Peconic Estuary Program 2004 Eelgrass (*Zostera marina*) Long-Term Monitoring Program

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Summary

The Peconic Estuary Program's Long-Term Eelgrass Monitoring Program was continued by Cornell Cooperative Extension's Marine Program in 2004. The six monitoring beds were sampled during the period of 15 August 2004 to 22 August 2004. Divers conducted 60 quadrat counts of eelgrass shoot density and macroalgae percent cover at each monitoring site. Temperature data from data loggers and PEP Routine Marine Surface Water Monitoring Program were analyzed to elucidate differences in surface versus bottom temperatures and annual temperature trends. Significant changes in the general health and extent of the six monitoring sites were observed in 2004. Nine out of a total of 36 stations (6 stations per each of the 6 sites) no longer supported eelgrass within the 10 m of the station coordinates. Macroalgal percent cover has remained stable or declined in a majority of the monitoring sites. Areal extent has declined significantly in Bullhead Bay, Orient Harbor and Three Mile Harbor, with Southold Bay having experienced minor loss in area, but no noticeable retreat in its deep edge. The temperature data found little difference between surface and bottom temperature at the sites analyzed, but tracked annual and summer temperature trends well.

The significant decrease in eelgrass shoot densities at Bullhead Bay, Orient Harbor and Three Mile Harbor has been sudden and with little evidence of cause. Losses are not attributed to water quality or macroalgae competition, at this time, as these parameters have maintained healthy levels for several consecutive years. The lack of rhizome/root in the sediment at the sites suggest that physical disturbance was the probable factor in the loss, though the exact mechanism has not been identified. Possible mechanisms include, ice scour, anchor ice, changes in long-shore erosion/deposition patterns, and shellfishing activities. The temperature data was found to be a useful tool for use in monitoring annual trends and identifying localized periods of high water temperature, and it should be continued in subsequent monitoring efforts.

Eelgrass Introduction

The decline of eelgrass (*Zostera marina* L.) in the Peconic Estuary over the last 70 years has contributed to the degradation of the estuary as a whole. This submerged, marine plant is inextricably linked to the health of the Estuary, providing an important habitat in near shore waters for shellfish and finfish and a food source for organisms ranging from bacteria to waterfowl. To better manage this valuable resource, a baseline of data must be collected to identify trends in the health of the eelgrass meadows and plan for future work in the Peconic Estuary, such as conservation/management and restoration activities. The more data that is collected on the basic parameters of eelgrass, the better able the Peconic Estuary Program will be to implement policies to protect and nurture the resource.

The basic purpose of a monitoring program is to collect data on a regularly scheduled basis to develop a basic understanding of the ecology of the target species. Since its inception, the Peconic Estuary Program's Submerged Aquatic Vegetation Monitoring Program, contracted to Cornell Cooperative Extension's Marine Program, has focused on collecting data pertaining to the health of the eelgrass beds in the Peconic Estuary. The development of this program reflects an adaptation to the unique ecology and demography of the eelgrass in the Peconic estuary and varies significantly from other monitoring programs in the Chesapeake and other areas on the east coast, which tend to focus more on remote sensing techniques (i.e., aerial photography) for monitoring.

Methods

Table 1. The six reference eelgrass beds and the townships in which the beds are located.

Bullhead Bay (BH)	Southampton
Gardiners Bay (GB)	Shelter Island
Northwest Harbor (NWH)	East Hampton
Orient Harbor (OH)	Southold
Southold Bay (SB)	Southold
Three Mile Harbor (TMH)	East Hampton

The PEP SAV Monitoring Program includes six eelgrass beds located throughout the estuary and representing a range of environmental factors. The name and township location of each of the reference beds are listed in Table 1 and an aerial perspective of each site can be found in Appendix 1. Included with each image are the locations of the six sampling stations within the bed and the GPS coordinates for each station.

The monitoring program has evolved its methodologies from its inception in 1997, however, the basic parameter of eelgrass health, shoot density, has always been the focus of the program, thus allowing for comparisons between successive years. In the beginning, sampling consisted of the destructive collection of three (four in Bullhead Bay) 0.25 m^2 (50cm x 50cm) quadrats of eelgrass including below ground and above ground biomass that was returned to the laboratory for analysis. The sampling in 1998 and 1999 continued to utilize destructive sampling to collect data, however, sample size was increased to a total of twelve quadrats and there was a decrease in the size of the quadrats to 0.0625 m^2 (12.5 x 12.5 cm).

In 2000, the methodology for the

monitoring program was amended to increase the statistical significance of the data collected. The adjustments reflected an increase in the number of sampling stations per site (from 3 to 6), the number of replicate samples per station (from 4 to 10) and the size of the quadrats. However, the 2000 methodology included an increase number of destructively sampled quadrats (24 quadrats) for use in biomass estimations. The 2001 protocols maintained the higher number of replicate samples per bed (60 quadrats) but eliminated the destructive sampling aspect of the program. Beginning in 2004, water temperature was collected at several of the monitoring sites using submersible temperature loggers. The specific monitoring protocol for 2004 is outlined below.

Water Quality

Water quality data is supplied by the Suffolk County Department of Health Services. The data represents monthly to bimonthly sampling of various water quality parameters. The nitrogen-based data sets, nitrate/nitrite (NOx), total nitrogen (TN), and total dissolved nitrogen (TDN), were analyzed for stations in or adjacent to the six, long-term monitoring sites and were incorporated into the long-term data set for trend analysis.

Water Temperature Monitoring

In an effort to better describe the relationship between water temperature and the life cycle of eelgrass, temperature loggers were deployed in several eelgrass beds in the Peconics, including 4 of the long-term monitoring sites. When possible, a surface logger (< 0.5 m from the surface) and a bottom logger (anchored to the bottom) were deployed at each site. The loggers were set to record temperature at six-hour intervals.

The following sites have been chosen to pair with the existing PEP Routine Marine Surface Water Monitoring Program (RMSWMP) stations as well as existing eelgrass meadows: 109-Mill Creek (outer channel adjacent to eelgrass meadow), 126-Sag Harbor (outside breakwater adjacent to eelgrass meadow), 148-Bullhead Bay, and 118-Northwest Harbor (in existing eelgrass meadow).

Sites that are not directly associated with current PEP RMSWMP, but are essential based on existing monitoring and restoration efforts include Hallocks Bay (Orient), Hay Beach Point (Shelter Island), Sag Harbor Cove (directly behind Long Beach) and Orient Point (near Cross Island Ferry site).

The loggers, Onset Tidbit® and Onset StowAway®, were deployed in May 2004 and retrieved in September-October 2004, except for the logger in Sag Cove, which was left in place to provide a long-term temperature dataset at the eelgrass restoration area at this site.

The May-October deployment was designed to track the rise and fall of water temperature through 15°, a temperature thought to influence flowering and seed germination. This period also allows for peak water temperature, the most stressful time of the year for eelgrass, to be recorded.

Temperature data was exported from the loggers into spreadsheets. The data was analyzed and graphed using SigmaStat® and SigmaPlot® (SPSS Inc., 1997) software.

Eelgrass Monitoring

The monitor, for the 2004 season, was initiated on 15 August, 2004 and completed on 22 August, 2004.

Sampling at each site was distributed among six stations that have been referenced using GPS. At each of the six stations, divers conducted a total of 10 random, replicate counts of eelgrass stem density and algal percent cover in 0.10 m^2 quadrats. Divers also made observations on blade lengths and overall health of plants that they observe. The divers stayed within a 10 meter radius of the GPS station point while conducting the survey. Algae within the quadrats were identified by genus and whether it was epiphytic or non-epiphytic on the eelgrass. Divers were careful not to disturb the eelgrass causing plants to be uprooted or otherwise damaged.

Data was incorporated into a spreadsheet and statistically analyzed using SigmaStat software (SPSS Inc., 1997). The trends, within sites, were analyzed by comparing the 2004 data with the data from the previous years.

Bed Delineation

For the 2004 season, the delineation for the deep edge was conducted using aerial photographs taken in Spring 2004. The aerial delineations were ground-truthed and found to accurately define the deep edge of most of the beds.

Genetics

Using microsatellite loci methodology to determine relatedness and diversity within and between these meadows we expect to be able to make some conclusions regarding the history of colonization and overall stability. An assessment of within bed diversity will allow us to determine the relative age and stability of these populations. This information will also allow us to better predict long-term survival of these meadows in the face of anthropogenic stressors. In addition to allowing us to better understand the history of extant meadows this information would allow us to better determine sources of seeds and adult shoots for future restoration efforts.

The following sites have been chosen to serve as sample locations based on geographic distribution and relative hydrologic isolation: Shinnecock Bay (north shore east of canal), Bullhead Bay, Noyack Creek, Southold Bay, Sag Harbor, Hallocks Bay, Orient Point (west of ferry terminal), Long Island Sound (Mulford Point), Hog Creek, and Lake Montauk.

At each site, 25 samples will be taken at 6 successive 1 meter intervals along the major compass bearings (N,S,E & W) from a central point to determine within bed clonality/diversity. It is expected that some of these samples will yield identical genetic results, but until we test this hypothesis we cannot assume this to be the case.

Results

Statistical analysis reports are included in Appendices 5 and include basic descriptive statistics as well as one-way ANOVAs. *P*-values when, not stated, are included in Appendices 5-10, as well.

Water Quality

Water quality analysis is represented in Appendix 1. The graphs represent the mean annual concentrations of the three parameters measured (NOx, TN, TDN) at or near the monitoring sites.

Bullhead Bay

Water quality continues to improve or remain stable in the Bullhead Bay system. Mean annual NOx concentrations continue to decline in the system, while the TN and TDN have remained relatively stable (Appendix 1a.).

Gardiner's Bay

Gardiner's Bay has continued to maintain relatively low concentrations of nitrogen-based parameters. The site experienced a slight increase in NOx concentration between 2002 and 2004, but analysis determined that it was statistically insignificant (Appendix 1b.). TN and TDN continue modest declines in concentration, though these changes were not significantly different between 2000 and 2004 (Appendix 1b.)

Northwest Harbor

All three water quality parameters continued to remain relatively stable in Northwest Harbor since 2000 (Appendix 1c.). While NOx has remained consistent since 2001, TN and TDN have shown minor, and insignificant, decreases in concentration of both of these parameters (Appendix 1c.).

Orient Harbor

Orient harbor, as with the previous sites, has shown slight decreases in concentrations of NOx, TN, and TDN since 2000 (Appendix 1d.). The only significant change in these parameters has been in TDN. The mean concentration has shown a significant ($p= 0.03$) decrease between 2000 and 2004 (Appendix 9).

Southold Bay

Appendix 1c represents the water quality data for Southold Bay. The data found no significant changes in parameter concentrations since 1999 at this site, though minor fluctuations in annual concentrations are evident (Appendix 1e).

Three Mile Harbor

The water quality in Three Mile Harbor has, like the other 5 sites, remained relatively stable with regard to annual concentrations or NOx, TN, and TDN (Appendix 1f). NOx and TN, have not shown a significant change since 1999 and 2000, respectively. TDN, however, was found to have significantly decrease in concentration between 2000 and 2004 (Appendix 11).

Water Temperature Monitoring

The graphs for the water temperature data are included in Appendix 2. All temperature data for each site were included on one graph. In general, sites that included surface and bottom temperature loggers (Hallocks Bay and Southold), displayed little difference in temperatures, within the water column (Appendices 2band 2f). The PEP RMSWMP data shows a similar lack of significant temperature difference between surface and bottom samples in its dataset, as well.

The PEP RMSWMP data, when plotted with the temperature logger data, correlates well with the logger data (Appendices 2a,c,e,f). Several deviations between the logger data and the PEP RMSWMP data are evident (e.g. the high temperature recorded by PEP RMSWMP in August 2004 for Bullhead Bay), though may be an artifact of the software analysis.

Eelgrass Stem Density and Areal Extent

The basic descriptive statistics for the eelgrass stem densities for the 2004 season are represented in Table 2. Included in the table are the sample sizes (replicates), number of stations without eelgrass, mean stem density, and standard error of the

Table 2. Descriptive statistics for eelgrass stem density.

Location	Sample Size (n)	# Stations w/ No Grass	Mean Stem Density (shoots/m^2)	Standard Error
Bullhead Bay (BH)	60	4	126	±28.1
Gardiner's Bay (GB)	60	0	300	±26.4
Northwest Harbor (NWH)	60	0	291	±18.3
Orient Harbor (OH)	60	3	56	±14.6
Southold Bay (SB)	60	0	210	±23.3
Three Mile Harbor (TMH)	60	2	29	±6.1

means.

In the past, the stem density data was further analyzed by looking for differences in densities between beds. It was found in the 5-Year Trends Analysis Report (Pickerell and Schott, 2004), that trends analysis of within-bed variation was a more appropriate statistical measure than comparison between beds, and that analysis continues in this report. Appendix 3 includes trend analysis graphs of the shoot density data for the six monitoring sites.

Bullhead Bay

The Bullhead Bay eelgrass population suffered significant loss in areal coverage between 2002 and 2004, resulting in a significant decline in stem density in 2004. The mean stem density for 2004 was found to be 126 shoots/m^2 (Figure 2), representing a significant decrease ($p < 0.05$) in mean shoot density from 2002 (Appendix 3a). The areal extent of the bed declined to the western half of the bay and includes only 2 sampling stations (STA 3 and 4). The current extent of the bed is illustrated in Appendix 3a and represents a significant decrease in areal extent from 2002 to 2004.

Gardiners Bay

Gardiners Bay has continued to maintain a relatively stable eelgrass stem density. The 2004 mean stem density of 300 shoots/m^2 (Figure 2), while slightly lower than the 2002, does not represent a significant decrease (Appendix 3b). There has not been a significant change in eelgrass stem density in this bed since 2000 (Appendix 3b; Appendix 7), though there has been an overall significant decline in shoot density of approximately 200 shoots/m^2 from 1999 to 2004.

The areal extent of this bed continues to be dynamic from year to year. The "finger-like" projections representing the outermost extent of the bed are constantly shifting due to erosion and deposition. The aerial photograph in Appendix 3b, shows the patchy, irregular nature of the deep edge of this bed.

Northwest Harbor

Northwest Harbor has remained the most stable eelgrass bed in the program. There has not been a significant change in the eelgrass shoot density in this bed since the monitoring was initiated in 1997 (Appendix 3c and Appendix 8), though the data from 1997 to 1999 should be regarded carefully due to the small number of replicates. The

Table 3. Mean macroalgal percent coverage (m^{-2}).

Eelgrass Bed	Percent Macroalgae Coverage
Bullhead Bay	< 1
Gardiners Bay	21.3
Northwest Harbor	81.4
Orient Harbor	1.1
Southold Bay	34.3
Three Mile Harbor	14.7

mean shoot density for 2004 (291 shoots/m^2) did show a decline from 2002 (349 shoots/m^2) (Appendix 3c), however the change was found to be insignificant after analysis (Appendix 8).

The areal extent of Northwest Harbor's eelgrass beds has shown moderate changes. However, it has been found that the deep edge delineated by Tiner (2003) was significantly underestimated when compared to the 2004 aerial photographs and groundtruthing (Appendix 4c).

Orient Harbor

Orient Harbor has seen the most drastic decline in its eelgrass stem density from previous years. In 2002, the mean stem density for Orient Harbor was 230 shoots/m^2 (Appendix 3d), but it decrease to only 56 shoots/m^2 (Figure 2) in 2004 (Appendix 3d). In 2004, 3 stations in this bed supported no eelgrass (STA 2,3 and 4), while 2 other stations (STA 1 and 6) showed reduced densities.

The areal extent of the bed is no longer distinct due to the heavy fragmentation occurring across the site, but the deep edge has noticeably receded from the prior depths of 7-9ft MLW (Appendix 4d).

Southold Bay

Southold Bay shoot density continued to show a decline from 1999 to 2004 (Appendix 3e). The decrease in shoot density from 2002 (384 shoots/m^2) to 2004 (210 shoots/m^2) was found to be a significant decline ($p < 0.05$) (Appendix 10).

The deep edge of the Southold Bay bed has remained relatively stable, though the areal extent of the bed has suffered some shrinkage along the eastern and western ends. (Appendix 4e).

Three Mile Harbor

Three Mile Harbor has seen a drastic decline in its eelgrass bed at the mouth of Hand's Creek. The mean shoot density declined from 135 shoots/m^2 in 2002, to just 29 shoots/m^2 in 2004 (Appendix 3f and Appendix 11). The 2004 survey found 2 stations devoid of grass, with 3 other stations supporting few plants.

The deep edge of this bed has not been affected by the above mentioned losses and remains at a depth of approximately 7-9ft MLW (Appendix 4f). However the areal extent of the bed has been significantly reduced with the loss of grass within two of the stations (Appendix 4f).

<u>Algal Percent Cover</u>

Algal percent cover was quantified for each quadrat within the six beds. Table 3 contains the mean percent coverage of macroalgae for each bed. Graphs for the individual sites are included in Appendix 5.

Bullhead Bay

Nonepiphytic, or drift, macroalgae has been a common component of the eelgrass community in Bullhead Bay since monitoring began in 1997. The percent cover of macroalgae at this site has been found to fluctuate from year to year, making a predictable trend difficult to identify

(Appendix 5a). The percent cover of macroalgae for 2004 was near zero (0.1%) (Table 3; Appendix 5a). With the loss of a large portion of the eelgrass bed, there has also been a decline in the macroalgae at the site. The dominate species encountered in Bullhead Bay continues to be the red, filamentous alga, *Spyridia filamentosa*, however, the areas once supporting eelgrass have shifted to bare bottom covered with films of diatoms and cyanobacteria.

Gardiner's Bay

Gardiner's Bay has supported a diverse, yet modest population of macroalgae. Since 2000, there has been no significant fluctuations in the percent cover of macroalgae at the site (Appendix 7) and the mean percent cover from 2002 to 2004 showed minimal change (Appendix 5b). The macroalgae population is greatly influenced by the fast currents that the site and the species that occur at the site can with the tides.

Northwest Harbor

Northwest Harbor has seen an increase in macroalgal percent cover since 2000 (Appendix 4c). With a mean percent cover of 81.4% (Table 3), the 2004 survey documented the highest percent algae cover, of any bed, that has been recorded since 2000, when analysis of the parameter was initiated (Appendix 5). This represents a substantial macroalgal population and, at this site, that population is dominated by *Spyridia filamentosa*, which almost forms a monoculture.

Orient Harbor

The macroalgae community in Orient Harbor has experienced a significant decline in 2004 (Appendix 5d). Though this site has not supported a large population of macroalgae over the course of this monitoring program (Appendix 5d), the 1.1% cover (Table 3) recorded for 2004 is a significant decline from 2002 (Appendix 9).

Southold Bay

Percent cover of macroalgae did not show significant change from 2002 to 2004 (Appendix 5e; Appendix 10). Although macroalgae has continued to encroach upon the eastern and western edges of the bed, the overall percent cover has decreased since 2001 (Appendix 5e). The macroalgal species composition of this bed continues to be dominated by *Spyridia filamentosa*, though *Codium fragile* has become established in sections of the bed.

Three Mile Harbor

Three Mile Harbor has seen a significant decline in macroalgae between 2000 and 2004 (Appendix 11). As with Bullhead Bay and Orient Harbor, there may be a correlation with the loss of eelgrass affecting the macroalgae community. As with Bullhead Bay and Orient Harbor, the eelgrass loss has left bare muck or sand sediment that provides little attachment for macroalgae and typically supports only diatomaceous or cyanobacteria films.

<u>Genetics</u>

Given difficulties in identifying an appropriate lab to analyze the samples for the genetics study, no data was generated for this portion of the monitoring program. When the appropriate lab is identified, the data will be provided as an addendum to this report.

Discussion

Significant changes were observed in the 2004 monitoring season. While water quality continued to improve or at least remain stable from 2002, several beds experienced significant declines in mean shoot density and loses in areal extent.

Long-Term Eelgrass Monitoring

Bullhead Bay

Bullhead Bay exhibited a significant decline in eelgrass shoot density and areal extent. Although the shoot density had only decreased by 76 shoots/m^2 from 2002 (Appendix 3a), the site includes 4 stations that no longer supports eelgrass reducing the overall areal extent of the bed by 66-75%. The cause of the losses are not clear. It has been proposed that physical removal, via a disturbance mechanism (e.g. ice scour, erosion, dredging, etc.), results in the loss/removal of the entire plant (roots, rhizomes and shoots). However, if other factors were responsible for the decline of an eelgrass population (e.g. disease, temperature-induced mortality, anchor ice, etc.), then some of the plant material, primarily the rhizomes, would remain intact in the sediment for a limited number of years. Within Bullhead Bay, examination of the sediment at unvegetated stations revealed 2 stations that contained rhizomes in the sediment and 2 station that included no rhizomes in the sediment. This suggests that the loss of eelgrass at two of the stations (relatively shallow and compact sand sediment) may have experienced ice scour between 2002 and 2004, possible multiple times over two winters. The other two stations consist of soft, muck sediment and are of slightly greater depth. It is possible that these stations were spared the scouring, but encountered another stressor that resulted in mortality, but left behind the remnants of the plants.

It was also eluded to in the results that there may be a correlation between the decline of the eelgrass and the subsequent decrease in macroalgae. The relationship between macroalgae and eelgrass includes the use of the eelgrass bed as an anchorage for drift macroalgae. In the specific case of Bullhead Bay, *Spyridia filamentosa*, being the dominant macroalgal species, grows intertwined in the eelgrass blades. Without this attachment, *Spyridia* has no anchorage and is subject to movement by the prevailing winds and currents.

Gardiner's Bay

Gardiner's Bay has supported a relatively stable eelgrass population with few changes over the years. The erosion/deposition caused by the fast currents at this site, continue to change the look and extent of the bed annually. However, it seems that natural propagation is able to keep pace with loss associated with erosion and other disturbances. The macroalgae community at this site is strongly influenced by the current and waves. A large proportion of the macroalgae encountered at the site are drift that became entangled in the eelgrass. When the current changes direction, much of the algae that accumulated on the previous tide, likely is dislodged and washed out of the bed, resulting in a high turn over rate of species and abundance.

One factor of concern at the Gardiner's Bay site is the continued boat traffic that travels over the bed to and from Greenport Harbor. Boats, large and small, tend to cut inside the green buoy marking the channel by as much as 200 yards. At MLW, there can be less than 3 ft of water over this bed and prop scars are common adjacent to the shoal on the Greenport side of the eelgrass bed. The addition of another navigation buoy closer to Hay Beach Point would likely reduce the traffic over this bed by directing boaters to the channel.

