

Implementing Long-Term Monitoring of Salt Marsh Communities within the Northeast Coastal and Barrier Network of the National Park Service

Year 2: Monitoring at Boston Harbor Islands National Park Area, Cape Cod National Seashore, Gateway National Recreation Area, and Sagamore Hill National Historic Site

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Chapter 1 - Introduction

The National Park Service has recently implemented a program to develop monitoring protocols in an effort to collect long-term data on natural and cultural resources. Cape Cod National Seashore (Massachusetts) was designated as the prototype park for the Atlantic and Gulf Coast biogeographic region where protocols were designed and tested. Two of these protocols, Monitoring Nekton in Shallow Estuarine Habitats (James-Pirri *et al.* In Review-b; Raposa & Roman 2001a) and Monitoring Salt Marsh Vegetation (James-Pirri *et al.* In Review-a; Roman *et al.* 2001) have been completed and are currently implemented on several US Fish and Wildlife Refuges along the Atlantic Coast (James-Pirri *et al.* 2002, 2003, 2004) (Fig 1-1). This is a 3 year study that will implement the salt marsh and nekton monitoring protocols at National Park Service units within the Northeast Coastal and Barrier Network as well as additional coastal Parks (Fig 1-1). This progress report summarizes the field sampling for year 2 conducted in 2004 at Boston Harbor Islands National Park Area (BOHA), Cape Cod National Seashore (CACO), Gateway National Recreation Area (GATE) (a second year of data collection), and Sagamore Hill National Historic Site (SAHI). Additional sampling was conducted at Saugus Iron Works National Historic Site (SAIR) as part of a restoration effort and those results are presented in a separate report (James-Pirri 2004).

Study sites

The Park units within the Northeast Coastal and Barrier Network where salt marsh vegetation and nekton communities will be monitored are: Assateague Island National Seashore (ASIS, coastal Maryland and Virginia), Colonial National Historic Park (COLO, Virginia Peninsula), Fire Island National Seashore (FIIS, Long Island, NY), Gateway National Recreation Area (GATE, New York City, NY and Sandy Hook, NJ), George Washington Birthplace National Monument (GEWA, Westmoreland County, VA), Sagamore Hill National Historic Site (SAHI, Oyster Bay, NY), and Thomas Stone National Historic Site (THST, Port Tobacco, MD).

Monitoring will be established at the selected Park units over a 3 year period, with an average of 3 Parks sampled each year. Due to immediate resource management needs, some parks may be added to the study [*i.e.* Saugus Iron Works NHS (SAIR) and Cape Cod NS (CACO) in 2004] while others may be dropped (*i.e.* THST) if it is determined that monitoring is not necessary. In 2004, monitoring of saltmarsh nekton and vegetation were conducted at BOHA, CACO (nekton only), GATE (nekton only), SAHI, and SAIR (results of SAIR sampling are presented in a separate report, James-Pirri 2004). In 2005, it is anticipated that monitoring will commence at ASIS, GEWA, and possibly COLO (a second year of monitoring). Monitoring at Acadia National Park (ACAD) may take place in the near future, however that effort will probably be initiated by the Northeast Temperate Network. Since THST has no wetlands, monitoring will not take place at this unit.

Methods

Nekton (Fish and Decapods)

Nekton is defined as free-swimming fish and decapod crustaceans (McIvor & Rozas 1996). As common residents of salt marshes, nekton utilizes the marsh surface, creeks and ditches, and marsh pools (Able *et al.* 1996). At each study site at 10 to 25 nekton sampling locations were established. Sampling locations included marsh pools, creeks, ditches, and shoreline areas depending on the topography of the site. James-Pirri *et al.* (In Review-b) and Raposa & Roman (2001a) offer a detailed summary of the protocol and good overview of the spatial and temporal variability, and sample size in the nekton sampling procedure. Depending on the amount and type of open water habitat (pools, tidal creeks, shoreline, or ditches) on the marsh, two different sampling techniques (throw trap and ditch net) may be employed. However, in 2004 all sites were sampled with throw traps (the preferred method) due to the lack of appropriate ditch habitat for the ditch net. All pools (up to 15, if present) within a marsh were sampled. If there were few pools on the marsh surface, then larger tidal creeks (more than 1.5m wide) and shoreline areas were also sampled with the throw trap. All nekton sampling stations were randomly located along the perimeter of the pool, tidal creek, shoreline, or ditch.

Nekton in marsh pools, large tidal creeks, and shoreline habitats (all less than 1m deep) were sampled with a 1m² aluminum throw trap (Kushlan 1981, Sogard & Able 1991, Raposa and Roman 2001b). The throw trap is an enclosure sampler that has excellent efficiency and provides quantitative, repeatable results (Rozas & Minello 1997). The trap had an open top and bottom, was 0.5m in height and 1m square, and the sides were covered with 3mm (1/8 in) wire mesh. Each sampling location was quietly approached, and at 3m to 5m from the area that was sampled, the person throwing the trap crouched and waited a few minutes to allow any disturbed nekton to resume normal activity. The person then tossed the trap into the pool, tidal creek, or shoreline area, imbedding it in the bottom sediments and captured any nekton within the 1m² area of the trap. All nekton were collected from the trap with a 1mm mesh dip net that fit snugly within the opposite sides of the trap. The trap was considered empty when three successive attempts with the dip net produced no organisms.

All fish and decapods were identified and enumerated. A representative number (up to 15 individuals) of each species collected was measured for length (fish – total length; crabs – carapace width; shrimp – total length). Once identified and measured all organisms were returned to the location where they were sampled. An example data sheet for the throw trap sampling method is shown in Appendix, Fig. 7-1.

Nekton was sampled on ebbing tides, after the marsh surface had drained. Sampling occurred twice per year, once in early summer (June-July) and once in late summer-early fall (August – October). Species composition and abundance were estimated and species richness was calculated for each site using the jack-knife method (Heltshe & Forrester 1983).

Vegetation

Plots to monitor salt marsh vegetation were located according to the salt marsh vegetation protocol (James-Pirri *et al.* In Review – a; Roman *et al.* 2001). At each location where vegetation was monitored 15 to 20 vegetation plots were established along transects to monitor salt marsh vegetation. Randomly located transects extended from the tidal creeks or shoreline to the upland and covered a representative portion of the study area. The first plot in each transect was randomly located and all subsequent plots were systematically placed along the transect at 10m to 50m intervals depending on the size of the study area. Within each plot all species were identified and the point-intercept method (Mueller-Dombois & Ellenberg 1974) was used to estimate percent cover of herbaceous vegetation. Categories and definitions of cover types used during the vegetation monitoring are shown in Table 1-1 (taken from Roman *et al.* 2001). An example data sheet for the point intercept is shown in Appendix, Figs. 7-2.

