Peconic Estuary Program Eelgrass Restoration Project
Final Report
1996-1999

Submitted to:
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Introduction

As identified in the Peconic Estuary Program (PEP) Action Plan, the most severe problem plaguing the Estuary in recent years has been the Brown Tide. The impacts of the Brown Tide blooms are widespread. The Brown Tide destroyed the bay scallop population and decimated eelgrass beds. The extreme importance of eelgrass beds, not only in the life cycle of bay scallops but in the trophic relationships and productivity of estuarine systems, is well known and documented (Thayer et. al., 1984). In fact, the PEP Action Plan states "the potential for devastating long-range effects of the Brown Tide on local fisheries is illustrated by the loss of eelgrass resulting from reduced light penetration in the water column; eelgrass is important habitat for certain finfish as well as shellfish (SCDHS, 1994)."

If the PEP is to maintain and improve habitat in the Estuary, then clearly, restoration of the eelgrass beds is a very important part of long-term management. Additionally, if restoration of bay scallop populations is to be successful, eelgrass beds should also be restored.

This project was designed to continue and expand eelgrass plantings at numerous sites throughout the Estuary based on work first initiated in the Town of East Hampton. The planting technique, density and suitability of donor plants are based on the results of a pilot project conducted in the Town of East Hampton during 1993 and 1994 (Hasbrouck & Pickerell 1994). This cooperative effort between the East Hampton Town Natural Resources Department and Cornell Cooperative Extension (CCE), Marine Program utilized the standard staple method (Fonseca et al. 1982) and a modification of this method using wooden stakes in place of the metal staples. The goals of this original work were to determine the most suitable planting techniques and transplant sites. During that first year, transplants were harvested from Northwest Harbor and Lake Montauk, in late June, for planting at two sites in Three-Mile Harbor and two in Accabonac Harbor.

The results of the pilot study indicated that fine, sandy sediment with organic matter was the only bottom type suited to this type of planting. Soft mud, though capable of supporting healthy natural growth, proved impractical since it was easily disturbed and was not sufficiently dense to hold the planting units (PU's) in place. The use of the metal landscape staples proved more effective than the wooden stake method attempted. An additional problem encountered (in Accabonac Harbor) was the proliferation of a brown macroalgae (possibly *Desmarestia* or *Ectocarpus sp.*) at one of the sites that entirely smothered the transplants preventing light penetration.

The goal of the PEP project conducted in cooperation with the Town of East Hampton Natural Resources Department and East Hampton Trustees was to conduct intensive plantings at several sites throughout East Hampton. Following initiation of a PEP-sponsored project ("Water quality criteria for eelgrass," EEA Inc.) eelgrass plantings were extended, with minor funding for materials, to work in cooperation with the new project.

The following narratives highlight major activities conducted during this project. Due the multiyear nature of the work and considering the wide range of sites planted and techniques utilized, results are presented by year.

YEAR I & II (1995-1996)

Year I & II - Background

Although this project was initiated in late summer of 1995, work during that year was limited to field reconnaissance of Three-Mile Harbor and Accabonac Harbor transplant sites. 1996 represents the first full year of work. The primary goal of this work was to pick up where the previous work in 1994 and 1995 ended. Based on the results of our 1994/1995 work, sites with coarse (sand) sediment in three East Hampton Harbors were selected for planting using the metal staple method of Fonseca et al. 1982. The following narrative summarizes activities for the 1996 season and is adapted from a report prepared for CCE by the Town of East Hampton (Schluter, 1996).

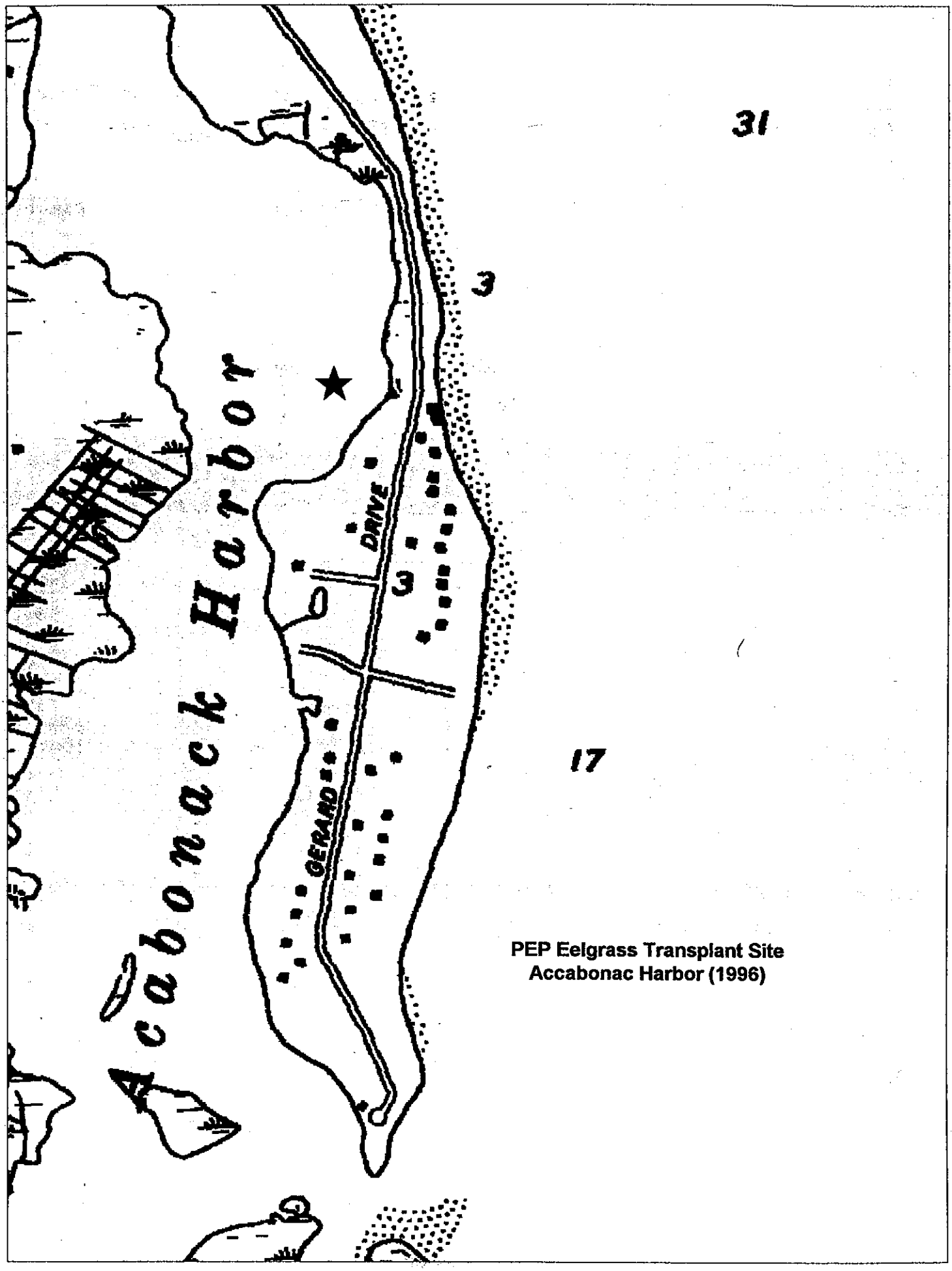
Year I & II - Activities

Four different sites were selected for the initial plantings: one each in Accabonac Harbor and Three-Mile Harbor and two in Northwest Creek (north and south). Due to high losses of transplants, additional plantings were conducted at Accabonac Harbor and the northern site at Northwest Creek. Donor material consisting of healthy eelgrass shoots with roots and rhizomes intact was collected by CCE and EHTNRD from thick meadows in Hog Creek and in Northwest Harbor. A standard long handled shovel was used to remove root and rhizome sods that were separated into individual shoots for processing. A total of approximately 2,500 eelgrass shoots were collected in this manner. Planting Units were created by attaching four to five shoots to a 6" (long) x 1"(span) landscape staple. Planting required the use of SCUBA gear; a dive knife was used to create a small whole in the sediment prior to pushing the staples in by hand.

