



Salt Marsh Vegetation and Nekton Community Monitoring at Fire Island National Seashore

2009 Summary Report

Natural Resource Report NPS/NCBN/NRDS—2010/068



ON THE COVER

Great Egret foraging salt marsh at Fire Island National Seashore
Photograph courtesy of Fire Island National Seashore

Salt Marsh Vegetation and Nekton Community Monitoring at Fire Island National Seashore

2009 Summary Report

Natural Resource Report NPS/NCBN/NRDS—2010/068

Erika L. Patenaude

Penelope S. Pooler

National Park Service
Northeast Coastal and Barrier Network
University of Rhode Island
1 Greenhouse Rd
Kingston, RI 02881

August 2010

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

The National Park Service, Natural Resource Program Center publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

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.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from (<http://www.nps.gov/nero/science/>) and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/NRPM>).

Please cite this publication as:

Patenaude, E. L., and P. S. Pooler. 2010. Salt marsh vegetation and nekton community monitoring at Fire Island National Seashore: 2009 summary report. Natural Resource Data Series NPS/NCBN/NRDS—2010/068. National Park Service, Fort Collins, Colorado.

Contents

	Page
Figures.....	v
Tables.....	v
Executive Summary	vii
Acknowledgments.....	ix
Introduction.....	1
Methods.....	3
Permanent Site Selection	3
Nekton Sampling Station Selection and Data Collection.....	3
Vegetation Plot Selection and Data Collection	5
Data Summary	6
<i>Nekton</i>	6
<i>Vegetation</i>	6
Results.....	9
Nekton.....	9
Vegetation.....	12
Discussion.....	15
Nekton.....	15
Vegetation.....	15
Literature Cited	17
Appendix 1. Nekton species and community density at FIIS in 2009 summarized by site and sampling.....	19
Appendix 2. Nekton species richness at FIIS in 2009 summarized by site	21
Appendix 3. Coordinates for nekton station locations at FIIS in 2009.....	23

Appendix 4. Coordinates for vegetation plot locations at FIIS in 2009	25
---	----

Figures

	Page
Figure 1. Locations of permanent nekton and vegetation monitoring sites established by NCBN at Fire Island National Seashore (FIIS).	4

Tables

	Page
Table 1. Sampling dates and total number of nekton sampling stations at five marsh sites at FIIS in 2009.	4
Table 2. Sampling dates and total number of vegetation plots sampled at six marsh sites at FIIS in 2009.	5
Table 3. Definition of standard cover type categories used in the Northeast Coastal and Barrier Network salt marsh vegetation monitoring program.	5
Table 4. Modified Braun-Blanquet scale and corresponding midpoint values for determining percent cover of salt marsh vegetation.	6
Table 5. Nekton species and community composition (% catch) at FIIS in 2009	9
Table 6. Average density and standard deviation [individuals per 1 m ² ± SD (total count)] of nekton captured at FIIS in 2009.	10
Table 7. Average density and standard deviation [individuals per 1 m ² ± SD (total count)] of nekton captured for each habitat type at FIIS in 2009.....	10
Table 8. Estimated nekton species richness (Est. Species Richness ± SD) summarized by sampling visit at FIIS in 2009.....	11
Table 9. Average length [mm ± SD (no. measured)] of nekton during each sampling visit at FIIS in 2009.	11
Table 10. Average vales for physical characteristics [Average ± SD (no. of stations)] at nekton sampling stations at FIIS in 2009.....	13
Table 11. Average percent cover (Average Cover % ± SD) and relative percent prevalence of each plant species and non-vegetation cover type at FIIS in 2009.....	14

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 Fire Island National Seashore (FIIS) located in New York. Approximately fifty vegetation plots and a subset of pools and ditches were sampled for nekton at six marshes June-August, 2009. Monitoring data is to be collected at these same marsh sites biennially. Nekton in marsh pools were sampled with a 1m² aluminum throw trap (Kushlan 1981, Sogard & Able 1991, Raposa and Roman 2001). Nekton in ditches were sampled using ditch nets (James-Pirri et al. 2010) Vegetation was monitored using 1m² 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 six FIIS sites, 26 vegetation species along with 4 non-vegetation cover types were recorded during vegetation sampling in 2009. Two of the identified vegetation species in the sample plots at FIIS, *Limonium carolinianum* and *Thelypteris palustris*, are listed by both by the USDA and the State of New York as exploitably vulnerable (USDA 2010, Young 2008). One of the identified vegetation species in the sample plots, *Phragmites australis*, is listed by the state of New York as highly invasive (Invasive Plant Council of New York 2007). Non-vegetation cover types recorded included wrack and litter, bare ground, water, and trash.

Six species of nekton were recorded at five sites at FIIS in 2009, including 4 fish species, 1 crab species, and 1 shrimp species. Examination of percent catch data indicates that two nekton species account for approximately 81% of all nekton captured. The most prevalent species, daggerblade grass shrimp (*Palaemonetes pugio*), accounts for approximately 49% of all nekton recorded at FIIS in 2009. The second most prevalent species, Atlantic silverside (*Menidia menidia*), accounts for approximately 32% of all nekton recorded.

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 FIIS salt marshes. 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 Fire Island National Seashore 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 Fire Island National Seashore (FIIS) 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

Six permanent 5-8 hectare salt marsh sites were selected for monitoring at FIIS (Fig. 1). The number of sites chosen within the park was based on the logistics and feasibility of sampling all sites within one summer. Marsh sites were chosen randomly from all salt marsh within a park, so that statistical inference could be extended to the entire park. 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).

Vegetation sampling was conducted at all six marsh sites and nekton sampling was conducted at five of the six sites. In future years, vegetation and nekton sampling will be conducted at these six marshes every 2 years. In addition, sediment elevation data will be collected three of these marshes on an annual basis.

Nekton Sampling Station Selection and Data Collection

Depending on available habitat, between 8 and 11 nekton sampling stations were established at each marsh site. Habitat types sampled included marsh pools/pannes, and ditches that were either obstructed or not. Because there were relatively few pools, all fishable pools within each site were sampled. In addition to the pool stations sampled, station locations were randomly selected from all available ditch habitat with each site. Some ditch habitat sampled was obstructed and some was not. Sampling of ditch habitat was not stratified by whether or not ditches were obstructed because, in many cases, obstructions may be transient and differences between these two types of ditches is not a focus of the nekton monitoring program. All nekton sampling stations were randomly located along the perimeter of a pool or the length of each ditch so that inference can apply to all fishable water within each site and can be biologically extended to the site as a whole. Nekton stations were sampled twice, once in early summer (June) and once in late summer (July-August) (Table 1).

Nekton in marsh pools less than 1m deep were sampled with a 1m² 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 snugly within the opposite sides of the trap.

Ditches were sampled using a ditch net, an enclosure gear designed to sample narrow mosquito ditches and smaller tidal creeks up to 1 m wide and 1 m deep (James-Pirri et al. 2010). All nekton were collected from the ditch net and density is calculated by measuring the area of water the net samples.

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.



Figure 1. Locations of permanent nekton and vegetation monitoring sites established by NCBN at Fire Island National Seashore (FIIS). These six sites will be monitored biennially.

Table 1. Sampling dates and total number of nekton sampling stations at five marsh sites at FIIS in 2009. Sampling stations are displayed by habitat type.