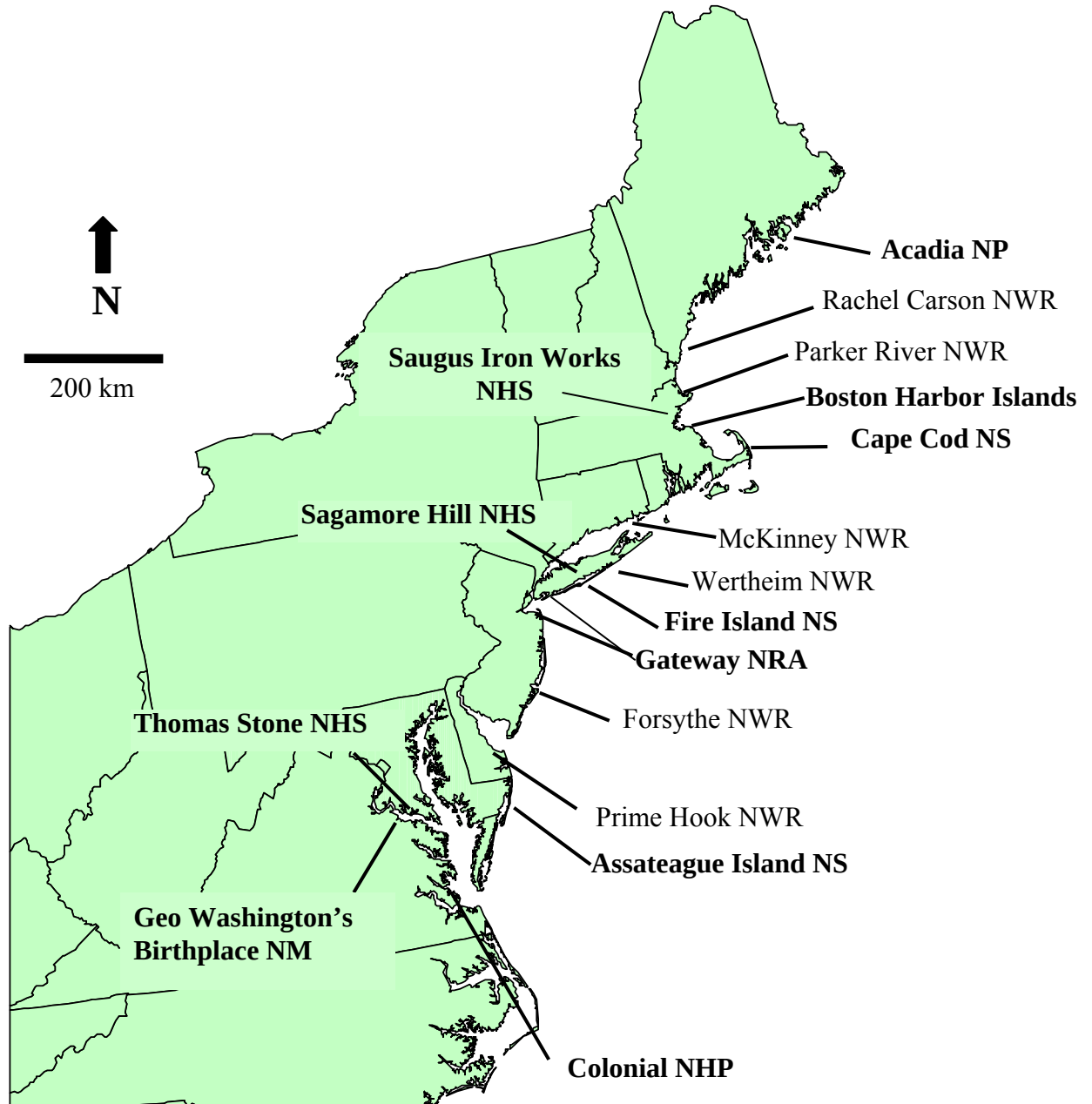


Figure 1-1. Coastal National Parks of the Northeast (in bold). Region 5 US Fish and Wildlife Refuges where salt marsh and nekton monitoring protocols are currently or may be implemented are shown.

Table 1-1. Definition of cover type categories used in the salt marsh vegetation monitoring program (after Roman *et al* 2001).

Live vascular plants (herbaceous and shrubs) identified by species.

Standing dead vascular plants identified by species (*e.g.*, *S. alterniflora* dead). This category only includes standing dead (attached) plants that are from a previous year's growth. There may be some dead leaves from this year's growth (*e.g.*, the ends of leaves or leaves that are being replaced by new growth, *etc.*). If you are sure these dead leaves are from the current growing season, then record as live.

Macroalgae identified by species. This category generally includes the rockweeds (*e.g.*, *Fucus*, *Ascophyllum*). Microalgae (*e.g.*, diatom mats) and fine filamentous algae are not included in this category.

Bare. Includes mud, sand, microalgae cover, *etc.* These are areas that are not flooded with water and are devoid of standing live, standing dead, or macroalgae. There can be a thin film of surface water within the bare category.

Water. Permanent standing water is identified in plots that are partly within a creek, ditch, marsh pool, or flooded panne.

Wrack/Litter. Wrack is material that has floated into the plot. This is generally dead (not attached) plant material, but could also be trash. Litter is dead plant material that is highly decomposed and is no longer attached.

Trash. Items such as logs, old piers, tires, *etc.*

Rock. Boulders or rocks can be found on the surface of northern New England marshes.

NOTES:

- If an intercept point has standing water that is covering a bare mud bottom, this point should be recorded as standing water. It is assumed that the bottom is bare and there is no need to record this.
 - If macroalgae or submerged aquatic vegetation are hit at the intercept point in a standing water habitat, then both the plant and water should be recorded.
 - If a plot is at the edge of a marsh pool (water), *Spartina* overhangs the water, and the intercept point hits the *Spartina* and water, then both *Spartina* and water should be recorded.
-

Chapter 2 - Boston Harbor National Park Area (BOHA)

Sampling and Sampling Stations

In 2004, salt marsh monitoring was conducted at BOHA on Calf Island (vegetation only) and Thompson Island (nekton and vegetation) (Fig. 2-1). Nekton was sampled twice at the same station locations, once in June and once in August; vegetation was sampled in July (Table 2-1). Sample station locations for nekton and vegetation are shown in Fig 2-2. Table 2-2 shows the number of vegetation plots per transect and distance between plots. UTM coordinates of sampling locations are given in the Appendix, Table 7-1.

At Thompson Island, a total of 20 nekton stations (8 in June, 12 in August) were sampled and 29 vegetation plots oriented along 3 transect were sampled (Fig. 2-2). At Calf Island only vegetation was sampled as there was too little open water habitat within the salt marsh to sample nekton. A total of 18 vegetation plots oriented along 2 transects were sampled (Fig. 2-2).

Nekton

Nekton community composition and abundance for Thompson Island marsh is shown in Table 2-3, and total fish, decapod, and nekton densities are shown in Table 2-4. Average lengths of sampled nekton are given in Table 2-5. Physical variables (water temperature, salinity, and dissolved oxygen) taken at nekton stations are given in Table 2-6.

Six nekton species (3 fish and 3 decapod species) were sampled at Thompson marsh (Table 2-3) and the species richness (jack-knife estimation, Heltshe and Forrester 1983) value for the sampled nekton was 6.0. Approximately 90% of the catch was comprised of four species: mummichog (*Fundulus heteroclitus*), grass shrimp (*Palaemonetes pugio*), green crab (*Carcinus maenas*), and Atlantic silverside (*Menidia menidia*).

Vegetation

At Thompson Island, a total of seven vegetation species and 3 additional cover types (bare ground, water, wrack and litter) were observed (Table 2-7). Dominant species, comprising approximately 90% of the vegetation cover, were live and dead salt marsh cordgrass (*Spartina alterniflora*), bare ground, glasswort (*Salicornia europaea*), and wrack and litter.

At Calf Island, a total of seven vegetation species and 1 additional cover type (wrack and litter) were observed (Table 2-7). Dominant species, comprising approximately 90% of the vegetation cover, were live and dead spike grass (*Distichlis spicata*), live and dead salt meadow cordgrass (*Spartina patens*), salt marsh cordgrass (*Spartina alterniflora*), live and dead common reed (*Phragmites australis*), and bare ground.

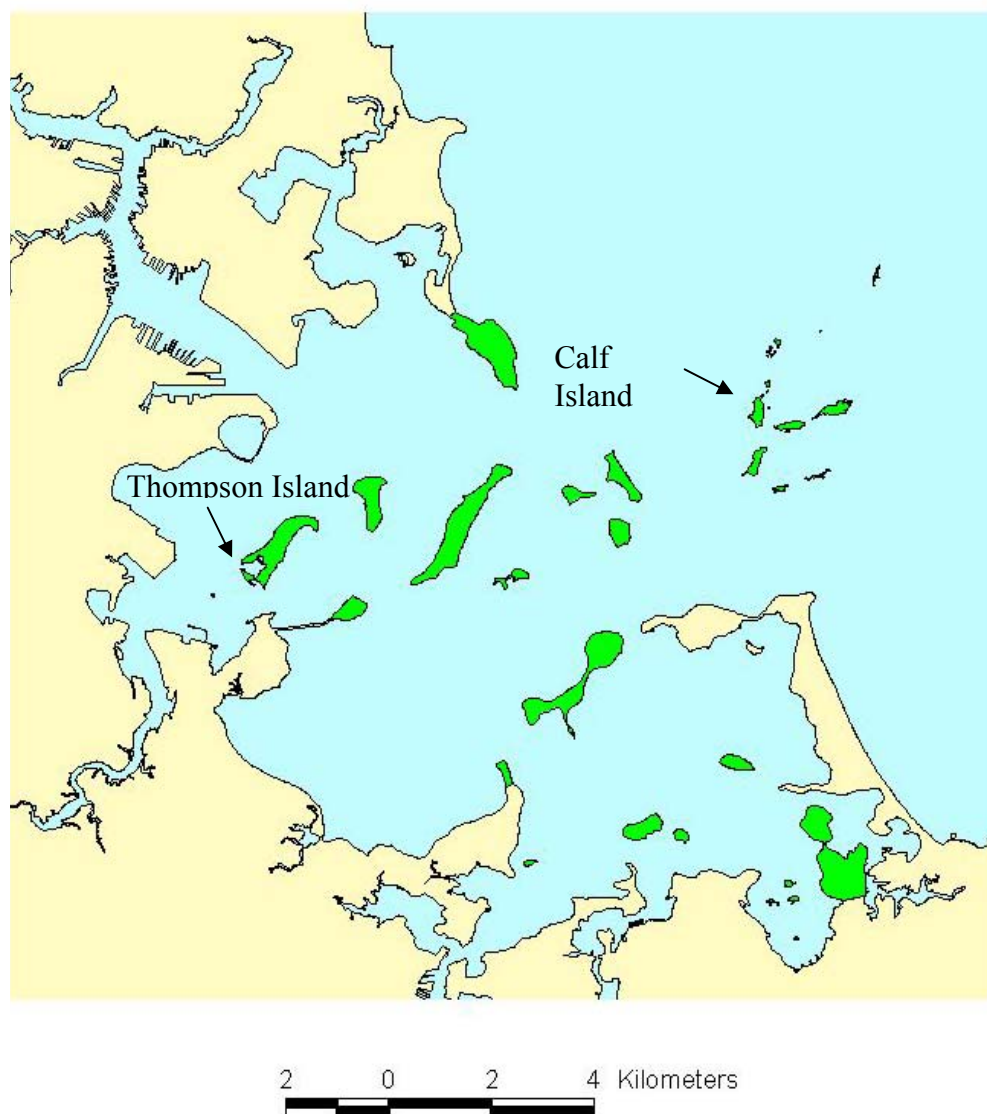


Figure 2-1. Map of BOHA showing sampling sites.