Shoots were collected on June 11 from Northwest Harbor, fastened to anchors as described above and planted on a sand/mud bottom in a plot approximately 25 x 25 feet in the northwest corner of Three Mile Harbor on June 12; 300 plugs were planted. The next planting, 200 plugs, took place in the northeast part of Accabonac Harbor in silty sand on June 14. These plugs consisted of shoots gathered earlier that day from Hog Creek. The final planting of 125 plugs was made on June 17 in Northwest Creek in two sites, one in the northwest, in sandy mud, another in the west central part, in muddy sediments.

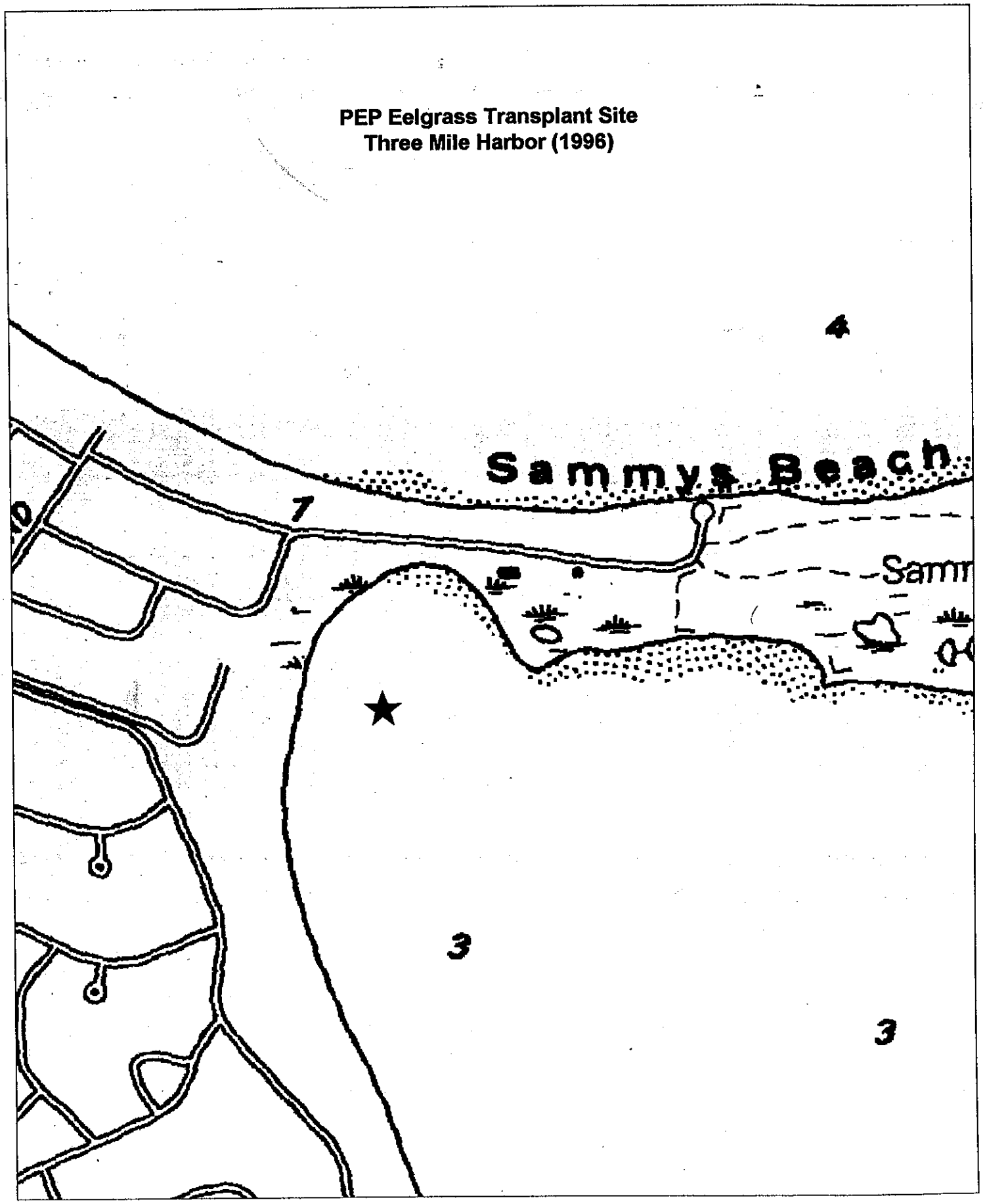
Following planting, each transplant site was delineated with metal stakes and twine to prevent human disturbance. PU's in all plots were placed in staggered lines along the perimeter and in the center of the enclosure to simplify monitoring. Control sites similar in size were situated in a naturally growing eelgrass meadow, one in each of the donor areas, and one each in Three Mile and Accabonac Harbors (see maps).

Monitoring was conducted by two person teams (EHTNRD) snorkeling over each site and recording observations. Observations included sediment texture, water temperatures and salinities, and a qualitative assessment of turbidity. Turbidity was measured on a scale of 0 to 10, 0 representing clear water and 10 being turbid, greatly hindering vision. Restoration sites were monitored weekly beginning in mid-July, except for the Accabonac Harbor site, where it was noted on June 27 that almost all of the eelgrass leaves on all of the plants above the roots were missing.

