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Salt Marsh Vegetation and Nekton Community Monitoring at Sagamore Hill National Historical Site

2009 Summary Report

Natural Resource Report NPS/NCBN/NRDS—2010/067

ON THE COVER
Boardwalk over salt marsh at Sagamore Hill National Historical Site
Photograph courtesy of Sagamore Hill National Historical Site

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2009 Summary Report

Natural Resource Report NPS/NCBN/NRDS—2010/067

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August 2010

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Please cite this publication as:

Patenaude, E. L., and P. S. Pooler. 2010. Salt marsh vegetation and nekton community monitoring at Sagamore Hill National Historical Site: 2009 summary report. Natural Resource Data Series NPS/NCBN/NRDS—2010/067. National Park Service, Fort Collins, Colorado.

NPS 419/105341, August 2010

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Executive Summary

The Northeast Coastal and Barrier Network (NCBN) is one of 32 networks of parks created by the Inventory and Monitoring Program (I&M Program) of the National Park Service. The I&M Program has two components, 1) to collect baseline ecological inventory datasets and 2) to implement *Vital Signs* monitoring, a long-term ecological monitoring program, in each of the Network parks. The Northeast Coastal and Barrier Network consists of eight parks linked by geography and shared ecological characteristics along the Northeastern Atlantic Coast. As part of the Vital Signs program, each Network has developed detailed protocols for monitoring a select number of Vital Signs, or ecological indicators. Because the majority of parks in the NCBN are coastal parks, salt marsh monitoring was chosen as a high priority and a protocol was developed for collecting long-term data on salt marsh vegetation and nekton (James-Pirri In Development-a,b).

This annual report summarizes the first year of data collected at Sagamore Hill National Historical Site (SAHI) located in New York. Fifty-one vegetation plots and a subset of creeks were sampled for nekton at one marsh in August of 2009. Monitoring data is to be collected at this same marsh site biennially. Nekton in large tidal creeks (all less than 1m deep) were sampled with a $1m^2$ aluminum throw trap (Kushlan 1981, Sogard & Able 1991, Raposa and Roman 2001). Vegetation was monitored using $1m^2$ plots and a revised Braun-Blanquet method (Kent and Coker 1992) to estimate percent cover of each vegetation species and non-vegetation cover type within each plot.

At the SAHI site, 13 vegetation species along with 4 non-vegetation cover types were recorded during vegetation sampling in 2009. One of the identified vegetation species in the sample plots at SAHI, *Panicum amarum* is listed by the State of New York as rare but unprotected (Young 2008). None of the identified vegetation species found at SAHI in 2009 are listed by the USDA as exotic, invasive, threatened, endangered, or rare (USDA 2010). Non-vegetation cover types recorded included wrack and litter, bare ground, water and trash.

Eight species of nekton were recorded at SAHI in 2009, including 6 fish species, 1 crab species, and 1 shrimp species. Examination of percent catch data indicates that two species account for approximately 98% of all nekton captured. The most prevalent species, daggerblade grass shrimp (*Palaemonetes pugio*), accounts for approximately 89% of all nekton recorded at SAHI in 2009 and was much more abundant during the second sampling visit. The second most common species, common mummichog (*Fundulus heteroclitus*), accounts for approximately 9% of all nekton recorded and was more abundant during the first sampling visit. Substantial differences in abundances and species composition between the two sampling visits are to be expected and reinforce our decision to sample nekton twice during the summer.

The information collected through this long-term monitoring program will equip park managers with scientific data to make informed decisions on both the aquatic and terrestrial resources they manage. This report summarizes the 2009 baseline data for the SAHI salt marsh selected for monitoring. Changes in salt marsh condition will be examined following data collection in 2011. By understanding the changes or trends occurring in salt marsh vegetation and nekton, communities managers will be able to better adapt and respond to these changes through their management practices.

Acknowledgments

We would like to thank Charles T. Roman and Mary-Jane James-Pirri for the development of the salt marsh vegetation and nekton monitoring protocols and Dennis Skidds for his work on the salt marsh monitoring database and data management support. We would also like to thank the 2009 salt marsh field crew members, Erin Wood, Margaret Hart, and Zachary Bourassa for their hard work and, of course, the Sagamore Hill National Historical Site staff for providing support to the NCBN field crew.