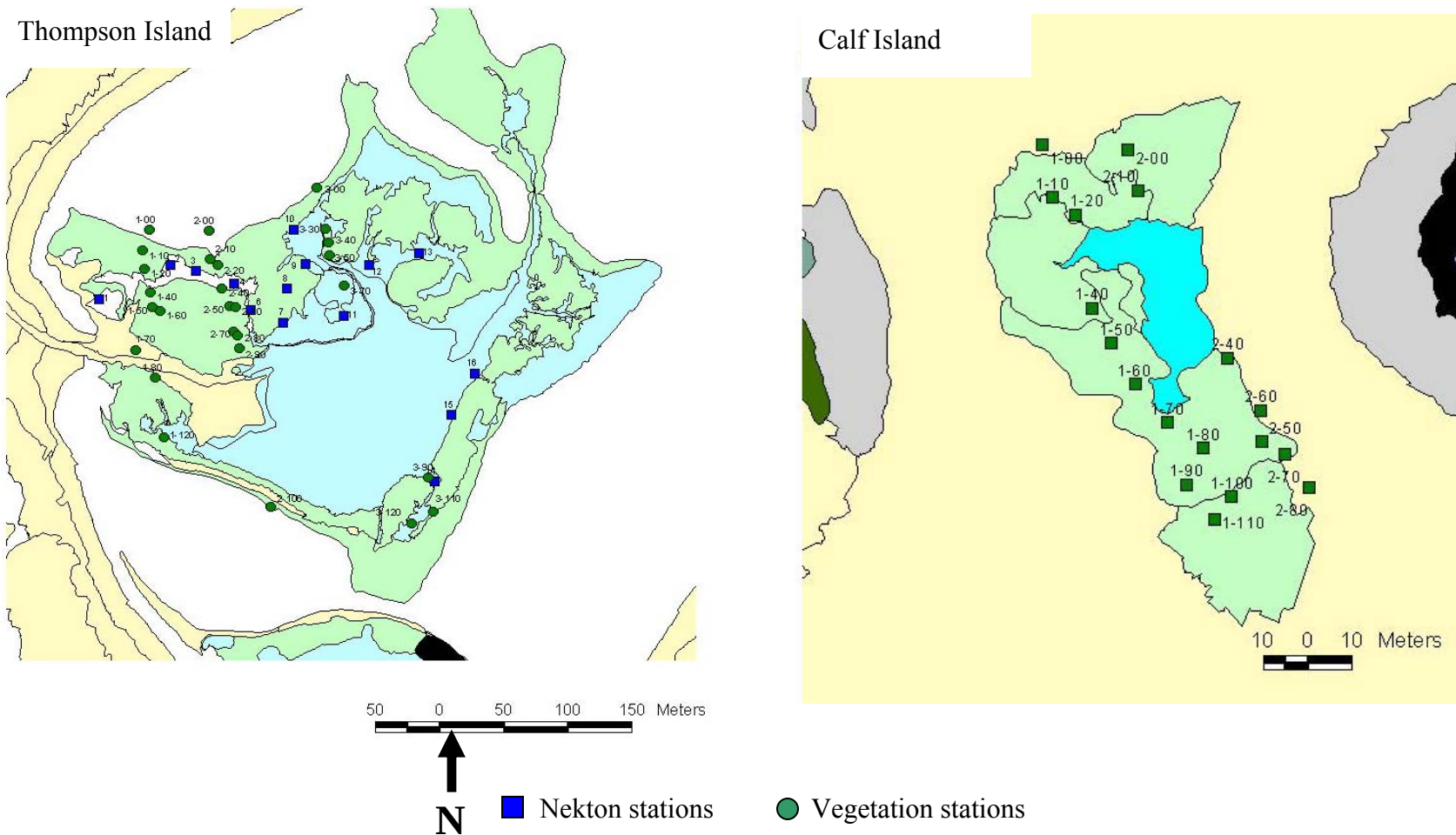


Figure 2-2. Map showing locations of nekton and vegetation stations sampled in 2004 at Thompson (left) and Calf Islands (right), BOHA.

Table 2-1. Dates of nekton and vegetation sampling in 2004 at BOHA.

Site	Nekton	Vegetation
Calf Island	Not sampled	July 28
Thompson Island	June 17 & Aug 10	July 28

Table 2-2. Vegetation plots sampled in 2004 at BOHA. UTM coordinates for each plot are listed in Appendix, Table 7-1. * Plots 2-20 and 2-30 on Calf Island and plots 1-30, 1-90, 1-110, 2-30, 3-10, 3-20, 3-60, and 3-100 on Thompson Island were in pools and therefore no vegetation cover was recorded.

Study Area	Transect	Distance between plots (m)	Plot ID and locations (m)	Total number of plots
Calf Island (18 plots)	1	10	1-00 to 1-110	11
	2	10	2-00 to 2-80	7*
Thompson Island (29 plots)	1	10	1-00 to 1-130	10*
	2	10	2-00 to 2-100	10*
	3	10	3-00 to 3-120	9*

Table 2-3. Average density [number m⁻² ±SD (total count)] of nekton sampled at Thompson Island marsh, BOHA, in 2004. A total of 20 nekton stations were sampled at Thompson Island (June and Aug sampling event combined).

Species	Common Name	Average density ±SD (total count)
<i>Carcinus maenas</i>	Green crab	1.60 ± 1.85 (32)
<i>Palaemonetes pugio</i>	Grass shrimp	1.70 ± 3.54 (34)
<i>Crangon septemspinosa</i>	Sevenspine bay shrimp	0.70 ± 1.72 (14)
<i>Fundulus heteroclitus</i>	Mummichog	2.45 ± 5.48 (49)
<i>Fundulus majalis</i>	Striped killifish	0.70 ± 2.30 (14)
<i>Menidia menidia</i>	Atlantic silverside	0.90 ± 2.49 (18)

Table 2-4. Average density [number m⁻² ±SD (total count)] of fish, decapods, and total nekton sampled at Thompson Island marsh, BOHA, in 2004. A total of 20 nekton stations were sampled at Thompson Island (June and August sampling events combined).

Group	Average density ±SD (total count)
Fish density	1.35 ± 2.37 (81)
Decapod density	1.33 ± 1.81 (80)
Nekton density	1.34 ± 1.21 (161)

Table 2-5. Average length (mm ± SD) of nekton species sampled at Thompson Island, BOHA, in 2004.

Species	Common Name	# individuals measured	Average length ± SD
<i>Carcinus maenas</i>	Green crab	31	21.8 ± 9.4
<i>Crangon septemspinosa</i>	Sevenspine bay shrimp	14	28.0 ± 10.0
<i>Fundulus heteroclitus</i>	Mummichog	46	25.5 ± 7.8
<i>Fundulus majalis</i>	Striped killifish	14	21.6 ± 9.6
<i>Menidia menidia</i>	Atlantic silverside	17	13.2 ± 4.1
<i>Palaemonetes pugio</i>	Grass shrimp	32	30.5 ± 5.0

Table 2-6 Physical characteristics (average ± SD) of nekton sampling stations at BOHA. Replicate sample size is given after variable.

Variable	Thompson Island
Water Temperature (°C) (n=20)	23.1 ± 2.7
Salinity (ppt) (n=20)	29.7 ± 4.2
Dissolved Oxygen (mg/l) (n=20)	6.1 ± 2.4

Table 2-7. Percent composition of salt marsh vegetation communities (calculated from average cover of all plots) at Calf Island and Thompson Island marshes, BOHA, in 2004. Number of vegetation plots sampled is given in parentheses after site name.

Species or cover type	Common Name	Percent Composition	
		Calf Island (n=18)	Thompson Island (n=29)
<i>Atriplex patula</i>	Spreading orache	-	0.1
Bare ground	Bare ground	5.9	28.2
<i>Calystegia sepium</i>	Hedge bindweed	1.1	-
<i>Distichlis spicata</i>	Spikegrass	25.3	-
<i>Distichlis spicata</i> (dead)	Spikegrass (dead)	12.2	-
<i>Limonium carolina</i>	Sea lavender	0.6	0.2
<i>Limonium Carolina</i> (dead)	Sea lavender (dead)	-	<0.1
<i>Phragmites australis</i>	Common reed	8.4	-
<i>Phragmites australis</i> (dead)	Common reed (dead)	6.3	-
<i>Salicornia europaea</i>	Glasswort	-	6.4
<i>Salicornia virginica</i>	Glasswort	-	0.1
<i>Solidago sempervirens</i>	Seaside goldenrod	3.5	-
<i>Spartina alterniflora</i>	Saltmarsh cordgrass	9.5	42.2
<i>Spartina alterniflora</i> (dead)	Saltmarsh cordgrass (dead)	-	11.9
<i>Spartina patens</i>	Salt meadow cordgrass	10.4	1.5
<i>Spartina patens</i> (dead)	Salt meadow cordgrass (dead)	13.8	0.9
<i>Suaeda maritima</i>	Herbaceous seepweed	-	1.1
Water	Water	-	1.8
Wrack& Litter	Wrack& Litter	2.9	5.5

Chapter 3 – Cape Cod National Seashore

Sampling and Sampling Stations

In 2004, salt marsh nekton monitoring was conducted at CACO at Nauset Marsh (vegetation is currently being sampled by CACO staff at this site) (Fig. 3-1). Sampling station locations for nekton are shown in Fig 3-2. Nekton was sampled twice, once in June and once in August. UTM coordinates of sampling locations are given in the Appendix, Table 7-2.