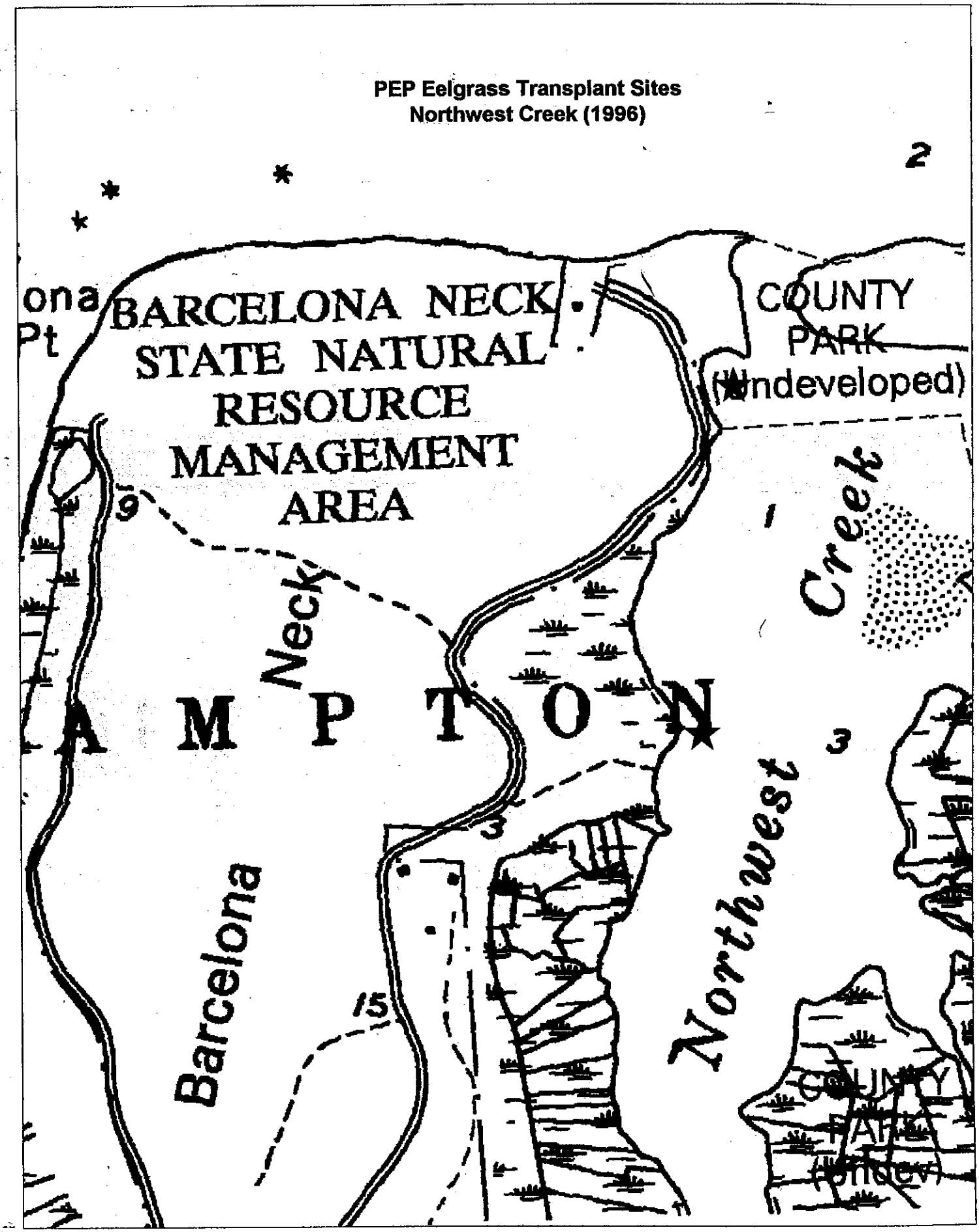


PEP Eelgrass Transplant Site
Accabonac Harbor (1996)

PEP Eelgrass Transplant Site
Three Mile Harbor (1996)



PEP Eelgrass Transplant Sites
Northwest Creek (1996)



Over the course of the restoration project, the salinity in Accabonac Harbor ranged from 26 ppt to 28 ppt, with water temperatures from 74° F to 84° F. Salinity at the Three-Mile Harbor site (Sammy's) went from 24 ppt early in the season to 28 ppt later in the season. Water temperatures also fluctuated for this site from 72° F to 78° F. Slight differences in water temperatures were found between the two Northwest Harbor sites. Water samples from the northern site (Barcelona) showed salinity values between 27 ppt and 28 ppt. Water temperatures declined during the season from 78° F to 74° F.

The sediment at each of the four planting sites consisted of a sand-silt mixture, however the percentage of sand to silt varied. The two sites at Northwest Creek were more silty than those at Accabonac and Three-Mile Harbors. The silt increased turbidity and complicated monitoring. Accabonac Harbor had the lowest turbidity. During the first three weeks of monitoring the Three-Mile Harbor site had an intermediate turbidity of 5, however, the water was very turbid (10) during the last three weeks of monitoring.

Due to losses of original transplants, additional transplants were made in Accabonac Harbor and Northwest Creek (northwest site) in the previously planted plots on August 7 and 9, respectively. Approximately 100 plugs, twenty anchored with washers, and 80 with nails, were planted at the Accabonac site by EHTNRD with assistance of CCE. In the Northwest Creek site about 120 plugs, 80 with nails and 40 without anchors were replanted. The unanchored plugs were pushed into the sediment by hand.

Although the transplants survived in Three-Mile Harbor through the end of August, they disappeared soon after. In order to determine the efficacy of fall plantings an October transplant date was scheduled. On October 16, 1996, eelgrass was collected from Hog Creek and attached to staples for replanting in Three-Mile Harbor. At the time of collection the salinity was 28 ppt, the pH was 8.3, and the water temperature was 56° F. The sediment composition in Hog Creek ranged from 9:1 to 6:4 (silt:sand) ratio. The PU's were stored overnight in polypropylene bags suspended in Three Mile Harbor.

On October 17, 1996, the eelgrass was planted south of Sammy's Beach in Three-Mile Harbor. At the time of planting the salinity was 29 ppt, the pH was 8.3, and the water temperature was 58° F. The sediment composition was a 2:8 (silt:sand) ratio. Using a trowel, approximately 156 planting units were planted. Sixty-five units were planted within a meter square on the northeast corner of the planting site. Approximately, 91 plants were planted from the southwest corner to the northwest corner. Percent algae coverage of the plot was 2% with only one rockweed algae and two codium plants observed. Flounder, ladycrabs, silversides, and grass shrimp were observed in the vicinity of the planting site.

The Three Mile Harbor site was monitored on October 22, 1996. Salinity was 29 ppt, the pH was 8.4, and the water temperature was 64° F. Overall appearance of eelgrass bed was excellent. There was no apparent loss of planting units via transplantation shock, dieback, crabs, or dislodgment due to turbulence (planting units did not dislodge during the October 19, 1996 noreaster). The only significant difference in eelgrass appearance from the time of planting to the time of monitoring was a layer of epiphytic growth that was evident on the day of monitoring. Approximately 80% of the plants on October 22, 1996 were covered with a thin layer of epiphytic growth. At the time of planting the eelgrass had very little or no epiphytic growth.

The restoration site was monitored again on October 29, 1996. Salinity was 27 ppt and the water temperature was 56° F. Overall appearance of the eelgrass bed was similar to the previous weeks monitoring; there was no apparent loss of planting units and plants appeared green.

Attempts were made to monitor on November 8 and November 11, 1996, however, environmental conditions (i.e. choppy seas, low sun, high tide, and cold temperatures) were such that observing the eelgrass was impossible.

The site was monitored again on November 18, 1996. Salinity was 27 ppt and water temperature was 41° F. Overall appearance of the eelgrass bed was excellent. Long green blades were observed and there was no apparent loss of planting units. Due to cold water temperatures snorkeling was impractical thus making detailed observations of the plants impossible.

The site was monitored for a fourth time on November 26, 1996. Salinity was 25 ppt and water temperature was 47° F. Green blades were observed and there was no apparent loss of planting units. Plants appeared less vigorous, however, observations were difficult because of heavy cloud cover and high tide.