Northwest Harbor

There is little concern for the health and areal extent of the Northwest Harbor bed at this time. The eelgrass population seems to be stable and little change is evident in the bed.

Though there has been little change in the eelgrass population at this site, the macroalgal population, primarily *Spyridia filamentosa*, has continued to increase since 2000. Though this increase in a potential competitor is cause for some concern, there has been no observable impact on the eelgrass. It may be that because the eelgrass populations have remained so stable over the years, that the *Spyridia* has been able to take advantage of the relatively plentiful anchorage that the shoots provide and expand accordingly. Though the macroalgal population was relatively high at the time of monitoring, it is likely that it declines significantly after storms and during periods in which eelgrass shoots slough old leaves, reducing the overall population.

Orient Harbor

Orient Harbor has long been considered one of the most stable eelgrass beds in the Peconic Estuary. Based on aerial photography, the bed has changed little in 70 years, until 2004. The aerial photograph of the site, shows that the once stable beds has become patchy and the deep edge has retreated from its position of two years prior.

The cause of the losses in this bed are unclear. It had been suggested that bulkheading was to blame, however, the stations adjacent to the hardened shoreline do not show the loss in eelgrass that the stations adjacent to undeveloped shoreline display. Examination of the sediment at the unvegetated stations revealed no rhizomes, suggesting that the plants were completely removed from the substrate by shellfishing or other physical disturbance. Ice scour may have been responsible for the loss in the shallow areas of the bed, but it is unlikely that it caused the loss in the deeper section of the bed, resulting in the shoreward retreat of the deep edge to only 5-6ft at MLW.

The decline macroalgae at this site is likely related to the loss of an anchoring substrate, in this case, eelgrass. The mechanism for this was detailed above and is the most likely causative factor in the decrease in algal percent cover as nitrogen concentrations have not significantly decreased at this site.

Southold Bay

The shoot density at Southold Bay continues to decline, though there is not a clear cause for this trend. Although this site was originally chosen due to the opinion that it was a “bed in decline,” it has proven to be more stable, to date, than other beds in the program. Water quality has improved at the site, likely relieving some stress on the eelgrass population, though water clarity may still be a stressor, as the site includes two, high-traffic boat channels that result in considerable turbidity (Pickerell and Schott, personal observations).

Changes in macroalgal abundance (percent cover) have not shown significant change since 2002, though encroachment by *Codium fragile* in areas that once supported eelgrass has increased and may prevent the bed from recolonizing lost areas. The current, relatively low abundance of macroalgae in this bed should provide more favorable growing conditions for the eelgrass.

Three Mile Harbor

The eelgrass bed in Three Mile Harbor is in rapid decline. Though it has only lost eelgrass in two stations, the shoot densities for the other stations have shown a marked decrease. The eelgrass growing near the deep edge are rooted in loose muck in 7-9 ft of water (MLW) and are easily uprooted by any disturbance that could fluidize the sediment. Turbidity is commonly high at these stations resulting in decreased light for growth and low shoot densities. In the shallower stations, the sediments are primarily sand, resulting in less turbidity and better anchorage. However, these stations experience more anthropogenic disturbances, such as mooring chain scour and prop scarring due to the mooring field and waterskiing area that are included in the confines of the bed. These continued activities in the eelgrass bed could lead to significant decline in the areal extent and overall health of the bed.

Macroalgae has not be a major concern for this bed. The percent cover has declined since 2000 and is significantly lower than other eelgrass beds in the program. It is likely that, as eelgrass densities continue to decline in Three Mile Harbor, the macroalgae will also decline due to loss of substrate for anchorage/attachment.

Overview

Significant changes in the general health and extent of the six monitoring sites were observed in 2004. Nine out of a total of 36 stations (6 stations per each of the 6 sites) no longer supported eelgrass within the 10 m of the station coordinates. That is up from only 2 stations in 2002. The three sites that represent these losses were Bullhead Bay (4 unvegetated stations), Orient Harbor (3 unvegetated stations) and Three Mile Harbor (2 unvegetated stations). These three beds represent an average loss of 118 shoots/m^2. Southold Bay also showed a significant decline in shoot density from 2002, with an approximate loss of 174 shoots/m^2.(Gardiner's Bay and Northwest Harbor continue to maintain stable shoot densities.

Areal extent has declined significantly in Bullhead Bay, Orient Harbor and Three Mile Harbor, and Southld Bay has experienced minor loss in area, but no noticeable retreat in its deep edge. Gardiner's Bay continues to be dynamic in its areal extent and deep edge, making it difficult to assess actual loss/gain at the site. Northwest Harbor is relatively unchanged from 2002 in extent and deep edge.

Macroalgal percent cover has remained stable or declined in a majority of the monitoring sites. The exception to this was Northwest Harbor, which saw an almost 20% increase in mean percent cover from 2002. Even with this increase in macroalgae, there was no significant decline in the eelgrass shoot density at this site.

The mechanism(s) of the reported losses have not been identified, but it has been suggested that the losses were the result of physical disturbances, rather than a biological agent or physiological event, due to the lack or rhizome/root remains in the sediment at the sites. Events that could explain these losses include ice scour, anchor ice, changes in local long-shore erosion/deposition patterns and dredging/shellfishing activities. The Peconic Estuary has experienced two cold winters since 2002 that resulted in most of the Estuary experiencing some level of freezing. This is of special concern in shallow areas, like eelgrass meadows, where the ice layers could sit on the bottom at low tides and crush the eelgrass or scour the sediment as it is moved by winds and tides. This is the likely cause of the loss of eelgrass in stations 5 and 6 in Bullhead Bay. Their location, in the south-southeast section of the bay make them susceptible to ice being piled up in the shallow waters by prevailing winter winds. Anchor ice, though a recognized event in estuarine and riverine waters, has not been the focus of much research and therefore it is unclear of the extent of damage this event could cause to seagrasses. Changes in long-shore currents, though not a probable cause for loss, still holds the potential to damage an eelgrass bed by changing the erosion/deposition dynamics of the site. These currents may be influenced by changes in shoreline structure (i.e., hardening shorelines) and could require several years for the change to significantly manifest itself. Lastly are dredging and shellfishing. Both are human-based sources of disturbance and may influence any or all of the monitoring beds at some point in time. Although anecdotal evidence has suggested that shellfishing impacts to meadows in the Peconic Estuary (e.g. Hallocks Bay), it is unlikely, due to the area of the eelgrass loss at the three sites, that the damage observed was caused by shellfishing activities, and no evidence of dredging was observed at these monitoring sites. The situation requires continued monitoring and the 2005 monitoring season may shed light on the losses observed in 2004.

Water Temperature Monitoring

The analysis of water temperature data from deployed temperature loggers and from the PEP RMSWMP has resulted in several conclusions. The PEP RMSWMP, though limited in the number of samples, describes a relatively accurate annual trend in water temperature for the Peconic Estuary, when compared to the continual, 4 -month dataset. While the PEP RMSWMP data is adequate for determining large time-scale (i.e., monthly) trends in temperature, it does not have the precision to illustrate the temperature dynamics on a smaller time-scale, like the logger data.

The analysis of surface versus bottom temperature data found no overall, significant differences between the surface and bottom temperatures at the indicated sites. The lack of significant differences between surface and bottom temperatures is likely due to the shallow nature of the sites. The depth at these sites, less than 3 meters, does not represent a significant depth for a thermocline to be established, or if a thermocline does occur, to be easily disrupted and mixed. While deploying loggers at sites with a greater depth may result in a significant difference between surface and bottom temperatures, these sites would not necessarily reflect the conditions experienced in the Estuary's eelgrass beds, which are relatively shallow.

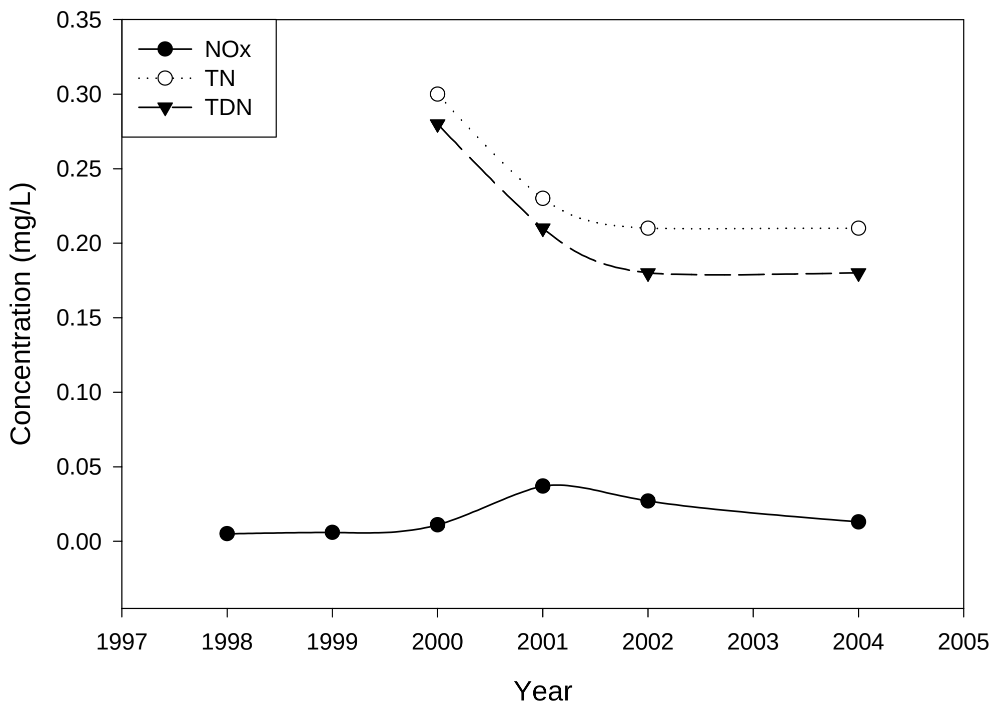
The benefits of these 2 datasets include the prediction/planning of restoration activities (i.e., timing of seed collection and germination). The data could also be used to explain acute/chronic changes, especially eelgrass loss in the Estuary, by identifying localized periods of high water temperature and/or long-term shifts in temperatures due to climatic events (e.g. global warming).

References

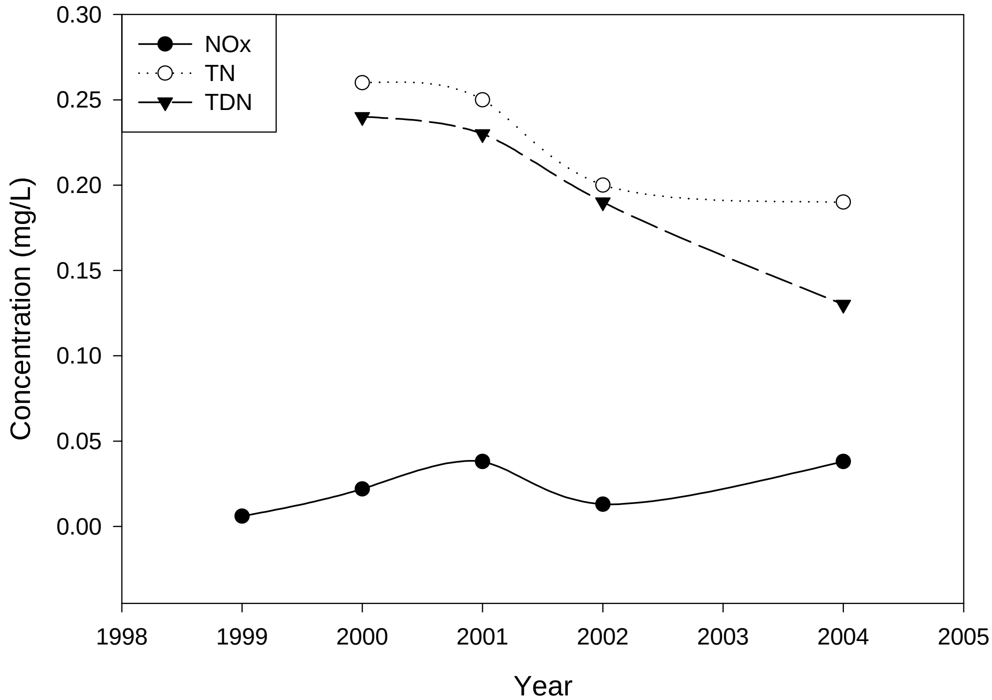
Pickerell, C. and S. Schott, 2004. Peconic Estuary Program Long Term Eelgrass Monitoring Program - Eelgrass Trends Analysis Report: 1997-2002. Prepared for the Peconic Estuary Program, SCDHS, Department of Ecology.

Appendix 1. Graphs plotting the 2004 annual mean NOx, TN, and TDN, based on the SCDHS Water Quality Data for the six long-term eelgrass monitoring sites. (Concentrations represent annual means in mg L^{-1}.

