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SHELLFISH STOCK ASSESSMENT OF LITTLE EGG HARBOR BAY (DSRT PROPOSAL #2001011)

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ABSTRACT

The New Jersey Bureau of Shellfisheries conducted a hard clam [*Mercenaria mercenaria* (Linnæus 1758)] stock assessment of Little Egg Harbor Bay. The Bureau sampled 194 stations from 16 July to 31 August 2001 using a hydraulic dredge to determine the bay's standing stock and relative distribution of hard clams. The hard clam resource in Little Egg Harbor Bay is estimated at 64.8 million clams, a decrease of over 67% from 1986/87, the last time a comprehensive shellfish survey was conducted in the bay. The decline in hard clam abundance per station between the two survey years was significant ($P << 0.0002$, $P << 0.0002$, $P < 0.0001$ and $P < 0.0001$). The mean size of hard clams collected in 2001 was 78.9 mm and represented a significant increase from 1986/87's mean size of 74.6 mm ($P < 0.0002$). Recruitment indices, based on a percentage of hard clams between 30 and 37 mm collected at a specific site as compared to all sized clams collected at the same site, were significantly lower in 2001 than in 1986/87 ($P = 0.025$). Mortality estimates were significantly greater in 2001 than in 1986/87 ($P << 0.0002$).

The bay contains an estimated 6,320 acres of submerged aquatic vegetation (SAV), a decrease of approximately 360 acres from 1986/87. However, there was no significant difference between the ratios of stations containing versus not containing SAV in 1986/87 versus 2001 ($P \approx 0.3576$).

This study represents the first comprehensive shellfish survey of Little Egg Harbor Bay since 1986/87 and points to the importance of the availability of current and quantitative stock estimates. This work represents an important step in the management of the bay's hard clam resource and should be followed by subsequent monitoring efforts.

INTRODUCTION

Little Egg Harbor Bay (Ocean County) has historically been one of New Jersey's most productive estuaries for hard clams, *Mercenaria mercenaria*, but reports from recreational and commercial shellfishermen indicate that stocks are down significantly. Recent "brown tide" events caused by *Aureococcus anophagefferens* have been hypothesized as causative agents in this reported decline. In New York, three years of successive brown tides have been implicated as the cause of extensive adult scallop [*Argopecten irradians* (Lamarck 1819)] mortality and severely limited larval recruitment (Tettelbach and Wenczel 1993). The bay scallop comprised a multimillion-dollar fishery in Long Island, New York prior to the first occurrence of *A. anophagefferens* algal blooms (Tettelbach and Wenczel 1993). Montagna *et al.* (1993) report that brown tides are known to have had catastrophic effects on bivalves. Effects have ranged from reproductive or recruitment failures, to adverse impacts on feeding, to toxic effects, in which mass mortalities of shellfish were usually reported (Montagna *et al.* 1993, and references therein).

A hard clam stock assessment has not been performed in Little Egg Harbor Bay since 1986/87 when the New Jersey Bureau of Shellfisheries sampled approximately 200 stations in Little Egg Harbor Bay as part of its Estuarine Shellfish Research and Inventory Program (ESRIP). The ESRIP was terminated in 1988 when legislative changes made such work ineligible for the 50% federal funding which had facilitated a comprehensive shellfish survey from Raritan Bay to Great Bay. Funding provided via the New Jersey Department of Environmental Protection's environmental indicator efforts provided a sorely needed hard clam

stock assessment for Little Egg Harbor Bay, which is essential to the Department's efforts to monitor, maintain and enhance the status of New Jersey's coastal ecosystem.

The purpose of this survey was to assess the standing stock, distribution and relative abundance of the hard clam, *Mercenaria mercenaria*, in Little Egg Harbor Bay in 2001. Quantitative and qualitative comparisons are made between this survey and an identical survey conducted in 1986/87, without inference as to what happened in the years prior to or in between these surveys. Another goal of this survey was to describe the distribution of submerged aquatic vegetation (SAV) species in Little Egg Harbor Bay and, again, compare these findings to those reported in 1986/87.

MATERIALS AND METHODS

Study Site

All fieldwork was conducted in Little Egg Harbor Bay, Ocean County, New Jersey (Figure 1). Little Egg Harbor Bay is one of three shallow microtidal bays that comprise the Barnegat Bay – Little Egg Harbor estuarine system (Barnegat Bay Estuary Program 1999). Seawater enters the system through the Point Pleasant Canal, Barnegat Inlet and Little Egg Inlet (Barnegat Bay Estuary Program 1999).

Sampling

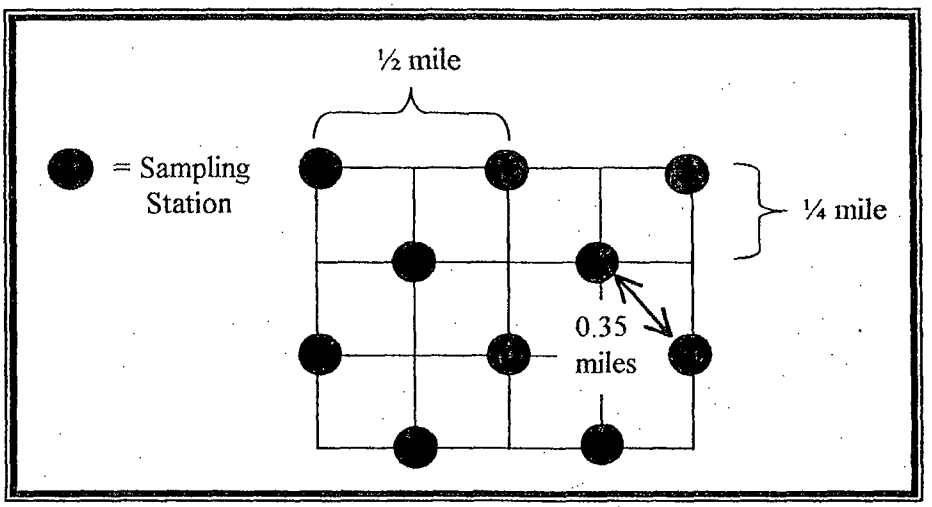
Quantitative sampling was conducted from 16 July 2001 to 31 August 2001 in Little Egg Harbor Bay. All stations were sampled using the Research Vessel *Notata*: a 32-foot long, Chesapeake dead rise style vessel equipped with a hydraulic dredge. The dredge is equipped with a 12-inch wide blade that cuts approximately 4-inches into the substrate. The dredge uses water jets to loosen the bottom sediments ahead of the digging blade and to expel sediments through the body of the dredge (see Ropes and Martin 1960). Water is supplied to the jets through a 3-inch hose attached to a water pump on the deck of the vessel. At 35-40 pounds of pressure per square inch the pump delivers approximately 300 gallons of water per minute. The dredge is designed to collect and retain all hard clams 30 millimeters (mm) in length or greater, therefore, clams less than 30 mm are not included in any analyses.

The dredge is deployed and retrieved via a 3/8-inch stainless steel wire cable attached to the main haul back winch on the vessel. The actual towing for sample collection was done with a 3/4-inch polypropylene graduated line.

Sampling protocols were similar to those used in the Bureau's 1986/87 shellfish survey of the same area (see Joseph 1987). Specifically, a systematic sampling design was employed. The original sampling design was not created to look specifically at statistical changes from year to year per se, but in large part, to depict the distribution and abundance of commercially valuable mulluscan shellfish within New Jersey's coastal estuaries (Joseph 1987). Stations sampled for the 2001 inventory were identical to those sampled in 1986/87 except for 31 of the 194 (16.0%) stations where it was not practicable due to recent obstructions, changes in bathymetry, aquaculture lease areas or submerged telecommunication/electric cable areas, in which case stations were relocated as close to the original stations as feasible (range: 138′ to 1,503′ away from original stations; $\bar{x} = 432'$). As in the original survey, station locations were established at ½-mile intervals offset along east-west transects ¼-mile apart such that stations on adjacent transects were approximately 0.35 miles apart (see Figure 2, below). All stations were located using a Northstar 951X Differential GPS receiver chart plotter.

After station position was established, a buoy was placed overboard to ensure the maintenance of the boat's position throughout sampling operations at each station. Following deployment of the buoy, water samples were collected with a Kemmerer water sampler (at the first and last stations sampled in a day) for later analysis of dissolved oxygen, salinity and pH at the New Jersey Division of Fish and Wildlife's Nacote Creek Research Laboratory, Port Republic, New Jersey. Air and water temperatures (surface and bottom) were recorded from a mercury thermometer in the field. Dissolved oxygen was determined by Winkler titration. Salinities were determined by a hand-held refractometer and pH readings were obtained using colorimetric visual analyses against know standards (Taylor ® slide comparator).

FIG. 2. Schematic of systematic sampling design grid.



Following collection of water samples, water depth was recorded from a Lowrance 3200® Computer Sonar unit and the towline length determined accordingly. A towline length-to-depth ratio of 4:1 was utilized, although, in several instances it was not possible to maintain this ratio because of water depth and water supply hose limitations (100 feet). In those instances, a ratio of 3:1 was maintained. The towline length-to-depth ratio was never less than 3:1.

Prior to each tow, the substrate was probed with a clam rake handle in order to assist with the determination of dredge nozzle selection. In hard substrates, the forward nozzles were opened and back nozzles closed. In soft substrates, the forward nozzles were closed and back nozzles opened. These nozzle positions have previously been determined to yield optimal dredge efficiency (McCloy and Joseph 1983). Upon dredge nozzle adjustment, one 100-foot tow was made. It was assumed that one tow was representative of a larger area (*i.e.*, an entire sampling cell). Unfortunately there are no data to either support or refute this assumption – limitations on time and funding precluded an investigation. However, to minimize this source of estimation error, sampling frequency was increased to the maximum extent practicable (see Figure 2).

The 100-foot distance was measured by paying out a graduated line while towing the dredge. In bottoms with a high percentage of clay, submerged obstructions or submerged aquatic vegetation (SAV), where it was not possible to tow the entire 100 feet, tows were shortened and the length of the tow recorded. In instances where it was suspected that the dredge was not fishing properly due to low water pump pressure, dredge knife obstruction or erratic tow speeds for example, the tow was repeated until these concerns were resolved. In all cases, at the end of the measured tow, the vessel was held as stationary as possible until the dredge was raised off the bottom to prevent sampling more than the desired area.

The dredge catch was deposited on a culling table for sorting and counting. All live hard clams and paired hard clam valves ("boxes") collected in each tow were counted and measured along their anterior-posterior axis to the nearest millimeter using vernier calipers. Hard clams were graded into the following size categories: "sublegals" (30-37 mm), "littlenecks" (38-55 mm), "cherrystones" (56-76 mm) and "chowders" (> 76 mm). Hard clam abundance indices (catch per tow) for each station are expressed in terms of number per square feet. Observations were also made on the presence and number of other animal and plant species collected in the dredge (*e.g.,* submerged aquatic vegetation and clam predators). Distribution charts of commercially important species (*e.g., Mercenaria mercenaria* and *Mytilus edulis*) were developed.

Population Size/Age Structure

A composite (the sum of all clams measured) length-percent-frequency distribution graph was constructed by appropriately grouping all hard clam lengths measured in the bay. Lengths were combined into three-millimeter groupings (starting at, but not including, 29 mm) as was done in 1986/87's survey; again, the dredge is designed to retain clams 30 mm in length and greater. The midpoints of each size grouping were plotted on the x-axis of the distribution graphs. Low clam abundances precluded preparation of length-percent-frequency distributions at all individual stations (all $n < 100$).

Mercenaria Distribution and Abundance Estimation

Spatial autocorrelation among stations was examined though the software module "EnvironmentalStats for S-Plus."

For the purpose of delineating relative abundance and distribution patterns of the hard clam resource, four classifications of none (0.00 *Mercenaria* foot^{-2}), occurrence (0.01-0.19 *Mercenaria* foot^{-2}), moderate abundance (0.20-0.49 *Mercenaria* foot^{-2}), and high abundance ($\geq$ 0.50 *Mercenaria* foot^{-2}) were established at each station after the data had been adjusted for the efficiency of the dredge (see below). The abundance categories selected equated with those used in the Bureau's 1986/87 survey.

For the purpose of calculating stock estimates of the hard clam resource, the following abundance classification intervals were established: (0.00), (0.01-0.05), (0.06-0.11), (0.12-0.49), (0.50-0.99), (1.00-1.99) and ($\geq$ 2.00) *Mercenaria* foot^{-2}. The abundance categories matched the intervals used in the Bureau's 1986/87 survey. Adjacent stations within the same abundance category listed were grouped together and a mean abundance for that area determined by utilizing the *Mercenaria* abundance means of the individual stations. The mean abundance was then applied to the size of the area to yield the standing stock estimate for that particular area. ArcView Geographic Information System (GIS) (2000) was utilized to estimate the size of the individual areas in feet^2. By summing the small areas, a resource estimate of the bay was developed. A 95% confidence interval was placed around the estimate (see below).

The Bureau of Shellfisheries conducted a separate study in Raritan Bay to assess the efficiency of the Bureau's dredge (Celestino 2003). Under ideal conditions, the study would have been conducted in Little Egg Harbor Bay, but practical considerations precluded this from occurring (*e.g.,* very low abundances of clams at most stations).

The Bureau examined the dredge's efficiency in each of five substrates (Table 1, below) using a mixed-model, hierarchical, two-way ANOVA. While other substrates were encountered, those selected represented the most frequently encountered. Three replicates were collected from

TABLE 1. Estimates of dredge efficiency among five substrates examined.

Substrate	Efficiency (%)
Sand	67.8
Mud & Shell	84.8
Sand & Gravel	91.6
Mud & Sand	95.6
Mud	100.0

each substrate; the number of replicates was chosen a priori such that the denominator of the F ratio had at least six degrees of freedom (Hicks and Turner 1999). The model used for analysis was:

$Y_{ijk} = \mu + S_i + L_{j(i)} + \mathcal{E}_{k(ij)}$, where $\mu =$ a common effect for the entire experiment, $S_i =$ substrate, $L_{j(i)} =$ station within substrate, and $\mathcal{E}_{k(ij)} =$ the error estimate. The model did not allow for an analysis of variance among the stations within each substrate [$L_{j(i)}$]; this is not a concern as the factor of interest was substrate (S_i). The results of the analysis indicated a "marginally" significant difference among the five substrates ($F_{4,10} = 3.51$, $P = 0.05$).

It is important to note that the experimental design looked at a necessarily limited number of variables (*e.g.*, substrate). Factors other than those examined could potentially influence the dredge's efficiency. Given the myriad factors that could affect dredge efficiency, the relatively small sample size, hard clam population dynamics, and the marginally significant result, it was decided to pool all efficiency estimates into a grand arithmetic mean with a 95% confidence interval. While this rationale has its drawbacks, it permits justifiable adjustment of raw data without quantitative analysis of substrate types, which would be time and cost prohibitive. (Separate efficiency estimates based on substrate composition would require a quantitative decision based on subjective criteria; that is, application of a specific efficiency estimate to qualitatively different substrates – qualitatively different without sediment grain size analysis).

The dredge had an overall mean efficiency of 88.0% (±7.7%); all hard clam raw abundances were therefore increased by a factor of 1.137 (100 ÷ 88.0%). However, for purposes of the present report, several analyses were conducted (see *Statistical Analyses: Mercenaria abundance*, below) to ensure that interpretation of the dredge efficiency results was not affecting the results or conclusions of the present paper. For more detail on the methods, analysis and interpretation of the dredge efficiency study please refer to Celestino (2003).

Mercenaria Mortality

An index of natural hard clam mortality was determined at each station. This index was based upon the percentage of empty paired valves ("boxes") in the entire sample of paired valves and live clams: Mortality = {[(no. of boxes at station i) ÷ (no. of boxes at station i + no. of live *Mercenaria* at station i)] × 100%}, for $i = 1,\ldots,194$. Our mortality index is independent of age, size, and gender of *Mercenaria*.

Mercenaria Recruitment

For the purpose of this study, recruitment is defined as the percentage of clams entering the fishery at the legal size of 38 mm in length. To estimate annual recruitment, "sublegals" (*Mercenaria* collected between 30 and 37 mm in length) represented a single year class and would thus be expected to be recruited into the fishery within the coming year. The recruitment index per station was calculated as: {[(no. of *Mercenaria* collected between 30 and 37 mm at station i) ÷ (total no. of *Mercenaria* collected at station i)] × 100%}, for $i = 1,\ldots,194$. The total

number of sublegals estimated to be present in the bay is also reported. As in 1986/87's study, data from areas of occurrence (abundance < 0.20 *Mercenaria* foot^{-2}) were not taken into consideration when calculating recruitment indices due to concerns related to interpretation of small sample sizes.