Due to the vast amount of open water habitat at Nauset Marsh, it was decided to sample both tidal creeks and marsh pools with many replicates. A total of 33 creek stations (18 in June, 15 in August) and 37 pool stations (18 in June, 17 in August) were sampled for a total 68 nekton sampled at this site (Table 3-1).

Nekton

Nekton community composition and abundance for Nauset Marsh creeks and pools are shown in Table 3-2, and total fish, decapod, and nekton densities are shown in Table 3-3. Average lengths of nekton sampled are given in Table 3-4. Physical variables (water temperature, salinity, and dissolved oxygen) taken at nekton stations are given in Table 3-5.

A total of 9 species (6 fish species and 3 decapod species) were sampled at Nauset Marsh (Table 3-2). The species richness (jack-knife estimation, Heltshe and Forrester 1983) value for the sampled nekton from creeks was 9.0 and from pools was 10.9 (these values were significantly different, $p < 0.001$, jack-knife estimation, Heltshe and Forrester 1983). The overall (creeks and pools combined) the species richness value was 10.0. In the creeks, approximately 90% of the nekton community was comprised of: mummichogs (*Fundulus heteroclitus*), striped killifish (*Fundulus majalis*), and sevenspine bay shrimp (*Crangon septemspinosa*). In the pools, approximately 90% of the nekton community was comprised of: threespine sticklebacks (*Gasterosteus aculeatus*), fourspine sticklebacks (*fourspine stickleback*), and mummichogs (*Fundulus heteroclitus*).

Figure 3-1. Map of CACO showing location of Nauset Marsh.

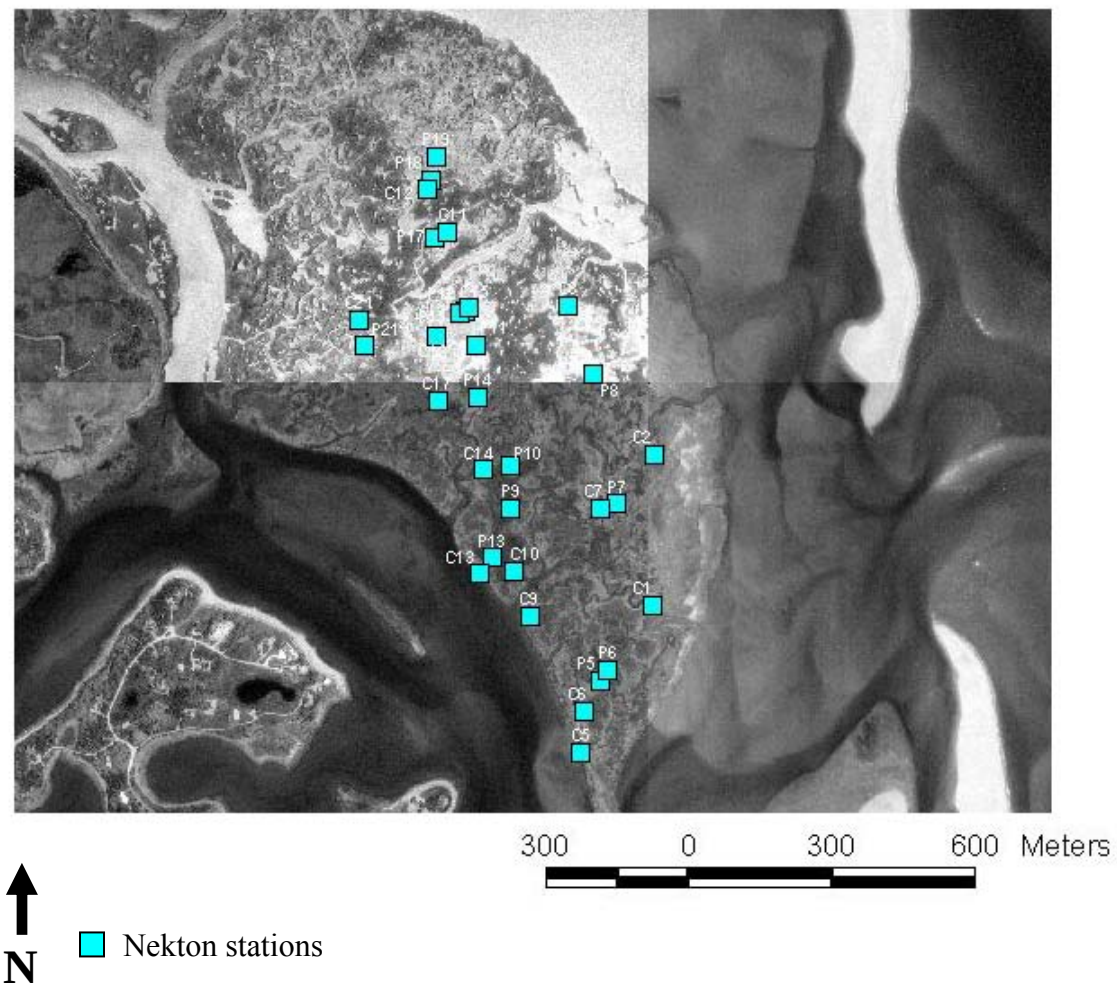


Figure 3-2. Map showing locations of stations sampled in 2004 for nekton at Nauset marsh, CACO. “C” indicates creek stations and “P” indicates pool station

Table 3-1. Dates of nekton sampling at Nauset Marsh, CACO, in 2004.

Site	Nekton
Nauset Marsh	June 22-23, August 17-18

Table 3-2. Average density [number m⁻² ±SD (total count)] of nekton sampled from tidal creeks and pools (with throw traps) at Nauset Marsh, CACO, in 2004. Number of stations sampled is given after habitat type.

Species	Common Name	Creek (n=33)	Pool (n=35)
<i>Apeltes quadracus</i>	Fourspine stickleback	0.1 + 0.4 (3)	5.9 + 20.0 (206)
<i>Carcinus maenas</i>	Green crab	0.3 + 0.8 (9)	0.2 + 0.6 (8)
<i>Crangon septemspinosa</i>	Sevenspine bay shrimp	4.0 + 19.3 (132)	0.7 + 1.9 (26)
<i>Fundulus heteroclitus</i>	Mummichog	6.8 + 24.3 (225)	4.4 + 7.6 (154)
<i>Fundulus majalis</i>	Striped killifish	2.2 + 9.0 (72)	0.5 + 1.9 (18)
<i>Gasterosteus aculeatus</i>	Threespine stickleback	0.2 + 1.1 (8)	9.5 + 35.6 (331)
<i>Menidia menidia</i>	Atlantic silversides	<0.1 (1)	0.4 + 2.5 (15)
<i>Palaemonetes pugio</i>	Grass shrimp	1.3 + 6.1 (44)	0.1 + 0.6 (5)
<i>Syngnathus fuscus</i>	Northern pipefish	(0)	<0.1 (1)

Table 3-3. Average density [number m⁻² ±SD (total count)] of fish, decapods, and total nekton sampled at Nauset Marsh from creeks and pools, CACO, in 2004. Number of stations sampled is given after habitat type.

Group	Creeks (n=33)	Pools (n=35)
Fish density	9.4 ± 26.3 (309)	20.7 ± 42.4 (725)
Decapod density	5.6 ± 20.0 (185)	1.1 ± 2.3 (39)
Total nekton density	15.0 ± 31.9 (494)	21.8 ± 43.3 (764)

Table 3-4. Average lengths [mm $\pm$ SD (number of individuals measured)] of nekton species sampled from creeks and pools at Nauset Marsh, CACO, in 2004.

Species	Common Name	Creeks	Pools
<i>Apeltes quadracus</i>	Fourspine stickleback	30.3 $\pm$ 0.6 (3)	17.5 $\pm$ 8.4 (83)
<i>Carcinus maenas</i>	Green crab	24.1 $\pm$ 14.1 (9)	28.3 $\pm$ 16.9 (8)
<i>Crangon septemspinosa</i>	Sevenspine bay shrimp	11.0 $\pm$ 2.2 (36)	10.7 $\pm$ 2.0 (26)
<i>Fundulus heteroclitus</i>	Mummichog	44.9 $\pm$ 18.4 (114)	38.6 $\pm$ 26.1 (124)
<i>Fundulus majalis</i>	Striped killifish	31.9 $\pm$ 11.2 (37)	24.2 $\pm$ 5.1 (18)
<i>Gasterosteus aculeatus</i>	Threespine stickleback	17.0 $\pm$ 10.7 (8)	14.0 $\pm$ 5.3 (67)
<i>Menidia menidia</i>	Atlantic silversides	42 (1)	21.7 $\pm$ 2.9 (3)
<i>Palaemonetes pugio</i>	Grass shrimp	17.0 $\pm$ 9.3 (25)	29.2 $\pm$ 7.6 (5)
<i>Syngnathus fuscus</i>	Northern pipefish	(0)	85 (1)

Table 3-5. Physical characteristics [average $\pm$ SD (number of stations sampled)] of nekton sampling stations at CACO.

