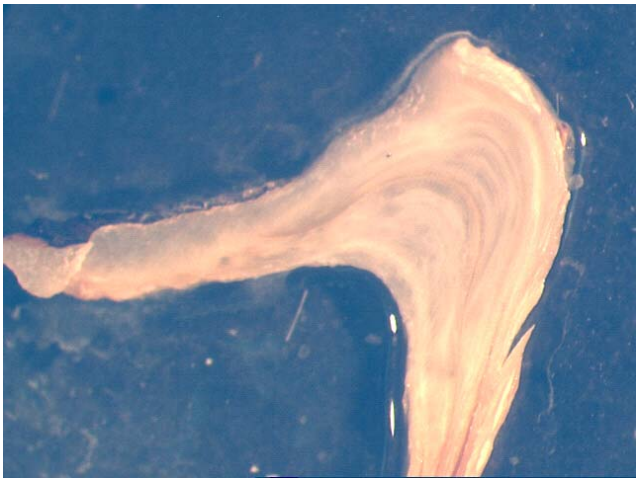
Known Age = 2 years, Estimated Age = 2 years



CN-8

Known Age = 2 years, Estimated Age = 0 years

Chest Neck (CN)



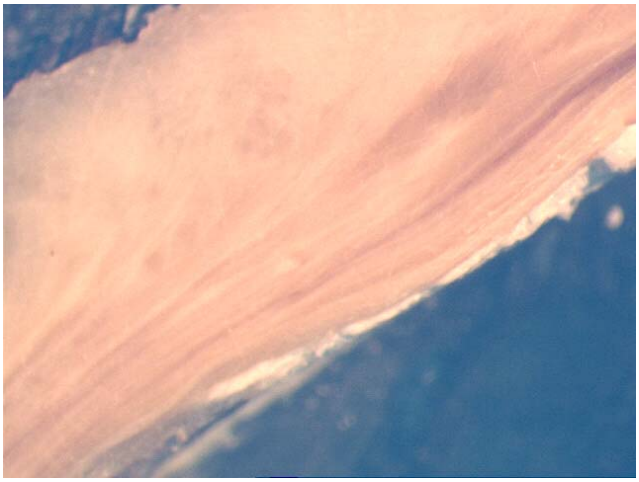
CN-9

Known Age = 2 years, Estimated Age = 7 years

CN-10

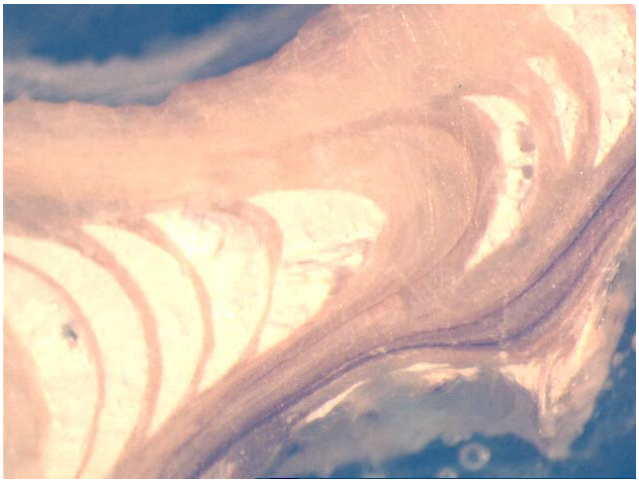
Known Age = 2 years, Estimated Age = 3 years

Spaniard Point (SPN)



SPN-1

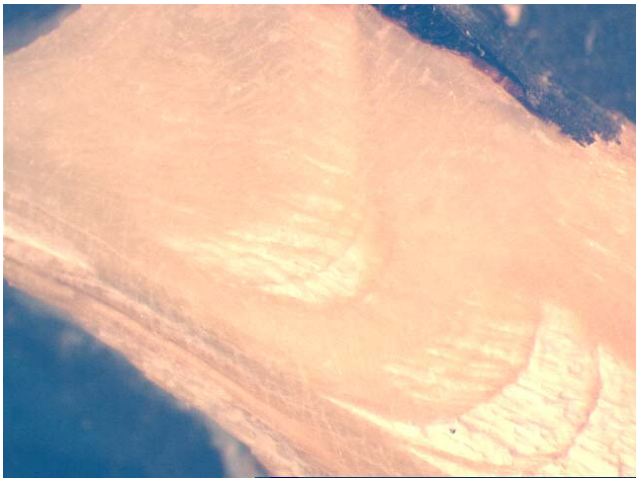
Known Age = 5 years, Estimated Age = 8 years



