Final Report of the NPS Vegetation Mapping Project at Fire Island National Seashore

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0.0 Executive Summary

In 1994, The United States Geological Survey (USGS) began the National Park Service (NPS) Vegetation Mapping Program in cooperation with the NPS. The vegetation mapping project at Fire Island National Seashore (FIIS) was initiated in June of 1999. The Conservation Management Institute at Virginia Tech was contracted to complete the photointerpretation, accuracy assessment, and fieldwork stages of the project. The Nature Conservancy (now NatureServe) along with the New York Natural Heritage Program (NYNHP), were subcontracted to complete vegetation sampling and develop a classification system for the FIIS.

The vegetation communities and spatial patterns on Fire Island, as on all barrier islands, is a direct result of dynamism. The forces of sand deposition, storm-driven over wash, salt spray, and surface water all play major roles in affecting vegetation distribution. More recently, disturbance from both humans and white-tailed deer have impacted vegetation communities on Fire Island.

The vegetation-mapping project at FIIS follows the standards and general procedures of other NPS Vegetation Mapping Program projects. The same standards, type of photography, vegetation classification system, and field procedures were employed for FIIS. There were, however, some unique conditions at FIIS that called for some changes in sampling as well as techniques that may not be applicable in other regions.

True-color photographs were used to delineate and interpret vegetation polygons at Fire Island. The detailed resolution of the aerial photography allowed us to identify and map many objects that would have been difficult to identify from digital orthoquads (DOQs) or other smaller-scale data. We opted to map at a minimum mapping unit of 0.25-ha to address the needs of the park managers, but could often discern objects and vegetation polygons well below this threshold.

NatureServe provided a preliminary classification that was used in the initial delineation phase. In October of 1999, CMI field staff and photointerpreters visited Fire Island to familiarize themselves with the dominant vegetative species on the island. The data collected during the initial reconnaissance mission was used to better identify areas and vegetation types that required comprehensive vegetation measurement. Field data collection was completed with two types of plots. The first, which was completed by the NatureServe ecologists, involved detailed data collection on representative plots for each vegetation type encountered. The second type, completed by CMI field staff, involved a more qualitative classification of vegetation types observed on the ground. The plot sampling methodology used by the NYNHP on Fire Island follow the methodology developed by The Nature Conservancy and the network of Natural Heritage Programs. The second data point set was selected in the field, and allowed us to maximize the contribution of each point to the knowledge base of the photointerpreter.

Polygon boundaries were delineated from the georeferenced photos on-screen through heads-up digitizing. Once the final classification was available, all polygons were assigned a vegetation association. A photointerpreter key was employed for consistency. Polygons were re-delineated and assigned as necessary. Polygons were also given values for height, density, and distribution pattern. The final vegetation map layers were converted to ArcInfo and all spatial errors were cleaned.

An accuracy assessment effort was completed for FIIS in accordance with the NPS vegetation mapping specifications. The accuracy assessment phase was carried out similar to other NPS vegetation mapping projects. We used guidelines from The Nature Conservancy (1994) to determine the number of accuracy assessment points needed for Fire Island. A target number of 665 accuracy assessment points was established, representing 579 polygons.

A total of 5 broadly defined vegetation groups were encountered on Fire Island and the William Floyd Estate. These include salt marshes, dune grasslands, dune shrublands, interdunal swales, and forests / shrublands. These types were further classified into 27 different associations. Six of the associations at Fire Island National Seashore are broadly classified as forest types ("Forest Class" in the National Vegetation Classification hierarchy), one as Woodland, five as Shrubland, two as Dwarf-Shrubland, twelve as Herbaceous, and one as Sparse Vegetation. These associations are representative of a typical middle and upper Atlantic barrier island system.

A total of 39 classes of land cover were mapped on Fire Island and the William Floyd Estate. These are comprised of 24 types mapped to NVCS association, 1 complex of 2 NVCS alliances, and 14 non-NVCS classes. Four associations were identified on Fire Island and the William Floyd Estate but do not appear on the map due to their rarity, small relative size, and/or difficulties in identifying them with aerial photography.

Spatial accuracy was assessed by collecting "map points" on the ground along with vegetation fieldwork. A total of 47 points were used to assess the spatial accuracy of the vegetation map. The mean error distance was found to be 4.42 m (± 4.94 m). Errors distances ranged from 0.00 m – 30.0 m. When the single 30 m error point was removed (assumed to be an outlier), the mean error distance was 3.86 m ((± 3.18 m) with a range of 0.00 m – 14.09 m.

A total of 495 points were used to assess the thematic accuracy of the vegetation map. Initial analysis showed a relatively low overall accuracy of 57.6%. Further examination revealed some fairly serious discrepancies between vegetation types classified in the field and those depicted on the map. After review, 428 points were available for use in the accuracy assessment. Of these 329 were located in polygons larger than 0.25 ha and 99 were found in smaller polygons. We used a fuzzy set matrix to evaluate the severity of error between each class and every other class. The fuzzy value was assigned based on the similarity between types observed on Fire Island. We present accuracy estimates for levels 5, 4 and 3 in the classification. The level 5 contains only those points where the observed type matched the mapped type exactly. The level 4 assessment considers both level 5 and 4 as being correct. The level 3 assessment similarly considers levels 5,4, and

3. The overall accuracy (and Kappa index) for the map at level 5 was 66.3% (64%). The level 4 and 3 accuracy was 78.1% (77%) and 87.5% (87%) respectively.

The vegetation of Fire Island is not much different than types observed in similar NPS areas (e.g., Asseteague Island). There are some unique associations on Fire Island not seen elsewhere. It was apparent early in the project that a minimum mapping unit of 0.25 hectares was insufficient to adequately capture the structural and vegetative diversity of the island. Attempts were made to delineate smaller discrete polygons. The final vegetation classification includes several types that were not delineated on the vegetation map. Many of these types are extremely rare on Fire Island (or the Floyd Estate) or are indistinguishable from the more prevalent associations on the island.

This project has identified several potential points for improvement or additional study. The base information for this project was more than adequate for the task of mapping vegetation on a barrier island. The barrier island is constantly changing. Dynamism is the foundation on which these species and communities are built. Updates to this product should be completed on a regular basis to ensure these changes are included.

1.0 Introduction

1.1 General Background

In 1994, The United States Geological Survey (USGS) began the National Park Service (NPS) Vegetation Mapping Program in cooperation with the NPS. The goal of this program is to provide quality vegetation maps for the over 250 properties managed by the NPS. This goal is accomplished by establishing and closely following standards for mapping and classifying vegetation.

These standards comply with all guidelines set forth by the Federal Geographic Data Commission (FGDC) for thematic consistency, spatial accuracy, and data production. The National Vegetation Classification is used for actual classification. The minimum accuracy for each mapped class will not be less than 80% at the 90% level of confidence. The mapping is conducted at a 0.5-ha minimum mapping unit with a horizontal positional accuracy of 12.2 meters on the ground conforming to the National Map Accuracy Standards (The Nature Conservancy 1994). All products must be accompanied by FGDC-compliant metadata, and all GIS data is provided in the Spatial Data Transfer Standard. All taxonomic references utilize the Integrated Taxonomic Information System.

1.2 Specific Park Information

The vegetation mapping project at Fire Island National Seashore (FIIS) was initiated in June of 1999. The Conservation Management Institute at Virginia Tech was contracted to complete the photointerpretation, accuracy assessment, and fieldwork stages of the project. The Nature Conservancy (now NatureServe) along with the New York Natural Heritage Program (NYNHP), were subcontracted to complete vegetation sampling and develop a classification system for the FIIS.

2.0 Project Area

2.1 Location and Regional Setting

The Fire Island National Seashore is located on Fire Island; a member of Long Island barrier island system in the State of New York. Located in Suffolk County, Fire Island extends 32 miles from Fire Island Inlet to Moriches Inlet. The Fire Island National Seashore is bounded on the West by the Robert Moses State Park and on the East by the Smith Point County Park. The Seashore contains 17 private communities scattered throughout the Western portion of the area.

2.1.1 Cultural History of Fire Island

The earliest inhabitants of Fire Island were likely the Secatogues who used the island for hunting. Later, European visitors included the Dutch and English. The first records of European habitation date back to the late 17^{th} century when William Smith owned the entire area. Fire Island has a colorful history as a haven for pirates, "wreckers"[1], whalers, fisherman, and slave runners. The first Fire Island light was established in 1825 (the lighthouse present today was built in 1858). Fire Island became a resort island after 1855. Several resort communities, still in existence, began appearing in the early 1900's. With the increasing interest in tourism, infrastructure projects facilitating access to Fire Island were inevitable. The bridge from Captree Island was built to the western end of Fire Island and plans to build a road eastward towards Smith Point were developed. The prospect of this road and the numbers of people it would bring spurred opponents to push for a federal presence on Fire Island.

2.1.2. History of the Fire Island National Seashore

In the mid 1950's, the U.S. Congress commissioned the NPS to study seashore and lakeshore areas for possible inclusion in the National Park system. As a result of this study, Fire Island was recommended for inclusion as a National Seashore. The Fire Island National Seashore was officially designated in 1964. The boundaries of the Seashore were extended from the original position of the Fire Island Inlet (now located some 5 miles to the west and administered by the New York State Park Authority as Robert Moses State Park) to the eastern tip of the Island at Moriches Inlet (encompassing what is now Smith Point County Park administered by Suffolk County) (see Figure 1). The administrative boundary extends 1,000 feet into the Atlantic Ocean to the South, and 4,000 feet North into the Great South Bay. This boundary encompasses several of the islands in Great South Bay including West and East Fire Island, Sexton Island, Ridge Island, John Boyle Island, Hospital Island, and Pattersquash Island. In 1980, approximately 1,300 acres stretching about 7 miles from Watch Hill to Smith Point County Park were designated as wilderness. The Otis Pike High Dune Wilderness is the only federally designated wilderness area in the state of New York.

The 640-acre William Floyd estate, the home of New York's Continental Congress delegate and signatory of the Declaration of Independence, became part of the FIIS in 1976. This parcel is located in Mastic, NY on Long Island.

The stated mission of the NPS at FIIS is:

> The National Park Service is committed to preserving Fire Island National Seashore's cultural and natural resources, its values of maritime and American history, barrier island dynamics and ecology, biodiversity, museum collection objects, and wilderness. The National Park Service is committed to providing access and recreational and educational opportunities to Fire Island National Seashore visitors in this natural and cultural setting close to densely populated urban and suburban areas, and to maintaining and exemplifying the policies of the National Park Service.

The administration of FIIS is as challenging as any in the NPS system. Close cooperation with the residents of Fire Island's 17 private communities, local municipalities, state agencies, and non-governmental groups compound administrative matters. The difficult logistics of operating and managing a barrier island further contribute to the weighty task.

The NPS has guided its management responsibility by following a simple statement of purpose to "administer and protect the Fire Island National Seashore with the primary aim of conserving the natural resources located there." (Public Law 88-587)

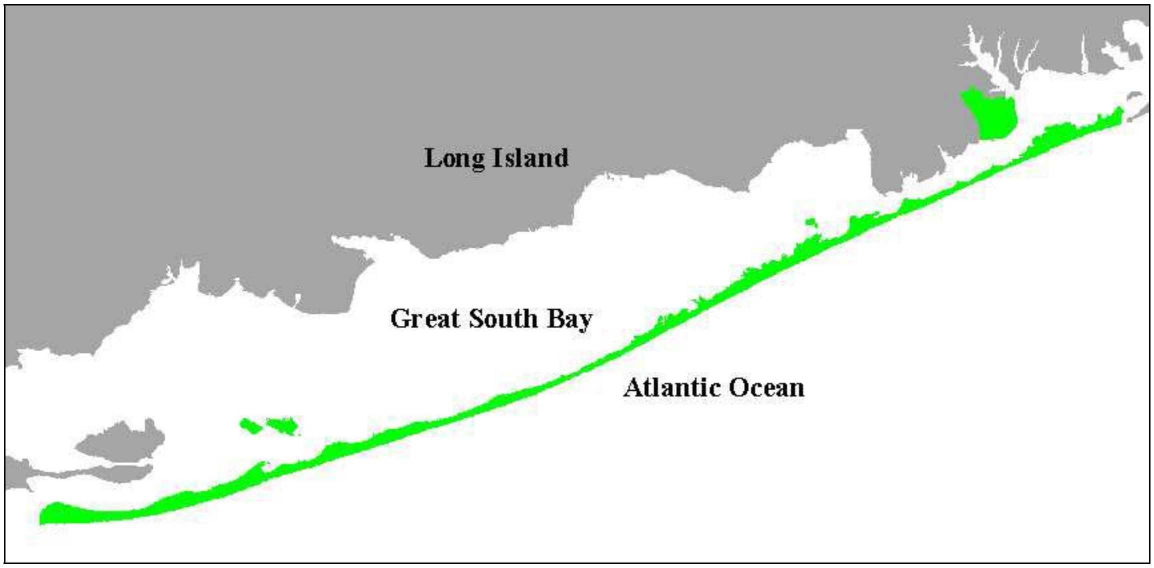

Figure 1. Mapping area for the Fire Island National Seashore Vegetation Mapping Project. Mapped areas are given in green.

2.2 Park Attributes Related to the Vegetation Mapping Project

The vegetation communities and spatial patterns on Fire Island, as on all barrier islands, is a direct result of dynamism. The forces of sand deposition, storm-driven over wash, salt spray, and surface water all play major roles in affecting vegetation distribution. More recently, disturbance from both humans and white-tailed deer have impacted vegetation communities on Fire Island.

The dune morphology of Fire Island is typical of a barrier island. There are several zones, each with different edaphic conditions (Figure 2a.). Vegetation patterns often follow these zones. The primary vegetation gradient extends from the Atlantic Ocean towards the Great South Bay (Figure 2b) roughly parallel to both along the entire island. Several zones can be readily identified along this gradient. Immediately adjacent to the open ocean is non-vegetated sand extending to the base of the primary dune. Sparse herbaceous plants can be found at the base of the primary dune and the dune face exposed to the ocean. Grass vegetation typically increases in cover from the crest of the primary dune and into the inter-dune (or swale) area. These swales are often a mosaic of shrub and grass types. Here, many different types of grass, dwarf-shrub, woody shrub, vine, and tree communities begin to appear. Occasionally depressions are present with near-surface water available to the vegetation. Shrubs tend to increase in density towards the secondary dune and the Bay salt marshes, although many areas of Fire Island do not have a well-defined secondary dune. When a well-formed secondary dune is present, larger trees often replace shrubs. These trees can be over 10 m in height. Most of the Bay-side of the island is salt marsh which gradually tapers into the shallows of the Great South Bay.

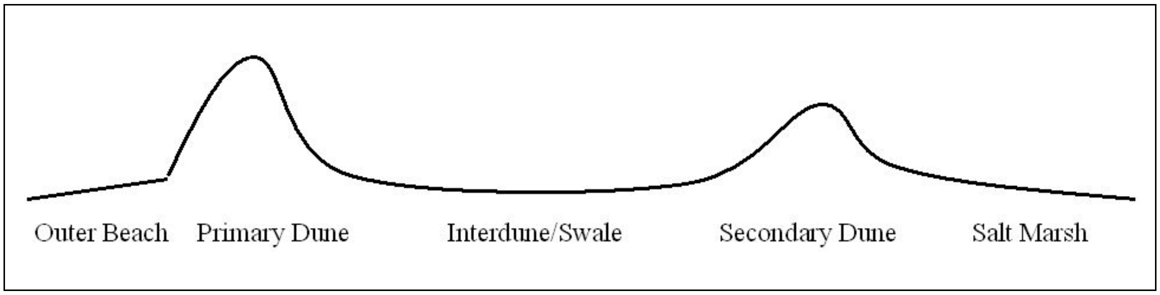

Figure 2a. Cross-section of Fire Island extending from the Atlantic Ocean (left) to the Great South Bay (right)

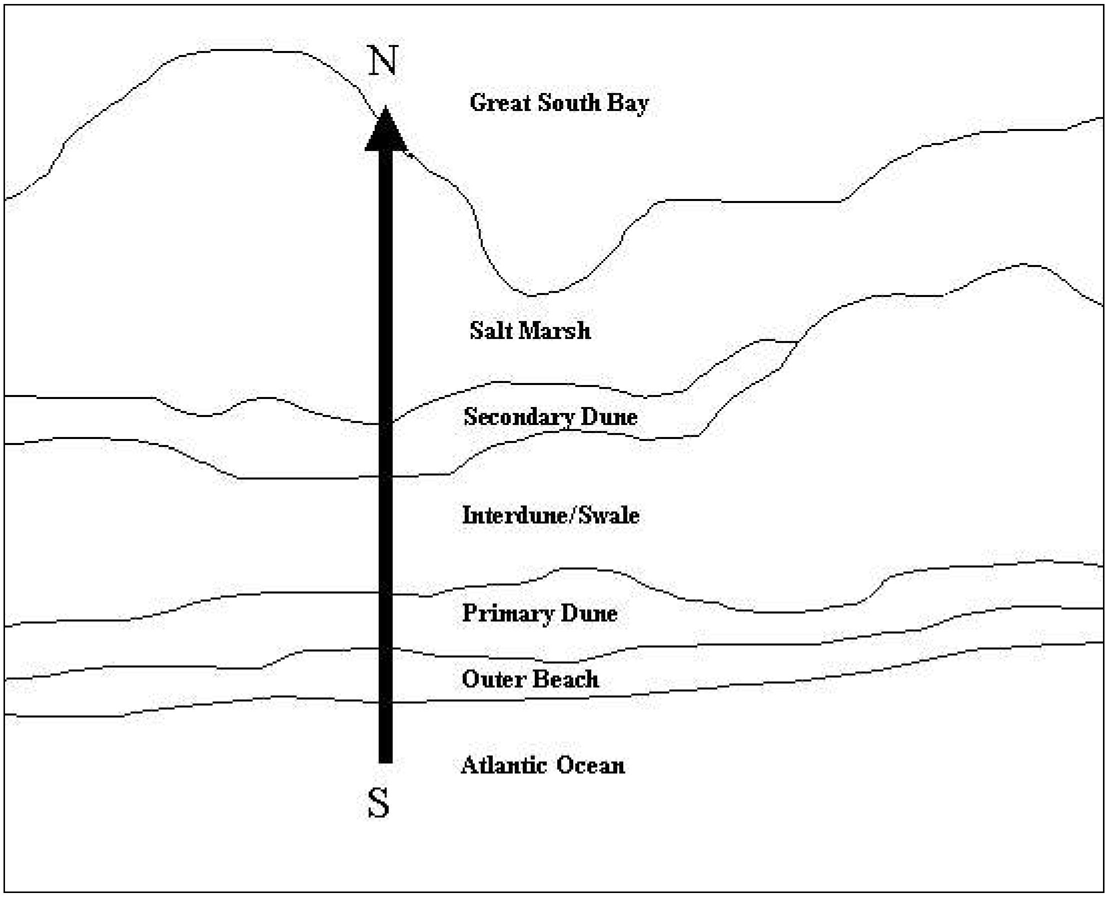

Figure 2b. The vegetation zones observed on Fire Island (from above).

This pattern from ocean to bay is very helpful in assisting with photointerpretation, as each zone is readily definable and vegetation communities are predictable.

3.0 Materials and Methods

A timeline of activities is provided in Table 1.

Table 1. Timeline of activities for the FIIS vegetation mapping project.

June 1999	Completed scoping meeting in Ronkonkoma, NY. Representatives from the CMI, NPS (both FIIS and regional), USGS-Biological Resources Division, and the NatureServe were in attendance.
October 1999	CMI field staff and photointerpreters completed initial reconnaissance on FIIS.
November 1999 - April 2000	CMI staff began photointerpretive work including photo acquisition, digital image georegistration, and preliminary vegetation polygon delineation.
May 2000	CMI staff and NatureServe-NYNHP completed field reconnaissance and initial vegetation classification work at FIIS.
June 2000 - August 2000	CMI photointerpreters completed preliminary vegetation polygon delineation for FIIS
July 2000	NYNHP ecologists completed vegetation plot data collection
September 2000	CMI field staff completes a second round of reconnaissance at FIIS. Met with NatureServe-NYNHP ecologists to discuss final vegetation classification.
October 2000 – July 2001	NatureServe- NYNHP completed vegetation data analysis and final vegetation classification.
July 2001	CMI photointerpreters completed final classification of vegetation polygons and vegetation map.
August 2001	NatureServe completed detailed vegetation descriptions and vegetation keys for the final vegetation classification.
September 2001	CMI field staff completed accuracy assessment data collection on FIIS.

The vegetation-mapping project at FIIS follows the standards and general procedures of other NPS Vegetation Mapping Program projects (USGS NPS Vegetation Mapping Program – http://biology.usgs.gov/npsveg/standards.html). The same standards, type of photography, vegetation classification system, and field procedures were employed. There were, however, some unique conditions at FIIS that called for some changes in sampling as well as techniques that may not be applicable in other regions.

3.1 Planning and Scoping Meeting

This meeting was organized to inform all cooperators about the USGS-NPS Vegetation Mapping Program, the project at FIIS, the techniques that would be employed, and the particulars of working on Fire Island. The project parameters were discussed and established. Vegetation mapping would be conducted at a 0.5-ha minimum mapping unit for both the Fire Island and William Floyd Estate properties. A 0.25-ha minimum mapping unit was preferred, but not accepted, as a standard since the ability to map at that level was yet undetermined. The study area was defined as all land within the NPS administrative boundary on Fire Island (including the Robert Moses State Park and Smith Point County Park), the islands in the Great South Bay, and the William Floyd Estate. Other logistical items pertaining to fieldwork on Fire Island (e.g., access, , travel, accommodations) were discussed. A project schedule was developed to guide the timing of project tasks. Lastly, a brief trip to Fire Island was conducted.

3.2 Preliminary Data Collection and Review of Existing Information

Immediately following the scoping meeting, CMI and NPS personnel began compiling and reviewing any existing datasets for FIIS. These datasets included GIS layers from the University of Rhode Island Support Center (Mandeville), citations from the NPS Natural Resource Bibliography (NRBIB), and other GIS data available from other sources (e.g., digital orthophotography, satellite imagery, etc.). These data were compiled into an ArcView GIS project and distributed to cooperators. These data were used for planning reconnaissance missions and learning the overall layout of Fire Island.

3.3 Aerial Photography Acquisition

Aerial photographs were already available for the FIIS and it was decided to use these rather than conduct a new photo acquisition project. The Army Corps of Engineers lent a set of color-infrared (CIR) imagery taken in July 1997. This photoset was scanned at a resolution of 600 dpi to be used as a reference for vegetation mapping work (Figure 3a). Because we were not able to maintain possession of the CIR photoset, we obtained print copies of an additional photoset for use in the FIIS project. This set of photos was obtained from Aerographics, Inc[1] – the same vendor who supplied the CIR photoset to the Army Corps of Engineers. This set was captured in true-color in April of 1997 for Fire Island, and in 1996 for the islands in the Great South Bay and the William Floyd Estate at a scale of 1:1,200. Two copies of each photo were acquired. One was sent to the FIIS headquarters in Patchogue and the other was kept at CMI.

The true-color photographs were used to delineate and interpret vegetation polygons at Fire Island. Aerographics scanned a subset of these same photographs at 600 dpi to serve as a backdrop for head-up digitizing (Figure 3b). Only about half of the photoset was scanned, as there was considerable overlap area within the photos. These photos were georeferenced by collecting 10-20 control points from available USGS digital orthoquarterquads (DOQQs) for the area. Photos were georeferenced to a spatial accuracy of 5 m on the ground, determined from the root mean square error term provided by the software during georeferencing (TNT-Mips, MicroImages, Inc., 11th Floor - Sharp Tower, 206 South 13th Street, Lincoln, NE 68508-2010). The georeferenced photoset was distributed to all project cooperators.

3.4 Development of Special Mapping and Data Collection Criteria

The detailed resolution of the aerial photography allowed us to identify and map many objects that would have been difficult to identify from DOQs or other smaller-scale data. We opted to map at a minimum mapping unit of 0.25-ha to address the needs of the park managers, but could often discern objects and vegetation polygons well below this threshold. These smaller polygons include structures such as homes, boardwalks, docks, and helipads. The inclusion of these features will allow users to better orient themselves in the field and provide information on the number and location of these features on Fire Island.

We also attempted to map certain vegetation types of interest to the FIIS. These mostly included exotic or invasive species such as Japanese knotweed (*Polygonum cuspidatum*) and bamboo (species unknown). Although attempts were made to identify these classes, they were either too rare or not easily interpretable from the aerial photography.

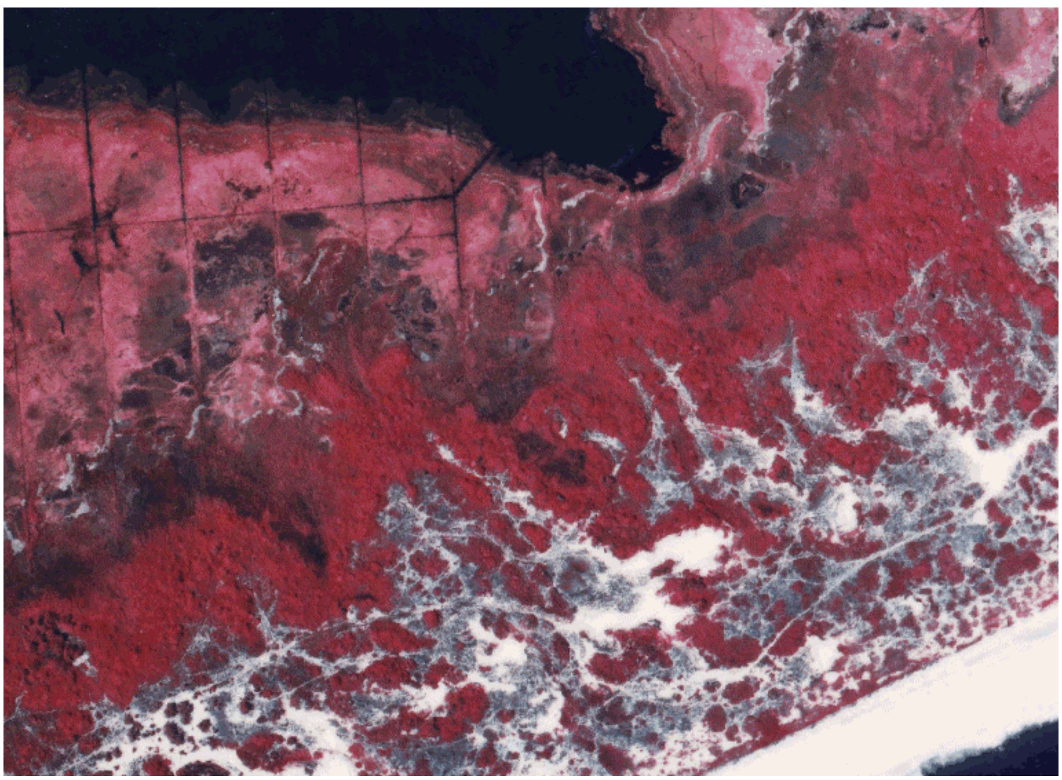

Figure 3a. Color-infrared aerial photo used as ancillary data for FIIS vegetation mapping.