Introduction

National Park Service (NPS) managers need accurate information about how, when and why natural systems change over time in order to make sound management decisions. To address this need, the NPS initiated natural resource monitoring through the Natural Resource Challenge funded by Congress in 2000. The Inventory and Monitoring Program (I&M), the key component of this effort, organizes 270 park units into 32 networks tasked with conducting long-term ecological monitoring. Networks were required to develop a monitoring plan addressing the implementation of long-term monitoring of key ecological indicators or “vital signs.” Vital signs are defined as measurable, early warning signals that may indicate change in the long-term health of natural systems. Early detection of potential problems allows park managers to take steps in restoring or maintaining ecological health of park resources.

The Northeast Coastal and Barrier Network (NCBN) is made up of eight parks: Assateague Island National Seashore (ASIS, coastal Maryland and Virginia), Thomas Stone National Historic Site (THST, Charles County, MD), Cape Cod National Seashore (CACO, Cape Cod, MA), Gateway National Recreation Area (GATE, New York, NY and Sandy Hook, NJ), Fire Island National Seashore (FIIS, Long Island, NY), Sagamore Hill National Historic Site (SAHI, Oyster Bay, NY), Colonial National Historical Park (COLO, Virginia Peninsula), and George Washington Birthplace National Monument (GEWA, Westmoreland County, VA). Vital Signs chosen as part of the Network’s monitoring plan include salt marsh vegetation communities, nekton communities, essential estuarine water quality parameters and specific coastal geomorphologic features (Stevens et al. 2005). Detailed monitoring protocols have been developed and implemented in the eight parks. This annual report summarizes salt marsh vegetation and nekton community data collected at Sagamore Hill National Historic Site (SAHI) in 2009 according to two protocols developed by Pirri et al., *Monitoring Nekton in Salt Marshes: A Protocol for the National Park Service’s Long-Term Monitoring Program, Northeast Coastal and Barrier Network* and *Monitoring Salt Marsh Vegetation: A Protocol for the National Park Service’s Long-Term Monitoring Program, Northeast Coastal and Barrier Network* (In Development-a,b).

The objective of salt marsh vegetation and nekton monitoring is to identify long-term trends in the structure of these communities, which in turn should provide a better understanding of the current status and condition of salt marsh within the parks. These data will assist park managers in making informed decisions regarding the management and continued protection of this rare and valuable coastal resource.

Methods

Permanent Site Selection

One permanent salt marsh site was selected for monitoring at SAHI (Fig. 1). This salt marsh site was the only accessible site at SAHI of appropriate size (5-8 hectares) for implementing intensive vegetation and nekton sampling. Detailed information about the site selection process and sampling design can be found in the Salt Marsh Vegetation and Nekton Protocols (James-Pirri et al. In Development-a,b). Both vegetation and nekton sampling will be conducted at this marsh every 2 years.

Nekton Sampling Station Selection and Data Collection

Based on an assessment of accessible habitat, 9 nekton sampling stations were established at the salt marsh site in tidal creek habitat. All nekton sampling stations were randomly located along tidal creeks so that inference can apply to all tidal creek habitat within the site and can be biologically extended to the site as a whole. Nekton stations were sampled once in late July and once in late August (Table 1).

Nekton in large tidal creeks, and shoreline habitats (all less than 1m deep) were sampled with a $1m^2$ aluminum throw trap (Kushlan 1981, Sogard and Able 1991, Raposa and Roman 2001). The throw trap is an enclosure sampler that has excellent efficiency and provides quantitative, repeatable results (Rozas and Minello 1997). The trap has an open top and bottom, is 0.5m in height and 1m square, and the sides are covered with 3mm (1/8 in) wire mesh. All nekton were collected from the trap with a 1mm mesh dip net that fit snuggly within the opposite sides of the trap.

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 collected.

Table 1. Sampling dates and total number of nekton sampling station and vegetation sampling plots at SAHI marsh site in 2009. All nekton sampling stations were located in tidal creek habitat.