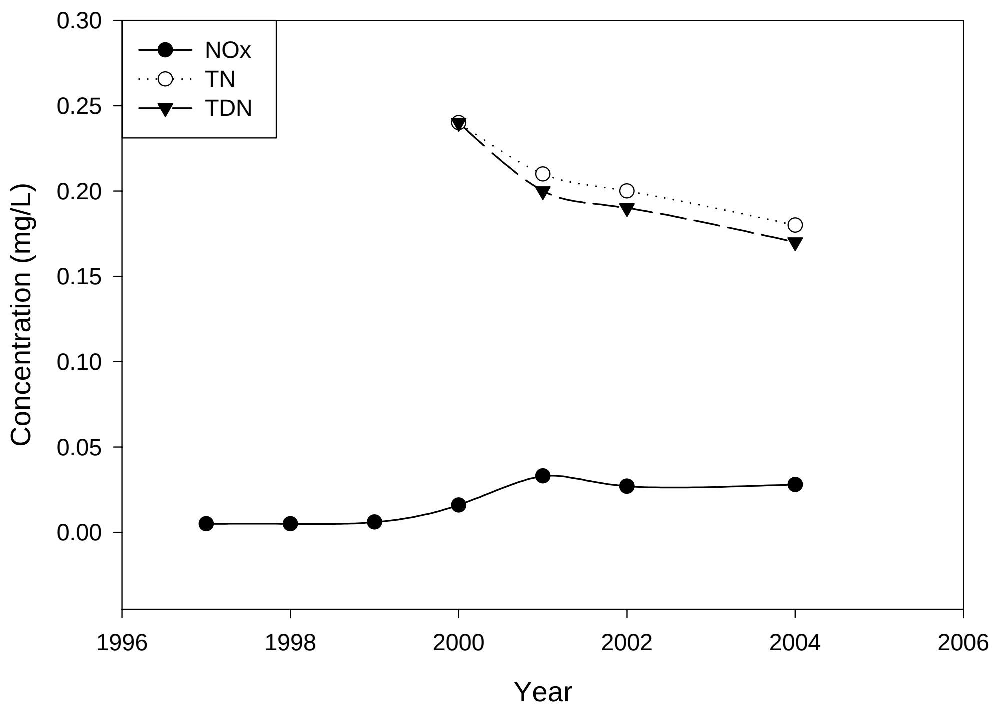
a) Bullhead Bay



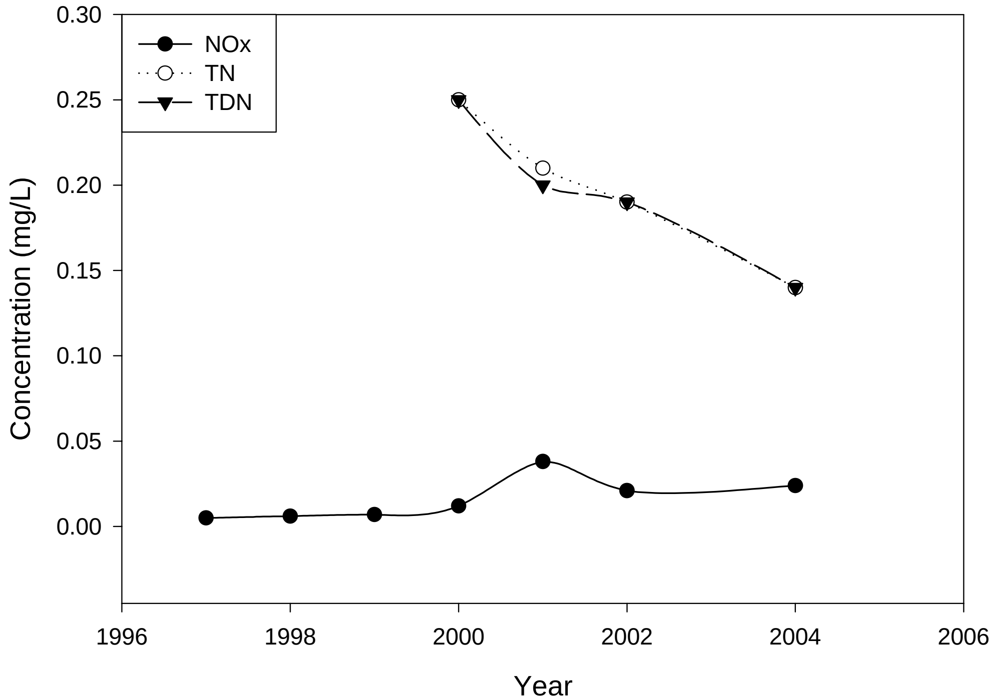
b) Gardiner's Bay



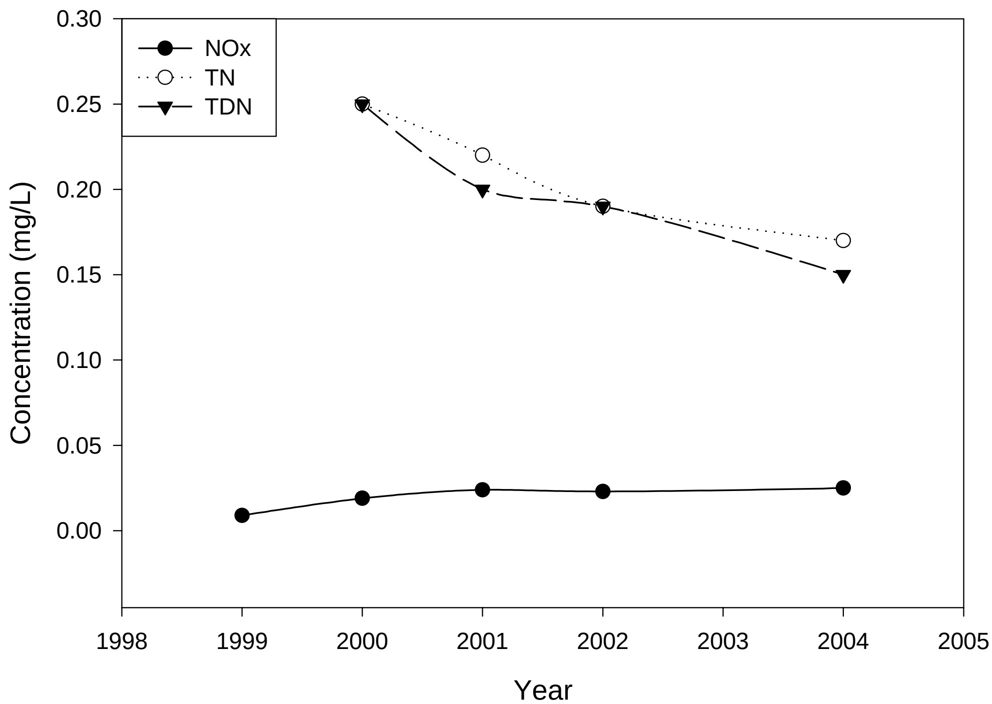
c) Northwest Harbor



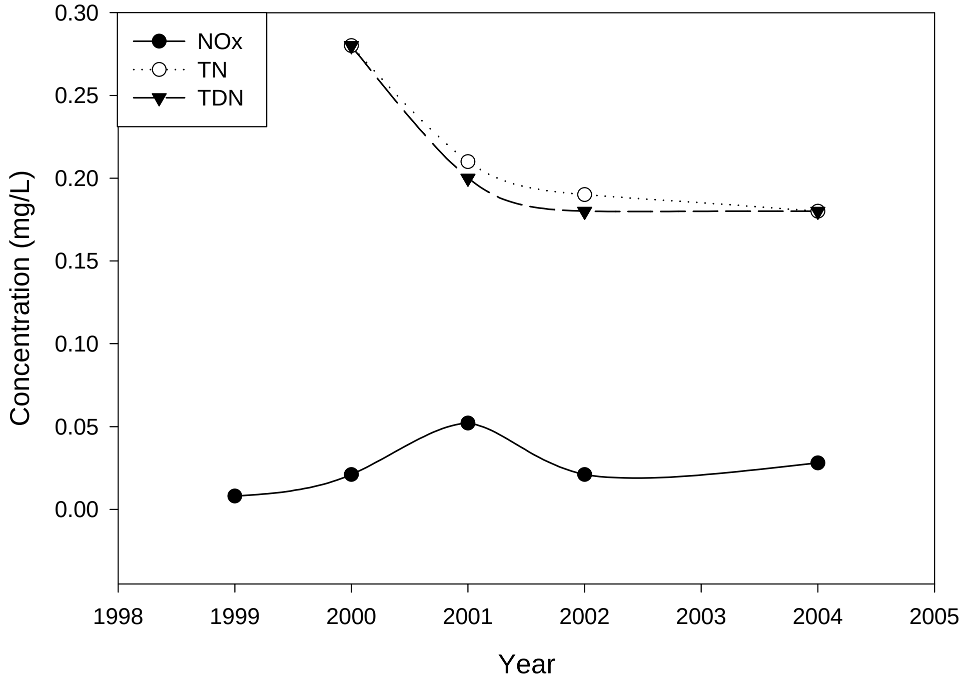
d) Orient Harbor



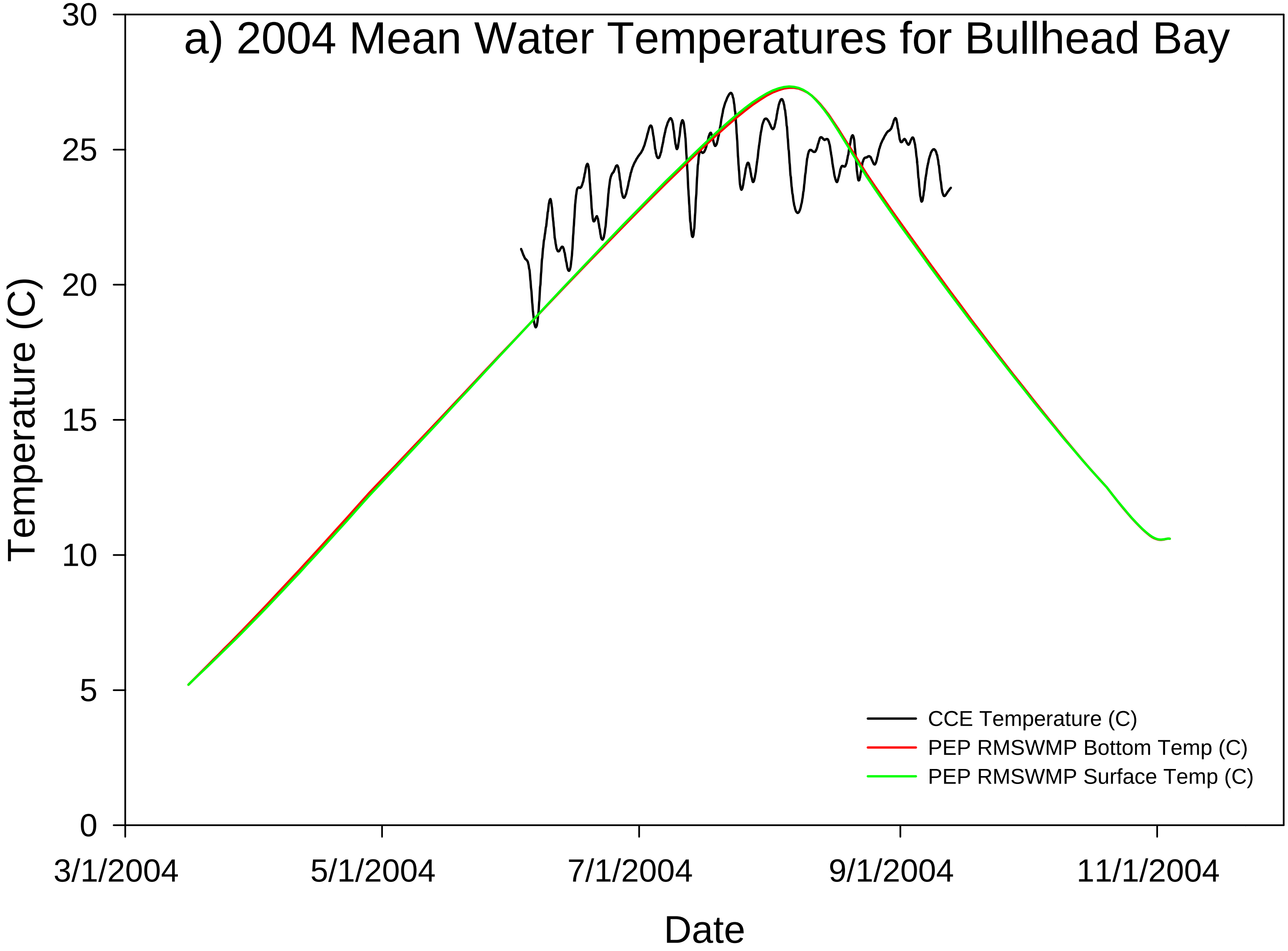
e) Southold Bay

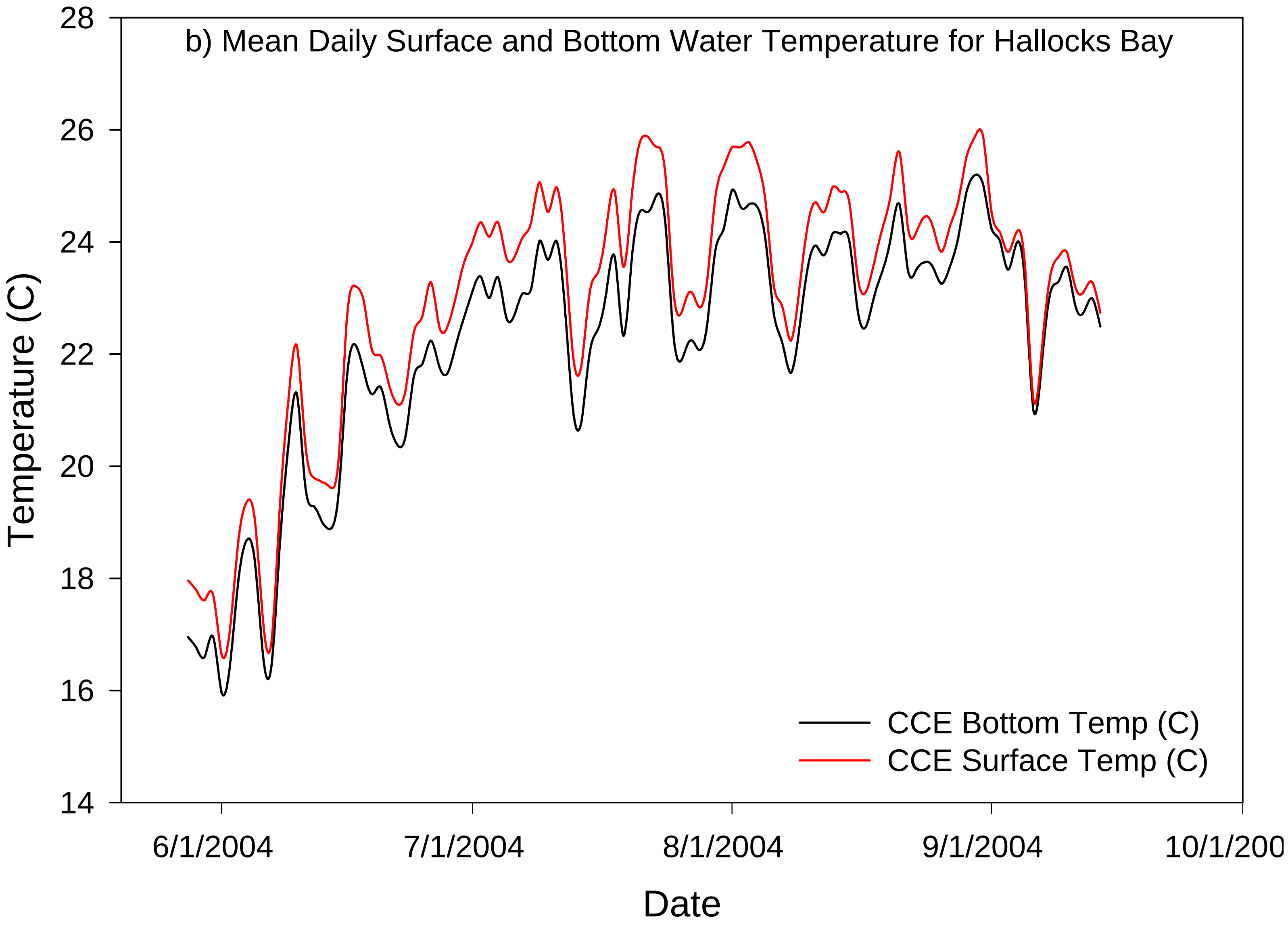


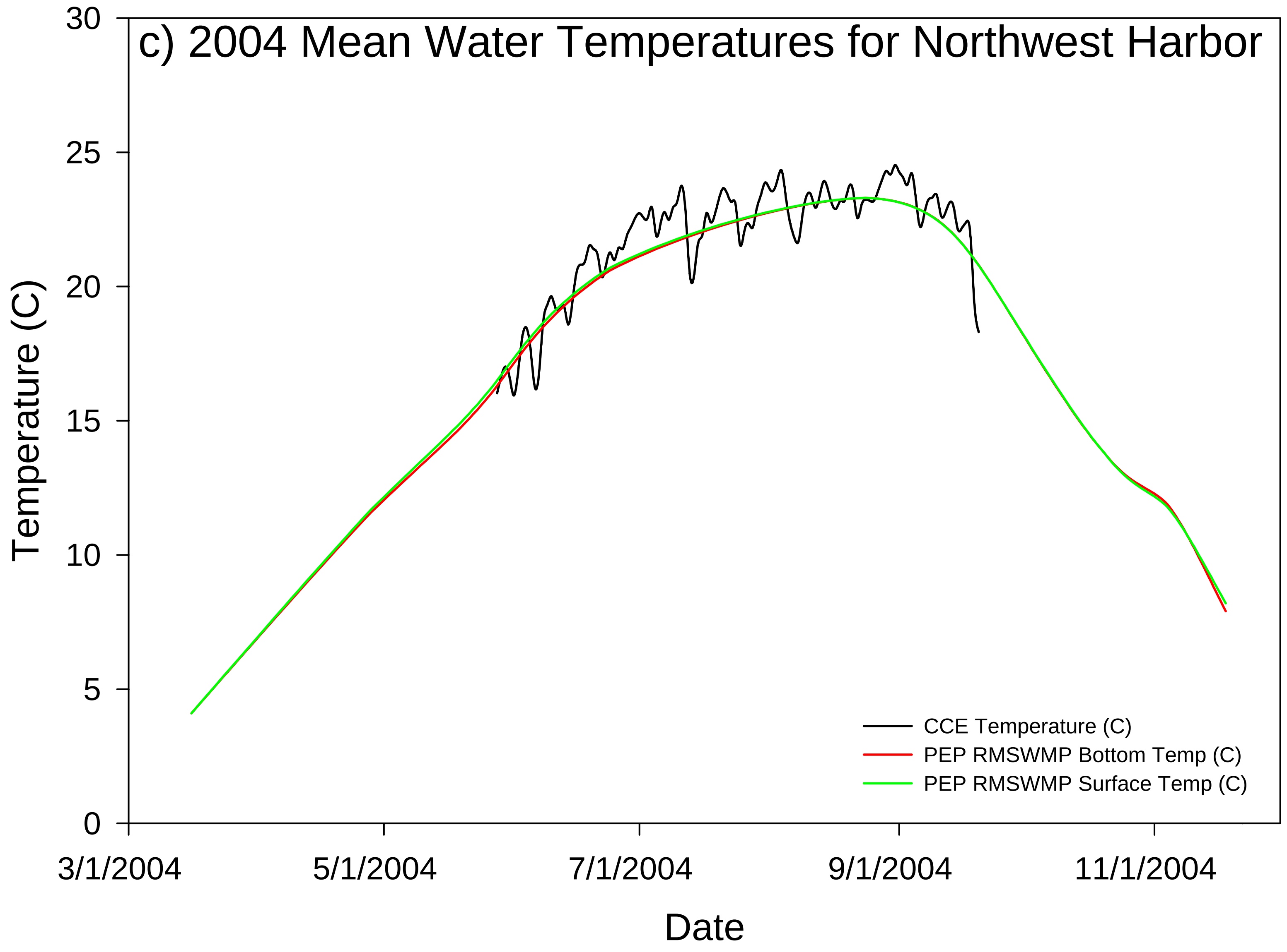
f) Three Mile Harbor

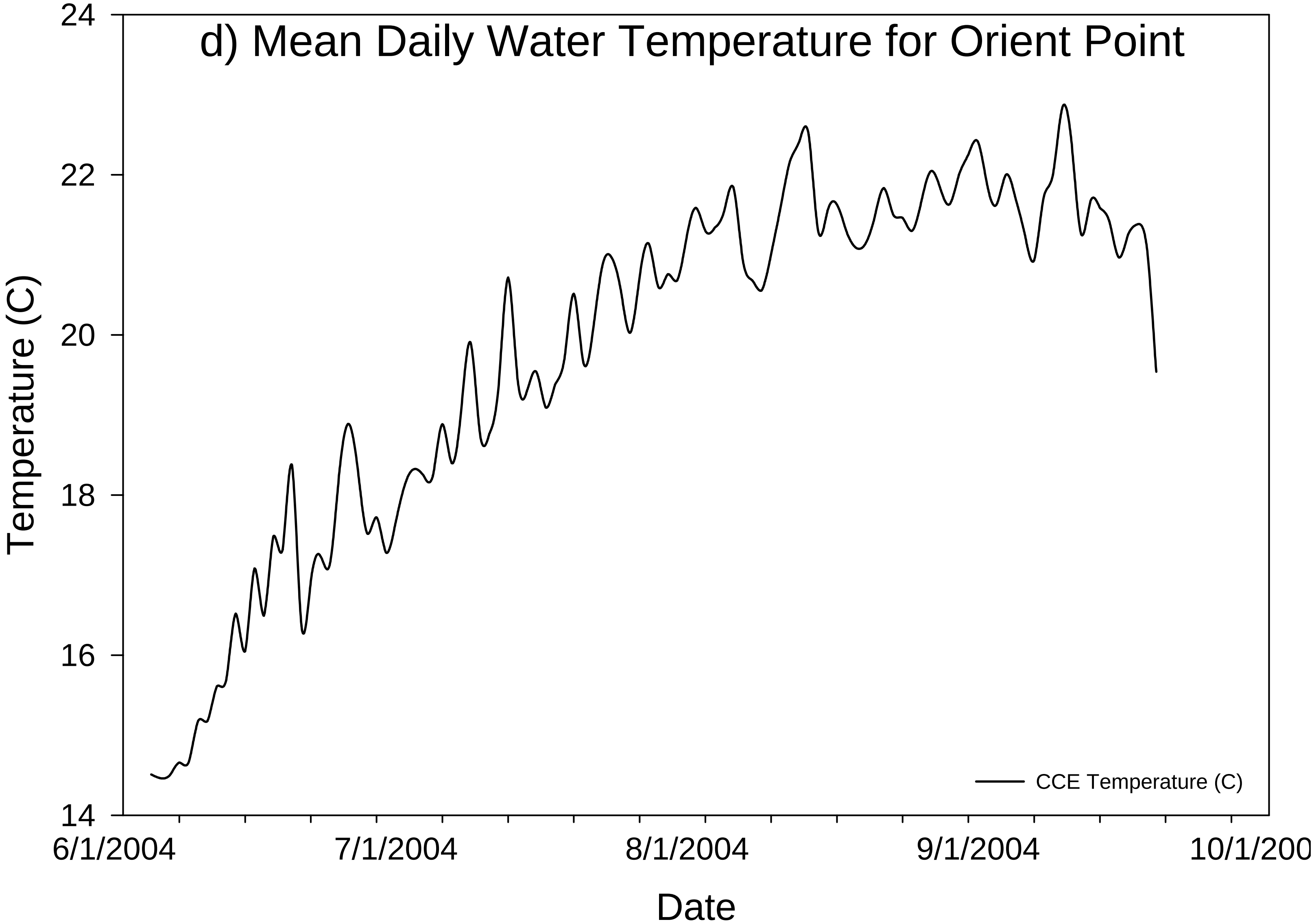


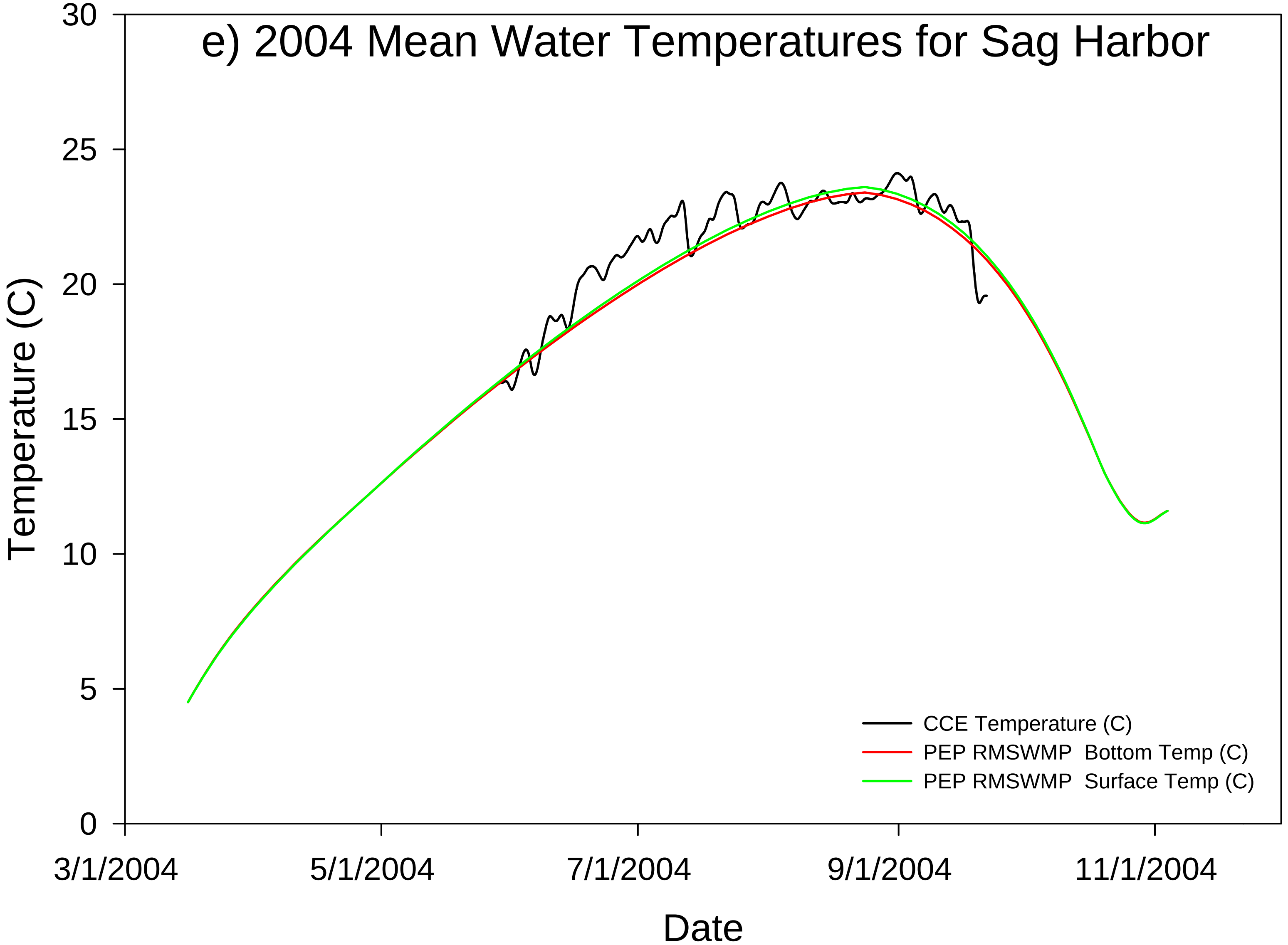
Appendix 2. Water temperature graphs for selected sites within the Peconic Estuary. Datasets include continuous logging by temperature loggers deployed by CCE and data from PEP RMSWMP.

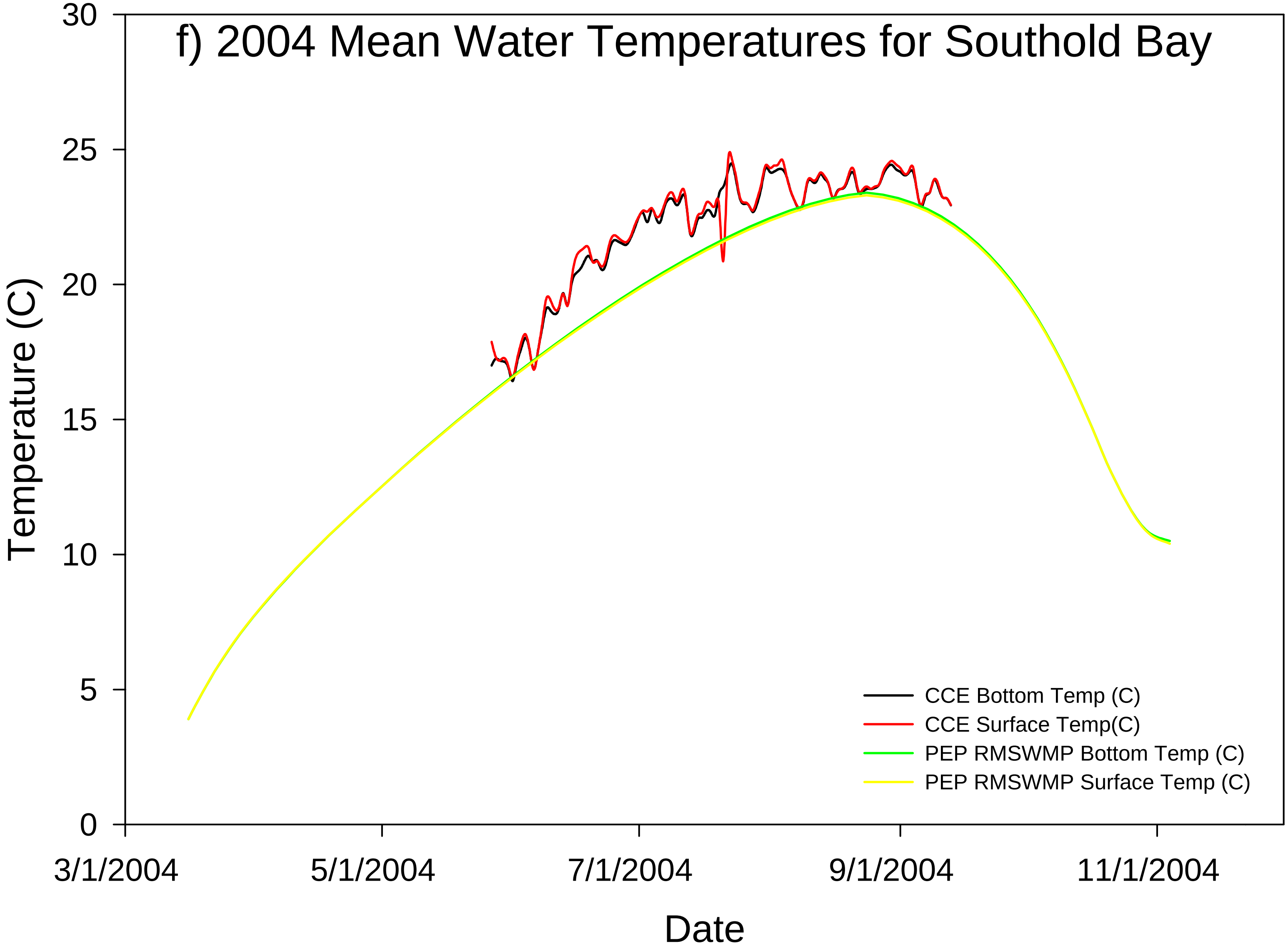

a) 2004 Mean Water Temperatures for Bullhead Bay
30
25
20
15
10
5
0
Temperature (C)
3/1/2004
5/1/2004
7/1/2004
9/1/2004
11/1/2004
Date
CCE Temperature (C)
PEP RMSWMP Bottom Temp (C)
PEP RMSWMP Surface Temp (C)


b) Mean Daily Surface and Bottom Water Temperature for Hallocks Bay
Temperature (C)
28
26
24
22
20
18
16
14
6/1/2004
7/1/2004
8/1/2004
9/1/2004
10/1/200
Date
CCE Bottom Temp (C)
CCE Surface Temp (C)