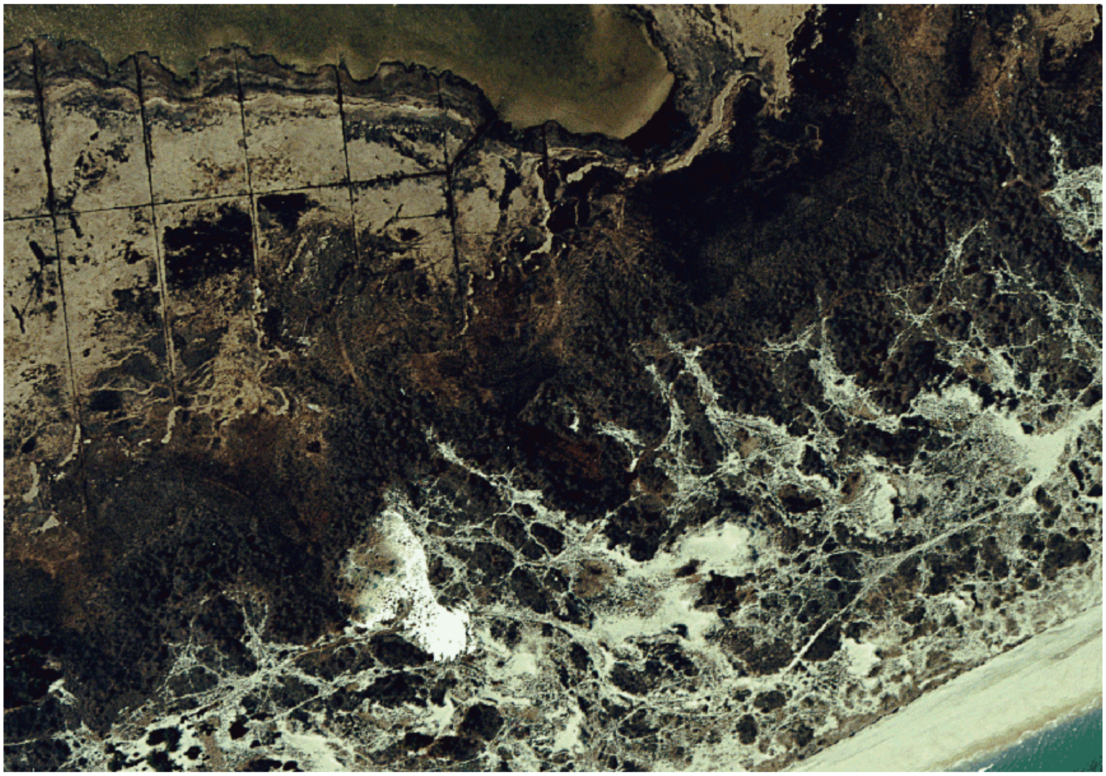

Figure 3b. Example of a true-color aerial photograph used for interpretation and delineation.

3.5 Field Data Collection and Classification

3.5.1 Development of Preliminary Classification

A preliminary classification was provided by NatureServe (Sneddon et al. 1999) for use in the initial delineation phase. This classification was based on previous work on barrier islands (e.g., Assateague Island) and regional expert knowledge. The preliminary classification, along with the target minimum mapping unit, provided photointerpreters with enough base information to begin delineating polygons. Formation level delineation (i.e., distinction between bare, herbaceous, and shrub types) was easily accomplished. These delineations provided an initial estimate of the locations and number of different vegetation polygons that would be encountered on the island. It also provided photointerpreters with an introductory view of which specific areas and types would need more directed ground information during fieldwork.

3.5.2 Initial Field Reconnaissance

In October of 1999, CMI field staff and photointerpreters visited Fire Island to familiarize themselves with the dominant vegetative species on the island. This trip also allowed researchers to identify vegetation characteristics that were readily discernable on the aerial photography.

It is important to note that these field data were used to guide the delineation and interpretation of polygons. Classification of each polygon to a final vegetation classification was not done until the more comprehensive vegetation plot work was completed and the final classification scheme was established.

3.5.3 Development of Field Collection Strategy

The data collected during the initial reconnaissance mission was used to better identify areas and vegetation types that required comprehensive vegetation measurement. By examining the aerial photos and coordinating with the NatureServe and NYNHP ecologists, we could identify where more field data would be needed to complete the vegetation map. The vegetation ecologists could then focus their efforts in the most diverse areas on the island and on the types not readily identifiable from the photography.

Field data collection was completed with two types of plots. The first, which was completed by the NatureServe ecologists, involved detailed data collection on representative plots for each vegetation type encountered (detailed described in section 3.5.4 below). The second type, completed by CMI field staff, involved a more qualitative classification of vegetation types observed on the ground. These vegetation data were collected with field global positioning systems (GPS; Trimble GeoExplorer II and CMT units) units loaded with data dictionaries. With these tools, field researchers could record dominant vegetation characteristics of specific polygons (Figure 4). These attributes included species, height, and estimates of percent cover for a particular polygon. The vegetation communities on Fire Island often occur in discrete polygons recognizable in the field, which made identification on aerial photography relatively easy.

Figure 4. Vegetation information and position were recorded with a GPS unit.

The selection of data collection points in the field followed a plan to maximize the contribution of each point to the knowledge base of the photointerpreter. This was accomplished by allowing the photointerpreters to direct field-sampling efforts towards polygons and areas of Fire Island where vegetation was most needed to complete the vegetation map. Points were selected either by the photointerpreter and visited by the field staff (using the GPS to navigate), or collected by the field staff as polygons were encountered in the field. This strategy was used to gather data for specific polygons for which the photointerpreter required assistance in classification, and allowed the field staff the freedom to recognize a vegetation polygon and gather data opportunistically. This allowed photointerpreters and field staff to focus efforts on types or polygons that were rare on the landscape, or were difficult to interpret from the photographs alone. The result was a large number of classified, georeferenced points with which to attribute the vegetation map.

All GPS points gathered were differentially corrected (when selective availability was still active) and attributed with the standard deviation information supplied by the GPS manufacturer's software (accuracy was typically within 5 m). These locations could be taken and attached to a particular polygon in the GIS. The beginnings of the photointerpretive key were constructed during the initial reconnaissance mission. Several example digital photographs were taken in each type of vegetation class encountered in order to facilitate future interpretation steps.

3.5.4 Field Data Collection

The plot sampling methodology used by the NYNHP on Fire Island follow the methodology developed by The Nature Conservancy and the network of Natural Heritage Programs (Sneddon 1994, Grossman et al. 1998, Edinger et al. 2000). Prior to fieldwork, aerial photos were reviewed and general areas selected for fieldwork to cover the diversity of Fire Island from Democrat Point to Moriches Inlet, and the William Floyd Estate. Survey efforts focused on large natural areas away from development. The Fire Island subset of the National Vegetation Classification was used to hypothesize what associations would be present on Fire Island. In the planning stages of the project, it was estimated that approximately 20 associations would occur within the project area and that NYNHP would do approximately three plots in each association (approximately 60 plots total). With preliminary fieldwork, it became apparent that there were more associations than had been predicted, (mostly attributable to additional unsuspected associations found on the William Floyd Estate). NYNHP ecologists thus shifted focus to doing at least one plot in each of the 33 associations identified and more plots in the vegetation types in need of refinement and in those that occurred most frequently. Whenever possible, multiple plots in a vegetation association were distributed across the area.

During each field day, the ecologists typically focused on one geographic region of the park. Surveys involved determining the vegetation associations present in an area and looking for specific vegetation associations in which plot data were needed. Expected vegetation associations for an area were based on aerial photo review, previous surveys, local experts, and literature. When a vegetation association for which plot data were needed was identified, a plot was placed at a random location within that area using a random number table or a digital watch (Edinger et al. 2000).

Plot size was based on the type of vegetation association; forested associations were sampled with larger plots than were shrub and herb-dominated associations (Edinger et al. 2000, Mueller-Dombois and Ellenberg 1974). Plot data were recorded on the NYNHP Community Form 3. Data collected included plant species composition and structure for all vegetative strata, soil properties (texture, color, pH, soil pore salinity), slope, aspect, hydrologic regime, composition of non-vegetated surface, faunal diversity and composition, and plot representativeness. Detailed information on how these data were collected is found in the NYNHP Community Field Form Instructions (Appendix 7.4). Plots were georeferenced to within 5 m using GPS unit and differentially corrected. A photographic slide of each plot was also taken for reference.

A total of 60 plots were sampled by NYNHP. After fieldwork was completed, the plot forms were cleaned up or recopied and the data were entered into the Plots Database System (The Nature Conservancy 1997). The data entry was error checked before the database was forwarded to NatureServe for analysis.

3.6 Vegetation Map Preparation

3.6.1 Preliminary Photointerpretation

As a result of the previous steps, photointerpreters could begin delineating and attributing polygons on Fire Island and the William Floyd Estate. Some types (e.g., *Ammopholia brevigulata*) were easily identified and attributed. Polygons were interpreted from the true-color photographic set using a stereoscope. Polygon boundaries were delineated from the georeferenced photos on-screen through heads-up digitizing. Photointerpreters targeted non-vegetation polygons such as buildings, docks, boardwalks, mosquito ditches, and bare sand during this phase of the project. Polygons that could not be classified were roughly delineated to their formation or alliance level. These polygons would be further delineated once the final vegetation classification was available. When possible, ancillary attributes of height class (Table 2a), coverage pattern (Table 2b), and density (Table 2c) were also added during this phase of photointerpretation. Examples of coverage and pattern are provided in Appendix 7.15.

Table 2a. Height categories used to attribute vegetation polygons

Height Category	Height Range (m)
1	0 - 0.5
2	0.5 - 1
3	1- 5
4	5 - 15
5	15 - 30

Table 2b. Coverage pattern values used to attribute polygons

Pattern Category	Description
1	Evenly dispersed
2	Clumped/Bunched
3	Gradational/Transitional
4	Alternating

Table 2c. Vegetation density values used to attribute vegetation polygons.

Density Category	Description
1	>60% Vegetation Coverage
2	40%-60% Vegetation Coverage
3	10%-40% Vegetation Coverage
4	<10% Vegetation Coverage

3.6.2 Field Verification

Photointerpreters made a third trip to Fire Island in September of 2000 to evaluate photointerpretation. As in previous trips, field staff collected vegetation information for both polygons that required additional field investigation as well as those polygons that had not been visited previously. By overlaying the points collected on the vegetation map, the photointerpreters could see exactly which polygons had been visited and those that were not. This allowed the photointerpreters to direct field staff to "unknown" polygons on the subsequent day's field trip. In this manner, photointerpreters could review their available information and direct field efforts to the exact locations where information was most needed in near real time. The result was a better distribution of effort across the landscapes that proved the most difficult to attribute from the photography alone. This also allowed us to use our field effort in the most cost-effective manner, as crews did not spend an inordinate amount of time in polygons and vegetation types that already had sufficient information.

3.6.3 Final Photointerpretation

Once the final classification was available, all polygons were assigned a vegetation class. A photo interpreter key was employed for consistency. Polygons were re-delineated and assigned as necessary.

Polygons were also given values for height, density, and distribution pattern. Much of this information came directly from the field data points, as the upper vegetative strata on Fire Island does not often reveal the height of the vegetation due to the extremely variable topography of the dunes.

3.6.4 Data Conversion

Since all the delineation of polygons was performed in ArcView 3.2 (Environmental Systems Research Institute, Redlands California), the resulting data files had to be imported to Arc Info to establish topology. This was done by first importing the shapefile using the SHAPEARC command. The coverage was then cleaned. The tolerance for building the topology was set to a sub-meter value to ensure that thin, linear features (e.g., mosquito ditches) were not lost. Any spatial errors such as overlapping polygons, holes, etc. were corrected during this phase. The result was an ArcInfo (Environmental Systems Research Institute, Redlands California) coverage with polygon topology.

3.7 Accuracy Assessment

An accuracy assessment effort was completed for FIIS in accordance with the NPS vegetation mapping specifications. Some modification was needed to address specific needs of this project. These are explained below.

3.7.1 Data Collection

The accuracy assessment phase was carried out similar to other NPS vegetation mapping projects. We used guidelines from The Nature Conservancy (1994) (Table 3.) to determine the number of accuracy assessment points needed for Fire Island. The target
Table 3. Target number of accuracy assessment points per class as presented by The Nature Conservancy (1994).

Scenario	Description	Polygons in class	Area occupied by class	Recommended number of samples in class
A	Abundant. Many polygons that cover a large area	≥ 30	≥ 50 ha	30
B	Relatively abundant. Class has few polygons that cover a large area	< 30	≥ 50 ha	20
C	Relatively rare. Class has many polygons, but covers a small area. Many polygons are close to the MMU.	> 30	< 50 ha	20
D	Rare. Class has few polygons, which may be widely distributed. Most or all polygons are close to the MMU.	≥ 5, ≤ 30	< 50 ha	5
E	Very rare. Class has too few polygons to permit sampling. Polygons are close to the MMU.	< 5	< 50 ha	Visit all and confirm

number of points was obtained by examining the number of polygons mapped at Fire Island, the area of the polygon itself, an expected 10% loss of points in the field, and the total area of each type mapped on the Island.

Because many of the discernable polygons at Fire Island were below the 0.25 ha MMU, we opted to further divide the assessment into polygons at or above the 0.25 ha MMU and to those below. An additional 10 points were added in polygons below the MMU in an attempt to assess whether the map accuracy was diminished by the presence of these smaller units. The result was a maximum of 43 points for vegetation types falling into Scenario A. This includes 30 points for polygons greater than 0.25 ha, 3 additional points to account for unattainable points in the field, and 10 points in polygons below the MMU. The list of accuracy assessment points by vegetation class is given in Table 4.

Table 4. Target number of accuracy assessment points for each map class. For vegetation codes see Table 6.

VegCode	Area (ha)	Total # Polys	# Polys > 0.25	# polys < 0.25	Total # of AA points	total small poly pts.	Overall
Forests							
6376	26.0	34	26	8	22	8	30
707	2.9	2	2	0	2	0	2
6373	0.3	1	1	0	1	0	1
6375	97.1	95	85	10	33	10	43
6156	5.2	10	7	3	7	3	10
802	76.6	171	82	89	33	10	43
6381	18.4	28	19	9	5	9	14
Woodland							
6117	15.0	53	22	31	22	10	32
Shrubland							
6295	182.2	523	244	279	33	10	43
6145	244.8	412	268	144	33	10	43
3886	3.4	12	6	6	5	6	11
6371	31.7	84	56	28	22	10	32
6063	68.7	229	92	137	33	10	43
Dwarf-Shrubland							
6143	74.5	193	100	93	33	10	43
6141	3.3	21	3	18	3	10	13
6243	38.3	31	21	10	21	10	31
Herbaceous							
6274	245.0	584	279	305	33	10	43
4097	3.9	7	5	2	5	2	7
6342	4.1	12	5	7	5	7	12
6611	0.0						0
6150	5.5	37	7	30	5	10	15
4187	136.8	324	161	163	33	10	43
4192	175.0	463	244	219	33	10	43
6006	169.9	363	238	125	33	10	43
6067	1.6	1	0	1	1	0	1
6107	19.0	25	21	4	20	4	24
Sparse Vegetation							
4400	0.0	0					
Totals	1649.4	3715	1994	1721	476	189	665

Once the target number of points per class was established, we employed the GIS to randomly select the actual accuracy assessment point location. Each individual vegetation class was selected from the map. Then a systematic grid of points spaced 60 m apart was generated for the entire area. Points that intersected the vegetation type were selected and the rest were deleted. These points were subdivided into points that intersected vegetation polygons greater than, or less than, the MMU. For the larger polygon set, all points that were less than 10 m of the delineated polygon edge were removed. The resulting points (if greater that the target number) were randomized and the target number of points was selected. The set of smaller polygon points were randomized and the target number was selected. These points were inspected and moved to the approximate center of their respective polygon to avoid confusion in the field. In either case, if not enough points met the above criterion polygons were randomly selected for visitation and points were added to their approximate geographic center to reach the target number of points.

A total of 665 accuracy assessment points were established, representing 579 polygons. These locations were divided into routes that could be gathered in a single field day (approximately 40 per day) and loaded into field GPS software. This allowed the field crews to navigate to accuracy assessment points with their GPS units.

The accuracy assessment mission was conducted in September of 2001. CMI and NPS staff that were not familiar with the vegetation map and had no previous experience at Fire Island served as assessors. The vegetation key (see Appendix 7.6) was used to classify the vegetation surrounding each assessment team. Assessors were instructed to visually establish the polygon boundary on the ground then assign a vegetation class from the key. In addition, the assessor was asked to provide a categorical confidence value to their assignment of low, medium, or high confidence. The navigator, using the GPS, recorded which class was observed and the confidence category. They also recorded the position of the point, the spatial confidence of the navigator, as well as any other notes the assessor or navigator deemed important. The completed accuracy assessment routes were loaded onto a laptop computer and differentially corrected to ensure spatial accuracy.

3.7.2 Analysis

The accuracy of the mapped classes was assessed with a traditional contingency table. We calculated the producers and consumers accuracy for each class as well as a 90% confidence interval for that estimate. We used a kappa, or k-hat, coefficient to estimate the overall map accuracy. This was performed separately on the accuracy assessment set for polygons at or above the 0.25 ha MMU as well as the set for smaller polygons.

4.0 Results

4.1 Vegetation Classification and Characterization

A detailed description of the vegetation data collection and analysis is given in Appendix 7.9. A summary of the results is provided here.

A total of 5 broadly defined vegetation groups were encountered on Fire Island and the William Floyd Estate. These include salt marshes, dune grasslands, dune shrublands, interdunal swales, and forests / shrublands. These types were further classified into 27 different associations (Table 5.). Six of the associations at Fire Island National Seashore are broadly classified as forest types ("Forest Class" in the National Vegetation Classification hierarchy), one as Woodland, five as Shrubland, two as dwarf-shrubland, twelve as Herbaceous, and one as Sparse Vegetation. These associations are representative of a typical middle and upper Atlantic barrier island system.

4.2 Vegetation Map Production

4.2.1 Map Units

A total of 39 classes of land cover were mapped on Fire Island and the William Floyd Estate (Table 6.). These are comprised of 24 types mapped to NVCS association, 1 complex of 2 NVCS alliances, and 14 non-NVCS classes (Figure 5a-d.). Four associations were identified on Fire Island and the William Floyd Estate but do not appear on the map due to their rarity, small relative size, and/or difficulties in identifying them with aerial photography. These types were Oligohaline Marsh, Brackish Marsh, Salt Panne, and North Atlantic Upper Ocean Beach.

The lee side of the fore dune and the inter-dune area is dominated by *Ammophila brevigulata, Hudsonia tometosa* and *Prunus maritima*. These types were found in patches varying in size and interspersion. Some polygons of *Ammophila* were especially large where it was planted, presumably for beach stabilization. Some stands of planted *Pinus thunbergii* were found at the foot of the fore dune in communities attempting dune stabilization.

As distance from the primary dune increases, so does the dominance of shrubland types. *Prunus maritima* and *Myrica pennsylvanica* were most common, but *Vaccinium corymbosum* and *Vaccinium macrocarpon* were found in wetter, freshwater areas. *Baccharis halimifolia* was found in some wetland areas with higher salinity along with *Phragmites australis.*

Herbaceous wetlands, or swales, were also scattered throughout the inter-dune zone. Like the shrubland types, hydrology and salinity affected these vegetation associations. These wetlands were typically small, although larger wetlands were found in some parts of the island. These swales were usually dominated by *Phragmites australis*, but also included *Scirpus pungens, Eleocharis parvula*, and other wetland plants.

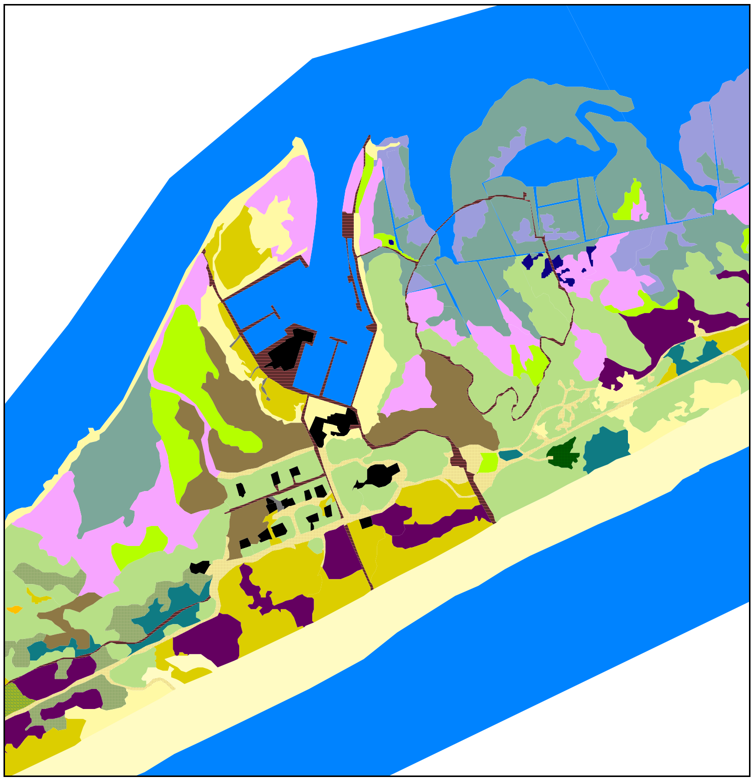

Figure 5a. An example of the vegetation map in the Watch Hill area of Fire Island.

Figure 5b. An example of the vegetation map for the William Floyd Estate.

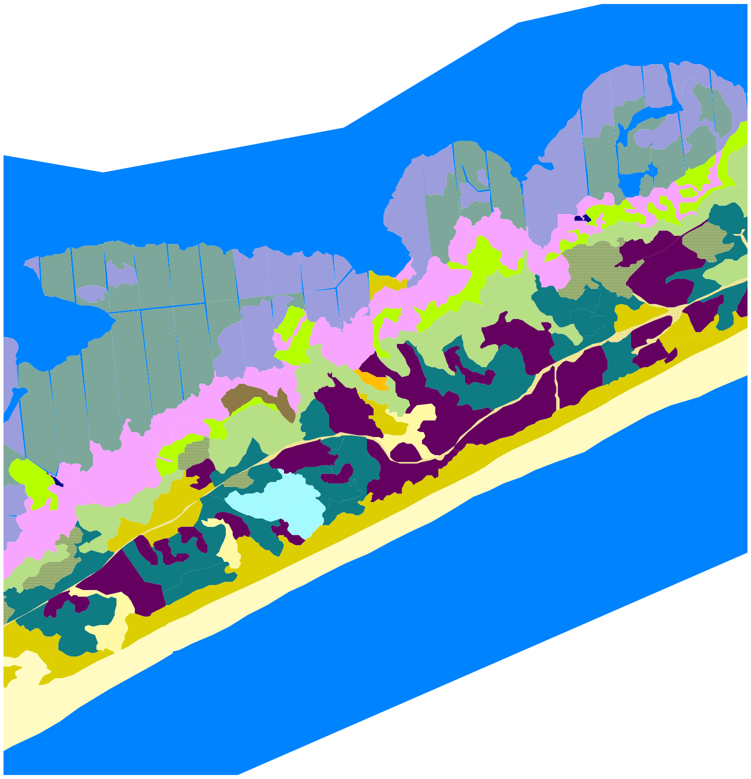

Figure 5c. Example of vegetation map in the Otis. G. Pike Wilderness Area on Fire Island.

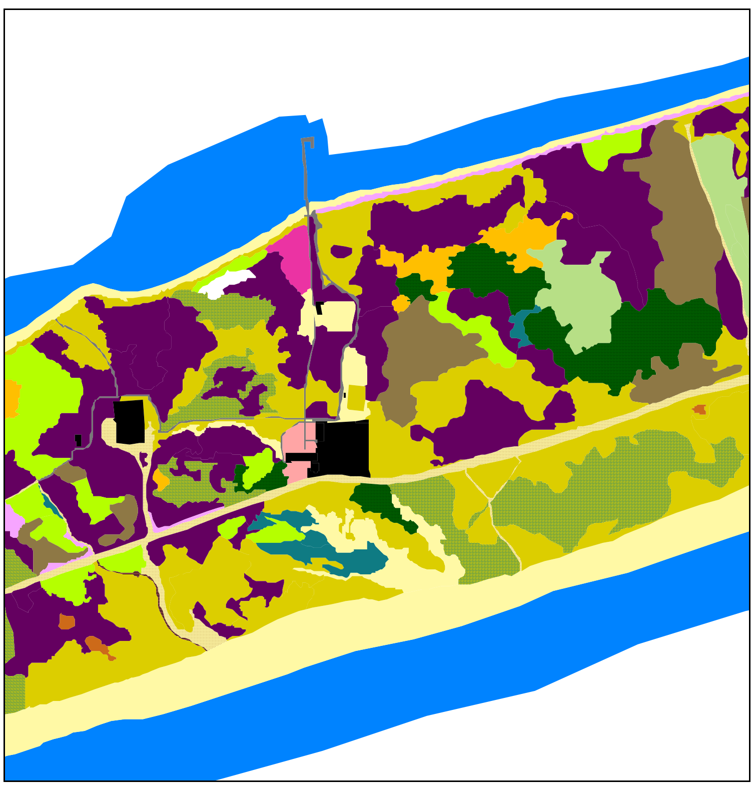

Figure 5d. An example of the vegetation map in the lighthouse area of Fire Island

Table 5. Vegetation associations found on FIIS.

Class Name	**Code**
Forests	
Maritime Holly Forest	CEGL006376
Old Field Red-Cedar Forest	CEGL006024
Maritime Post Oak Forest	CEGL006373
Coastal Oak-Heath Forest	CEGL006375
Acidic Red Maple Basin Swamp Forest	CEGL006156
Japanese Black Pine Forest	CEGL006012
Woodlands	
Pitch Pine Dune Woodland	CEGL006117
Shrublands	
Northern Dune Shrubland	CEGL006295
Maritime Deciduous Scrub Forest	CEGL006145
Maritime Vine Dune	CEGL003886
Highbush Blueberry Shrub Forest	CEGL006371
Northern Salt Shrub	CEGL006063
Dwarf-shrublands	
Beach Heather Dune	CEGL006143
Northern Interdunal Cranberry Swale	CEGL006141
Grasslands	
Northern Beach Grass Dune	CEGL006274
Overwash Dune Grassland	CEGL004097
Brackish Interdunal Swale	CEGL006342
Brackish Meadow	CEGL006150
Reedgrass Marsh	CEGL004187
Low Salt Marsh	CEGL004192
Oligohaline Marsh	CEGL006611
High Salt Marsh	CEGL006006
Brackish Marsh	CEGL004201
Northern Sandplain Grassland	CEGL006067
Salt Panne	CEGL006032
Cultivated Pasture	CEGL006517
Sparse Vegetation	
North Atlantic Upper Ocean Beach	CEGL004400

Table 6. Land cover classes appearing on the FIIS vegetation map.