Vital Sign	Site	Visit	Dates	No. of Stations/Plots
Nekton	1	1	7/25/2009	9
		2	8/25-26/2009	8

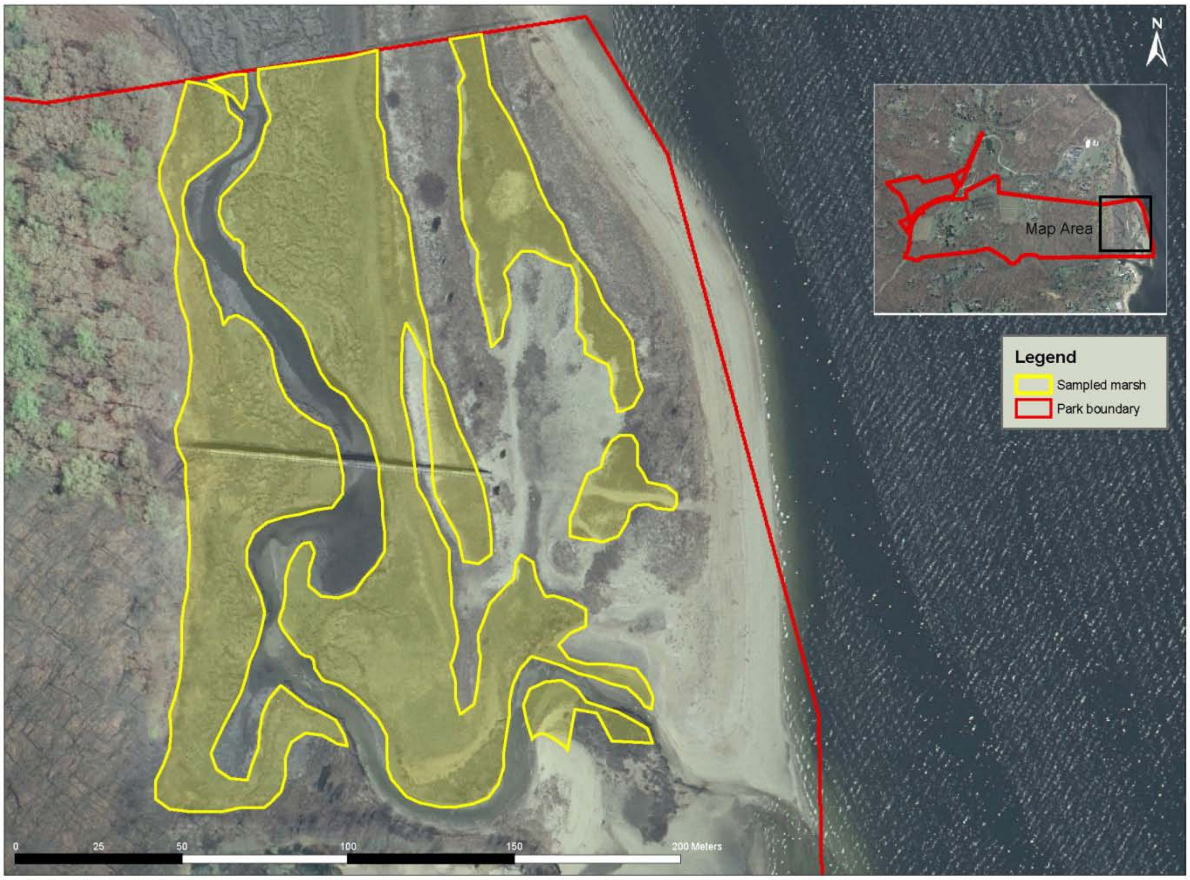

Figure 1. Aerial view and location of permanent nekton and vegetation monitoring site (yellow shaded area) established by NCBN at Sagamore Hill National Historical Site (SAHI) in New York. This site will be monitored biennially.

Vegetation Plot Selection and Data Collection

Vegetation sampling was conducted at the permanent marsh site on August 26th. Ten transects, extending from creek bank to upland, were randomly located within the marsh and 51 $1m^2$ plots were randomly placed along these transects. Each plot was visited once during the summer sampling season.

For each plot, all vegetation species and non-vegetation cover types were recorded (Table 2), and the estimated percent cover was determined using a modified Braun-Blanquet cover scale (0: 0%; 1: <1%; 2: 1-5%; 3: 6-25%; 4: 26-50%; 5: 51-75%; 6: 76-100%), (Kent and Coker 1992).

Table 2. Definition of standard cover type categories used in the Northeast Coastal and Barrier Network salt marsh vegetation monitoring program. (James-Pirri et al. In Development-b)

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

Standing non-living vascular plants identified by species (*e.g., S. alterniflora* Not Living). 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*.). In cases where dead leaves are from the current growing season, plant cover is recorded 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 Ground. 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 ground 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.