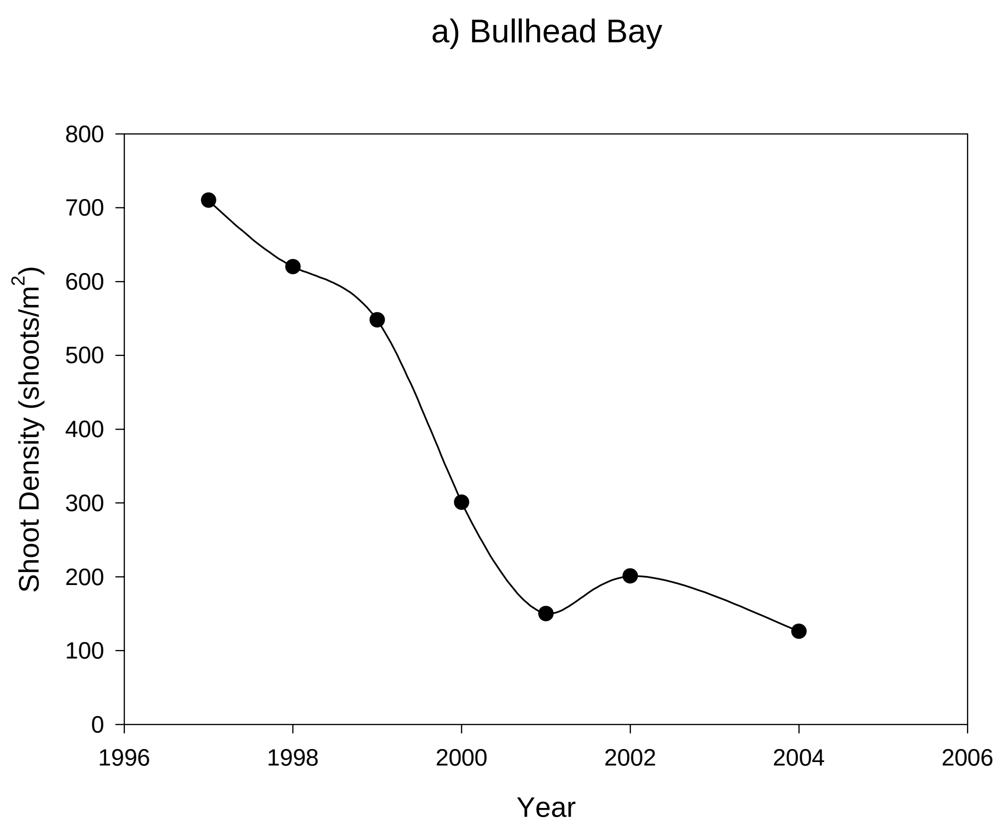

c) 2004 Mean Water Temperatures for Northwest Harbor
Temperature (C)
30
25
20
15
10
5
0
3/1/2004
5/1/2004
7/1/2004
9/1/2004
11/1/2004
Date
CCE Temperature (C)
PEP RMSWMP Bottom Temp (C)
PEP RMSWMP Surface Temp (C)


d) Mean Daily Water Temperature for Orient Point
Temperature (C)
24
22
20
18
16
14
6/1/2004
7/1/2004
8/1/2004
9/1/2004
10/1/200
Date
CCE Temperature (C)

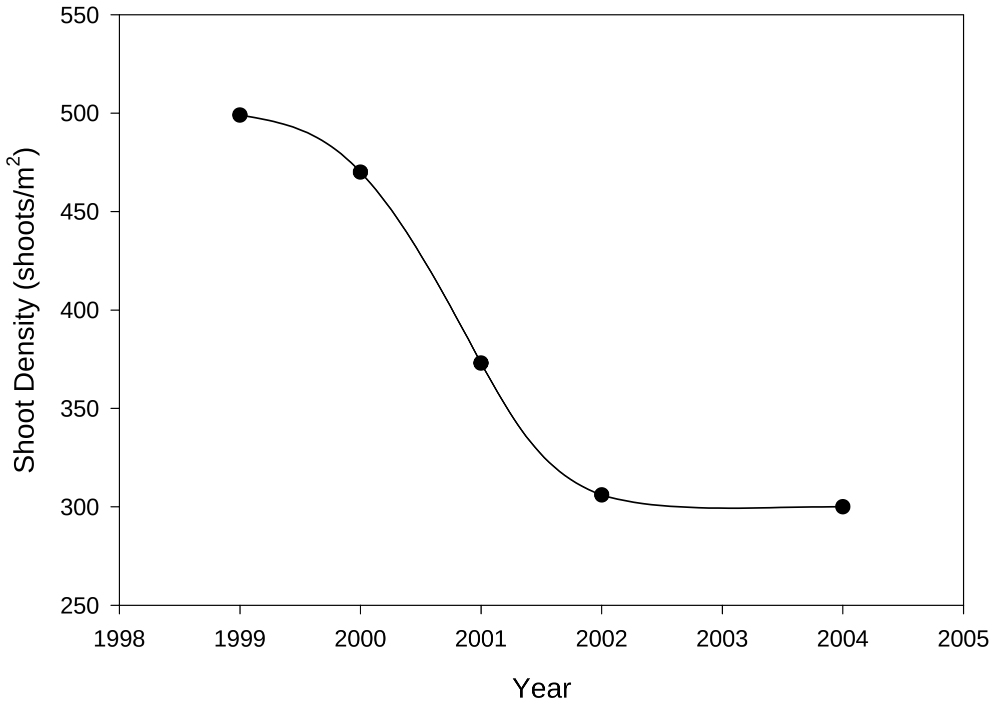

e) 2004 Mean Water Temperatures for Sag Harbor
Temperature (C)
30
25
20
15
10
5
0
3/1/2004
5/1/2004
7/1/2004
9/1/2004
11/1/2004
Date
CCE Temperature (C)
PEP RMSWMP Bottom Temp (C)
PEP RMSWMP Surface Temp (C)


f) 2004 Mean Water Temperatures for Southold Bay
Temperature (C)
30
25
20
15
10
5
0
3/1/2004
5/1/2004
7/1/2004
9/1/2004
11/1/2004
Date
CCE Bottom Temp (C)
CCE Surface Temp(C)
PEP RMSWMP Bottom Temp (C)
PEP RMSWMP Surface Temp (C)

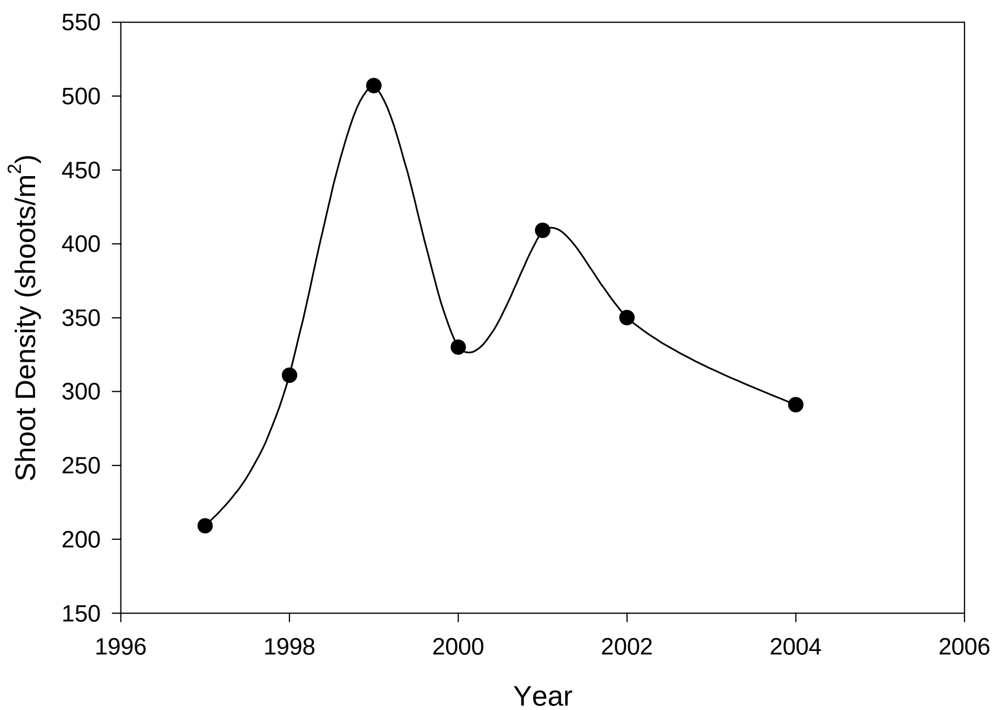
Appendix 3. Graphs of the mean eelgrass shoot densities for the six long-term monitoring sites. (Shoot density is expressed as shoots m^{-2}).



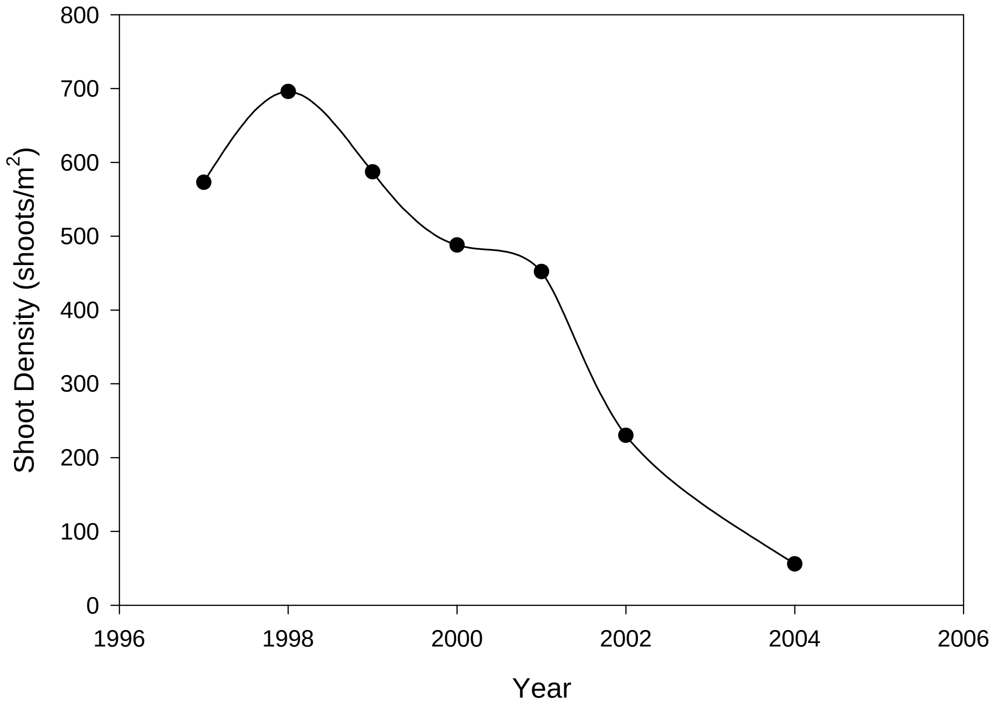
b) Gardiner's Bay



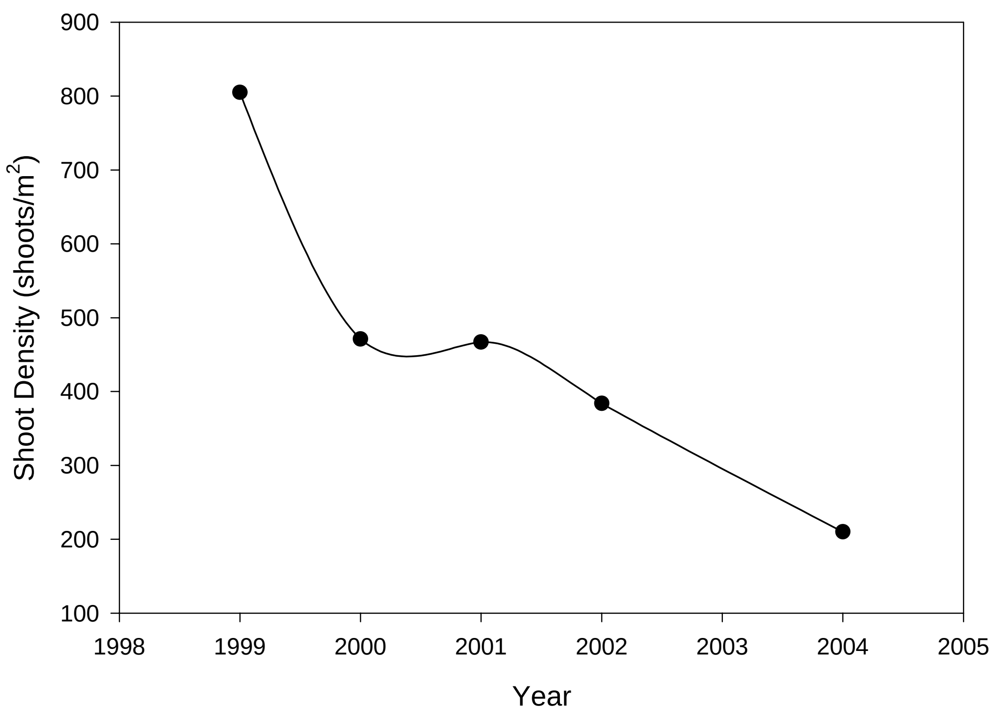
c) Northwest Harbor



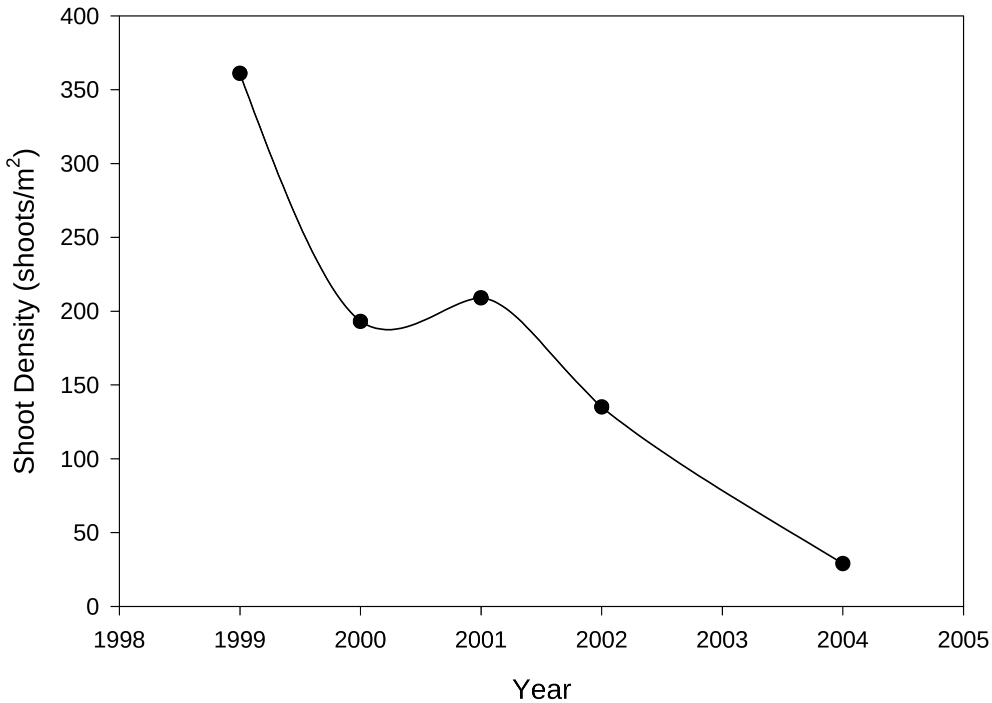
d) Orient Harbor



e) Southold Harbor

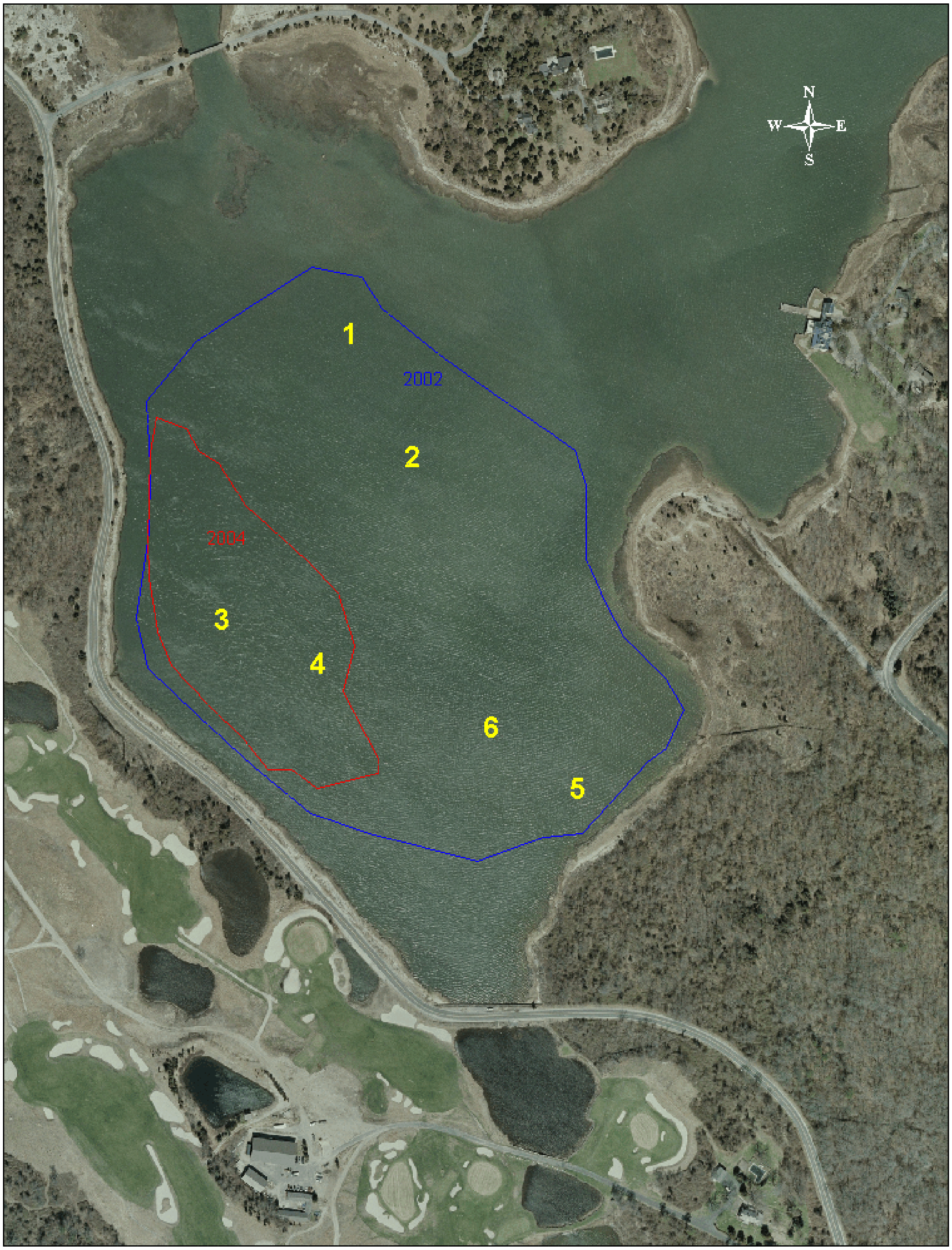


f) Three Mile Harbor



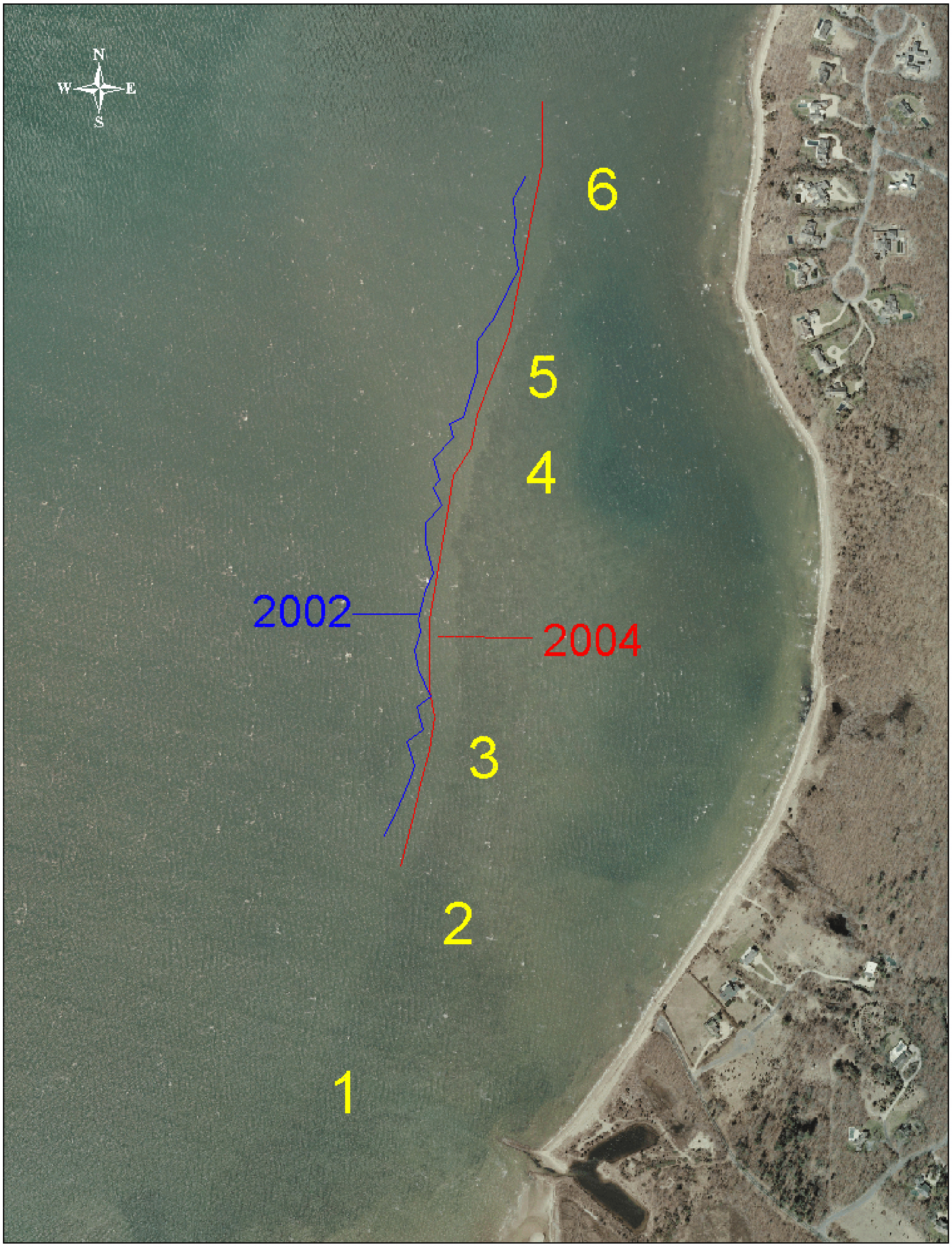
Appendix 4. Aerial photographs, with deep edge delineations, of the six monitoring sites for 2004. Monitoring stations are indicated by numbers (1-6) for each site.