Statistical Analyses: Mercenaria abundance

I. Comparison of Mercenaria abundances between 1986/87 and 2001 with dredge efficiency applied to <u>both</u> datasets:

A single dredge efficiency adjustment factor (*i.e.*, 1.137 – see above) was applied to all *Mercenaria* abundance data from both surveys for which paired data exists [*i.e.*, "paired data" = the same station was sampled in 1986/87 and 2001; stations added or deleted in 2001 would not have a "companion" station from 1986/87, and are consequently omitted from these analyses – 7 of 194 stations did not have a companion ($\therefore$N=187)]. Because the data are paired, and therefore not independent, Wilcoxon's distribution-free signed rank test for paired replicates was employed. The null hypothesis is that there is no shift in location (median) due to treatment (Hollander and Wolfe 1999). Because there were tied values among the data, the test is only approximate, and not exactly of significance level α [an exact level α test statistic in the tied setting requires deriving the exact conditional distribution of the test statistic (T^+) which has, in this case, 1.92×10^{53} possible outcomes] (Hollander and Wolfe 1999). A point estimator associated with Wilcoxon's signed rank test statistic was calculated to provide some measure of the magnitude of change in *Mercenaria* abundance. Finally, a distribution-free confidence interval around the point estimator based on Wilcoxon's signed rank test was calculated.

II. Comparison of Mercenaria abundances between 1986/87 and 2001 with dredge efficiency applied to <u>one</u> dataset:

The previous analysis assumes that the dredge efficiency was the same in 1986/87 as it was in 2001. This is a fair assumption as the exact same equipment (*e.g.*, vessel, water pump, and dredge) was employed, however, it is possible that the dredge efficiency did change over time and that any statistical differences arising in the analyses are a result of a change in the dredge's efficiency and not in the abundance of *Mercenaria*. To account for the possibility that the dredge's efficiency decreased over time, the dredge efficiency correction factor was applied only to data collected in 2001 – it was therefore assumed that the dredge was 100% efficient in 1986/87, resulting in a conservative test (*i.e.*, this assumption examines the smallest possible differences in *Mercenaria* abundance – therefore, if this analysis results in a significant difference, all other efficiency permutations would as well). Wilcoxon's distribution-free signed rank test for paired replicates was conducted.

III. Comparison of Mercenaria abundances between 1986/87 and 2001 with substrate-specific dredge efficiencies applied to both data sets:

To explore the possibility that observed differences in *Mercenaria* abundance between the two survey years were due to the dredge operating at different efficiencies in different substrates (see Table 1 on page 5), substrate-specific efficiency correction factors were applied to *Mercenaria* abundances at individual stations based on their field-assigned substrate classification. That is, *Mercenaria* abundances were multiplied by 1.475 (100 ÷ 67.8%; see Table 1) if the substrate at a given station was classified as "sand," a correction factor of 1.179 (100 ÷ 84.8%; see Table 1) was applied to *Mercenaria* abundance if the substrate at a station was classified as "mud and shell," and so on though a correction factor of 1.000 (100 ÷ 100.0%; see Table 1) for substrates classified as "mud."

Stations were "assigned" substrates in two fashions: 1) substrates, as recorded on data sheets in the field, were interpreted literally such that if a substrate was not field-classified explicitly as one of the types listed in Table 1, data for that station was not included in the analysis; consequently, N = 40 using this method. 2) Substrates were interpreted more liberally so that, for example, substrates field-classified as "hard sand" or "soft mud" were assigned efficiencies corresponding to those of "sand" and "mud," respectively. The nozzle position selected at a station and recorded on the data sheet aided with interpretation. Using this method, N = 45 for this analysis.

As in previous analyses, Wilcoxon's distribution-free signed rank test for paired replicates was employed. See SAS (1990) for details of calculation methods.

Note on *Mercenaria* abundance analyses: because multiple tests are being performed (*i.e.*, *Mercenaria* abundance analyses I, II and III), significance levels need to be corrected for maintenance of experimentwise error rate levels. This was done using Bonferroni corrections [see Rice (1990)].

Statistical Analysis: Mercenaria mortality

Wilcoxon's distribution-free signed rank test for paired replicates was used to analyze the mortality indices from 1986/87 to 2001 – the large sample approximation was used [see *Statistical Analysis: Mercenaria I* above for details]. A distribution-free point estimator and confidence interval were developed as well (see above for details).

Statistical Analysis: Mercenaria recruitment

Wilcoxon's distribution-free signed rank test for paired replicates was used to analyze the recruitment indices from 1986/87 to 2001 – an exact test (not large sample approximation) was used. A distribution-free point estimator and confidence interval were developed as well (see above for details). Only stations where *Mercenaria* abundances were ≥ 0.20 clams foot^{-2} were incorporated into the analysis, therefore total sample size is 14 (*i.e.*, only 14 pairs of stations contained *Mercenaria* abundances ≥ 0.20 clams foot^{-2} in both survey years).

Statistical Analysis: Mercenaria size/age

Wilcoxon's distribution-free signed rank test for paired replicates was used to analyze mean *Mercenaria* lengths from 1986/87 to 2001 – the large sample approximation was used (see *Statistical Analysis: Mercenaria I* above for details). A distribution-free point estimator and confidence interval were developed as well (see above for details). Only stations where *Mercenaria* were collected during both surveys were incorporated into analyses, therefore total sample size is 120 (*i.e.*, only 120 pairs of stations contained ≥ 1 *Mercenaria* per station in both survey years). Stations where only ≥ 1 *Mercenaria* were collected were included in analyses because 0 clams collected results in a "mean size" of 0/0 (= undefined).

Submerged Aquatic Vegetation (SAV) Distribution

To develop the total acreage of SAV in Little Egg Harbor Bay, SAV was determined to be either present or absent based on the same dredge sample used to collect hard clams. No quantitative description was made in the field with respect to SAV acreage, only presence or absence. For distributional analysis, when SAV was collected at a station (*i.e.*, present), a polygon was drawn around said station using ArcView GIS software (2000). Said polygon encompassed any adjacent stations where SAV was also collected. The analysis requires the same assumption as the *Mercenaria* analysis; specifically, that SAV's presence (or absence) is constant within a given polygon [water depths aided interpolation between stations (*e.g.*, it was

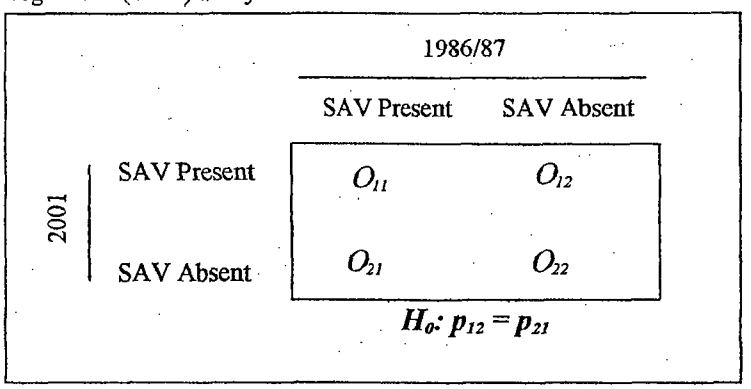
assumed that water depths in navigation channels would preclude the presence of SAV)]. This seems reasonable given station location proximity. Total acreage was derived by summing individual polygon acreages.

Statistical Analysis: Submerged Aquatic Vegetation

The null hypothesis (H_0) asserts that the proportions of stations containing versus not containing SAV did not change from 1986/87 to 2001 (Figure 3). H_0 was tested using McNemar's Test. This test is nonparametric and is appropriate for categorical data based on dependent samples (Hollander and Wolfe 1999). Our data for this analysis are paired and therefore constitute dependent data. Taking the pairing into account will provide the best chance of detecting a departure from the null hypothesis (Hollander and Wolfe 1999).

Because not all stations between the two sampling years had a direct paired station, total sample size for this analysis was 184.

FIG. 3. Conceptualization of null hypothesis for submerged aquatic vegetation (SAV) analysis.



RESULTS

Description of Study Site

Substrates qualitatively ranged from hard sand to soft mud. All locations were characterized by having salinities between 26‰ and 31‰ ($\bar{x}$ = 29.2‰; SD = 1.4‰), water temperatures between 23° and 30°C ($\bar{x}$ = 26°C; SD = 1.7°C) and air temperatures between 21° and 33.5°C ($\bar{x}$ = 26°C; SD = 3.5°C). Physical and chemical data are summarized in Table 2.

Submerged Aquatic Vegetation

In 2001, a total of 6,320 acres in Little Egg Harbor Bay was mapped as containing submerged aquatic vegetation (SAV), compared to 6,683 acres in 1986/87 (Table 3, to the right). Figures 4 and 5 depict the distribution of SAVs in Little Egg Harbor Bay in 1986/87 and 2001, respectively (the 1986/87 SAV distribution chart is provided for illustrative purposes only). In 2001, *Zostera marina* (eelgrass) was the

TABLE 3. Comparison of acres of submerged aquatic vegetation (SAV) mapped in Little Egg Harbor Bay from the 1986/87 and 2001 surveys.

Survey Year	Acres of SAV
1986/87	6,683
2001	6,320

dominant SAV collected; *Ruppia maritima* (widgeon grass) was collected at only three stations: 12.5, 83 and 173 (Figure 6, Table 4). SAV was collected in water up to 8 feet in depth (Table 4).

McNemar's Test indicated no significant difference between the proportions of stations containing versus not containing SAV in 1986/87 versus 2001 *($d = 0.365$, $P \approx 0.3576$)*.

Mercenaria Abundance and Distribution

All *Mercenaria* data provided is adjusted for the dredge's efficiency unless otherwise specified.

All results must be interpreted in light of autocorrelation analyses that indicated that *Mercenaria* abundances were correlated within approximately 10,000 feet for 1986/87's survey. The 2001 survey data showed a similar (but weaker) correlation, again within approximately 10,000 feet.

Station location, hard clam abundance, mean length, percent mortality, commercial size class percentages [including percent sublegals (the measure of recruitment for purposes of this study)], and presence/absence of SAV at each station are presented in Table 4. The locations of the 194 stations sampled are presented in Figure 6.

The hard clam resource in Little Egg Harbor Bay (taking into account the dredge's efficiency) is estimated at 64.8 (-5.2 / +6.2) million clams (Table 5) – a conservative estimate of the resource (*i.e.*, not taking into account the dredge's efficiency) is 57.0 million clams. Stock estimates by commercial size class are presented in Table 6.

TABLE 5. Comparison of hard clam stock estimates in Little Egg Harbor Bay from the 1986/87 and 2001 hard clam surveys.

64,803,901	= 2001 stock estimate (clams)
201,476,066	= 1986/87 stock estimate (clams)
136,672,165	= Difference in stock estimates (clams)
67.8%	= Percent difference in stock estimates

Table 7 depicts the number and percentage of stations sampled with no *Mercenaria*, low, moderate and high abundances of *Mercenaria* in Little Egg Harbor Bay for both the 1986/87 and 2001 surveys.

Figures 7 and 8 depict the distribution and abundance of hard clams in Little Egg Harbor Bay in 1986/87 and 2001, respectively [NOTE: the 1986/87 chart shows unadjusted hard clam abundances (*i.e.*, not adjusted for dredge efficiency), while the 2001 chart depicts dredge-efficiency adjusted abundances]. Hard clam abundances ranged from 0.00 to 0.75 clams foot^{-2} in 2001 ($\bar{x} = 0.09$ clams foot^{-2}; SD = 0.14 clams foot^{-2}) and from 0.00 to 2.98 clams foot^{-2} in 1986/87 ($\bar{x} = 0.28$ clams foot^{-2}; SD = 0.32 clams foot^{-2}) (Table 8, below). Wilcoxon's signed rank test (on all dredge efficiency adjusted data) indicated a significant decline in hard clam abundances in 1986/87 versus 2001 *($T^* = -9.068$, $P << 0.0002$)*. The mean decline ($\hat{\theta}$) is estimated at -0.14 clams foot^{-2} *[Pr (-0.18 clams foot^{-2} < θ <-0.11 clams foot^{-2}) = 95%]*. Analysis of dredge efficiency adjusted 2001 data and unadjusted 1986/87 data (see *Statistical Analysis: Mercenaria abundance II*, described above) also indicated a significant decline in hard clam abundances between the two surveys *($T^* = -8.570$, $P << 0.0002$)*. Finally, the analysis of substrate-specific dredge efficiency adjusted 1986/87 and 2001 data (see *Statistical Analysis: Mercenaria abundance III*, described above) also indicated a significant decline in hard clam

abundances between the two surveys for both literal *(S = -290.5, P < 0.0001)* and liberal *(S = -364.5, P < 0.0001)* substrate interpretations.

TABLE 8. Comparison of hard clam abundance statistics from Little Egg Harbor Bay between the 1986/87 and 2001 surveys.

Summary Statistic	1986/87 clams foot^{-2}	2001 clams foot^{-2}
Average Abundance	**0.28**	**0.09**
Minimum Abundance	0.00	0.00
Maximum Abundance	2.98	0.75
Standard Deviation	0.32	0.14

Population Structure

To give an overall description of the hard clam population in Little Egg Harbor Bay, composite (the sum of all clams measured) length-percent-frequency distribution graphs are presented in Figures 9 and 10 for the surveys conducted in 1986/87 and 2001, respectively. The total number of clams collected in each survey, mean lengths and standard deviations are listed in Table 9, to the right. Wilcoxon's signed rank test indicated a significant increase in the mean size of hard clams collected in 1986/87 versus 2001 *($T^* = 5.099$, $P < 0.0002$)*. The mean increase ($\hat{\theta}$) is estimated at 6.9 mm *[Pr (4.82 mm < θ < 9.12 mm) = 95%]*.

TABLE 9. Comparison of hard clam population statistics (number collected, mean size, and standard deviation of sizes) in Little Egg Harbor Bay for the 1986/87 and 2001 surveys.

	1986/87	2001
n =	7,113	939
$\bar{x}$ =	74.6 mm	78.9 mm
SD =	11.0 mm	15.3 mm

Recruitment

Recruitment indices were variable among stations in 2001, ranging from 0.0% to 12.1% with a mean of 1.2% in 2001, compared to a range of 0.0% to 34.6% with a mean of 3.9% in 1986/87 (Tables 4 and 10). Wilcoxon's signed rank test indicated a significant decline in the recruitment indices in 1986/87 versus 2001 *($T^+ = 21.0$, $P = 0.025$)*. The mean decline ($\hat{\theta}$) is estimated at -1.55% *[Pr (-3.35% < θ < 0.00%) = 95.2%]*. Figures 11 and 12 spatially depict recruitment indices in Little Egg Harbor Bay in 1986/87 and 2001, respectively.

Mortality

The average hard clam mortality for Little Egg Harbor Bay in 2001 was 39.7% compared to 11.6% in 1986/87 (Table 10). Mortalities were very variable, ranging from 0% to 100% in both surveys (Tables 10 and 11). Wilcoxon's signed rank test indicated a significant increase in mortality indices in 1986/87 versus 2001 *($T^* = 8.165$, $P << 0.0002$)*. The mean increase ($\hat{\theta}$) is estimated at 28.97% *[Pr (21.85% < θ < 35.23%) = 95%]*. Mortality indices are spatially depicted in Figures 13a and 13b for the 1986/87 survey, and in Figures 14a and 14b for the 2001 survey. Table 12 lists abundances of some common clam predators collected in the survey potentially contributing to juvenile *Mercenaria* mortality (this table also lists other organisms collected during the 2001 survey).

TABLE 11. Comparison of mortality index intervals between the 1986/87 and 2001 surveys.

Mortality Index	1986/87 (number of stations)	2001 (number of stations)
≤ 25%	162	94
26 – 50%	24	37
51 – 75%	2	15
> 75%	1	48

Associated Commercial Species' Abundance and Distribution

In 2001 blue mussels [*Mytilus edulis* (Linnæus 1758)] were collected at 14 stations (Table 4, Figure 15). The distribution of *Mytilus* from 1986/87 is provided in Figure 16 for comparison. In both surveys, *Mytilus* were collected only in the southern portions of the bay. Soft clams (*Mya arenaria* Linnæus 1758) were not collected during the 1986/87 or 2001 surveys. Quantitative estimates of blue mussels are not provided because the dredge was not designed to efficiently retain the small sizes that were observed. Length-percent-frequency distributions were not created, as insufficient numbers were collected or measured ($n < 100$ per station). However, of the mussels retained in the dredge, abundances ranged from 0.02 to 162 mussels foot^{-2} and had a mean length of 28.1 mm (SEM = 4.7 mm).

DISCUSSION AND CONCLUSIONS

Several indicators uncovered in this study point to causes for concern. However, all results must be viewed in light of the fact that data are not available for *Mercenaria* population dynamics for the years prior to or in between the two surveys discussed in this report. Consequently, definitive statements cannot be made regarding interpretation of observed differences between the two surveys. However, as previously mentioned, the purpose of the study was to assess the standing stock, distribution and abundance of the hard clam in Little Egg Harbor Bay and compare those metrics with hard clam population metrics from a survey conducted in 1986/87, without making any inference as to what happened in the years prior to or in between these two surveys.

The estimated standing stock of hard clams in Little Egg Harbor Bay is 64.8 million clams, a decline of over 67% from 1986/87's stock estimate (Table 5). Table 8 indicates that average abundances (per station sampled) in the bay have decreased by two thirds, and quantitative examinations of hard clam abundances per station (between survey years) indicated that the decline was significant (four different tests indicated: $P << 0.0002$, $P << 0.0002$, $P < 0.0001$ and $P < 0.0001$).

In general, the 2001 survey found bay-wide declines in the abundance of hard clams. Some areas of prominent decline include a large, high abundance area (~2,060 acres) present in the southern section of the bay in 1986/87 that has been reduced to patches of zero, low and moderate abundances of hard clams (Figures 7 and 8). In 2001, only four stations contained high abundances of hard clams compared to 32 stations in 1986/87 (Table 7). The western-most parts of the bay that previously contained hard clams predominantly in the "occurrence" classification have largely been reduced to zero abundance areas (Figures 7 and 8).