Data Summary

Nekton

Species composition, average density, average length of nekton, and standard deviations were all calculated using standard formulae. The same is true of the average values of the physical characteristics calculated for each habitat type during each visit. Details can be found in the Analysis and Reporting Standard Operating Procedure of James-Pirri et al. (In Development-a). Species richness was calculated using the algorithm described in Heltshe and Forester (1983). An explanation and example of using the algorithm is provided in the Analysis and Reporting Standard Operating Protocol of James-Pirri et al. (In Development-a).

Vegetation

Vegetation data were recorded using the modified Braun-Blanquet scale as described above (Kent and Coker 1992). For summary purposes, each Braun-Blanquet value in the data was converted to the midpoint of the percent range it represented (Table 3) as described in Wikum and Shanholtzer (1978).

Wikum and Shanholtzer (1978) outline a method for calculating an importance value for each species. So as not to confuse this value with ecological importance, we rename it a 'relative prevalence' value. The calculation is essentially identical to that described in Wikum and Shanholtzer's publication. Although Wikum and Shanholtzer (1978) present their importance value as a sum of the percent frequency and percent cover values, this report takes the average of these values so that relative prevalence is on a more readily interpretable percent scale. We estimated the relative percent prevalence for each species which is the average of the relative percent cover and the relative percent frequency.

Table 3. Modified Braun-Blanquet scale and corresponding midpoint values for determining percent cover of salt marsh vegetation.

BB Value	Percent Cover	Midpoint
0	0%	0%
1	< 1%	0.5%
2	1 - 5%	3%
3	6 - 25%	15.5%
4	26 - 50%	38%
5	51 - 75%	63%
6	76 - 100%	88%

Relative percent cover is the percent of all plots that each species or cover type covers relative to all other species and non-vegetation cover types present in the marsh plots. The sum of all relative percent cover values for all species and cover types equals 100%. Relative percent frequency is the number of plots where each species or cover type is present, relative to all other species and non-vegetation cover types present. The sum of the relative percent frequency values for all species is 100%.

Taking the average of the relative percent cover and the relative percent frequency gives the relative percent prevalence for each species, or non-vegetation cover type present. Because the relative percent prevalence incorporates both percent frequency and percent cover, it is likely to differ substantially from the average percent cover for a given species or non-vegetation cover type. We also report the average percent cover of each species for all plots combined.

Lastly, if any identified vegetation species in the sample plots are listed by the United States Department of Agriculture (USDA) or the state of New York as exotic, invasive, threatened, endangered, or rare, these species are noted in the vegetation table. Information about plants listed by each state as exotic, invasive, threatened, endangered, or rare is available online (USDA 2010). In some cases, more specific information may be available on state websites. Information about plants listed by the state of New York as exotic or invasive is available online (Invasive Plant Council of New York 2007). Information about plants listed by the state of New York as threatened, endangered, or rare can be obtained from the rare plant list edited by Young (2008) for the New York Natural Heritage Program.

If any species found in the sample plots are noted as being from one of these categories, plots with those categories of vegetation present will be noted in Appendix 2, the list of all vegetation sample plots and their respective Universal Transverse Mercator (UTM) coordinates.

Results

Nekton

Eight nekton species consisting of 6 fish, 1 decapod and 1 arthropod species were captured at SAHI during the summer of 2009 at tidal creek sampling stations in the permanent site. Examination of nekton species composition (% catch) indicates that two species account for approximately 98% of all nekton recorded during summer sampling at SAHI in 2009 (Table 4). The most prevalent species, daggerblade grass shrimp (*Palaemonetes pugio*), accounts for approximately 89% of all nekton recorded. The second most common species, common mummichog (*Fundulus heteroclitus*), accounts for 9% of all nekton recorded. Community composition percentages show that fish comprised 60% of nekton caught during the sampling visit. In contrast, a single decapod species comprised 95% of all nekton caught during the second sampling visit.

The average density of each species and community is presented in Table 5. Daggerblade grass shrimp (*P. pugio*) had the highest density of all species captured in 2009, and Common Mummichog (*F. heteroclitus)* had the second highest. It is important to note that both the species and community composition by sampling visit (Table 4) and average density of each species and community by visit (Table 5) show obvious differences between the two sampling visits. From what is known about the life history of fish and decapods, differences between sampling visits are expected, and this is the primary reason for sampling the nekton community twice each summer.