a) Bullhead Bay



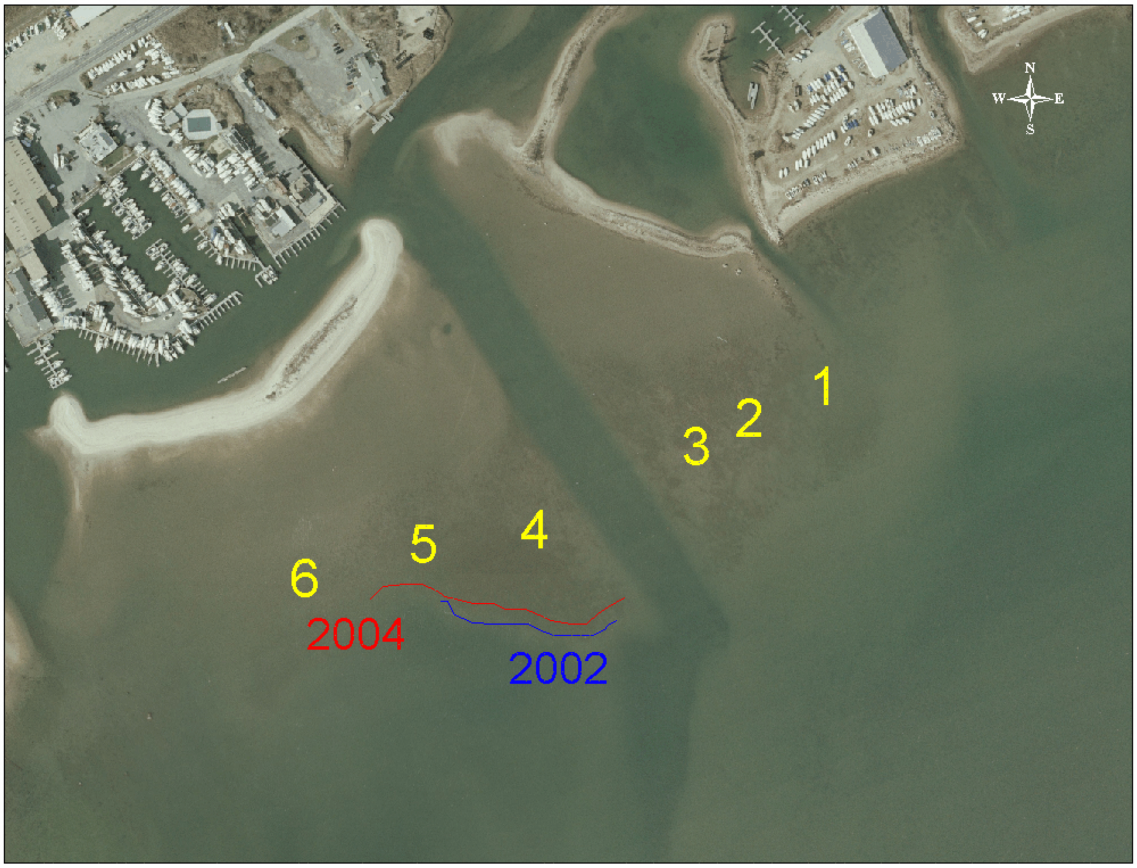
b) Gardiner's Bay

c) Northwest Harbor



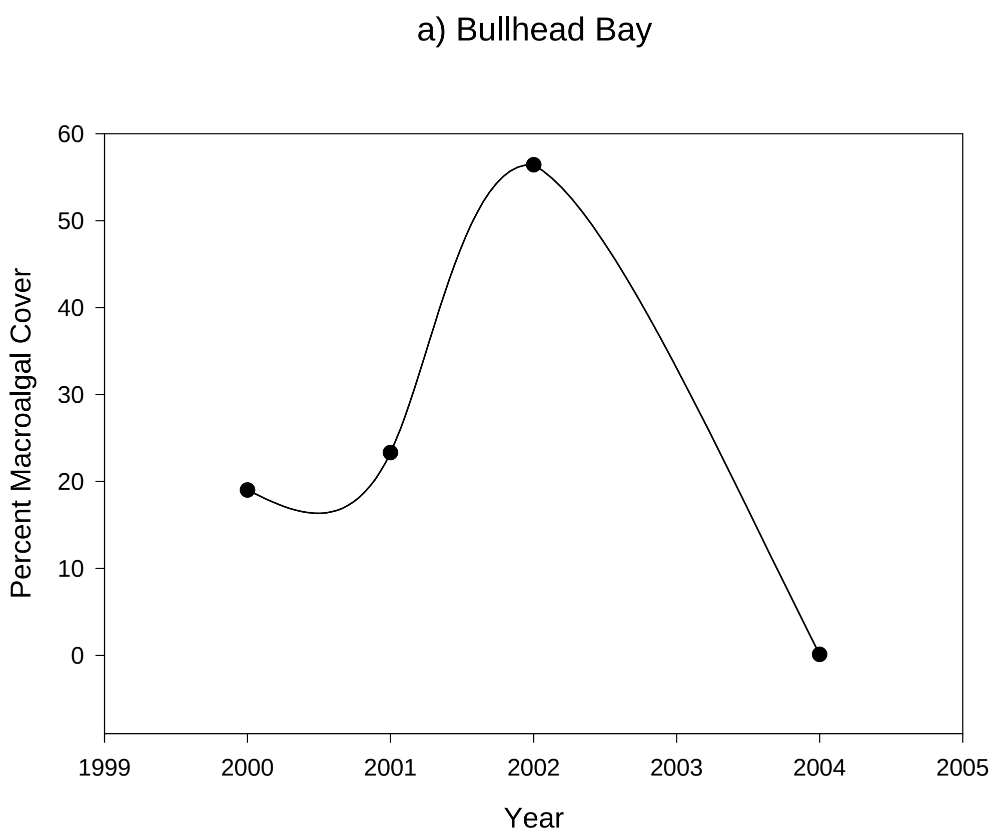
d) Orient Harbor

e) Southold Bay

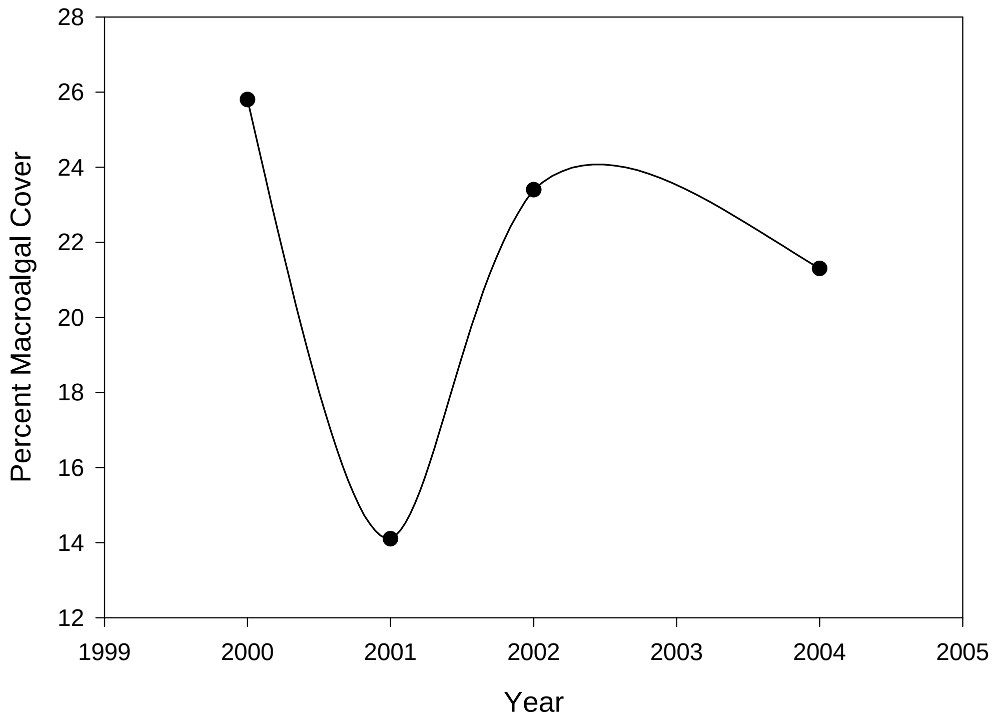


f) Three Mile Harbor

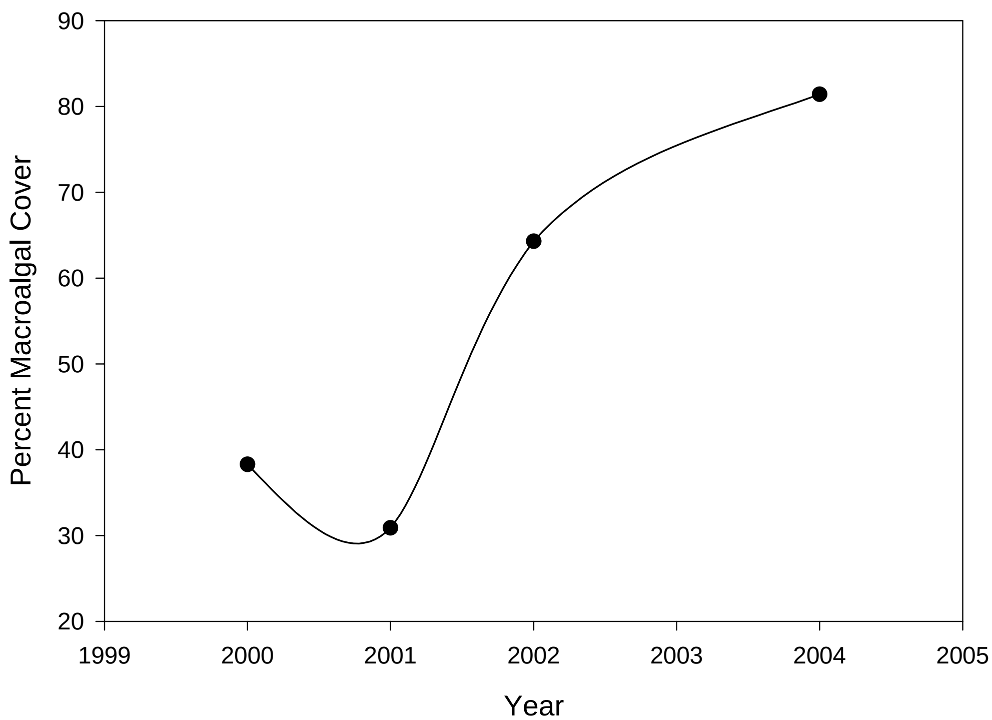
Appendix 5. Graphs representing the mean Percent macroalgal cover at the six sites from 2000 to 2004.



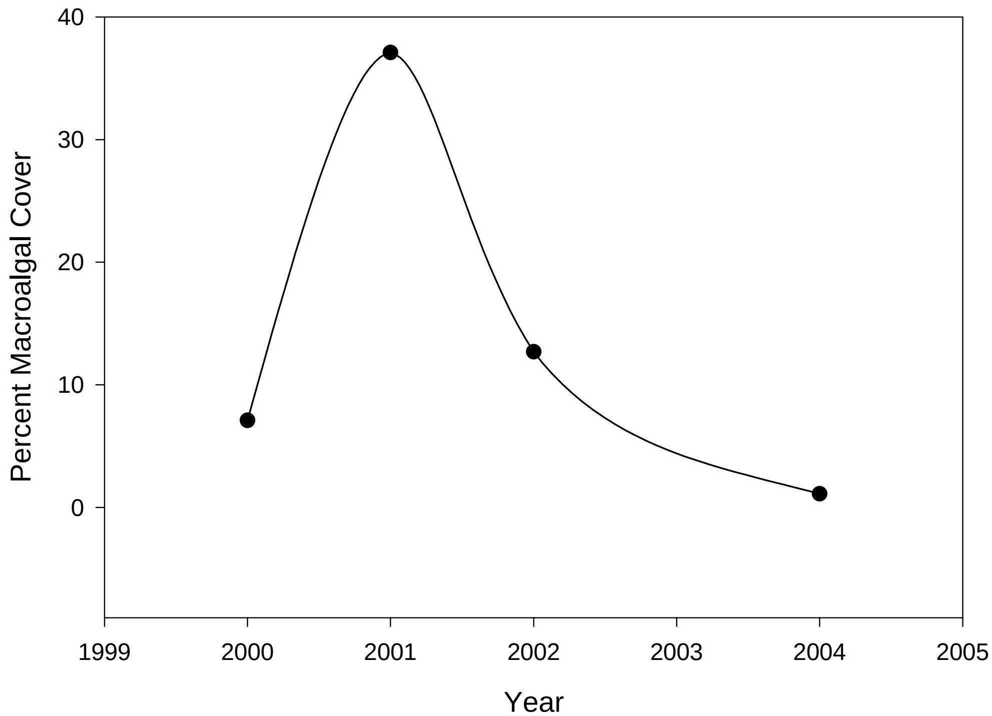
b) Gardiner's Bay



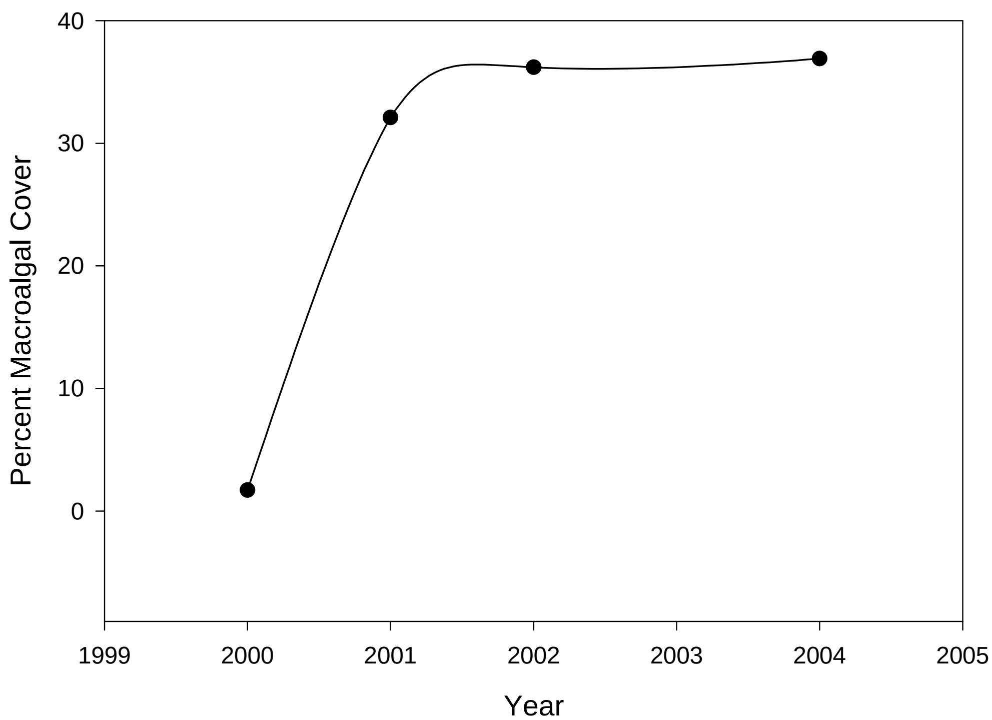
c) Northwest Harbor



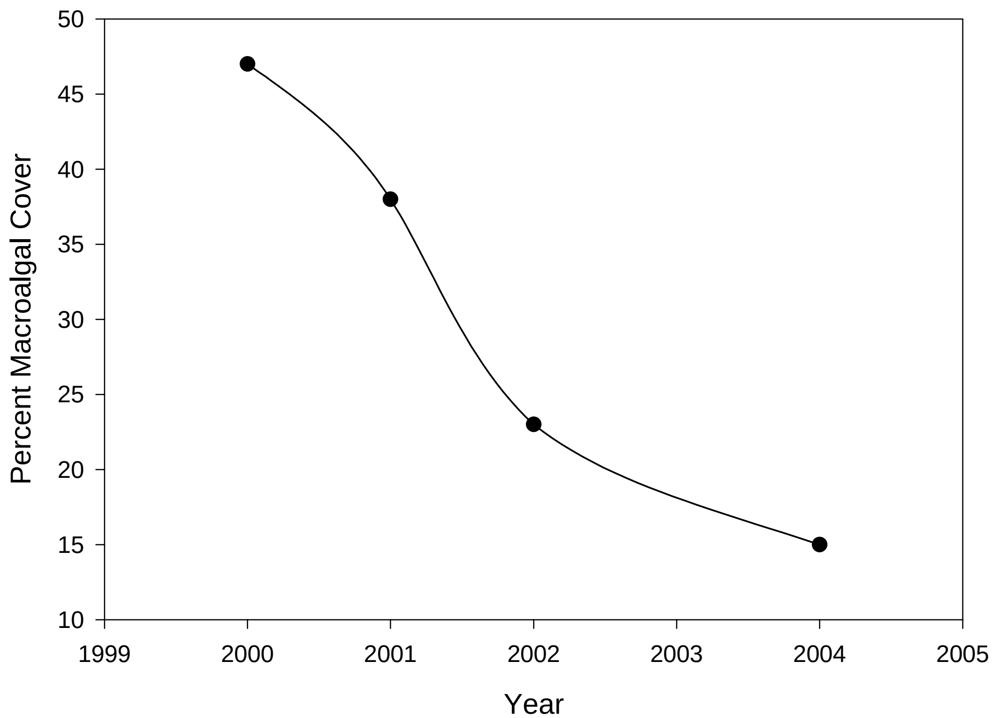
d) Orient Harbor



e) Southold Bay



f) Three Mile Harbor



Appendix 6. The statistical reports generated for all of the analyses conducted in the synthesis of 2004 Long-Term Monitoring Report for Bullhead Bay.

Descriptive Statistics:

Data source: BB Water Quality Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
BB 98 NOx	16	0	0.0051	0.00025	0.000063	0.00013
BB 99 NOX	17	0	0.0057	0.0022	0.00053	0.0011
BB 00 NOx	20	0	0.011	0.011	0.0025	0.0051
BB 01 NOx	22	0	0.037	0.032	0.0067	0.014
BB 02 NOx	26	0	0.027	0.030	0.0058	0.012
BB 04 NOx	12	0	0.013	0.015	0.0042	0.0093
BB 00 TN	10	0	0.30	0.061	0.019	0.044
BB 01 TN	22	0	0.23	0.078	0.017	0.035
BB 02 TN	26	0	0.21	0.074	0.015	0.030
BB 04 TN	12	0	0.21	0.20	0.058	0.13
BB 00 TDN	9	0	0.28	0.072	0.024	0.056
BB 01 TDN	22	0	0.21	0.082	0.018	0.037
BB 02 TDN	26	0	0.18	0.068	0.013	0.028
BB 04 TDN	12	0	0.18	0.20	0.057	0.12

Column	Range	Max	Min	Median	25%	75%
BB 98 NOx	0.00100	0.0060	0.0050	0.0050	0.0050	0.0050
BB 99 NOX	0.0090	0.014	0.0050	0.0050	0.0050	0.0052
BB 00 NOx	0.037	0.042	0.0050	0.0055	0.0050	0.012
BB 01 NOx	0.10	0.11	0.0050	0.028	0.0090	0.056
BB 02 NOx	0.11	0.12	0.0050	0.014	0.0070	0.040
BB 04 NOx	0.053	0.058	0.0050	0.0095	0.0050	0.014
BB 00 TN	0.17	0.39	0.22	0.30	0.27	0.35
BB 01 TN	0.25	0.38	0.13	0.20	0.19	0.27
BB 02 TN	0.29	0.37	0.080	0.19	0.16	0.22
BB 04 TN	0.64	0.69	0.050	0.13	0.060	0.34
BB 00 TDN	0.18	0.38	0.20	0.29	0.21	0.35
BB 01 TDN	0.27	0.39	0.12	0.18	0.16	0.24
BB 02 TDN	0.24	0.33	0.090	0.17	0.12	0.20
BB 04 TDN	0.56	0.61	0.050	0.080	0.050	0.29

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
BB 98 NOx	4.00	16.00	0.54	<0.001	0.081	0.00041
BB 99 NOX	3.91	15.70	0.39	<0.001	0.097	0.00063
BB 00 NOx	2.14	3.79	0.31	<0.001	0.22	0.0048
BB 01 NOx	0.88	-0.10	0.18	0.052	0.82	0.051
BB 02 NOx	1.78	2.64	0.27	<0.001	0.70	0.041
BB 04 NOx	3.07	10.01	0.37	<0.001	0.16	0.0044
BB 00 TN	0.026	-1.26	0.15	0.676	3.03	0.95
BB 01 TN	0.97	-0.13	0.23	0.004	5.00	1.26
BB 02 TN	0.93	0.43	0.20	0.007	5.33	1.23
BB 04 TN	1.48	1.75	0.23	0.091	2.52	0.97
BB 00 TDN	0.23	-1.68	0.18	0.503	2.55	0.76
BB 01 TDN	1.10	-0.0034	0.24	0.002	4.64	1.12
BB 02 TDN	0.90	0.018	0.15	0.112	4.68	0.96

BB 04 TDN	1.41	0.62	0.28	0.012	2.19	0.82

One Way Analysis of Variance
Data source: BB Water Quality Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: BB in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
BB 98 NOx	16	0	0.0050	0.0050	0.0050
BB 99 NOX	17	0	0.0050	0.0050	0.0052
BB 00 NOx	20	0	0.0055	0.0050	0.012
BB 01 NOx	22	0	0.028	0.0090	0.056
BB 02 NOx	26	0	0.014	0.0070	0.040
BB 04 NOx	12	0	0.0095	0.0050	0.014