Table 7 indicates that stations with low abundances of hard clams were the most common in both 1986/87 and 2001. Alarmingly, the percentage of stations containing no clams increased from 3.2% in 1986/87 to 35.1% in 2001. Almost 47% of the stations sampled in 1986/87 had moderate or high abundances of *Mercenaria*, compared to 14% in 2001 (Table 7).

Several results suggest little recruitment in Little Egg Harbor Bay. Stock estimates by commercial size class (Table 6) indicate a preponderance of "chowder" clams in the bay (66.3%). Sublegal sized clams represented the smallest percentage of clams (1.7%). Analysis of mean sizes of *Mercenaria* collected in 1986/87 and 2001 indicated that clams were significantly larger in 2001 than in 1986/87 (on average +~7 mm). Inspection of the 2001 composite length-percent-frequency distribution graph (Figure 10) revealed a relatively "old" population, with a dominant size of approximately 90 mm (chowders). It appears as though a minimum of nine year classes was present in the bay in 2001. Comparison of the distribution graphs from 1986/87 and 2001 (Figures 9 and 10, respectively) shows a population growing older with little recruitment – a conclusion supported by the results reported above. Additionally, with the exception of four stations, all areas of the bay exhibited 0% recruitment in 2001. Recent studies have demonstrated the importance of relatively close proximity of adults to successful reproduction among some marine species that spawn in the water column (Levitan *et al.* 1992, as cited by Fegley 2001). Under conditions where large numbers of widely dispersed spawners occur, low fertilization rates are likely (Fegley 2001).

Mortality estimates have increased from 11.6% in 1986/87 to 39.7% in 2001. In general, mortality rates appeared to be consistently high in the western portions of the bay in 2001 (Figures 14a and 14b), especially from Cedar Run south to the extensive aquaculture lease area of Tuckerton. While production data are not available for aquaculture leases, an investigation into lease occupancy indicated that ~70 leases were occupied in the Tuckerton area in 1986/87, while only ~50 were occupied in 2001 (a decline of approximately 29%). Reasons for the decline in occupancy have been at least partially contributed to marketability issues related to discolored clam meats in the area (N. Loveland. NJDEP, pers. comm. 2002).

Mortalities in 1986/87 were, in general, lower than in 2001. For example, only three stations in 1986/87 had mortality rates > 50%, whereas 63 stations did in 2001 (see Table 11).

A review of the literature uncovered no information on the amount of time *Mercenaria* paired valves remain intact. Consequently, the mortality index is of an indeterminate period of time. It is possible that the reason mortality estimates were higher in 2001 is that they include 1986/87's estimates as well.

Observed abundance of the common clam predators such as conchs (*Busycotypus canaliculatus* and *Busycon carica*), moon snails (*Polinices duplicatus*), oyster drills (*Urosalpinx cinerea*), lady crabs (*Ovalipes ocellatus*), blue crabs (*Callinectes sapidus*), sea stars (*Asterias forbesi*), horseshoe crabs (*Limulus polyphemus*), and xanthid crabs were relatively low (Table 12). Rock crabs (*Cancer irroratus*) were relatively abundant (0.30 crabs feet^{-2}; Table 12).

Finally, with respect to Little Egg Harbor Bay submerged aquatic vegetation (SAV), while there was a decline of approximately 5% in the total estimated acreage in 1986/87 to 2001, McNemar's Test indicated no significant difference between the proportions of stations containing versus not containing SAV during this time *($d = 0.365$, $P \approx 0.3576$)*. Nevertheless, some of the more prominent changes in SAV distribution include some fragmentation of the extensive beds located in the northern half of the bay (Figures 4 and 5). Some SAV was also absent in 2001 adjacent to Long Beach Island. However, SAV was collected in several areas in 2001 where it was not collected in 1986/87:

- Edge Cove,
- Dinner Point,
- Along the western side of Mordacai Island, and
- In the south-central portion of Little Egg Harbor Bay (*e.g.*, Barrel Island).

This study represents the first comprehensive shellfish survey of Little Egg Harbor Bay since 1986/87 and points to the importance of the availability of current and quantitative stock estimates. Our conclusions are necessarily limited by the availability of data between the two surveys. This work represents an important step in the management of the bay's hard clam resource and should be followed by subsequent monitoring efforts.

While "brown tide" events have been hypothesized to be the causative agents responsible (entirely or in part) for hard clam declines, further work is needed to resolve this question. Brown tides can affect shellfish populations through a variety of mechanisms (see Montagna *et al.* 1993), however it is possible that non-bloom factors (*sensu* Montagna *et al.* 1993) are partly or wholly responsible. Despite the ecological and economic importance that can be attached to hard clam populations, little information has been gathered that provides insight into their dynamics (Fegley 2001).

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Table 2. Physical and chemical data collected during the 2001 Little Egg Harbor Bay hard clam stock assessment.

	LITTLE EGG HARBOR BAY								
	Air Temperature (°C)	Surface water Temperature (°C)	Bottom water Temperature (°C)	Surface Dissolved Oxygen (mg/l)	Bottom Dissolved Oxygen (mg/l)	Surface Salinity (°/oo)	Bottom Salinity (°/oo)	Surface pH	Bottom pH
Average	25.8	26.1	25.9	6.5	6.4	29.3	29.1	8.2	8.3
Minimum	21	23.5	23	4.9	4.7	26	26	8.0	8.1
Maximum	33.5	30	29	7.8	9.5	31	31	8.4	8.4
Standard Deviation	3.5	1.8	1.7	0.9	1.1	1.4	1.5	0.1	0.1
Count (n)	24	23	24	23	24	23	24	16	18

Table 4. Station locations, hard clam abundances, percent mortalities, commercial size class percentages and presence/absence of submerged aquatic vegetation (SAV) for the 2001 hard clam stock assessment of Little Egg Harbor Bay.

Station	Date	Latitude	Longitude	Depth (feet)	*Abundance* $_{adj}$ ** (clams/foot^2)	Mean Length (mm)	Percent Mortality	Percent Sublegals	Percent Littlenecks	Percent Cherrystones	Percent Chowders	SAV$^{\Delta}$ present?	*Mytilus* present?
LEHB-01-179	27-Aug-01	39 35.00	74 16.33	8.0	0.11	89.0	0.00	0.00	0.00	0.00	100.00	0	0
LEHB-01-180	27-Aug-01	39 35.00	74 16.97	7.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-181	27-Aug-01	39 35.25	74 17.29	8.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-182	27-Aug-01	39 35.50	74 17.61	8.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-183	27-Aug-01	39 35.50	74 18.26	7.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-184	27-Aug-01	39 35.70	74 18.40	7.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-185	27-Aug-01	39 36.25	74 17.94	7.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-186	27-Aug-01	39 35.50	74 18.90	7.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-187	27-Aug-01	39 34.972	74 19.463	7.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-188	31-Aug-01	39 34.500	74 15.030	3.0	0.04	81.0	0.00	0.00	0.00	0.00	100.00	+	0
LEHB-01-189	31-Aug-01	39 34.500	74 15.350	3.0	0.26	85.7	12.50	0.00	14.29	0.00	85.71	+	0
LEHB-01-190	31-Aug-01	39 32.000	74 16.330	15.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	+
LEHB-01-191	31-Aug-01	39 31.75	74 16.65	14.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-192	31-Aug-01	39 31.500	74 17.050	15.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	+

* LEHB-01-018 tow repeated on 8/3/01 (water depth = 4') due to low water pump pressure on 7/17/01.

* LEHB-01-043 tow repeated on 8/3/01 (water depth = 5') due to low water pump pressure on 7/17/01.

* LEHB-01-062 tow repeated on 8/6/01 (water depth = 5').

* LEHB-01-111 additional tow performed on 8/9/01 (water depth = 4') outside of cable area at 39° 33.563, 74° 15.662 (approximately 0.07 nm from original coordinates) due to suspected abandoned telecommunications cable impeding dredge.

* Station LEHB-01-160 deleted - station located within an aquaculture lease.

Δ SAV: + = *Zostera marina* collected, 0 = *Z. marina* not collected, *Ruppia* = *Ruppia maritima* collected.

** Abundance$_{adj}$ = Hard clam abundances adjusted for dredge efficiency.

Table 4. Station locations, hard clam abundances, percent mortalities, commercial size class percentages and presence/absence of submerged aquatic vegetation (SAV) for the 2001 hard clam stock assessment of Little Egg Harbor Bay.

Station	Date	Latitude	Longitude	Depth (feet)	*Abundance* $_{adj}$ ** (clams/foot^2)	Mean Length (mm)	Percent Mortality	Percent Sublegals	Percent Littlenecks	Percent Cherrystones	Percent Chowders	SAV[Δ] present?	*Mytilus* present?
LEHB-01-142	21-Aug-01	39 32.455	74 16.982	3.5	0.14	45.5	42.86	25.00	58.33	16.67	0.00	0	+
LEHB-01-143	21-Aug-01	39 32.75	74 17.29	3.0	0.66	55.7	9.38	12.07	48.28	29.31	10.34	0	0
LEHB-01-144	21-Aug-01	39 32.00	74 17.71	8.0	0.03	63.0	50.00	0.00	0.00	100.00	0.00	0	+
LEHB-01-145	21-Aug-01	39 32.25	74 17.84	8.0	0.05	46.5	50.00	0.00	100.00	0.00	0.00	0	+
LEHB-01-146	21-Aug-01	39 32.25	74 17.29	8.0	0.02	30.0	50.00	100.00	0.00	0.00	0.00	0	+
LEHB-01-147	21-Aug-01	39 31.75	74 17.29	7.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-148	22-Aug-01	39 34.50	74 18.26	6.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-149	22-Aug-01	39 34.50	74 18.90	6.0	0.02	90.0	83.33	0.00	0.00	0.00	100.00	0	0
LEHB-01-150	22-Aug-01	39 34.36	74 19.18	5.0	0.07	88.0	62.50	0.00	0.00	0.00	100.00	0	0
LEHB-01-151	22-Aug-01	39 34.063	74 19.988	4.0	0.25	84.5	35.29	0.00	0.00	18.18	81.82	0	0
LEHB-01-152	22-Aug-01	39 34.000	74 19.926	4.0	0.08	91.5	77.78	0.00	0.00	0.00	100.00	0	0
LEHB-01-153	22-Aug-01	39 33.75	74 19.87	5.0	0.13	81.6	0.00	6.67	13.33	6.67	73.33	0	0
LEHB-01-154	22-Aug-01	39 33.50	74 19.55	3.5	0.10	68.0	10.00	0.00	33.33	33.33	33.33	0	0
LEHB-01-155	23-Aug-01	39 33.00	74 18.90	12.0	0.09	95.3	42.86	0.00	0.00	0.00	100.00	0	0
LEHB-01-156	22-Aug-01	39 33.25	74 18.65	4.0	0.18	99.4	20.00	0.00	0.00	0.00	100.00	0	0
LEHB-01-157	22-Aug-01	39 33.50	74 18.90	3.0	0.05	80.3	33.33	25.00	0.00	0.00	75.00	0	0
LEHB-01-158	22-Aug-01	39 33.75	74 19.23	4.0	0.06	90.6	0.00	0.00	0.00	0.00	100.00	0	0
LEHB-01-159	22-Aug-01	39 33.25	74 19.23	4.0	0.02	90.0	50.00	0.00	0.00	0.00	100.00	0	0
LEHB-01-161	22-Aug-01	39 34.75	74 20.20	6.0	0.48	71.4	22.22	0.00	4.76	66.67	28.57	0	0
LEHB-01-162	23-Aug-01	39 32.75	74 18.58	5.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-163	23-Aug-01	39 34.75	74 17.94	8.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-164	22-Aug-01	39 35.25	74 17.81	8.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-165	23-Aug-01	39 34.875	74 17.440	8.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-166	23-Aug-01	39 34.75	74 17.29	8.0	0.01	60.0	95.00	0.00	0.00	100.00	0.00	0	0
LEHB-01-167	23-Aug-01	39 34.50	74 16.97	7.0	0.19	87.0	58.33	0.00	0.00	0.00	100.00	0	0
LEHB-01-168	23-Aug-01	39 34.75	74 16.65	7.0	0.23	86.1	44.44	0.00	0.00	0.00	100.00	0	0
LEHB-01-169	23-Aug-01	39 34.00	74 16.33	6.0	0.17	80.5	40.00	8.33	8.33	0.00	83.33	+	0
LEHB-01-170	23-Aug-01	39 33.00	74 16.33	5.0	0.49	92.5	18.75	0.00	8.33	0.00	91.67	+	0
LEHB-01-171	23-Aug-01	39 32.50	74 16.33	4.0	0.01	96.0	0.00	0.00	0.00	0.00	100.00	0	0
LEHB-01-172	23-Aug-01	39 32.220	74 16.585	3.0	0.36	81.8	15.79	0.00	6.25	18.75	75.00	0	+
LEHB-01-173	23-Aug-01	39 33.75	74 14.95	3.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	*Ruppia* only	0
LEHB-01-174	23-Aug-01	39 33.55	74 14.85	4.0	0.05	84.0	0.00	0.00	0.00	0.00	100.00	0	0
LEHB-01-175	27-Aug-01	39 34.25	74 14.39	4.0	0.14	85.5	45.45	0.00	0.00	16.67	83.33	+	0
LEHB-01-176	27-Aug-01	39 34.25	74 16.01	8.0	0.42	82.1	8.33	0.00	9.09	0.00	90.91	0	0
LEHB-01-177	27-Aug-01	39 34.50	74 16.33	8.0	0.26	82.7	0.00	0.00	14.29	0.00	85.71	0	0
LEHB-01-178	27-Aug-01	39 34.75	74 16.01	10.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0

Table 4. Station locations, hard clam abundances, percent mortalities, commercial size class percentages and presence/absence of submerged aquatic vegetation (SAV) for the 2001 hard clam stock assessment of Little Egg Harbor Bay.

Station	Date	Latitude	Longitude	Depth (feet)	*Abundance* $_{adj}$ ** (clams/foot^2)	Mean Length (mm)	Percent Mortality	Percent Sublegals	Percent Littlenecks	Percent Cherrystones	Percent Chowders	SAV$^{\Delta}$ present?	*Mytilus* present?
LEHB-01-106	8-Aug-01	39 33.50	74 16.33	5.0	0.06	95.5	25.00	0.00	0.00	0.00	100.00	+	0
LEHB-01-107	9-Aug-01	39 33.25	74 16.01	4.0	0.38	92.9	13.16	0.00	3.03	0.00	96.97	0	0
LEHB-01-108	9-Aug-01	39 34.00	74 15.03	4.0	0.05	88.5	0.00	0.00	0.00	50.00	50.00	+	0
LEHB-01-109	27-Aug-01	39 34.25	74 15.25	8.0	0.70	93.6	3.13	0.00	0.00	0.00	100.00	+	0
LEHB-01-110	9-Aug-01	39 33.75	74 15.35	8.0	0.03	39.0	0.00	0.00	100.00	0.00	0.00	0	+
LEHB-01-111*	9-Aug-01	39 33.50	74 15.67	6.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-112	9-Aug-01	39 33.00	74 15.67	8.0	0.11	108.0	0.00	0.00	0.00	0.00	100.00	0	+
LEHB-01-113	9-Aug-01	39 32.70	74 15.82	8.0	0.01	48.0	0.00	0.00	100.00	0.00	0.00	0	0
LEHB-01-114	9-Aug-01	39 32.50	74 15.74	5.0	0.05	89.3	42.86	25.00	0.00	0.00	75.00	0	+
LEHB-01-115	9-Aug-01	39 32.25	74 16.01	6.0	0.08	90.0	0.00	0.00	0.00	0.00	100.00	0	+
LEHB-01-116	9-Aug-01	39 32.00	74 16.97	4.0	0.03	44.0	25.00	0.00	100.00	0.00	0.00	0	0
LEHB-01-117	9-Aug-01	39 33.35	74 15.30	4.0	0.16	81.9	12.50	0.00	14.29	28.57	57.14	+	0
LEHB-01-118	9-Aug-01	39 33.75	74 16.01	6.0	0.41	93.7	5.26	0.00	0.00	2.78	97.22	0	0
LEHB-01-119	9-Aug-01	39 34.00	74 15.67	8.0	0.14	95.5	0.00	0.00	0.00	0.00	100.00	0	+
LEHB-01-120	9-Aug-01	39 35.302	74 13.790	6.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-121	9-Aug-01	39 36.691	74 12.525	4.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-122	14-Aug-01	39 36.282	74 12.798	10.0	0.68	73.2	6.25	3.33	10.00	40.00	46.67	0	0
LEHB-01-123	14-Aug-01	39 36.00	74 16.33	8.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-124	14-Aug-01	39 36.25	74 16.65	8.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-125	14-Aug-01	39 36.50	74 16.97	4.0	0.00	n/a	50.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-126	14-Aug-01	39 36.25	74 17.29	7.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-127	14-Aug-01	39 36.00	74 16.97	8.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-128	14-Aug-01	39 35.75	74 16.65	9.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-129	14-Aug-01	39 35.50	74 16.33	7.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-130	14-Aug-01	39 35.25	74 16.01	4.0	0.43	89.1	18.37	0.00	0.00	0.00	100.00	0	0
LEHB-01-131	14-Aug-01	39 35.25	74 16.65	7.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-132	14-Aug-01	39 35.50	74 16.97	9.0	0.02	96.0	83.33	0.00	0.00	0.00	100.00	0	0
LEHB-01-133	14-Aug-01	39 35.75	74 17.29	8.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-134	14-Aug-01	39 36.00	74 17.61	8.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-135	14-Aug-01	39 36.00	74 18.26	6.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-136	14-Aug-01	39 35.75	74 17.94	7.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-137	21-Aug-01	39 31.709	74 17.813	10.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	+
LEHB-01-138	21-Aug-01	39 32.50	74 17.61	4.0	0.07	62.0	25.00	0.00	66.67	0.00	33.33	0	+
LEHB-01-139	21-Aug-01	39 32.60	74 17.94	4.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-140	21-Aug-01	39 32.50	74 18.26	8.0	0.09	75.0	0.00	0.00	25.00	25.00	50.00	0	0
LEHB-01-141	21-Aug-01	39 32.769	74 16.709	4.0	0.25	77.7	21.43	9.09	18.18	27.27	45.45	0	0

Table 4. Station locations, hard clam abundances, percent mortalities, commercial size class percentages and presence/absence of submerged aquatic vegetation (SAV) for the 2001 hard clam stock assessment of Little Egg Harbor Bay.