Table 4. Nekton species and community composition (% catch) at SAHI in 2009. Data are shown for each visit separately and both visits combined. n = total number of nekton caught during that visit. '-' indicates a species or community was not present.

		Community/Species Composition (%)		
Community/Species	Common Name	Visit 1 (n = 537)	Visit 2 (n = 3951)	Visits 1 & 2 (n = 4488)
Fish		**59.6**	**4.8**	**11.2**
Fundulus heteroclitus	Common Mummichog	50.8	3.5	9.2
Menidia menidia	Atlantic Silverside	5.0	0.8	1.3
Fundulus majalis	Striped Killifish	3.2	0.4	0.7
Anguilla rostrata	American Eel	-	0.1	< 0.05
Cyprinodon variegatus	Sheepshead Minnow	0.4	-	< 0.05
Unidentified Juvenile Fish	Unidentified Juvenile Fish	0.2	-	< 0.05
Decapods		**40.4**	**95.2**	**88.7**
Palaemonetes pugio	Daggerblade Grass Shrimp	40.4	95.2	88.7
Arthropods		**-**	**< 0.05**	**< 0.05**
Limulus polyphemus	Atlantic Horseshoe Crab	-	< 0.05	< 0.05

Table 5. Average density and standard deviation [individuals per 1 m2 ± SD (total count)] of nekton captured at SAHI in 2009. '-' indicates a species or community was not present. n = number of nekton stations sampled. . Most stations were sampled during both visits. The difference in the number of stations sampled between visits was due to one station being dry

		Average Density [individuals per 1 m^2 ± SD (total count)]		
Community/Species	Common Name	Visit 1 (9)	Visit 2 (8)	Visits 1 & 2 (9)
Fish		**35.6 ± 28.3 (320)**	**20.9 ± 16.9 (188)**	**28.2 ± 20.2 (508)**
Fundulus heteroclitus	Common Mummichog	30.3 ± 28.9 (273)	15.4 ± 17.4 (139)	22.9 ± 20.4 (412)
Menidia menidia	Atlantic Silverside	3.0 ± 4.5 (27)	3.7 ± 9.9 (33)	3.3 ± 5.2 (60)
Fundulus majalis	Striped Killifish	1.9 ± 2.8 (17)	1.6 ± 2.6 (14)	1.7 ± 1.5 (31)
Anguilla rostrata	American Eel	-	0.2 ± 0.4 (2)	0.1 ± 0.2 (2)
Cyprinodon variegatus	Sheepshead Minnow	0.2 ± 0.7 (2)	-	0.1 ± 0.3 (2)
Unidentified Juvenile Fish	Unidentified Juvenile Fish	0.1 ± 0.3 (1)	-	0.1 ± 0.2 (1)
Decapods		**24.1 ± 38.5 (217)**	**418.0 ± 496.5 (3762)**	**221.1 ± 261.7 (3979)**
Palaemonetes pugio	Daggerblade Grass Shrimp	24.1 ± 38.5 (217)	418.0 ± 496.5 (3762)	221.1 ± 261.7 (3979)
Arthropods		**-**	**0.1 ± 0.3 (1)**	**0.1 ± 0.2 (1)**
Limulus polyphemus	Atlantic Horseshoe Crab	-	0.1 ± 0.3 (1)	0.1 ± 0.2 (1)
Total		**59.7 ± 56.4 (537)**	**493.9 ± 513.8 (3951)**	**249.3 ± 272.7 (4488)**

Another summary measure we examined for these data, species richness, provided additional information about differences between sampling visits (Table 6). Although 6 species were found during each sampling visit, species richness was slightly higher during the first sampling visit, 7.8 ± 1.2, than during the second sampling visit, 6.9 ± 0.9. This disparity is a result of there being one more unique species (species recorded at only one station) caught during the first visit than during the second visit. Because the majority of the data were collected at identical locations within each site, variability due to microhabitat differences has been minimized and these results represent a best estimate of difference between sampling visits. These species richness estimates for the two sampling visits provide a baseline for future trend analyses at SAHI.

Table 6. Estimated nekton species richness (Est. Species Richness ± SD) summarized by sampling visit at SAHI in 2009.