Variable	Creeks	Pools
Temperature ($^{\circ}$ C)	21.6 $\pm$ 2.5 (33)	21.4 $\pm$ 2.4 (34)
Salinity (ppt)	29.2 $\pm$ 4.8 (32)	30.6 $\pm$ 2.3 (35)
Dissolved oxygen (mg/l)	7.6 $\pm$ 2.6 (32)	6.9 $\pm$ 2.7 (33)

Chapter 4 – Gateway National Recreation Area

Sampling and Sampling Stations

Salt marsh nekton (fish and decapods) was sampled at sites within Big Egg Control and Treatment (sediment sprayed marsh) marshes at GATE following the protocols established in Raposa and Roman (2001). Nekton was sampled with a 1m² throw trap in salt marsh pools and creeks. In 2003, due to a mis-communication, mesh size of the throw trap was larger (6mm) in 2003 than the protocol standard of 3mm which was used in 2004. This could bias the sampling in 2003 towards larger individuals as smaller nekton may not have been sampled as efficiently in 2003.

Nekton was sampled at Big Egg Control and Treatment marshes in 2003 and 2004 (Fig. 4-1). In an effort to restore wetlands losses, the National Park Service is conducting a demonstration restoration project at the Big Egg Treatment. The project involves dredging the adjacent tidal creek and spraying sediment onto the marsh using a high-pressure apparatus (C. Roman, National Park Service, personal communication). One marsh was sprayed in August to October of 2003 (Big Egg Treatment) while an adjacent unsprayed marsh serves as a control (Big Egg Control). Only nekton was sampled at the Big Egg sites because GATE staff were already monitoring vegetation at these marshes. Nekton was sampled twice each year, once in June and once in July/August (Table 4-1). Locations of nekton sampling stations are shown in Fig. 4-2. UTM coordinates of sampling locations are given in the Appendix, Table 7-3.

In 2003, at Big Egg Control, 21 nekton stations (12 stations in June, 9 stations in July) were sampled and at Big Egg Treatment 25 nekton stations (14 stations in June, 11 stations in July) were sampled (Fig. 4-2, Table 4-1). In 2004, 22 stations were sampled at the Control marsh (11 stations in each in June and August) and 27 stations were sampled at the Control marsh (14 in June and 13 in August) (Fig. 4-2, Table 4-1). Not all stations could be sampled in both months due to low water at some stations.

Nekton

Nekton community composition and abundance for Big Egg marshes in both years are shown in Table 4-2, and total fish, decapod, and nekton densities are shown in Table 4-3. Physical variables (water temperature, salinity, and dissolved oxygen) taken at nekton stations are given in Table 4-4. Average lengths of nekton are given in Table 4-5.

In 2003, at Big Egg Control, 6 species were sampled (4 fish and 2 decapod species) and had a species richness (jack-knife estimation, Heltshe and Forrester 1983) value of 7.9. At Big Egg Treatment, 8 species were sampled (4 fish and 4 decapod) and had a species richness (jack-knife estimation, Heltshe and Forrester 1983) value of 10.9. The species richness values between the control and treatment marshes were significantly different

($p < 0.001$, jack-knife estimation, Heltshe and Forrester 1983) with the treatment marsh having a higher species richness. In 2003, over 90% of the nekton community on the control marsh was comprised of grass shrimp (*Palaemonetes* species) and mummichogs (*Fundulus heteroclitus*), on the treatment marsh dominant species representing 90% of the nekton community were grass shrimp (*Palaemonetes* species), mummichogs (*Fundulus heteroclitus*), and silversides (*Menidia menidia*).

In 2004, at Big Egg Control, 9 species were sampled (3 fish species and 6 decapods or other species) and had a species richness (jack-knife estimation, Heltshe and Forrester 1983) value of 10.9. At Big Egg Treatment, 7 species were sampled (4 fish and 3 decapod species) and had a species richness (jack-knife estimation, Heltshe and Forrester 1983) value of 8.0. The species richness values between the control and treatment marshes were significantly different ($p < 0.001$, jack-knife estimation, Heltshe and Forrester 1983) with the control marsh having a higher species richness. In 2004, 90% of the nekton community on both the control marsh and Treatment marsh were comprised of mummichogs (*Fundulus heteroclitus*) and grass shrimp (*Palaemonetes pugio*).

Due to the discrepancy in mesh size used in the two sampling years, statistical comparisons of nekton species composition and abundance were only performed between the control treatment marshes within each year (*i.e.*, comparisons were not made among years). An Analysis of Similarities (ANOSIM) detected no difference in nekton species composition between the control and treatment marshes in either 2003 (pre-spray) ($p = 0.220$) or in 2004 (post-spray) ($p = 0.454$) indicating that nekton species composition and abundance were similar between the control and treatment marshes in both sampling years.



Figure 4-1. Map of sampling sites at GATE

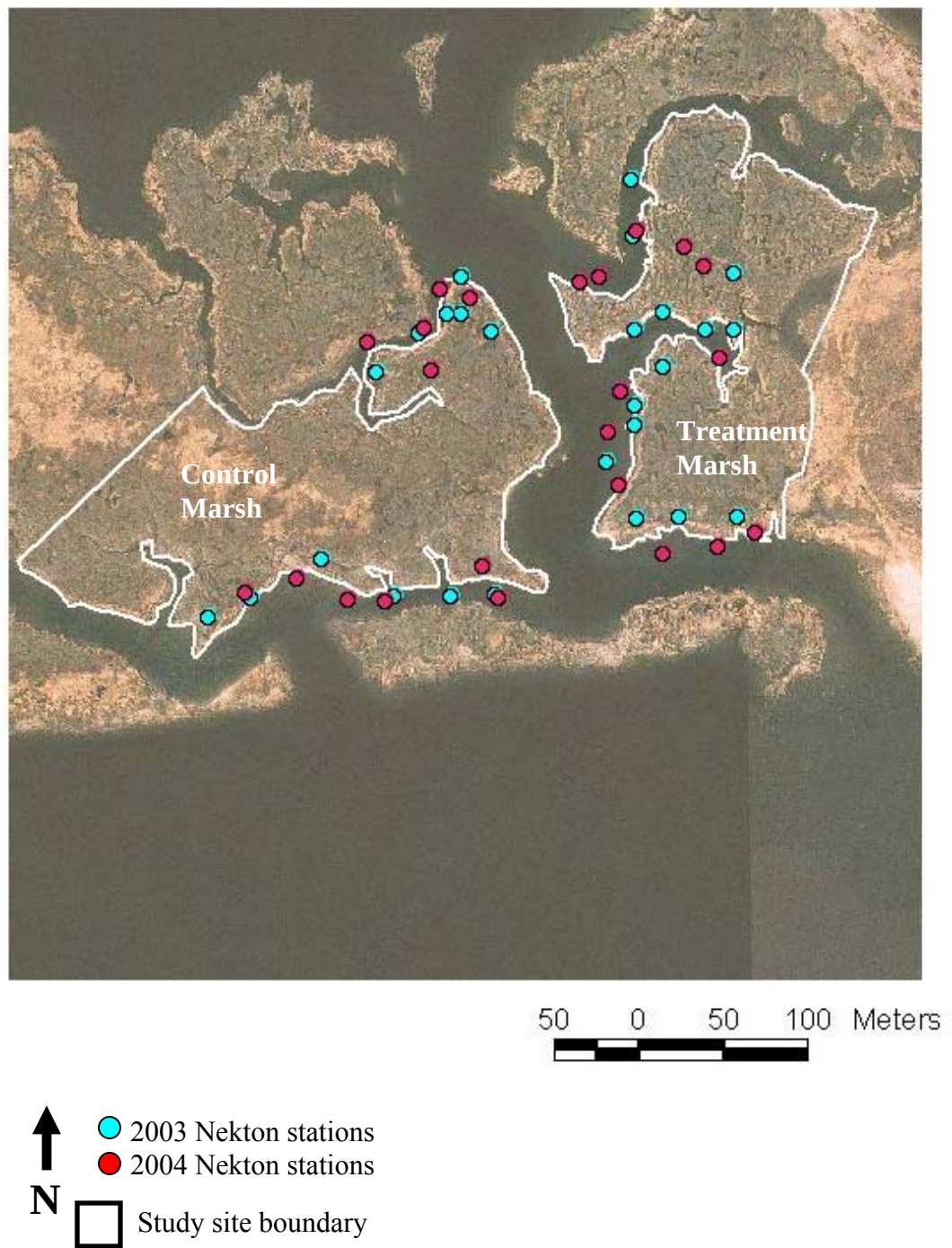


Figure 4-2. Map showing locations of nekton stations sampled in 2003 and 2004 at Big Egg control and treatment marshes, GATE.

Table 4-1. Dates of nekton sampling in 2003 and 2004 at GATE. Number of stations sampled is given in parentheses after sampling dates.

Site	2003	2004
Big Egg Control	June 4-5, July 30 (n=21)	June 15-16, Aug 24-26 (n=22)
Big Egg Treatment	June 4-5, July 30 (n=25)	June 15-16, Aug 24-26 (n=27)

Table 4-2. Average densities of nekton [number of individuals $1\text{m}^{-2} \pm \text{SD}$ (total count)] at Big Egg marshes in 2003 and 2004. Sample size (n) is the number of stations sampled.