Station	Date	Latitude	Longitude	Depth (feet)	*Abundance*$_{adj}$ ** (clams/foot^2)	Mean Length (mm)	Percent Mortality	Percent Sublegals	Percent Littlenecks	Percent Cherrystones	Percent Chowders	SAV[a] present?	*Mytilus* present?
LEHB-01-070	6-Aug-01	39 35.50	74 13.43	9.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-071	6-Aug-01	39 35.25	74 14.07	5.0	0.02	93.0	66.67	0.00	0.00	0.00	100.00	+	0
LEHB-01-072	6-Aug-01	39 35.10	74 14.00	7.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-073	6-Aug-01	39 35.50	74 14.39	6.0	0.14	88.0	64.71	0.00	0.00	16.67	83.33	+	0
LEHB-01-074	6-Aug-01	39 35.50	74 15.03	7.0	0.34	86.0	31.82	6.67	0.00	0.00	93.33	+	0
LEHB-01-075	6-Aug-01	39 35.75	74 14.71	5.0	0.02	87.0	50.00	0.00	0.00	0.00	100.00	+	0
LEHB-01-076	6-Aug-01	39 36.00	74 14.39	5.0	0.08	71.6	27.78	0.00	0.00	71.43	28.57	+	0
LEHB-01-077	6-Aug-01	39 35.75	74 14.07	5.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-078	6-Aug-01	39 36.00	74 13.75	4.0	0.01	57.0	0.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-079	6-Aug-01	39 36.25	74 13.43	5.0	0.05	49.5	0.00	0.00	100.00	0.00	0.00	+	0
LEHB-01-080	6-Aug-01	39 36.538	74 12.575	6.0	0.03	61.5	0.00	0.00	50.00	50.00	0.00	+	0
LEHB-01-081	6-Aug-01	39 37.017	74 12.110	5.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-082	6-Aug-01	39 38.00	74 11.51	4.0	0.07	66.0	25.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-083	6-Aug-01	39 38.25	74 11.34	4.0	0.02	72.0	0.00	0.00	0.00	100.00	0.00	*Ruppia* only	0
LEHB-01-084	7-Aug-01	39 37.25	74 12.05	5.0	0.27	64.5	0.00	0.00	8.33	91.67	0.00	+	0
LEHB-01-085	7-Aug-01	39 35.757	74 13.146	12.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-086	7-Aug-01	39 36.25	74 15.35	9.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-087	7-Aug-01	39 35.25	74 15.35	6.0	0.23	89.4	33.33	0.00	0.00	0.00	100.00	+	0
LEHB-01-088	7-Aug-01	39 35.00	74 15.67	7.0	0.30	85.2	13.33	0.00	0.00	23.08	76.92	+	0
LEHB-01-089	7-Aug-01	39 34.758	74 15.219	< 3.0	0.05	69.0	0.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-090	7-Aug-01	39 35.00	74 15.03	5.0	0.02	72.0	16.67	0.00	0.00	50.00	50.00	+	0
LEHB-01-091	7-Aug-01	39 35.25	74 14.71	6.0	0.11	93.0	58.33	0.00	0.00	0.00	100.00	+	0
LEHB-01-092	7-Aug-01	39 34.75	74 14.71	6.0	0.07	74.0	25.00	0.00	0.00	66.67	33.33	+	0
LEHB-01-093	7-Aug-01	39 34.50	74 14.39	5.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-094	7-Aug-01	39 34.77	74 13.87	7.0	0.05	103.5	71.43	0.00	0.00	0.00	100.00	0	0
LEHB-01-095	8-Aug-01	39 35.75	74 15.35	7.0	0.11	93.0	37.50	0.00	0.00	0.00	100.00	0	0
LEHB-01-096	8-Aug-01	39 36.00	74 15.67	8.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-097	8-Aug-01	39 35.50	74 15.67	8.0	0.14	87.0	21.43	0.00	0.00	0.00	100.00	0	0
LEHB-01-098	8-Aug-01	39 34.50	74 17.61	7.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-099	8-Aug-01	39 34.25	74 17.29	6.0	0.06	93.6	28.57	0.00	0.00	0.00	100.00	0	0
LEHB-01-100	8-Aug-01	39 34.25	74 17.94	6.0	0.10	94.3	75.00	0.00	0.00	0.00	100.00	0	0
LEHB-01-101	8-Aug-01	39 34.25	74 18.58	6.0	0.23	87.0	50.00	0.00	0.00	0.00	100.00	0	0
LEHB-01-102	8-Aug-01	39 33.80	74 18.60	4.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-103	8-Aug-01	39 34.00	74 18.90	6.0	0.20	87.3	28.00	0.00	0.00	5.56	94.44	0	0
LEHB-01-104	8-Aug-01	39 33.999	74 17.670	< 3.0	0.14	99.5	53.85	0.00	0.00	0.00	100.00	0	0
LEHB-01-105	8-Aug-01	39 34.25	74 16.65	7.0	0.45	86.9	20.00	0.00	2.50	2.50	95.00	+	0

Table 4. Station locations, hard clam abundances, percent mortalities, commercial size class percentages and presence/absence of submerged aquatic vegetation (SAV) for the 2001 hard clam stock assessment of Little Egg Harbor Bay.

Station	Date	Latitude	Longitude	Depth (feet)	*Abundance* $_{adj}$ ** (clams/foot^2)	Mean Length (mm)	Percent Mortality	Percent Sublegals	Percent Littlenecks	Percent Cherrystones	Percent Chowders	SAV$^{\Delta}$ present?	*Mytilus* present?
LEHB-01-034	7-Aug-01	39 37.00	74 15.03	6.0	0.01	99.0	83.34	0.00	0.00	0.00	100.00	0	0
LEHB-01-035	17-Jul-01	39 36.75	74 15.35	6.0	0.05	90.0	83.33	0.00	0.00	0.00	100.00	0	0
LEHB-01-036	17-Jul-01	39 37.00	74 15.67	5.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-037	17-Jul-01	39 37.25	74 15.35	5.0	0.02	84.0	75.00	0.00	0.00	0.00	100.00	+	0
LEHB-01-038	17-Jul-01	39 37.25	74 15.03	8.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-039	17-Jul-01	39 37.730	74 15.266	4.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-040	17-Jul-01	39 38.25	74 14.71	5.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-041	17-Jul-01	39 38.25	74 14.07	3.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-042	17-Jul-01	39 38.50	74 14.39	6.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-043	17-Jul-01*	39 38.50	74 13.75	5.0	0.03	85.0	81.25	0.00	0.00	0.00	100.00	0	0
LEHB-01-044	17-Jul-01	39 38.50	74 13.11	9.0	0.25	73.6	0.00	0.00	0.00	72.73	27.27	0	0
LEHB-01-045	2-Aug-01	39 38.25	74 12.15	4.0	0.02	66.0	66.67	0.00	0.00	100.00	0.00	+	0
LEHB-01-046	2-Aug-01	39 38.00	74 12.00	4.0	0.03	70.5	66.67	0.00	0.00	100.00	0.00	+	0
LEHB-01-047	2-Aug-01	39 38.00	74 12.47	4.0	0.07	61.0	0.00	0.00	33.33	66.67	0.00	+	0
LEHB-01-048	2-Aug-01	39 37.75	74 12.79	4.0	0.05	66.0	0.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-049	2-Aug-01	39 37.50	74 13.11	5.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-050	2-Aug-01	39 37.25	74 13.43	5.0	0.11	72.6	44.44	0.00	0.00	60.00	40.00	+	0
LEHB-01-051	2-Aug-01	39 37.00	74 13.75	6.0	0.02	84.0	33.33	0.00	33.33	66.67	0.00	+	0
LEHB-01-052	2-Aug-01	39 37.50	74 12.47	5.0	0.07	70.0	40.00	0.00	33.33	33.33	33.33	+	0
LEHB-01-053	2-Aug-01	39 37.50	74 12.15	4.0	0.05	72.8	71.43	0.00	0.00	75.00	25.00	0	0
LEHB-01-054	2-Aug-01	39 37.75	74 12.15	4.0	0.39	65.8	5.56	0.00	11.76	88.24	0.00	+	0
LEHB-01-055	2-Aug-01	39 37.85	74 11.80	4.0	0.02	75.0	50.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-056	3-Aug-01	39 37.75	74 13.43	4.0	0.02	63.0	0.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-057	3-Aug-01	39 37.25	74 12.79	5.0	0.11	42.0	50.00	0.00	0.00	60.00	40.00	+	0
LEHB-01-058	3-Aug-01	39 37.00	74 13.11	5.0	0.05	76.5	50.00	0.00	0.00	50.00	50.00	+	0
LEHB-01-059	3-Aug-01	39 36.75	74 13.43	5.0	0.06	53.4	0.00	0.00	80.00	20.00	0.00	+	0
LEHB-01-060	3-Aug-01	39 36.50	74 13.11	6.0	0.16	77.6	12.50	0.00	14.29	14.29	71.43	+	0
LEHB-01-061	3-Aug-01	39 36.25	74 14.07	4.0	0.10	72.4	29.17	0.00	0.00	62.50	37.50	+	0
LEHB-01-062	3-Aug-01*	39 36.25	74 14.71	4.0	0.01	90.0	0.00	0.00	0.00	0.00	100.00	+	0
LEHB-01-063	7-Aug-01	39 36.00	74 15.03	6.0	0.06	89.3	55.00	0.00	0.00	0.00	100.00	+	0
LEHB-01-064	6-Aug-01	39 37.70	74 11.80	18.0	0.20	70.3	10.00	0.00	0.00	100.00	0.00	0	0
LEHB-01-065	6-Aug-01	39 37.00	74 12.40	4.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-066	6-Aug-01	39 36.75	74 12.79	4.0	0.07	57.0	40.00	0.00	33.33	66.67	0.00	+	0
LEHB-01-067	6-Aug-01	39 36.00	74 13.11	4.0	0.07	77.0	50.00	0.00	0.00	66.67	33.33	+	0
LEHB-01-068	6-Aug-01	39 35.75	74 13.43	4.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-069	6-Aug-01	39 35.50	74 13.75	10.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0

Table 4. Station locations, hard clam abundances, percent mortalities, commercial size class percentages and presence/absence of submerged aquatic vegetation (SAV) for the 2001 hard clam stock assessment of Little Egg Harbor Bay.

Station	Date	Latitude	Longitude	Depth (feet)	*Abundance*$_{adj}$ ** (clams/foot^2)	Mean Length (mm)	Percent Mortality	Percent Sublegals	Percent Littlenecks	Percent Cherrystones	Percent Chowders	SAV[a] present?	*Mytilus* present?
LEHB-01-001	16-Jul-01	39 39.75	74 12.79	5.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-002	16-Jul-01	39 39.50	74 12.79	6.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-003	16-Jul-01	39 39.25	74 12.79	5.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-004	16-Jul-01	39 39.00	74 12.79	5.0	0.02	63.0	0.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-005	2-Aug-01	39 39.25	74 12.15	4.0	0.05	36.0	50.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-006A	16-Jul-01	39 39.713	74 12.518	6.0	0.02	69.0	0.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-006B	2-Aug-01	39 39.70	74 12.47	11.0	0.02	66.0	0.00	0.00	0.00	100.00	0.00	0	0
LEHB-01-007	16-Jul-01	39 39.50	74 12.47	4.0	0.02	69.0	0.00	0.00	0.00	100.00	0.00	0	0
LEHB-01-008	16-Jul-01	39 39.00	74 12.47	5.0	0.02	66.0	0.00	0.00	0.00	100.00	0.00	0	0
LEHB-01-009	2-Aug-01	39 38.75	74 12.15	4.0	0.08	55.5	0.00	0.00	50.00	50.00	0.00	+	0
LEHB-01-010	2-Aug-01	39 38.75	74 11.51	3.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-011	16-Jul-01	39 38.976	74 11.405	13.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-011.5	2-Aug-01	39 39.05	74 11.30	14.0	0.18	64.1	11.11	0.00	25.00	62.50	12.50	0	0
LEHB-01-012	16-Jul-01	39 39.286	74 11.429	13.0	0.43	62.4	0.00	0.00	15.79	78.95	5.26	0	0
LEHB-01-012.5	2-Aug-01	39 39.25	74 11.35	4.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	*Ruppia* only	0
LEHB-01-013	16-Jul-01	39 39.00	74 11.19	18.0	0.75	70.9	10.81	0.00	3.03	66.67	30.30	0	0
LEHB-01-014	16-Jul-01	39 38.501	74 11.242	9.0	0.05	73.5	0.00	0.00	0.00	50.00	50.00	0	0
LEHB-01-015	2-Aug-01	39 38.50	74 11.83	3.0	0.11	60.6	44.44	0.00	20.00	80.00	0.00	+	0
LEHB-01-016	2-Aug-01	39 38.50	74 12.47	5.0	0.07	73.0	0.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-017	17-Jul-01	39 38.75	74 14.07	6.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-018	17-Jul-01*	39 38.25	74 13.43	5.0	0.08	64.3	25.00	0.00	42.86	42.86	14.29	+	0
LEHB-01-019	3-Aug-01	39 38.100	74 12.966	3.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-020	17-Jul-01	39 38.00	74 13.75	5.0	0.02	51.0	0.00	0.00	100.00	0.00	0.00	+	0
LEHB-01-021	17-Jul-01	39 37.50	74 13.75	6.0	0.05	88.5	33.33	0.00	0.00	0.00	100.00	+	0
LEHB-01-022	17-Jul-01	39 37.75	74 14.07	5.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-023	17-Jul-01	39 38.00	74 14.39	5.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0	0
LEHB-01-024	3-Aug-01	39 37.50	74 14.39	4.0	0.02	79.5	50.00	0.00	0.00	50.00	50.00	+	0
LEHB-01-025	17-Jul-01	39 37.75	74 14.71	5.0	0.00	n/a	100.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-026	17-Jul-01	39 37.25	74 14.71	5.0	0.05	78.0	71.43	0.00	0.00	50.00	50.00	+	0
LEHB-01-027	17-Jul-01	39 36.75	74 14.71	6.0	0.07	77.0	50.00	0.00	0.00	66.67	33.33	0	0
LEHB-01-028	17-Jul-01	39 36.50	74 15.03	6.0	0.00	n/a	0.00	0.00	0.00	0.00	0.00	+	0
LEHB-01-029	17-Jul-01	39 37.00	74 14.39	6.0	0.09	84.0	20.00	0.00	0.00	0.00	100.00	0	0
LEHB-01-030	17-Jul-01	39 37.25	74 14.07	5.0	0.11	82.8	28.57	0.00	0.00	20.00	80.00	+	0
LEHB-01-031	17-Jul-01	39 36.75	74 14.07	5.0	0.07	71.0	0.00	0.00	0.00	100.00	0.00	+	0
LEHB-01-032	17-Jul-01	39 36.50	74 13.75	4.0	0.09	66.8	55.56	0.00	0.00	100.00	0.00	+	0
LEHB-01-033	17-Jul-01	39 36.50	74 14.39	5.0	0.18	70.9	38.46	0.00	12.50	50.00	37.50	+	0

Table 6. 2001 Little Egg Harbor Bay hard clam stock estimates, means, standard deviations and standard errors by commercial size class.

LITTLE EGG HARBOR BAY COMMERCIAL SIZE CLASS ABUNDANCES				
	Sublegals	Littlenecks	Cherrystones	Chowders
Clams	1,088,308	6,130,523	14,614,435	42,970,475
Mean*	13,272	74,762	178,225	524,030
St. Dev.	55,942	223,890	335,509	1,520,252
St. Error	6,178	24,724	37,051	167,884
Percent of Total	1.7%	9.5%	22.6%	66.3%

* Mean is the average of all values used in grand sum of clams.

Sublegals: 30-37 mm; Littlenecks: 38-55 mm; Cherrystones: 56-76 mm; Chowders: >76 mm.

Difference in estimates between this table and text on page 9 of report are due to rounding and averaging.

