The Cornelius Point Eelgrass Restoration Project
Shelter Island, NY

A Summary Report to:
The Peconic Estuary Program
Agreement # 525-8235-1120-00-00001

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EXECUTIVE SUMMARY

The Cornelius Point Eelgrass Restoration site was first identified as a potential restoration area based on the results of a Transplant Suitability Index Model project initiated in 2002 and has been the focus of test plantings since that time. This site once supported a very extensive eelgrass meadow in 1930 and still supported a very small population of grass as recently as 2004. Cornelius Point was chosen as a good restoration candidate based on good water quality and minimal human disturbance. Early work focused on the use of seeds for restoration, but the high tidal currents and wave energy caused over-burial of seeds to the point of making this method unsuitable. Transplanting adult shoots began in 2003 and involved using various densities to determine the most effective methods. Eventually, planting into circular $1m^2$ plots at a density of 200 shoots/m^2 was determined as the most favorable method. Large-scale transplants began in June 2006, were discontinued during summer, given the high water temps and re-initiated in September 2006. Although there were some losses of the June plots due to bioturbation, the fall plantings were very successful and nearly 28,000 shoots were planted at the 1-acre site between September and December 2006. In addition to the bulk, single plot transplants, several experimental plots were installed to help refine future planting efforts. To date, this project has been the most successful eelgrass restoration project in the Peconic Estuary with plants surviving more than two growing seasons. Additional monitoring during the coming season will determine if the objective of creating a 1-acre meadow as met.

BACKGROUND

The Cornelius Point Eelgrass Restoration Project site (Figure 1) is located just south of Cornelius Point, Shelter Island in the area historically referred to as "bunker city" by local baymen. This site supported a very large eelgrass meadow in 1930 and is bordered by existing grass at Hay Beach (0.25 miles to the north) and Ram Island (2 miles to the southeast). In addition to favorable water quality, this area has the added advantage of lacking a significant shellfishing resource that would otherwise make it susceptible to disturbance.

The recent completion of the Planting Suitability Index Model for the Peconic Estuary has lead to the identification of several planting sites that had not previously been targeted for planting. In general, the model has called for planting in water that is cooler and deeper than has previously been attempted. Most of the sites identified in the model are east of Shelter Island.

Figure 1. Location (red star) of eelgrass restoration site at Cornelius Point, Shelter Island, NY.

Figure 2 shows the partial model output with the Cornelius Point site showing as the large area near the center of the map. Once the site was identified as a potential restoration site test plantings began during summer 2003 to determine the most appropriate methods and time of year for planting. Table 1 provides an overview of all activities conducted at this site to date.

Although use of seeds is preferred over adult shoot transplants, the results of early test- seeding using both broadcast seeding and buoy deployed seeding indicated that this site was not a suitable candidate. After these initial failures, all work at the site focused on the use of adult shoot transplants.

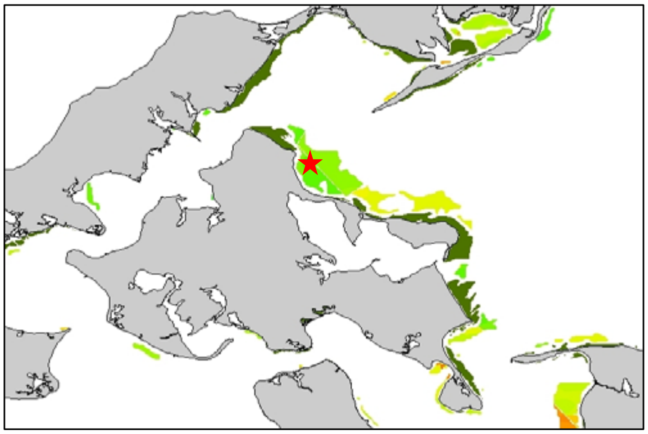

Figure 2. Results of the Transplant Suitability Index Model showing favorable restoration sites (medium green) on the eastern shore of Shelter Island, NY. Red star indicates the restoration site.

OBJECTIVE

The objective of this restoration project was to create a 1-acre eelgrass meadow at Cornelius Point, Shelter Island, in an area that historically supported eelgrass.

Table1. Summary of field activities conducted at Cornelius Point, Shelter Island, New York (2003-2006). The current project began in 2006.