Vegetation Associations		Other Map Types	
Class	Map Code	Class Name	Map Code
Maritime Holly Forest	6376	Ocean/Bay	40
Old Field Red-Cedar Forest	6024	Inland water	42
Maritime Post Oak Forest	6373	Residence/Building	51
Coastal Oak-Heath Forest	6375	Commercial Property	53
Japanese Black Pine Forest	6012	Open Beach	59
Pitch pine-Oak Forest	6381	Lawn/Cut grass	79
Pitch Pine Dune Woodland	6117	Pavement/ Parking Areas	590
Northern Dune Shrubland	6295	Paved Road	591
Maritime Deciduous Scrub Forest	6145	Boardwalk/Dock	593
Acidic Red Maple Basin Swamp Forest	6156	Sparsely vegetated sand	594
Maritime Vine Dune	3886	Mosquito Ditch	595
Highbush Blueberry Shrub Forest	6371	Rock piles or Jetties	596
Northern Salt Shrub	6063	Sand road/path	597
Beach Heather Dune	6143	Autumn Olive	713
Northern Interdunal Cranberry Swale	6141		
Northern Beach Grass Dune	6274		
Overwash Dune Grassland	4097		
Brackish Interdunal Swale	6342		
Brackish Meadow	6150		
Reedgrass Marsh	4187		
Low Salt Marsh	4192		
High Salt Marsh	6006		
Northern Sandplain Grassland	6067		
Cultivated Pasture	6517		
Interdune Beachgrass-Beach Heather Mosaic	6243		

The herbaceous salt marsh was dominated by *Spartina patens* and *Spartina alterniflora* found in close proximity to one another. Also common were *Distichlis spicata* and *Salicornia* spp. Stands of *Iva frutescens* and *Baccahris halimifolia* could be found as well. *Phragmites australis* was common and appears to be increasing in abundance at the highest areas of the salt marsh.

It was immediately apparent to the photointerpreters and the field crews that many of the distinct vegetation polygons on Fire Island are discernable at units smaller that 0.25 ha. We agreed to map smaller polygons where possible. Not all vegetation types are discernable at this scale, however. That is, small polygons of some vegetation types could not be delineated at this level of detail because of their similarity to surrounding vegetation types, position on the island, etc. We decided to leave the smaller polygons as distinct units on the map, but considered them separately for all accuracy assessment purposes. A separate assessment was provided for small polygons (Appendix 7.14).

4.2.2 Spatial Accuracy

Spatial accuracy was assessed by collecting “map points” on the ground along with vegetation fieldwork. Map points were selected in the field as CMI personnel moved about collecting vegetation information. We attempted to select discrete locations on the ground that were likely to be recognizable in aerial photographs, unlikely to change position between photoacquisition and fieldwork, and could be located again if needed. These included cement or paved road intersections, boardwalks, buildings, parking lot corners, or recognizable natural features (e.g., sand blowouts).

We collected a total 89 map points on Fire Island and the William Floyd Estate. Of these, 21 points were removed because the standard deviation of the differentially corrected location was higher than 10 m. The resulting 68 points were then overlaid onto the vegetation map and georeferenced aerial photography to assess spatial accuracy of the map. Each point was examined, and the difference (in meters) between the GPS location and map location was measured using the measuring tool in Arc View. This value was entered into the appropriate field in the database. If the exact location of the map point could not be determined or discerned from the aerial photograph, the point was eliminated from consideration.

A total of 21 points were removed because they could not be accurately measured. This left 47 points for assessing the spatial accuracy of the vegetation map. The mean error distance was found to be 4.42 m (± 4.94 m). Error distances ranged from 0.00 m – 30.0 m. When the single 30 m error point was removed (assumed to be an outlier), the mean error distance was 3.86 m ((± 3.18 m) with a range of 0.00 m – 14.09 m.

4.2.3 Aerial Photograph Interpretation

Photointerpreters established and followed decision criteria for assigning vegetation classes to delineated polygons. The criteria listed below are based on both visual and ecological characteristics as seen from the photography. More detailed descriptions and examples can be found in the photointerpretation key (Appendix 7.7).

<u>Forests</u>

Maritime Holly Forest Forest (code 6376)
This type is characteristically green on the color photographs (where deciduous species do not have leaves). This type has a definite forest signature, with height apparent in stereoscopic view and large tree-like canopies. It occurs just behind the backdune. Can be distinguished from younger shrublands by visible tree canopies, tall vegetation and dominance of green color signifying the dominant evergreen holly.

Old Field Red-Cedar Forest (code 6024)
This type appeared with a dark green signature and was found on William Floyd Estate. Individual trees are smaller-crowned and scattered in with hardwoods. Distinct shadows are visible through the canopy.

Maritime Post Oak Forest (code 6373)
This type was limited to the edge of waterways on the Floyd Estate. Only one stand was identified through ground survey. This stand appears very similar to the other oak-dominated types found on the property.

Coastal Oak-Heath Forest (code 6375)
This type covers a large portion of the William Floyd Estate. It appears on the photography as a tall, forested area with a tan or brown color stippled with shadows from tree trunks oriented all in the same direction. Individual green *Pinus rigida* is often present but not in high enough proportion to classify as coniferous forest.

Acidic Red Maple Basin Swamp Forest (code 6156)
This forest type is found on both the Floyd Estate and Fire Island. It appears as a light grayish tree canopy over very dark understory (i.e., wet). These types are usually near water or other wetland types.

Pitch pine - Oak Forest (code 6381)
This type is very similar to *Quercus coccinea - Quercus velutina/Sassafras albidum/Vaccinium palladium* Forest in color and texture except that the coniferous *Pinus rigida* is more dominant.

Japanese Black Pine Forest (code 6012)
Pinus thunbergii is found in many isolated patches on Fire Island. It is often used to stabilize the fore dune – especially on the eastern end of the island and around human communities. This type appears very similar to the Pitch Pine Dune Woodland but the density is usually higher and the canopy more continuous.

<u>Woodland</u>

Pitch Pine Dune Woodland (code 6117)
The type is found throughout Fire Island behind the primary dune. Green to dark-green interspersed with brown to tan coloring. Polygons appear splotchy due to varying canopy heights within one polygon (signifying open canopy of *Pinus rigida* with shrubs/herbaceous layer below). Bright patches of sand are often seen within the polygon.

<u>Shrubland</u>

Maritime Vine Dune (code 3886)
This type is difficult to identify from photos as the *Toxidendron radicans* is often found growing over shrubs. It is perhaps best described as what it is not, for it does not appear like *Myrica pennsylvanica* usually found

around it. This type does appear as a brown color highly interspersed with open sand when occurring in larger polygons.
Northern Salt Shrub (code 6063)
This type is often found between the more obvious, taller shrub types on and around the backdune. It is always near wetlands. *Baccharis halimifolia* has a uniform gray color lighter than the surrounding wetter areas and very fine speckling can be seen. Individual plants are impossible to discern.

Maritime Deciduous Scrub Forest (code 6145)
This vegetation type is found on the bay side, often behind a large primary dune on wider parts of the island. It appears as a mix of brown, gray, and green with variable-sized discernable crowns in most cases.

Northern Dune Shrubland (code 6295)
This type is very common and dominates the interdune areas on Fire Island. It varies in height between 0 and 1 meter. It is often interspersed with lighter-colored signatures of *Ammophila brevigulata* and *Hudsonia tomentosa*. This type has a dark brownish-red color and is typically uniform in texture throughout the polygon. Little sand shows through.

Highbush Blueberry Shrub Forest (code 6371)
This is a wet shrub type found on both Fire Island and the William Floyd Estate. It is a brown color finely dissected with dark lines, which is the water showing through the canopy. It is seen in noticeable depressions or swales throughout the interdune area.

<u>Dwarf-shrubland</u>

Northern Interdunal Cranberry Swale (code 6141)
This association is found in the interdune zone as small, pond-like bodies of shallow water. They appear dark, like open water, but do have a partially submerged layer of *Vaccinium macrocarpon.* These small polygons are found mostly in the Otis Pike Wilderness Area of Fire Island.

Beach Heather Dune (code 6143)
This type is widespread on Fire Island and is found from Fire Island Inlet to the Moriches Inlet predominantly, although not exclusively, in the interdune zone. The color is a very dark green with equal amounts of bright sand showing through. It is often intermingled with *Ammophila brevigulata* which has a light tan color. Because of this mixing, this type is also found in complex with the Northern Beach Grass Dune association.

Overwash Dune Grassland (code 4097)
This type is difficult to identify from photography alone, although it occurs on recent overwash areas (breach) near the foredune. These

overwashes may be identified. The vegetation is typically more sparse and therefore "washed out" on the photography.

Reedgrass Marsh (code 4187)
This widespread type is found in and around most wetland areas on both the Floyd Estate and Fire Island. It has variable color and texture on the photographs ranging from a very "soft" light brown/tan to a dark, "dirty"-looking brown at the high ends of the salt marshes. There is often a readily identifiable band of horizontal debris associated with the bay-side of these polygons which can aid in identifying the taller *Phragmites australis* stands.

Low Salt Marsh (code 4192)
One of the two common salt marsh types found on both the William Floyd Estate and Fire Island. This type is associated with more regularly flooded parts of the marsh. The color of this type is usually a medium to dark gray adjacent to water bodies, mosquito ditches, and salt pannes. The *Spartina patens* types are found in close proximity but tend to be lighter in color and more tan.

High Salt Marsh (code 6006)
This association dominates the salt marshes of Fire Island and the Floyd Estate. It is found in close proximity to *Spartina alterniflora* on the less-frequently flooded portions of the salt marsh. This type has a uniform tan color and is often bisected by mosquito ditches (which dry the areas further).

Northern Sandplain Grassland (code 6067)
This type was rare and apparently limited to the wider parts of the Otis Pike Wilderness Area. The codominance of *Myrica pensylvanica* in this type makes it difficult, if not impossible, to separate from the Northern Dune Shrubland type.

Cultivated Pasture (code 6517)
These types are found on the William Floyd Estate where past land use practice has left openings in the forest. These types were seeded and used for managing game for hunting. It is easily classified from the photography as very lawn-like tan and green areas. Individual fields differ in species composition due primarily to management (i.e., mowing, seeding, etc.). Older, less disturbed areas are reverting to Successional Meadow

Brackish Meadow (code 6150)
This type is found uncommonly near the highest portions of the salt marsh on the bay side of Fire Island. It typically occurs in small polygons or in thin bands on the edge of the Northern Salt Shrub type. It has a distinctive

rusty-red color and appears wet (i.e., dark surface water is sometimes visible).

Northern Beach Grass Dune (code 6274)
This type is perhaps the most prevalent on Fire Island. It is found on the ocean side of the interdune area from the crest through the high salt marsh. This association appears as a uniform tan when cover is high, but can have streaks of bright sand showing through. It is often found in small polygons interspersed with the Beach Heather Dune type (where it is classified as a mosaic) and with Northern Dune Shrubland polygons.

Brackish Interdunal Swale (code 6342)
This type is found behind primary and secondary dunes where saline surface water is found. When these wetlands are not dominated by *Phragmites australis* they appear dark and closely match open water. The vegetation is emergent and is difficult to identify specifically from the photography.

By area, the majority of the vegetated portions of Fire Island are comprised of 4 associations (Table 7). These are the Northern Beach Grass Dune, Maritime Deciduous Scrub Forest, Northern Dune Shrubland, Low Salt Marsh. These 4 types cover approximately 51% of the island. Nearly 70% of the vegetated area is accounted for if High Salt Marsh and Reedgrass Marsh are added. At the Floyd Estate, the dominant association is Coastal Oak-Heath Forest covering about 40% of the vegetated area.

The ecological separation of types was, as expected, due mostly to freshwater hydrology and relative position on the island. Distinct zones of Herbaceous, Dwarf-Shrubland, Shrubland, Maritime Forest, and salt marsh were the norm from the ocean northward to the Bay. Within these general zones surface water, salinity, and disturbance accounted for most of the observed differences in vegetation community within these zones.

There were several types found on Fire Island that we were not able to identify from aerial photographs. These types will be represented on the final vegetation maps in one of two ways. The North Atlantic Upper Beach type was impossible to identify with the aerial photography, it was commonly found on shifting dunes and the ocean beach at Fire Island. This type will be represented on the map by a zone delineated from the crest of the primary dune extending 10 m onto the outer beach. Other rarely identified types such as Salt Panne, Oligohaline Marsh, and Brackish Tidal Marsh are identified as point locations. These points are included so NPS personnel can locate examples of these types.

Approximately 20% of the island is part of a residential community or built-up areas. The homes are often built in and around the vegetation. Some of the communities have wetlands or other naturally vegetated areas. Most of these areas were not visited on the ground due to public relations and private property issues, but we did attempt to classify vegetated polygons within residential communities as best we could from the aerial

Table 7. Percent composition of vegetated areas on FIIS

Vegetation Type	Area (ha)	% of Total	Cummulative % of Total
Northern Beach Grass Dune	245.0	14.9%	14.9%
Maritime Deciduous Scrub Forest	244.8	14.8%	29.7%
Northern Dune Shrubland	182.2	11.0%	40.7%
Low Salt Marsh	175.0	10.6%	51.3%
High Salt Marsh	169.9	10.3%	61.6%
Reedgrass Marsh	136.8	8.3%	69.9%
Coastal Oak-Heath Forest	97.1	5.9%	75.8%
Japanese Black Pine Forest	76.6	4.6%	80.5%
Beach Heather Dune	74.5	4.5%	85.0%
Northern Salt Shrub	68.7	4.2%	89.2%
Interdune mosaic	38.3	2.3%	91.5%
Highbush Blueberry Shrub Forest	31.9	1.9%	93.4%
Maritime Holly Forest Forest	26.0	1.6%	95.0%
Cultivated Field	19.0	1.2%	96.1%
Pitch pine - Oak Forest	18.4	1.1%	97.2%
Pitch Pine Dune Woodland	15.0	0.9%	98.2%
Brackish Meadow	5.5	0.3%	98.5%
Acidic Red Maple Basin Swamp Forest	5.2	0.3%	98.8%
Brackish Interdunal Swale	4.1	0.2%	99.1%
Overwash Dune Grassland	3.9	0.2%	99.3%
Maritime Vine Dune	3.4	0.2%	99.5%
Northern Interdunal Cranberry Swale	3.3	0.2%	99.7%
Old Field Red-Cedar Forest	2.9	0.2%	99.9%
Northern Sandplain Grassland	1.6	0.1%	100.0%
Maritime Post Oak Forest	0.3	0.0%	100.0%

photographs. These residential communities cut across the island and can encompass all the associations along the North-South gradient described above.

The vegetation on the upland areas of the Floyd Estate differs from that of Fire Island in most cases. The property is predominantly forested with *Quercus velutina*, *Quercus coccinea*, *Carya* spp.and *Pinus rigida*. There are some forests of *Juniperus virginiana*, *Quercus stellata*, *Acer rubrum*, and *Amelanchior canadensis* but these types collectively make up less than 10% of the area. There are several fields on the Estate that have historically been seeded with a mix of native and non-native grasses. Some of these fields are succeeding with *Robinia pseudoacacia* and other hardwoods emerging. The salt marsh on the Floyd Estate is similar to those found on Fire Island with the majority of the area in either *Spartina patens* or *Spartina alterniflora*. The mosquito ditches on the Floyd Estate have been plugged recently, so changes in the plant communities on these marshes can be expected.

4.3 Accuracy Assessment

A total of 495 points were collected to assess the thematic accuracy of the vegetation map. These points were collected in September of 2001. The data and location of each point was collected with a GPS unit. All data was post-processed and overlaid on the vegetation map. Each point was attributed with the type of vegetation polygon it intersected. These points were then exported from the GIS to a spreadsheet for analysis.

Initial analysis showed a relatively low overall accuracy of 57.6%. Further examination revealed some fairly serious discrepancies between vegetation types classified in the field and those depicted on the map. When specific point locations were examined, we noted a high incidence of field assessors describing what appeared to be smaller, non-target polygons existing within larger mapped polygons. Often field notes indicated that the assessor has some question as to which polygon he or she were supposed to be describing, and also described larger polygons at the same location.

We decided to review each of the points individually. We were looking for points where the assessor felt they either couldn't adequately identify which polygon they were supposed to be describing, where the navigator was unsure about the actual point they were navigating to, or some problem with using the field key (see Appendix 7.12 for a detailed procedure). We also used the standard deviation of the GPS position to determine if discrepancies could be due to positional error. Each point was assigned a code to denote what decision was made regarding its subsequent use on the accuracy assessment (see Table 8). Points with problems in either classification or position were removed.

Table 8. Codes used to attribute points after post-field correction.

Code	Value
1	No corrections/modifications
2	Spatial Modifications
3	Thematic modification
4	Spatial and Thematic Change
5	Point removed

After review, 428 points were available for use in the accuracy assessment. Of these 329 were located in polygons larger than 0.25 ha and 99 were found in smaller polygons. These points were attributed with the vegetation code of the polygon it intersected. Because many of the associations contain similar suites of characteristic species, we decided to employ a fuzzy accuracy assessment. This will allow future users to evaluate errors in the map on an application-by-application basis.

We used a fuzzy set matrix to evaluate the severity of error between each class and every other class (Table 9). The fuzzy value was assigned based on the similarity between types observed on Fire Island (Appendix 7.13 contains detailed class-by-class justification for assignment of fuzzy levels). This similarity is evaluated from a user standpoint and will not include confusion issues pertaining to vegetation interpretation or delineation. Each interaction is assigned a fuzzy level of accuracy as follows:

Table 9. Definitions of fuzzy set classifications.

Level	Description
5	**Exact match**; The associations are exactly the same.
4	**Acceptable Error** - mapped type has minor differences with type observed in the field; often species dominance or composition is very similar.
3	**Understandable Error** - mapped class does not match field point; types have structural or ecological similarity, or have similar species associates.
2	**Vague Similarity** - types seen in the field and on map match in Formation and structure, but species or ecological conditions are not similar.
1	**Complete Error** – the types have no conditions or structural similarity.

Once the fuzzy matrix was complete, we completed a contingency table. We present accuracy estimates for levels 5, 4 and 3 in the classification. The level 5 contains only those points where the observed type matched the mapped type exactly. The level 4 assessment considers both level 5 and 4 as being correct. The level 3 assessment similarly considers levels 5,4, and 3. We report the overall accuracy and Kappa statistic for each level of the analysis as well as the accuracy for all classes with 90% confidence intervals.

The overall accuracy (and Kappa index) for the map at level 5 was 66.3% (64%). The level 4 and 3 accuracy was 78.1% (77%) and 87.5% (87%) respectively. The contingency table provides all by-class values (Apendix 7.14.1). A detailed evaluation of each mapped class at Level 4 is given in Table 10.

Table 10. Class-by-class evaluation of mapping accuracy at fuzzy Level 4.

Class	Producer's Accuracy	User's Accuracy	Explanation
Maritime Holly Forest	88.9%	85.7%	This type was very similar to Maritime Deciduous Scrub Forest and was considered the same at Level 4.
Old Field Red-Cedar Forest	100%	100%	The type was easily identified and limited to two large stands on the Floyd Estate.
Maritime Post Oak Forest	0%	0%	Only one stand was identified as this type. That stand was classified as Coastal Oak-Heath Forest during accuracy assessment.
Coastal Oak-Heath Forest	100%	88.9%	This type was most often confused with Pitch pine - Oak Forest which differs only in amount of *Pinus rigida* in the canopy.
Japanese Black Pine Forest	75%	78.6%	This type was most often confused with Pitch Pine Dune Woodland. The two types were considered the same at Level 4.

Pitch Pine – Oak Forest	100%	85.7%	The photointerpreters felt that some polygons on the Floyd Estate were more appropriately assigned to this class rather than the Coastal Oak-Heath Forest. This type was very similar to the Coastal Oak –Heath type and was considered to be the same thing at Level 4. This type may actually be a product of a more oak dominated canopy with dense *Smilax* spp. beneath.
Pitch Pine Dune Woodland	81.3%	83.3%	This type was often found in small, linear, polygons, which may account for confusion with non-coniferous associations. Considered the same as Japanese Black Pine Forest for Level 4.
Northern Dune Shrubland	57.1%	76.9%	There is no clear pattern of confusion beyond other shrubs, although some confusion (with herbaceous types) is due to complex polygon interspersion and small polygons.
Maritime Deciduous Scrub Forest	68.0%	64.7%	Nearly all of the confusion with this type occurs with other shrub associations such as Highbush Blueberry Shrub Forest. This type was considered the same as Maritime Holly Forest at Level 4.
Maritime Vine Dune	25.0%	25.0%	This type is difficult to identify both from photography and in the field. It is closely associated with Northern Dune Shrubland and is often confused with it. It is also a rare type on Fire Island.
Highbush Blueberry Shrub Forest	50.0%	20.0%	This type is frequently confused with the other, more common wetland shrub types Maritime Deciduous Scrub Forest and Northern Salt Shrub.
Northern Salt Shrub	60.0%	57.9%	This type is frequently confused with other wetland types such as Highbush Blueberry Shrub Forest. *Phragmites australis* is found frequently within these stands as well.
Beach Heather Dune	81.5%	86.4%	This type exists both as an association and with Northern Beach Grass Dune in mosaic. Errors are thought to occur in smaller polygons juxtaposed with Northern Beach Grass Dune and Northern Dune Shrubland.
Northern Interdunal Cranberry Swale	100%	40%	No single polygon of this association exists at the 0.25 MMU. These accuracy estimates are from small polygons. This type may be over-predicted on the landscape because it is easily confused with small herbaceous wetlands that are also filled with water at the time of photo acquisition.
Northern Beach Grass Dune	87.5%	76.9%	This is the most prevalent association on Fire Island. It is part of a mosaic with Beach Heather Dune and most observed confusion is likely due to smaller polygons interspersed with that and Northern Dune Shrubland.

Overwash Dune Grassland	0%	0%	This type was very limited in distribution on Fire Island. Although several polygons were labeled as this type, none were identified as such in the field. This type is easily confused with Beach Heather Dune or Northern Beach Grass Dune which further confounds mapping efforts.
Brackish Interdunal Swale	66.7%	50.0%	This wetland type was often delineated with adjacent Reedgrass Marsh. It is also a rare type on Fire Island existing in polygons at or below the 0.25 ha MMU
Brackish Meadow	100%	20.0%	Although this type occurs all over Fire Island, it is found in narrow bands or small polygons often associated with Reedgrass Marsh. Only 1 field assessment point was located within this type.
Reedgrass Marsh	58.8%	64.7%	Low accuracy is likely due to small sample size in the accuracy assessment set. This type was almost exclusively confused with other wetland types. Variable coverage density of *Phragmites australis* in other types may lead to confusion.
Low Salt Marsh	97.3%	100%	This type was most often confused with High Salt Marsh. Photointerpretation was mostly determined by presence of water in the photographs which is highly variable (tides, season). This type was considered the same as High Salt Marsh for Level 4.
High Salt Marsh	81.3%	100%	This type is found in close proximity and intermingled with the Low Salt Marsh type. These two were considered the same for the Level 4 assessment.
Northern Sandplain Grassland	0%	0%	This type was only mapped in a single small polygon and was identified elsewhere during accuracy assessment. It is a very rare type and likely exists in very few small patches. Further confounding this type is its similarity to Northern Dune Shrubland.
Cultivated Pasture	100%	100%	This type is easily identified on the Floyd Estate.
Interdune Beachgrass-Beach Heather Mosaic	100%	89.5%	This mosaic was considered correct if identified as either Northern Beach Grass Dune or Beach Heather Dune. There is likely much more of this type on Fire Island, but the sub-0.25 ha polygons make its appearance in the map more rare.

5.0 Discussion

The barrier island ecosystem is dynamic. Changes in dune topography, water availability, and salinity drive the community structure of the island. Periodic disturbances further change the vegetation communities. This dynamism, so integral to the function of the barrier island ecosystem, is often at odds with social and economic goals of the surrounding human communities. All of these factors contribute to the diversity and complexity of the vegetation found on Fire Island.

The Fire Island Vegetation Mapping project represents a diligent effort to identify and map specific types of vegetation on Fire Island and the William Floyd Estate. Although vegetation cannot be completely categorized and classified on a map, we feel that the combination of fieldwork, discussion, and analyses for this study results in a product useful for the administrators at Fire Island.

Photointerpretation and fieldwork were used in concert for this project. Although there are inherent difficulties in combining these techniques for vegetation survey they can be used to produce a viable, useful product. A considerable amount of time was spent on the ground at Fire Island by both the photointerpreters and the vegetation surveyors. Field work can be an arduous and expensive task, but the experience and knowledge it provides is invaluable. Field operations on Fire Island allowed us to visit approximately 25% of the over 4,000 delineated vegetation polygons.

5.1 Vegetation Classification and Characterization

The vegetation of Fire Island is not much different than types observed in similar NPS areas (e.g., Asseteague Island). There are some unique situations on Fire Island not seen elsewhere. The presence of a large human population, especially on the western half of the island, has drastically changed the vegetative landscape. In addition, the impacts of a large population of white-tailed deer also effect vegetation and consequently the classification of that vegetation.

The vegetation types found in and around the residential communities on Fire Island are of interest to the NPS staff. We made every effort to examine the types found in these areas, paying special attention to larger polygons within residential community boundaries. This task proved very difficult. Vegetated polygons were often very sparse or thin within these areas. Access to these areas was also difficult, and care was taken to minimize negative public contact during this project. Further confounding classification of these polygons was the presence of exotic plantings, massive deer browse, and human disturbance on these areas. Overall, the vegetation found in the residential communities of Fire Island is similar to those found in uninhabited areas. Many of the residential communities exist on the widest parts of the island, and are therefore found in areas that would otherwise be tall shrubland or maritime forest. It is likely that the presence of human development has adversely affected natural communities, and in some cases eliminated them.