Site	Visit	Dates	Habitat			Total
			Ditch		Pool/Panne	
			Unobstructed	Obstructed		
1	1	6/30/2009	2	6	0	8
	2	8/24/2009	2	6	0	8
2	1	6/25/2009	7	1	0	8
	2	8/21/2009	7	1	0	8
3	1	6/24/2009	5	3	3	11
	2	8/3/2009	5	3	2	10
4	1	6/26/2009, 7/1/2009	8	0	3	11
	2	8/14/2009	8	0	2	10
5	1	6/29/2009	5	3	0	8
	2	8/4/2009	5	3	0	8

Vegetation Plot Selection and Data Collection

Vegetation sampling was conducted at each of the six permanent marsh sites during July and August. Ten transects, extending from creek bank to upland, were randomly located within each marsh and approximately 50 1m² plots were randomly placed along these transects. Each plot was visited once during the summer sampling season (Table 2).

For each plot, all vegetation species and non-vegetation cover types were recorded (Table 3), 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. Sampling dates and total number of vegetation plots sampled at six marsh sites at FIIS in 2009.

Site	Dates	Total
1	7/30/2009	49
2	8/7/2009	50
3	7/17/2009	49
4	7/14/2009	47
5	7/29/2009	52
6	7/27/2009	51

Table 3. 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 4) as described in Wikum and Shanholtzer (1978).

Table 4. 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%

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.

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 4, the list of all vegetation sample plots and their respective Universal Transverse Mercator (UTM) coordinates.

Results

Nekton

Six nekton species consisting of 4 fish and 2 decapod species were captured at FIIS during the summer of 2009 on five salt marsh sites in pools and ditches. Examination of nekton species and composition (% catch) indicates that 1 decapod species and 1 fish species account for approximately 81% of all nekton recorded during summer sampling at FIIS in 2009 (Table 5). The most prevalent species, daggerblade grass shrimp (*Palaemonetes pugio*) accounts for approximately 49% of all nekton recorded. The second most prevalent species, Atlantic silverside (*Menidia menidia*), accounts for approximately 32% of all nekton caught. Community composition percentages show that during the first visit, decapods comprised 57% of all nekton caught. In contrast, during the second visit, fish comprised approximately 91% of all nekton caught.

The average density of each species and community for each sampling visit is presented in Table 6. Daggerblade grass shrimp (*P. pugio*) had the highest density of all species captured in 2009, with Atlantic silverside (*M. menidia*) following respectively. 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. Species and community densities for each sampling visit at each site can be found in Appendix 1.

Table 7 shows species and community density by sampling visit and habitat type (pool/panne or ditch). The two species with the highest densities, daggerblade grass shrimp (*P. pugio*) and Atlantic silverside (*M. menidia*) were only found in ditch habitat and Atlantic silverside (*M. menidia*) were not recorded at all during the second sampling visit. Both decapod species, daggerblade grass shrimp (*P. pugio*) and blue crab (*C. sapidus*) were only found in obstructed ditches and were found in much higher numbers during the first sampling visit.

Table 5. Nekton species and community composition (% catch) at FIIS in 2009. Data are shown for each visit separately and both visits combined. n = total number of nekton caught during that visit. '-' indicates that a species was not present.

Community/Species	Common Name	Community/Species Composition (%)		
		Visit 1 (n = 708)	Visit 2 (n = 116)	Visits 1 & 2 (n = 824)
Fish		42.8	91.4	49.6
<i>Menidia menidia</i>	Atlantic Silverside	37.2	-	31.9
<i>Fundulus heteroclitus</i>	Common Mummichog	4.9	73.3	14.6
<i>Cyprinodon variegatus</i>	Sheepshead Minnow	0.7	14.7	2.7
Unknown Juvenile				
Fish	Unknown Juvenile Fish	-	3.4	0.4
Decapods		57.2	8.6	50.4
	Daggerblade Grass			
<i>Palaemonetes pugio</i>	Shrimp	56.5	4.3	49.2
<i>Callinectes sapidus</i>	Blue Crab	0.7	4.3	1.2

Table 6. Average density and standard deviation [individuals per 1 m² ± SD (total count)] of nekton captured at FIIS in 2009. ‘-’ indicates that a species 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 some stations being dry.

Community/Species	Common Name	Average Density [individuals per 1 m ² ± SD (total count)]		
		Visit 1 (n = 46)	Visit 2 (n = 44)	Visits 1 & 2 (n = 46)
Fish		6.2 ± 12.8 (303)	3.7 ± 7.1 (106)	4.9 ± 7.0 (409)
<i>Menidia menidia</i>	Atlantic Silverside	5.2 ± 12.8 (263)	-	2.6 ± 6.4 (263)
<i>Fundulus heteroclitus</i>	Common Mummichog	0.8 ± 1.6 (35)	3.2 ± 6.7 (85)	1.9 ± 3.4 (120)
<i>Cyprinodon variegatus</i>	Sheepshead Minnow	0.1 ± 0.4 (5)	0.5 ± 1.6 (17)	0.3 ± 0.8 (22)
Unknown Juvenile				
Fish	Unknown Juvenile Fish	-	0.1 ± 0.6 (4)	< 0.05 (4)
Decapods		10.4 ± 41.9 (405)	0.3 ± 1.0 (10)	5.4 ± 21.1 (415)
	Daggerblade Grass			
<i>Palaemonetes pugio</i>	Shrimp	10.3 ± 41.7 (400)	0.2 ± 0.5 (5)	5.2 ± 20.9 (405)
<i>Callinectes sapidus</i>	Blue Crab	0.1 ± 0.3 (5)	0.2 ± 0.5 (5)	0.1 ± 0.3 (10)
Total Nekton		16.6 ± 46.0 (708)	4.0 ± 7.6 (116)	10.2 ± 24.6 (824)

10

Table 7. Average density and standard deviation [individuals per 1 m² ± SD (total count)] of nekton captured for each habitat type at FIIS in 2009. ‘-’ indicates that a species was not present. n = number of nekton stations sampled. The difference in the number of stations sampled between visits was due to some stations being dry.

Community/Species	Common Name	Average Density [individuals per 1 m ² ± SD (total count)]					
		Visit 1			Visit 2		
		Ditch (40)			Ditch (40)		
		Unobstructed (27)	Obstructed (13)	Pool/Panne (6)	Unobstructed (27)	Obstructed (13)	Pool/Panne (4)
Fish		9.2 ± 15.8 (273)	1.4 ± 3.8 (13)	2.8 ± 3.2 (17)	4.6 ± 8.6 (72)	1.1 ± 1.6 (8)	6.5 ± 4.8 (26)
<i>Menidia menidia</i>	Atlantic Silverside	8.4 ± 15.8 (254)	1.1 ± 3.8 (9)	-	-	-	-
<i>Fundulus heteroclitus</i>	Common Mummichog	0.7 ± 1.0 (17)	0.4 ± 1.0 (4)	2.3 ± 3.4 (14)	4.3 ± 8.3 (68)	1.1 ± 1.6 (8)	2.3 ± 2.6 (9)
<i>Cyprinodon variegatus</i>	Sheepshead Minnow	0.1 ± 0.3 (2)	-	0.5 ± 0.8 (3)	0.3 ± 0.7 (4)	-	3.3 ± 4.6 (13)
Unknown Juvenile Fish	Unknown Juvenile Fish	-	-	-	-	-	1.0 ± 2.0 (4)
Decapods		17.7 ± 53.9 (405)	-	-	0.5 ± 1.2 (10)	-	-
<i>Palaemonetes pugio</i>	Daggerblade Grass Shrimp	17.6 ± 53.6 (400)	-	-	0.3 ± 0.6 (5)	-	-
<i>Callinectes sapidus</i>	Blue Crab	0.2 ± 0.4 (5)	-	-	0.2 ± 0.6 (5)	-	-
Total Nekton		26.9 ± 58.2 (678)	1.4 ± 3.8 (13)	2.8 ± 3.2 (17)	5.1 ± 9.2 (82)	1.1 ± 1.6 (8)	6.5 ± 4.8 (26)

Another summary measure we examined for these data, species richness, provided additional information about the two visits samplings. Despite the dramatic differences in nekton density, species richness was relatively consistent over the two visits (Table 8). 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 visits. This consistency in species richness between the two sampling visits provides a baseline for future trend analyses at FIIS. Species richness information for each site at FIIS, summarized over both visits, can be found in Appendix 2.