H = 43.24 with 5 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
BB 01 NOx vs BB 98 NOx	53.11	4.93	Yes
BB 01 NOx vs BB 99 NOx	46.86	4.43	Yes
BB 01 NOx vs BB 00 NOx	30.64	3.03	Yes
BB 01 NOx vs BB 04 NOx	21.93	1.86	No
BB 01 NOx vs BB 02 NOx	8.98	0.95	No
BB 02 NOx vs BB 98 NOx	44.12	4.24	Yes
BB 02 NOx vs BB 99 NOx	37.87	3.71	Yes
BB 02 NOx vs BB 00 NOx	21.65	2.22	No
BB 02 NOx vs BB 04 NOx	12.95	1.13	No
BB 04 NOx vs BB 98 NOx	31.18	2.49	No
BB 04 NOx vs BB 99 NOx	24.93	2.02	No
BB 04 NOx vs BB 00 NOx	8.71	0.73	No
BB 00 NOx vs BB 98 NOx	22.47	2.04	No
BB 00 NOx vs BB 99 NOx	16.22	1.50	No
BB 99 NOx vs BB 98 NOx	6.25	0.55	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

One Way Analysis of Variance
Data source: BB Water Quality Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: BB in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
BB 00 TN	10	0	0.30	0.27	0.35
BB 01 TN	22	0	0.20	0.19	0.27
BB 02 TN	26	0	0.19	0.16	0.22
BB 04 TN	12	0	0.13	0.060	0.34

H = 12.56 with 3 degrees of freedom. (P = 0.006)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.006)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
BB 00 TN vs BB 04 TN	28.17	3.23	Yes
BB 00 TN vs BB 02 TN	23.42	3.09	Yes
BB 00 TN vs BB 01 TN	17.41	2.24	No
BB 01 TN vs BB 04 TN	10.76	1.47	No
BB 01 TN vs BB 02 TN	6.01	1.02	No
BB 02 TN vs BB 04 TN	4.74	0.67	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

One Way Analysis of Variance

Data source: BB Water Quality Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: BB in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
BB 00 TDN	9	0	0.29	0.21	0.35
BB 01 TDN	22	0	0.18	0.16	0.24
BB 02 TDN	26	0	0.17	0.12	0.20
BB 04 TDN	12	0	0.080	0.050	0.29

H = 13.69 with 3 degrees of freedom. (P = 0.003)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.003)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
BB 00 TDN vs BB 04 TDN	30.68	3.47	Yes
BB 00 TDN vs BB 02 TDN	22.94	2.96	Yes
BB 00 TDN vs BB 01 TDN	15.92	2.01	No
BB 01 TDN vs BB 04 TDN	14.76	2.05	No
BB 01 TDN vs BB 02 TDN	7.02	1.21	No
BB 02 TDN vs BB 04 TDN	7.74	1.11	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Descriptive Statistics:
Data source: BB in Eelgrass Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
BB 1997	4	0	710.00	392.32	196.16	624.27
BB 1998	12	0	620.00	387.15	111.76	245.98
BB 1999	12	0	548.00	271.97	78.51	172.80
BB 2000	60	0	301.17	200.09	25.83	51.69
BB 2001	60	0	150.17	138.66	17.90	35.82
BB 2002	60	0	201.17	109.19	14.10	28.21
BB 2004	60	0	125.50	217.85	28.12	56.28

Column	Range	Max	Min	Median	25%	75%
BB 1997	920.00	1264.00	344.00	616.00	460.00	960.00
BB 1998	1184.00	1296.00	112.00	424.00	368.00	976.00
BB 1999	944.00	1136.00	192.00	496.00	368.00	672.00
BB 2000	880.00	930.00	50.00	250.00	155.00	385.00
BB 2001	820.00	820.00	0.00	130.00	55.00	210.00
BB 2002	450.00	450.00	0.00	180.00	120.00	270.00
BB 2004	870.00	870.00	0.00	0.00	0.00	180.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
BB 1997	1.31	2.33	0.30	0.209	2840.00	2478144.00
BB 1998	0.42	-1.27	0.27	0.016	7440.00	6261504.00
BB 1999	0.92	0.69	0.21	0.155	6576.00	4417280.00
BB 2000	1.34	1.50	0.15	0.002	18070.00	7804300.00
BB 2001	2.21	8.59	0.14	0.005	9010.00	2487300.00
BB 2002	0.18	-0.63	0.094	0.210	12070.00	3131500.00
BB 2004	1.73	2.06	0.38	<0.001	7530.00	3745100.00

One Way Analysis of Variance
Data source: BB in Eelgrass Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: BB in Eelgrass Trend analysis

Group	N	Missing	Median	25%	75%
BB 1997	4	0	616.00	460.00	960.00
BB 1998	12	0	424.00	368.00	976.00
BB 1999	12	0	496.00	368.00	672.00
BB 2000	60	0	250.00	155.00	385.00
BB 2001	60	0	130.00	55.00	210.00
BB 2002	60	0	180.00	120.00	270.00
BB 2004	60	0	0.00	0.00	180.00

H = 87.37 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
BB 1997 vs BB 2004	162.41	4.06	Yes
BB 1997 vs BB 2001	135.47	3.38	Yes
BB 1997 vs BB 2002	104.66	2.61	No
BB 1997 vs BB 2000	76.12	1.90	No
BB 1997 vs BB 1998	21.67	0.48	No
BB 1997 vs BB 1999	16.63	0.37	No
BB 1999 vs BB 2004	145.78	5.95	Yes
BB 1999 vs BB 2001	118.84	4.85	Yes
BB 1999 vs BB 2002	88.03	3.59	No
BB 1999 vs BB 2000	59.49	2.43	No
BB 1999 vs BB 1998	5.04	0.16	No
BB 1998 vs BB 2004	140.74	5.74	Yes
BB 1998 vs BB 2001	113.80	4.64	Yes
BB 1998 vs BB 2002	82.99	3.39	No
BB 1998 vs BB 2000	54.45	2.22	No
BB 2000 vs BB 2004	86.29	6.10	Yes
BB 2000 vs BB 2001	59.35	4.19	Yes
BB 2000 vs BB 2002	28.54	2.02	No
BB 2002 vs BB 2004	57.75	4.08	Yes
BB 2002 vs BB 2001	30.81	2.18	No
BB 2001 vs BB 2004	26.94	1.90	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Descriptive Statistics:
Data source: BB Algae Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean

BB 2000	24	0	18.96	20.11	4.10	8.49
BB 2001	60	0	23.27	33.11	4.28	8.55
BB 2002	60	0	56.42	38.98	5.03	10.07
BB 2004	60	0	0.100	0.66	0.085	0.17

Column	Range	Max	Min	Median	25%	75%
BB 2000	75.00	75.00	0.00	15.00	2.50	25.00
BB 2001	100.00	100.00	0.00	5.00	0.00	50.00
BB 2002	100.00	100.00	0.00	50.00	10.00	100.00
BB 2004	5.00	5.00	0.00	0.00	0.00	0.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
BB 2000	1.50	2.15	0.26	<0.001	455.00	17925.00
BB 2001	1.25	0.14	0.29	<0.001	1396.00	97176.00
BB 2002	-0.14	-1.60	0.20	<0.001	3385.00	280625.00
BB 2004	7.34	55.27	0.53	<0.001	6.00	26.00

One Way Analysis of Variance
Data source: BB Algae Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: BB in Algae Trend Analysis

Group	N	Missing	Median	25%	75%
BB 2000	24	0	15.00	2.50	25.00
BB 2001	60	0	5.00	0.00	50.00
BB 2002	60	0	50.00	10.00	100.00
BB 2004	60	0	0.00	0.00	0.00

H = 98.12 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks		Q	P<0.05
BB 2002 vs BB 2004	100.09		9.29	Yes
BB 2002 vs BB 2001	50.29	4.67	Yes	
BB 2002 vs BB 2000	39.20	2.75	Yes	
BB 2000 vs BB 2004	60.90	4.27	Yes	
BB 2000 vs BB 2001	11.10	0.78	No	
BB 2001 vs BB 2004	49.80	4.62	Yes	

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Appendix 7. The statistical reports generated for all of the analyses conducted in the synthesis of 2004 Long-Term Monitoring Report for Gardiner's Bay.

Descriptive Statistics:
Data source: GB Water Quality Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
GB 97 NOx	16	0	0.0054	0.0015	0.00037	0.00080
GB 98 NOx	15	0	0.0050	0.000000000088	0.000000000023	0.000000000049
GB 99 NOx	13	0	0.0072	0.0056	0.0016	0.0034
GB 00 NOx	18	0	0.022	0.022	0.0051	0.011
GB 01 NOx	7	0	0.038	0.022	0.0082	0.020
GB 02 NOx	16	0	0.013	0.011	0.0029	0.0061
GB 04 NOx	8	0	0.038	0.035	0.012	0.029
GB 00 TN	12	0	0.26	0.081	0.023	0.051
GB 01 TN	7	0	0.25	0.097	0.037	0.090
GB 02 TN	16	0	0.20	0.084	0.021	0.045
GB 04 TN	8	0	0.19	0.15	0.051	0.12
GB 00 TDN	12	0	0.24	0.084	0.024	0.053
GB 01 TDN	7	0	0.23	0.10	0.039	0.094
GB 02 TDN	16	0	0.19	0.091	0.023	0.048
GB 04 TDN	8	0	0.13	0.12	0.041	0.097

Column	Range	Max	Min	Median	25%	75%
GB 97 NOx	0.0060	0.011	0.0050	0.0050	0.0050	0.0050
GB 98 NOx	0.00	0.0050	0.0050	0.0050	0.0050	0.0050
GB 99 NOx	0.018	0.023	0.0050	0.0050	0.0050	0.0050
GB 00 NOx	0.054	0.059	0.0050	0.0090	0.0050	0.045
GB 01 NOx	0.053	0.059	0.0060	0.045	0.017	0.057
GB 02 NOx	0.033	0.038	0.0050	0.0060	0.0050	0.018
GB 04 NOx	0.10	0.11	0.0050	0.028	0.011	0.055
GB 00 TN	0.24	0.36	0.12	0.27	0.19	0.34
GB 01 TN	0.24	0.36	0.12	0.20	0.19	0.35
GB 02 TN	0.31	0.39	0.080	0.16	0.14	0.27
GB 04 TN	0.39	0.44	0.050	0.14	0.075	0.31
GB 00 TDN	0.24	0.35	0.11	0.25	0.16	0.32
GB 01 TDN	0.24	0.35	0.11	0.19	0.16	0.34
GB 02 TDN	0.30	0.38	0.080	0.15	0.13	0.28
GB 04 TDN	0.32	0.37	0.050	0.075	0.050	0.20

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
GB 97 NOx	4.00	16.00	0.54	<0.001	0.086	0.00050
GB 98 NOx	0.00	-2.33	0.50	<0.001	0.075	0.00038
GB 99 NOx	2.47	5.41	0.50	<0.001	0.094	0.0011
GB 00 NOx	0.87	-1.11	0.27	0.001	0.39	0.016
GB 01 NOx	-0.70	-1.36	0.20	0.480	0.27	0.013
GB 02 NOx	1.42	0.65	0.31	<0.001	0.20	0.0045
GB 04 NOx	1.27	1.43	0.19	0.491	0.30	0.020
GB 00 TN	-0.21	-1.37	0.17	0.371	3.08	0.86
GB 01 TN	0.078	-2.12	0.27	0.136	1.75	0.49
GB 02 TN	0.85	0.061	0.23	0.021	3.15	0.73
GB 04 TN	0.84	-0.78	0.21	0.329	1.54	0.44
GB 00 TDN	-0.13	-1.54	0.14	0.642	2.88	0.77

GB 01 TDN	0.16	-2.39	0.25	0.184	1.64	0.45
GB 02 TDN	0.72	-0.66	0.24	0.016	3.06	0.71
GB 04 TDN	1.40	1.43	0.26	0.102	1.07	0.24

One Way Analysis of Variance
Data source: GB Water Quality Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: GB in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
GB 97 NOx	16	0	0.0050	0.0050	0.0050
GB 98 NOx	15	0	0.0050	0.0050	0.0050
GB 99 NOx	13	0	0.0050	0.0050	0.0050
GB 00 NOx	18	0	0.0090	0.0050	0.045
GB 01 NOx	7	0	0.045	0.017	0.057
GB 02 NOx	16	0	0.0060	0.0050	0.018
GB 04 NOx	8	0	0.028	0.011	0.055

H = 42.54 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
GB 01 NOx vs GB 98 NOx	49.71	4.02	Yes
GB 01 NOx vs GB 97 NOx	47.40	3.88	Yes
GB 01 NOx vs GB 99 NOx	43.14	3.41	Yes
GB 01 NOx vs GB 02 NOx	26.93	2.20	No
GB 01 NOx vs GB 00 NOx	20.80	1.73	No
GB 01 NOx vs GB 04 NOx	9.90	0.71	No
GB 04 NOx vs GB 98 NOx	39.81	3.37	Yes
GB 04 NOx vs GB 97 NOx	37.50	3.21	Yes
GB 04 NOx vs GB 99 NOx	33.24	2.74	No
GB 04 NOx vs GB 02 NOx	17.03	1.46	No
GB 04 NOx vs GB 00 NOx	10.90	0.95	No
GB 00 NOx vs GB 98 NOx	28.92	3.06	Yes
GB 00 NOx vs GB 97 NOx	26.60	2.87	No
GB 00 NOx vs GB 99 NOx	22.34	2.27	No
GB 00 NOx vs GB 02 NOx	6.14	0.66	No
GB 02 NOx vs GB 98 NOx	22.78	2.35	No
GB 02 NOx vs GB 97 NOx	20.47	2.14	No
GB 02 NOx vs GB 99 NOx	16.20	1.61	No

GB 99 NOx vs GB 98 NOx	6.58	0.64	No
GB 99 NOx vs GB 97 NOx	4.26	0.42	No
GB 97 NOx vs GB 98 NOx	2.31	0.24	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

One Way Analysis of Variance
Data source: GB Water Quality Trend Analysis

Normality Test: Failed (P = 0.003)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: GB in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
GB 00 TN	12	0	0.27	0.19	0.34
GB 01 TN	7	0	0.20	0.19	0.35
GB 02 TN	16	0	0.16	0.14	0.27
GB 04 TN	8	0	0.14	0.075	0.31

H = 4.93 with 3 degrees of freedom. (P = 0.177)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.177)

One Way Analysis of Variance

Data source: GB Water Quality Trend Analysis

Normality Test: Failed (P = 0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: GB in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
GB 00 TDN	12	0	0.25	0.16	0.32
GB 01 TDN	7	0	0.19	0.16	0.34
GB 02 TDN	16	0	0.15	0.13	0.28
GB 04 TDN	8	0	0.075	0.050	0.20

H = 6.92 with 3 degrees of freedom. (P = 0.074)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.074)

Descriptive Statistics: Thursday, August 25, 2005, 09:55:47

Data source: GB in 5-Year Eelgrass Trend Aanalysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
GB 1999	12	0	498.67	127.42	36.78	80.96
GB 2000	60	0	470.17	178.49	23.04	46.11
GB 2001	60	0	372.83	123.95	16.00	32.02
GB 2002	60	0	305.83	190.78	24.63	49.28
GB 2004	60	0	300.17	204.78	26.44	52.90

Column	Range	Max	Min	Median	25%	75%
GB 1999	464.00	720.00	256.00	504.00	424.00	584.00
GB 2000	820.00	950.00	130.00	465.00	340.00	580.00
GB 2001	700.00	760.00	60.00	365.00	280.00	455.00
GB 2002	670.00	670.00	0.00	340.00	160.00	410.00
GB 2004	680.00	680.00	0.00	275.00	135.00	450.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
GB 1999	-0.23	0.038	0.10	0.834	5984.00	3162624.00
GB 2000	0.20	-0.17	0.050	0.880	28210.00	15143100.00
GB 2001	0.40	0.89	0.065	0.698	22370.00	9246700.00
GB 2002	-0.27	-0.71	0.15	0.001	18350.00	7759500.00
GB 2004	0.16	-1.01	0.080	0.428	18010.00	7880100.00

One Way Analysis of Variance
Data source: GB Eelgrass Trend Analysis

Normality Test: Passed (P > 0.200)

Equal Variance Test: Failed (P = 0.002)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: GB in Eelgrass Trend analysis

Group	N	Missing	Median	25%	75%
GB 1999	12	0	504.00	424.00	584.00
GB 2000	60	0	465.00	340.00	580.00
GB 2001	60	0	365.00	280.00	455.00
GB 2002	60	0	340.00	160.00	410.00
GB 2004	60	0	275.00	135.00	450.00

H = 33.24 with 4 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
GB 1999 vs GB 2004	77.77	3.37	Yes
GB 1999 vs GB 2002	75.01	3.25	Yes
GB 1999 vs GB 2001	54.87	2.38	No
GB 1999 vs GB 2000	17.23	0.75	No
GB 2000 vs GB 2004	60.53	4.55	Yes
GB 2000 vs GB 2002	57.78	4.34	Yes
GB 2000 vs GB 2001	37.63	2.83	No
GB 2001 vs GB 2004	22.90	1.72	No
GB 2001 vs GB 2002	20.14	1.51	No
GB 2002 vs GB 2004	2.76	0.21	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Descriptive Statistics:

Data source: GB Algae Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
GB 2000	24	0	25.83	21.40	4.37	9.04
GB 2001	60	0	14.18	15.53	2.01	4.01
GB 2002	60	0	23.37	25.29	3.26	6.53
GB 2004	60	0	21.30	22.52	2.91	5.82

Column	Range	Max	Min	Median	25%	75%
GB 2000	75.00	75.00	0.00	22.50	7.50	50.00
GB 2001	100.00	100.00	0.00	10.00	5.00	20.00
GB 2002	90.00	90.00	0.00	10.00	5.00	45.00
GB 2004	90.00	90.00	0.00	10.00	5.00	30.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
GB 2000	0.70	-0.54	0.18	0.038	620.00	26550.00
GB 2001	3.27	15.35	0.29	<0.001	851.00	26301.00
GB 2002	1.15	0.087	0.27	<0.001	1402.00	70482.00
GB 2004	1.41	1.35	0.26	<0.001	1278.00	57140.00

One Way Analysis of Variance
Data source: GB Algae Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: GB in Algae Trend Analysis

Group	N	Missing	Median	25%	75%
GB 2000	24	0	22.50	7.50	50.00
GB 2001	60	0	10.00	5.00	20.00
GB 2002	60	0	10.00	5.00	45.00
GB 2004	60	0	10.00	5.00	30.00

H = 4.77 with 3 degrees of freedom. (P = 0.190)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.190)

Appendix 8. The statistical reports generated for all of the analyses conducted in the synthesis of 2004 Long-Term Monitoring Report for Northwest Harbor.

Descriptive Statistics:

Data source: NWH Water Quality Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
NWH 97 NOx	47	0	0.0053	0.0020	0.00030	0.00060
NWH 98 NOx	42	0	0.0050	0.00015	0.000024	0.000048
NWH 99 NOx	36	0	0.0057	0.0021	0.00036	0.00073
NWH 00 NOx	21	0	0.016	0.024	0.0051	0.011
NWH 01 NOx	20	0	0.033	0.024	0.0054	0.011
NWH 02 NOx	18	0	0.027	0.036	0.0085	0.018
NWH 04 NOx	9	0	0.028	0.021	0.0069	0.016
NWH 00 TN	8	0	0.24	0.055	0.020	0.046
NWH 01 TN	20	0	0.21	0.084	0.019	0.039
NWH 02 TN	18	0	0.20	0.089	0.021	0.044
NWH 04 TN	9	0	0.18	0.19	0.063	0.15
NWH 00 TDN	8	0	0.24	0.050	0.018	0.042
NWH 01 TDN	20	0	0.20	0.080	0.018	0.038
NWH 02 TDN	18	0	0.19	0.083	0.019	0.041
NWH 04 TDN	9	0	0.17	0.19	0.063	0.15

Column	Range	Max	Min	Median	25%	75%
NWH 97 NOx	0.014	0.019	0.0050	0.0050	0.0050	0.0050
NWH 98 NOx	0.00100	0.0060	0.0050	0.0050	0.0050	0.0050
NWH 99 NOx	0.0100	0.015	0.0050	0.0050	0.0050	0.0050
NWH 00 NOx	0.089	0.094	0.0050	0.0050	0.0050	0.011
NWH 01 NOx	0.075	0.080	0.0050	0.039	0.0075	0.051
NWH 02 NOx	0.10	0.11	0.0050	0.0075	0.0050	0.034
NWH 04 NOx	0.056	0.061	0.0050	0.018	0.014	0.047
NWH 00 TN	0.18	0.32	0.14	0.23	0.22	0.28
NWH 01 TN	0.25	0.36	0.11	0.17	0.16	0.26
NWH 02 TN	0.32	0.40	0.080	0.19	0.13	0.28
NWH 04 TN	0.56	0.61	0.050	0.080	0.050	0.24
NWH 00 TDN	0.15	0.31	0.16	0.23	0.21	0.29
NWH 01 TDN	0.25	0.36	0.11	0.17	0.14	0.24
NWH 02 TDN	0.29	0.37	0.080	0.16	0.12	0.27
NWH 04 TDN	0.53	0.58	0.050	0.060	0.050	0.25

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
NWH 97 NOx	6.80	46.49	0.52	<0.001	0.25	0.0015
NWH 98 NOx	6.48	42.00	0.54	<0.001	0.21	0.0011
NWH 99 NOx	3.44	11.73	0.49	<0.001	0.21	0.0013
NWH 00 NOx	2.58	6.18	0.39	<0.001	0.33	0.016
NWH 01 NOx	0.20	-1.23	0.19	0.057	0.66	0.033
NWH 02 NOx	1.45	0.50	0.35	<0.001	0.49	0.035
NWH 04 NOx	0.84	-0.98	0.26	0.080	0.25	0.010
NWH 00 TN	-0.16	0.62	0.19	0.513	1.90	0.47
NWH 01 TN	0.93	-0.53	0.25	0.002	4.19	1.01
NWH 02 TN	0.65	-0.35	0.14	0.386	3.63	0.87
NWH 04 TN	1.82	3.21	0.25	0.099	1.58	0.56