Table 7. *Comparison of the number and percent of stations sampled in 1986/87 and 2001 with no hard clams, low, moderate and high abundances of hard clams.*

Bay	Year	**Number** of stations with no clams	**Number** of stations with **low** abundances of hard clams	**Number** of stations with **moderate** abundances of hard clams	**Number** of stations with **high** abundances of hard clams	*Total*
Little Egg Harbor Bay	1986/87	6	95	56	32	189
Little Egg Harbor Bay	2001	68	99	23	4	194

Bay	Year	**Percent** of stations with no clams	**Percent** of stations with **low** abundances of hard clams	**Percent** of stations with **moderate** abundances of hard clams	**Percent** of stations with **high** abundances of hard clams
Little Egg Harbor Bay	1986/87	3.2	50.3	29.6	16.9
Little Egg Harbor Bay	2001	35.1	51.0	11.9	2.1

Low abundance: 0.01-.019 clams foot^{-2}; moderate abundance: 0.20-0.49 clams foot^{-2}; high abundance: $\geq$ 0.50 clams foot^{-2}.

Table 10. Comparison of 1986/87 and 2001 recruitment and mortality indices for Little Egg Harbor Bay.

Little Egg Harbor Bay 2001		
Statistic	Recruitment (%)	Mortality (%)
Average	1.2	39.7
Minimum	0.0	0.0
Maximum	12.1	100.0
Standard Deviation	3.1	39.0
Count (n)	27	194

Little Egg Harbor Bay 1986/87		
Statistic	Recruitment (%)	Mortality (%)
Average	3.9	11.6
Minimum	0.0	0.0
Maximum	34.6	100.0
Standard Deviation	5.3	13.8
Count (n)	88	189

Table 12. Average, minimum and maximum abundance of species collected during the 2001 hard clam inventory of Little Egg Harbor Bay.

Species	Abundance*				
	Average	Minimum	Maximum	SD **	No. of "+" ***
Aequipecten irradians	N/A ****	0.00	0.00	N/A	0
Anadara ovalis	0.07	0.01	0.42	0.07	0
Arbacia punctulata	N/A	0.00	0.00	N/A	0
Asterias forbesi	0.02	0.02	0.02	0.02	0
Busycon carica	0.02	0.01	0.07	0.02	0
Busycotypus canaliculatus	0.01	0.01	0.01	0.01	0
Callinectes sapidus	0.02	0.01	0.04	0.02	0
Cancer borealis	N/A	0.00	0.00	N/A	0
Cancer irroratus	0.30	0.02	1.04	0.30	0
Crepidula spp.	0.04	0.04	0.04	0.04	11
Ensis directus	0.08	0.01	0.50	0.08	0
Eupleura caudata	N/A	0.00	0.00	N/A	0
Ilyanassa obsoletus	N/A	0.00	0.00	N/A	2
Libinia dubia	0.03	0.03	0.03	0.03	0
Libinia emarginata	0.09	0.01	0.50	0.09	0
Libinia spp.	0.07	0.03	0.10	0.07	0
Limulus polyphemus	0.01	0.01	0.01	0.01	0
Littorina littorea	N/A	0.00	0.00	N/A	0
Lunatia heros	N/A	0.00	0.00	N/A	0
Mulinia lateralis	N/A	0.00	0.00	N/A	0
Mya arenaria	N/A	0.00	0.00	N/A	0
Mytilus edulis	18.03	0.02	162.24	18.03	0
Nassarius trivittatus	N/A	0.00	0.00	N/A	0
Noetia ponderosa	0.03	0.02	0.04	0.03	0
Ovalipes ocellatus	0.04	0.01	0.10	0.04	0
Pagurus spp.	0.02	0.02	0.02	0.02	8
Petricola pholadiformis	N/A	0.00	0.00	N/A	0
Pitar morrhuana	0.04	0.01	0.06	0.04	0
Polinices duplicatus	0.04	0.01	0.10	0.04	0
Retusa spp.	0.01	0.01	0.01	0.01	0
Sclerodactyla briareus	0.03	0.02	0.03	0.03	0
Solemya velum	0.02	0.02	0.03	0.02	26
Spisula solidissima	N/A	0.00	0.00	N/A	0
Squilla empusa	0.02	0.01	0.03	0.02	0
Tagelus spp.	0.02	0.02	0.03	0.02	4
Tellina spp.	N/A	0.00	0.00	N/A	2
Urosalpinx cinerea	0.03	0.03	0.03	0.03	0
Xanthidae (Family)	0.03	0.02	0.03	0.03	15

* Abundance = number collected per square foot.

** SD = Standard Deviation.

*** + = Number of stations where species was present (no quantitative description).

**** N/A = Not Available (due to division by 0).

Figure 1. Location of the 2001 shellfish inventory sampling area (Little Egg Harbor Bay, Ocean County, New Jersey).

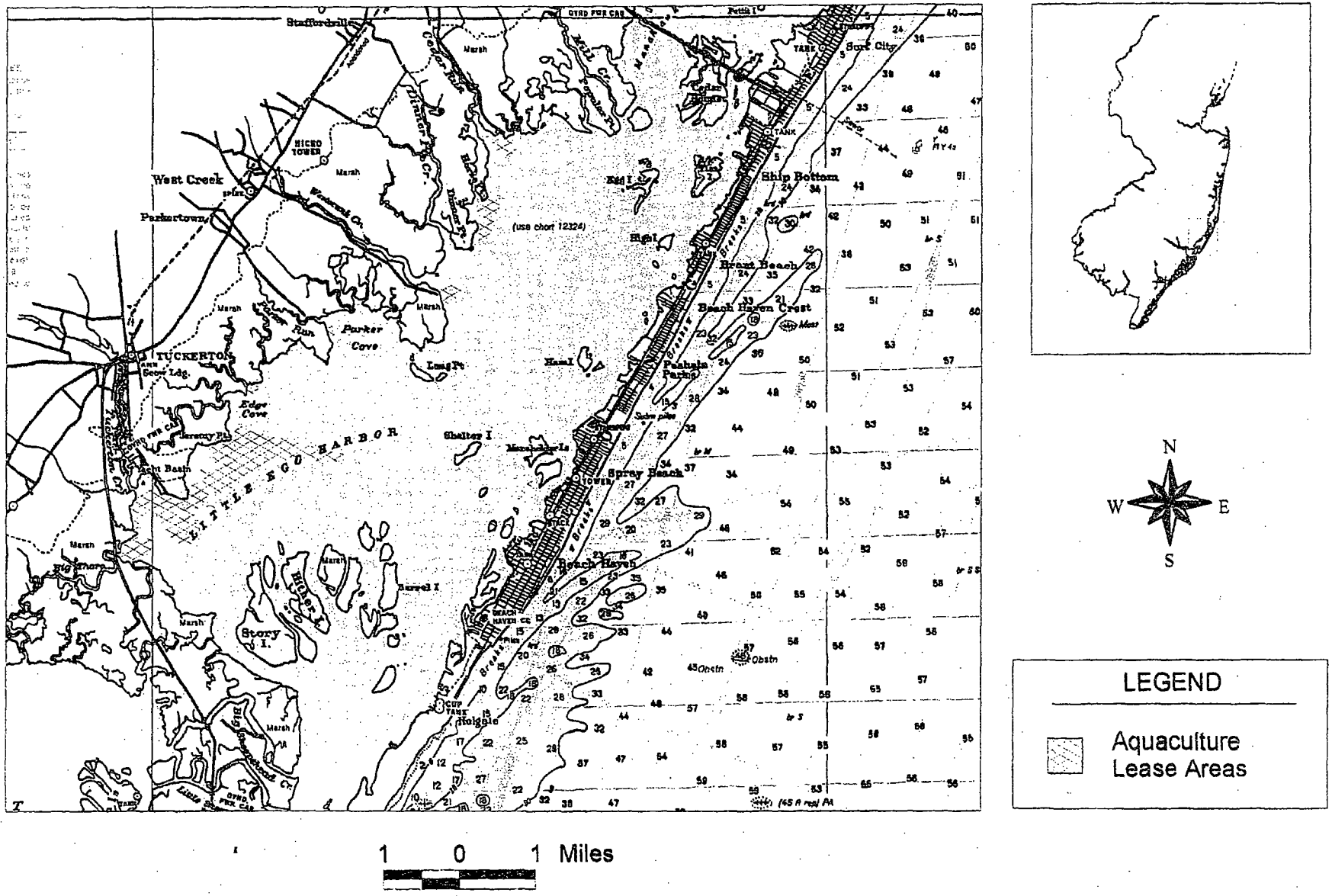


Figure 4. 1986/87 Little Egg Harbor Bay Shellfish Inventory: SAV distribution.

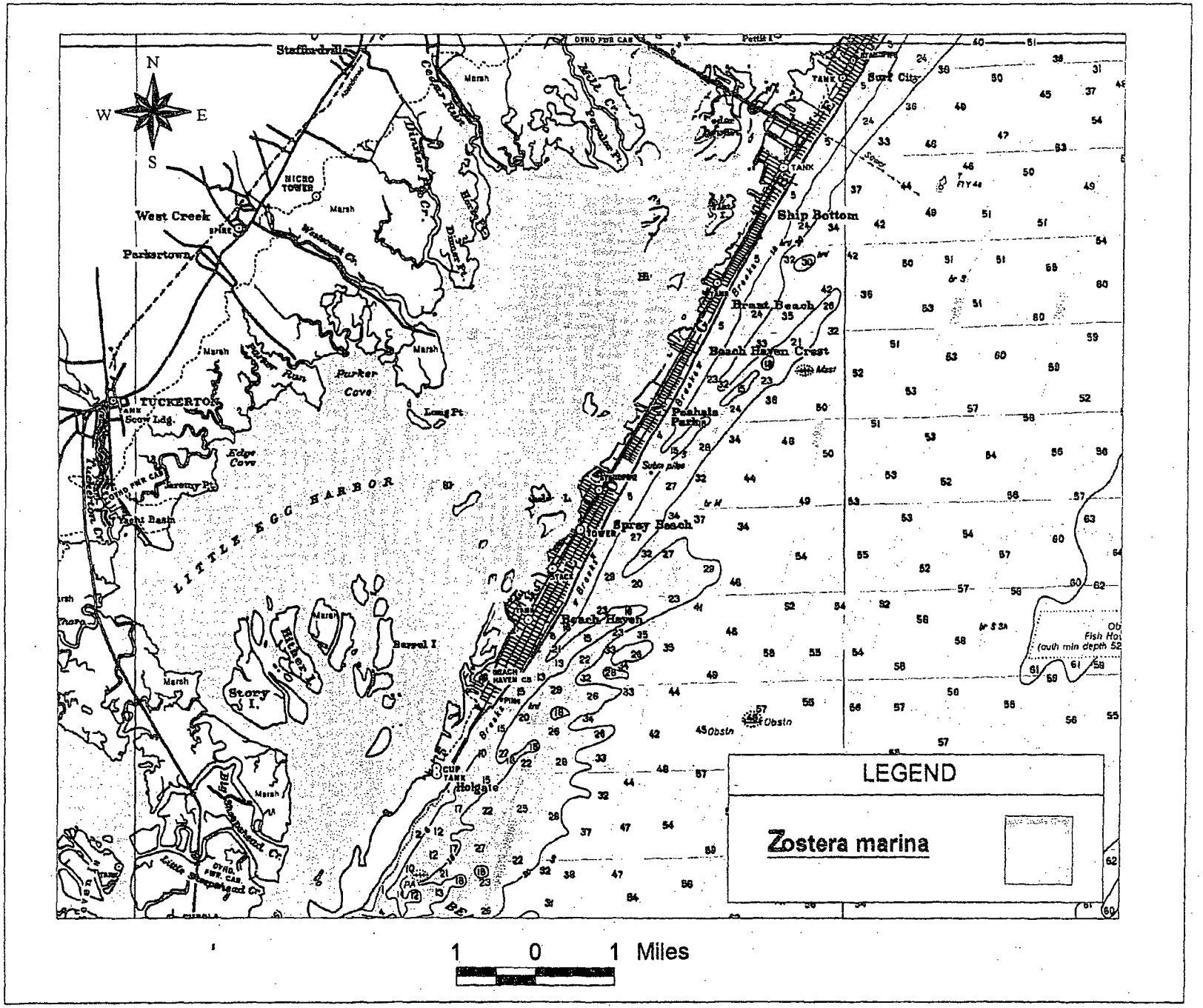


Figure 5. 2001 Little Egg Harbor Bay Shellfish Inventory: SAV distribution.

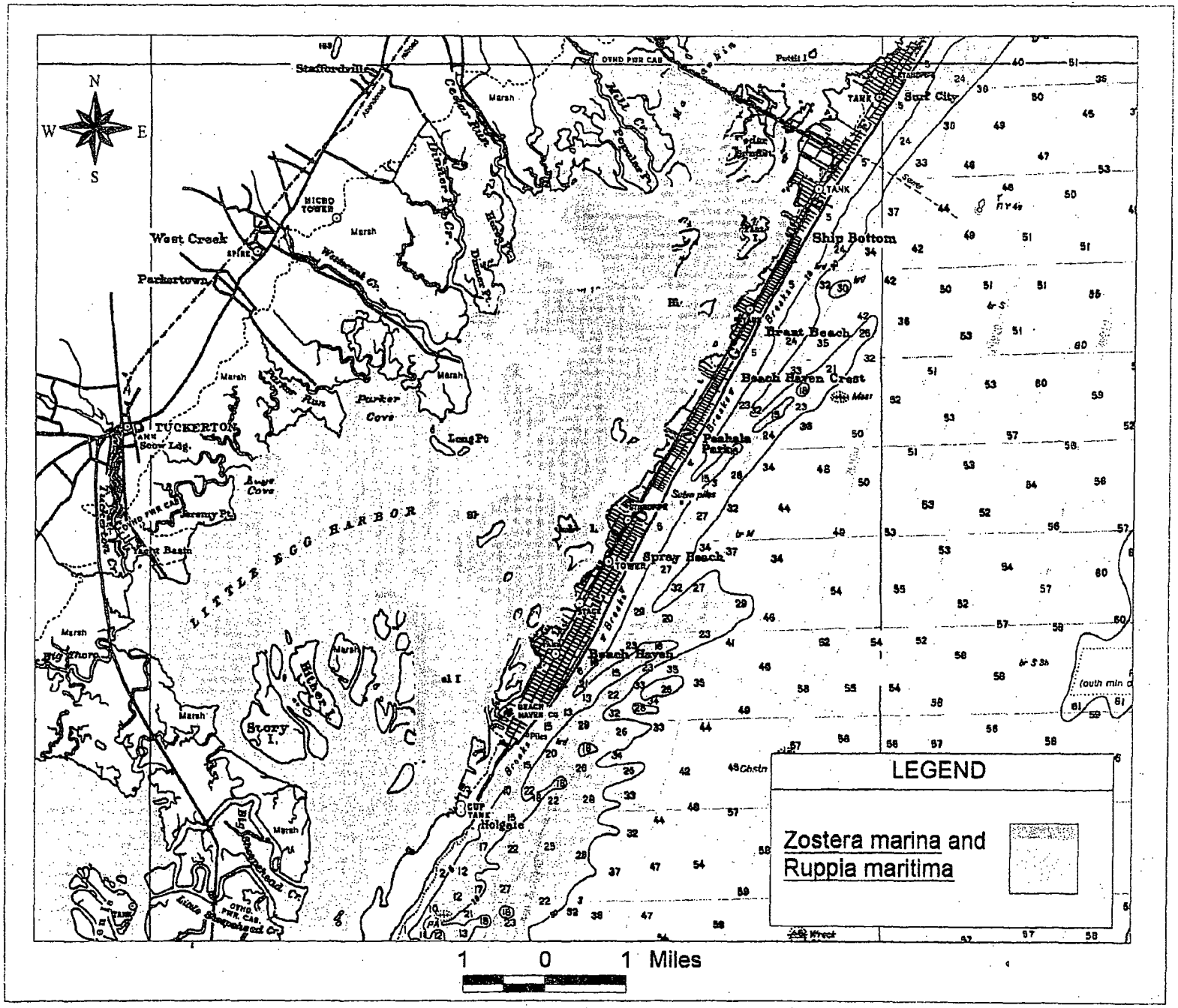


Figure 6. 2001 Little Egg Harbor Bay Shellfish Inventory: station locations.