SPN-2

Known Age = 5 years, Estimated Age = 4 years

Spaniard Point (SPN)



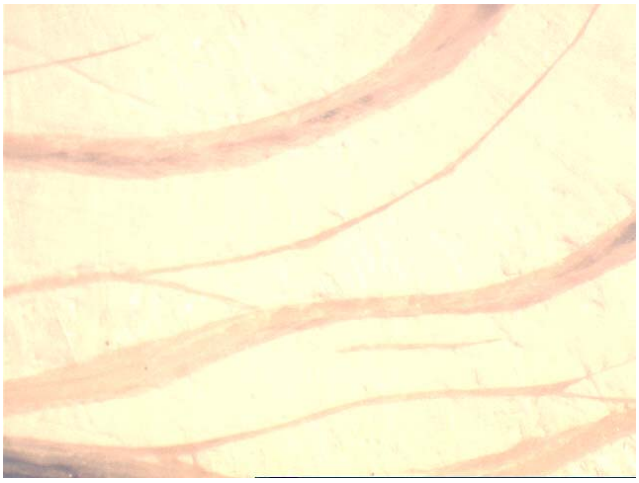
SPN-3

Known Age = 5 years, Estimated Age = 5 years

SPN-4

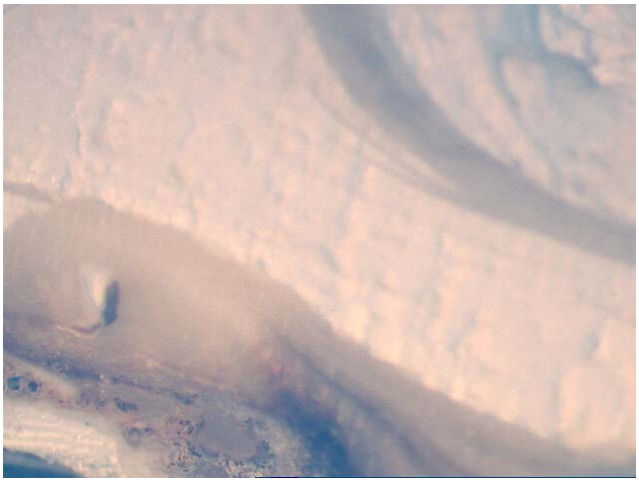
Known Age = 5 years, Estimated Age = 1 years

Spaniard Point (SPN)



SPN-5

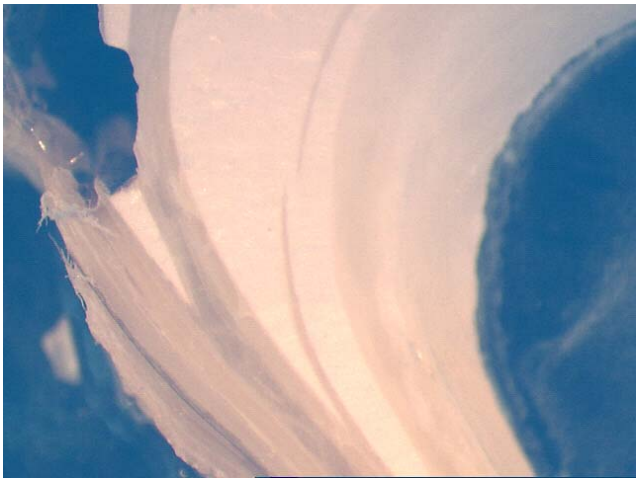
Known Age = 5 years, Estimated Age = 2 years



SPN-6

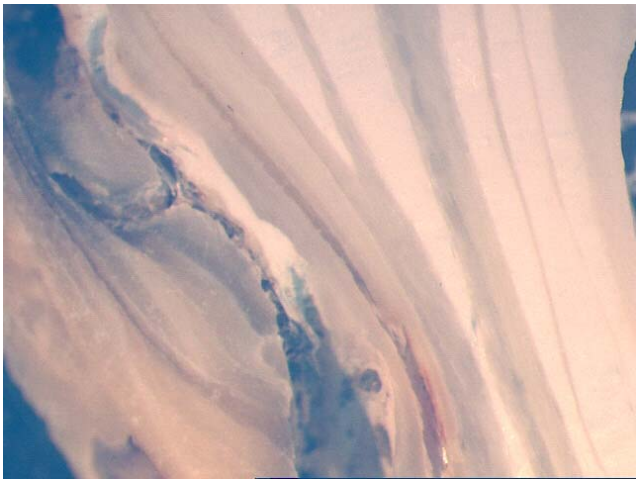
Known Age = 5 years, Estimated Age = 4 years