NWH 00 TDN	-0.14	-0.57	0.17	0.603	1.94	0.49
NWH 01 TDN	1.12	-0.20	0.31	<0.001	4.03	0.94
NWH 02 TDN	0.66	-0.46	0.17	0.187	3.35	0.74
NWH 04 TDN	1.66	1.96	0.31	0.014	1.52	0.54

One Way Analysis of Variance

Data source: NWH Water Quality Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: NWH in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
NWH 97 NOx	47	0	0.0050	0.0050	0.0050
NWH 98 NOx	42	0	0.0050	0.0050	0.0050
NWH 99 NOx	36	0	0.0050	0.0050	0.0050
NWH 00 NOx	21	0	0.0050	0.0050	0.011
NWH 01 NOx	20	0	0.039	0.0075	0.051
NWH 02 NOx	18	0	0.0075	0.0050	0.034
NWH 04 NOx	9	0	0.018	0.014	0.047

H = 92.31 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
NWH 04 NOx vs NWH 98 NOx	87.55	4.27	Yes
NWH 04 NOx vs NWH 97 NOx	85.65	4.21	Yes
NWH 04 NOx vs NWH 99 NOx	77.69	3.73	Yes
NWH 04 NOx vs NWH 00 NOx	45.04	2.02	No
NWH 04 NOx vs NWH 02 NOx	33.83	1.48	No
NWH 04 NOx vs NWH 01 NOx	7.90	0.35	No
NWH 01 NOx vs NWH 98 NOx	79.65	5.25	Yes
NWH 01 NOx vs NWH 97 NOx	77.75	5.21	Yes
NWH 01 NOx vs NWH 99 NOx	69.79	4.48	Yes
NWH 01 NOx vs NWH 00 NOx	37.14	2.13	No
NWH 01 NOx vs NWH 02 NOx	25.93	1.43	No
NWH 02 NOx vs NWH 98 NOx	53.72	3.41	Yes
NWH 02 NOx vs NWH 97 NOx	51.82	3.35	Yes
NWH 02 NOx vs NWH 99 NOx	43.86	2.72	No
NWH 02 NOx vs NWH 00 NOx	11.21	0.62	No
NWH 00 NOx vs NWH 98 NOx	42.51	2.85	No

NWH 00 NOx vs NWH 97 NOx	40.61	2.77	No
NWH 00 NOx vs NWH 99 NOx	32.65	2.13	No
NWH 99 NOx vs NWH 98 NOx	9.86	0.78	No
NWH 99 NOx vs NWH 97 NOx	7.96	0.64	No
NWH 97 NOx vs NWH 98 NOx	1.90	0.16	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

One Way Analysis of Variance

Data source: NWH Water Quality Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: NWH in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
NWH 00 TN	8	0	0.23	0.22	0.28
NWH 01 TN	20	0	0.17	0.16	0.26
NWH 02 TN	18	0	0.19	0.13	0.28
NWH 04 TN	9	0	0.080	0.050	0.24

H = 5.46 with 3 degrees of freedom. (P = 0.141)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.141)

One Way Analysis of Variance

Data source: NWH Water Quality Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: NWH in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
NWH 00 TDN	8	0	0.23	0.21	0.29
NWH 01 TDN	20	0	0.17	0.14	0.24
NWH 02 TDN	18	0	0.16	0.12	0.27
NWH 04 TDN	9	0	0.060	0.050	0.25

H = 7.40 with 3 degrees of freedom. (P = 0.060)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.060)

Descriptive Statistics:
Data source: NWH Eelgrass Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
NWH 1997	3	0	209.33	41.05	23.70	101.98
NWH 1998	12	0	310.67	72.67	20.98	46.17
NWH 1999	12	0	506.67	196.71	56.79	124.98
NWH 2000	60	0	329.83	166.03	21.43	42.89
NWH 2001	60	0	408.83	155.71	20.10	40.22
NWH 2002	60	0	349.83	146.15	18.87	37.76
NWH 2004	60	0	290.50	141.81	18.31	36.63

Column	Range	Max	Min	Median	25%	75%
NWH 1997	80.00	244.00	164.00	220.00	178.00	238.00
NWH 1998	240.00	400.00	160.00	336.00	272.00	360.00
NWH 1999	704.00	864.00	160.00	520.00	368.00	616.00
NWH 2000	640.00	720.00	80.00	320.00	185.00	475.00
NWH 2001	700.00	820.00	120.00	400.00	280.00	520.00
NWH 2002	730.00	800.00	70.00	330.00	245.00	445.00
NWH 2004	650.00	650.00	0.00	300.00	190.00	390.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
NWH 1997	-1.09	--	0.27	0.429	628.00	134832.00
NWH 1998	-1.01	0.18	0.22	0.128	3728.00	1216256.00
NWH 1999	-0.060	-0.024	0.15	0.613	6080.00	3506176.00
NWH 2000	0.38	-0.77	0.13	0.010	19790.00	8153700.00
NWH 2001	0.31	0.041	0.067	0.664	24530.00	11459100.00
NWH 2002	0.71	0.86	0.087	0.297	20990.00	8603300.00
NWH 2004	0.18	-0.097	0.072	0.562	17430.00	6249900.00

One Way Analysis of Variance
Data source: NWH Eelgrass Trend Analysis

Normality Test: Passed (P = 0.197)

Equal Variance Test: Passed (P = 0.068)

Group Name	N	Missing	Mean	Std Dev	SEM
NWH 1997	3	0	209.33	41.05	23.70
NWH 1998	12	0	310.67	72.67	20.98
NWH 1999	12	0	506.67	196.71	56.79
NWH 2000	60	0	329.83	166.03	21.43
NWH 2001	60	0	408.83	155.71	20.10
NWH 2002	60	0	349.83	146.15	18.87
NWH 2004	60	0	290.50	141.81	18.31

Source of Variation	DF	SS	MS	F	P
Between Groups	6	816678.82	136113.14	5.91	<0.001
Residual	260	5990604.00	23040.78		

Total	266	6807282.82

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.05: 0.994

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
NWH 1999 vs. NWH 1997	297.33	7	4.29	0.039	Yes
NWH 1999 vs. NWH 2004	216.17	7	6.37	<0.001	Yes
NWH 1999 vs. NWH 1998	196.00	7	4.47	0.026	Yes
NWH 1999 vs. NWH 2000	176.83	7	5.21	0.004	Yes
NWH 1999 vs. NWH 2002	156.83	7	4.62	0.019	Yes
NWH 1999 vs. NWH 2001	97.83	7	2.88	0.390	No
NWH 2001 vs. NWH 1997	199.50	7	3.14	0.284	No
NWH 2001 vs. NWH 2004	118.33	7	6.04	<0.001	No
NWH 2001 vs. NWH 1998	98.17	7	2.89	0.386	No
NWH 2001 vs. NWH 2000	79.00	7	4.03	0.066	No
NWH 2001 vs. NWH 2002	59.00	7	3.01	0.335	No
NWH 2002 vs. NWH 1997	140.50	7	2.21	0.705	No
NWH 2002 vs. NWH 2004	59.33	7	3.03	0.328	No
NWH 2002 vs. NWH 1998	39.17	7	1.15	0.983	No
NWH 2002 vs. NWH 2000	20.00	7	1.02	0.991	No
NWH 2000 vs. NWH 1997	120.50	7	1.90	0.832	No
NWH 2000 vs. NWH 2004	39.33	7	2.01	0.792	No
NWH 2000 vs. NWH 1998	19.17	7	0.56	1.000	No
NWH 1998 vs. NWH 1997	101.33	7	1.46	0.946	No
NWH 1998 vs. NWH 2004	20.17	7	0.59	1.000	No
NWH 2004 vs. NWH 1997	81.17	7	1.28	0.972	No

Descriptive Statistics:

Data source: NWH Algae Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
NWH 2000	24	0	38.29	28.73	5.87	12.13
NWH 2001	60	0	30.92	23.91	3.09	6.18
NWH 2002	60	0	64.25	29.38	3.79	7.59
NWH 2004	60	0	81.42	24.06	3.11	6.22

Column	Range	Max	Min	Median	25%	75%
NWH 2000	89.00	90.00	1.00	40.00	10.00	60.00
NWH 2001	100.00	100.00	0.00	30.00	10.00	37.50
NWH 2002	90.00	100.00	10.00	75.00	40.00	90.00
NWH 2004	80.00	100.00	20.00	92.50	75.00	100.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
NWH 2000	0.23	-1.03	0.14	0.284	919.00	54179.00
NWH 2001	1.33	1.51	0.25	<0.001	1855.00	91075.00

NWH 2002	-0.44	-1.11	0.24	<0.001	3855.00	298625.00
NWH 2004	-1.25	0.38	0.26	<0.001	4885.00	431875.00

One Way Analysis of Variance
Data source: NWH Algae Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: NWH in Algae Trend Analysis

Group	N	Missing	Median	25%	75%
NWH 2000	24	0	40.00	10.00	60.00
NWH 2001	60	0	30.00	10.00	37.50
NWH 2002	60	0	75.00	40.00	90.00
NWH 2004	60	0	92.50	75.00	100.00

H = 75.95 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
NWH 2004 vs NWH 2001	86.82	8.06	Yes
NWH 2004 vs NWH 2000	77.17	5.41	Yes
NWH 2004 vs NWH 2002	32.05	2.97	Yes
NWH 2002 vs NWH 2001	54.77	5.08	Yes
NWH 2002 vs NWH 2000	45.12	3.16	Yes
NWH 2000 vs NWH 2001	9.66	0.68	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Appendix 9. The statistical reports generated for all of the analyses conducted in the synthesis of 2004 Long-Term Monitoring Report for Orient Harbor.

Descriptive Statistics:
Data source: OH Water Quality Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
OH 97 NOx	46	0	0.0054	0.0020	0.00030	0.00060
OH 98 NOx	70	0	0.0061	0.0045	0.00054	0.0011
OH 99 NOx	25	0	0.0069	0.0039	0.00077	0.0016
OH 00 NOx	21	0	0.012	0.012	0.0027	0.0055
OH 01 NOx	20	0	0.038	0.030	0.0068	0.014
OH 02 NOx	17	0	0.021	0.022	0.0053	0.011
OH 04 NOx	9	0	0.024	0.031	0.010	0.024
OH 00 TN	8	0	0.25	0.062	0.022	0.052
OH 01 TN	20	0	0.21	0.085	0.019	0.040
OH 02 TN	17	0	0.19	0.090	0.022	0.046
OH 04 TN	9	0	0.14	0.12	0.039	0.090
OH 00 TDN	8	0	0.25	0.059	0.021	0.050
OH 01 TDN	20	0	0.20	0.079	0.018	0.037
OH 02 TDN	17	0	0.19	0.082	0.020	0.042
OH 04 TDN	9	1	0.14	0.14	0.048	0.11

Column	Range	Max	Min	Median	25%	75%
OH 97 NOx	0.013	0.018	0.0050	0.0050	0.0050	0.0050
OH 98 NOx	0.029	0.034	0.0050	0.0050	0.0050	0.0050
OH 99 NOx	0.013	0.018	0.0050	0.0050	0.0050	0.0073
OH 00 NOx	0.050	0.055	0.0050	0.0050	0.0050	0.014
OH 01 NOx	0.097	0.10	0.0050	0.029	0.013	0.057
OH 02 NOx	0.081	0.086	0.0050	0.011	0.0050	0.028
OH 04 NOx	0.074	0.079	0.0050	0.0100	0.0050	0.030
OH 00 TN	0.18	0.33	0.15	0.26	0.21	0.31
OH 01 TN	0.26	0.37	0.11	0.19	0.14	0.27
OH 02 TN	0.31	0.39	0.080	0.19	0.12	0.25
OH 04 TN	0.32	0.37	0.050	0.070	0.050	0.20
OH 00 TDN	0.16	0.33	0.17	0.24	0.21	0.30
OH 01 TDN	0.24	0.35	0.11	0.17	0.14	0.26
OH 02 TDN	0.29	0.38	0.090	0.17	0.11	0.24
OH 04 TDN	0.39	0.44	0.050	0.070	0.050	0.19

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
OH 97 NOx	5.87	36.39	0.52	<0.001	0.25	0.0015
OH 98 NOx	4.98	26.24	0.48	<0.001	0.43	0.0040
OH 99 NOx	2.26	4.32	0.41	<0.001	0.17	0.0015
OH 00 NOx	2.58	7.52	0.28	<0.001	0.26	0.0061
OH 01 NOx	0.81	-0.51	0.17	0.111	0.76	0.046
OH 02 NOx	1.97	4.03	0.27	0.002	0.35	0.015
OH 04 NOx	1.56	0.63	0.40	<0.001	0.21	0.013
OH 00 TN	-0.27	-0.55	0.14	0.757	2.03	0.54
OH 01 TN	0.85	-0.62	0.16	0.178	4.24	1.03
OH 02 TN	0.67	-0.25	0.18	0.176	3.31	0.77
OH 04 TN	1.08	0.12	0.28	0.036	1.27	0.29
OH 00 TDN	0.29	-0.78	0.18	0.561	1.98	0.52

OH 01 TDN	0.87	-0.70	0.19	0.070	3.94	0.89
OH 02 TDN	0.87	0.25	0.16	0.266	3.15	0.69
OH 04 TDN	1.93	3.83	0.29	0.048	1.10	0.28

One Way Analysis of Variance

Data source: OH Water Quality Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: OH Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
OH 97 NOx	46	0	0.00500	0.00500	0.00500
OH 98 NOx	70	0	0.00500	0.00500	0.00500
OH 99 NOx	25	0	0.00500	0.00500	0.00725
OH 00 NOx	21	0	0.00500	0.00500	0.0143
OH 01 NOx	20	0	0.0290	0.0130	0.0575
OH 02 NOx	17	0	0.0110	0.00500	0.0283
OH 04 NOx	9	0	0.01000	0.00500	0.0298

H = 87.552 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
OH 01 NOx vs OH 97 NOx	97.188	6.029	Yes
OH 01 NOx vs OH 98 NOx	92.411	6.056	Yes
OH 01 NOx vs OH 99 NOx	77.565	4.296	Yes
OH 01 NOx vs OH 00 NOx	54.025	2.873	No
OH 01 NOx vs OH 04 NOx	42.192	1.746	No
OH 01 NOx vs OH 02 NOx	28.496	1.435	No
OH 02 NOx vs OH 97 NOx	68.692	4.021	Yes
OH 02 NOx vs OH 98 NOx	63.915	3.927	Yes
OH 02 NOx vs OH 99 NOx	49.069	2.593	No
OH 02 NOx vs OH 00 NOx	25.529	1.300	No
OH 02 NOx vs OH 04 NOx	13.696	0.552	No
OH 04 NOx vs OH 97 NOx	54.996	2.507	No
OH 04 NOx vs OH 98 NOx	50.219	2.356	No
OH 04 NOx vs OH 99 NOx	35.373	1.512	No
OH 04 NOx vs OH 00 NOx	11.833	0.493	No
OH 00 NOx vs OH 97 NOX	43.163 2.723	No	
OH 00 NOx vs OH 98 NOx	38.386 2.563	No	

OH 00 NOx vs OH 99 NOx	23.540	1.321	No
OH 99 NOx vs OH 97 NOX	19.623	1.312	No
OH 99 NOx vs OH 98 NOx	14.846	1.059	No
OH 98 NOx vs OH 97 NOX	4.777	0.418	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

One Way Analysis of Variance
Data source: OH Water Quality Trend Analysis

Normality Test: Passed (P = 0.032)

Equal Variance Test: Passed (P = 0.388)

Group Name	N	Missing	Mean	Std Dev	SEM
OH 00 TN	8	0	0.25	0.062	0.022
OH 01 TN	20	0	0.21	0.085	0.019
OH 02 TN	17	0	0.19	0.090	0.022
OH 04 TN	9	0	0.14	0.12	0.039

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.057	0.019	2.36	0.083
Residual	50	0.40	0.0081		
Total	53	0.46			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.083).

Power of performed test with alpha = 0.05: 0.330

The power of the performed test (0.330) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

One Way Analysis of Variance

Data source: OH Water Quality Trend Analysis

Normality Test: Failed (P = 0.003)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: OH in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
OH 00 TDN	8	0	0.24	0.21	0.30
OH 01 TDN	20	0	0.17	0.14	0.26
OH 02 TDN	17	0	0.17	0.11	0.24
OH 04 TDN	9	1	0.070	0.050	0.19

H = 8.92 with 3 degrees of freedom. (P = 0.030)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.030)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
OH 00 TDN vs OH 04 TDN	22.69	2.94	Yes
OH 00 TDN vs OH 02 TDN	12.97	1.96	No
OH 00 TDN vs OH 01 TDN	10.38	1.61	No
OH 01 TDN vs OH 04 TDN	12.31	1.91	No
OH 01 TDN vs OH 02 TDN	2.60	0.51	No
OH 02 TDN vs OH 04 TDN	9.72	1.47	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Descriptive Statistics:

Data source: OH in 5-Year Eelgrass Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
OH 1997	3	0	573.33	118.28	68.29	293.82
OH 1998	10	0	696.00	260.00	82.22	185.99
OH 1999	12	0	586.67	171.29	49.45	108.83
OH 2000	60	0	487.83	200.57	25.89	51.81
OH 2001	60	0	451.50	127.24	16.43	32.87
OH 2002	60	0	229.50	103.77	13.40	26.81
OH 2004	60	0	55.50	113.26	14.62	29.26

Column	Range	Max	Min	Median	25%	75%
OH 1997	236.00	696.00	460.00	564.00	486.00	663.00
OH 1998	880.00	1088.00	208.00	712.00	576.00	832.00
OH 1999	496.00	832.00	336.00	600.00	456.00	720.00
OH 2000	950.00	990.00	40.00	460.00	350.00	610.00
OH 2001	720.00	780.00	60.00	460.00	360.00	540.00
OH 2002	430.00	440.00	10.00	235.00	150.00	305.00
OH 2004	650.00	650.00	0.00	0.00	0.00	75.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
OH 1997	0.35	--	0.20	0.633	1720.00	1014112.00
OH 1998	-0.52	0.22	0.16	0.560	6960.00	5452544.00
OH 1999	-0.12	-1.26	0.16	0.514	7040.00	4452864.00
OH 2000	0.34	-0.074	0.089	0.278	29270.00	16652300.00
OH 2001	-0.100	0.72	0.064	0.708	27090.00	13186300.00
OH 2002	-0.065	-0.75	0.100	0.139	13770.00	3795500.00
OH 2004	3.15	12.58	0.32	<0.001	3330.00	941700.00

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: OH Eelgrass Trend Analysis

Normality Test: Failed (P = <0.001)

Group	N	Missing	Median	25%	75%
OH 1997	3	0	564.00	486.00	663.00
OH 1998	10	0	712.00	576.00	832.00
OH 1999	12	0	600.00	456.00	720.00
OH 2000	60	0	460.00	350.00	610.00
OH 2001	60	0	460.00	360.00	540.00
OH 2002	60	0	235.00	150.00	305.00
OH 2004	60	0	0.00	0.00	75.00

H = 177.13 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
OH 1998 vs OH 2004	184.23	7.04	Yes
OH 1998 vs OH 2002	126.71	4.84	Yes
OH 1998 vs OH 2001	46.41	1.77	No
OH 1998 vs OH 2000	42.40	1.62	No
OH 1998 vs OH 1999	12.36	0.38	No
OH 1998 vs OH 1997	7.15	0.14	No
OH 1997 vs OH 2004	177.08	3.91	Yes
OH 1997 vs OH 2002	119.56	2.64	No
OH 1997 vs OH 2001	39.26	0.87	No
OH 1997 vs OH 2000	35.25	0.78	No
OH 1997 vs OH 1999	5.21	0.11	No
OH 1999 vs OH 2004	171.88	7.09	Yes
OH 1999 vs OH 2002	114.35	4.72	No
OH 1999 vs OH 2001	34.05	1.40	No
OH 1999 vs OH 2000	30.04	1.24	No
OH 2000 vs OH 2004	141.83	10.14	Yes
OH 2000 vs OH 2002	84.31	6.03	No
OH 2000 vs OH 2001	4.01	0.29	No
OH 2001 vs OH 2004	137.83	9.85	Yes
OH 2001 vs OH 2002	80.30	5.74	No
OH 2002 vs OH 2004	57.52	4.11	Yes

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Descriptive Statistics:

Data source: OH Algae Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
OH 2000	24	0	7.13	11.95	2.44	5.04
OH 2001	60	0	37.08	23.80	3.07	6.15
OH 2002	60	0	12.70	16.46	2.12	4.25
OH 2004	60	0	1.13	3.66	0.47	0.95

Column	Range	Max	Min	Median	25%	75%
OH 2000	50.00	50.00	0.00	3.00	0.00	7.50
OH 2001	95.00	100.00	5.00	30.00	20.00	50.00
OH 2002	90.00	90.00	0.00	7.50	5.00	10.00
OH 2004	25.00	25.00	0.00	0.00	0.00	1.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
OH 2000	2.45	6.66	0.32	<0.001	171.00	4501.00
OH 2001	0.82	0.098	0.15	0.002	2225.00	115925.00
OH 2002	2.61	8.12	0.35	<0.001	762.00	25662.00
OH 2004	5.36	32.04	0.45	<0.001	68.00	868.00

One Way Analysis of Variance

Data source: OH Algae Trend Analysis

Normality Test: Failed   (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: OH in Algae Trend Analysis

Group	N	Missing	Median	25%	75%
OH 2000	24	0	3.00	0.00	7.50
OH 2001	60	0	30.00	20.00	50.00
OH 2002	60	0	7.50	5.00	10.00
OH 2004	60	0	0.00	0.00	1.00

H = 130.69 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
OH 2001 vs OH 2004	118.43	10.99	Yes
OH 2001 vs OH 2000	87.77	6.16	Yes
OH 2001 vs OH 2002	50.80	4.71	Yes
OH 2002 vs OH 2004	67.63	6.28	Yes
OH 2002 vs OH 2000	36.97	2.59	No
OH 2000 vs OH 2004	30.67	2.15	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Appendix 10. The statistical reports generated for all of the analyses conducted in the synthesis of 2004 Long-Term Monitoring Report for Southold Harbor.