On December 3, 1996 environmental conditions were excellent for monitoring; the tide was low, the sun high, and the wind still. Eelgrass appeared green and healthy with a thin layer of epiphytic growth covering the blades. Salinity was 26 ppt and water temperature was 45° F. In the northwest corner and southeast corner of the plot (where planting units are clumped) there appeared to be an accumulation of sand around plants. The PU's clustered at the northeast corner of the plot appeared more vigorous than the plants along the north fence line that were planted singly.

Again on December 9, 1996 the eelgrass plot looked excellent. Green blades were observed and there was no apparent loss of planting units. Salinity was 24 ppt and the water temperature was 42° F. However, when this site was checked again in the summer of 1997, all shoots had died. It is not clear if the shoots died during the winter or in spring or what the cause of mortality was. When last observed in early winter, the transplants were doing excellent.

On December 9, 1996 two of the other eelgrass restoration sites from 1996 and one site from 1995 were revisited. The Accabonac site off Gerard Drive (a 1996 site) had a salinity of 24.5 ppt and a water temperature of 42° F. Algae coverage in the plot was approximately 75%, the algae appeared close and prostrate along the sediment. Eelgrass was not observed in the plot.

The Northern Barcelona site at Northwest Creek (another 1996 site) had a salinity of 24.5 and a water temperature of 42° F. Approximately, eight eelgrass clumps were observed lying flat along ground. The blades were brown but low sun and sediment disturbance made it impossible to discern whether the plants were dead or in dieback phase.

Even though the general area was identifiable, there were no longer site markers at the 1995 Three Mile Harbor site, so it was impossible to tell exactly where the plot was located. The salinity was 24 ppt and the water temperature was 43° F. The area had 10% algae coverage consisting primarily of *Codium*. Eelgrass was evident in small patches. The blades were brown/green with epiphytic growth responsible for the brown color. However, high turbidity made it difficult to ascertain the health of the plants.

Year I & II - Conclusions

The first planting at the Accabonac Harbor site (June 14, 1996) did not survive. All plants seemed to have been physically disturbed by some form of bioturbation. Most PU's died or disappeared within two weeks. However no geese, swans, or other waterfowl that graze on eelgrass were noted in the proximity of the planting site throughout the course of the monitoring. Seining on June 27, 1996 in the vicinity of the site did not produce many crabs. During times of spring tide, the area is used by horseshoe crabs coming ashore to spawn. One spring tide occurred on or about the time of the initial June planting. Observation of the roots on several of the PU's appeared indicated that most of the roots/rhizomes were dead.

On August 23, two weeks after the second planting, 75% of the plants anchored with washers were missing and 20% of the plants anchored with nails were missing. Apparently these plants were dislodged since no washers and nails could be recovered from the sediment. However, the percent algae coverage of the plot increased from 30% at the time of planting, to 90% coverage by the second week, making it more difficult to find the anchors. The plants remaining at the site were approximately eighteen inches tall and were green/brown in color.

At the same site the following week on August 30, all the plants anchored with washers had disappeared and 75% of plants anchored with nails were gone. The remaining plants were still 18 inches tall and covered with epiphytic growth. The algae coverage, still at 90% was a mixture of false agardhiella *(Graccilaria verrocosa)*, tubed weed *(Polysiphonia ssp.)*, Green filamentous (Genus unknown), and hollow green weed *(Enteromorpha intestinalis)*. The dense presence of algae surrounded the individual eelgrass PU's, permitted only approximately 6 inches of the blades to protrude above the algae canopy.

Like the Accabonac site, the planting at the more southern site in Northwest Creek experienced an invasion and rapid growth of similar algae species. Within two weeks of the planting date all the eelgrass had died. At the time of planting, percent algae coverage was 5%. Two weeks after the planting, percent algae coverage was 95% and no eelgrass was present. The extent of the algae coverage in the area surrounding the plots was similarly great. This site was not replanted.

The first planting at the northern site in Northwest Creek off Barcelona, experienced a 100% loss of eelgrass blades by the time of the first monitoring on July 25. The week following the replanting (August 9), all of the plants anchored with nails were visible while only half of those planted without anchors were visible. Both the eelgrass shoots planted with and without nails were only 2-4 inches high, and brownish/green in color. The shoots did not appear vigorous. At the time of planting the eelgrass blades were at least 8 inches long. The plants that remained in the second monitoring looked the same. The plants without any anchor died more quickly than those anchored with nails so that only 10% of all the replants were still alive.

The Sammy's Beach Three Mile Harbor site had the most robust growth and longest survival rate of any of the year I & II transplants from the spring planting. Approximately 13 shoots were found in a meter square with a rate of 7 to 2 shoots per planting unit. The average height of each blade in the healthier plants was about 10 inches. Surprisingly, in spite of this vigorous growth these plants, too, eventually died back. They had survived two months longer than the others planted at about the same time. Unlike the other sites, there was no noticeable increase in percent algae coverage. On the day of the last monitoring (September 3) all of the blades were either brown and dying, or already gone. Roots appeared to be either dead or decaying.

Similarly, the fall planting (Oct. 1996) took very well and robust plants survived until the final montoring in December 1996. However, by the summer of 1997, the transplants had all died.

Though growth in the transplant sites was completely arrested and all of the plants from all of the plantings disappeared at the end of the summer, the natural control sites were found to be thriving at the end of the monitoring period. The sites chosen for this restoration project mimicked the characteristics of the control sites. However, the individual plants in the control sites grew in dense stands, whereas our individual plants were spaced relatively far apart, making them more vulnerable to predation and invasion by competitive algae.

Fall plantings proved more promising in that the transplants lasted well into the winter, but in the end, these PU's eventually were lost. It is not clear what was responsible for this loss since growth looked favorable as late as December 9th. Some factor over the winter was responsible for killing or physically removing the shoots.

Year I & II - Summary and Recommendations

Although all of the sites and methods used for the eelgrass plantings were largely unsuccessful, some positive findings come to light. Of all the sites planted, Three Mile Harbor proved to be the most successful, allowing for the emergence of numerous new shoots. Of the different types of anchors used, the metal staples were the best. Staples proved relatively easy to plant and relatively stable in the bottom. The initial success of fall plantings may be a key to future transplant success. The studies done on the natural eelgrass beds has given us a better idea of the conditions needed to grow healthy, vigorous eelgrass beds. According to the natural site descriptions, areas with water temperatures ranging in the mid 70's (Fahrenheit) and sediment with a large percentage of silt make for good eelgrass habitats. In view of the high percentage of loss at all planting sites, some of which may be attributed to grazing and/or cutting by crabs and other animals and competition from algal species, some form of protection may be in order.

YEAR III (1997)

Year III - Background

Based on the work during the 1996 season, we decided to avoid plantings at the previous sites and focus our efforts on an entirely different system, Napeague Harbor. Napeague Harbor supports a unique natural eelgrass bed along the eastern shore that proved ideal for removing intact plugs and sods. In order to simplify our methods and reduce the effects of transplant shock and bioturbation/physical scouring we decided to utilize intact sods in addition to the staples. We assumed that these intact, heavier units would provide more protection and stability to the PU's.