Table 8. Estimated nekton species richness (Est. Species Richness $\pm$ SD) summarized by sampling visit at FIIS in 2009.

Visit	No. of Stations	Observed No. of Species	Est. Species Richness $\pm$ SD
1	46	5	5.0
2	44	5	6.0 $\pm$ 1.0

Average length of each species, is summarized in Table 9. One of the species present during both sampling visits, *F. heteroclitus* showed no change in length over the two visits. In contrast, *C. variegatus* showed a substantial increase in length from visit 1 to visit 2. (Table 9). Among the two decapod species, *C. sapidus* showed an increase in length, and *P. pugio* showed a decrease in length from sampling visit 1 to 2. There were very few of each of these decapod species recorded during sampling visit 2, however, so these differences may not provide reliable baseline data.

Table 9. Average length [mm $\pm$ SD (no. measured)] of nekton during each sampling visit at FIIS 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			
<i>Cyprinodon variegatus</i>	Sheepshead Minnow	14.8 ± 8.6 (5) 26.3 ± 13.7	20.5 ± 6.6 (17)
<i>Fundulus heteroclitus</i>	Common Mummichog	(35) 23.1 ± 5.8	26.3 ± 11.3 (76)
<i>Menidia menidia</i>	Atlantic Silverside	(121)	-
Unknown Juvenile Fish	Unknown Juvenile Fish	-	6.5 ± 0.6 (4)
Decapods			
<i>Callinectes sapidus</i>	Blue Crab	57.0 ± 10.2 (5)	92.2 ± 14.3 (5)
	Daggerblade Grass		
<i>Palaemonetes pugio</i>	Shrimp	35.5 ± 5.4 (77)	27.0 ± 9.5 (5)

Physical characteristics of each nekton sampling station were recorded for each station during each visit. These measures provide limited insight into differences between habitats and visits that may affect nekton (Table 10). 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.

Vegetation

Twenty-six vegetation species along with four non-vegetation cover types were recorded at six salt marsh sites during vegetation sampling at FIIS in 2009 (Table 11). 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.

Two of the identified vegetation species in the sample plots at FIIS, *Limonium carolinianum* and *Thelypteris palustris*, are listed by both by the USDA and the State of New York as exploitably vulnerable (USDA 2010, Young 2008). One of the identified vegetation species in the sample plots, *Phragmites australis*, is listed by the state of New York as highly invasive (Invasive Plant Council of New York 2007).

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. *S. alterniflora* has the highest living percent cover, 37.2 ± 32.1 , but has a substantially lower relative percent prevalence, 21.4. 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. Almost all of the species recorded at FIIS have relative percent prevalence values that are lower than their average percent covers indicating that they are all fairly patchy in distribution.

Table 10. Average vales for physical characteristics [Average $\pm$ SD (no. of stations)] at nekton sampling stations at FIIS in 2009. Data are summarized over all five marshes for each habitat type within each visit separately.

Habitat	Average $\pm$ SD (no. of stations)					
	Visit 1			Visit 2		
	Ditch		Pool/Panne	Ditch		Pool/Panne
	Unobstructed	Obstructed		Unobstructed	Obstructed	
Depth (cm)	32.8 $\pm$ 12.9 (27)	30.4 $\pm$ 15.9 (13)	13.3 $\pm$ 4.3 (6)	34.8 $\pm$ 14.0 (27)	25.7 $\pm$ 8.4 (13)	11.0 $\pm$ 6.0 (4)
Temperature ($^{\circ}$ C)	21.4 $\pm$ 0.9 (25)	22.0 $\pm$ 1.0 (13)	24.3 $\pm$ 1.2 (6)	25.0 $\pm$ 2.0 (27)	25.3 $\pm$ 1.9 (13)	32.6 $\pm$ 4.3 (4)
Salinity (ppt)	22.0 $\pm$ 3.5 (25)	20.4 $\pm$ 4.9 (13)	23.2 $\pm$ 2.5 (6)	19.8 $\pm$ 4.8 (22)	18.7 $\pm$ 8.1 (10)	18.0 (1)

Table 11. Average percent cover (Average Cover % $\pm$ SD) and relative percent prevalence of each plant species and non-vegetation cover type at FIIS in 2009. Data summarized over all 298 plots. % cover was estimated using the midpoint values of Braun-Blanquet percent ranges (Table 4). (NL) indicates standing non-living vegetation. '*' indicates an invasive or exotic species. '+' indicates a species listed as exploitably vulnerable by New York State.

Species/Cover Type	Common name	Average Cover % $\pm$ SD	Relative Prevalence %
<i>Spartina alterniflora</i>	Saltmarsh Cordgrass	37.2 $\pm$ 32.1	21.4
<i>S. alterniflora</i> (NL)	Saltmarsh Cordgrass (NL)	21.2 $\pm$ 27.0	14.8
<i>Spartina patens</i>	Salt Meadow Cordgrass	23.3 $\pm$ 29.6	14.1
<i>S. patens</i> (NL)	Salt Meadow Cordgrass (NL)	10.6 $\pm$ 17.7	8.7
<i>Distichlis spicata</i>	Spikegrass	9.7 $\pm$ 19.5	7.4
<i>D. spicata</i> (NL)	Spikegrass (NL)	5.0 $\pm$ 11.8	5.0
Wrack/Litter		7.9 $\pm$ 21.0	6.1
Water		7.5 $\pm$ 20.6	5.6
* <i>Phragmites australis</i>	Common Reed	3.9 $\pm$ 14.6	2.8
* <i>P. australis</i> (NL)	Common Reed (NL)	1.9 $\pm$ 8.2	2.1
Bare Ground		1.8 $\pm$ 5.9	2.5
<i>Juncus gerardii</i>	Black Grass	1.5 $\pm$ 8.8	1.0
<i>J. gerardii</i> (NL)	Black Grass (NL)	0.4 $\pm$ 3.0	0.4
<i>Salicornia species</i>	Glasswort Species	0.6 $\pm$ 2.0	3.7
<i>Salicornia species</i> (NL)	Glasswort Species (NL)	< 0.05	0.2
Unidentified Algae	Unidentified Algae	0.6 $\pm$ 7.2	0.3
<i>Baccharis halimifolia</i>	Sea Myrtle	0.5 $\pm$ 5.7	0.4
<i>B. halimifolia</i> (NL)	Sea Myrtle (NL)	0.1 $\pm$ 0.9	0.2
Trash		0.3 $\pm$ 5.1	0.2
<i>Hibiscus species</i>	Hibiscus Species	0.2 $\pm$ 3.7	0.2
<i>Malvaceae</i>	Mallow Family	0.2 $\pm$ 2.4	0.2
<i>Solidago sempervirens</i>	Seaside Goldenrod	0.2 $\pm$ 1.3	0.4
<i>Schoenoplectus pungens</i>	Common Three-Square	0.2 $\pm$ 1.6	0.2
<i>S. pungens</i> (NL)	Common Three-Square (NL)	< 0.05	< 0.05
<i>Pluchea odorata</i>	Marsh Fleabane	0.1 $\pm$ 2.2	0.2
+ <i>Limonium carolinianum</i>	Sea Lavender	0.1 $\pm$ 1.0	0.5
+ <i>L. carolinianum</i> (NL)	Sea Lavender (NL)	< 0.05	< 0.05
<i>Iva frutescens</i>	Marsh Elder	0.1 $\pm$ 0.9	0.1
<i>I. frutescens</i> (NL)	Marsh Elder (NL)	< 0.05	< 0.05
<i>Teucrium canadense</i>	American Germander	0.1 $\pm$ 0.9	0.1
<i>Eleocharis species</i>	Spikerush Species	0.1 $\pm$ 0.9	0.1
<i>Eleocharis species</i> (NL)	Spikerush Species (NL)	0.1 $\pm$ 2.2	0.1
<i>Hibiscus moscheutos</i>	Rose Mallow	0.1 $\pm$ 0.9	0.1
<i>Aster tenuifolius</i>	Saltmarsh Aster	< 0.05	0.2
Unidentified Plant	Unidentified Plant	< 0.05	0.2
<i>Panicum species</i>	Panic Grass Species	< 0.05	0.1
<i>Panicum species</i> (NL)	Panic Grass Species (NL)	0.1 $\pm$ 0.9	0.1
<i>Polygonum punctatum</i>	Dotted Smartweed	< 0.05	0.1
<i>P. punctatum</i> (NL)	Dotted Smartweed (NL)	< 0.05	< 0.05
<i>Toxicodendron radicans</i>	Poison Ivy	< 0.05	0.1
<i>Triadenum virginicum</i>	Marsh St. John's-Wort	< 0.05	< 0.05
<i>Cakile edentula</i>	Sea Rocket	< 0.05	< 0.05
<i>C. edentula</i> (NL)	Sea Rocket (NL)	< 0.05	< 0.05
+ <i>Thelypteris palustris</i>	Marsh Fern	< 0.05	< 0.05