Phragmites australis has a constant presence in wet areas of Fire Island and the William Floyd Estate. Historical data was not used on this project so we were unable to quantify how rapidly *Phragmites australis* establishes itself or how quickly it displaces the existing vegetation. Discussions with NPS staff and others indicate that this plant is becoming more prevalent on Fire Island. It causes confusion in both field classification and photointerpretation efforts. If *Phragmites australis* establishes itself in short periods of time then it is possible that types have changed (or at least *Phragmites australis* has become more evident) in the years since the photography used in this project was taken. This could be contributing to errors reported here.

5.2 Vegetation Map Production

It was apparent early in the project that a minimum mapping unit of 0.25 hectares was insufficient to adequately capture the structural and vegetative diversity of the island. Attempts were made to delineate smaller discrete polygons. This endeavor was successful in that a more useful map was created. This was, apparently, at the expense of class accuracy. Also we should keep in mind that smaller polygons could not be delineated for all associations on Fire Island. The ease of delineation was not similar across types and therefore smaller polygons are often limited to the high-contrast areas on the ocean side of the island.

The final vegetation classification includes several types that were not delineated on the vegetation map. Many of these types are extremely rare on Fire Island (or the Floyd Estate) or are indistinguishable from the more prevalent associations on the island. It is difficult to resolve which approach is best for dealing with these associations. They are of obvious interest because they are rare, and their presence on Fire Island is of integral importance. These associations may not be adequately assessed through photointerpretation.

The photographs used for the vegetation delineation were taken in March, a period where surface water is present in swales and marshes on Fire Island. These water bodies were easily identifiable from the photographs and this aided interpreters in classifying smaller wetland associations such as the Cranberry Swale types. This may also have confounded some types, like those observed with the Low and High Salt Marsh associations.

For this project, we used digital versions of the aerial photography to delineate polygons. This method proved useful at Fire Island because we had an accurate reference data layer available in the USGS digital orthophotoquad set and Fire Island has minimal vertical complexity. That is, there are no large changes in elevation on Fire Island that made orthorectification of the digital photography challenging. Care should be taken if this technique is employed elsewhere, as topography can greatly affect its utility. Recently software has been made available that can efficiently and inexpensively orthorectify photography, making this technique more applicable to other NPS mapping projects.

5.3 Recommendations for Future Projects

This project has identified several potential points for improvement or additional study. As a result of our work at Fire Island, we recommend the following for future projects:

1. The MMU of 0.25 ha may be too large to accurately capture the true shape and position of associations on the barrier island landscape. Contractors should work closely with Park personnel to identify potential uses for the map product and build a map at an appropriate scale to meet these needs.

2. Geospatial accuracy is of the utmost importance when creating a vegetation map such as this. Every effort must be made to eliminate potential sources of error. The inevitable changes in the spatial arrangement of polygons in a dynamic system like a barrier island further compound spatial accuracy, especially at increasing scales.

3. The most effective, useful, and accurate vegetation map for Fire Island will likely come from a concerted effort employing both detailed field and remotely-sensed based mapping. Allocation of field time to areas with high interspersion of associations will improve accuracy, identify rare types, and provide sufficient information to proceed with photointerpretation over the remaining portions of the island.

4. Mapping vegetation in the residential communities was difficult. More field time spent in these areas will improve classification of polygons found there and likely identify rare types not located on other parts of Fire Island.

Like all vegetation mapping endeavors, much benefit can be gained from a first edition followed by an investigation building on what is now known.

The base information for this project was more than adequate for the task of mapping vegetation on a barrier island. Having both a true-color and color-infrared dataset was helpful. Perhaps other remotely sensed data such as LIDAR or radar imaging would be useful in targeting the types that were easily confused or were rare on the landscape. Over 90% of Fire Island and the William Floyd Estate were covered with relatively few types. This division makes delineation of rare types more easily accomplished with different datasets, or a more sophisticated sampling approach which eliminates “known” areas and allows remaining resources to be directed where they are most needed in “unknown” areas and associations.

Much interest from park personnel and affiliated researchers was expressed in using the products of this study for habitat mapping. We must be careful to remind potential users of these data that, although this is a very good resource for habitat mapping, it was not designed and carried out as such. Many integral components of habitat such as vertical structure and diversity, juxtaposition, and landscape ecology are not explicitly included here. We must also keep in mind that these vegetation maps cannot and should not be considered a comprehensive plant survey or inventory. Further study can be designed around the datasets presented here.

The barrier island is constantly changing. Dynamism is the foundation on which these species and communities are built. Updates to this product should be completed on a regular basis to ensure these changes are included. These updates would likely not require the same amount of effort and expense as this one. Updates could be carried out for sub-regions of the FIIS over several years or where known changes have occurred.

6.0 Bibliography

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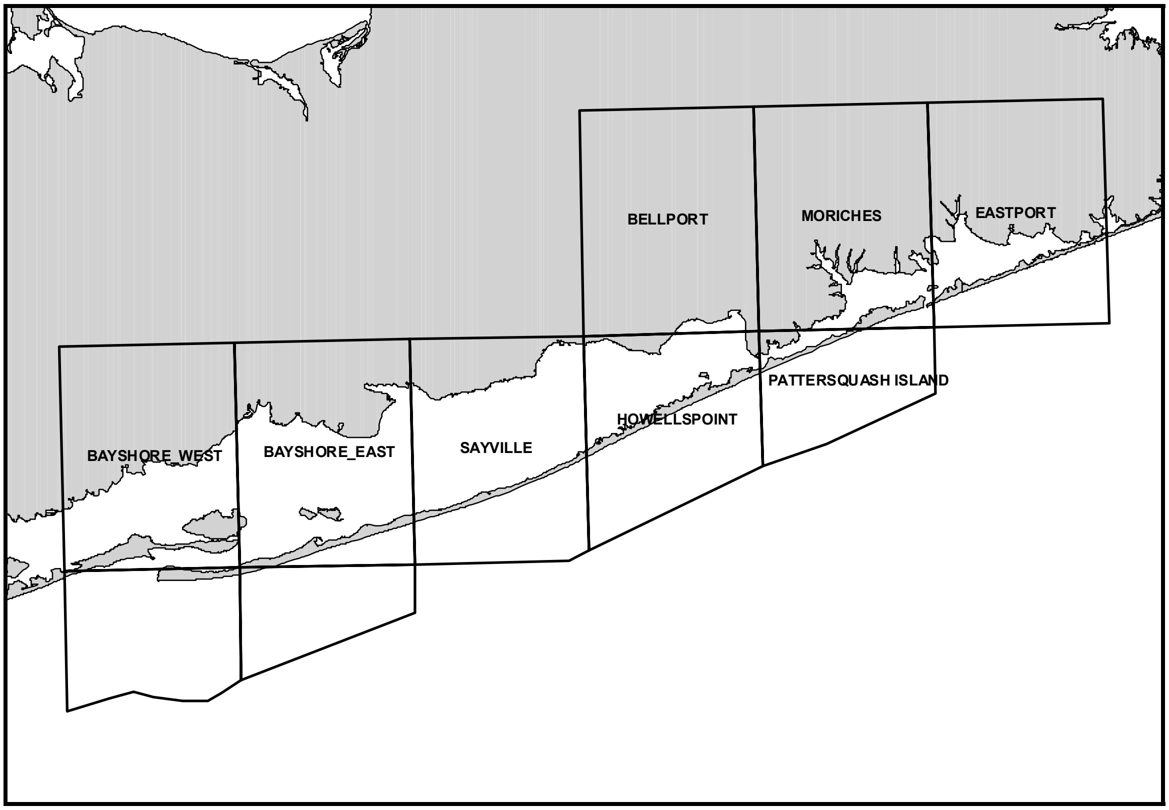
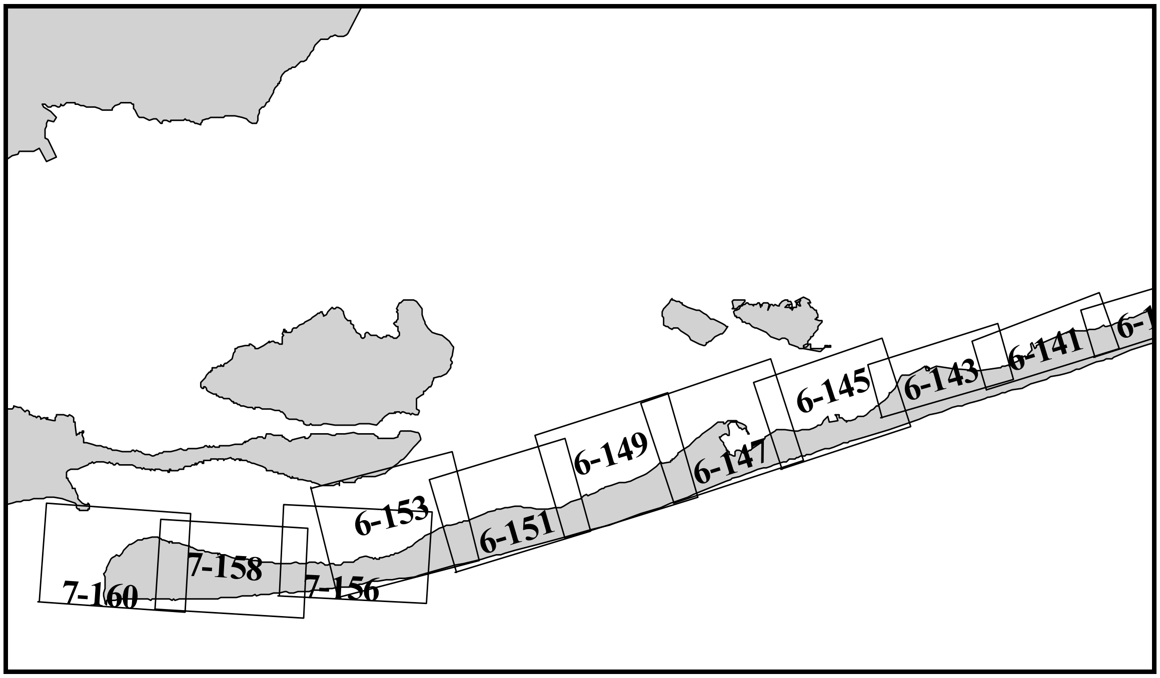
7.0 Appendicies

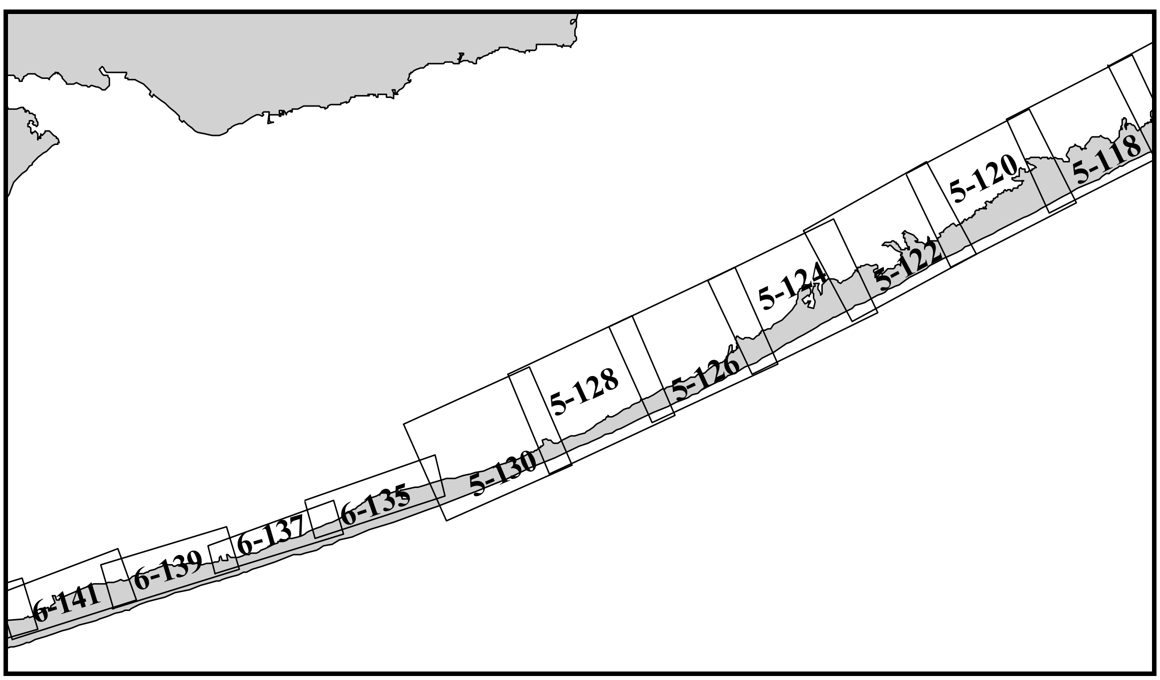
7.1 Index of USGS 7.5-minute Topographic Quad Maps for Fire Island National Seashore



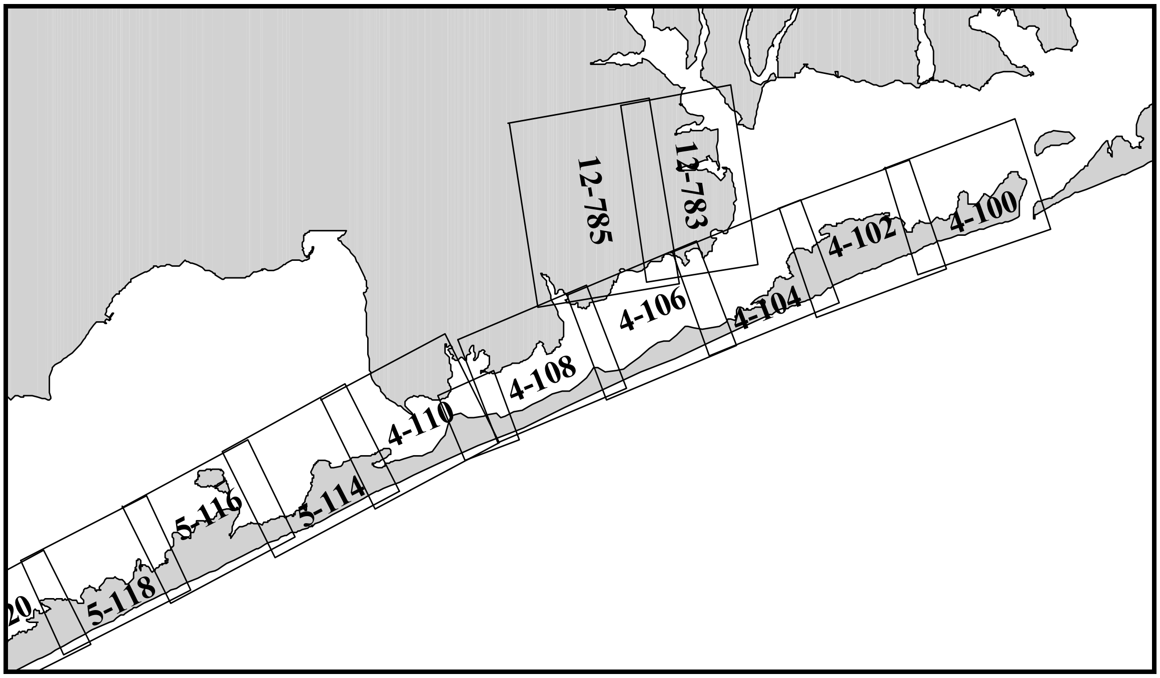
7.2 Index to Aerial Photos Used for Vegetation Mapping Fire Island National Seashore



- Photo reference numbers from Fire Island Inlet to Point O'Woods.



- Photo reference numbers from Point O' Woods to Barrett Beach



- Photo reference numbers from Barrett Beach to Moriches Inlet (including the William Floyd Estate)

7.3 Database Structure Used for Collecting Field Vegetation Mapping Information on GPS Units

In order to collect field information more efficiently and quickly, CMI field staff employed data dictionaries in the field. Data dictionaries allowed quick access and data entry along with a georeferenced location of the point being described. This proved useful in determining which association was involved and in attributing polygon height.

The basic structure of the field database was as follows:

1. Vegetation Points (used for mapping vegetation)
    a. Observer (records observer name)
    b. Site ID (number assigned in the field to denote plot)
    c. Veg. Species 1 (identified a dominant plant species for classification)
    d. Veg. Species 1 % (categorical value for the percent dominance of species 1 in the polygon by total coverage; see below for categories)
    e. Veg. Species 1 Height (categorical value for height; see below for categories)
    f. Veg. Species 2 (identified a dominant plant species for classification)
    g. Veg. Species 2 % (categorical value for the percent dominance of species 1 in the polygon by total coverage; see below for categories)
    h. Veg. Species 2 Height (categorical value for height; see below for categories)
    i. Veg. Species 3 (identified a dominant plant species for classification)
    j. Veg. Species 3 % (categorical value for the percent dominance of species 1 in the polygon by total coverage; see below for categories)
    k. Veg. Species 3 Height (categorical value for height; see below for categories)
    l. Veg. Species 4 (identified a dominant plant species for classification)
    m. Veg. Species 4 % (categorical value for the percent dominance of species 1 in the polygon by total coverage; see below for categories)
    n. Veg. Species 4 Height (categorical value for height; see below for categories)
    o. Date (automatically generated by the GPS)
    p. Time (automatically generated by the GPS)
    q. Notes (text field for entering additional information deemed useful to the photointerpreter)
    r. General Description (overall description of the polygon; e.g. wetland)
    s. Other Species (additional species present but not listed as dominant)
    t. Shrub Layer (species present in shrub layer if applicable)
    u. Herbaceous Layer (species in herbaceous layer if applicable)
    v. Notes (additional space for more comments)
    w. Photo ID (ID number assigned to match file name of digital photo if taken)

2. Map Points (used for mapping features)
    a. Observer (records observer name)

   b. Site ID (number assigned in the field to denote plot)
   c. Description (text description of feature being mapped)
   d. Date (automatically generated by the GPS)
   e. Time (automatically generated by the GPS)
   f. Notes (additional space for more comments)
   g. Photo ID (ID number assigned to match file name of digital photo if taken)

3. Photo Points (used to record the locations of photos)
   a. Observer (records observer name)
   b. Photo ID (ID number assigned to match file name of digital photo if taken)
   c. Description (text description of feature being mapped)
   d. Date (automatically generated by the GPS)
   e. Time (automatically generated by the GPS)

Some variables were entered as categorical values. This allowed a more rapid way to enter data and also reduces the effects of error in estimation.

Height Categories	Height
1	0-0.5 m
2	0.5-1m
3	1-5 m
4	5-15 m
5	15-30
6	30+

Percent Cover Categories	Percent Cover
1	1-10%
2	10-20%
3	20-30%
4	30-40%
5	40-50%
6	50-60%
7	60-70%
8	70-80%
9	80-90%
10	90-100%

7.4 Plot Survey Form

COMMUNITY FORM 3: QUANTITATIVE COMMUNITY CHARACTERIZATION revised May 10, 2001

NY Natural Heritage Program
Reviewed by NY Natural Heritage Program: Date:____________ Initials: ____________

A. IDENTIFIERS / LOCATION (GENERAL EOR INFORMATION)

1. Survey site name:____________________
2. Quad code(s):____________________
3. Quad name(s): ____________________
4. County name(s):____________________5. Town:____________________
6. Directions to this transect:____________________
____
____
7. Sourcecode:____________________ **8. Survey date:**____________________ -
-

B. ENVIRONMENTAL DESCRIPTION

11. **Community name** ____________________
12. National Association____________________

13. Transect/observation point #

14. Image annotation #

15. Elevation:

16. Topographic position:
___Interfluve
___High slope
___High level
___Midslope
___Backslope
___Step in slope
___Lowslope
___Toeslope
___Low level
___Channel wall
___Channel bed
___Basin floor
___Other:

17. Topographic sketch (show where plot is located within surrounding topography):

18. Slope degrees:__________

19. Slope aspect:__________

20. Parent material/bedrock:

21. Soil profile description: note depth, texture, and color of each horizon. Note significant changes such as depth to mottling, depth to water table, root penetration depth
22. Organic horizon depth:__________
23. Organic horizon type: Mor:__ Mull:___
24. Average pH of mineral soil:__________

25. Soil moisture regime:
___Extremely dry
___Dry
___Somewhat moist
___Somewhat wet
___Permanently inundated
___Periodically inundated
___Very dry
___Well drained
___Moist
___Wet
___Very wet
Soil pore salinity______________ppt. (optional)

26.Soil drainage:
___Rapidly drained
___Well drained
___Moderately well drained
___Somewhat poorly drained
___Poorly drained
___Very poorly drained

27. Hydrologic Regime of plot (adapted from Cowardin 1979):
___Semipermanently flooded
___Seasonally flooded
___Saturated
___Temporarily flooded
___Never Inundated
___Intermittently flooded
___Permanently flooded
___Tidally flooded
___Unknown

Optional fields below
pH of water__________
Flood depth__________
Tidal range__________

28. Stoniness:
__Stone free <0.1%
__Moderately stony 0.1-1%
__Stony 3-15%
__Very stony 15-50%
__Exceedingly stony 50-90%
__Stone piles >90%

29. Average mineral soil texture (Brewer 1982):
___ sand
___ loam
___ silt loam
___ clay loam
___ silt
___ clay
___ loamy sand
___ sandy loam
___ sandy clay loam
___ silty clay loam
___ sandy clay
___ silty clay

30. Average organic soil texture:
___muck
___peat

Von Post scale of peat decomposition:_________
pH of peat:

31.Unvegetated surface (total):__________%
___% Bedrock
___% Large rocks (>10cm)
___% Small rocks (0.2-10cm)
___% Sand (0.1-2mm)
___% Bare soil
___% Litter, duff
___% Wood >1cm
___% Water
___% Other:

32. Environmental Comments: Note homogeneity of vegetation, evidence of erosion/sedimentation, further observations of inundation, etc.____________________
____

33. Plot representativeness:____________________
____

C. VEGETATION

Community name:______________________________________

34. System:____Terrestrial ___Palustrine ____Estuarine 35. Plot number:____________ 36. Plot dimensions:______________

37. Leaf type:
(of dominant stratum)
___Broad-leaf
___Semi-broad-leaf
___Mixed broad-needle leaf
___Semi-needle-leaf
___Needle-leaf
___Graminoid
___Broad-leaf herbaceous
___Pteridophyte
___Non-vascular

38. Leaf phenology:
(of dominant stratum)
___Deciduous
___Semi-deciduous
___Mixed deciduous-evergreen
___Semi-evergreen
___Evergreen
___Perennial
___Annual

39. Physiognomic type:
___Forest
___Woodland
___Sparse woodland
___Shrubland
___Sparse shrubland
___Dwarf shrubland
___Sparse dwarf shrubland
___Herbaceous
___Sparsely vegetated
___Non-vegetated

40. Strata/life forms	%cover	height
T1 Emergent tree (>5m)		
T2 Tree canopy (>5m)		
T3 Tree sub-canopy (>5m)		
S1 Tall shrub (2m - 5m)		
S2 Short shrub (< 2m)		
V Vine/liana		
H Herbaceous		
N Non-vascular		
E Epiphyte		
A1 Emergent aquatic		
A2 Floating-leaved aquatic		
A3 Submerged aquatic		

41. Species/percent cover: starting with the uppermost stratum, list all species and % cover for each in the stratum. For forests and woodlands, list the DBH of all trees over 10 cm diameter on a separate line below each tree species. Separate the measurements with a comma and note whether in cm or inches. Estimate number of fauna.

7.5 Database Structure Used for Accuracy Assessment on GPS Units

Accuracy assessment point collection was conducted similarly to the field data collection with a GPS unit. Along with a field key, interpreters entered their information into a database stored on the GPS unit along with their location.

The database was structured as follows:

1. Accuracy Assessment Point
    a. Observer (denoted the identity of the field assessor)
    b. Vegetation Type (a list of possible vegetation types from the field key)
    c. Classification Confidence (assessor assigns high, medium, or low depending on their confidence in the choice for association type).
    d. Spatial Confidence (navigator assigns high, medium, or low confidence in the spatial quality of the location; i.e., whether or not the polygon being described is in fact the target polygon)
    e. Photo/Video ID (filenae corresponding to digital photo or video taken if applicable)
    f. Notes (assessor includes observations affecting association assignment, or other useful information)

Table of Names and Codes

Common Name	Scientific Name	NVC Code
Acidic Red Maple Basin Swamp	**Acer rubrum - Nyssa sylvatica / Rhododendron viscosum - Clethra alnifolia Forest**	**CEGL006156**
Beach Heather Dune	**Hudsonia tomentosa - Arctostaphylos uva-ursi Dwarf-shrubland**	**CEGL006143**
Black Pine Forest	**Pinus thunbergii Forest**	**CEGL006012**
Brackish Interdunal Swale	**Spartina patens - Eleocharis parvula Herbaceous Vegetation**	**CEGL006342**
Brackish Marsh	**Typha angustifolia – Hibiscus moscheutos Herbaceous Vegetation**	**CEGL004201**
Brackish Meadow	**Panicum virgatum - Carex silicea Herbaceous Vegetation**	**CEGL006150**
Coastal Oak-Heath Forest	**Quercus coccinea - Quercus velutina / Sassafras albidum / Vaccinium pallidum Forest**	**CEGL006375**
Deciduous Maritime Scrub Forest	**Prunus serotina - Sassafras albidum - Amelanchier canadensis / Smilax rotundifolia Shrubland**	**CEGL006145**
High Salt Marsh	**Spartina patens - Distichlis spicata - Plantago maritima Herbaceous Vegetation**	**CEGL006006**
Highbush Blueberry Shrub Swamp	**Vaccinium corymbosum - Rhododendron viscosum - Clethra alnifolia Shrubland**	**CEGL006371**
Low Salt Marsh	**Spartina alterniflora / (Ascophyllum nodosum) Acadian/Virginian Zone Herbaceous Vegetation**	**CEGL004192**
Maritime Deciduous Scrub Forest	**Prunus serotina - Sassafras albidum - Amelanchier canadensis / Smilax rotundifolia Shrubland**	**CEGL006145**
Maritime Holly Forest	**Ilex opaca / Myrica pensylvanica Forest**	**CEGL006376**
Maritime Post Oak Forest	**Quercus stellata – Quercus velutina / Myrica pensylvanica / Deschampsia flexuosa Forest CEGL006373**	
Maritime Vine Dune	**Smilax glauca - Toxicodendron radicans Vine-Shrubland**	**CEGL003886**
North Atlantic Upper Beach	**Cakile edentula ssp. edentula - Chamaesyce polygonifolia Sparse Vegetation**	**CEGL004400**

Northern Beachgrass Dune	**Ammophila breviligulata - Lathyrus japonicus Herbaceous Vegetation**	**CEGL006274**
Northern Dune Shrubland	**Myrica pensylvanica - Rosa rugosa Shrubland**	**CEGL006295**
Northern Interdunal Cranberry Swale	**Vaccinium macrocarpon – Myrica pensylvanica Dwarf-shrubland**	**CEGL006141**
Northern Salt Shrub	**Baccharis halimifolia - Iva frutescens / Panicum virgatum Shrubland**	**CEGL006063**
Northern Sandplain Grassland	**Myrica pensylvanica / Schizachyrium scoparium ssp. littorale - Danthonia spicata Shrub Herbaceous Vegetation**	**CEGL006067**
Old Field Red-Cedar Forest	**Juniperus virginiana Forest**	**CEGL006024**
Oligohaline Marsh	**Eleocharis rostellata - Spartina patens Herbaceous Vegetation**	**CEGL006611**
Overwash Dune Grassland	**Spartina patens - Scirpus pungens - Solidago sempervirens Herbaceous Vegetation**	**CEGL004097**
Pitch Pine Dune Woodland	**Pinus rigida / Hudsonia tomentosa Woodland**	**CEGL006117**
Reedgrass Marsh	**Phragmites australis Tidal Herbaceous Vegetation**	**CEGL004187**
Salt Panne	**Sarcocornia perennis - Salicornia spp. - Spartina alterniflora Dwarf-shrubland**	**CEGL004308**
Successional Meadow	**Dactylis glomerata - Solidago spp. Herbaceous Vegetation**	**CEGL006517**

7.7 PhotoInterpretation Key

The photointerpretation key was designed for use in a web-browser format. This facilitates the inclusion of example photographs and links to similar vegetation associations. This key can be found on the data CD accompanying this report. The key provided below is identical to the front end of the web version.