Date	***Activity/Outcome***
August 12, 2003	Deployed 15 BuDS buoys stocked with flowers collected at Mulford Point LIS. No seedlings were observed in spring.
October 16, 2003	Broadcast 500ml of seeds in two (one shallow, one deep) 1,250 ft2 plots. Seedlings were observed on April 20, 2004 in the shallow plot and showed excessive burial and eventually died. No seedlings were observed at the deep plot.
June 24, 2004	Planted 16 TERFS frames adjacent to some extremely eroded remnants of meadow using plants collected at Hallocks Bay. All of these plantings and the remaining natural grass eventually were lost due to severe erosion.
Fall 2004	Six (6) circular plots were planted using two densities (200 & 400 shoots/m^2) and two treatments (cut leaves and uncut leaves). Both densities and treatments worked and several of these plots survived and persist to this day.
Fall 2005	The first 1m^2 test plots were established at this site using transplants collected from Orient Point. Although several of the plots were eventually lost, several of these plots still persist today.
June , 2006	A small number of plots were planted out in Spring to determine the efficacy of June planting at the site. Several plots failed due to bioturbation.
September-December, 2006	During this time period 138 individual 1m^2 plots were planted. The majority of the plots have persisted into January 2007.

METHODS

Planting

The transplant method used for this project was based on several years of test-planting at the site. Transplanting Eelgrass Remotely using Frame System (TERFS) and low-density (<100 shoots m^{-2}) free planting did not work in early tests plots, due to the high tidal currents. These methods were discontinued after 2004. Medium to high-density (200-400 shoots m^{-2}) free plantings were tested during 2004 and proved successful, so adaptations of this method were used for the remainder of the plantings. Although both 300 and 400 shoots/m^2 were effective at this site, the goal was to determine the minimum number of shoots necessary to create stable plots. After several tests, a density of 200 shoots m^{-2} was determined to be the most effective. It is interesting to note that this density is identical to that used by other restoration practitioners in nearby states (Sue Tuxbury, personal communication).

Depth of planting at this site ranged from 1.5 to 2 m (MLW). The bottom type throughout the site consisted of coarse sand to gravel. High wave energy at the site causes the formation of sand waves and prevents excessive macroalgae growth. Macroalgae are only present within the planting plots and attached to large rocks scattered near the landward edge of the planting site.

In order to minimize the impact from crabs and currents to the planting plots, a circular plot layout was chosen over a typical square design. Individual 1m^2 circular plots were planted at approximately 2m intervals spread throughout the restoration site (Figure 3 & 4). Each plot was individually marked using a numbered rock (Figure 5) set on the sediment surface at the center of the plot. Although sand accretion at the center of the plots, caused by wave damping of the plant canopy, often caused burial of the rock, it was generally easy to relocate the rocks for subsequent plot identification and photographs.

The time of year of the plantings is critical to success. Both spring/early summer and fall plantings were planned for this project. After June plantings did not prove favorable, the bulk of the planting effort was undertaken in the fall (September through December).

Transplant Collection, Processing and Storage

Adult shoots used for transplant were collected at several sites located throughout the region including Orient Point and Hay Beach Point (PE) and Mulford Point and Fishers Island (LIS). However, more that 95% of the plants were collected at the large meadow at Orient Point between the Cross Sound Ferry terminal and the utility building for Plum Island located at the Point. This area proved to be a very effective site to collect transplants in that this meadow contains a large number of “blowouts” or naturally occurring openings in the continuous meadow where plants are regularly uprooted. Uprooted and sediment-free shoots can regularly collected from the shoreward facing edge of these blowouts. It is a relatively simple task for SCUBA divers to swim along the blowout edges and gather shoots in large numbers in mesh bags. Collection efficiency can be as high as 1000 shoots/hour when conditions are suitable.

Figure 3. Plot map of the Cornelius Point, Shelter Island, NY eelgrass restoration project. Individual plot locations were generated using a Garmin GPSmap 76S handheld GPS overlaid on a 2004 aerial photograph. Corrections were made based on the known distance between plots.