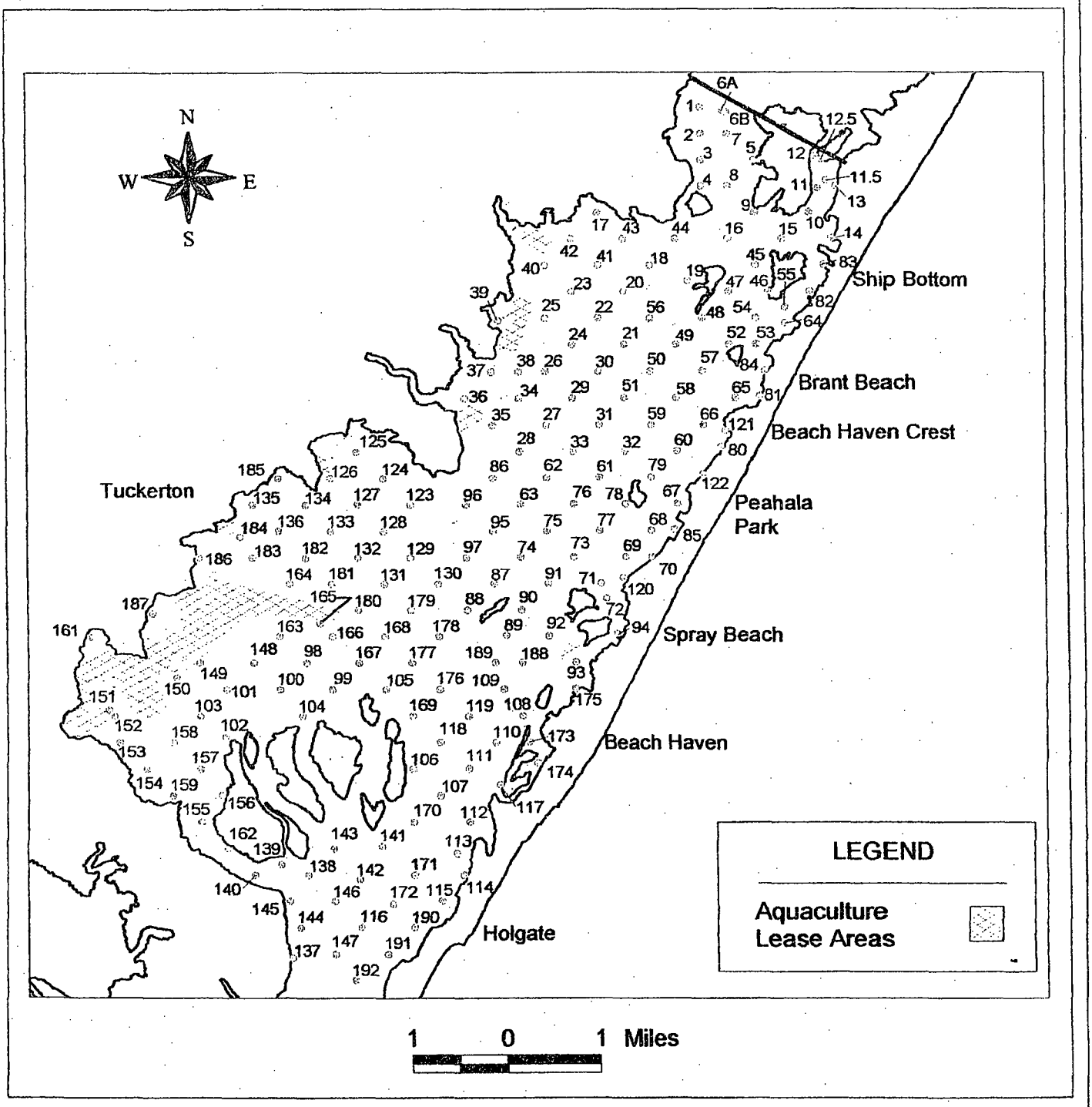


Figure 7. 1986/87 Little Egg Harbor Bay Shellfish Inventory: distribution and abundance of the hard clam, Mercenaria mercenaria.

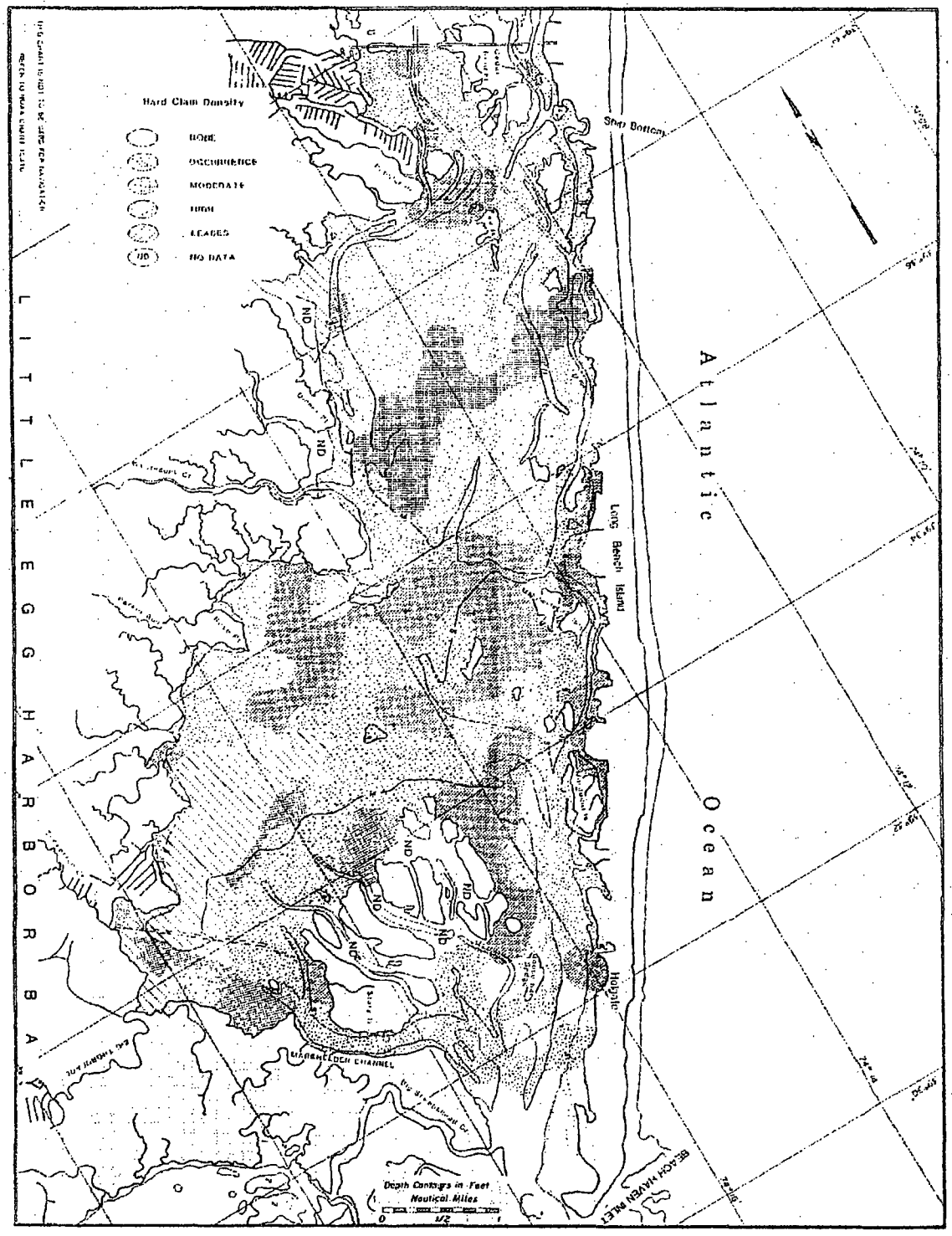


Figure 8. 2001 Little Egg Harbor Bay Shellfish Inventory: distribution and abundance of the hard clam, Mercenaria mercenaria.

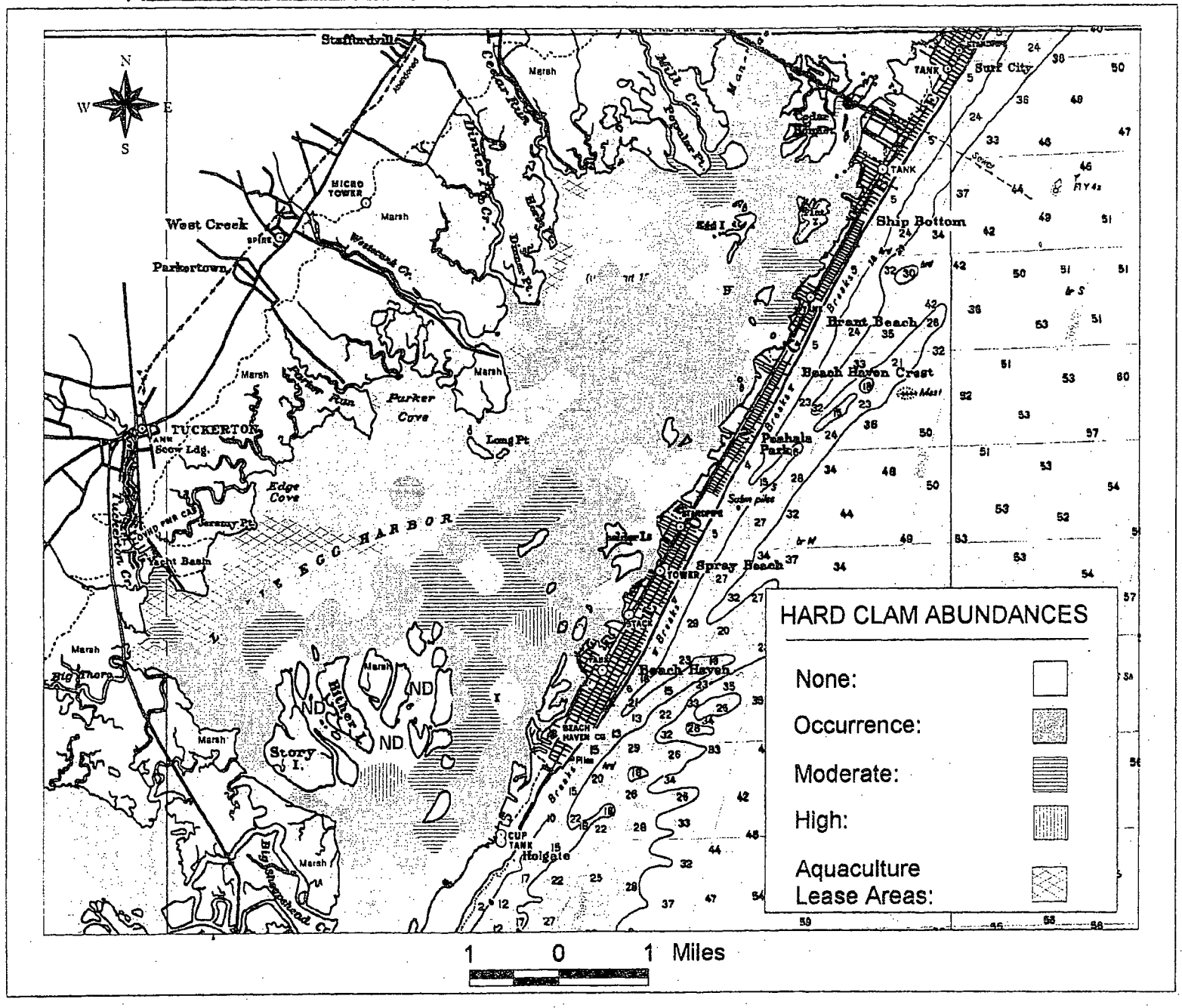


Figure 9. 1986/87 Little Egg Harbor Bay Shellfish Inventory: composite length-percent-frequency distribution graph.

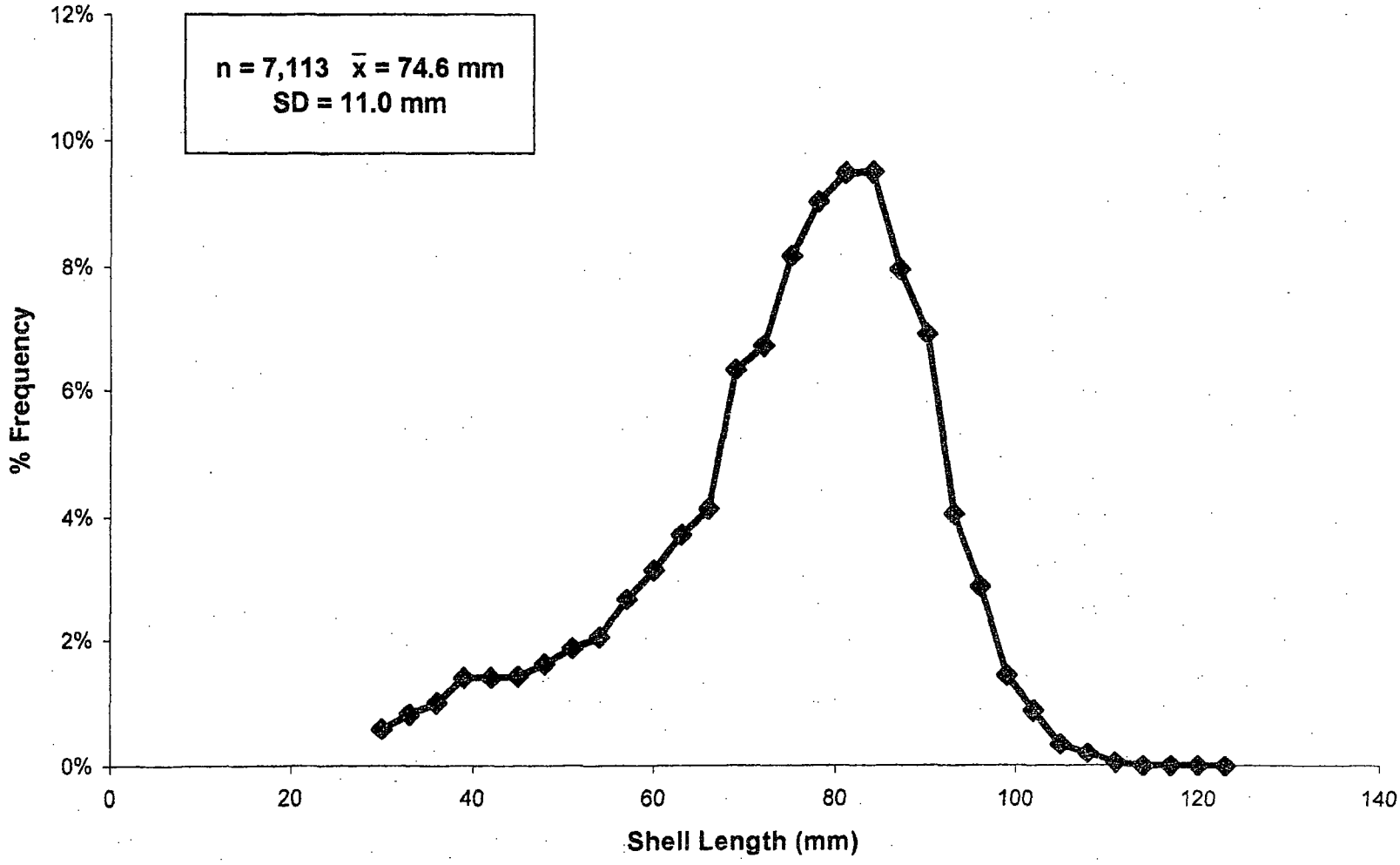


Figure 10. 2001 Little Egg Harbor Bay Shellfish Inventory: composite length-percent-frequency distribution graph.

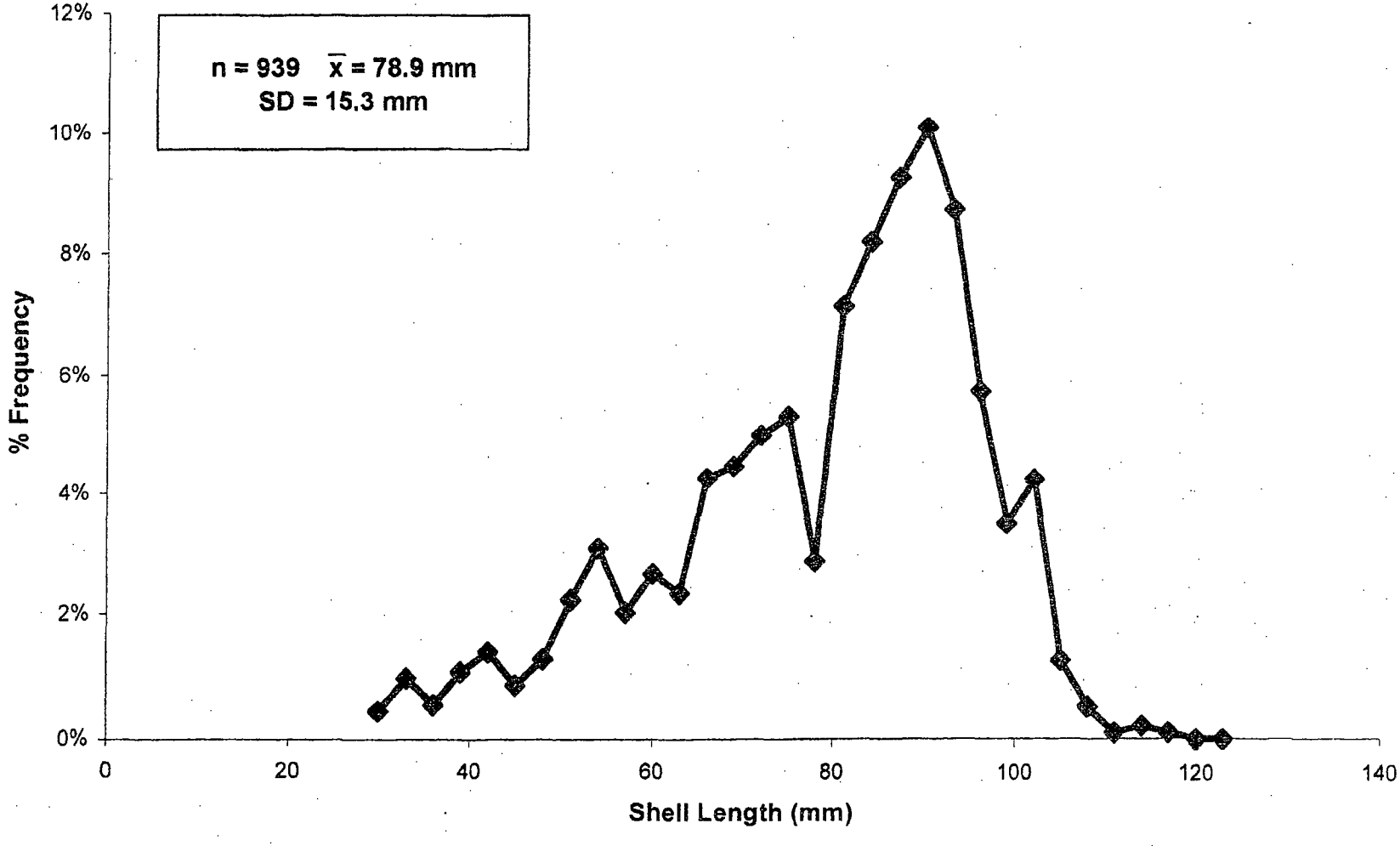


Figure 11. 1988/89 Little Egg Harbor Bay shellfish inventory: recruitment indices (%) at stations with moderate and high abundances of hard clams.