Descriptive Statistics:

Data source: SB Water Quality Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
SB 97 NOx	24	0	0.0059	0.0028	0.00056	0.0012
SB 98 NOx	15	0	0.0047	0.0010	0.00027	0.00057
SB 99 NOx	15	0	0.0094	0.0069	0.0018	0.0038
SB 00 NOx	11	0	0.019	0.021	0.0063	0.014
SB 01 NOX	13	0	0.024	0.023	0.0064	0.014
SB 02 NOx	11	0	0.023	0.016	0.0050	0.011
SB 04 NOx	4	0	0.025	0.017	0.0086	0.027
SB 00 TN	5	0	0.25	0.053	0.024	0.065
SB 01 TN	13	0	0.22	0.086	0.024	0.052
SB 02 TN	11	0	0.19	0.086	0.026	0.058
SB 04 TN	4	0	0.17	0.11	0.055	0.17
SB 00 TDN	5	0	0.25	0.031	0.014	0.038
SB 01 TDN	13	0	0.20	0.081	0.022	0.049
SB 02 TDN	11	0	0.19	0.088	0.026	0.059
SB 04 TDN	4	0	0.15	0.088	0.044	0.14

Column	Range	Max	Min	Median	25%	75%
SB 97 NOx	0.012	0.017	0.0050	0.0050	0.0050	0.0050
SB 98 NOx	0.0040	0.0050	0.00100	0.0050	0.0050	0.0050
SB 99 NOx	0.020	0.025	0.0050	0.0050	0.0050	0.015
SB 00 NOx	0.051	0.056	0.0050	0.0080	0.0050	0.037
SB 01 NOX	0.058	0.063	0.0050	0.0090	0.0065	0.049
SB 02 NOx	0.054	0.062	0.0080	0.020	0.0100	0.033
SB 04 NOx	0.042	0.047	0.0050	0.024	0.014	0.036
SB 00 TN	0.14	0.34	0.20	0.24	0.22	0.28
SB 01 TN	0.27	0.39	0.12	0.18	0.16	0.26
SB 02 TN	0.24	0.35	0.11	0.16	0.12	0.23
SB 04 TN	0.22	0.27	0.050	0.19	0.080	0.27
SB 00 TDN	0.080	0.29	0.21	0.26	0.23	0.27
SB 01 TDN	0.24	0.35	0.11	0.18	0.13	0.24
SB 02 TDN	0.26	0.35	0.090	0.16	0.13	0.22
SB 04 TDN	0.21	0.26	0.050	0.15	0.085	0.22

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
SB 97 NOx	3.38	11.89	0.50	<0.001	0.14	0.0010
SB 98 NOx	-3.87	15.00	0.54	<0.001	0.071	0.00035
SB 99 NOx	1.24	0.19	0.41	<0.001	0.14	0.0020
SB 00 NOx	1.19	-0.51	0.33	0.001	0.21	0.0082
SB 01 NOX	0.77	-1.36	0.34	<0.001	0.31	0.014
SB 02 NOx	1.39	2.11	0.18	0.399	0.26	0.0086
SB 04 NOx	0.34	1.30	0.23	0.533	0.100	0.0034
SB 00 TN	1.31	2.28	0.25	0.327	1.27	0.33
SB 01 TN	1.08	0.017	0.28	0.007	2.81	0.70
SB 02 TN	1.24	0.30	0.26	0.035	2.06	0.46
SB 04 TN	-0.25	-4.52	0.29	0.272	0.69	0.16

SB 00 TDN	-0.085	-0.66	0.23	0.464	1.25	0.32
SB 01 TDN	0.81	-0.56	0.18	0.321	2.61	0.60
SB 02 TDN	1.13	0.26	0.21	0.187	2.05	0.46
SB 04 TDN	0.30	0.054	0.16	0.709	0.60	0.11

One Way Analysis of Variance
Data source: SB Water Quality Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: SB in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
SB 97 NOx	24	0	0.0050	0.0050	0.0050
SB 98 NOx	15	0	0.0050	0.0050	0.0050
SB 99 NOx	15	0	0.0050	0.0050	0.015
SB 00 NOx	11	0	0.0080	0.0050	0.037
SB 01 NOX	13	0	0.0090	0.0065	0.049
SB 02 NOx	11	0	0.020	0.0100	0.033
SB 04 NOx	4	0	0.024	0.014	0.036

H = 42.54 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
SB 02 NOx vs SB 98 NOx	47.61	4.44	Yes
SB 02 NOx vs SB 97 NOx	40.79	4.15	Yes
SB 02 NOx vs SB 99 NOx	30.71	2.87	No
SB 02 NOx vs SB 00 NOx	20.05	1.74	No
SB 02 NOx vs SB 01 NOX	10.50	0.95	No
SB 02 NOx vs SB 04 NOx	6.40	0.41	No
SB 04 NOx vs SB 98 NOx	41.21	2.71	No
SB 04 NOx vs SB 97 NOx	34.40	2.36	No
SB 04 NOx vs SB 99 NOx	24.31	1.60	No
SB 04 NOx vs SB 00 NOx	13.65	0.87	No
SB 04 NOx vs SB 01 NOX	4.11	0.27	No
SB 01 NOX vs SB 98 NOx	37.10	3.63	No
SB 01 NOX vs SB 97 NOx	30.29	3.26	No
SB 01 NOX vs SB 99 NOx	20.20	1.98	No
SB 01 NOX vs SB 00 NOx	9.54	0.86	No
SB 00 NOx vs SB 98 NOx	27.56	2.57	No

SB 00 NOx vs SB 97 NOx	20.75	2.11	No
SB 00 NOx vs SB 99 NOx	10.66	0.99	No
SB 99 NOx vs SB 98 NOx	16.90	1.71	No
SB 99 NOx vs SB 97 NOx	10.09	1.14	No
SB 97 NOx vs SB 98 NOx	6.81	0.77	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

One Way Analysis of Variance
Data source: SB Water Quality Trend Analysis

Normality Test: Failed (P = 0.005)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: SB in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
SB 00 TN	5	0	0.24	0.22	0.28
SB 01 TN	13	0	0.18	0.16	0.26
SB 02 TN	11	0	0.16	0.12	0.23
SB 04 TN	4	0	0.19	0.080	0.27

H = 3.90 with 3 degrees of freedom. (P = 0.273)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.273)

One Way Analysis of Variance
Data source: SB Water Quality Trend Analysis

Normality Test: Passed (P = 0.097)

Equal Variance Test: Passed (P = 0.824)

Group Name	N	Missing	Mean	Std Dev	SEM
SB 00 TDN	5	0	0.25	0.031	0.014
SB 01 TDN	13	0	0.20	0.081	0.022
SB 02 TDN	11	0	0.19	0.088	0.026
SB 04 TDN	4	0	0.15	0.088	0.044

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.024	0.0081	1.29	0.297
Residual	29	0.18	0.0063		
Total	32	0.21			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.297).

Power of performed test with alpha = 0.05: 0.097

The power of the performed test (0.097) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Descriptive Statistics:
Data source: SB Eelgrass Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
SB 1999	12	0	805.33	237.65	68.60	150.99
SB 2000	60	0	471.17	238.09	30.74	61.50
SB 2001	60	0	466.83	247.46	31.95	63.93
SB 2002	60	0	384.33	120.71	15.58	31.18
SB 2004	60	0	209.83	180.35	23.28	46.59

Column	Range	Max	Min	Median	25%	75%
SB 1999	864.00	1392.00	528.00	768.00	632.00	864.00
SB 2000	930.00	1070.00	140.00	420.00	300.00	540.00
SB 2001	950.00	970.00	20.00	405.00	285.00	685.00
SB 2002	470.00	660.00	190.00	370.00	285.00	455.00
SB 2004	760.00	760.00	0.00	190.00	50.00	290.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
SB 1999	1.46	2.54	0.24	0.064	9664.00	8403968.00
SB 2000	0.99	0.36	0.15	0.001	28270.00	16664300.00
SB 2001	0.27	-0.85	0.12	0.027	28010.00	16688900.00
SB 2002	0.49	-0.53	0.083	0.372	23060.00	9722400.00
SB 2004	0.79	0.22	0.12	0.026	12590.00	4560900.00

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: SB Eelgrass Trend Analysis

Normality Test: Failed (P = <0.001)

Group	N	Missing	Median	25%	75%
SB 1999	12	0	768.00	632.00	864.00
SB 2000	60	0	420.00	300.00	540.00
SB 2001	60	0	405.00	285.00	685.00
SB 2002	60	0	370.00	285.00	455.00
SB 2004	60	0	190.00	50.00	290.00

H = 72.06 with 4 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
SB 1999 vs SB 2004	159.27	6.91	Yes
SB 1999 vs SB 2002	97.38	4.22	Yes

SB 1999 vs SB 2001	79.96	3.47	Yes
SB 1999 vs SB 2000	78.49	3.41	Yes
SB 2000 vs SB 2004	80.78	6.07	Yes
SB 2000 vs SB 2002	18.89	1.42	No
SB 2000 vs SB 2001	1.47	0.11	No
SB 2001 vs SB 2004	79.31	5.96	Yes
SB 2001 vs SB 2002	17.42	1.31	No
SB 2002 vs SB 2004	61.88	4.65	Yes

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Descriptive Statistics:

Data source: SB Algae Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
SB 2000	24	0	1.67	4.82	0.98	2.03
SB 2001	60	0	63.67	32.15	4.15	8.31
SB 2002	60	0	32.62	36.23	4.68	9.36
SB 2004	60	1	34.25	36.94	4.81	9.63

Column	Range	Max	Min	Median	25%	75%
SB 2000	20.00	20.00	0.00	0.00	0.00	0.00
SB 2001	90.00	100.00	10.00	60.00	30.00	100.00
SB 2002	100.00	100.00	0.00	10.00	0.00	50.00
SB 2004	100.00	100.00	0.00	25.00	1.00	57.50

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
SB 2000	3.07	9.46	0.51	<0.001	40.00	600.00
SB 2001	-0.18	-1.45	0.20	<0.001	3820.00	304200.00
SB 2002	0.72	-0.88	0.25	<0.001	1957.00	141257.00
SB 2004	0.81	-0.84	0.19	<0.001	2021.00	148369.00

One Way Analysis of Variance

Data source: SB Algae Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: SB in Algae Trend Analysis

Group	N	Missing	Median	25%	75%
SB 2000	24	0	0.00	0.00	0.00
SB 2001	60	0	60.00	30.00	100.00
SB 2002	60	0	10.00	0.00	50.00
SB 2004	60	1	25.00	1.00	57.50

H = 66.25 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
SB 2001 vs SB 2000	109.67	7.73	Yes
SB 2001 vs SB 2002	52.37	4.88	Yes
SB 2001 vs SB 2004	44.49	4.13	Yes
SB 2004 vs SB 2000	65.17	4.58	Yes
SB 2004 vs SB 2002	7.87	0.73	No
SB 2002 vs SB 2000	57.30	4.04	Yes

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Appendix 11. The statistical reports generated for all of the analyses conducted in the synthesis of 2004 Long-Term Monitoring Report for Three Mile Harbor.

Descriptive Statistics:

Data source: TMH Water Quality Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
TMH 97 NOx	18	0	0.0057	0.0021	0.00050	0.0010
TMH 98 NOx	13	0	0.0072	0.0059	0.0016	0.0036
TMH 99 NOx	16	0	0.0081	0.0064	0.0016	0.0034
TMH 00 NOx	18	0	0.021	0.030	0.0071	0.015
TMH 01 NOx	16	0	0.052	0.041	0.010	0.022
TMH 02 NOx	17	0	0.021	0.022	0.0053	0.011
TMH 04 NOx	6	0	0.028	0.039	0.016	0.041
TMH 00 TN	9	0	0.28	0.048	0.016	0.037
TMH 01 TN	16	0	0.22	0.085	0.021	0.045
TMH 02 TN	17	0	0.19	0.090	0.022	0.046
TMH 04 TN	6	0	0.18	0.11	0.044	0.11
TMH 00 TDN	9	0	0.28	0.046	0.015	0.036
TMH 01 TDN	16	0	0.20	0.081	0.020	0.043
TMH 02 TDN	17	0	0.19	0.082	0.020	0.042
TMH 04 TDN	6	0	0.18	0.12	0.050	0.13

Column	Range	Max	Min	Median	25%	75%
TMH 97 NOx	0.0070	0.012	0.0050	0.0050	0.0050	0.0050
TMH 98 NOx	0.020	0.025	0.0050	0.0050	0.0050	0.0050
TMH 99 NOx	0.022	0.027	0.0050	0.0050	0.0050	0.0075
TMH 00 NOx	0.12	0.13	0.0050	0.0060	0.0050	0.032
TMH 01 NOx	0.14	0.15	0.0050	0.043	0.018	0.075
TMH 02 NOx	0.081	0.086	0.0050	0.011	0.0050	0.028
TMH 04 NOx	0.10	0.11	0.0050	0.013	0.0070	0.022
TMH 00 TN	0.14	0.32	0.18	0.29	0.26	0.32
TMH 01 TN	0.27	0.39	0.12	0.19	0.17	0.26
TMH 02 TN	0.31	0.39	0.080	0.19	0.12	0.25
TMH 04 TN	0.26	0.34	0.080	0.14	0.100	0.28
TMH 00 TDN	0.15	0.33	0.18	0.27	0.26	0.32
TMH 01 TDN	0.24	0.37	0.13	0.17	0.16	0.21
TMH 02 TDN	0.29	0.38	0.090	0.17	0.11	0.24
TMH 04 TDN	0.29	0.34	0.050	0.14	0.070	0.31

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
TMH 97 NOx	2.74	6.28	0.52	<0.001	0.10	0.00067
TMH 98 NOx	2.79	7.77	0.49	<0.001	0.094	0.0011
TMH 99 NOx	2.34	5.08	0.37	<0.001	0.13	0.0016
TMH 00 NOx	2.73	8.64	0.31	<0.001	0.38	0.024
TMH 01 NOx	1.00	0.69	0.15	0.437	0.83	0.068
TMH 02 NOx	1.97	4.03	0.27	0.002	0.35	0.015
TMH 04 NOx	2.33	5.52	0.39	0.005	0.17	0.012
TMH 00 TN	-1.32	1.24	0.20	0.338	2.52	0.72
TMH 01 TN	1.08	-0.14	0.25	0.010	3.51	0.88
TMH 02 TN	0.67	-0.25	0.18	0.176	3.31	0.77
TMH 04 TN	0.80	-1.34	0.27	0.203	1.07	0.25
TMH 00 TDN	-1.14	1.81	0.23	0.182	2.51	0.72
TMH 01 TDN	1.52	0.81	0.30	<0.001	3.25	0.76
TMH 02 TDN	0.87	0.25	0.16	0.266	3.15	0.69
TMH 04 TDN	0.62	-1.71	0.28	0.152	1.05	0.26

One Way Analysis of Variance

Data source: TMH Water Quality Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: TMH in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
TMH 97 NOx	18	0	0.0050	0.0050	0.0050
TMH 98 NOx	13	0	0.0050	0.0050	0.0050
TMH 99 NOx	16	0	0.0050	0.0050	0.0075
TMH 00 NOx	18	0	0.0060	0.0050	0.032
TMH 01 NOx	16	0	0.043	0.018	0.075
TMH 02 NOx	17	0	0.011	0.0050	0.028
TMH 04 NOx	6	0	0.013	0.0070	0.022

H = 40.09 with 6 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
TMH 01 NOx vs TMH 97 NOx	50.69	4.89	Yes
TMH 01 NOx vs TMH 98 NOx	47.44	4.21	Yes
TMH 01 NOx vs TMH 99 NOx	41.91	3.93	Yes
TMH 01 NOx vs TMH 00 NOx	29.08	2.81	No
TMH 01 NOx vs TMH 02 NOx	20.47	1.95	No
TMH 01 NOx vs TMH 04 NOx	15.77	1.09	No
TMH 04 NOx vs TMH 97 NOx	34.92	2.46	No
TMH 04 NOx vs TMH 98 NOx	31.67	2.13	No
TMH 04 NOx vs TMH 99 NOx	26.14	1.81	No
TMH 04 NOx vs TMH 00 NOx	13.31	0.94	No
TMH 04 NOx vs TMH 02 NOx	4.70	0.33	No
TMH 02 NOx vs TMH 97 NOx	30.22	2.96	No
TMH 02 NOx vs TMH 98 NOx	26.97	2.43	No
TMH 02 NOx vs TMH 99 NOx	21.44	2.04	No
TMH 02 NOx vs TMH 00 NOx	8.61	0.84	No
TMH 00 NOx vs TMH 97 NOx	21.61	2.15	No
TMH 00 NOx vs TMH 98 NOx	18.36	1.67	No
TMH 00 NOx vs TMH 99 NOx	12.83	1.24	No
TMH 99 NOx vs TMH 97 NOx	8.78	0.85	No
TMH 99 NOx vs TMH 98 NOx	5.53	0.49	No

TMH 98 NOx vs TMH 97 NOx	3.25	0.30	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

One Way Analysis of Variance

Data source: TMH Water Quality Trend Analysis

Normality Test: Passed (P > 0.200)

Equal Variance Test: Passed (P = 0.360)

Group Name	N	Missing	Mean	Std Dev	SEM
TMH 00 TN	9	0	0.28	0.048	0.016
TMH 01 TN	16	0	0.22	0.085	0.021
TMH 02 TN	17	0	0.19	0.090	0.022
TMH 04 TN	6	0	0.18	0.11	0.044

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.053	0.018	2.48	0.074
Residual	44	0.32	0.0072		
Total	47	0.37			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.074).

Power of performed test with alpha = 0.05: 0.354

The power of the performed test (0.354) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

One Way Analysis of Variance

Data source: TMH Water Quality Trend Analysis

Normality Test: Failed (P = 0.002)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: TMH in Water Quality Trend Analysis

Group	N	Missing	Median	25%	75%
TMH 00 TDN	9	0	0.27	0.26	0.32
TMH 01 TDN	16	0	0.17	0.16	0.21
TMH 02 TDN	17	0	0.17	0.11	0.24
TMH 04 TDN	6	0	0.14	0.070	0.31

H = 9.24 with 3 degrees of freedom. (P = 0.026)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.026)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
TMH 00 TDN vs TMH 04 TDN	18.22	2.47	No
TMH 00 TDN vs TMH 02 TDN	16.03	2.78	No
TMH 00 TDN vs TMH 01 TDN	12.31	2.11	No
TMH 01 TDN vs TMH 04 TDN	5.92	0.88	No
TMH 01 TDN vs TMH 02 TDN	3.72	0.76	No
TMH 02 TDN vs TMH 04 TDN	2.20	0.33	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Descriptive Statistics:

Data source: TMH Eelgrass Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
TMH 1999	12	0	361.33	169.12	48.82	107.45
TMH 2000	60	0	192.83	129.80	16.76	33.53
TMH 2001	60	0	208.83	99.12	12.80	25.60
TMH 2002	60	0	135.38	74.00	9.55	19.12
TMH 2004	60	0	29.00	47.25	6.10	12.21

Column	Range	Max	Min	Median	25%	75%
TMH 1999	480.00	576.00	96.00	376.00	208.00	504.00
TMH 2000	560.00	600.00	40.00	165.00	100.00	255.00
TMH 2001	450.00	470.00	20.00	205.00	140.00	265.00
TMH 2002	260.00	260.00	0.00	150.00	110.00	190.00
TMH 2004	210.00	210.00	0.00	0.00	0.00	40.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
TMH 1999	-0.29	-1.23	0.14	0.616	4336.00	1881344.00
TMH 2000	1.31	1.44	0.16	<0.001	11570.00	3225100.00
TMH 2001	0.29	-0.13	0.069	0.635	12530.00	3196300.00
TMH 2002	-0.66	-0.36	0.15	0.001	8123.00	1422809.00
TMH 2004	1.96	3.71	0.31	<0.001	1740.00	182200.00

Kruskal-Wallis One Way Analysis of Variance on Ranks
Data source: TMH Eelgrass Trend Analysis

Normality Test: Failed (P = <0.001)

Group	N	Missing	Median	25%	75%
TMH 1999	12	0	376.00	208.00	504.00
TMH 2000	60	0	165.00	100.00	255.00
TMH 2001	60	0	205.00	140.00	265.00
TMH 2002	60	0	150.00	110.00	190.00
TMH 2004	60	0	0.00	0.00	40.00

H = 115.57 with 4 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
TMH 1999 vs TMH 2004	163.83	7.11	Yes
TMH 1999 vs TMH 2002	83.64	3.63	Yes
TMH 1999 vs TMH 2000	60.57	2.63	No
TMH 1999 vs TMH 2001	41.07	1.78	Do Not Test
TMH 2001 vs TMH 2004	122.76	9.22	Yes
TMH 2001 vs TMH 2002	42.57	3.20	Yes
TMH 2001 vs TMH 2000	19.50	1.47	Do Not Test
TMH 2000 vs TMH 2004	103.26	7.76	Yes
TMH 2000 vs TMH 2002	23.07	1.73	No
TMH 2002 vs TMH 2004	80.19	6.03	Yes

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Descriptive Statistics:
Data source: TMH Algae Trend Analysis

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
TMH 2000	24	0	47.08	42.37	8.65	17.89
TMH 2001	60	0	38.37	35.15	4.54	9.08
TMH 2002	60	0	22.83	29.12	3.76	7.52
TMH 2004	60	2	14.72	30.11	3.95	7.92

Column	Range	Max	Min	Median	25%	75%
TMH 2000	100.00	100.00	0.00	45.00	0.00	90.00
TMH 2001	100.00	100.00	0.00	30.00	0.00	75.00
TMH 2002	100.00	100.00	0.00	5.00	0.00	50.00
TMH 2004	100.00	100.00	0.00	0.00	0.00	10.00

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	Sum	Sum of Squares
TMH 2000	0.072	-1.81	0.20	0.014	1130.00	94500.00
TMH 2001	0.41	-1.16	0.17	<0.001	2302.00	161202.00
TMH 2002	1.00	-0.38	0.29	<0.001	1370.00	81300.00
TMH 2004	2.11	3.06	0.36	<0.001	854.00	64238.00

One Way Analysis of Variance

Data source: TMH Algae Trend Analysis

Normality Test: Failed (P = <0.001)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: TMH in Algae Trend Analysis

Group	N	Missing	Median	25%	75%
TMH 2000	24	0	45.00	0.00	90.00
TMH 2001	60	0	30.00	0.00	75.00
TMH 2002	60	0	5.00	0.00	50.00
TMH 2004	60	2	0.00	0.00	10.00

H = 20.03 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
TMH 2000 vs TMH 2004	46.50	3.28	Yes
TMH 2000 vs TMH 2002	28.91	2.05	No
TMH 2000 vs TMH 2001	6.24	0.44	No
TMH 2001 vs TMH 2004	40.26	3.74	Yes
TMH 2001 vs TMH 2002	22.67	2.12	No
TMH 2002 vs TMH 2004	17.59	1.63	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.