Key to Aerial Photograph Interpretation

Key A: Forest signature, with height apparent in stereoscopic view

1 Light colored understory - indicates dry, upland areas

2 Present on Fire Island

3 Mix of brown, gray and green color with variable sized crowns. . . . .

. . . . Maritime Deciduous Scrub Forest (6145)

3 Dominance of dark green color

4 Truly green signature, visible tree canopies. . . . .

. . . . Maritime Holly Forest (6376)

4 Green interspersed with brown to tan coloring

5 Varying canopy heights, bright patches of sand within poygon. . . . .

. . . . Pitch Pine Dune Woodland (6117)

5 Continuous, found on eastern end of island and adjacent to human communities. . . . .

. . . . Japanese Black Pine Forest (6012)

2 Present on William Floyd Estate

6 Mix of brown, gray and green color

7 Variable sized discernable crowns, found adjacent to salt marsh at Floyd Estate. . . . .

. . . . Maritime Deciduous Scrub Forest (6145)

7 Tall, forested area

8 Shadows from tree trunks. . . . .

. . . . Coastal Oak-Heath Forest (6375)

8 Found on edge of waterways, identified through ground survey. . . . .

. . . . Maritime Post Oak Forest (6373)

6 Dominance of dark green color

9 Dark green signature, distinct crown shadows show through canopy. . . . .

. . . . Old Field Red-Cedar Forest (6024)

9 Tall, forested area with green interspersed with brown to tan coloring. . . . .

. . . . Pitch pine-Oak Forest (6381)

1 Dark colored understory - indicates wet understory

10 Light grayish tree canopy over very dark understory. . . . .

. . . . Acidic Red Maple Basin Swamp (6156)

10 Brown color finely dissected with dark lines
. . . . Highbush Blueberry Shrub Swamp (6371)

Key B: Small shrub, herbaceous signature

1 Small shrub signature with variable herbaceous signature
2 Interspersed with light color - indicates dry, sandy upland
3 Small shrub interspersed with open sand
4 Brown color interspersed with open sand. . . . .
. . . . Maritime Vine Dune (3886)
4 Very dark green with equal amounts of open sand. . . . .
. . . . Beach Heather Dune (6143)
3 Dark brownish-red color, uniform in texture, little sand shows through
5 Dominance of shrub. . . . .
. . . . Northern Dune Shrubland (6295)
5 Codominance of shrub and herbaceous signature, identified through ground survey. . . . .
. . . . Northern Sandplain Grassland (6067)
2 Interspersed with dark color - indicates wetland
6 Uniform gray color lighter than surrounding wetter areas. . . . .
. . . . Northern Salt Shrub (6063)
6 Small, pond-like bodies of shallow water. . . . .
. . . . Northern Interdunal Cranberry Swale (6141)

1 Herbaceous signature, with little height apparent in stereoscopic view
7 Interspersed with light color - indicates dry, sandy upland
8 Lawn like, tan and green areas of Floyd Estate. . . . .
. . . . Cultivated Pasture (6107)
8 Other upland, herbaceous vegetation of Fire Island
9 Grass signature, present on dunes of Fire Island
10 Uniform tan with streaks of bright sand showing through. . . . .
. . . . Northern Beach Grass Dune (6274)
10 Recent overwash areas near foredune, "washed out" appearance. . . . .
. . . . Overwash Dune Grassland (4097)
7 Interspersed with dark color - indicates wetland
11 Behind primary and secondary dunes, dark color. . . . .
. . . . Brackish Interdunal Swale (6342)
11 Adjacent to the Bay
12 Located closest to waterbodies
13 Medium to dark gray color, adjacent to water bodies, mosquito ditches, and salt pannes. . . . .

. . . . Low Salt Marsh (4192)

13 Uniform tan color, lighter in color then low salt marsh. . . . .
. . . . High Salt Marsh (6006)

12 Located at high end of salt marsh

14 Light brown to a dark brown, often band of debris on bay side. . . . .
.
. . . . Reedgrass Marsh (4187)

14 Rusty-red color appearing wet. . . . .
. . . . Brackish Meadow (6150)

7.8 Metadata

Metadata for Fire Island National Seashore, Spatial Vegetation Data: Cover type / Association level of the National Vegetation Classification System

Identification_Information:
Citation:
Citation_Information:
Originator: Conservation Management Institute
Originator: NatureServe
Originator: New York Natural Heritage Program
Publication_Date: 200204
Title: NPS Vegetation Mapping Program: Vegetation of Fire Island National Seashore
Edition: 1.0
Geospatial_Data_Presentation_Form: vector digital data
Online_Linkage: http://biology.usgs.gov/npsveg/fiis/fiisveg.html
Online_Linkage: ftp://ftp.cbi.usgs.gov/pub/vegmapping/fiis/fiis.exe
Online_Linkage: ftp://ftp.cbi.usgs.gov/pub/vegmapping/fiis/fiissdts.exe
Description:
Abstract: This dataset is the finished product of the NPS Vegetation Mapping Project at Fire Island National Seashore. This dataset depicts the association-level vegetation map for the entire length of Fire Island and the William Floyd Estate. The park islands in the Great South Bay can be found in a separate file included on the disk. These vegetation polygons were interpreted and delineated from 1:1200-scale true-color aerial photographs taken in April 1997. They are attributed with NVCS associations as well as height, pattern, and density information.
Purpose: The purpose of this data is to provide the managers and researchers on Fire Island with an accurate spatially referenced dataset to assist in their efforts.
Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 199704
Currentness_Reference: ground condition as of 1997
Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
Description_of_Geographic_Extent: Fire Island National Seashore and environs
Bounding_Coordinates:
West_Bounding_Coordinate: -73.315058
East_Bounding_Coordinate: -72.751087
North_Bounding_Coordinate: 40.785117
South_Bounding_Coordinate: 40.607277
Keywords:
Theme:
Theme_Keyword_Thesaurus: Fire Island
Theme_Keyword: Fire Island
Theme_Keyword: barrier island
Theme_Keyword: NVCS
Theme_Keyword: photointerpretation
Theme_Keyword: GPS
Theme_Keyword: vegetation classification
Theme_Keyword: NPS Vegetation Mapping Project
Theme_Keyword: GIS
Place:
Place_Keyword_Thesaurus: None

Place_Keyword: Long Island
Place_Keyword: coastal mapping
Place_Keyword: William Floyd Estate
Access_Constraints: There are no access constraints attached to these data.
Use_Constraints: These data were designed to identify and map vegetation polygons only. They are not appropriate for other uses such as legal property boundary identification, tax assessment, etc.
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Conservation Management Institute
Contact_Person: Scott Klopfer
Contact_Position: GIS & Remote Sensning Division Coordinator
Contact_Address:
Address_Type: mailing and physical address
Address: 203 West Roanoke Street
City: Blacksburg
State_or_Province: Virginia
Postal_Code: 24061
Country: USA
Contact_Voice_Telephone: 540 231 7348
Contact_TDD/TTY_Telephone: none
Contact_Facsimile_Telephone: 540 231 7019
Contact_Electronic_Mail_Address: sklopfer@vt.edu
Hours_of_Service: 8-5 Monday through Friday EST
Contact_Instructions: email preferred
Native_Data_Set_Environment: Microsoft Windows 2000 Version 5.0 (Build 2195) ; ESRI ArcCatalog 8.1.0.642
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report:
The accuracy of classification to association was completed with both a traditional and a fuzzy-set assessment. This assessment only determined accuracy for polygons at or above the MMU. The overall accuracy of the map was determined to be .58 (Kappa). The subsequent Level 5,4, and 3 level fuzzy accuracy assessment produced valuesof .64, .77 and .87 respectively. The Level 4 accuracy assessment value from the fuzzy assessment is provided for each class.

Accuracy assessments were also performed for polygons below the MMU. These can be found in the final report.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Maritime Holly Forest
Attribute_Accuracy_Explanation:
Producers:88.9%
Users: 85.7%
This type was very similar to Maritime Deciduous Scrub Forest and was considered the same at Level 4.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Old Field Red-Cedar Forest
Attribute_Accuracy_Explanation:
Producers:100%
Users: 100%
The type was easily identified and limited to two large stands on the Floyd Estate.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Maritime Post Oak Forest
Attribute_Accuracy_Explanation:
Producers: 0%
Users: 0%
Only one stand was identified as this type. That stand was classified as Coastal Oak-Heath Forest during accuracy assessment.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Coastal Oak-Heath Forest
Attribute_Accuracy_Explanation:
Producers: 100%
Users: 88.9%

This type was most often confused with Pitch pine - Oak Forest which differs only in amount of Pinus rigida in the canopy.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Japanese Black Pine Forest
Attribute_Accuracy_Explanation:
Producers: 75%
Users: 78.6%
This type was most often confused with Pitch Pine Dune Woodland. The two types were considered the same at Level 4.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Pitch Pine - Oak Forest
Attribute_Accuracy_Explanation:
Producers: 100%
Users: 85.7%
The photointerpreters felt that some polygons on the Floyd Estate were more appropriately assigned to this class rather than the Coastal Oak-Heath Forest. This type was very similar to the Coastal Oak -Heath type and was considered to be the same thing at Level 4. This type may actually be a product of a more oak dominated canopy with dense Smilax spp.
beneath.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Pitch Pine Dune Woodland
Attribute_Accuracy_Explanation:
Prodcuers: 81.3%
Users: 83.3%
This type was often found in small, linear, polygons, which may account for confusion with non-coniferous associations. Considered the same as Japanese Black Pine Forest for Level 4.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Northern Dune Shrubland
Attribute_Accuracy_Explanation:
Producers: 57.1%
Users: 76.9%
There is no clear pattern of confusion beyond other shrubs, although some confusion (with herbaceous types) is due to complex polygon interspersion and small polygons.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Maritime Deciduous Scrub Forest
Attribute_Accuracy_Explanation:
Prodcuers: 68.0%
Users: 64.7%
Nearly all of the confusion with this type occurs with other shrub associations such as Highbush Blueberry Shrub Forest. This type was considered the same as Maritime Holly Forest at Level 4.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Maritime Vine Dune
Attribute_Accuracy_Explanation:
Producers: 25.0%
Users: 25.0%
This type is difficult to identify both from photography and in the field. It is closely associated with Northern Dune Shrubland and is often confused with it. It is also a rare type on Fire Island.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Highbush Blueberry Shrub Forest
Attribute_Accuracy_Explanation:
Prodcuers: 50.0%
Users: 20.0%
This type is frequently confused with the other, more common wetland shrub types Maritime Deciduous Scrub Forest and Northern Salt Shrub.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Northern Salt Shrub
Attribute_Accuracy_Explanation:
Prodcuers: 60.0%
Users: 57.9%
This type is frequently confused with other wetland types such as Highbush Blueberry Shrub Forest. Phragmites is found frequently within these stands as well.

Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Beach Heather Dune
Attribute_Accuracy_Explanation:
Producers: 81.5%
Users: 86.4%
This type exists both as an association and with Northern Beach Grass Dune in mosaic. Errors are thought to occur in smaller polygons juxtaposed with Northern Beach Grass Dune and Northern Dune Shrubland.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Northern Interdunal Cranberry Swale
Attribute_Accuracy_Explanation:
Producers: 100%
Users: 40%
No single polygon of this association exists at the 0.25 MMU. These accuracy estimates are from small polygons. This type may be over-predicted on the landscape because it is easily confused with small herbaceous wetlands that are also filled with water at the time of photo acquisition.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Northern Beach Grass Dune
Attribute_Accuracy_Explanation:
Producers: 87.5%
Users: 76.9%
This is the most prevalent association on Fire Island. It is part of a mosaic with Beach Heather Dune and most observed confusion is likely due to smaller polygons interspersed with that and Northern Dune Shrubland.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Overwash Dune Grassland
Attribute_Accuracy_Explanation:
Producers: 0%
Users: 0%
This type was very limited in distribution on Fire Island. Although several polygons were labeled as this type, none were identified as such in the field. This type is easily confused with Beach Heather Dune or Northern Beach Grass Dune which further confounds mapping efforts.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Brackish Interdunal Swale
Attribute_Accuracy_Explanation:
Producers: 66.7%
Users: 50.0%
This wetland type was often delineated with adjacent Reedgrass Marsh. It is also a rare type on Fire Island existing in polygons at or below the 0.25 ha MMU.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Brackish Meadow
Attribute_Accuracy_Explanation:
Producers: 100%
Users: 20.0%
Although this type occurs all over Fire Island, it is found in narrow bands or small polygons often associated with Reedgrass Marsh. Only 1 field assessment point was located within this type.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Reedgrass Marsh
Attribute_Accuracy_Explanation:
Producers: 58.8%
Users: 64.7%
Low accuracy is likely due to small sample size in the accuracy assessment set. This type was almost exclusively confused with other wetland types. Variable coverage density of Phragmites in other types may lead to confusion.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Low Salt Marsh
Attribute_Accuracy_Explanation:
Producers: 97.3%
Users: 100%
This type was most often confused with High Salt Marsh. Photointerpretation was mostly determined by presence of water in the photographs which is highly variable (tides, season). This type was considered the same as High Salt Marsh for Level 4.

Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: High Salt Marsh
Attribute_Accuracy_Explanation:
Producers: 81.3%
Users: 100%
This type is found in close proximity and intermingled with the Low Salt Marsh type. These two were considered the same for the Level 4 assessment.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Northern Sandplain Grassland
Attribute_Accuracy_Explanation:
Producers: 0%
Users: 0%
This type was only mapped in a single small polygon and was identified elsewhere during accuracy assessment. It is a very rare type and likely exists in very few small patches. Further confounding this type is its similarity to Northern Dune Shrubland.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Cultivated Pasture
Attribute_Accuracy_Explanation:
Producers: 100%
Users: 100%
This type is easily identified on the Floyd Estate.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Interdune Beachgrass-Beach Heather Mosaic
Attribute_Accuracy_Explanation:
Producers: 100%
Users: 89.5%This mosaic was considered correct if identified as either Northern Beach Grass Dune or Beach Heather Dune. There is likely much more of this type on Fire Island, but the sub-0.25 ha polygons make its appearance in the map more rare.
Logical_Consistency_Report: All linework was cleaned before building topology. All reulting polygons are attributed with the appropriate information.
Completeness_Report: The minimum mapping unit for this project is 0.25-ha. There are, however, several polygons in the map that are smaller than this mapping area. We decided to include these small polygons for several reasons. The most important of these is that many of the recognizable vegetation and man-made features on Fire Island are smaller than the 0.25 MMU planned in the contract. Inclusion of smaller mapping units allowed us to capture these features and improve the utility of the vegetation map. It also allowed us to avoid conglomerating obviously homogeneous blocks of vegetation into "mosaics" or "complexes" at the 0.25-ha unit level.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
We collected a total 89 map points on Fire Island and the William Floyd Estate. Of these, 21 points were removed because the standard deviation of the differentially corrected location was higher than 10 m. The resulting 68 points were then overlaid onto the vegetation map and georeferenced aerial photography to assess spatial accuracy of the map. Each point was examined, and the difference (in meters) between the GPS location and map location was measured using the masuring tool in Arc View. This value was entered into the appropriate field in the database. If the exact location of the map point could not be determined or discerned from the aerial photograph, the point was eliminated from consideration.

A total of 21 points were removed because they could not be accurately measured. This left 47 points for assessing the spatial accuracy of the vegetation map. The mean error distance was found to be 4.42 m (± 4.94 m). Errors distances ranged from 0.00 m - 30.0 m. When the single 30 m error point was removed (assumed to be an outlier), the mean error distance was 3.86 m ((± 3.18 m) with a range of 0.00 m - 14.09 m.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: Aerographics, Inc.
Publication_Date: 199704
Title: Aerial Photography
Geospatial_Data_Presentation_Form: true-color aerial photography
Type_of_Source_Media: hard copy stereo pair photographs

Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 199707
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: FIIS 1997 CIR Aerial Photographs
Source_Contribution: This dataset was used for photointerpretation (with steroscopes).
Source_Information:
Source_Citation:
Citation_Information:
Originator: Aerographics, Inc.
Publication_Date: 199704
Title: Aerial Photography
Geospatial_Data_Presentation_Form: Georeferenced True Color aerial photography
Type_of_Source_Media: digital image
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 199707
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: FIIS 1997 CIR Aerial Photographs
Source_Contribution: These are the scanned and georeferenced versions of the true color photography. These were used to delineate polygon boundaries with on-screen digitizing.
Process_Step:
Process_Description: This vegetation map was created from aerial photographs. The photos were scanned at 600 dpi and georeferenced using control points gathered from georeferenced digital orthophoto quads from the USGS. Once the digital photos were georeferenced, they were used to delineate map polygons interpreted from the stero-paired aerial photographs. Once the delineation of polygons was complete, each polygon was attributed with it's appropriate map class (or vegetation association), height class, pattern class, and density value. The final layer was converted to an ARCINFO coverage and topology was built.
Process_Date: 199704
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Complete chain
Point_and_Vector_Object_Count: 15733
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Label point
Point_and_Vector_Object_Count: 7738
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 7738
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 4
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 18
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -75.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000

Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000336
Ordinate_Resolution: 0.000336
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Vegetation / Land Cover (fiis_veg.pat)
Entity_Type_Definition: Association-level vegetation / landcover information for the entire length of Fire Island and the William Floyd Estate. The park islands in the Great South Bay can be found in a separate file included on the disk. These vegetation polygons were interpreted and delineated from 1:1200-scale true-color aerial photographs taken in April 1997. They are attributed with NVCS associations as well as height, pattern, and density information.
Entity_Type_Definition_Source: Fire Island National Seashore and the USGS-NPS Vegetation Mapping Program.
Attribute:
Attribute_Label: FID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Polygon
Enumerated_Domain_Value_Definition: A two-dimensional feature representing an area such as a state or county.
Enumerated_Domain_Value_Definition_Source: ESRI Glossary definitions.
Attribute:
Attribute_Label: AREA
Attribute_Definition: Area of feature in internal units squared.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
Attribute_Label: PERIMETER
Attribute_Definition: Perimeter of feature in internal units.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
Attribute_Label: FIIS_VEG#
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: FIIS_VEG-ID
Attribute_Definition: User-defined feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:

Unrepresentable_Domain: Whole numbers
Attribute:
Attribute_Label: MAP_CODE
Attribute_Definition: numeric code corresponding to map class
Attribute_Definition_Source: National Vegetation Classification Standard
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: Fire Island Vegetation Map Codeset
Codeset_Source: Conservation Management Institute
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: National Vegetation Classification Standard
Codeset_Source: Federal Geographic Data Commission
Attribute:
Attribute_Label: MAP_CODE_DESC
Attribute_Definition: English (not latin names) textual description of the map class name
Attribute_Definition_Source: Fire Island National Seashore
Attribute_Domain_Values:
Unrepresentable_Domain: textual class name
Attribute:
Attribute_Label: HEIGHT_CODE
Attribute_Definition: numeric code corresponding to height categories
Attribute_Definition_Source: USGS-NPS Vegetation Mapping Program
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: 0 - 0.5 m
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: 0.5 - 1m
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 3
Enumerated_Domain_Value_Definition: 1- 5 m
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 4
Enumerated_Domain_Value_Definition: 5 - 15 m
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 5
Enumerated_Domain_Value_Definition: 15 - 30 m
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 0
Enumerated_Domain_Value_Definition: Not Applicable
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Attribute:
Attribute_Label: HEIGHT_CODE_DESC
Attribute_Definition: textual description of the height class name
Attribute_Definition_Source: USGS-NPS Vegetation Mapping Program
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: "Not Applicable"
Enumerated_Domain_Value_Definition: Vegetation height is not applicable to this map unit class
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:

Enumerated_Domain_Value: "0 m - 0.5 m"
Enumerated_Domain_Value_Definition: Vegetation is between 0 meters and 0.5 meters in height
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "0.5 m - 1 m"
Enumerated_Domain_Value_Definition: Vegetation is between 0.5 meters and 1 meter in height
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "1 m - 5 m"
Enumerated_Domain_Value_Definition: Vegetation is between 1 meter and 5 meters in height
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "5 m - 15 m"
Enumerated_Domain_Value_Definition: Vegetation is between 5 meters and 15 meters in height
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "15 m - 30 m"
Enumerated_Domain_Value_Definition: Vegetation is between 15 meter and 30 meters in height
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Attribute:
Attribute_Label: DENSITY_CODE
Attribute_Definition: code corresponding to the percent coverage of vegetative material covering the plot
Attribute_Definition_Source: USGS-NPS Vegetation Mapping Program
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: >60% Vegetation Coverage
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: 40%-60% Vegetation Coverage
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 3
Enumerated_Domain_Value_Definition: 10%-40% Vegetation Coverage
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 4
Enumerated_Domain_Value_Definition: <10% Vegetation Coverage
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 0
Enumerated_Domain_Value_Definition: Not Applicable
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Attribute:
Attribute_Label: DENSITY_CODE_DES
Attribute_Definition: textual description of Density Code
Attribute_Definition_Source: USGS-NPS Vegetation Mapping Program
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: ">60% Vegetation Coverage"
Enumerated_Domain_Value_Definition: Vegetation has a crown closure that is greater than 60%
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "40%-60% Vegetation Coverage"
Enumerated_Domain_Value_Definition: Vegetation has a crown closure that is between 40% and 60%
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:

Enumerated_Domain_Value: "10%-40% Vegetation Coverage"
Enumerated_Domain_Value_Definition: Vegetation has a crown closure that is between 10% and 40%
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "<10% Vegetation Coverage"
Enumerated_Domain_Value_Definition: Vegetation has a crown closure that is less than 10%
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "Not Applicable"
Enumerated_Domain_Value_Definition: Vegetation density is not applicable to this map class
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Attribute:
Attribute_Label: LANDUSE_CODE
Attribute_Definition: project standard field not used for vegetation mapping at Fire Island National Seashore
Attribute_Definition_Source: Fire Island National Seashore
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: "0"
Enumerated_Domain_Value_Definition: Attribute not used for vegetation mapping at Fire Island National Seashore
Enumerated_Domain_Value_Definition_Source: Fire Island National Seashore
Attribute:
Attribute_Label: LANDUSE_CODE_DES
Attribute_Definition: project standard field not used for vegetation mapping at Fire Island National Seashore
Attribute_Definition_Source: Fire Island National Seashore
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: blank
Enumerated_Domain_Value_Definition: Attribute not used for vegetation mapping at Fire Island National Seashore
Enumerated_Domain_Value_Definition_Source: Fire Island National Seashore
Attribute:
Attribute_Label: PATTERN_CODE
Attribute_Definition: numeric code corresponding to the vegetation pattern observed in the polygon
Attribute_Definition_Source: USGS-NPS Vegetation Mapping Program
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: Evenly dispersed
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: Clumped/Bunched
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 3
Enumerated_Domain_Value_Definition: Gradational/Transitional
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 4
Enumerated_Domain_Value_Definition: Alternating
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: 0
Enumerated_Domain_Value_Definition: Not Applicable
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Attribute:
Attribute_Label: PATTERN_CODE_DES
Attribute_Definition: textual description of the pattern code
Attribute_Definition_Source: USGS-NPS Vegetation Mapping Program

Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: "Evenly dispersed"
Enumerated_Domain_Value_Definition: Vegetation is evenly dispersed across the map unit
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "Clumped/Bunched"
Enumerated_Domain_Value_Definition: Vegetation has a clumped or bunched pattern across the map unit
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "Gradational/Transitional"
Enumerated_Domain_Value_Definition: Vegetation has a gradational or transitional pattern across the map unit
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "Alternating"
Enumerated_Domain_Value_Definition: Vegetation has an alternating pattern across the map unit
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Enumerated_Domain:
Enumerated_Domain_Value: "Not Applicable"
Enumerated_Domain_Value_Definition: The pattern of the vegetation is not applicable to this map unit
Enumerated_Domain_Value_Definition_Source: USGS-NPS Vegetation Mapping Program
Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: USGS Biological Resources Division, Center for Biological Informatics
Contact_Person: USGS-NPS Vegetation Mapping Program Coordinator
Contact_Address:
Address_Type: Physical Address
Address: USGS
Address: Biological Resources Division, CBI
Address: Building 810, Room 8000
City: Denver
State_or_Province: Colorado
Postal_Code: 80225-0046
Country: USA
Contact_Address:
Address_Type: Mailing Address
Address: USGS
Address: Biological Resources Division, CBI
Address: PO BOX 25046, DFC, MS302
City: Denver
State_or_Province: Colorado
Postal_Code: 80225-0046
Country: USA
Contact_Voice_Telephone: (303) 202-4220
Contact_Facsimile_Telephone: 303-202-4229
Contact_Facsimile_Telephone: 303-202-4219 (org)
Contact_Electronic_Mail_Address: gs-b-npsveg@usgs.gov
Resource_Description: NPS Vegetation Mapping Program: Vegetation Map of Fire Island National Seashore
Distribution_Liability: The distributor maintains no liability for the use and application of these data beyond it's intended use as a depiction of vegetation.
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: HTML
Digital_Transfer_Option:
Online_Option:

Computer_Contact_Information:
Network_Address:
Network_Resource_Name: http://biology.usgs.gov/npsveg/fiis/fiisveg.html
Fees: None
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: EXE
Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:
Network_Address:
Network_Resource_Name: ftp://ftp.cbi.usgs.gov/pub/vegmapping/fiis/fiis.exe
Fees: None
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: SDTS
Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:
Network_Address:
Network_Resource_Name: ftp://ftp.cbi.usgs.gov/pub/vegmapping/fiis/fiissdts.exe
Fees: None
Metadata_Reference_Information:
Metadata_Date: 20020425
Metadata_Review_Date: 20030409
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Theresa Singh
Contact_Organization: USGS/BRD, Center for Biological Informatics
Contact_Address:
Address_Type: Physical Address
Address: USGS Biological Resources
Address: Center for Biological Informatics
Address: Denver Federal Center, Building 810
Address: Room 8000, MS302
City: Denver
State_or_Province: CO
Postal_Code: 80225-0046
Country: USA
Contact_Voice_Telephone: (303) 202-4227
Contact_Facsimile_Telephone: 303-202-4229
Contact_Facsimile_Telephone: 303-202-4219 (org)
Contact_Electronic_Mail_Address: theresa_singh@usgs.gov
Metadata_Standard_Name: FGDC-STD-001.1-1999 Content Standard for Digital Geospatial Metadata, 1998 Part 1: Biological Data Profile, 1999
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Extensions:
Online_Linkage: http://biology.usgs.gov/fgdc.bio/bionwext.txt
Profile_Name: Biological Data Profile FGDC-STD-001.1-1999

APPENDIX A. ALLIANCE DESCRIPTIONS

I. FOREST

I.A.4.N.a. Lowland temperate seasonal evergreen forest

I.A.4.N.a.300. ILEX OPACA FOREST ALLIANCE
American Holly Forest Alliance

Concept: Maritime evergreen forest dominated by *Ilex opaca*. Canopy associates may include *Quercus* spp., *Juniperus virginiana, Sassafras albidum, Amelanchier canadensis*. The canopy is flat-topped from wind-pruning. Shrub associates are *Myrica pensylvanica, Vaccinium corymbosum, Viburnum recognitum, Gaylussacia baccata.* Vines may be frequent, including *Smilax rotundifolia, Toxicodendron radicans, Parthenocissus quinquefolia,* and *Vitis* spp. The herb layer is characterized by *Aralia nudicaulis, Maianthemum* spp. This community occurs on the lee sides of dunes.**Comments:**
Range: This alliance is found in Massachusetts, New York and New Jersey.
States/Provinces: MA NJ NY
TNC Ecoregions: 62:C
Synonymy:
References: Art 1987
Authors: L. SNEDDON, ECS **Identifier:** A.3002

I.A.8.N.c. Lowland temperate seasonal evergreen forest

I.A.8.N.c.2. JUNIPERUS VIRGINIANA FOREST ALLIANCE
Eastern Red-cedar Forest Alliance

Concept: Forests in this alliance are strongly dominated by Juniperus virginiana var. virginiana on usually high pH, fire-suppressed sites or old fields, but also mature (100+ year) stands, on limestone or chalk, mostly in blacklands, but occasionally on sandstone (Oklahoma). This alliance is most common in old fields and pastures, successional cleared land, and other various disturbed areas, especially on calcareous rocks. The growth of low Juniperus virginiana var. virginiana may be very dense, and the stature may be rather low. In Tennessee examples, other species that may occur in the canopy include Carya alba, Carya ovata, Cercis canadensis, and ~Pinus virginiana. Various oaks (including Quercus coccinea, Quercus falcata, and Quercus phellos) also may be present. The midstory is typically sparse, with canopy species as well as Cornus florida, Ilex opaca, Liquidambar styraciflua, and Prunus serotina var. serotina. Frangula caroliniana may occur in several strata. Herb distribution is patchy, and typical species include Asplenium platyneuron, Chasmanthium laxum, Eupatorium spp., Polystichum acrostichoides, and ~Carex spp. This vegetation is also found in the Blackbelt of Alabama, on the margins of Chalk Prairies.