In order to address the recommendations from the Peconic Estuary Program, we also planned to conduct transplants in Southold Town. The PEP Office and CCE contacted the Town regarding this effort. In response, the Town was very cooperative and supportive of this effort, but effectively turned the decision making process over to members of the Shellfish Advisory Committee and Baymen's Association. Unfortunately, these groups were concerned that our efforts would affect their ability to harvest clams in productive areas. Given this concern, the sites chosen by the PEP were eliminated. In order to satisfy the request of the PEP, we decided to move forward with two plantings in the Town in areas that would not affect shellfishing. Based on this, Cutchogue Harbor and Cedar Beach Creek, behind the Suffolk County Marine Environmental Learning Center, were chosen.

Year III - Activities

Site reconnaissance prior to the Napeague Harbor planting was completed on June 17. During this day two divers swam over the existing meadow and proposed transplant site in the Harbor. On June 26, 1997 representatives from East Hampton Town Natural Resource Department, Cornell Cooperative Extension and EEA Inc met at the end of Napeague Harbor Rd. in East Hampton and eelgrass was harvested from beds running twenty to forty feet offshore. This location was chosen for its accessibility and its healthy eelgrass beds. Harvesting began at 8:30 a.m. (roughly mean low water) with shovels being inserted below the roots of the eelgrass. Masses of roots and shoots were placed in floating plastic mesh trays for handling. The eelgrass was cleaned and separated into individual stems and planting units were assembled. Planting units are compromised of three to four stems attached to a metal horticultural staple. To attach stems to the staple, card stock was wrapped around the metal staples and stems (just above the root) and secured with paper coated wire twist ties. The planting units were kept in a cooler with seawater and care was taken to keep the cooler out of the sun. EEA personnel assisted with the days activities and documented all work. Photographs of the day's activities and a more detailed description of the techniques utilized are documented in the Peconic Estuary Program document entitled "Protocols for Harvesting and Transplanting Eelgrass in the Peconic Estuary"(EEA, 1997).

Unlike previous eelgrass collection sites (Northwest Harbor and Hog Creek) the Napeague eelgrass meadow grows in a unique and dense organic substrate similar in consistency to marsh peat. In fact this meadow may be growing on the remnant of a submerged salt marsh. Given the density and consolidated nature of this sediment, it was relatively easy to remove intact cores or sods with roots and rhizomes intact.

At 10:00 am three people began collecting eelgrass sods for transplantation. Sods were collected by inserting a shovel into the "peat," below the roots of the grass. Care was taken to spread the collection points evenly across this large meadow and stay within the center of the bed to minimize disturbance. Sods were staged on large plastic trays lined with burlap bags and submerged at the deepwater edge of the meadow.

The transplant site chosen in Napeague was located in a sandy open flat approximately 4ft deep at low tide along the south shore of the Harbor (see map). PU's including staples and sods were planted into discrete circles in a fenced area approximately 25ft x 25ft. Trays were covered with wet burlap bags to keep plants moist and protected from the sun. At the transplant site trays were submerged adjacent to the transplant plot. Eelgrass sods were out of the water for approximately fifteen minutes. Staples were kept in the cooler of seawater until planting (approximately 30 minutes).

Sods were planted by inserting a long-handled shovel into the bottom to a depth matching the depth matching the sod. Sods were planted into three discrete clusters to imitate the conditions in nearby natural meadows. Staples were planted as previously described using a dive knife to create a pilot hole in the sediment.

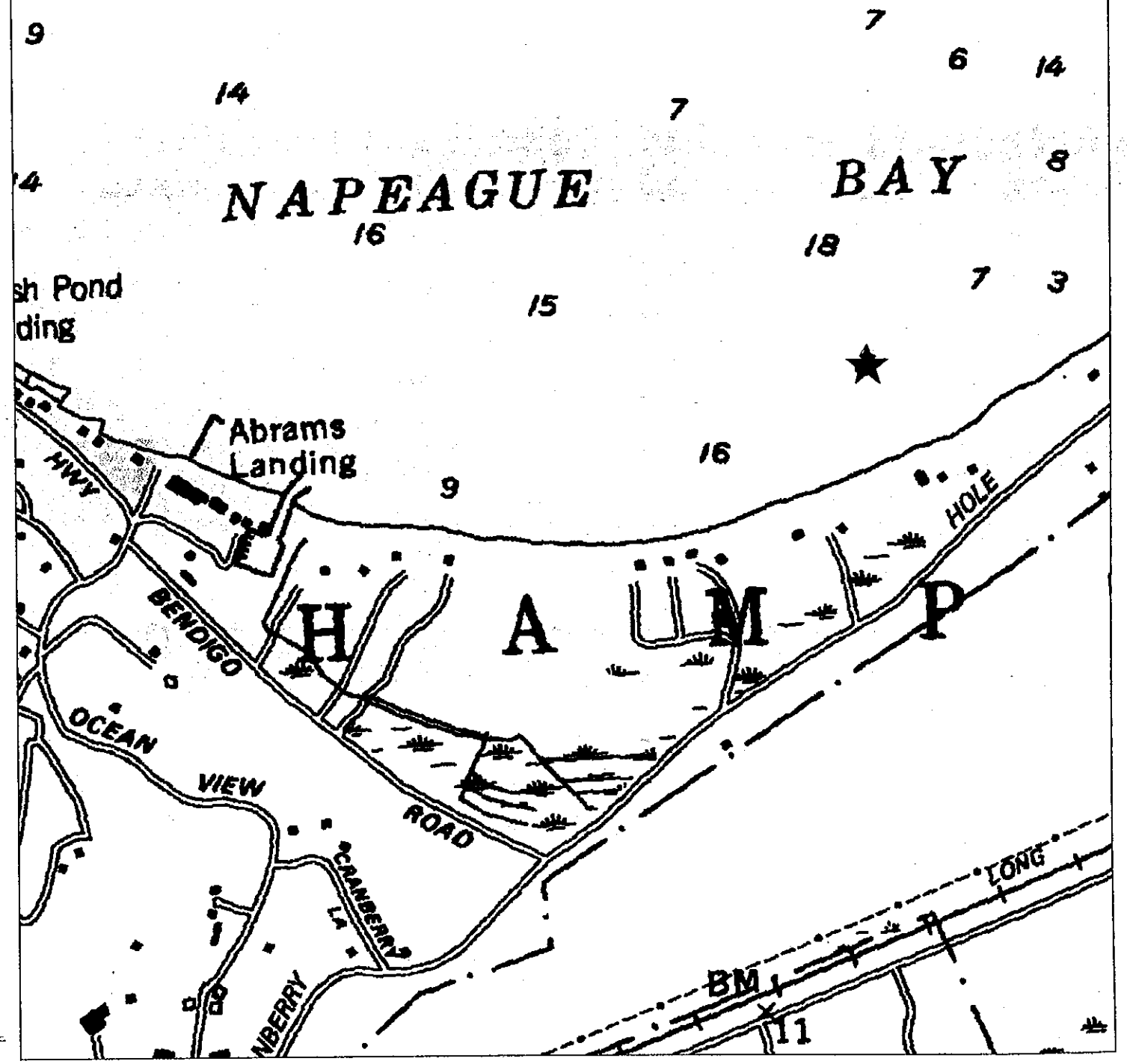
Monitoring of the transplant site was conducted by EHTNRD personnel and involved revisiting the site several times over the remainder of the summer. Observations of this area indicated a sudden loss of the bare-root PU's and a steady decline of the sods. The fact that there was no relief in the area may indicate that some of the sods that were planted deep survived throughout the season.