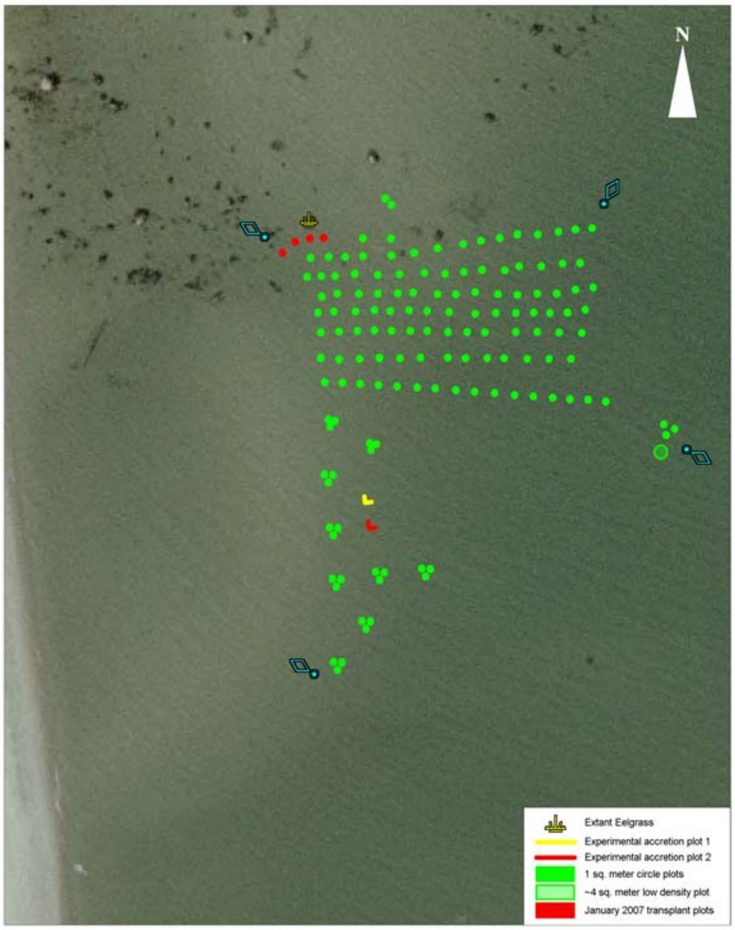

Figure 4. Detailed plot map of the Cornelius Point, Shelter Island, NY eelgrass restoration project showing general planting layout and various experimental plots used at the site.

Figure 5. Typical 1m^2 circular planting plot showing numbered rock used to facilitate subsequent monitoring. Note the heavy algae growth attached to the grass typical of winter.

After collection, the shoots were transported to the CCE eelgrass culture facility for processing and storage.

All shoot processing and storage took place in large flowing seawater tanks in a polypropylene greenhouse located at Cedar Beach, Southold, NY. Processing involved removing excess rhizome material and sorting the shoots into groups of 100. Plants were floated at the surface of tanks for 1 to 14 days to ensure maximum light. Excessive algal fouling was prevented by turning and rinsing the shoots regularly. On the day of plantings bundles of 100 shoots were placed in mesh bags and transported to the site in fish totes filled with cool seawater. Once at the site, the plants were tied off the side of the boat until they were used for planting

Monitoring
Short-term monitoring (within the first growing season) was achieved through regular observation of all transplants. On the day of planting, each plot was photographed using a Sea & Sea 8000G, 8.2 mega pixel digital camera in a waterproof housing. Photos were date-stamped to simplify future analysis. Planting success can usually be determine within the first two to three weeks following planting as the major causes of failure include bioturbation from crabs (immediately following planting) or scouring by waves prior to rooting (caused by storm events). Following the initial planting, plots were photographed at approximately monthly intervals. Plots that survived the first month typically survive into the second growing season. Given the large number of plots (138), not all of the plots could be photographed on the same day. The “final” monitoring photographs for this project were

taken on January 3 & 4, 2007. Only after several years of monitoring can the project truly be considered successful.

RESULTS

The results for this project have been very successful to date. Nearly 30,000 adult shoots were transplanted to the site during the 2006 field season. Early test plantings (see Table 1) followed by the survival of the most recent plots indicate that this site is an ideal candidate for restoration. In fact, this is the first eelgrass restoration site in the Peconic Estuary where transplant have survived for more than one growing season. Plants from the original fall 2004 planting (more than 2 years old) still persist at the site today and show no signs of loss. It is expected that the majority of the plots planted during fall 2006 will persist through the winter and into the following spring when they will put on additional growth and expand. Figure 6 shows that the individual plots are visible from above the surface of the water. Over the next several years we expect the individual plots to coalesce into a continuous meadow.