Discussion

Nekton

The data summarized above show that the FIIS salt marsh provides habitat for a diverse and abundant nekton community. One of the most notable results of the 2009 sampling season was the decrease in nekton densities and consistency in species richness values from the first to the second sampling visit. Seasonal differences are to be expected, but the extent of change in density 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 FIIS in 2009 provide an informative baseline to which future data will be compared.

Vegetation

This first year of vegetation monitoring at FIIS 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 FIIS 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.

Literature Cited

- Bertness, M.D. 1991. Zonation of *Spartina Patens* and *Spartina Alterniflora* in New England Salt Marsh. *Ecology* 20: 138-148.
- Heltshe, J.F. and N.E. Forrester. 1983. Estimating species richness using the jackknife procedure. *Biometrics* 39:1-11.
- Invasive Plant Council of New York. 2007. New York State Early Detection Invasive Plants by Region, Assessment of Naturalized Invasive Plants, Region LIISMA.
<http://www.ipcnys.org/files/ED%20Lists/LIISMA.pdf>
- James-Pirri, M.-J., C.T. Roman, J.L. Swanson. 2010. A method to quantitatively sample nekton in salt marsh ditches and small tidal creeks. *Transactions of the American Fisheries Society* 139:413-419.
- James-Pirri, M.J., C.T. Roman, and K.B. Raposa. In Development-a. Monitoring nekton in Salt Marshes - A Protocol for the National Park Service's Long-Term Monitoring Program, Northeast Coastal and Barrier Network. Submitted to Sara Stevens, National Park Service Northeast Coastal and Barrier Network.
- James-Pirri, M.J., C.T. Roman, and J.F. Heltshe. In Development-b. Monitoring Salt Marsh Vegetation - A Protocol for the National Park Service's Long-Term Monitoring Program, Northeast Coastal and Barrier Network. Submitted to Sara Stevens, National Park Service Northeast Coastal and Barrier Network.
- Kent, M., and P. Coker. 1992. Vegetation description and analysis: a practical approach. J. Wiley and Sons, Ltd., Chichester, England.
- Kushlan, J.A. 1981. Sampling characteristics of enclosure fish traps. *Transactions of the American Fisheries Society* 110:557-562.
- Raposa, K.B. and C.T. Roman. 2001. Seasonal habitat-use patterns of nekton in a tide-restricted and unrestricted New England salt marsh. *Wetlands* 21: 451-461.
- Rozas, L.P. and T.J. Minello. 1997. Estimating densities of small fishes and decapod crustaceans in shallow estuarine habitats: a review of sampling design with focus on gear selection. *Estuaries* 20:199-213.
- Sogard, S.M. and K.W. Able. 1991. A comparison of eelgrass, sea lettuce macroalgae, and marsh creeks as habitats for epibenthic fishes and decapods. *Estuarine, Coastal and Shelf Science* 33:501-519.

- Stevens, S., B. Milstead, M. Albert, G. Entsminger. 2005. Northeast Coastal and Barrier Network Vital Signs Monitoring Plan. Technical Report NPS/NER/NRTR--2005/025. National Park Service. Boston, Massachusetts.
- United States Department of Agriculture. 2010. Natural Resources Conservation Service. Plants Database. <http://plants.usda.gov/>
- Wikum, D.A., G.F. Shanholtzer. 1978. Application of the Braun-Blanquet Cover-Abundance Scale for Vegetation Analysis in Land Development Studies. 2: 323-329.
- Young, S.M., ed. 2008. New York Rare Plant Status Lists. New York Natural Heritage Program. http://www.dec.ny.gov/docs/wildlife_pdf/nynhprpsl.pdf

Appendix 1. Nekton species and community density at FIIS in 2009 summarized by site and sampling

Table 1. Average density and standard deviation [individuals per 1 m² ± SD (total count)] of nekton captured for each site and visit at FIIS in 2009. ‘-’ indicates that a species was not present.

Community/Species	Common Name	Average Density [individuals per 1 m ² ± SD (total count)]					
		Site 1		Site 2		Site 3	
		Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2
Fish		3.2 ± 4.9 (19)	0.6 ± 1.2 (2)	19.5 ± 23.6 (182)	5.7 ± 14 (29)	7.5 ± 11 (84)	4.1 ± 5.6 (28)
<i>Menidia menidia</i>	Atlantic Silverside	2.6 ± 5.1 (15)	-	18.7 ± 23.4 (176)	-	6.1 ± 11.5 (70)	-
<i>Fundulus heteroclitus</i>	Common Mummichog	0.6 ± 1.3 (4)	0.6 ± 1.2 (2)	0.8 ± 0.7 (6)	5.2 ± 13.5 (26)	1.3 ± 2.7 (14)	3.0 ± 5.4 (17)
<i>Cyprinodon variegatus</i>	Sheepshead Minnow	-	-	-	0.5 ± 0.8 (3)	-	1.1 ± 3.1 (11)
Unknown Juvenile Fish	Unknown Juvenile Fish	-	-	-	-	-	-
Decapods		-	-	58.2 ± 90.1 (390)	0.7 ± 1.2 (4)	1.2 ± 3.5 (15)	-
<i>Palaemonetes pugio</i>	Daggerblade Grass Shrimp	-	-	57.8 ± 89.6 (387)	0.4 ± 0.7 (2)	1.1 ± 3.2 (13)	-
<i>Callinectes sapidus</i>	Blue Crab	-	-	0.4 ± 0.6 (3)	0.4 ± 0.7 (2)	0.2 ± 0.4 (2)	-
Total Nekton		3.2 ± 4.9 (19)	0.6 ± 1.2 (2)	77.7 ± 89.9 (572)	6.5 ± 15.1 (33)	8.7 ± 14.0 (99)	4.1 ± 5.6 (28)