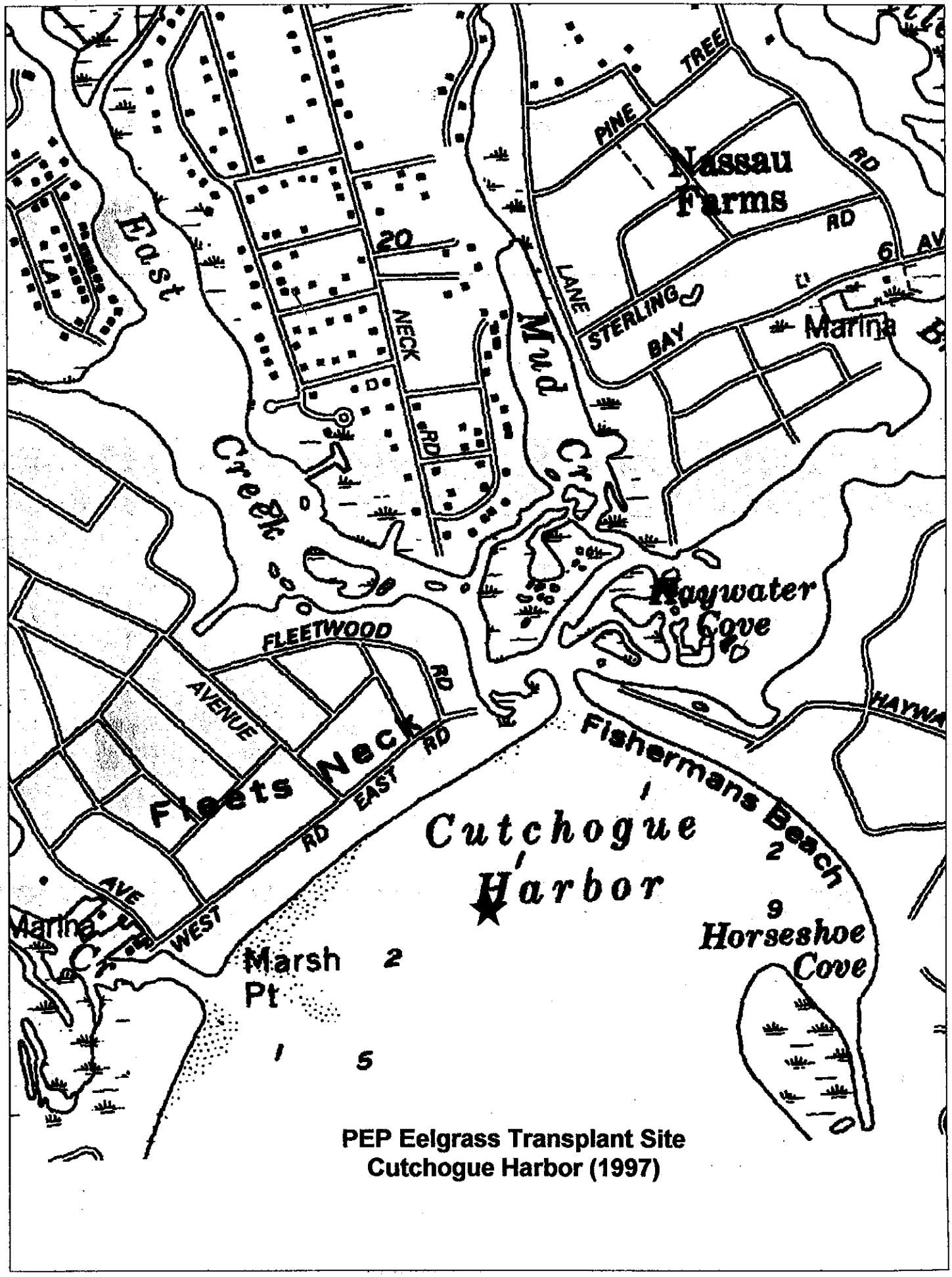
Plantings in the Town of Southold took place on October 22. Sods of approximately 20cm diameter were collected with a shovel from an existing bed at Northwest Harbor in East Hampton with sediment and roots intact. A total of 45 sods were obtained in this way. All sods were placed in mesh trays and covered with a double layer of burlap wetted with seawater. Sods were transported directly from the donor site to the transplant site in a boat. Transplants took place on the same day as collection. 20 sods were planted in sandy sediments at Cutchogue Harbor and 25 were planted in sandy sediment at Cedar Beach Creek. The transplants at Cedar Beach Creek were observed weekly for several weeks following transplant. The Cutchogue Harbor site was not visited until the following summer.