Species	Common Name	Control 2003 (n=21)	Treatment 2003 (n=25)	Control 2004 (n=22)	Treatment 2004 (n=27)
<i>Alosa pseudoharengus</i>	Alewife	(0)	(0)	(0)	0.2 + 1.0 (6)
<i>Callinectes sapidus</i>	Blue Crab	(0)	<0.1 (1)	0.1 + 0.4 (2)	<0.1 (1)
<i>Cancer irroratus</i>	Rock crab	(0)	(0)	0.1 + 0.3 (2)	(0)
<i>Carcinus maenas</i>	Green Crab	(0)	(0)	0.2 + 0.5 (4)	(0)
<i>Crangon septemspinosa</i>	Sevenspine Bay Shrimp	(0)	0.9 + 4.4 (22)	0.1 + 0.4 (2)	0.6 + 2.4 (17)
<i>Fundulus heteroclitus</i>	Mummichog	11.4 + 18.7 (240)	5.8 + 11.6 (145)	24.3 + 29.5 (535)	37.4 + 58.0 (1011)
<i>Fundulus majalis</i>	Striped killifish	0.6 + 2.6 (12)	0.5 + 1.2 (12)	0.5 + 1.9 (12)	1.1 + 2.1 (29)
<i>Limulus polyphemus</i>	Atlantic horseshoe crab	(0)	(0)	0.1 + 0.3 (2)	(0)
<i>Menidia menidia</i>	Atlantic silverside	0.8 + 3.0 (16)	5.0 + 9.8 (126)	1.9 + 8.1 (42)	1.6 + 3.7 (44)
<i>Menidia</i> species	Silverside species	1.2 + 5.5 (25)	<0.1 (2)	-	-
<i>Palaemonetes pugio</i>	Grass shrimp	19.6 + 41.3 (411)	14.8 + 63.1 (370)	13.6 + 35.2 (299)	3.5 + 8.4 (95)
<i>Palaemonetes</i> species	Grass shrimp species	0.2 + 0.4 (4)	0.3 + 0.8 (8)	-	-

Table 4-3. Average density [number m⁻² ±SD (total count)] of fish and decapods sampled at GATE in 2003 and 2004. Replicate size (number of stations sampled) is given after site name.

Site and Year	Total Fish	Total Decapods	Total Nekton
2003			
Control (n=21)	14.0 ± 19.6 (293)	19.8 ± 41.2 (415)	33.7 ± 53.0 (708)
Treatment (n=25)	11.4 ± 18.4 (285)	16.0 ± 63.1 (401)	27.4 ± 70.8 (686)
2004			
Control (n=22)	26.8 ± 30.1 (589)	14.1 ± 35.5 (311)	40.9 ± 60.0 (900)
Treatment (n=27)	40.4 ± 61.4 (1090)	4.2 ± 8.6 (113)	44.6 ± 61.6 (1203)

Table 4-4. Physical characteristics (average ± SD) of nekton sampling stations at GATE. Replicate size (number of stations sampled) is given after site name

Site and Year	Water Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/l)
2003			
Control (n=21)	19.9 ± 5.1	25.1 ± 2.1	4.1 ± 2.7
Treatment (n=25)	21.9 ± 3.4	22.6 ± 8.5	6.3 ± 2.1
2004			
Control (n=22)	24.6 ± 1.6	25.0 ± 3.3	6.2 ± 3.8
Treatment (n=27)	25.8 ± 3.5	26.2 ± 2.9	8.2 ± 2.8

Table 4-5. Average length [mm $\pm$ SD (number of individuals measured)] of nekton species sampled at Big Egg Marshes (Control and Treatment), GATE, in 2003 and 2004. Note due to a discrepancy in throw trap mesh size (6mm 2003, 3mm in 2004) average size of nekton should not be compared between years as smaller individuals may not have been sampled as efficiently in 2003. “-” indicates no individuals of that species were measured.

Species	Common Name	2003		2004	
		Control	Treatment	Control	Treatment
<i>Alosa pseudoharengus</i>	Alewife	-	-	-	31.4 +1.3 (5)
<i>Callinectes sapidus</i>	Blue crab	-	-	11.0 +1.4 (2)	19 (1)
<i>Carcinus maenas</i>	Green crab	-	-	14.5 +9.1 (4)	-
<i>Crangon septemspinosa</i>	Sevenspine bay shrimp	-	36.7 +8.6 (15)	21.0 +1.4 (2)	26.2 +3.5 (17)
<i>Fundulus heteroclitus</i>	Mummichog	34.1 +13.2 (152)	36.3 +13.0 (110)	27.2 +14.5 (274)	30.4 +13.3 (275)
<i>Fundulus majalis</i>	Striped killifish	86.3 +30.4 (12)	40.3 +15.6 (11)	45.9 +14.7 (11)	29.7 +9.7 (28)
<i>Limulus polyphemus</i>	Atlantic horseshoe crab	-	-	47 (1)	-
<i>Menidia menidia</i>	Atlantic silverside	57.1 +13.1 (16)	44.2 +14.0 (86)	35.8 +8.7 (19)	29.1 +6.0 (44)
<i>Menidia</i> species	Silverside species	10.6 +1.5 (15)	7.5 +0.7 (2)	-	-
<i>Palaemonetes pugio</i>	Grass shrimp	17.7 +4.0 (84)	20.0 +4.1 (48)	18.3 +4.8 (75)	22.5 +6.0 (62)
<i>Palaemonetes</i> species	Grass shrimp species	34.3 +3.2 (3)	29.6 +7.5 (8)	-	-

Chapter 5 - Sagamore Hill National Historic Site

Sampling and Sampling Stations

In 2004, salt marsh monitoring was conducted at SAHI on the small marsh adjacent to Cold Spring Harbor (Fig. 5-1). Nekton was sampled twice at the same station locations for a total of 20 stations, once in June and once in August (10 stations sampled in each month); vegetation was sampled in July (Table 5-1). Vegetation transects were placed within 2 distinct areas of the marsh, a washover area dominated by bare ground and dune species (transects 1-4, 16 plots), and the salt marsh proper (transects 5-9, 15 plots). The study site was divided into these 2 regions as environmental factors may differentially affect these two areas. Sampling station locations for nekton and vegetation are shown in Fig 5-1. Table 5-2 shows the number of vegetation plots per transect and distance between plots. UTM coordinates of sampling locations are given in the Appendix, Table 7-4.

Nekton

Nekton community composition and abundance for SAHI are shown in Table 5-3, and total fish, decapod, and nekton densities are shown in Table 5-4. Average lengths of sampled nekton are given in Table 5-5. Physical variables (water temperature, salinity, and dissolved oxygen) taken at nekton stations are given in Table 5-6.

Ten species (6 fish and 4 decapods) were sampled (Table 5-3) and the species richness (jack-knife estimation, Heltshe and Forrester 1983) value for the sampled nekton was 16.8. The dominant species, comprising approximately 90% of the catch were grass shrimp (*Palaemonetes pugio*) and mummichogs (*Fundulus heteroclitus*).

Vegetation

The washover/bare ground area (Transects 1-4) had a total of 12 cover types (Table 5-7). Dominant species, comprising 75% of the cover types were American beachgrass (*Ammophila breviligulata*), bare ground, and dead and alive spikegrass (*Distichlis spicata*). The salt marsh proper (transects 5-9) had a total of 9 cover types (Table 5-7). Dominant species, comprising approximately 75% of the cover types were bare ground and salt marsh cordgrass (*Spartina alterniflora*).