I.A.8.N.c.300. PINUS THUNBERGII FOREST ALLIANCE
Japanese Black Pine Forest Alliance

Concept: This alliance includes forests dominated by naturalized Pinus thunbergii and occurring in the northeastern coastal region and likely beyond. This alliance includes evergreen forests dominated by naturalized Pinus thunbergii. These forests are usually dense and can contain admixtures of Pinus rigida, and others.
States: NY, RI, MA
Authors: L. SNEDDON
Origin: 2001-08-28 **Edition:**
References: Sneddon and Lundgren 2001

I.B.2.N.a. Lowland or submontane cold-deciduous forest

I.B.2.N.a.29. QUERCUS ALBA – QUERCUS (FALCATA, STELLATA) FOREST ALLIANCE
White Oak – (Southern red oak, Post oak) Forest Alliance

Concept: This alliance contains vegetation that can be described as dry oak and oak - hickory forests. These are usually dominated by a mixture of Quercus alba and Quercus falcata; Quercus stellata may be dominant or codominant. In addition, Quercus coccinea, Quercus velutina, Quercus marilandica, Carya alba, Carya glabra, Carya pallida, Carya carolinae-septentrionalis, Carya ovata, and Fraxinus americana often are present. Common subcanopy and shrub species include Oxydendrum arboreum, Acer rubrum, Ulmus alata, Juniperus virginiana var. virginiana, Vaccinium arboreum, Cornus florida, Sassafras albidum, Gaylussacia frondosa (= var. frondosa), Gaylussacia baccata, Vaccinium pallidum, and Vaccinium stamineum. Herbaceous species that may be present include Chimaphila maculata, Polystichum acrostichoides, Asplenium platyneuron, Hexastylis arifolia, Coreopsis major, Tephrosia virginiana, Sanicula canadensis, Desmodium nudiflorum, Desmodium nuttallii, Symphyotrichum urophyllum? (= Aster sagittifolius?), Symphyotrichum patens (= Aster patens), Solidago ulmifolia, and Hieracium venosum. These often are successional forests following logging and/or agricultural cropping. Some examples occur in upland flats and have been called xerohydric because they occasionally will have standing water in the winter due to a perched water table, but are droughty by the end of the growing season. Other occurrences are found on well-drained sandy loam or clay loam soils that are often, although not always, shallow. Karst topography can be found in areas where this alliance occurs. Soils are most often a well-drained sandy loam, although clay loams are not uncommon. Forests of this alliance may occupy narrow bands of dry-mesic habitat transitional between lower and midslope mesic communities and xeric ridgetops. This alliance is found in the Upper East Gulf Coastal Plain, Piedmont, low mountains (including Cumberlands and Ridge and Valley), and Interior Low Plateau. Distribution in the Atlantic Coastal Plain, East Gulf Coastal Plain, and Upper West Gulf Coastal Plain needs assessment. In the Shawnee Hills, Knobs, Coastal Plain, and Appalachian Plateau regions of Kentucky, these forests form a common matrix vegetation over acid sandstone and shales. These Kentucky forests are dominated by Quercus alba with little or no Quercus falcata and occupy middle to upper slope positions. In the southern Illinois portion of the range, examples occur on south- to west-facing slopes where increased temperatures favor Quercus falcata over Quercus rubra.
Comments: These often are successional forests following logging and/or agricultural cropping. Some examples occur in upland flats and have been called xerohydric because they occasionally will have standing water in the winter due to a perched water table, but are droughty by the end of the growing season. Other occurrences are found on well-drained sandy loam or clay loam soils that are often, although not always, shallow.
Similar Alliances: These forests are drier than those of the I.B.2.N.a Quercus alba - (Quercus rubra, Carya spp.) Forest Alliance (A.239) and the I.B.2.N.a Quercus velutina - Quercus alba - (Quercus coccinea) Forest Alliance (A.1911) and often occur on poorer soils or on south- and west-facing slopes. Related forests, drier than those of this alliance, are placed in the more southerly ranging I.B.2.N.a Quercus falcata Forest Alliance (A.243).
Range: This alliance is widespread across the United States from Texas to Georgia, north to Indiana and New England.
States/Provinces: AL, AR, CT, DE, GA, IL, IN, KY, LA, MD, MS, NC, NJ, NY, OK, SC, TN, TX, VA
TNC Ecoregions: 32:P, 40:C, 41:P, 42:C, 43:C, 44:C, 50:C, 52:C, 53:P, 56:C, 57:P, 58:C, 59:P, 61:C, 62:C
Synonymy: White Oak - Black Oak - Northern Red Oak, as the White Oak - Southern Red Oak variant: 52, in part (Eyre 1980).
References: Allard 1990, Diamond 1993, Evans 1991, Eyre 1980, Foti 1994, Foti, Blaney, X. Li, and K. G. Smith1994, Pyne 1994, Schafale and Weakley 1990,
Authors: M. PYNE/A.S. WEAKLEY 6-94, MOD. S. LANDAAL **Identifier:**

I.B.2.N.a.100. QUERCUS VELUTINA - QUERCUS ALBA – (QUERCUS COCCINEA) FOREST ALLIANCE
Black Oak - White Oak - (Scarlet Oak) Forest Alliance

Concept: Forests in this alliance represent the drier end of the white oak - red oak - black oak cover type and are difficult to identify easily. This alliance is distributed in the Ozark Highlands, Ouachita Mountains,

Arkansas Valley, the Interior Highlands, Piedmont, and Blue Ridge, codominated by *Quercus alba* with *Quercus coccinea, Quercus velutina*, and *Quercus rubra. Quercus stellata, Quercus prinus, Carya alba, Carya glabra, Carya ovata, Pinus virginiana*, and *Pinus echinata* are common associates. Other common associates can include *Nyssa sylvatica, Acer rubrum var. rubrum, Sassafras albidum, Quercus falcata, Quercus macrocarpa* (within its range), and *Prunus serotina var. serotina*. Typical shrubs and small trees include *Cornus florida, Corylus americana, Ostrya virginiana, Oxydendrum arboreum, Sassafras albidum, Kalmia latifolia, Rhododendron calendulaceum, Gaylussacia ursina, Vaccinium* spp., *Viburnum acerifolium*, and *Hamamelis virginiana*. Common herbs include *Agrimonia rostellata, Amphicarpaea bracteata, Botrychium virginianum, Carex blanda, Danthonia spicata, Antennaria plantaginifolia, Desmodium nudiflorum, Thelypteris noveboracensis, Prenanthes altissima, Galium* spp., *Dioscorea villosa, Conopholis americana, Polygonatum biflorum, Medeola virginiana*, and *Maianthemum racemosum*. Stands can be found on mid to upper slopes and terraces where dry-mesic conditions persist and where soils are more sandy and/or rocky. Bedrock is sandstone, siltstone, chert, or shale. Disturbance in the form of wind and logging tends to favor *Quercus velutina* in these forests. These forests generally occur on slopes and sheltered ridgetops. One example from the Interior Low Plateau of Tennessee occurs on elevated terraces adjacent to river floodplains.
Comments: A new association will be added from the Arkansas Field Office Ouachita Inventory. This alliance is also present in Virginia, at least in the Ridge and Valley; a new association is likely needed. Stands previously placed in this alliance that occur in what are called inland maritime situations in older mature stands in the outer Coastal Plain of South Carolina (C. Aulbach-Smith pers. comm.) need to be accommodated elsewhere. In Kentucky, these forests lack *Quercus rubra* as a dominant and occur in the Shawnee Hills and on upper slopes and ridgetops in the Appalachian Plateaus, and are abundant in the Interior Low Plateau.
Range: This alliance is distributed in the Ozark Highlands, Ouachita Mountains, Arkansas Valley, the Interior Highlands, Piedmont, and Blue Ridge. It is found in Arkansas, Georgia, North Carolina, South Carolina, Tennessee, Connecticut, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, Pennsylvania, Rhode Island, Virginia, West Virginia, Iowa, Illinois, Indiana, Michigan, Minnesota, Missouri, Ohio, and Wisconsin, and in Ontario, Canada, and possibly in Alabama (?), Kentucky (?), Mississippi (?), and Oklahoma (?).
States/Provinces: AL? AR CT DE GA? IA IL IN KY? MA MD MI MN MO MS? NC NH NJ NY OH ON PA RI SC TN VA WI WV
TNC Ecoregions: 36:C, 38:C, 39:C, 43:P, 44:C, 45:C, 46:C, 48:C, 50:C, 51:C, 52:C, 59:C, 61:C, 62:C
Synonymy: Submesic Oak - Hickory Forest (Foti 1994); Acidic sub-xeric forest, in part (Evans 1991); Montane Oak--Hickory Forest, in part (Schafale and Weakley 1990); TIB4aII4c. *Quercus alba - Quercus velutina - Quercus falcata* (Foti et al. 1994); White Oak - Black Oak - Northern Red Oak: 52, in part (Eyre 1980)
References: C. Aulbach-Smith pers. comm., Evans 1991, Eyre 1980, Faber-Langendoen et al. 1996, Foti 1994, Foti et al. 1994, Jones 1988a, Jones 1988b, Schafale and Weakley 1990
Authors: D. FABER-LANGENDOEN/L.A., MP, SCS **Identifier:** A.1911

I.B.2.N.g. Saturated cold-deciduous forest

I.B.2.N.g.2. ACER RUBRUM - NYSSA SYLVATICA SATURATED FOREST ALLIANCE
Red Maple - Blackgum Saturated Forest Alliance

Concept: Forests in this alliance have variable canopy composition, but *Acer rubrum* and *Nyssa sylvatica* are common components. Canopy composition differs from the surrounding upland and varies with geography. Typical canopy species across the range of this alliance include *Acer rubrum var. trilobum, Nyssa sylvatica*, and *Liquidambar styraciflua*. Understory and shrub species include *Alnus serrulata, Ilex opaca var. opaca, Aronia arbutifolia*, and *Ilex verticillata*. Characteristic herbaceous species are *Osmunda cinnamomea* and *Osmunda regalis*. *Sphagnum* spp. are typical. These wetland forests occur where surface water is seldom present, but the substrate is saturated to the surface for extended periods during the growing season, and include forested acid seeps on hillsides or streamheads, on edges of floodplains, and

other poorly drained depressions. Individual occurrences of these forests tend to be small in extent, and can provide habitat for rare plant species.
Comments: This alliance may only cover a portion of the variation in wooded seeps in Arkansas, where a calcareous shale and a sandstone seep type need to be defined (D. Zollner pers. comm.).
Range: This alliance is known from the Cumberland Plateau of Alabama, Kentucky and Tennessee, the Allegheny Plateau of Kentucky, the upper East Gulf Coastal Plain of Kentucky and Tennessee, the Piedmont of North Carolina, South Carolina, and Virginia, the Arkansas River Valley, and the Coastal Plain of North Carolina, New Jersey, Pennsylvania, Delaware, Maryland, and Virginia. It may also be found in Georgia (?), Oklahoma, Connecticut, Massachusetts, Maine, New Hampshire, New York, Vermont, West Virginia, and Illinois (?).
States/Provinces: AL AR CT DE GA IL? KY LA? MA MD ME NC NH NJ NY OK PA RI SC TN TX VA VT WV
TNC Ecoregions: 32:P, 38:P, 39:C, 43:C, 44:C, 49:C, 50:C, 51:C, 52:C, 53:P, 56:P, 57:C, 58:C, 59:C, 60:C, 61:C, 62:C, 63:C, 64:P
Synonymy: IIA9a. Forested Mountain Seep, in part (Allard 1990); Wooded Seep, in part (Foti 1994); Appalachian Acid Seep, in part (Evans 1991); Cretaceous Hills forested acid seep (Evans 1991); Low Elevation Seep (Schafale and Weakley 1990); Boggy Streamside Seep (M. Schafale pers. comm.)
References: Allard 1990, Breden 1989, Campbell 1989, Evans 1991, Foti 1994, Funk 1975, Funk and Fuller 1978, Harvill 1967, Heckscher 1994, M. Schafale pers. comm., Schafale and Weakley 1990
Authors: K.D. PATTERSON/J. CAMPBEL, KP, ECS **Identifier:** A.348

II. Woodland

II.A.4.N.a. Rounded-crowned temperate or subpolar needle-leaved evergreen Woodland

II.A.4.N.a.26. PINUS RIGIDA WOODLAND ALLIANCE
Pitch Pine Woodland Alliance

Concept: This alliance includes evergreen woodlands of rock outcrops, summits, exposed slopes, or, less frequently, sandy soils. In the southeastern United States, associations are dominated by *Pinus rigida* with or without an admixture of *Pinus virginiana*. In the northeastern United States, associated canopy species include *Pinus resinosa, Pinus strobus*, and *Pinus banksiana*, sometimes with an understory of *Quercus ilicifolia*. Associations in this alliance occur at low elevations in the Ridge and Valley, and Cumberland Mountains, on sites outside the geographic range of *Pinus pungens*. Fire plays an important role in maintaining these communities, but on the most extreme sites, these communities are maintained by topo-edaphic conditions.
Comments: In South Carolina, there are probably two associations, one fire-maintained on deeper soils of south-facing slopes in the Blue Ridge with scattered *Vaccinium* and patches of *Schizachyrium scoparium ssp. scoparium*, with *Liatris microcephala, Sorghastrum nutans, Aletris farinosa, Xerophyllum asphodeloides*; the other is a rocky type that is not fire-maintained and not grassy (B. Pittman pers. comm.).
Range: This alliance is found in Kentucky, North Carolina, South Carolina, Tennessee, Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Virginia (?), and West Virginia (?).
States/Provinces: CT DE KY MA ME NC NH NJ NS NY ON PA RI VA? VT WV
TNC Ecoregions: 50:C, 52:C, 59:C, 61:C, 62:C, 63:C, 64:P
Synonymy: Pine savanna/woodland, in part (Evans 1991); Pine--Oak/Heath, in part (Schafale and Weakley 1990); Pitch Pine: 45, in part (Eyre 1980)
References: B. Pittman pers. comm., Evans 1991, Eyre 1980, Schafale and Weakley 1990
Authors: ECS, KP, ECS **Identifier:** A.524

III. SHRUBLAND

III.B.2.N.a. Temperate cold-deciduous shrubland

III.B.2.N.a.9. MYRICA PENSYLVANICA - (PRUNUS MARITIMA) SHRUBLAND ALLIANCE
Northern Bayberry - (Beach Plum) Shrubland Alliance

Concept: Dune thickets of the Atlantic Coast.This alliance includes maritime shrublands dominated by *Myrica pensylvanica*, with *Baccharis halimifolia, Rhus copallinum*, and / or *Rosa rugosa.* Stunted individuals of *Pinus taeda* are frequent in mid-Atlantic occurrences, *Prunus maritima* is characteristic of this community from Maryland to the north. The constant movement of sand in this community limits the herbaceous cover. Typical herbaceous species include *Ammophila breviligulata, Cenchrus tribuloides, Chamaesyce polygonifolia, Cyperus grayi, Dichanthelium acuminatum, Diodia teres, Hudsonia tomentosa, Lechea maritima, Oenothera humifusa, Panicum amarum var. amarulum, Parthenocissus quinquefolia, Rumex acetosella, Solidago sempervirens, Spartina patens, Toxicodendron radicans*, and *Triplasis purpurea*. This maritime shrubland usually occupies the intermediate areas between the very unstable oceanward portions of the dunes and the more protected backdunes, where it forms partially open to dense shrub thickets. The substrate is sand with no soil profile development, and with variable amounts of accumulated leaf litter. Where this community occupies the lee side of foredunes, greater exposure to winds and storms contributes to a shorter stature and more open aspect of the vegetation. Here there are large patches of open unvegetated or sparsely vegetated sand.
Comments:
Range: This alliance is found on the Atlantic coast of the U.S. from North Carolina north to Maine.**States/Provinces:** CT DE MA MD ME NC NH NJ NY RI VA
TNC Ecoregions: 57:C, 58:C, 62:C, 63:C
Synonymy: Maritime Shrub, in part (Schafale and Weakley 1990); *Prunus maritima-Myrica pensylvanica* coastal dune scrub (Clancy 1993); dunegrass-shrub transition zone, in part (Higgins et al. 1971); shrub succession community, in part (Hill 1986); upland (dune) thicket, in part (Klotz 1986)
References: Clancy 1993, Higgins et al. 1971, Hill 1986, Klotz 1986, Schafale and Weakley 1990, Sneddon et al. 1996
Authors: ECS, MP, ECS **Identifier:** A.902

III.B.2.N.a.300. PRUNUS SEROTINA - AMELANCHIER CANADENSIS - QUERCUS SPP. SHRUBLAND ALLIANCE
Black Cherry - Canada Serviceberry - Oak species Shrubland Alliance

Concept: This alliance includes temperate deciduous maritime shrublands, generally occurring on the lee side of sand dunes. The physiognomy of this vegetation is highly variable and may range from open woodland to stunted forest to dense nearly impenetrable thicket. Individual trees tend to be wind-pruned and multiple-stemmed. The canopy may contain *Prunus serotina var. serotina, Amelanchier canadensis, Pinus taeda, Aronia arbutifolia*, and *Sassafras albidum* in varying proportions. *Acer rubrum, Diospyros virginiana*, and *Malus angustifolia* may also be present; *Pinus taeda* and *Ilex opaca var. opaca* may occur locally. *Myrica cerifera* may form a subcanopy, but if the community is particularly stunted, this species may contribute substantially to the canopy as well. This vegetation combines with tall *Vaccinium formosum* to form dense thickets. Examples support vines in great abundance, such as *Smilax rotundifolia, Smilax glauca, Parthenocissus quinquefolia*, and *Toxicodendron radicans*. Herbs are generally scarce to entirely lacking, due to heavy shading from the dense canopy above, and when present are generally tree and vine seedlings sparsely scattered on the dry leaf litter. *Festuca rubra* and *Rumex acetosella* may also be present. Some examples on the coast are subject to salt spray and winds, exhibiting wind pruning. The substrate varies from pure sand directly adjacent to the ocean, to loamy sands in more sheltered areas. Vegetation in these sheltered areas is sometimes referred to as "sunken forest." This name refers to the topographic position of these examples, which are found in large depressions, lower in elevation (by 1 to 3 m) than the interdunes. These examples are shielded from strong prevailing winds and salt spray, which permits lush growth of broadleaf shrub and vine species.
Comments: The physiognomy is better described as shrubland, as height is generally <5 m and is comprised of multiple stems.
Range: This alliance is found in Connecticut, Delaware, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Virginia.

States/Provinces: CT DE MA MD NH NJ NY RI VA
TNC Ecoregions: 58:C, 62:C
Synonymy: White Oak: 53, in part (Eyre 1980); Black Oak: 110, in part (Eyre 1980)
References: Bellis 1993, Boule 1979, Dunlop and Crow 1985, Eyre 1980, Higgins et al. 1971, Hill 1986, Martin 1959b, Sneddon et al. 1994, Stalter 1979
Authors: ECS 12-95, MOD., KP, ECS **Identifier:** A.237

III.B.2.N.a.16. SMILAX SPP. - TOXICODENDRON RADICANS VINE-SHRUBLAND ALLIANCE
Greenbrier species - Poison-ivy Vine-Shrubland Alliance

Concept: This alliance includes vine-covered maritime sand dunes. Generally confined to barrier beach systems, this vegetation is comprised of dense vines that cover the crests of dunes exposed to salt spray and winds. Very little soil development occurs, and the water table is located greater than three feet (one meter) below the soil surface. The dominant species of any single dune may be one of any number of vine species such as *Smilax glauca, Smilax rotundifolia, Vitis rotundifolia, Parthenocissus quinquefolia*, or *Toxicodendron radicans*. In some cases, the vines are low-growing and occur directly on the sand surface, but in others, the vegetation has a height of 1 meter or more, with vines growing over older stems of the same species, or over other shrubs such as *Myrica pensylvanica* or *Myrica cerifera*. The vegetation is generally low to the ground (less than half a meter tall) and generally covers 70 to 80% of the surface of the ground, the remainder being exposed sand.
Comments:
Range: This alliance is found in North Carolina, Delaware, Maryland, Massachusetts, New York, and possibly Virginia (?).
States/Provinces: DE MA MD NC NY VA?
TNC Ecoregions: 57:C, 58:C, 61:P, 62:C
Synonymy: Vine dune (Martin 1959b); Greenbrier thicket (Martin 1959b)
References: Martin 1959b
Authors: ECS, JT, ECS **Identifier:** A.909

III.B.2.N.e. Seasonally flooded cold-deciduous shrubland

III.B.2.N.e.7. VACCINIUM FORMOSUM - VACCINIUM FUSCATUM SEASONALLY FLOODED SHRUBLAND ALLIANCE
Southern Highbush Blueberry - Black Highbush Blueberry Seasonally Flooded Shrubland Alliance

Concept: Depressional wetlands in uplands of the coastal plain and extreme lower Piedmont dominated by *Vaccinium formosum, Vaccinium fuscatum*, and other heaths locally, such as *Lyonia ligustrina var. foliosiflora, Lyonia lucida*, and others. Other shrub/vine species which may be present include *Leucothoe racemosa, Smilax walteri*, and *Viburnum nudum var. nudum*. The shrub coverage sometimes has an open, sparse structure. Trees may be interspersed among the shrubs; these may include *Liquidambar styraciflua, Acer rubrum var. rubrum, Pinus palustris*, and *Pinus taeda*. Herbaceous species that may be present include *Carex crinita, Carex glaucescens, Eleocharis* sp., *Rhynchospora* sp., *Scleria* sp., and *Utricularia gibba*. *Sphagnum* spp. are present in some examples. *Vaccinium* spp. sometimes exceed 5 m in height, but are placed here.
Comments:
Range: This alliance is found in uplands of the coastal plain and extreme lower Piedmont from New England to the Carolinas.
States/Provinces: CT DE MA MD NC NJ NY RI SC VA
TNC Ecoregions: 52:C, 57:C, 58:C, 62:C
Synonymy: Small Depression Pond (Schafale and Weakley 1990); Upland Pool (Schafale and Weakley 1990)
References: Schafale and Weakley 1990
Authors: A.S. WEAKLEY, MP, SCS **Identifier:** A.992

III.B.2.N.h. Tidal cold-deciduous shrubland

III.B.2.N.h.1. BACCHARIS HALIMIFOLIA - IVA FRUTESCENS TIDAL SHRUBLAND ALLIANCE
Groundsel-tree - Maritime Marsh-elder Tidal Shrubland Alliance