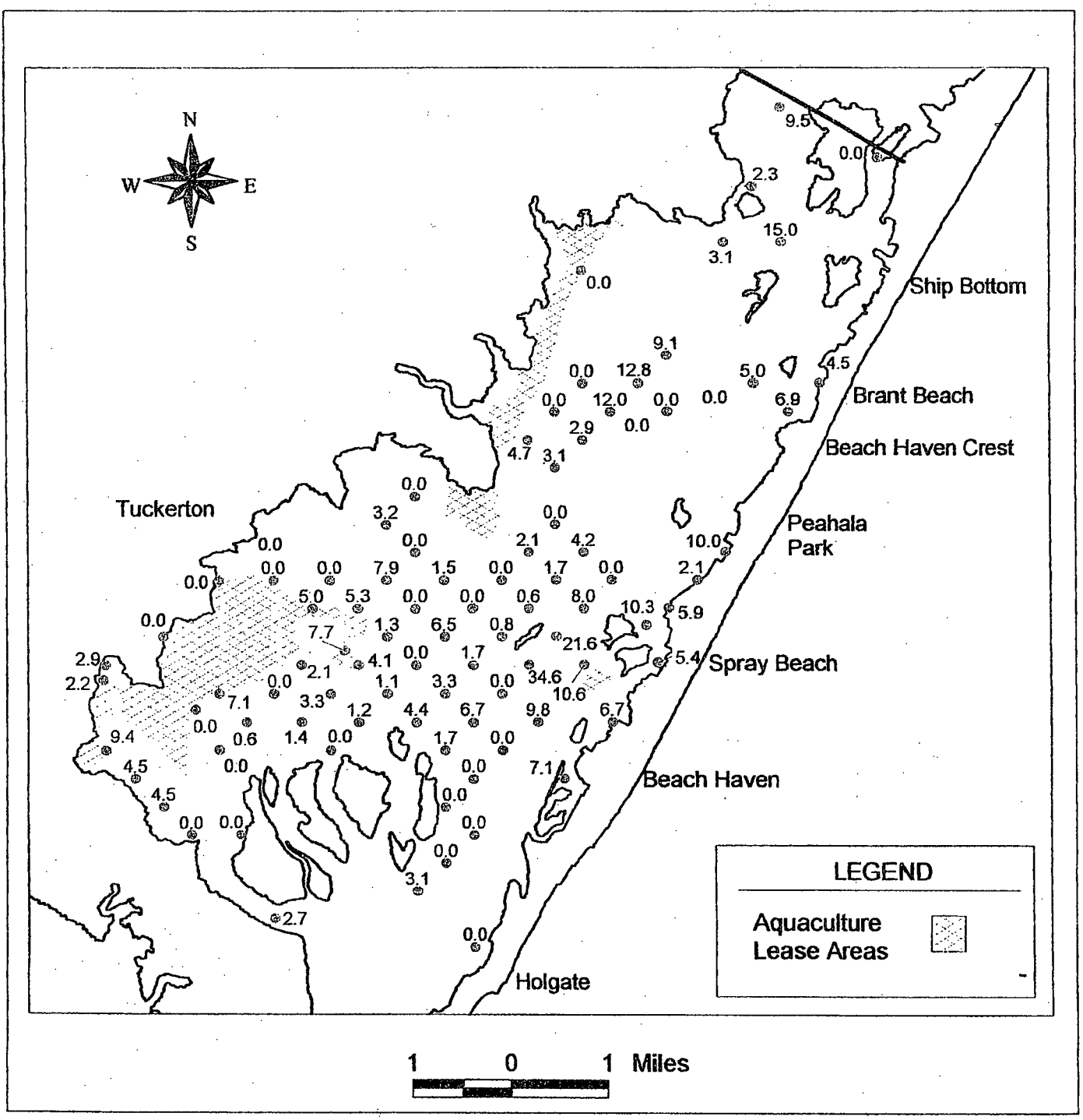


Figure 12. 2001 Little Egg Harbor Bay Shellfish Inventory: Recruitment indices (%) at stations with moderate and high abundances of hard clams.

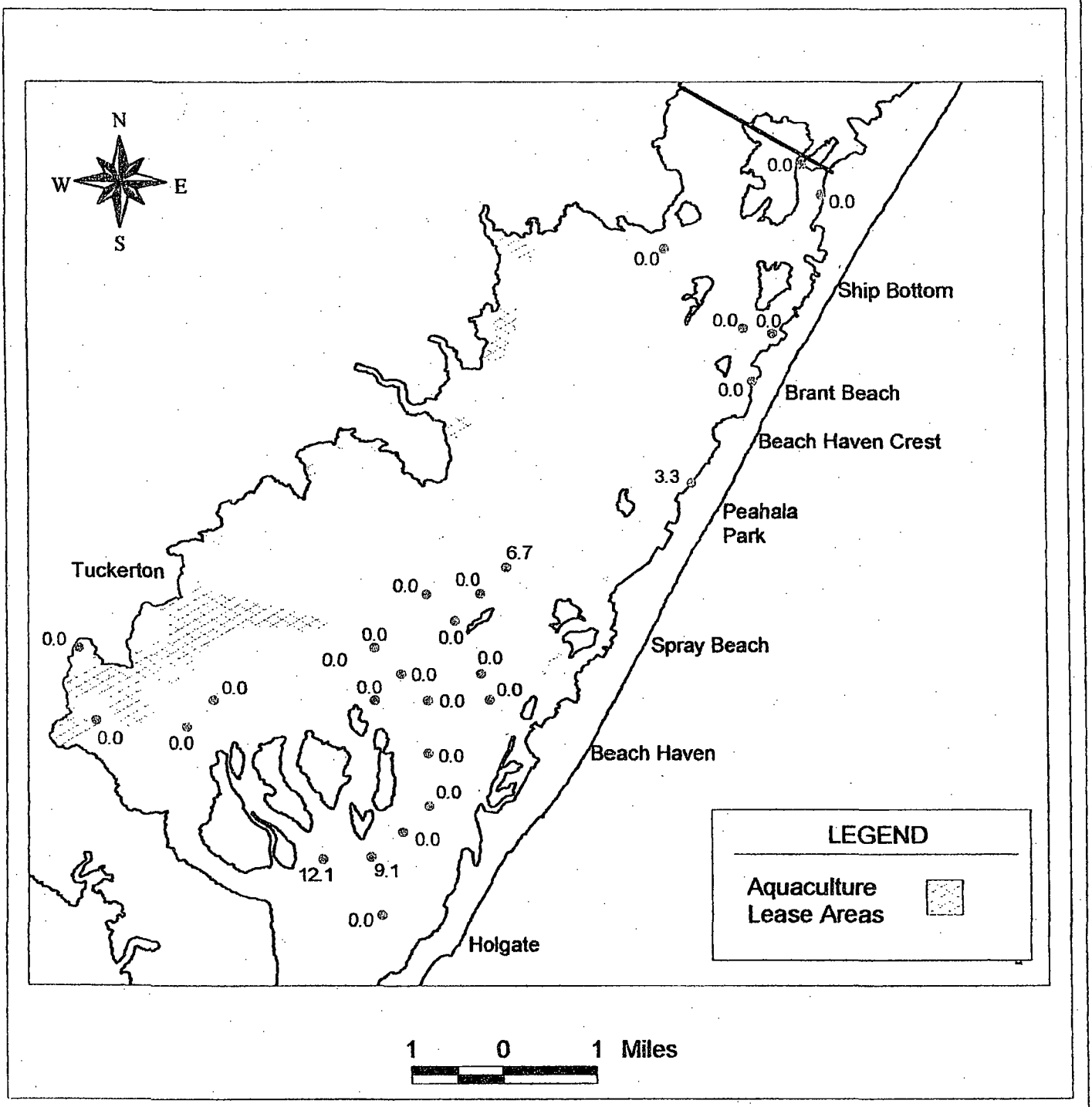


Figure 13a. 1986/87 Little Egg Harbor Bay Shellfish Inventory: mortality indices (%) at all stations (northern Little Egg Harbor Bay).

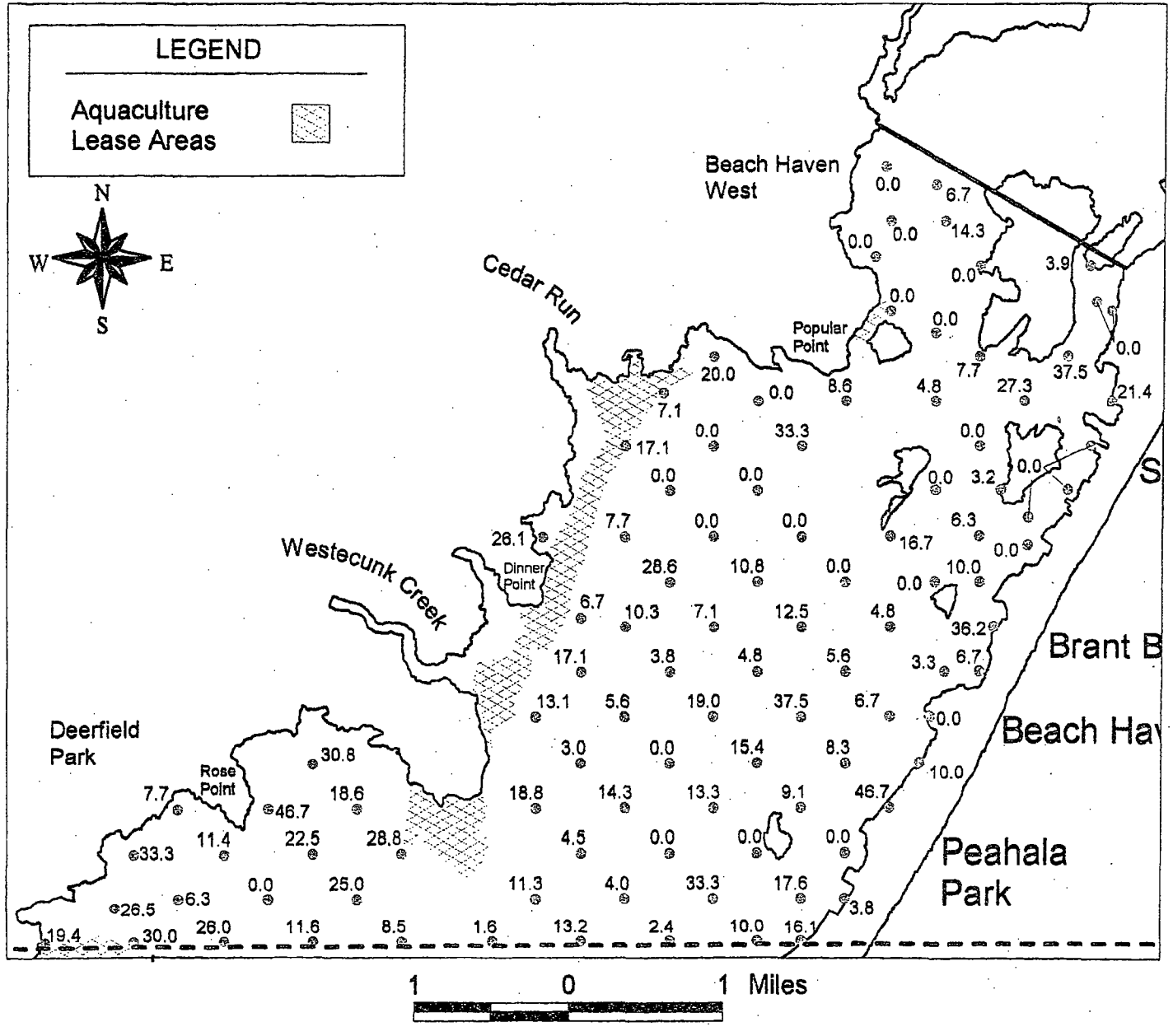


Figure 13b. 1986/87 Little Egg Harbor Bay Shellfish Inventory: mortality indices (%) at all stations (southern Little Egg Harbor Bay).

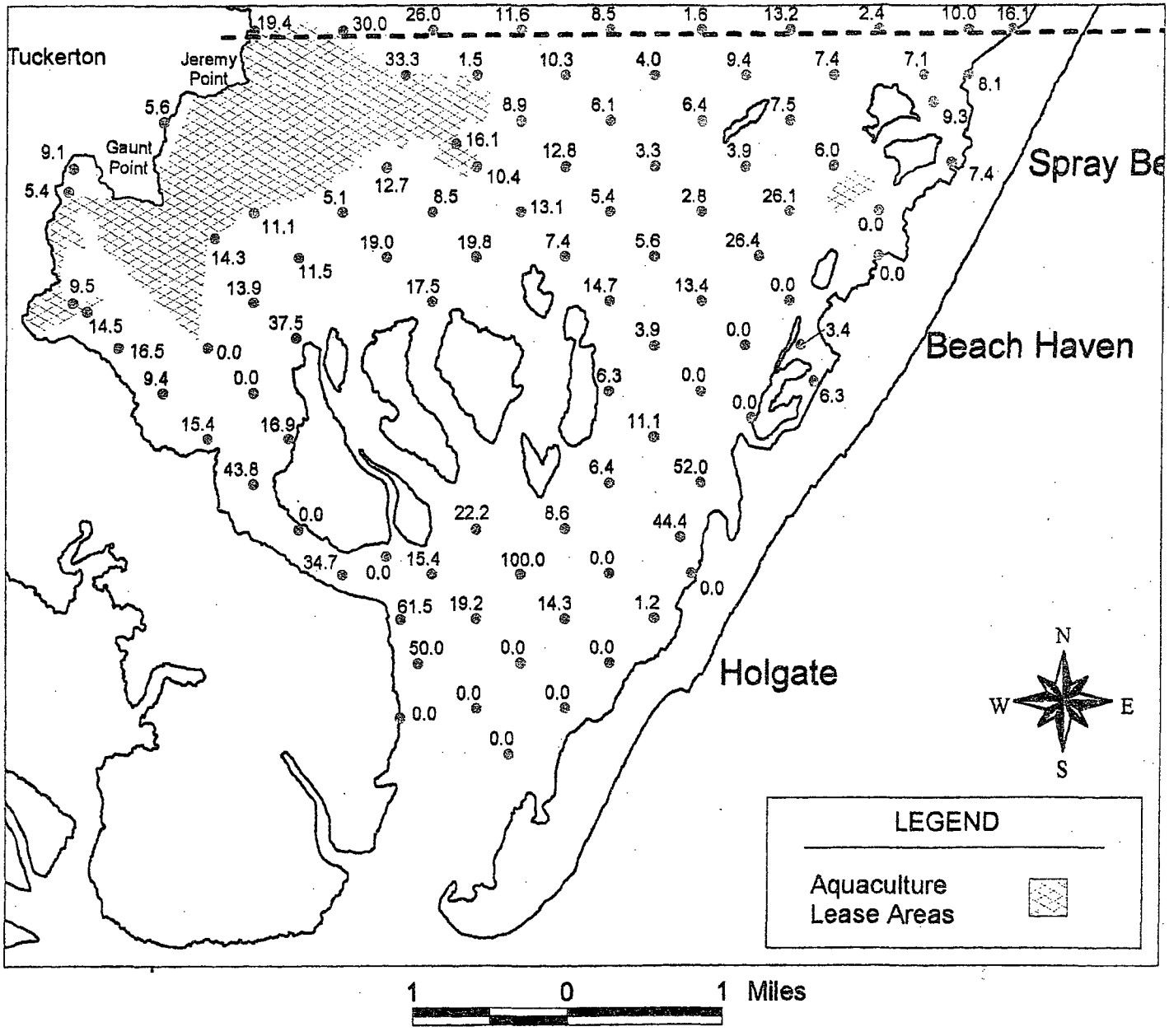


Figure 14a. 2001 Little Egg Harbor Bay Shellfish Inventory: mortality indices (%) at all stations (northern Little Egg Harbor Bay).