Spaniard Point (SPN)



SPN-7

Known Age = 5 years, Estimated Age = 7 years



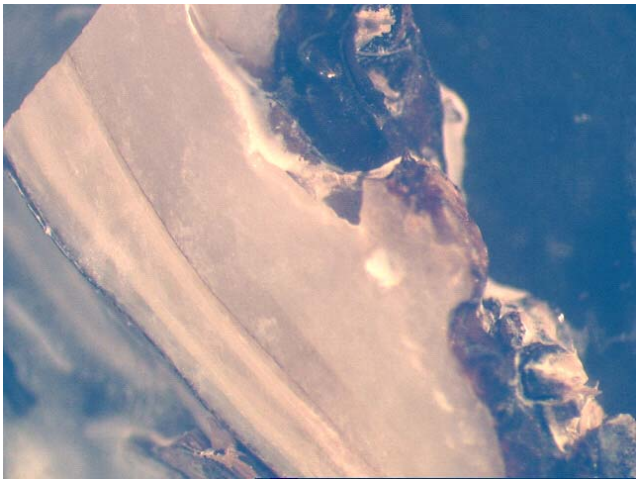
SPN-8

Known Age = 5 years, Estimated Age = 10 years

Spaniard Point (SPN)

SPN-9

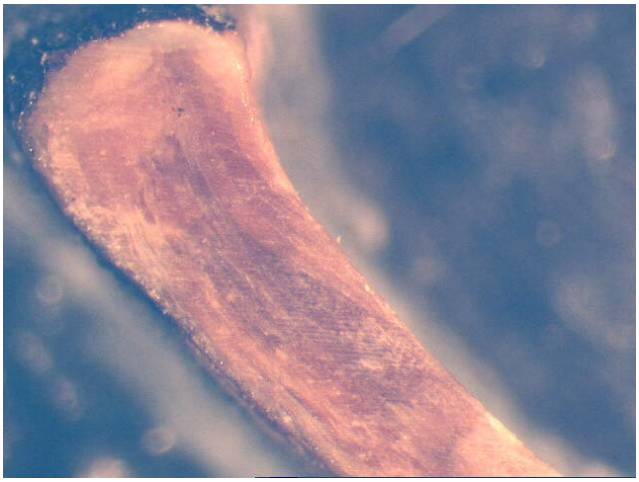
Known Age = 5 years, Estimated Age = 6 years



SPN-10

Known Age = 5 years, Estimated Age = 7 years

Weems Upper (WU)



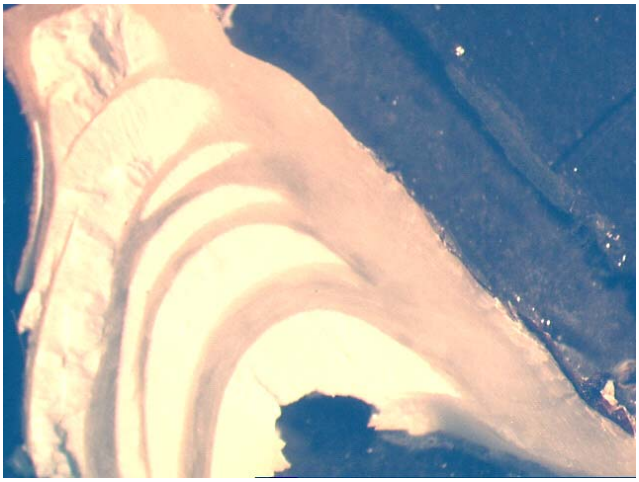
WU-1

Known Age = 2 years, Estimated Age = 5 years

WU-2

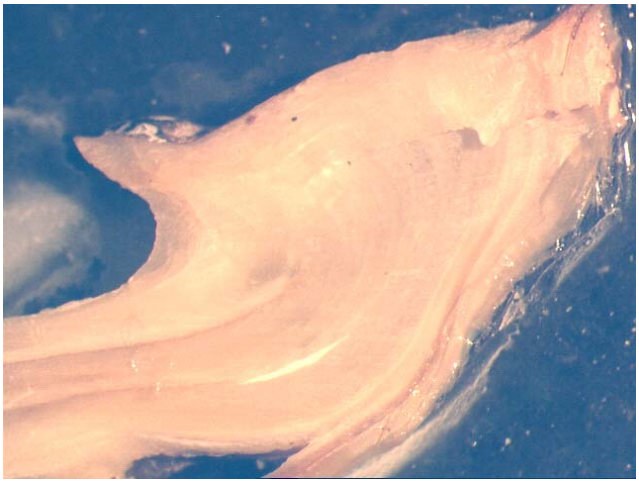
Known Age = 2 years, Estimated Age = 5 years