Concept: This alliance includes maritime scrub communities typically dominated by *Iva frutescens* or *Baccharis halimifolia* or both, growing in association with salt marshes. These communities occur primarily in estuarine margin situations, especially on the sound sides of barrier islands. Characteristically these communities form an ecotone between salt marsh and upland vegetation or in other areas within areas of salt marsh having slightly higher elevations and lower salinity levels than in the salt marsh proper. Storm-induced disturbance causes periodic die-back of the shrubs restricting the extent of their spread. Characteristic species include *Baccharis halimifolia, Iva frutescens, Rosa carolina, Spartina patens*, and *Panicum virgatum*.
Comments:
Range: This alliance is found in Alabama, Florida, Georgia, Louisiana (?), Mississippi, North Carolina, South Carolina, Texas, Connecticut, Delaware, Massachusetts, Maine, Maryland, New Hampshire, New Jersey, New York, Rhode Island, and Virginia.
States/Provinces: AL CT DE FL GA LA MA MD ME MS NC NH NJ NY RI SC TX VA
TNC Ecoregions: 31:C, 53:C, 55:?, 56:C, 57:C, 58:C, 62:C
Synonymy: Tidal Marsh, in part (Florida Natural Areas Inventory 1992a); Salt Shrub, in part (Schafale and Weakley 1990); Shrub succession community, in part (Higgins et al. 1971); Salt marsh community, in part (Hill 1986); Swamp thicket, in part (Klotz 1986); salt marsh and upper border (Barry 1980); salt grass - marsh elder savanna (Martin 1959b); saltbush zone (Boule 1979); Estuarine scrub-shrub wetland (Tiner 1985b); Salt bush - salt meadow marsh (Daiber et al. 1976); *Iva frutescens-Baccharis halimifolia* (Good 1965); *Iva frutescens* (Klemas et al. 1973); *Baccharis halimifolia* (Klemas et al. 1973); Salt shrub (Reschke 1990); Salt marsh complex, marsh-upland border (Breden 1989)
References: Au 1974, Barry 1980, Boule 1979, Breden 1989, Daiber et al. 1976, Florida Natural Areas Inventory 1992a, Florida Natural Areas Inventory 1992b, Good 1965, Higgins et al. 1971, Hill 1986, Hillestad et al. 1975, Hosier 1975, Klemas et al. 1973, Klotz 1986, Martin 1959b, Nelson 1986, Reschke 1990, Schafale and Weakley 1990, Tiner 1977, Tiner 1985b, Wharton 1978, Wolfe 1990
Authors: D.J. ALLARD, MOD. A.S. WE, JT, ECS **Identifier:** A.1023

IV. DWARF-SHRUBLAND

IV.A.1.N.a. Caespitose needle-leaved or microphyllous evergreen dwarf-shrubland

IV.A.1.N.a.4. HUDSONIA TOMENTOSA DWARF-SHRUBLAND ALLIANCE
Woolly Beach-heather Dwarf-shrubland Alliance

Concept: This alliance consists of sandy or rocky areas dominated by *Hudsonia tomentosa*. This alliance is largely confined to maritime interdunes. This alliance occurs on well-drained sands of back dunes and interdunes, and is documented from Assateague Island; it is a maritime dwarf-shrubland characterized by *Hudsonia tomentosa*, a species adapted to sand burial. *Hudsonia tomentosa* is dominant, occurring as discrete patches that may coalesce into a dense mat on older, more stabilized dunes. A number of other shrubs, such as *Myrica pensylvanica, Myrica cerifera, Pinus taeda* saplings, and *Prunus maritima*, may occur but are low in abundance and cover. *Myrica pensylvanica* shrubs and *Pinus taeda* saplings are almost non-existent but can occur as scattered individuals. Herbaceous vegetation is also quite sparse (less than 5% cover) but may include scattered individuals of *Panicum amarum var. amarulum, Panicum amarum var. amarum, Solidago sempervirens, Nuttallanthus canadensis, Lechea maritima, Ammophila breviligulata, Gnaphalium obtusifolium, Schizachyrium scoparium ssp. littorale, Dichanthelium acuminatum, Oenothera humifusa, Cyperus grayi, Artemisia stelleriana, Chamaesyce polygonifolia*, and *Diodia teres. Toxicodendron radicans* is a common vine. Scattered vines of *Smilax rotundifolia* and canes

of *Rubus argutus* are occasional. The unstable substrate is influenced by wind-deposited sand and supports no soil development; large patches of sparsely vegetated or unvegetated sand are common.
Comments:
Range: This alliance is found in North Carolina, Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Virginia.
States/Provinces: CT DE MA MD ME NC NH NJ NY RI VA
TNC Ecoregions: 57:C, 58:C, 62:C, 63:C
Synonymy:
References: Breden 1989, Clancy 1993, Collins and Anderson 1994, Higgins et al. 1971, Hill 1986, Martin 1959b
Authors: A.S. WEAKLEY/L.E. MORSE, KP, ECS **Identifier:** A.1062

IV.A.1.N.g. Saturated needle-leaved or microphyllous evergreen dwarf-shrubland

IV.A.1.N.g.3. VACCINIUM MACROCARPON SATURATED DWARF-SHRUBLAND ALLIANCE
Large Cranberry Saturated Dwarf-shrubland Alliance

Concept: This alliance, found in parts of the northeastern United States, contains vegetation found in maritime dune-swale communities and mountain bogs of Central Appalachians (beyond the range of *Chamaedaphne calyculata*), as well as cranberry bogs in Ohio. Further information is needed to characterize this alliance.
Comments: The *Sarracenia* bogs of Maryland coastal plain need to be compared with this type. Mountain bogs generally have scattered *Picea rubens* in canopy, which may require a separate alliance.
Range: This alliance is found in Delaware, Massachusetts, New Jersey, New York, Virginia, and Ohio, and possibly Maryland (?).
States/Provinces: DE MA MD? NJ NY RI VA
TNC Ecoregions: 45:C, 48:C, 49:C, 59:C, 62:C, 63:C
Synonymy:
References: Faber-Langendoen et al. 1996
Authors: KP, ECS **Identifier:** A.1094

V. HERBACEOUS VEGETATION

V.A.5.N.c. Medium-tall sod temperate or subpolar grassland

V.A.5.N.c.2. AMMOPHILA BREVILIGULATA HERBACEOUS ALLIANCE
American Beachgrass Herbaceous Alliance

Concept: Dune grasslands dominated by *Ammophila breviligulata*. This alliance includes maritime dune grasslands dominated by *Ammophila breviligulata, Panicum amarum var. amarum*, and *Panicum amarum var. amarulum*. Plant cover is variable, ranging from 10 to 75%, but is usually low. Other associated species include *Solidago sempervirens, Strophostyles helvula, Triplasis purpurea, Cenchrus tribuloides, Chamaesyce polygonifolia, Oenothera humifusa, Scirpus pungens* (where overwashed by sand), *Diodia teres, Cakile edentula ssp. edentula, Nuttallanthus canadensis, Salsola caroliniana, Lechea maritima*, and *Spartina patens*. Sparse individuals of stunted *Myrica pensylvanica* shrubs and seedlings may occur, but make up less than 2% of the total vegetation cover. Diagnostic species are *Ammophila breviligulata, Solidago sempervirens, Panicum amarum var. amarulum*, and *Oenothera humifusa*. This dune grassland community occurs almost exclusively on sandy, unstable, droughty substrates with no soil profile development. Eolian processes cause active sand deposition and erosion. The sand substrate is usually visible, and litter accumulation from plant debris is nearly absent. This community generally occurs on foredunes that receive the force of wind and salt spray, but is beyond the influence of most storm tides.
Comments: This grassland often occurs in a complex with *Myrica pensylvanica / Diodia teres* Shrubland (CEGL003881). It is restricted to the mid-Atlantic Coast and is vulnerable to development pressure.

Range: This alliance occurs on dunes and sandy shores from Maine south to northern North Carolina, on Lake Champlain shorelines in Vermont, and on the Great Lakes shoreline in Michigan, Wisconsin, and Ontario, Canada.
States/Provinces: CT DE IL IN MA MD ME MI NC NH NJ NY ON RI VA VT WI
TNC Ecoregions: 48:C, 57:C, 58:C, 62:C, 63:C, 64:P
Synonymy: Dune Grass, in part (Schafale and Weakley 1990); Dunegrass community (Hill 1986); Dunegrass community (Higgins et al. 1971); Mid-Atlantic *Ammophila breviligulata - Panicum amarulum* dune grassland variant (Clancy 1993); *Ammophila - Panicum amarum* dunes (Harvill 1965); *Panicum - Ammophila* community (Egler 1962); foredune (Klotz 1986); foredune (Boule 1979); sand dune (Fender 1937); dune community (Baumann 1978); coastal dune grass community (Breden 1989); primary dune (Stalter 1990); dunegrass community (Clampitt 1991)
References: Baumann 1978, Boule 1979, Breden 1989, Chapman 1986, Clampitt 1991, Clancy 1993, Egler 1962, Faber-Langendoen et al. 1996, Fender 1937, Harvill 1965, Higgins et al. 1971, Hill 1986, Klotz 1986, Martin 1959b, Schafale and Weakley 1990, Sneddon 1996, Stalter 1990
Authors: ECS, JT, ECS **Identifier:** A.1207

V.A.5.N.k. Seasonally flooded temperate or subpolar grassland

A.1390—SPARTINA PATENS SEASONALLY FLOODED HERBACEOUS ALLIANCE (V.A.5.N.k.29)

Saltmeadow Cordgrass Seasonally Flooded Herbaceous Alliance

Concept: This alliance consists of seasonally flooded (non-tidal) wetlands dominated by ~Spartina patens$, occurring from northeastern United States south and west to Tamaulipas, Mexico.
Synonymy:

- Maritime Wet Grassland, in part (Schafale and Weakley 1990)

Range: This alliance is found in Florida, Louisiana, North Carolina, Texas, New York, Virginia, and possibly in Georgia (?), South Carolina (?), Connecticut (?), Delaware (?), Massachusetts (?), Maryland (?), New Jersey (?), Rhode Island (?), and Tamaulipas (?), Mexico.
Nations: MX? US
States: AL CT? DE? FL GA? LA MA? MD? MXTM? NC NJ? NY RI? SC? TX VA
TNC Ecoregions: 31:C, 53:C, 56:P, 57:C, 58:C, 62:C
Authors: ECS
Origin: 1997-11-26 **Edition:**
References: Schafale and Weakley 1990

V.A.5.N.n. Tidal temperate or subpolar grassland

V.A.5.N.n.1. SPARTINA ALTERNIFLORA TIDAL HERBACEOUS ALLIANCE

Saltmarsh Cordgrass Tidal Herbaceous Alliance

Concept: This alliance includes various tidal marshes dominated by *Spartina alterniflora*. The hydrology is usually regularly tidally flooded. In the northern part of its range, southern Maine to Cape Hatteras, North Carolina, this alliance is generally limited to the zone between mean sea level and the mean high water level. The habitat occurs in protected inlets behind barrier beaches or in drowned river valleys. Peat depth ranges from a few feet, if the community formed over a mud flat, to 80 feet in drowned river valleys. *Spartina alterniflora* is limited to the low marsh zone by moderate salinity; it can withstand longer submergence than other salt marsh grasses, but still requires periodic exposure of the substrate. It also requires moderately high levels of iron (7-15 ppm). This community is commonly known as the "low salt marsh," occurring as a tall grassland strongly dominated by *Spartina alterniflora*. There is little variation in vascular plant species composition across the range. It occurs in nearly pure stands, with occasional low growing species such as *Spergularia salina (= Spergularia marina), Salicornia* spp., *Suaeda maritima*, and seaweeds such as *Ulva lactuca* and other algae such as *Fucus vesiculosus* and *Ascophyllum nodosum*, which grow at the bases of the *Spartina* plants. Herbs of *Salicornia virginica* and *Salicornia bigelovii* can be quite common mixed in with the *Spartina*, often becoming more apparent later in the growing season.

Limonium carolinianum is another characteristic herb, but only as scattered individuals. More detailed information is needed on the variability of the alliance in the southern parts of its range.
Comments:
Range: This alliance is found in Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas, Connecticut, Delaware, Massachusetts, Maine, Maryland, New Hampshire, New Jersey, Rhode Island, and Virginia.
States/Provinces: AL CT DE FL GA LA MA MD ME MS NC NH NJ NY RI SC TX VA
TNC Ecoregions: 30:P, 31:C, 41:P, 53:C, 54:P, 55:P, 56:C, 57:C, 58:C, 62:C, 63:C
Synonymy: Tidal Marsh, in part (Florida Natural Areas Inventory 1992a); Saline Marsh, in part (Wieland 1994a); Saline Marsh, in part (Wieland 1994); Salt Marsh (Schafale and Weakley 1990); Salt Marsh (Smith 1996); Salt Marsh (Nelson 1986); Brackish Marsh, in part (Nelson 1986); Smooth Cordgrass Series, in part (Diamond 1993); Smooth Cordgrass Marsh (Wharton 1978)
References: Diamond 1993, Eleuterius 1972, Florida Natural Areas Inventory 1992a, Kurz and Wagner 1957, Montague and Wiegert 1990, Nelson 1986, Odum 1988, Schafale and Weakley 1990, Smith 1996, Tiner 1977, Wharton 1978, Wieland 1994, Wieland 1994a
Authors: D.J. ALLARD, JT, ECS **Identifier:** A.1471

A.1472—TYPHA (ANGUSTIFOLIA, DOMINGENSIS) TIDAL HERBACEOUS ALLIANCE (V.A.5.N.n.2)

(Narrowleaf Cattail, Southern Cattail) Tidal Herbaceous Alliance

Concept: Tidal marshes dominated by Typha angustifolia$ and/or Typha domingensis. Examples of this alliance are composed of a mixture of salt marsh and freshwater tidal marsh species. The vegetation is dense and characterized by tall graminoids such as Typha angustifolia, with associates including Spartina cynosuroides, Phragmites australis or Schoenoplectus americanus (= Scirpus americanus), Pontederia cordata, Lilaeopsis chinensis, Hibiscus moscheutos (= Hibiscus palustris), and Pluchea odorata. Other characteristic species include Hibiscus moscheutos, Spartina patens, Distichlis spicata, Schoenoplectus pungens (= Scirpus pungens), Lycopus americanus, Eleocharis palustris, Hydrocotyle umbellata, Eupatorium capillifolium, Ptilimnium capillaceum, Bidens spp., and Spartina alterniflora. This community is typically a brackish tidal marsh occurring where water salinity ranges from 0.5-18.0 ppt. Brackish marshes are most extensive on large tidal rivers, but smaller marshes of this alliance also occur at the upper limits of larger tidal creeks. The alliance occurs along the Atlantic coast from Maine through South Carolina and along the Gulf coast in Alabama and Texas. Alabama and Texas communities occur in oligohaline tidal marshes and are dominated by Typha domingensis. Further research is necessary to determine the classification, and thus the range, with confidence.
Synonymy:

- Tidal Freshwater Marsh, in part (Schafale and Weakley 1990)
- Cattail Community Type (Odum et al. 1984)
- Transitional fresh marsh, in part (Hill 1986)
- ~Typha angustifolia-Hibiscus palustris$ community (Metzler and Barrett 1992)
- Brackish tidal marsh (Reschke 1990)
- Brackish tidal marsh complex (Breden 1989)
- Brackish tidal marsh community (Maine Natural Heritage Program (MENHP) 1991)
- Brackish marsh (Sperduto 1994)
- ~Hibiscus$ marsh (Cahoon and Stevenson 1986)
- narrowleaf cattail type (McCormick and Ashbaugh 1972)
- ~Typha angustifolia$ community (Good and Good 1975a)
- ~Typha angustifolia$ type (Ferren et al. 1981)
- fresh-brackish marsh (Klotz 1986)

Range: The alliance occurs along the Atlantic coast from Maine through South Carolina and along the Gulf coast in Alabama and Texas.
Nations: US
States: AL CT DE FL? MA MD ME MS? NC? NH NJ NY RI SC? TX VA
TNC Ecoregions: 31:C, 53:C, 56:C, 57:C, 58:C, 62:C, 63:C
Authors: ECS/A.S. WEAKLEY
Origin: 1997-11-26

References: Breden 1989, Cahoon and Stevenson 1986, Ferren et al. 1981, Good and Good 1975a, Hill 1986, Klotz 1986, Maine Natural Heritage Program (MENHP) 1991, McCormick and Ashbaugh 1972, Metzler and Barrett 1992, Nelson 1986, Odum et al. 1984, Reschke 1990, Schafale and Weakley 1990, Sperduto 1994

V.A.5.N.n.4. ELEOCHARIS FALLAX - ELEOCHARIS ROSTELLATA TIDAL HERBACEOUS ALLIANCE (A.1474)

Creeping Spikerush - Beaked Spikerush Tidal Herbaceous Alliance

Concept: This alliance includes peaty oligohaline marshes, well away from tidal guts, with frequent to dominant *Eleocharis fallax* and *Eleocharis rostellata*; these have been termed "spikerush lawns" in very slightly brackish (oligohaline) marshes. Other characteristic species can include *Centella erecta, Eriocaulon decangulare, Ludwigia alata, Cyperus haspan, Cladium mariscoides, Sabatia dodecandra, Eryngium aquaticum, Proserpinaca palustris, Ludwigia alata*, and *Juncus* spp. This alliance ranges from Maryland southwards along the southeastern coastal plain. Salinity is 0.5-5 parts per thousand. Even though there is some variability in the expression of this marsh vegetation between North Carolina and Virginia examples, only one association has been described. May occur north to Long Island, NY.
Range: This alliance ranges from Maryland southwards along the southeastern coastal plain. It is found in Alabama, Delaware, Florida, Louisiana, North Carolina, Maryland, Virginia, and possibly elsewhere.
States/Provinces: AL,DE,FL,LA,MD,NC,VA
TNC Ecoregions: 31:C, 53:C, 55:P, 57:C, 58:C
Synonymy: Tidal Freshwater Marsh, Oligohaline Variant, in part (Schafale and Weakley 1990)
References: Fleming 1998, Schafale and Weakley 1990
Authors: ASW 1-95, MOD. GPF **Identifier:** A.1474

A.1476—PANICUM VIRGATUM TIDAL HERBACEOUS ALLIANCE (V.A.5.N.n.6)

Switchgrass Tidal Herbaceous Alliance

Concept: This alliance consists of brackish to oligohaline tidal marshes dominated by Panicum virgatum$. Hydrology of this alliance is irregularly tidally inundated, usually occurring above ~Juncus roemerianus$ and other tidal marshes, and at the conceptual edge of tidal and upland communities. Associated species in the northern part of the alliance's range include Spartina pectinata, Agrostis stolonifera, Cladium mariscoides, Schoenoplectus americanus (= Scirpus americanus), Solidago sempervirens, Baccharis halimifolia, and Tripsacum dactyloides. Associates in the southern portion of the range include Cladium mariscus ssp. jamaicense, Sagittaria lancifolia, and Spartina cynosuroides.
Similar Alliances:

- BACCHARIS HALIMIFOLIA - IVA FRUTESCENS TIDAL SHRUBLAND ALLIANCE (A.1023)

Comments: This vegetation typically intergrades with the Baccharis halimifolia - Iva frutescens Tidal Shrubland Alliance (A.1023); its status as a distinct alliance may require further study. More information is needed on its expression and extent in the southeastern U.S.
Range: This alliance is found in Alabama, Mississippi, Connecticut, Delaware, Massachusetts, Maryland, New Jersey, New York, Rhode Island, and Virginia, and possibly in Florida (?) and Louisiana (?).
Nations: US
States: AL CT DE FL? LA? MA MD MS NJ NY RI
TNC Ecoregions: 53:C, 55:P, 56:P, 57:P, 58:P, 61:C, 62:C
Authors: ECS
Origin: 1997-11-26
References: Sneddon et al. 1994

V.A.5.N.n.7. PHRAGMITES AUSTRALIS TIDAL HERBACEOUS ALLIANCE

Common Reed Tidal Herbaceous Alliance

Concept: This alliance consists of tidal marshes, dominated (usually essentially monospecific) by *Phragmites australis*. In the southeastern United States, it is well documented that *Phragmites* is alien, only

recently introduced and spreading rapidly in tidal and non-tidal situations. Associated species are highly variable, depending on the vegetation that has been invaded. Spreading in large colonies, *Phragmites* eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Myrica cerifera* shrubs, *Kosteletzkya virginica, Calystegia sepium, Boehmeria cylindrica, Typha angustifolia, Apocynum cannabinum, Rosa palustris, Polygonum sp*., and *Mikania scandens*. Vines of *Toxicodendron radicans* are also frequent, but typically occur at low cover. Although *Phragmites australis* rhizomes have been noted in salt marsh sediments exceeding three thousand years in age and is thus a native component of salt marshes in some areas of North America, the growth habit of the species in its native condition was likely to have been significantly different than the dense monotypic stands that characterize this alliance. The presence of the *Phragmites australis* alliance in wetlands today generally indicates human-induced disturbance, either through direct habitat manipulation or through passive introduction of reproductive material to naturally disturbed substrates. In cases where *Phragmites australis* is a significant component of the vegetation but the vegetation retains sufficient species composition to retain its identity, the site is considered an unhealthy or degraded example of that vegetation type. This is in contrast to cases where *Phragmites australis* cover is so high that native species have been excluded and the original alliance is no longer recognizable, then the occurrence falls within the *Phragmites australis* Tidal Herbaceous Alliance (A.1477).
Comments:
Range: This alliance is found in Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas, Connecticut, Delaware, Massachusetts, Maine, Maryland, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Virginia, and most likely in the maritime provinces of Canada.
States/Provinces: AL CT DE FL GA LA MA MD ME MS NC NF? NH NJ NS? NY PA PE? QC? RI SC TX VA
TNC Ecoregions: 31:C, 53:C, 55:P, 56:C, 57:C, 58:C, 59:C, 62:C
Synonymy: Tidal Freshwater Marsh, in part (Nelson 1986); *Phragmites australis* Association (Fleming 1998); *Phragmites australis* community (Metzler and Barrett 1992); *Phragmites australis* tidal marsh association (Clancy 1993); No equivalent (Schafale and Weakley 1990)
References: Clancy 1993, Fleming 1998, Metzler and Barrett 1992, Nelson 1986, Niering and Warren 1977, Odum et al. 1984, Schafale and Weakley 1990
Authors: A.S. WEAKLEY, MP, SCS **Identifier:** A.1477

V.A.5.N.n.11. SPARTINA PATENS - (DISTICHLIS SPICATA) TIDAL HERBACEOUS ALLIANCE
Saltmeadow Cordgrass - (Saltgrass) Tidal Herbaceous Alliance

Concept: Vegetation strongly dominated by *Distichlis spicata* and occurring in tidal situations, or with mixtures of *Distichlis spicata* and *Spartina patens*. From Delaware south to Florida, this high salt marsh coastal community is dominated by *Spartina patens*, forming meadows at slightly higher elevations in relation to the adjacent *Spartina alterniflora* Tidal Herbaceous Alliance (A.1471). *Distichlis spicata, Limonium carolinianum, Agalinis maritima, Salicornia virginica, Sabatia stellaris, Borrichia frutescens, Lythrum lineare, Scirpus pungens, Eleocharis rostellata, Solidago sempervirens, Fimbristylis castanea, Pluchea odorata (= Pluchea purpurascens), Hibiscus moscheutos (= Hibiscus palustris)*, and *Atriplex prostrata (= Atriplex patula var. hastata)* are characteristic associates. This alliance can include areas locally dominated by *Distichlis spicata* or *Limonium carolinianum*. Shrub seedlings such as *Baccharis halimifolia* and *Myrica cerifera* may also be present. This alliance receives irregular tidal flooding. The substrate is peat of variable depths overlying sand. Diagnostic species are *Spartina patens, Distichlis spicata, Borrichia frutescens, Kosteletzkya virginica*, and *Pluchea odorata*. The associated *Juncus roemerianus* Tidal Herbaceous Alliance (A.1475) occurs as discrete patches which reach substantial size. This alliance also includes salt or brackish marshes of the Gulf Coast in Texas. In these examples, *Distichlis spicata* often forms pure stands, but *Spartina alterniflora, Spartina patens, Spartina spartinae, Paspalum* spp., and *Eragrostis* spp. may be present. Other species present may include forbs such as *Suaeda linearis*. Here, this alliance forms mosaics with Gulf Coast coastal cordgrass marshes and saline herbaceous vegetation. Western states have a different alliance for inland situations, the *Distichlis spicata* Intermittently Flooded Herbaceous Alliance (A.1332).
Comments: Concept needs revision following name change that resulted from inter-regional crosswalk. "Intermediate Marsh" vegetation from Louisiana is reported to be dominated by *Spartina patens* and to

additionally contain *Spartina cynosuroides, Cladium mariscus ssp. jamaicense, Scirpus californicus, Scirpus americanus (= Scirpus olneyi), Echinochloa walteri, Phragmites australis (= Phragmites communis), Sagittaria lancifolia*, and *Bacopa monnieri*. This may represent multiple zones; more research is needed.
Range: This alliance is found in Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas, Delaware, Maryland, and Virginia.
States/Provinces: AL CT DE FL GA LA MA MD ME MS NC NH NJ NY RI SC TX VA
TNC Ecoregions: 30:P, 31:C, 41:P, 53:C, 54:P, 55:P, 56:C, 57:C, 58:C, 62:C, 63:C
Synonymy: Intermediate Marsh (Smith 1996); Salt Marsh, in part (Smith 1996); Salt Marsh, in part (Wieland 1994); Salt Marsh, in part (Schafale and Weakley 1990); Salt Marsh, in part (Nelson 1986); Brackish Marsh, in part (Wieland 1994); Brackish Marsh, in part (Nelson 1986); Marshhay Cordgrass Series, in part (Diamond 1993); Saltgrass-Cordgrass Series (Diamond 1993)
References: Adams 1963, Clancy 1993, Cooper and Waits 1973, Diamond 1993, Higgins et al. 1971, Hill 1986, Montague and Wiegert 1990, Nelson 1986, Odum 1988, Odum and Smith 1981, Penfound 1952, Schafale and Weakley 1990, Smith 1996, Tiner 1977, Wieland 1994, Wieland 1994a
Authors: A.S. WEAKLEY 9-94, MOD., JT, ECS **Identifier:** A.1481

V.A.7.N.g. Medium-tall temperate or subpolar grassland with a sparse cold-deciduous shrub layer

V.A.7.N.g.1. SCHIZACHYRIUM SCOPARIUM SSP. LITTORALE SHRUB HERBACEOUS ALLIANCE
Seaside Little Bluestem Shrub Herbaceous Alliance