Visit	No. of Stations	Observed No. of Species	Est. Species Richness ± SD
1	9	6	7.8 ± 1.2
2	8	6	6.9 ± 0.9

Average length of each species, is summarized in Table 7. These data provide a baseline for length data that will be recorded in future years. Two fish species, *F. heteroclitus* and *M. Menidia*, showed an increase in length from visit 1 to visit 2. One fish species, *F. majalis*, and one decapod species, *P. pugio*, showed a decrease in length from visit 1 to visit 2. The remainder of the nekton species were only present during one sampling visit.

Table 7. Average length [mm ± SD (no. measured)] of nekton for each sampling visit at SAHI in 2009. Length data for each species was summarized over all stations sampled during each visit. '-' indicates that a species was not present.

		Average Length [mm ± SD (no. measured)]	
Community/Species	Common Name	Visit 1	Visit 2
Fish			
Anguilla rostrata	American Eel	-	161.0 ± 83.4 (2)
Cyprinodon variegatus	Sheepshead Minnow	15.0 ± 4.2 (2)	-
Fundulus heteroclitus	Common Mummichog	27.7 ± 22.4 (108)	33.8 ± 16.8 (67)
Fundulus majalis	Striped Killifish	45.2 ± 24.8 (17)	24.5 ± 5.5 (13)
Menidia menidia	Atlantic Silverside	24.7 ± 6.0 (26)	35.1 ± 8.6 (18)
Unidentified Juvenile Fish	Unidentified Juvenile Fish	10.0 (1)	-
Decapods			
Palaemonetes pugio	Daggerblade Grass Shrimp	33.0 ± 8.5 (52)	22.5 ± 5.6 (105)
Arthropods			
Limulus polyphemus	Atlantic Horseshoe Crab	-	27.0 (1)

Physical characteristics of each nekton sampling station were recorded for each station. These measures provide limited insight into differences between habitats that may affect nekton (Table 8). Currently, these data are collected in a manner that may help to explain anomalies in nekton observed at a particular location during a specific visit. These parameters would need to be measured over the course of the field season in order to lend any real insight into observed changes in the nekton community.

Table 8. Average values for physical characteristics [Average ± SD (no. of stations)] at nekton sampling stations at SAHI in 2009. Data are summarized over all stations for each sampling visit.

	Average ± SD (no. of stations)	
Variable	Visit 1	Visit 2
Depth (cm)	21.0 ± 7.8 (8)	28.7 ± 15.2 (8)
Temperature (˚C)	29.4 ± 2.5 (8)	27.1 ± 1.7 (7)
Salinity (ppt)	20.2 ± 4.2 (6)	22.3 ± 2.6 (7)

Vegetation

Thirteen vegetation species along with four non-vegetation cover types were recorded at nine salt marsh sites during vegetation sampling at SAHI in 2009 (Table 9). Non-vegetation cover types recorded included bare ground, water, wrack and litter, and trash. The average percent cover and the relative percent prevalence of each species or non-vegetation cover type are also shown.

One of the identified vegetation species in the sample plots at SAHI, *Panicum amarum* is listed by the State of New York as rare but unprotected (Young 2008). None of the identified vegetation species found at SAHI in 2009 are listed by the USDA (USDA 2010) as exotic, invasive, threatened, endangered, or rare.

Data are sorted by average percent cover of living vegetation species. Average percent cover of non-living vegetation is also shown by species. As explained in the Data Summary section, the relative percent prevalence combines information about how much of each site each species or cover type covers relative to all other cover types present and how frequently it appears throughout the site relative to all other cover types present. The species with the highest living percent cover, *S. alternaflora* dwarfs the percent cover of all other species at 45.2 ± 35.6, but its relative percent prevalence, 35.0, while still high, is substantially lower. This is an indication that the patchy growing pattern of *S. alterniflora*, which has been documented to thrive in low marsh zones closer to coastal waters, (Bertness 1991) decreased its overall relative percent prevalence. In contrast, *S. calceoliformis* has a higher relative percent prevalence, 14.7, than its average percent cover, 12.8 ± 24.2 indicating that although this species covers a lower proportion of the sites sampled at SAHI than *S. alterniflora*, it is more dispersed throughout the sites where it is found (Table 9).

Table 9. Average percent cover (Average % Cover ± SD) and relative percent prevalence of each plant species and non-vegetation cover type at SAHI in 2009. Data were summarized over all 51 plots. Percent cover was estimated using the midpoint values of Braun-Blanquet percent ranges (Table 3). (NL) indicates standing non-living vegetation. '+' indicates a species listed as rare in New York State.