Figure 6. Oblique surface photo showing several of the 138 1m^2 planting plots at the Cornelius Point eelgrass restoration site. Photograph was taken on January 4, 2007.

We did experience some loss of plants in plots from both bioturbation and storm damage, especially in the June plantings. The results of this damage include partial plots or in the extreme cases loss of most plants within a plot. However, the latter case may have been caused by the incorrect planting protocol being used by one diver during one planting day.

The only known cases of total plant loss were from several of the few lower density (100 shoots/m^2) plots planted as an experiment. Spider crabs had the most impact on plantings during June as they were apparently attracted by the disturbance of the sediment, associated with planting, and were generally observed entering the plots soon after planting. In some cases, these crabs removed a number of shoots as they buried themselves in the protection of the new leaf canopy. Storm losses occurred after a couple plantings in the fall. Given the orientation of the site, this impact was greatest from easterly and southeast winds. Fortunately, this wind direction was not common in the fall of 2006.

DISCUSSION

Although there was a desire to collect plants from various sites for use in this restoration project, only the Orient Point meadow proved a ready source of naturally uprooted shoots. If additional plants from other sites were used, most would have had to be dug from these areas, a practice we do not recommend. As in all of our restoration work, every attempt was made to incorporate experimentation into the plantings to refine methods. This experimentation proved valuable during the early stages of the project as it identified the most appropriate planting density for this site (200 shoots m^{-2}). This density may or may not be suited to other locations in the Peconic Estuary, but it should be considered as a reasonable starting point for any planting trials. Use of labeled rocks on individual plots involved additional labor, including that necessary to collect, label, prepare the rocks as well as the effort needed to dig up the rocks on subsequent visits, but these labels proved invaluable in tracking individual plots and determining the effect of time of year, transplant stock, density, diver error and other factors that influence transplant success. Although this level of tracking is unheard of for large-scale restoration projects, it was invaluable to this and future efforts. The results of some of the experimental layouts incorporated into plantings at this site have yet to be determined given the short monitoring period (one growing season). For example, it is still to be determined whether the trio plots show better growth and survival than the single plots. The results of this work will be better understood during the 2007 growing season. The progress of this project can tracked at www.seagrassli.org in the "projects" section.

CONCLUSIONS

The methods developed over the last three years at Cornelius Point can be used to plan and implement future eelgrass restoration projects in the Peconic Estuary. However, before this work takes place, it is essential to work with an appropriate site selection model, such at that used for this project. Once a suitable site is identified, it is crucial that at least one season's worth of experimental plantings be undertaken to determine the most appropriate depth and shoot density. Without this preliminary work, such projects are destined to fail. Work at Cornelius Point, to expand the existing plantings, will continue and additional projects, in the PE and surrounding waters, will be undertaken in the coming years.

APPENDIX I

Transplant data sheets for the Cornelius Point Eelgrass Restoration Project

Cornelius Point
Restoration Site Plantings (Fall 2006)

#	Plot #	Date	Density/Size	Donor	Depth	Diver	Notes
1	101	9/21/06	200	Fishers		SS	CLEAN & NARROW PLANTS COLLECTED 9/18
2	104	9/21/06	200	Long Beach		SS	FAIRLY SHORT LEAVES
3	107	9/21/06	200	↑		SS	AND SOME HEAVY EPI.
4	109	9/21/06	200			SS	LOAD ON OLDER LEAVES
5	110	9/21/06	200	↓		SS	PLANTS COLLECTED 9/20
6	111	9/21/06	200	Long Bch		SS	
7	102	9/21/06	200	Fishers		KP	VERY CLEAN & NARROW
8	103		50 Fishers/117 LBch	Fishers/LBch		KP	LEAVES
9	106		200	Long Bch		KP	
10	108		200	Long Bch		KP	
11	105	↓	200	Long Bch		KP	
12	112	9/21/06	200	Long Bch		KP	
13	128	9/22/06	300	Orient Pt		MP	PLANTS COLLECTED 9/21
14	130		300			MP	CLEAN/SOME LONG
15	125		300			MP	SHEATHS
16	124		300			KP	
17	140		300			KP	
18	131		300			KP	
19	148		300			KP	
20	134		300			KP&SS	
21	126		200			SS	
22	123		200			SS	
23	121		200			SS	
24	129		200			SS	
25	149		300			SS	
26	122		300	"	DEEP	CP	PLANTED IN A CLOSE
27	138		"	"	"	CP	TRIO NEAR DEEP BUOY
28	147		"	"	"	CP	ONE RING APART
29	135	9/26	100	O.P.		MP	
30	153		100			MP	
31	139		100			MP	
32	142		100	↓		MP	
33	150		100			MP	
34	116		200			KP	
35	114		200			KP	
36	115		200			KP	
37	118		200			KP	
38	113		200			KP	
39	119		200			SS	
40	133		200			SS	
41	151		200			SS	
42	141	9/26	200			SS	