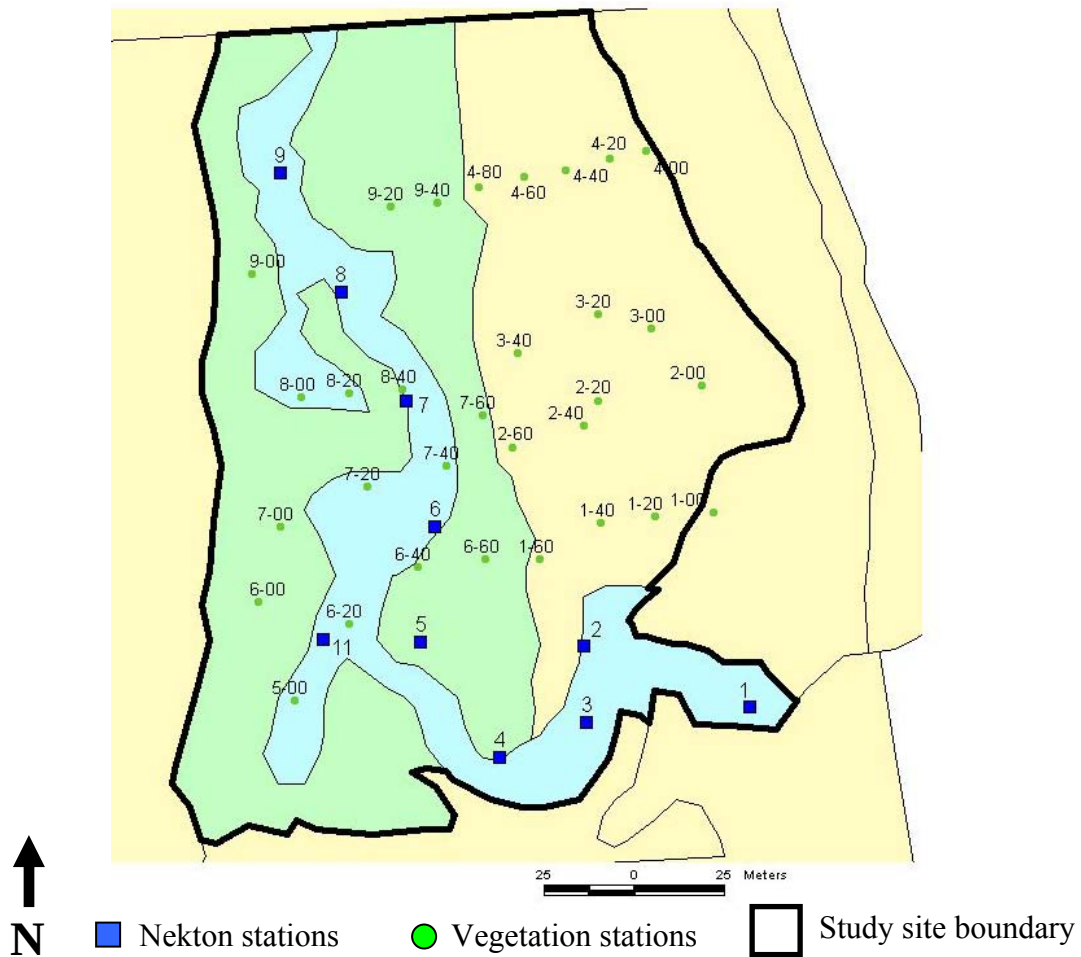
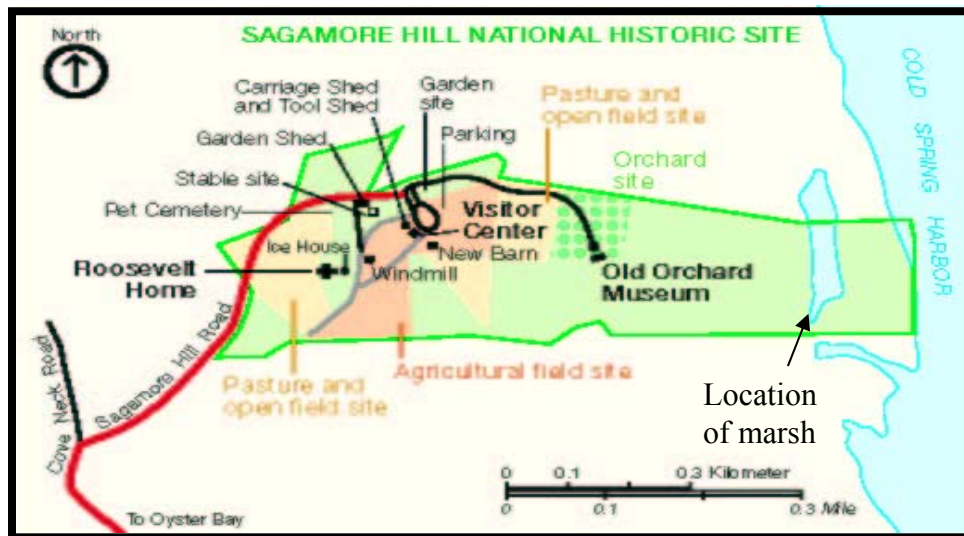


Figure 5-1. Location of marsh at SAHI (top) and locations of nekton and vegetation sampling stations within marsh (bottom).

Table 5-1. Dates of nekton and vegetation sampling in 2004 at SAHI. Number of stations sampled is given in parentheses.

Site	Nekton (n=20)	Vegetation (n=31)
SAHI marsh	June 29, Aug 24	Aug 24-25

Table 5-2. Vegetation plots sampled in 2004 at SAHI. UTM coordinates for each plot are listed in Appendix, Table 7-4.

Study Area	Transect	Distance between plots (m)	Plot ID and locations (m)	Total number of plots
SAHI washover area (16 plots)	1	20	1-00 to 1-60	4
	2	20	2-00 to 2-60	4
	3	20	3-00 to 3-30	3
	4	20	4-00 to 4-80	5
SAHI salt marsh (15 plots)	5	-	5-00	1
	6	20	6-00 to 6-60	4
	7	20	7-00 to 7-60	4
	8	20	8-00 to 8-40	3
	9	20	9-00 to 9-40	3

Table 5-3 Average density [number m⁻² ±SD (total count)] of nekton sampled at SAHI in 2004. A total of 20 nekton stations were sampled in 2004.

Species	Common Name	Average density ± SD (total count)
<i>Anguilla rostrata</i>	American eel	0.1 ± 0.2 (1)
<i>Callinectes sapidus</i>	Blue crab	0.2 ± 0.9 (4)
<i>Carcinus maenas</i>	Green crab	0.1 ± 0.3 (2)
<i>Crangon septemspinosus</i>	Sevenspine bay shrimp	0.2 ± 0.5 (4)
<i>Cyprinodon variegatus</i>	Sheepshead minnow	0.3 ± 1.3 (6)
<i>Fundulus heteroclitus</i>	Mummichog	13.6 ± 17.8 (272)
<i>Fundulus majalis</i>	Striped killifish	6.2 ± 15.0 (123)
<i>Menidia menidia</i>	Atlantic silverside	5.4 ± 14.3 (107)
<i>Palaemonetes pugio</i>	Grass shrimp	81.5 ± 212.2 (1630)
<i>Pseudopleuronectes americanus</i>	Winter flounder	0.2 ± 0.7 (3)

Table 5-4. Average density [number m⁻² ±SD (total count)] of fish, decapods, and total nekton sampled at SAHI in 2004. A total of 20 nekton stations were sampled in 2004 (June and August sampling events combined).

Group	Average density ± SD (total count)
Fish	25.6 ± 28.9 (512)
Decapods	80.2 ± 212.6 (1604)
Total nekton	105.8 ± 222.9 (2116)

Table 5-5. Average length (mm ± SD) of nekton species sampled at SAHI in 2004.

Species	Common Name	# individuals measured	Average length ± SD
<i>Anguilla rostrata</i>	American eel	1	60.0
<i>Carcinus maenas</i>	Green crab	6	19.0 ± 13.0
<i>Crangon septemspinosa</i>	Sevenspine bay shrimp	4	20.5 ± 1.0
<i>Cyprinodon variegatus</i>	Sheepshead minnow	6	42.5 ± 4.2
<i>Fundulus heteroclitus</i>	Mummichog	160	26.1 ± 10.9
<i>Fundulus majalis</i>	Striped killifish	59	26.4 ± 14.8
<i>Menidia menidia</i>	Atlantic silverside	53	25.4 ± 4.2
<i>Palaemonetes pugio</i>	Grass shrimp	153	22.5 ± 6.8
<i>Pseudopleuronectes americanus</i>	Winter flounder	3	52.0 ± 7.2

Table 5-6. Physical characteristics (average ± SD) of nekton sampling stations at SAHI. Replicate sample size is given after variable.

Variable	Average ± SD
Water temperature °C (n=20)	27.2 ± 2.3
Salinity (ppt) (n=20)	21.6 ± 3.5
Dissolved oxygen (mg/l) (n=20)	5.6 ± 2.2

Table 5-7. Percent composition of salt marsh vegetation communities (calculated from average cover of all plots) at SAHI marsh in 2004. Number of vegetation plots sampled is given in parentheses after site name.

Species	Common Name	Overwash area (T1-4, n=16)	Salt marsh (T5-9, n=15)
<i>Ammophila breviligulata</i>	American beachgrass	20.5	-
<i>Atriplex pentrandia</i>	Crested saltbush	4.2	-
Bare ground	Bare ground	40.4	28.5
<i>Distichlis spicata</i>	Spike grass	7.0	3.8
<i>Distichlis spicata</i> (dead)	Spike grass (dead)	10.4	3.9
<i>Limonium carolina</i>	Sea lavender	5.0	0.9
<i>Solidago sempervirens</i>	Seaside goldenrod	1.7	-
<i>Spartina alterniflora</i>	Saltmarsh cordgrass	-	43.6
<i>Spartina patens</i>	Salt meadow cordgrass	3.5	3.9
<i>Spartina patens</i> (dead)	Salt meadow cordgrass (dead)	3.5	-
<i>Suaeda maritima</i>	herbaceous seepweed	0.3	0.2
<i>Toxicodendron radicans</i>	Poison ivy	0.1	-
Unknown grass	Unknown grass	3.5	-
Water	Water	-	12.9
Wrack& litter	Wrack & litter	-	2.3

Chapter 6 - Literature Cited

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Chapter 7 – Appendix

Figure 7-1. Throw trap data sheet

Figure 7-2. Point intercept vegetation data sheet

Table 7-1. Sampling station coordinates for BOHA

Table 7-2. Sampling station coordinates for CACO

Table 7-3. Sampling station coordinates for GATE

Table 7-4. Sampling station coordinates for SAHI

Throw Trap Data Sheet

SITE: _____

DATE: _____

STATION #: _____

SAMPLING CREW: _____

Coordinates: N: _____ E: _____

Habitat Type: Pool/Panne Tidal Creek Plugged Ditch Open Ditch

Aquatic Veg. Species & cover (if present) _____
(cover classes: <1% 1-5% 5-10% 11-25% 26-50% 51-75% >75%)

Time: _____ Water temp: _____ Salinity: _____ DO: _____

Water Depth: _____ Tide: Flood or Ebb

NEKTON SPECIES & MEASUREMENTS

SPECIES #1 _____ Total # of individuals: _____

Talley (include measured fish): _____

LENGTHS (15): _____

SPECIES #2 _____ Total # of individuals: _____

Talley (include measured fish): _____

LENGTHS (15): _____

SPECIES #3 _____ Total # of individuals: _____

Talley (include measured fish): _____

LENGTHS (15): _____

SPECIES #4 _____ Total # of individuals: _____

Talley (include measured fish): _____

LENGTHS (15): _____

SPECIES #5 _____ Total # of individuals: _____

Talley (include measured fish): _____

LENGTHS (15): _____

Figure 7-1. Throw trap data sheet

VEGETATION DATA SHEET (1m² point intercept method)

Site _____ Field Crew _____ Date _____ Time _____

Plot ID _____ Coord N: _____ Coord E: _____

Point-- record species, first row is for points 1-25, second row is for points 26-50.