Community/Species	Common Name	Average Density [individuals per 1 m ² ± SD (total count)]			
		Site 4		Site 5	
		Visit 1	Visit 2	Visit 1	Visit 2
Fish		1.4 ± 1.9 (13)	5.4 ± 5.3 (35)	0.6 ± 0.7 (5)	2.2 ± 3.6 (12)
<i>Menidia menidia</i>	Atlantic Silverside	-	-	0.3 ± 0.5 (2)	-
<i>Fundulus heteroclitus</i>	Common Mummichog	0.9 ± 1.4 (8)	4.6 ± 4.3 (28)	0.4 ± 0.6 (3)	2.2 ± 3.6 (12)
<i>Cyprinodon variegatus</i>	Sheepshead Minnow	0.5 ± 0.7 (5)	0.5 ± 1.0 (3)	-	-
Unknown Juvenile Fish	Unknown Juvenile Fish	-	0.4 ± 1.3 (4)	-	-
Decapods		-	-	-	1.0 ± 1.8 (6)
<i>Palaemonetes pugio</i>	Daggerblade Grass Shrimp	-	-	-	0.5 ± 0.9 (3)
<i>Callinectes sapidus</i>	Blue Crab	-	-	-	0.5 ± 0.9 (3)
Total Nekton		1.4 ± 1.9 (13)	5.4 ± 5.3 (35)	0.6 ± 0.7 (5)	3.1 ± 4.9 (18)

Appendix 2. Nekton species richness at FIIS in 2009 summarized by site

Table 1. Estimated nekton species richness (Est. Species Richness $\pm$ SD) summarized by site at FIIS in 2009.

Site	No. of Stations	Observed No. of Species	Est. Species Richness $\pm$ SD
1	8	2	2.0
2	8	5	5.0
3	11	5	5.0
4	11	3	3.9 $\pm$ 0.9
5	8	4	4.0

Appendix 3. Coordinates for nekton station locations at FIIS in 2009

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

Station ID	Habitat	UTM X (east)	UTM Y (north)
F1D1_2009	Unobstructed Ditch	675963	4509906
F1D17_2009	Unobstructed Ditch	676028	4510059
F1D7_2009	Obstructed Ditch	676013	4509946
F1D9_2009	Obstructed Ditch	676040	4510024
F1D12_2009	Obstructed Ditch	676089	4509927
F1D14_2009	Obstructed Ditch	676002	4509969
F1D16_2009	Obstructed Ditch	676001	4509822
F1D19_2009	Obstructed Ditch	676054	4510003

Table 2. Coordinates for nekton station locations sampled at FIIS site 2 in 2009, UTM, Zone 18, NAD 83, meters.

Station ID	Habitat	UTM X (east)	UTM Y (north)
F2D1_2009	Unobstructed Ditch	676714	4510019
F2D7_2009	Unobstructed Ditch	676616	4509898
F2D9_2009	Unobstructed Ditch	676555	4509928
F2D13_2009	Unobstructed Ditch	676484	4509837
F2D15_2009	Unobstructed Ditch	676654	4510005
F2D17_2009	Unobstructed Ditch	676588	4509885
F2D18_2009	Unobstructed Ditch	676729	4509950
F2D11_2009	Obstructed Ditch	676776	4509885

Table 3. Coordinates for nekton station locations sampled at FIIS site 3 in 2009, UTM, Zone 18, NAD 83, meters.

Station ID	Habitat	UTM X (east)	UTM Y (north)
F3P10_54_2009	Pool/Panne	676323	4510056
F3P11_82_2009	Pool/Panne	676309	4510033
F3P12_85_2009	Pool/Panne	676219	4510016
F3D1_2009	Unobstructed Ditch	676341	4510010
F3D3_2009	Unobstructed Ditch	676288	4510221
F3D7_2009	Unobstructed Ditch	676240	4510035
F3D10_2009	Unobstructed Ditch	676259	4510139
F3D13_2009	Unobstructed Ditch	676192	4510139
F3D2_2009	Obstructed Ditch	676353	4510081
F3D4_2009	Obstructed Ditch	676360	4510052
F3D6_2009	Obstructed Ditch	676271	4510110

Table 4. Coordinates for nekton station locations sampled at FIIS site 4 in 2009, UTM, Zone 18, NAD 83, meters.

Station ID	Habitat	UTM X (east)	UTM Y (north)
F4P1_26_2009	Pool/Panne	670755	4506974
F4P2_69_2009	Pool/Panne	670724	4506953
F4P3_98_2009	Pool/Panne	670710	4506982
F4D1_2009	Unobstructed Ditch	670681	4507011
F4D2_2009	Unobstructed Ditch	670737	4507065
F4D3_2009	Unobstructed Ditch	670631	4506903
F4D4_2009	Unobstructed Ditch	670677	4507042
F4D5_2009	Unobstructed Ditch	670647	4506889
F4D6_2009	Unobstructed Ditch	670806	4506988
F4D7_2009	Unobstructed Ditch	670740	4507034
F4D8_2009	Unobstructed Ditch	670684	4506980

Table 5. Coordinates for nekton station locations sampled at FIIS site 5 in 2009, UTM, Zone 18, NAD 83, meters.

Station ID	Habitat	UTM X (east)	UTM Y (north)
F5D5_2009	Unobstructed Ditch	675664	4509536
F5D6_2009	Unobstructed Ditch	675704	4509595
F5D8_2009	Unobstructed Ditch	675596	4509538
F5D13_2009	Unobstructed Ditch	675652	4509563
F5D15_2009	Unobstructed Ditch	675571	4509739
F5D12_2009	Obstructed Ditch	675465	4509532
F5D14_2009	Obstructed Ditch	675486	4509450
F5D24_2009	Obstructed Ditch	675470	4509437

Appendix 4. Coordinates for vegetation plot locations at FIIS in 2009

Table 1. Coordinates for vegetation plot locations sampled FIIS site 1 in 2009, UTM, Zone 18, NAD 83, meters. ‘*’ indicates that invasive or exotic species is present at that sample plot location. ‘+’ indicates a species listed as exploitably vulnerable by New York state is present at that sample plot location.