Species/Cover Type	Common Name	Average Cover % ± SD	Relative Prevalence %
Spartina alterniflora	Saltmarsh Cordgrass	45.2 ± 35.6	35.0
S. alterniflora (NL)	Saltmarsh Cordgrass (NL)	2.8 ± 5.6	7.5
Suaeda calceoliformis	Pursh Seepweed	12.8 ± 24.2	14.7
Wrack/Litter		9.5 ± 18.1	14.2
Distichlis spicata	Spikegrass	7.6 ± 23.9	5.9
D. spicata (NL)	Spikegrass (NL)	1.3 ± 4.2	2.5
Spartina patens	Salt Meadow Cordgrass	6.2 ± 20.8	4.6
S. patens (NL)	Salt Meadow Cordgrass (NL)	1.0 ± 5.7	1.1
Suaeda maritima	Herbaceous Seepweed	1.4 ± 6.0	2.0
Iva frutescens	Marsh Elder	1.3 ± 8.8	1.2
Salicornia species	Glasswort Species	1.1 ± 5.7	1.3
Atriplex cristata	Crested Saltbush	0.6 ± 3.0	1.4
Water		0.6 ± 2.3	2.4
Solidago sempervirens	Seaside Goldenrod	0.6 ± 3.0	0.8
Limonium carolinianum	Sea Lavender	0.4 ± 2.2	1.5
Bassia hyssopifolia	Fivehook Bassia	0.4 ± 2.2	1.0
Bare Ground		0.3 ± 2.2	1.0
+ *Panicum amarum*	Bitter Panicgrass	0.3 ± 2.2	0.4
Suaeda species	Seepweed Species	0.3 ± 2.2	0.4
Trash		< 0.05	1.1

Discussion

Nekton

The data summarized above show that SAHI’s salt marsh provides habitat for a small but thriving nekton community. One of the most notable results of the 2009 sampling season was the substantial increase in nekton density from the first sampling to the second sampling visit that was primarily due to one species. These seasonal differences are to be expected, but the extent of change between visits will be one of the variables monitored over time in looking for trends. Extent of seasonal change in abundance, species richness and nekton community structure is subject to variability due to expected year to year climate differences. This annual variability will make trends difficult to isolate in the short term. Long term trends in sea-level rise associated with climate change, however, are likely to result in identifiable changes in the extent of seasonal difference in nekton density and species richness as well as differences in the variables themselves. With this goal in mind, the extensive nekton data collected at SAHI in 2008 provide an informative baseline to which future data will be compared.

Vegetation

This first year of vegetation monitoring at SAHI provides essential information about the species present and how prevalent they are. These data also include information about non-vegetation cover types such as bare ground and standing water which will be important to monitor over time. Because salt marshes are located in coastal areas and many of the plant species are sensitive to subtle changes in soil salinity and saturation, changes in the spatial distribution of some species will be important primary indicators of change in salt marsh condition. Trends in the spatial distribution of vegetation species and prevalence of bare ground and water will also provide information about changes in the overall condition of the salt marsh and whether or not it may transition to mud flat due to sea-level rise and climate change.

This first year of data at SAHI establishes a baseline for monitoring trends in vegetation community structure and spatial distribution of both vegetation species and non-vegetation cover types. Long-term monitoring of salt marsh vegetation will allow us to test hypotheses about whether apparent changes are due to year to year variability or represent significant trends.

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Appendix 1. Coordinates for nekton station locations at SAHI in 2009

Table 1. Coordinates for nekton station locations sampled at SAHI marsh site in 2009, UTM, Zone 18, NAD 83, meters.

Station ID	Habitat	UTM X (east)	UTM Y (north)
SAG1C_339_2009	Tidal Creek	627139	4527138
SAG1C_393_2009	Tidal Creek	627112	4527184
SAG1C_497_2009	Tidal Creek	627093	4527252
SAG1C_515_2009	Tidal Creek	627098	4527239
SAG1C_542_2009	Tidal Creek	627083	4527220
SAG1C_613_2009	Tidal Creek	627118	4527161
SAG1C_688_2009	Tidal Creek	627100	4527107
SAG1C_727_2009	Tidal Creek	627094	4527071
SAG1C_808_2009	Tidal Creek	627112	4527073

Appendix 2. Coordinates for vegetation plot locations at SAHI in 2009

Table 1. Coordinates for vegetation station locations sampled at SAHI site in 2009, UTM, Zone 18, NAD 83, meters. '+' indicates a species listed as rare by New York State.