Weems Upper (WU)



WU-3

Known Age = 2 years, Estimated Age = 3 years



WU-4

Known Age = 2 years, Estimated Age = 4 years

Weems Upper (WU)

WU-5

Known Age = 2 years, Estimated Age = 6 years

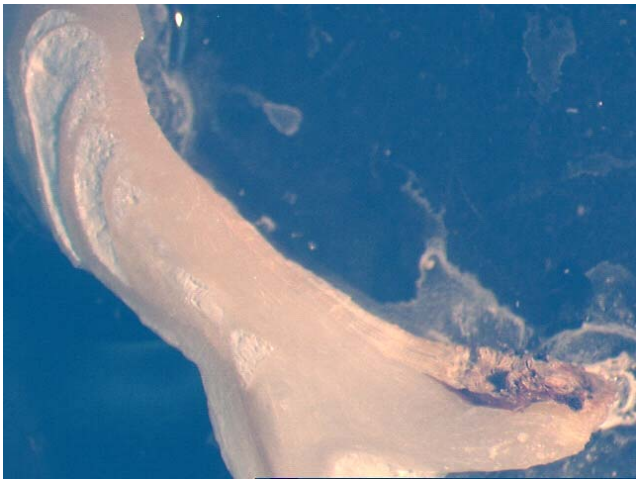
WU-6

Known Age = 2 years, Estimated Age = 4 years

Weems Upper (WU)

WU-7

Known Age = 2 years, Estimated Age = 5 years



WU-8

Known Age = 2 years, Estimated Age = 2 years

Weems Upper (WU)

WU-9

Known Age = 2 years, Estimated Age = 2 years

WU-10

Known Age = 2 years, Estimated Age = 4 years

Appendix XII The results from 10 oysters hinge sections read from each site. The associated shell lengths are also given. Only the third reading was used in subsequent analyses.

Site	Oyster	Length (mm)	First read	Second Read	Third Read
Bollingbroke Sands	**1**	69.9	3	4	3
Bollingbroke Sands	**2**	75.8	2	4	4
Bollingbroke Sands	**3**	78.2	6	6	6
Bollingbroke Sands	**4**	70.8	0	0	0
Bollingbroke Sands	**5**	84.8	3	3	3
Bollingbroke Sands	**6**	62.9	3	4	4
Bollingbroke Sands	**7**	44.6	2	3	2
Bollingbroke Sands	**8**	67.3	2	2	4
Bollingbroke Sands	**9**	72	3	4	5
Bollingbroke Sands	**10**	50.9	6	8	8
Chest Neck	**1**	59	0	0	0
Chest Neck	**2**	59.5	1	1	2
Chest Neck	**3**	52	5	4	4
Chest Neck	**4**	40.9	3	3	3
Chest Neck	**5**	53.8	2	2	2
Chest Neck	**6**	70.2	3	2	3
Chest Neck	**7**	73.4	4	3	2
Chest Neck	**8**	73.2	4	4	5
Chest Neck	**9**	47.8	7	5	7
Chest Neck	**10**	61.8	2	3	3
Spaniard Point	**1**	92.2	7	8	8
Spaniard Point	**2**	109.1	4	4	4
Spaniard Point	**3**	128.2	4	5	5
Spaniard Point	**4**	108.5	0	0	1
Spaniard Point	**5**	121.4	2	2	2
Spaniard Point	**6**	106.3	2	2	4
Spaniard Point	**7**	108.8	7	9	7
Spaniard Point	**8**	125.4	9	10	10
Spaniard Point	**9**	124.4	5	7	6
Spaniard Point	**10**	113.1	5	7	7
Weems Upper	**1**	37.7	3	5	5
Weems Upper	**2**	67.3	6	6	5
Weems Upper	**3**	61.4	3	4	3
Weems Upper	**4**	55	4	4	4
Weems Upper	**5**	47.3	4	6	6
Weems Upper	**6**	44.8	3	4	4
Weems Upper	**7**	50.4	3	3	5
Weems Upper	**8**	52.6	1	2	2
Weems Upper	**9**	66.2	2	2	2
Weems Upper	**10**	59.7	4	5	4