25

Plot ID	UTM X (east)	UTM Y (north)	Plot ID	UTM X (east)	UTM Y (north)
FIIS_F1_F1V109_2009	676118.2122	4509740.013	FIIS_F1_F1V3009_2009	675964.7448	4509983.561
FIIS_F1_F1V309_2009	676028.562	4510027.551	FIIS_F1_F1V3109_2009	676095.4023	4509801.946
FIIS_F1_F1V409_2009	675970.2661	4509968.544	FIIS_F1_F1V3209_2009	675914.8437	4510031.865
FIIS_F1_F1V509_2009	676056.4998	4509951.522	FIIS_F1_F1V3309_2009	675974.7958	4510042.599
FIIS_F1_F1V609_2009	676081.3335	4509883.94	FIIS_F1_F1V3709_2009	675995.2796	4509943.633
FIIS_F1_F1V709_2009	675978.6201	4509901.895	FIIS_F1_F1V3909_2009	675946.4553	4510033.305
FIIS_F1_F1V809_2009	676043.4762	4509856.127	FIIS_F1_F1V4009_2009	676065.0809	4509754.077
FIIS_F1_F1V909_2009	676016.8228	4509841.917	FIIS_F1_F1V4109_2009	675938.5835	4510097.601
FIIS_F1_F1V1009_2009	676113.7552	4509795.708	FIIS_F1_F1V4209_2009	676019.9392	4510051.017
FIIS_F1_F1V1209_2009	676069.8275	4509871.386	FIIS_F1_F1V4309_2009	675953.4422	4510057.249
FIIS_F1_F1V1409_2009	676044.8587	4509852.373	FIIS_F1_F1V4409_2009	676013.4939	4510024.342
FIIS_F1_F1V1509_2009	676007.8673	4510083.869	FIIS_F1_F1V4509_2009	676093.0605	4509852.026
FIIS_F1_F1V1609_2009	675969.9731	4509925.352	FIIS_F1_F1V4609_2009	676043.0483	4509988.128
FIIS_F1_F1V1709_2009	675969.3376	4510014.083	FIIS_F1_F1V4709_2009	675983.0046	4509933.897
FIIS_F1_F1V1809_2009	675980.6713	4510026.647	* FIIS_F1_F1V4809_2009	676141.8553	4509806.538
FIIS_F1_F1V1909_2009	676021.4428	4510002.76	* FIIS_F1_F1V4909_2009	676142.5425	4509804.66
FIIS_F1_F1V2009_2009	675943.4212	4510084.463	FIIS_F1_F1V5009_2009	676020.3199	4509918.998
* FIIS_F1_F1V2109_2009	676066.1176	4509751.261	FIIS_F1_F1V5109_2009	676044.6934	4509809.442
FIIS_F1_F1V2209_2009	676036.15	4510006.901	FIIS_F1_F1V5209_2009	676068.5718	4509918.669
FIIS_F1_F1V2309_2009	675970.9563	4509966.667	FIIS_F1_F1V5309_2009	675928.511	4510082.111
* FIIS_F1_F1V2409_2009	676089.4432	4509731.323	FIIS_F1_F1V5409_2009	675961.7354	4510034.728
FIIS_F1_F1V2509_2009	675968.9355	4509928.166	FIIS_F1_F1V5509_2009	676008.8859	4509863.504
FIIS_F1_F1V2609_2009	676023.7332	4510040.692	FIIS_F1_F1V5609_2009	676037.6862	4509958.656
FIIS_F1_F1V2709_2009	676041.1423	4509949.272	FIIS_F1_F1V5809_2009	676101.6833	4509828.56
* FIIS_F1_F1V2909_2009	676131.3457	4509747.838			

Table 2. Coordinates for vegetation plot locations sampled FIIS site 2 in 2009, UTM, Zone 18, NAD 83, meters. ‘*’ indicates that invasive or exotic species is present at that sample plot location. ‘+’ indicates a species listed as exploitably vulnerable by New York state is present at that sample plot location.

26						
	Plot ID	UTM X (east)	UTM Y (north)	Plot ID	UTM X (east)	UTM Y (north)
	FIIS_F2_F2V109_2009	676504.9834	4509880.755	FIIS_F2_F2V2809_2009	676613.7627	4509858.975
	FIIS_F2_F2V209_2009	676534.5898	4509915.092	* FIIS_F2_F2V2909_2009	676405.3797	4509715.313
	FIIS_F2_F2V309_2009	676671.6193	4509842.016	* FIIS_F2_F2V3109_2009	676714.9762	4509850.677
	* FIIS_F2_F2V409_2009	676547.2969	4509805.885	* FIIS_F2_F2V3209_2009	676504.4701	4509796.385
	* FIIS_F2_F2V509_2009	676716.9768	4509847.213	FIIS_F2_F2V3409_2009	676557.9084	4509874.285
	FIIS_F2_F2V609_2009	676644.4579	4509972.776	FIIS_F2_F2V3509_2009	676610.7953	4509864.19
	FIIS_F2_F2V709_2009	676694.4695	4509971.867	FIIS_F2_F2V3609_2009	676656.9611	4509951.127
	+ FIIS_F2_F2V809_2009	676633.0514	4509825.079	* FIIS_F2_F2V3709_2009	676530.0763	4509836.355
	* FIIS_F2_F2V909_2009	676505.9436	4509793.772	FIIS_F2_F2V3909_2009	676703.8782	4509955.36
	* + FIIS_F2_F2V1009_2009	676610.4991	4509782.251	FIIS_F2_F2V4009_2009	676606.8386	4509871.143
	* FIIS_F2_F2V1109_2009	676429.6643	4509759.569	* FIIS_F2_F2V4309_2009	676431.0821	4509756.925
	FIIS_F2_F2V1209_2009	676596.0719	4509973.913	+ FIIS_F2_F2V4409_2009	676460.4932	4509789.154
	FIIS_F2_F2V1309_2009	676575.1854	4509926.767	* FIIS_F2_F2V4509_2009	676679.0746	4509829
	* FIIS_F2_F2V1409_2009	676595.1188	4509809.167	FIIS_F2_F2V4609_2009	676573.7848	4509846.501
	* + FIIS_F2_F2V1509_2009	676637.9972	4509816.387	FIIS_F2_F2V4709_2009	676483.8398	4509832.969
	FIIS_F2_F2V1609_2009	676591.1497	4509816.113	FIIS_F2_F2V4809_2009	676678.9669	4509913.026
	* FIIS_F2_F2V1709_2009	676499.5581	4509805.096	* FIIS_F2_F2V4909_2009	676579.7385	4509836.082
	FIIS_F2_F2V1809_2009	676617.4438	4509936.6	* FIIS_F2_F2V5009_2009	676722.4782	4509837.688
	* FIIS_F2_F2V1909_2009	676473.6391	4509765.57	* + FIIS_F2_F2V5109_2009	676645.9105	4509802.481
	FIIS_F2_F2V2009_2009	676665.158	4509853.297	* FIIS_F2_F2V5209_2009	676732.1044	4509905.839
	FIIS_F2_F2V2209_2009	676541.5358	4509902.937	FIIS_F2_F2V5309_2009	676529.0922	4509838.096
	* FIIS_F2_F2V2309_2009	676772.2152	4509835.468	FIIS_F2_F2V5509_2009	676728.1428	4509912.79
	FIIS_F2_F2V2409_2009	676676.6425	4510003.143	FIIS_F2_F2V5609_2009	676623.4081	4509926.187
	+ FIIS_F2_F2V2509_2009	676631.0731	4509828.555	* FIIS_F2_F2V5709_2009	676608.4974	4509952.219
	FIIS_F2_F2V2609_2009	676642.4484	4509808.565	* FIIS_F2_F2V5909_2009	676756.8642	4509862.4

Table 3. Coordinates for vegetation plot locations sampled FIIS site 3 in 2009, UTM, Zone 18, NAD 83, meters.