Year III - Conclusions

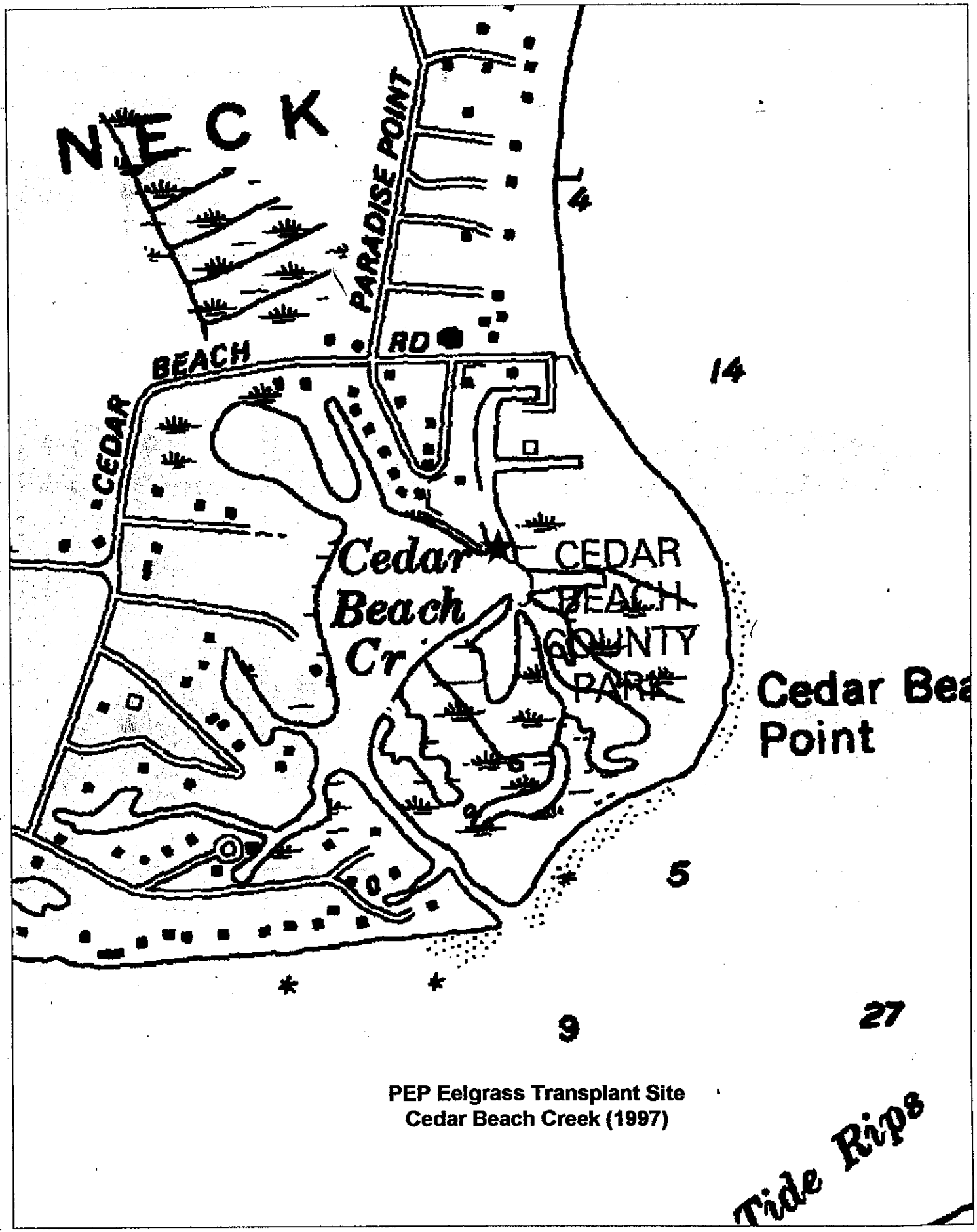
Although the transplant stock collected from Napeague Harbor was of high quality and growing in consolidated organic sediment that allowed for sods to be formed, the transplant site chosen was not suitable. Based on previous work it should have been understood that open unvegetated areas with no relief might be prone to high erosive forces. However, this experience was unheeded in site selection for this planting and the plantings failed. Sods proved a more viable alternative to staple plugs in this environment and outlasted the staples by months. The variability in planting depth offered us an opportunity to observe the effects planting to a slightly greater than normal depth for sods (surface of the sod below the surface of the surrounding sediment by approximately 2cm). Based on EHTNRD observations, the sods planted deeper in the sediment survived longer than those planted with the surface of the sod at or above the surrounding sediment.

PEP Eelgrass Transplant Site
Napeague Harbor (1997)





PEP Eelgrass Transplant Site
Cutchogue Harbor (1997)



PEP Eelgrass Transplant Site
Cedar Beach Creek (1997)

Plantings in the Town of Southold were not successful based on follow up observations in 1998. There was no evidence of either the Cutchogue Harbor or Cedar Beach Creek plantings during the summer of 1998. Closer observations of the sites indicate that the Cutchogue Harbor site was too open and unprotected to support eelgrass while water temperatures in Cedar Beach Creek may get too a high (approaching 90°F) for the grass to survive. In Cutchogue, there was nothing on the bottom at or near the transplant site during 1997 or 1998.

Year III - Summary and Recommendations

Intact sods appeared to offer an opportunity for eelgrass establishment that avoids any undue transplant shock and physical disturbance. However, regardless of the advantages of this technique, these facts are not outweighed by the need to undertake prudent site selection prior to undertaking plantings. Future efforts should focus on refining the sod method in areas where there is existing eelgrass. In this way the water quality and sediment suitability requirements should not affect our efforts.

YEAR IV & V (1998-1999)

Year IV & V - Background

Based on the results of the sod transplants during the 1997 season in Napeague Harbor, we decided to conduct additional sod work during 1998. To avoid the complication of selecting a site with suitable water quality and sediment type, we focused on re-establishing growth in vacant areas of an existing eelgrass bed in Napeague. We planned to remove sods from dense growth areas of the meadow in Napeague and plant them into existing openings in the same meadow. This technique would serve to determine the effectiveness of our new technique.

Year IV & V - Activities

Our efforts in 1998 and 1999 focused on the eastern portion of Napeague Harbor and demonstrated that large intact clumps of rhizome with sediment intact could be successfully established in and adjacent to an existing meadow. Mid-summer and fall plantings focused in interior areas and the deep water edge habitats. This work proved that this very labor intensive technique was effective and donor sites vegetated with new growth within months of harvest.

In order to improve the effectiveness and standardize the harvest and installation of sods, a modified coring method was employed using a 20cm diameter plug cutter. This technique involved using a specially constructed "T" handle with a circular serrated blade, 20cm in diameter, mounted at the base. Plugs were cut by gently placing the blade over a clump of eelgrass, pushing downward and rotating the handle. The intact plug was removed by placing one hand under the blade as it was lifted from the sediment. This operation was most efficient using a diver assisted by a person in waders. The diver placed the cutter and assisted in keeping the sod intact as it was lifted. The person in waders provided the force to cut the sod and held the cutter when it was not needed.

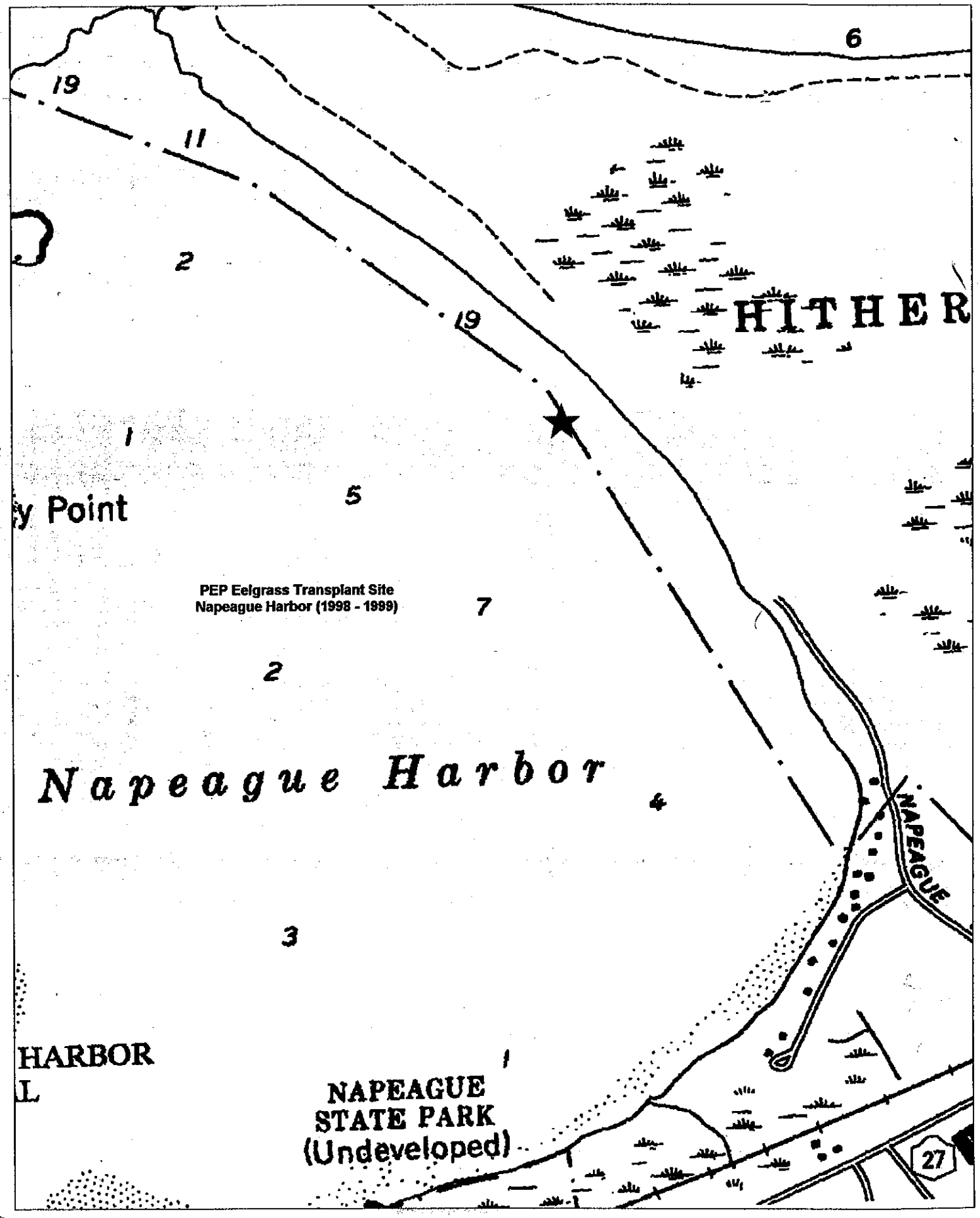
Planting of the sods was a very labor intensive technique involving pushing the cutter into the transplant site to the same depth as the plug to be planted, removing all sediment inside the blade by hand and gently placing the intact plug in this depression. After the plug was in place, the diver gently lifted the blade from the sediment and handed it to the person in waders nearby. Care was taken to pack sediment around the newly planted plug.