SPECIES	1 26	2 27	3 28	4 29	5 30	6 31	7 32	8 33	9 34	10 35	11 36	12 37	13 38	14 39	15 40	16 41	17 42	18 43	19 44	20 45	21 46	22 47	23 48	24 49	25 50	Total Tally	
1.																											
2																											
3																											
4																											
5																											
6																											

Figure 7-2. Point intercept data sheet.

Table 7-1. Coordinates for nekton and vegetation station locations sampled at BOHA in 2004, UTM, Zone 18, NAD 83, meters. * Indicates that original GPS coordinates were not in correct location and new coordinates were estimated from GIS.

Site	Sampling variable	Station	UTM X (east)	UTM Y (north)
Thompson Island	Nekton	1	333828	4686459
		2	333885	4686484
		3	333904	4686479
		4	333934	4686468
		6	333946	4686447
		7	333971	4686437
		8	333975	4686463
		9	333990	4686482
		10	333981	4686509
		11	334018	4686441
		12	334039	4686480
		13	334078	4686488
		14	334085	4686310
		15	334100	4686361
		16	334119	4686393
	Vegetation	1-00	333869	4686512
		1-10	333863	4686496
		1-20	333864	4686482
		1-30	In creek no data recorded	
		1-40	333868	4686463
		1-50	333869	4686452
		1-60*	333870	4686442
		1-70*	333871	4686422
		1-80	333870	4686397
		1-90	In creek no data recorded	
		1-100	In creek no data recorded	
		1-110	In creek no data recorded	
		1-120	333875	4686350
		1-130*	333876	4686338
		2-00	333915	4686510
		2-10	333915	4686488
		2-20	333921	4686483
		2-30	In creek no data recorded	
		2-40	333924	4686465
		2-50	333929	4686451
		2-60*	333930	4686441

Site	Sampling variable	Station	UTM X (east)	UTM Y (north)
Thompson Island (continued)	Vegetation	2-70	333932	4686431
		2-80*	333933	4686424
		2-90	333936	4686418
		2-100	333957	4686294
		3-00	334000	4686541
		3-10	In creek no data recorded	
		3-20	In creek no data recorded	
		3-30	334006	4686509
		3-40	334008	4686498
		3-50	334008	4686488
		3-60	In creek no data recorded	
		3-70	334019	4686464
		3-80*	334022	4686453
		3-90	334080	4686313
		3-100	In creek no data recorded	
		3-110	334083	4686286
		3-120*	334085	4686272
Calf Island	Vegetation	1-00*	343785	4689492
		1-10	343788	4689481
		1-20	343793	4689477
		1-40	343796	4689456
		1-50	343800	4689448
		1-60*	343805	4689438
		1-70	343812	4689430
		1-80	343820	4689424
		1-90	343816	4689416
		1-100	343826	4689413
		1-110	343822	4689408
		2-00	343805	4689491
		2-10	343807	4689482
		2-40	343826	4689444
		2-50	343833	4689425
		2-60	343833	4689432
		2-70	343838	4689422
		2-80*	343843	4689414

Table 7-2. Coordinates for nekton station locations sampled at CACO in 2004, UTM, Zone 18, NAD 83, meters.

Site	Habitat	Station	UTM X (east)	UTM Y (north)
Nauset Marsh	Creek	C1	421320	4629508
		C2	421334	4629823
		C3	421338	4629921
		C5	421162	4629202
		C6	421171	4629289
		C7	421217	4629713
		C8	421163	4630141
		C9	421064	4629491
		C10	421032	4629587
		C11	420914	4630300
		C12	420875	4630391
		C13	420963	4629583
		C14	420975	4629801
		C15	420955	4630140
		C17	420885	4629948
		C18	420886	4630083
		C19	420884	4630492
		C21	420726	4630122
	Pool	P1	421337	4629434
		P2	421360	4629632
		P3	421319	4629952
		P4	431309	4629990
		P5	421206	4629353
		P6	421222	4629373
		P7	421251	4629721
		P8	421212	4629994
		P9	421031	4629719
		P10	421034	4629807
		P11	420967	4630062
		P12	420947	4630136
		P13	420990	4629616
		P14	420968	4629953
		P15	420936	4630129
		P17	420889	4630290
		P18	420885	4630410
		P19	420896	4630459
		P20	421267	4630138
		P21	420735	4630067

Table 7-3. Coordinates for nekton station locations sampled at Big Egg marshes (control and treatment) at GATE in 2003 and 2004, UTM, Zone 18, NAD 83, meters. NC and C = Nekton Control; NT and T = Nekton Treatment.

Site	Year	Station	UTM X (east)	UTM Y (north)
Big Egg Control	2003	NC_15	599166.419	4494649
		NC_16	599149.052	4494682
		NC_17	599149.348	4494659
		NC_18	599140.886	4494659
		NC_19	599124.111	4494648
		NC_20	599099.022	4494625
		NC_21	598999.402	4494480
		NC_22	599024.639	4494491
		NC_23	599066.652	4494514
		NC_24	599109.256	4494492
		NC_25	599143.103	4494493
		NC_26	599168.487	4494493
Big Egg Treatment	2003	NT_1	599311.744	4494539
		NT_2	599277.897	4494539
		NT_3	599252.512	4494539
		NT_4	599235.146	4494572
		NT_5	599251.773	4494594
		NT_6	599251.625	4494605
		NT_7	599251.033	4494650
		NT_8	599267.808	4494661
		NT_9	599268.252	4494628
		NT_10	599293.341	4494650
		NT_11	599310.264	4494650
		NT_12	599309.82	4494684
		NT_13	599250.294	4494705
		NT_14	599249.85	4494738
Big Egg Control	2004	04_C1	599171	4494491
		04_C2	599162	4494510
		04_C3	599104	4494489
		04_C4	599082	4494490
		04_C5	599052	4494503
		04_C6	599022	4494494
		04_C7	599131	4494626

Site	Year	Station	UTM X (east)	UTM Y (north)
Big Egg Control (continued)	2004	04_C8	599154	4494669
		04_C9	599137	4494674
		04_C10	599127	4494651
		04_C11	599094	4494643
Big Egg Treatment	2004	04_T1	599323	4494530
		04_T2	599301	4495622
		04_T3	599268	4494517
		04_T4	599242	4494558
		04_T5	599236	4494589
		04_T6	599243	4494614
		04_T7	599256	4494631
		04_T8	599259	4494642
		04_T9	599302	4494633
		04_T10	599219	4494678
		04_T11	599231	4494681
		04_T12	599281	4494699
		04_T13	599252	4494709
		04_T14	599292	4494688
		04_T15	599287	4494562

Table 7-4. Coordinates for nekton and vegetation station locations sampled at SAHI in 2004, UTM, Zone 18, NAD 83, meters. * Indicates UTM coordinates of stations were estimated from GIS maps because original GPS coordinates did not match up with adjacent stations.

Site	Sampling Variable	Station	UTM X (east)	UTM Y (north)
SAHI marsh	Nekton	1	627222	4527063
		2	627176	4527080
		3	627177	4527059
		4	627153	4527049
		5	627131	4527081
		6	627135	4527113
		7	627127	4527148
		8	627109	4527178
		9	627092	4527211
		11	627104	4527082
	Vegetation	1-00	627212	4527117
		1-20	627196	4527116
		1-40	627181	4527114
		1-60	627164	4527104
		2-00	627209	4527152
		2-20	627180	4527148
		2-40	627176	4527141
		2-60*	627156	4527135
		3-00	627195	4527168
		3-20	627180	4527172
		3-40	627158	4527161
		4-00*	627194	4527217
		4-20*	627183	4527215
		4-40*	627171	4527212
		4-60*	627160	4527210
		4-80*	627147	4527207
		5-00	627096	4527065
		6-00	627086	4527092
		6-20	627111	4527086
		6-40	627130	4527102
		6-60	627149	4527104
		7-00	627092	4527113
		7-20	627116	4527124
		7-40	627138	4527130
		7-60	627148	4527144
		8-00	627098	4527149
		8-20	627111	4527150
		8-40	627126	4527151

Site	Sampling Variable	Station	UTM X (east)	UTM Y (north)
SAHI marsh	Vegetation (continued)	9-00	627084	4527183
		9-20*	627123	4527202
		9-40*	627136	4527203