Plot ID	UTM X (east)	UTM Y (north)	Plot ID	UTM X (east)	UTM Y (north)
FIIS_F3_F3V509_2009	676274.3716	4510095.771	FIIS_F3_F3V3109_2009	676392.8533	4510054.601
FIIS_F3_F3V609_2009	676336.3356	4510201.319	FIIS_F3_F3V3209_2009	676278.6749	4510213.317
FIIS_F3_F3V709_2009	676306.7844	4510211.985	FIIS_F3_F3V3309_2009	676190.4429	4510106.557
FIIS_F3_F3V809_2009	676336.4596	4510061.891	FIIS_F3_F3V3409_2009	676346.3774	4510150.298
FIIS_F3_F3V909_2009	676279.256	4510210.373	FIIS_F3_F3V3509_2009	676368.2236	4510178.17
FIIS_F3_F3V1009_2009	676264.0257	4510147.751	FIIS_F3_F3V3609_2009	676191.6067	4510100.671
FIIS_F3_F3V1109_2009	676384.6434	4510095.791	FIIS_F3_F3V3709_2009	676395.3945	4510041.852
FIIS_F3_F3V1209_2009	676285.648	4510177.998	FIIS_F3_F3V3809_2009	676371.7421	4510160.518
FIIS_F3_F3V1309_2009	676356.6124	4510098.295	FIIS_F3_F3V3909_2009	676222.0679	4510083.619
FIIS_F3_F3V1409_2009	676288.8169	4510023.194	FIIS_F3_F3V4009_2009	676277.319	4510220.184
FIIS_F3_F3V1509_2009	676284.8732	4510181.923	FIIS_F3_F3V4109_2009	676189.8609	4510109.5
FIIS_F3_F3V1609_2009	676367.2462	4510183.074	FIIS_F3_F3V4209_2009	676228.1185	4510053.216
FIIS_F3_F3V1709_2009	676170.5801	4510067.626	FIIS_F3_F3V4309_2009	676194.7103	4510084.975
FIIS_F3_F3V1809_2009	676229.4847	4510046.35	FIIS_F3_F3V4409_2009	676325.3282	4510257.246
FIIS_F3_F3V1909_2009	676269.2962	4510121.271	FIIS_F3_F3V4509_2009	676194.3224	4510086.937
FIIS_F3_F3V2009_2009	676381.7113	4510110.501	FIIS_F3_F3V4609_2009	676178.4316	4510027.385
FIIS_F3_F3V2109_2009	676366.268	4510049.236	FIIS_F3_F3V4709_2009	676248.4899	4510089.456
FIIS_F3_F3V2209_2009	676320.9432	4510140.372	FIIS_F3_F3V4809_2009	676257.779	4510179.136
FIIS_F3_F3V2309_2009	676280.0326	4510067.329	FIIS_F3_F3V4909_2009	676219.5306	4510096.369
FIIS_F3_F3V2409_2009	676281.9678	4510196.638	FIIS_F3_F3V5009_2009	676302.7114	4510232.587
FIIS_F3_F3V2509_2009	676415.6606	4510079.156	FIIS_F3_F3V5109_2009	676369.7874	4510170.325
FIIS_F3_F3V2609_2009	676188.5031	4510116.367	FIIS_F3_F3V5209_2009	676228.3136	4510052.235
FIIS_F3_F3V2709_2009	676302.1123	4510094.608	FIIS_F3_F3V5309-2009	676327.9255	4510105.055
FIIS_F3_F3V2809_2009	676303.0993	4510230.625	FIIS_F3_F3V5409_2009	676286.6165	4510173.093
FIIS_F3_F3V2909_2009	676325.7144	4510255.284			

Table 4. Coordinates for vegetation plot locations sampled FIIS site 4 in 2009, UTM, Zone 18, NAD 83, meters. ‘*’ indicates that invasive or exotic species is present at that sample plot location. ‘+’ indicates a species listed as exploitably vulnerable by New York state is present at that sample plot location.

Plot ID	UTM X (east)	UTM Y (north)	Plot ID	UTM X (east)	UTM Y (north)
FIIS_F4_F4V109_2009	670821.7957	4507069.942	FIIS_F4_F4V3109_2009	670882.6383	4506930.375
FIIS_F4_F4V209_2009	670714.7546	4507044.797	FIIS_F4_F4V3209_2009	670636.2915	4506918.688
FIIS_F4_F4V309_2009	670780.3808	4506972.408	FIIS_F4_F4V3309_2009	670676.3319	4506991.798
* FIIS_F4_F4V409_2009	670846.1456	4506909.939	FIIS_F4_F4V3509_2009	670893.2401	4507084.009
* FIIS_F4_F4V509_2009	670846.8868	4506920.914	FIIS_F4_F4V3609_2009	670682.9818	4507089.572
FIIS_F4_F4V609_2009	670847.6953	4506932.887	FIIS_F4_F4V3709_2009	670819.9213	4507042.005
FIIS_F4_F4V709_2009	670682.6425	4507084.583	FIIS_F4_F4V3909_2009	670710.6899	4506983.932
FIIS_F4_F4V909_2009	670710.5567	4506981.937	FIIS_F4_F4V4009_2009	670817.9798	4507013.07
FIIS_F4_F4V1009_2009	670746.659	4506993.881	FIIS_F4_F4V4109_2009	670639.3984	4506964.583
FIIS_F4_F4V1109_2009	670816.4401	4506990.121	FIIS_F4_F4V4209_2009	670754.4837	4507108.614
+ FIIS_F4_F4V1309_2009	670715.8874	4507061.759	FIIS_F4_F4V4309_2009	670747.3394	4507003.858
FIIS_F4_F4V1509_2009	670678.9104	4507029.71	FIIS_F4_F4V4409_2009	670824.9422	4507116.836
+ FIIS_F4_F4V1609_2009	670849.1103	4506953.839	FIIS_F4_F4V4509_2009	670749.8569	4507040.772
FIIS_F4_F4V1709_2009	670892.6894	4507076.028	FIIS_F4_F4V4609_2009	670819.051	4507029.034
FIIS_F4_F4V1809_2009	670786.4138	4507059.198	FIIS_F4_F4V4809_2009	670893.5843	4507088.997
FIIS_F4_F4V1909_2009	670610.0475	4507050.962	FIIS_F4_F4V4909_2009	670819.1179	4507030.032
FIIS_F4_F4V2009_2009	670847.9648	4506936.878	FIIS_F4_F4V5309_2009	670708.7575	4506954.997
FIIS_F4_F4V2109_2009	670683.321	4507094.56	FIIS_F4_F4V5409_2009	670609	4507065
FIIS_F4_F4V2209_2009	670745.9786	4506983.904	FIIS_F4_F4V5509_2009	670641.1544	4506990.524
FIIS_F4_F4V2309_2009	670786.6219	4507062.191	FIIS_F4_F4V5609_2009	670886.9065	4506992.227
FIIS_F4_F4V2509_2009	670746.1147	4506985.899	FIIS_F4_F4V5709_2009	670678.4354	4507022.726
FIIS_F4_F4V2609_2009	670747.4755	4507005.853	FIIS_F4_F4V5809_2009	670749.3126	4507032.79
* FIIS_F4_F4V2909_2009	670852.1424	4506998.737	FIIS_F4_F4V5909_2009	670821.1263	4507059.964
FIIS_F4_F4V3009_2009	670707.9579	4506943.023			

Table 5. Coordinates for vegetation plot locations sampled FIIS site 5 in 2009, UTM, Zone 18, NAD 83, meters. ‘*’ indicates that invasive or exotic species is present at that sample plot location.