Despite the great success of the transplant method, regular monitoring in 1999 by the Town of East Hampton eventually determined that uncontrolled recreational clamming threatens both the transplants and the natural meadow. It appears that many of the open areas in the bed targeted for planting were actually the result of recreational clamming. Closer observation of this bed indicates clear evidence of mechanical harvest of clams. The damage was most apparent along the deepwater edge of the meadow where up to 1 meter of growth has been lost.

In addition to the plantings in Napeague Harbor CCE worked with the EHTNRD to monitor sites that were planted during 1994-1997. Planting sites monitored during 1998 included Three Mile Harbor, Accabonac Harbor and Northwest Harbor. The only sites to show evidence of continued eelgrass growth during 1998, other than the meadow in Napeague, was the original site in Three Mile Harbor (just north of Gardiners Marina). The success in Napeague harbor was the most likely due to the modified (plug) planting technique. Eelgrass sods were transplanted from

adjacent donor sites into voids in existing beds and along the external margins of these beds. The success of the Three Mile Harbor site is likely due to very favorable growth conditions. The planting in Three Mile Harbor were anchored bare-root planting plugs.

Failures of eelgrass planting in Accabonac Harbor and Northwest Creek are consistent with natural eelgrass meadows in these harbors. During the time period of this project, natural eelgrass meadows in these two harbors have experienced a steady decline to the point where these areas no longer support any significant eelgrass.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PEP Eelgrass Transplant Site
Napeague Harbor (1998 - 1999)
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Napeague Harbor
4
NAPEAGUE
3
HARBOR
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1
NAPEAGUE
STATE PARK
(Undeveloped)
27

Year IV & V - Conclusions

The modified plug technique, though somewhat labor intensive, proved very effective at transplanting eelgrass. This is understandable given the care that was taken during this effort and the fact that the donor and transplant sites were within the same meadow. This technique or a modification of it should be considered for additional work elsewhere. It is not recommended that additional transplants be conducted in this meadow given the uncertainty of it's future.

Year IV & V - Summary and Recommendations

In the interest of saving the eelgrass meadow in Napeague Harbor, there should be an effort by the Town of East Hampton to manage the current shellfishing activities. Left unchecked, there may be little left of this remnant meadow in a few years. Since this work proved that the modified plug technique could work effectively, there is no need to continue transplants in this meadow. Future efforts should focus on adapting the technique to reduce labor needs.

Project Summary

Despite considerable effort at many sites throughout the Estuary, the only site where bare-root plantings really became established were those planted during the earliest work at the Gardiners Marina Site at Three Mile Harbor. This Harbor has consistently supported eelgrass and will likely support eelgrass into the future if water quality does not degrade significantly. It is not clear at this time whether the failure of all other bare-root plantings was the result of poor site selection or an indication of a general decline of the suitability of the various planting areas to support eelgrass.

Napeague Harbor is the other site were some of the transplants survived and there is an existing meadow that should support eelgrass in the future if properly managed. Transplanting of intact plugs (sods) proved effective in filling existing openings in the center of the meadow. Transplanted and natural grass coalesced after several months of growth. Intact plugs (sods) appeared to offer an opportunity for eelgrass establishment that avoids any undue transplant shock and physical disturbance. However, regardless of the advantages of this technique, these facts are not outweighed by the need to undertake prudent site selection prior to undertaking plantings.

Project Conclusions

The results of this work were enlightening though discouraging. Most transplants were not successful due to poor choice of transplant site, disturbance by local animals, competition from algal species, or possibly, inadequate water quality. Failure of some of this effort may be linked in part to a larger die-off in the Peconic Estuary indicated by a complete loss of natural beds in Northwest Creek and Accabonac Harbor over the last decade. If there is some overriding water quality or climate issue that has resulted in declines in existing remnant meadows, there is little chance the transplants will be successful. Closer tracking of the existing resource is necessary before a decision can be made regarding the appropriateness of additional restoration effort.

Of all the techniques and locations planted, intact plugs (sods) appear to offer the most hope. Working in an area with existing grass further enhances this work. In the interest of saving the eelgrass meadow in Napeague Harbor, there should be an effort by the Town of East Hampton to manage the current shellfishing activities. Left unchecked, there may be little left of this remnant meadow in a few years. Since this work proved that the modified plug technique could work effectively, there is no need to continue transplants in this meadow. Future efforts should focus on adapting the technique to reduce labor needs. However, until there is a general assessment of the status of existing natural beds, transplants of this type should proceed with caution. Care should be taken during transplant efforts to avoid damage to existing meadows. An alternative to collecting natural grass should be developed possibly relying on seeds or naturally dislodged shoots.

References

Fonseca, M.S. W.J. Kenworthy and G.W. Thayer. 1982. A low-cost planting technique for eelgrass (Zostera marina L.). Coastal Engineering Technical Aid No. 82-67. U.S. Army Corps of Engineers, Waterways Experimental Station, Vicksburg, Mississippi.

Thayer, G.W., W.J. Kenworthy and M.S. Fonseca. 1984. The Ecological of Eelgrass Meadows. USFWS/OBS-84/02

EEA, 1997. Protocols for Harvesting and Transplanting Eelgrass in the Peconic Estuary.

Suffolk County Department of Health Services, Riverhead, New York. 1994. Peconic Estuary Program Action Plan