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Cornelius Point
Restoration Site Plantings (Fall 2006)

#	Plot #	Date	Density/Size	Donor	Depth	Diver	Notes
43	155	9/26/06	200	O.P.		SS	Rock Marker Placed 10/2
44	156	10/2	200	O.P.		SS	
45	143		200			SS	
46	157		200			SS	
47	132		200			SS	SHOOTS COLLECTED
48	136		200	O.P.		MP	9/21
49	120		200			MP	
50	137		200			MP	
51	127		200			KP	
53	117		200			KP	
54	152		200			KP	
55	146	10/2	200			KP	
56	154	10/10	200	OP		KP	Shoots Collected 10/3
57	179		200			KP	+ 10/4
58	175		200			KP	
59	168		200			KP	
60	163		200			KP	
61	161		200			MP	
62	171		200			MP	
63	170		200			MP	
64	172		200			MP	
65	169		200			SS	
66	158		200			SS	
67	164		200			SS	
68	144	10/10	200	O.P.		SS	
69	159	10/17	200	O.P.		MP	Shoots Collected 10/16
70	165		200			MP	
71	176		200			MP	
72	166		200			SS	
73	160		200			SS	
74	173		200			SS	
75	174	10/17	200	O.P.		SS	
76	190	10/25	"	"		MP	
77	187					MP	shoots collected 10/23
78	193					MP	
79	182					MP	
80	180					KP	
81	196					KP	
82	191					KP	
83	181					KP	
84	162		"	"		KP	
85	198					SS	

←15467

Cornelius Point
Restoration Site Plantings (Fall 2006)

#	Plot #	Date	Density/Size	Donor	Depth	Diver	Notes
86	184		200			SS	
87	201		"			SS	
88	200					SS	
89	185					SS	
90	189					SS	
91	199					CP	in middle of 147, 138+ 122
92	194					CP	SE of trio
93	186					CP	NE of trio
94	188					CP	
95	177	10/25	over 4-5m²			CP	
96	209	11/6	200 in triplets	Orient	Shallow	SS	209, 210, 183 triplet
97	210			Collected 10/31/06		KP	
98	183					SS	
99	202					KP	202, 192, 197 triplet
100	192					KP	
101	197					SS	
102	178					KP	178, 205, 195 triplet
103	205					SS	
104	195	11/6					
105	203	11/7	200 in trips	Orient		KP	203, 202, 207 in triplet
106	207			Collected 10/31 + 11/1		KP	
106	202					MP	
108	204					MP	204, 206, 208 in triplet
109	206					MP	
110	208	11/7				KP	
111	217	11/9	200	Orient		KP	
112	214			11/8/06		KP	
113	211					KP	
114	222					KP	
115	216					KP	
116	221					SS	
117	223					SS	
118	219					SS	
119	213					SS	
120	212					SS	
121	215					SS	
122	218	11/9		Orient		SS	
123	255	11/27	200	Orient		SS	255, 228, 258 in triplet
124	228					SS	
125	258					KP	
126	229					KP	229, 253, 227 in triplet
127	253	11/27	200	Orient		KP	

Cornelius Point
Restoration Site Plantings (Fall 2006)

#	Plot #	Date	Density/Size	Donor	Depth	Diver	Notes
128	227	11/27	200	Orient		SS	
129	259					SS	259, 261, 251 in triplet
130	261					SS	
131	251					KP	
132	256					KP	256, 252, 226 in triplet
133	252					KP	
134	226	11/27/06	200	Orient		SS	
135	239	1/4/07	200	Shinnecock		SS	
136	252		200	Orient		SS	
137	254		200	Orient		SS	
138	260	1/4/07	200	Shinnecock		SS	
139							
140							
141							
142							
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Divers: CP-Chris Pickerell, KP-Kimberly Petersen, MP-Matt Parsons,
SS-Stephen Schott