29						
	Plot ID	UTM X (east)	UTM Y (north)	Plot ID	UTM X (east)	UTM Y (north)
	* FIIS_F5_F5V109_2009	675470.3438	4509428.888	* FIIS_F5_F5V3209_2009	675631.1064	4509478.3
	FIIS_F5_F5V209_2009	675617.991	4509608.221	FIIS_F5_F5V3309_2009	675499.6419	4509665.805
	* FIIS_F5_F5V309_2009	675718.1819	4509521.285	FIIS_F5_F5V3509_2009	675555.9067	4509641.539
	FIIS_F5_F5V409_2009	675529.4941	4509623.228	FIIS_F5_F5V3609_2009	675519.1606	4509637.966
	FIIS_F5_F5V509_2009	675499.0307	4509555.209	* FIIS_F5_F5V3709_2009	675542.0944	4509438.084
	FIIS_F5_F5V609_2009	675488.6959	4509569.946	FIIS_F5_F5V3809_2009	675530.6749	4509677.586
	FIIS_F5_F5V709_2009	675695.8012	4509553.224	FIIS_F5_F5V3909_2009	675532.9687	4509674.309
	FIIS_F5_F5V809_2009	675427.5931	4509545.774	FIIS_F5_F5V4009_2009	675519.7002	4509525.734
	* FIIS_F5_F5V909_2009	675470.9192	4509428.07	FIIS_F5_F5V4109_2009	675496.0818	4509615.069
	FIIS_F5_F5V1209_2009	675554.3226	4509699.146	FIIS_F5_F5V4209_2009	675501.2509	4509607.702
	FIIS_F5_F5V1309_2009	675473.2739	4509536.389	FIIS_F5_F5V4309_2009	675648.8056	4509508.822
	FIIS_F5_F5V1409_2009	675468.6859	4509542.942	FIIS_F5_F5V4409_2009	675696.3751	4509552.405
	FIIS_F5_F5V1509_2009	675491.8513	4509454.042	* FIIS_F5_F5V4509_2009	675582.8081	4509491.459
	* FIIS_F5_F5V1709_2009	675474.9477	4509422.345	FIIS_F5_F5V4709_2009	675661.0102	4509546.785
	* + FIIS_F5_F5V1809_2009	675739.9887	4509490.165	FIIS_F5_F5V4809_2009	675604.6987	4509515.965
	FIIS_F5_F5V1909_2009	675513.9927	4509478.225	FIIS_F5_F5V4909_2009	675647.0852	4509511.28
	FIIS_F5_F5V2009_2009	675663.3045	4509543.508	* FIIS_F5_F5V5009_2009	675553.0012	4509478.247
	FIIS_F5_F5V2109_2009	675455.1324	4509506.46	FIIS_F5_F5V5109_2009	675489.1896	4509624.892
	* FIIS_F5_F5V2209_2009	675509.9782	4509483.96	* FIIS_F5_F5V5209_2009	675545.5355	4509433.169
	FIIS_F5_F5V2309_2009	675532.3645	4509619.134	* FIIS_F5_F5V5309_2009	675700.5878	4509490.264
	FIIS_F5_F5V2409_2009	675500.179	4509553.571	FIIS_F5_F5V5409_2009	675574.3982	4509670.476
	FIIS_F5_F5V2509_2009	675433.9042	4509536.765	FIIS_F5_F5V5509_2009	675457.4273	4509503.184
	* FIIS_F5_F5V2609_2009	675700.0142	4509491.083	FIIS_F5_F5V5609_2009	675478.4355	4509529.016
	* FIIS_F5_F5V2709_2009	675533.4919	4509450.372	* FIIS_F5_F5V5709_2009	675531.1979	4509453.649
	* FIIS_F5_F5V3009_2009	675660.848	4509491.618	FIIS_F5_F5V5909_2009	675528.92	4509624.047
	FIIS_F5_F5V3109_2009	675673.4206	4509585.163	FIIS_F5_F5V6009_2009	675569.6695	4509621.878

Table 6. Coordinates for vegetation plot locations sampled FIIS site 6 in 2009, UTM, Zone 18, NAD 83, meters. ‘+’ indicates a species listed as exploitably vulnerable by New York state is present at that sample plot location.

30

Plot ID	UTM X (east)	UTM Y (north)	Plot ID	UTM X (east)	UTM Y (north)
FIIS_F6_F6V109_2009	687339.8975	4514808.414	FIIS_F6_F6V2809_2009	687266.277	4514775.417
FIIS_F6_F6V209_2009	687012.1628	4514698.391	FIIS_F6_F6V2909_2009	687435.8011	4514871.719
FIIS_F6_F6V309_2009	687182.5158	4514795.676	FIIS_F6_F6V3009_2009	687057.7306	4514760.46
FIIS_F6_F6V409_2009	687396.6888	4514818.557	FIIS_F6_F6V3209_2009	687030.7488	4514790.392
FIIS_F6_F6V509_2009	686992.6338	4514671.79	FIIS_F6_F6V3309_2009	687342.8613	4514812.441
FIIS_F6_F6V609_2009	687408.541	4514834.667	FIIS_F6_F6V3409_2009	687246.7163	4514748.839
FIIS_F6_F6V709_2009	687058.9142	4514762.072	FIIS_F6_F6V3509_2009	687111.1648	4514765.309
FIIS_F6_F6V809_2009	687388.5042	4514874.455	FIIS_F6_F6V3609_2009	687294.1362	4514813.27
FIIS_F6_F6V909_2009	687377.2417	4514859.153	FIIS_F6_F6V3709_2009	687127.9852	4514721.579
FIIS_F6_F6V1009_2009	687180.2659	4514725.586	FIIS_F6_F6V3809_2009	687330.2938	4514862.399
FIIS_F6_F6V1109_2009	687336.9337	4514804.387	FIIS_F6_F6V3909_2009	686961.9038	4514697.03
FIIS_F6_F6V1209_2009	687161.7065	4514833.651	FIIS_F6_F6V4009_2009	686976.7411	4514717.151
+ FIIS_F6_F6V1309_2009	687352.2255	4514892.198	FIIS_F6_F6V4109_2009	687380.7982	4514863.985
+ FIIS_F6_F6V1409_2009	687340.3705	4514876.09	FIIS_F6_F6V4209_2009	687467.8644	4514848.149
FIIS_F6_F6V1509_2009	687418.6154	4514848.36	FIIS_F6_F6V4309_2009	687009.3831	4514761.418
FIIS_F6_F6V1609_2009	687144.4629	4514810.334	+ FIIS_F6_F6V4409_2009	687168.2904	4514776.347
FIIS_F6_F6V1709_2009	687128.5779	4514722.385	FIIS_F6_F6V4509_2009	687278.7247	4514792.33
FIIS_F6_F6V1809_2009	687089.1642	4514735.561	+ FIIS_F6_F6V4609_2009	687088.5696	4514734.757
FIIS_F6_F6V1909_2009	687357.5602	4514899.446	FIIS_F6_F6V4709_2009	687249.0873	4514752.06
FIIS_F6_F6V2009_2009	687332.6648	4514865.62	FIIS_F6_F6V4809_2009	687195.6648	4514746.536
+ FIIS_F6_F6V2109_2009	687407.4726	4514900.227	FIIS_F6_F6V4909_2009	687083.8127	4514728.325
FIIS_F6_F6V2209_2009	687384.3548	4514868.817	+ FIIS_F6_F6V5009_2009	687026.0008	4514783.953
FIIS_F6_F6V2309_2009	687436.3938	4514872.525	FIIS_F6_F6V5109_2009	686973.1802	4514712.322
FIIS_F6_F6V2409_2009	687012.944	4514766.247	FIIS_F6_F6V5209_2009	687023.9986	4514714.513
FIIS_F6_F6V2509_2009	687251.3376	4514822.276	FIIS_F6_F6V5309_2009	687289.3942	4514806.827
+ FIIS_F6_F6V2609_2009	687328.5156	4514859.982	FIIS_F6_F6V5409_2009	687006.2449	4514690.33
FIIS_F6_F6V2709_2009	686945.1666	4514741.394			