Station ID	UTM X (east)	UTM Y (north)
SAHI_SAG1_SAG1V209_2009	627141.3107	4527050.738
SAHI_SAG1_SAG1V309_2009	627130.6328	4527234.417
SAHI_SAG1_SAG1V409_2009	627129.5345	4527188.31
SAHI_SAG1_SAG1V509_2009	627140	4527102
SAHI_SAG1_SAG1V609_2009	627098.1142	4527094.642
SAHI_SAG1_SAG1V709_2009	627099.6711	4527232.877
+ SAHI_SAG1_SAG1V809_2009	627166.059	4527121.048
SAHI_SAG1_SAG1V909_2009	627172.2724	4527052.278
SAHI_SAG1_SAG1V1009_2009	627156.7243	4527074.531
SAHI_SAG1_SAG1V1109_2009	627158.741	4527097.658
SAHI_SAG1_SAG1V1209_2009	627130.7756	4527096.267
+ SAHI_SAG1_SAG1V1409_2009	627198.7496	4527122.675
SAHI_SAG1_SAG1V1509_2009	627128.7781	4527096.167
SAHI_SAG1_SAG1V1609_2009	627102.1093	4527094.841
SAHI_SAG1_SAG1V1709_2009	627172.6859	4527075.325
SAHI_SAG1_SAG1V1809_2009	627093	4527170
SAHI_SAG1_SAG1V1909_2009	627210.0646	4527169.29
SAHI_SAG1_SAG1V2009_2009	627119.6464	4527233.87
SAHI_SAG1_SAG1V2109_2009	627113.9253	4527210.56
SAHI_SAG1_SAG1V2209_2009	627134.5283	4527188.558
SAHI_SAG1_SAG1V2309_2009	627140.892	4527211.901
SAHI_SAG1_SAG1V2409_2009	627072	4527235
SAHI_SAG1_SAG1V2509_2009	627108.0663	4527141.189
SAHI_SAG1_SAG1V2609_2009	627115	4527097
SAHI_SAG1_SAG1V2709_2009	627095.1179	4527094.493
+ SAHI_SAG1_SAG1V2809_2009	627146.5135	4527189.154

Station ID	UTM X (east)	UTM Y (north)
SAHI_SAG1_SAG1V2909_2009	627104.9364	4527210.112
SAHI_SAG1_SAG1V3009_2009	627097.8259	4527163.706
SAHI_SAG1_SAG1V3109_2009	627188.2855	4527099.128
SAHI_SAG1_SAG1V3209_2009	627083.8935	4527232.092
SAHI_SAG1_SAG1V3309_2009	627081	4527190
SAHI_SAG1_SAG1V3409_2009	627115.0576	4527141.537
SAHI_SAG1_SAG1V3509_2009	627186.288	4527099.028
SAHI_SAG1_SAG1V3609_2009	627208.0132	4527077.083
SAHI_SAG1_SAG1V3709_2009	627114	4527100
SAHI_SAG1_SAG1V3809_2009	627103	4527239
SAHI_SAG1_SAG1V3909_2009	627115.9229	4527210.659
+ SAHI_SAG1_SAG1V4009_2009	627211.0634	4527169.34
SAHI_SAG1_SAG1V4109_2009	627147.124	4527120.106
SAHI_SAG1_SAG1V4309_2009	627079.1021	4527139.749
+ SAHI_SAG1_SAG1V4409_2009	627154.1153	4527120.454
SAHI_SAG1_SAG1V4609_2009	627149.733	4527074.183
SAHI_SAG1_SAG1V4709_2009	627135.7694	4527096.515
SAHI_SAG1_SAG1V4809_2009	627111.1668	4527256.475
SAHI_SAG1_SAG1V4909_2009	627113	4527076
SAHI_SAG1_SAG1V5109_2009	627129	4527229
SAHI_SAG1_SAG1V5209_2009	627114.9241	4527210.609
SAHI_SAG1_SAG1V5309_2009	627080	4527260
SAHI_SAG1_SAG1V5409_2009	627147	4527103
SAHI_SAG1_SAG1V5509_2009	627102.6674	4527233.026
+ SAHI_SAG1_SAG1V5709_2009	627135.8982	4527211.653