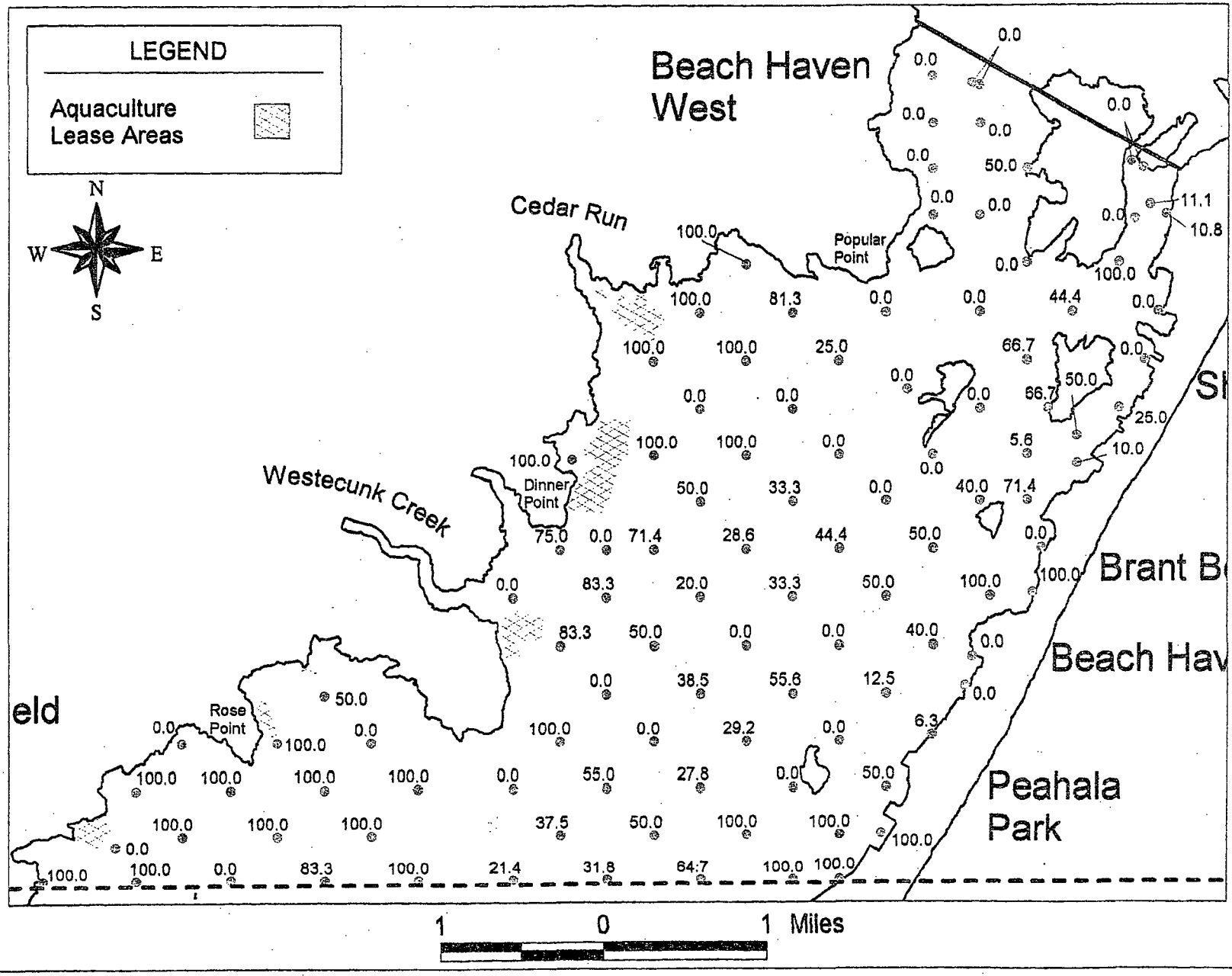


Figure 14b. 2001 Little Egg Harbor Bay Shellfish Inventory: mortality indices (%) at all stations (southern Little Egg Harbor Bay).

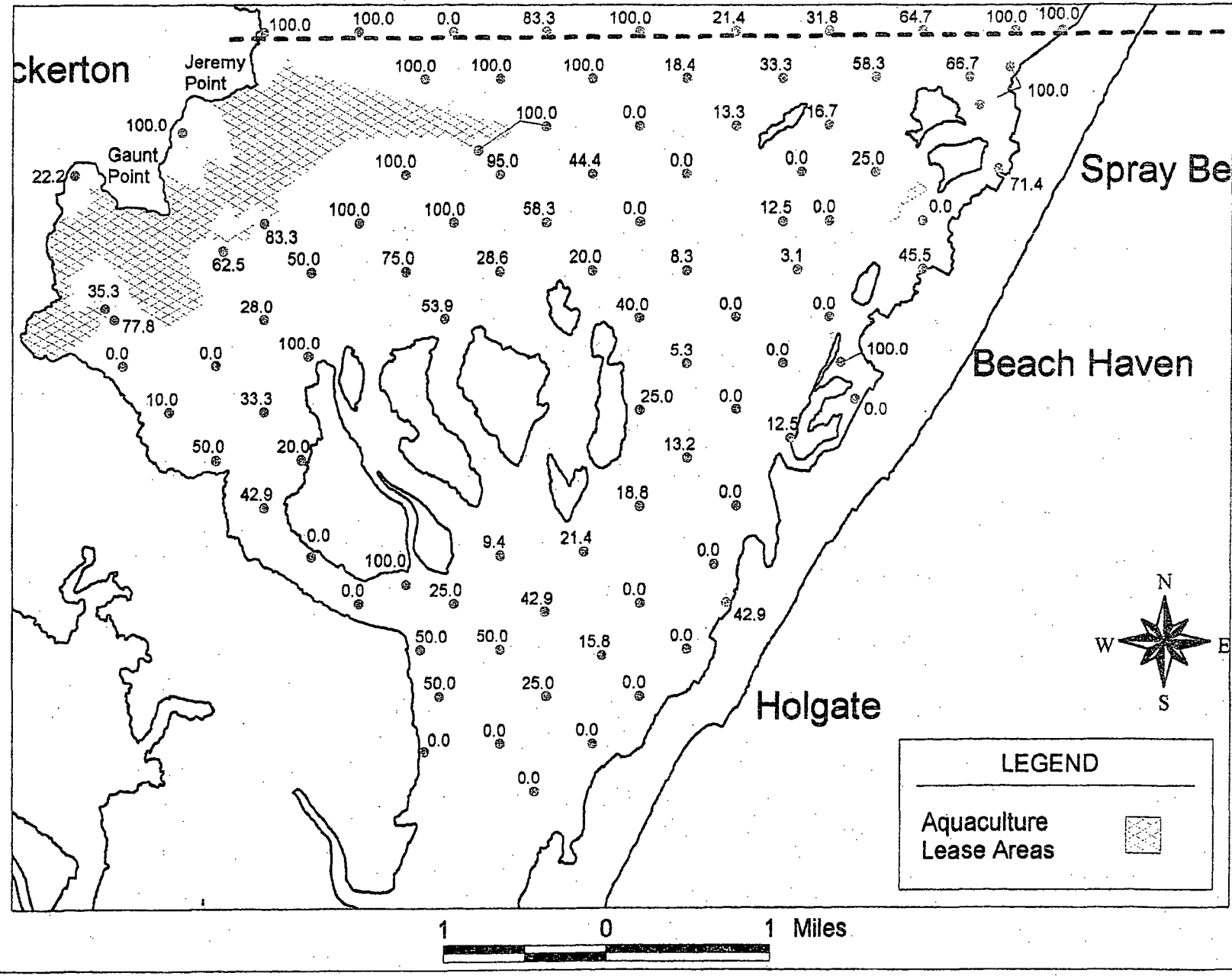


Figure 15. 2001 Little Egg Harbor Bay Shellfish Inventory: distribution of blue mussels, Mytilus edulis.

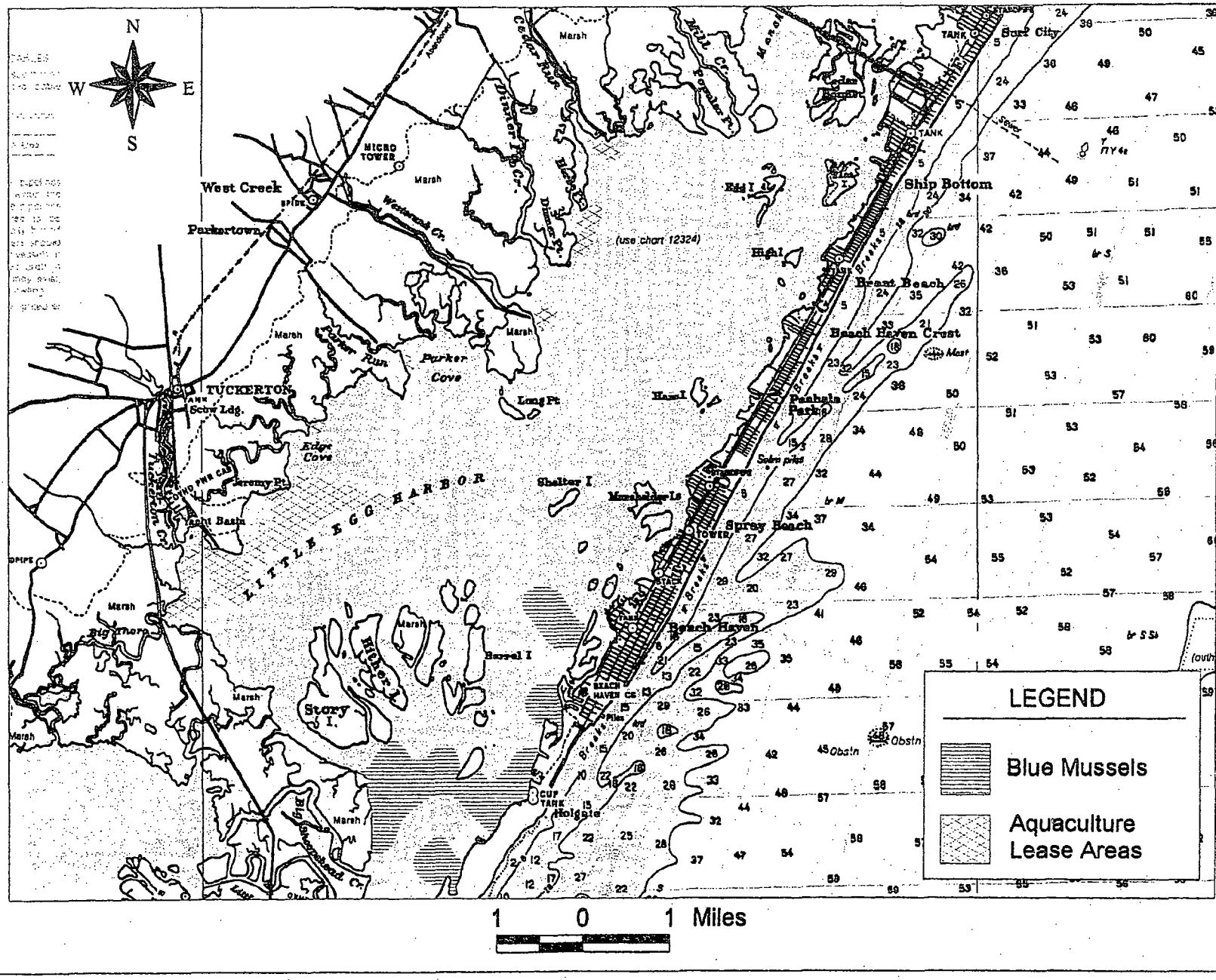
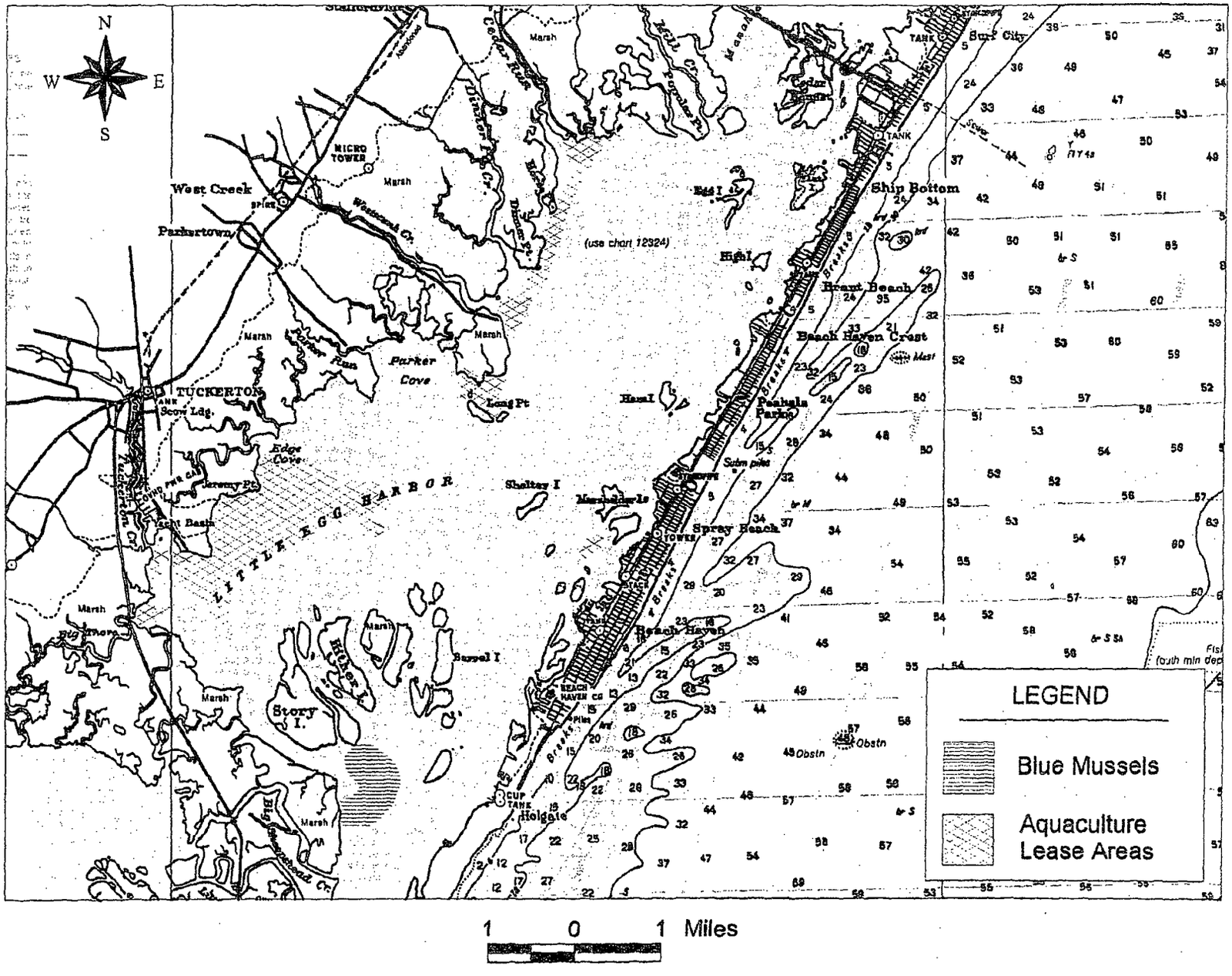


Figure 16. 1986/87 Little Egg Harbor Bay Shellfish Inventory: distribution of blue mussels, Mytilus edulis.



MULLICA RIVER OYSTER SEED BED DATA

1974 - 1986

EAR	MOSS POINT BED						FRENCHES POINT BED					
	BED CONDITION % OYSTER	AGE COMPOSITION OF POPULATION % SPAT	% YEARLING	% OLDER OYSTERS	# SPAT /BUSHEL*	% ANNUAL MORTALITY	BED CONDITION % OYSTER	AGE COMPOSITION OF POPULATION % SPAT	% YEARLING	% OLDER OYSTERS	# SPAT /BUSHEL*	% ANNUAL MORTALIT
974	ND	24.1	15.8	60.1	ND	ND	ND	30.6	25.8	43.6	ND	ND
975	80.9	5.2	25.6	69.2	77	6.4	79.3	3.2	28.1	68.7	53	5.6
976	85.9	0.2	3.2	96.6	2	10.4	91.8	0.3	2.1	97.6	3	5.9
977	67.7	6.0	0.9	93.1	46	24.0	78.7	12.3	3.1	84.6	132	14.4
978	65.3	1.0	4.1	94.9	5	13.7	84.7	8.8	14.7	76.5	80	6.2
979	81.1	62.5	0.8	36.7	1066	4.9	84.2	65.7	0.6	33.7	1635	5.0
980	81.0	3.0	43.9	53.1	13	5.8	91.2	1.0	42.1	56.9	31	1.1
981	56.8	59.1	14.0	26.9	1145	10.2	87.4	30.5	6.3	63.2	384	4.1
982	73.8	8.5	19.8	71.7	80	11.7	94.7	13.3	17.7	68.9	178	2.2
983	81.4	28.9	5.1	66.0	394	11.3	78.2	18.6	13.0	68.4	245	11.9
984	94.8	1.7	7.3	91.0	21	1.7	85.3	1.7	12.3	86.0	21	3.0
985	65.5	39.3	0.7	60.0	235	36.6	65.8	59.7	3.0	37.3	675	34.6
986	10.4	33.3	30.8	35.9	74	62.1	45.2	21.2	54.0	24.8	262	26.5

ND - No Data Available
*37 qt./bushel

Source: Nacote Creek Shellfish Office Records