Concept: Dune grasslands dominated by *Schizachyrium scoparium ssp. littorale*. This alliance occurs on deep well-drained sands of old leveled interdunes. It usually occurs within the influence of offshore winds and salt spray. Although highly variable in species composition, the typical expression of this alliance is characterized by a predominance (25-50% cover) of bunchgrasses including *Schizachyrium scoparium ssp. littorale, Andropogon virginicus, Panicum amarum var. amarulum, Ammophila breviligulata, Dichanthelium scoparium*, and *Dichanthelium acuminatum*. Generally one or two of these species will dominate while the others occur as more infrequent, scattered clumps. Occasionally *Spartina patens*, growing in a dry "wispy" condition, will form the dominant graminoid cover. Shrubs of *Myrica pensylvanica* are sparse, and stunted *Baccharis halimifolia* and *Diospyros virginiana* are even less frequent. Dense tangles of *Toxicodendron radicans* are very characteristic of this alliance as they sprawl over the bareground and sparse vegetation. *Rubus argutus* is also scattered throughout. Much of the remaining dry sands are exposed with sparsely distributed herbs. Characteristic herb species include *Cirsium horridulum, Solidago sempervirens, Gnaphalium obtusifolium, Nuttallanthus canadensis, Euthamia tenuifolia, Oenothera humifusa*, and *Diodia teres*. This vegetation is related to maritime grasslands of New England and New York. Further analysis is required to determine the classification, and thus the range, with confidence.
Comments:
Range: This vegetation is related to maritime grasslands of New England and New York. This alliance is found in North Carolina, Maryland, New Jersey, and Virginia, and elsewhere.
States/Provinces: DE LA MA MD ME NC? NJ NY TX VA
TNC Ecoregions: 31:C, 57:C, 58:C, 62:C
Synonymy:
References: Higgins et al. 1971, Hill 1986, Sneddon et al. 1996
Authors: A.S. WEAKLEY, JT, ECS **Identifier:** A.1533

A.1704—SARCOCORNIA PERENNIS - (DISTICHLIS SPICATA, SALICORNIA SPP.) TIDAL HERBACEOUS ALLIANCE (V.B.2.N.g.4)
Woody-glasswort - (Saltgrass, Saltwort species) Tidal Herbaceous Alliance

Comments: This alliance is reported from two very disjunct areas, California and New Hampshire. In California it is very poorly known, and documented only by Sawyer and Keeler-Wolf (1995). Not enough information was available to complete a description of this alliance at this time, and the two associations (one from New Hampshire and one from California) need to be reviewed to determine if they belong to the same alliance.
Authors: M.S. REID
Origin: 1997-11-26 **Edition:** 99-05-23

VII. SPARSE VEGETATION

VII.C.2.N.a. Sand flats

VII.C.2.N.a.2. CAKILE EDENTULA SPARSE VEGETATION ALLIANCE
Sea-rocket Sparse Vegetation Alliance

Concept: Annual-dominated sand flats on island end flats and upper ocean beaches, within the reach of storm tides and extreme lunar tides. This alliance has less perennial species than the related *Cakile constricta* Sparsely Vegetated Alliance (A.1860), since the Atlantic Coast shoreline is a higher-energy system, and the alliance is more dynamic and more frequently disturbed. Vegetative cover is variable, depending on the amount of exposure to wave and wind action, but on average is sparse; no species can be considered dominant. Annual or biennial species more or less restricted to beach habitats are characteristic of this alliance, including *Cakile edentula ssp. edentula*, as well as *Salsola caroliniana, Chamaesyce polygonifolia, Honckenya peploides, Cenchrus tribuloides, Amaranthus retroflexus, Chenopodium album, Erechtites hieraciifolia*, and *Atriplex pentandra (= Atriplex arenaria)*. Associated species include *Ammophila breviligulata, Chamaesyce polygonifolia, Salsola caroliniana*, and *Triplasis purpurea*. At Assateague Island National Seashore, this alliance is sparsely vegetated with *Cakile edentula ssp. edentula*, covering approximately one percent of the area. Other associated species in this alliance are just as sparse and generally adapted to a low growth form, given the exposed windy conditions of their environment. The South Atlantic Coast phase of this alliance occupies the upper portion of ocean beaches in the southern part (Cape Hatteras, North Carolina, to Cape Romain, South Carolina) of the microtidal region (barrier islands with coastal geomorphology dominated by hurricane overwash rather than tidal energy). Other characteristic species include mostly annual herbs, such as *Chamaesyce polygonifolia, Chamaesyce bombensis, Sesuvium portulacastrum, Salsola caroliniana*, and the rare *Amaranthus pumilus*. In addition to the two associations in the Southeast, there is also an association in the Great Lakes; in this association the dominant plant is *Cakile edentula ssp. edentula var. lacustris*.
Comments:
Range: This alliance is found in Florida (?), Georgia (?), North Carolina, South Carolina, Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Virginia, Illinois, Indiana, Michigan, Ohio, and Wisconsin; and in Canada in Ontario.
States/Provinces: CT DE FL? GA? IL IN MA MD ME MI NC NH NJ NY OH ON PA RI SC VA WI
TNC Ecoregions: 48:C, 56:C, 57:C, 58:C, 62:C
Synonymy: Upper Beach, in part (Schafale and Weakley 1990); Maritime Grassland, in part (Nelson 1986); Beach community (Hill 1986); Beach community (Johnson 1985); Beach community (Baumann 1978); beach (Higgins et al. 1971); beach (Fender 1937); beach (McDonnell 1979); pioneer beach community (Boule 1979); dune-strand area (Clovis 1968); dune community (Jenkins 1974); middle beach (Shreve et al. 1910); middle beach (Nichols 1920); *Cakiletum edentula* (Conard 1935); sea-strand vegetation, beach formation (Harshberger 1900); embryo dune (Klotz 1986); maritime beach (Reschke 1990); beach vegetation (Moul 1973); marine sandy beach (Clancy 1993); marine intertidal gravel/sand

beach community (Breden 1989); coastal beach strand (Sperduto 1994); Beach strand community (Maine Natural Heritage Program (MENHP) 1991); *Cakile edentula-Chenopodium album* community (Metzler and Barrett 1992); dune and swale community, in part (Stalter 1990)
References: Baumann 1978, Boule 1979, Breden 1989, Clancy 1993, Clovis 1968, Conard 1935, Fender 1937, Harshberger 1900, Higgins et al. 1971, Hill 1986, Jenkins 1974, Johnson 1985, Klotz 1986, Maine Natural Heritage Program (MENHP) 1991, McDonnell 1979, Metzler and Barrett 1992, Moul 1973, Nelson 1986, Nichols 1920, Reschke 1990, Schafale and Weakley 1990, Shreve et al. 1910, Sperduto 1994, Stalter 1990
Authors: JT, ECS **Identifier:** A.1861

7.10 Species List

Family	Scientific Name	Common Name
Aceraceae		
	Acer rubrum	red maple
Anacardiaceae		
	Rhus copallina	dwarf sumac
	Toxicodendrom radicans	eastern poison ivy
Aquifoliaceae		
	Ilex glabra	inkberry
	Ilex opaca	American holly
Araceae		
	Arisaema triphyllum	swamp jack-in-the-pulpit
Araliaceae		
	Aralia nudicaulis	wild sarsaparilla
Asteraceae		
	Achillea millefolium	common yarrow
	Antennaria plantaginifolia	plantain-leaf pussytoes
	Aster dumosus	bushy aster
	Aster ericoides	white heath aster
	Aster lateriflorus	starved aster
	Aster paternus	toothed white-top aster
	Aster spectabilis	showy aster
	Baccharis halimifolia	eastern baccharis
	Bidens frondosa	devil's beggartick
	Chrysopsis mariana	Maryland goldenaster
	Cirsium horridulum	yellow thistle
	Conyza Canadensis	Canadian horseweed
	Erechtites hieracifolia	burnweed
	Eupatorium perfoliatum	common boneset
	Euthamia graminifolia	flattop goldentop
	Euthamia tenuifolia	slender goldentop

	Gnaphalium obtusifolium	fragrant cudweed
	Hieracium caespitosum	meadow hawkweed
	Hypochaeris radicata	hairy catsear
	Krigia virginica	Virginia dwarfdandelion
	Petradoria pumila	giant rockgoldenrod
	Pluchea odorata	sweetscent
	Solidago sempervirens	seaside goldenrod
	Solidago tenuifolia	grass-leaved goldenrod
	Taraxacum officinale	common dandelion
Aulacomniaceae		
	Aulacomnium palustre	aulacomnium moss
Berberidaceae		
	Berberis thunbergii	japanese barberry
Brassicaceae		
	Cakile edentula	American searocket
	Lepidium virginicum	Virginia pepperweed
Bryaceae		
	Bryum pseudotriquetrum	bryum moss
Caprifoliaceae		
	Lonicera japonica	Japanese honeysuckle
	Viburnum dentatum	southern arrowwood
Caryophyllaceae		
	Cerastium spp.	chickweed spp.
	Moehringia lateriflora	bluntleaf sandwort
Chenopodiaceae		
	Salicornia maritime	slender grasswort
	Salicornia virginica	Virginia glasswort
Cistaceae		
	Hudsonia tomentosa	woolly beachheather

	Lechea maritime	beach pinweed
Cladoniaceae		
	Cladina rangiferina	greygreen reindeer lichen
	Cladina subtenuis	reindeer lichen
	Cladonia cristatella	cup lichen
	Cladonia uncialis	cup lichen
Clethraceae		
	Clethra alnifolia	coastal sweetpepperbush
Climaciaceae		
	Climacium spp.	climacium moss
Clusiaceae		
	Hypericum canadense	lesser Canadian St. Johnswort
	Hypericum gentianoides	orangegrass
	Triadenum virginicum	Virginia marsh St. Johnswort
Convolvulaceae		
	Convovulus sepium	hedge false bindweed
Cupressaceae		
	Juniperus virginiana	eastern redcedar
Cuscutaceae		
	Cuscuta spp.	dodder
Cyperaceae		
	Bolboschoenus maritimus	saltmarsh bulrush
	Carex crinita	fringed sedge
	Carex gracillima	graceful sedge
	Carex lurida	shallow sedge
	Carex multicaulis	manystem sedge
	Carex pensylvanica	Pennsylvania sedge
	Carex silicea	beach sedge
	Cladium mariscoides	smooth sawgrass

	Cladium mariscus	swamp sawgrass
	Cyperus gracilis	slimjim flatsedge
	Cyperus grayi	Gray's flatsedge
	Cyperus polystachyos	manyspike flatsedge
	Cyperus strigosus	strawcolored flatsedge
	Eleocharis acicularis	needle spikerush
	Eleocharis olivacea	bright green spikerush
	Eleocharis parvula	small spikerush
	Eleocharis rostellata	beaked spikerush
	Fimbristylis autumnalis	slender fimbry
	Rhynchospora alba	whitebeaked rush
	Rhynchospora capitellata	brownish beaksedge
	Scirpus americanus	three-square bulrush
	Scirpus cyperinus	woolgrass
	Scirpus pungens	three-square bulrush
	Scirpus robustus	saltmarsh bulrush
Dennstaedtiaceae		
	Pteridium aquilinum	western brackenfern
Dicranaceae		
	Dicranella spp.	dicranella moss
	Dicranum spp.	dicranum moss
	Dicranum polysetum	dicranum moss
Ditrichaceae		
	Ceratodon purpureus	ceratodon moss
Droseraceae		
	Drosera intermedia	spoonleaf sundew
	Drosera rotundifolia	roundleaf sundew
Ericaceae		
	Arctostaphylos spp	manzanita species
	Epigaea repens	trailing arbutus
	Gaultheria procumbens	eastern teaberry
	Gaylussacia baccata	black huckleberry

	Gaylussacia frondosa	blue huckleberry
	Leucothoe racemosa	swamp doghobble
	Lyonia ligustrina	maleberry
	Lyonia mariana	piedmont staggerbush
	Rhododendron viscosum	swamp azalea
	Vaccinium angustifolium	lowbush blueberry
	Vaccinium corymbosum	highbush blueberry
	Vaccinium macrocarpon	cranberry
	Vaccinium pallidum	Blue Ridge blueberry
Euphorbiaceae		
	Chamaesyce polycarpa	smallseed sandmat
	Chamaesyce polygonifolia	seaside sandmat
Fabaceae		
	Lathyrus japonicus	sea peavine
	Robinia pseudoacacia	black locust
	Strophostyles helvula	trailing fuzzybean
	Trifolium pratense	red clover
	Trifolium repens	white clover
	Quercus alba	white oak
	Quercus coccinea	scarlet oak
	Quercus ilicifolia	bear oak
	Quercus stellata	post oak
	Quercus veluntina	black oak
Gentianaceae		
	Sabatia stellaris	rose of Plymouth
Hypnaceae		
	Hypnum imponens	hypnum moss
Juglandaceae		
	Carya glabra	pignut hickory
	Carya tomentosa	mockernut hickory
Juncaceae		

	Juncus ambiguous	rush
	Juncus Canadensis	Canadian rush
	Juncus dichotomus	forked rush
	Juncus dudleyi	Dudley's rush
	Juncus effusus	common rush
	Juncus gerardii	saltmeadow rush
	Juncus greenei	Greene's rush
	Juncus pelocarpus	brownfruit rush
	Juncus scirpoides	needlepod rush
	Juncus tenuis	poverty rush
Lamiaceae		
	Lycopus uniflorus	northern bugleweed
	Lycopus virginicus	Virginia waterhorehound
	Scutellaria nervosa	veiny skullcap
	Teucrium canadense	Candad germander
Lauraceae		
	Lindera benzoin	northern spicebush
	Sassafras albidum	sassafras
Lentibulariaceae		
	Utricularia subulata	zigzag bladderwort
Leucobryaceae		
	Leucobryum glaucum	leucobryum moss
Liliaceae		
	Maianthemum canadense	Canada beadruby
Lycopodiaceae		
	Lycopodiella inundata	inundated clubmoss
Lythraceae		
	Decodon verticillatus	swamp loosestrife
Malvaceae		

	Hibiscus moscheutos	crimsoneyed rosemallow
Mniaceae		
	Mnium spp.	mnium calcareous moss
Monotropaceae		
	Monotropa uniflora	Indianpipe
Myricaceae		
	Myrica pensylvanica	northern bayberry
Myrtaceae		
	Myrcia paganii	ausu
Nyssaceae		
	Nyssa sylvatica	blackgum
Onagraceae		
	Epilobium coloratum	purpleleaf willowherb
	Ludwigia palustris	marsh seedbox
	Oenothera oakesiana	Oakes' eveningprimrose
	Oenothera perennis	small eveningprimrose
Orchidaceae		
	Spiranthes cernua	nodding ladiestresses
Osmundaceae		
	Osmunda cinnamomea	cinnamon fern
	Osmunda regalis	royal fern
Parmeliaceae		
	Cetraria spp.	cetraria lichen
	Flavoparmelia spp.	flavoparmelia lichen
Pinaceae		
	Pinus rigida	pitch pine
	Pinus thungergii	Japanese black pine

Plumbaginaceae		
	Limonium californicum	California sealavender
Poaceae		
	Agrostis capillaries	colonial bentgrass
	Agrostis scabra	rough bentgrass
	Agrostis stolonifera	spreading bentgrass
	Ammophila breviligulata	American beachgrass
	Andropogon spp.	bluestem species
	Andropogon virginicus	broom-sedge
	Anthoxanthum odoratum	sweet vernal grass
	Cinna spp.	Woodreed
	Danthonia spicata	poverty danthonia
	Deschampsia flexuosa	wavy hairgrass
	Dichanthelium acuminatum	tapered rosette grass
	Dichanthelium clandestinum	deertongue panicgrass
	Dichanthelium dichotomum	cypress panicgrass
	Dichanthelium sabulorum	hemlock rosette grass
	Dichanthelium sphaerocarpon	
	Distichlis spicata	inland saltgrass
	Echinochloa spp.	Cockspur
	Elymus canadensis	Canada wildrye
	Elymus virginicus	Virginia wildrye
	Eragrostis spectabilis	purple lovegrass
	Festuca rubra	red fescue
	Glyceria striata	fowl mannagrass
	Panicum amarum	bitter panicgrass
	Panicum virgatum	switchgrass
	Phragmites australis	common reed
	Poa compressa	Canada bluegrass
	Poa pratensis	Kentucky bluegrass
	Schizachyrium scoparium	little bluestem
	Spartina alterniflora	smooth cordgrass
	Spartina patens	saltmeadow cordgrass
	Tridens flavus	purpletop tridens
Polygonaceae		
	Polygonum glaucum	seaside knotweed

	Polygonella articulata	coastal jointweed
	Polygonum convolvulus	black bindweed
	Polygonum hydropiper	marshpepper knotweed
	Polygonum hydropiperoides	swamp smartweed
	Rumex acetosella	common sheep sorrel
	Rumex obtusifolius	bitter dock
Polytrichaceae		
	Atrichum spp.	atrichum moss
	Polytrichum juniperinum	juniper polytrichum moss
Primulaceae		
	Lysimachia terrestris	earth loosestrife
	Trientalis borealis	American starflower
Pyrolaceae		
	Chimaphila maculata	striped prince's pine
Rhamnaceae		
	Frangula alnus	buckthorn
Rosaceae		
	Amelanchier arborea	downy serviceberry
	Amelanchier canadensis	oblong-leaf serviceberry
	Aronia melanocarpa	black chokeberry
	Prunus maritima	beach plum
	Prunus serotina	black cherry
	Prunus virginiana	chokecherry
	Rosa carolina	Carolina rose
	Rosa multiflora	multiflora rose
	Rosa palustris	swamp rose
	Rosa rugosa	rugosa rose
	Rosa virginiana	Virginia rose
	Rubus flagellaris	northern dewberry
	Rubus hispidus	bristly dewberry
	Rubus pubescens	dwarf red blackberry
Salicaceae		
	Populus grandidentata	bigtooth aspen
Salix discolor		pussy willow

Scophulariaceae		
	Linaria canadensis	old-field toadflax
	Agalinis maritime	salt-marsh false-foxglove
	Agalinis purpurea	large-purple false-foxglove
	Nuttallanthus canadensis	Canada toadflax
	Verbascum thapsus	common mullein
Smilacaceae		
	Smilax glauca	cat greenbrier
	Smilax rotundifolia	roundleaf greenbrier
Solanaceae		
	Solanum dulcamara	climbing nightshade
Sphagnaceae		
	Sphagnum angustifolium	sphagnum
	Sphagnum centrale	sphagnum
	Sphagnum fallax	sphagnum
Thelypteridaceae		
	Thelypteris noveboracensis	New York fern
	Thelypteris palustris	eastern marsh fern
Typhaceae		
	Typha angustifolia	narrowleaf cattail
	Typha latifolia	broadleaf cattail
Urticaceae		
	Pilea spp.	Clearweed
Verbenaceae		
	Verbena hastata	swamp verbena
Violaceae		
	Viola lanceolata	bog white violet
Vitaceae		
	Parthenocissus quiquefolia	Virginia creeper
	Vitis labrusca	fox grape
Xyridaceae		
	Xyris torta	slender yelloweyed grass

7.11 Annotated List of Ground Photos

Photo Name	Photo Description	Trip Dates	Category
010912d18p2	Acidic Red Maple Basin Swamp	Sep. 2001	vegetation
GoldenHeather.jpg	Beach Heather Dune	Jun-99	vegetation
000508D4P2.jpg	Beach Heather Dune	May-00	vegetation
000510D1P1.jpg	Beach Heather Dune	May-00	vegetation
000512D1P7.jpg	Beach Heather Dune	May-00	vegetation
BeachHeather.jpg	Beach Heather Dune	May-00	vegetation
BeachHeather.jpg	Beach Heather Dune	Oct. 1999	vegetation
000927d3p2	Beach Heather Dune	Sep. 2000	vegetation
000927d3p3	Beach Heather Dune	Sep. 2000	vegetation
00925d14p4	Beach Heather Dune	Sep. 2000	vegetation
00927d4p3	Beach Heather Dune	Sep. 2000	vegetation
Heather Dune.jpg	Beach Heather Dune	Sep. 2001	vegetation
000511D15P1.jpg	Black Pine Forest	May-00	vegetation
jap black pine.jpg	Black Pine Forest	Oct. 1999	vegetation
PineSpp.jpg	Black Pine Forest	Oct. 1999	vegetation
000927d3p1	Black Pine Forest	Sep. 2000	vegetation
00928d5p1	Black Pine Forest	Sep. 2000	vegetation
idunal_swale1.jpg	Brackish Interdunal Swale	TNC	vegetation
idunal_swale2.jpg	Brackish Interdunal Swale	TNC	vegetation
idunal_swale3.jpg	Brackish Interdunal Swale	TNC	vegetation
idunal_swale4.jpg	Brackish Interdunal Swale	TNC	vegetation
idunal_swale5.jpg	Brackish Interdunal Swale	TNC	vegetation
idunal_swale6.jpg	Brackish Interdunal Swale	TNC	vegetation
idunal_swale7.jpg	Brackish Interdunal Swale	TNC	vegetation
PIVI.jpg	Brackish Meadow	May-00	vegetation
00925d13p2	Brackish Meadow	Sep. 2000	vegetation
00925d13p3	Brackish Meadow	Sep. 2000	vegetation
00925d14p1	Brackish Meadow	Sep. 2000	vegetation
Brackish Meadow 2.jpg	Brackish Meadow	Sep. 2001	vegetation
Brackish Meadow 3.jpg	Brackish Meadow	Sep. 2001	vegetation
Brackish Meadow.jpg	Brackish Meadow	Sep. 2001	vegetation
brackish_meadow1.jpg	Brackish Meadow	TNC	vegetation
brackish_meadow2.jpg	Brackish Meadow	TNC	vegetation
DecidForFloyd.jpg	Coastal Oak-Heath Forest	Jun-99	vegetation
HedgerowFloyd.jpg	Coastal Oak-Heath Forest	Jun-99	vegetation
ForestAtFLoyd.jpg	Coastal Oak-Heath Forest	Oct. 1999	vegetation
000929d1p2	Coastal Oak-Heath Forest	Sep. 2000	vegetation
000929d1p1	Coastal Oak-Heath Forest	Sep. 2000	vegetation
000929d2p2	Coastal Oak-Heath Forest	Sep. 2000	vegetation
010912d18p1	Coastal Oak-Heath Forest	Sep. 2001	vegetation
634F	Coastal Oak-Heath Forest	Sep. 2001	vegetation
641F	Coastal Oak-Heath Forest	Sep. 2001	vegetation
642F	Coastal Oak-Heath Forest	Sep. 2001	vegetation
644	Coastal Oak-Heath Forest	Sep. 2001	vegetation
MixEarlyForFloydEstate.jpg	Cultivated Pasture and Successional Meadow	Jun-99	vegetation
000509D13P2.jpg	Cultivated Pasture and Successional Meadow	May-00	vegetation
000509D14P3.jpg	Cultivated Pasture and Successional Meadow	May-00	vegetation
FieldatFloydEstate.jpg	Cultivated Pasture and Successional Meadow	Oct. 1999	vegetation
010912d18p4	Cultivated Pasture and Successional Meadow	Sep. 2001	vegetation
010912d17p4	Cultivated Pasture and Successional Meadow	Sep. 2001	vegetation
GrassOldInlet.jpg	High Salt Marsh	Jun-99	vegetation
000512D4P3.jpg	High Salt Marsh	May-00	vegetation

000515D1P1.jpg	High Salt Marsh	May-00	vegetation
000515D1P2.jpg	High Salt Marsh	May-00	vegetation
disp.jpg	High Salt Marsh	Oct. 1999	vegetation
Meadowgrass.jpg	High Salt Marsh	Oct. 1999	vegetation
	High Salt Marsh	Sep. 2001	vegetation
Mvc-044f.jpg	Low Salt Marsh	Jun-99	vegetation
000506D1P3.jpg	Low Salt Marsh	May-00	vegetation
000506D1P4.jpg	Low Salt Marsh	May-00	vegetation
000507D1P1.jpg	Low Salt Marsh	May-00	vegetation
000512D1P2.jpg	Low Salt Marsh	May-00	vegetation
000512D1P3.jpg	Low Salt Marsh	May-00	vegetation
00923d20p5	Low Salt Marsh	Sep. 2000	vegetation
ACRUbranching.jpg	Maritime Deciduous Scrub Forest	Jun-99	vegetation
Amelanchior.jpg	Maritime Deciduous Scrub Forest	Jun-99	vegetation
AmelanchiorTalisman.jpg	Maritime Deciduous Scrub Forest	Jun-99	vegetation
SunkenForestUnderstory.jpg	Maritime Deciduous Scrub Forest	Jun-99	vegetation
000507D1P2.jpg	Maritime Deciduous Scrub Forest	May-00	vegetation
000511D14P2.jpg	Maritime Deciduous Scrub Forest	May-00	vegetation
00923d20p3	Maritime Deciduous Scrub Forest	Sep. 2000	vegetation
maritime_forest1.jpg	Maritime Deciduous Scrub Forest	TNC	vegetation
maritime_forest2.jpg	Maritime Deciduous Scrub Forest	TNC	vegetation
maritime_forest3.jpg	Maritime Deciduous Scrub Forest	TNC	vegetation
000508D4P1.jpg	Maritime Holly Forest	May-00	vegetation
000508D5P5.jpg	Maritime Holly Forest	May-00	vegetation
Sunken_Forest.jpg	Maritime Holly Forest	May-00	vegetation
Sunken_Forest1.jpg	Maritime Holly Forest	May-00	vegetation
Sunken_Forest2.jpg	Maritime Holly Forest	May-00	vegetation
00923d21p4	Maritime Holly Forest	Sep. 2000	vegetation
holly_forest1.jpg	Maritime Holly Forest	TNC	vegetation
holly_forest2.jpg	Maritime Holly Forest	TNC	vegetation
PoisonIvy.jpg	Maritime Vine Dune	Jun-99	vegetation
000509D1P1.jpg	Maritime Vine Dune	May-00	vegetation
Poison_Ivy_Yikes.jpg	Maritime Vine Dune	May-00	vegetation
000927d1p1	Maritime Vine Dune	Sep. 2000	vegetation
000509D13P1.jpg	Mosaic	May-00	vegetation
000509D14P1.jpg	Mosaic	May-00	vegetation
000509D14P2.jpg	Mosaic	May-00	vegetation
000509D15P1.jpg	Mosaic	May-00	vegetation
00924d22p4	Mosaic	Sep. 2000	vegetation
Mosaic.JPG	Mosaic	Sep. 2001	vegetation
Mosaic2.jpg	Mosaic	Sep. 2001	vegetation
Mosaic3.jpg	Mosaic	Sep. 2001	vegetation
000506D2P3.jpg	North Atlantic Upper Beach	May-00	vegetation
000509D6P3.jpg	North Atlantic Upper Beach	May-00	vegetation
EndangeredKnotweed1.jpg	North Atlantic Upper Beach	Oct. 1999	vegetation
EndangeredKnotweed2.jpg	North Atlantic Upper Beach	Oct. 1999	vegetation
Sea Beach Amaranth 2.jpg	North Atlantic Upper Beach	Sep. 2001	vegetation
Sea Beach Amaranth.jpg	North Atlantic Upper Beach	Sep. 2001	vegetation
maritime_beach1.jpg	North Atlantic Upper Beach	TNC	vegetation
BeachGrass.jpg	Northern Beach Grass Dune	Jun-99	vegetation
ForeduneGrass.jpg	Northern Beach Grass Dune	Jun-99	vegetation
000506D2P1.jpg	Northern Beach Grass Dune	May-00	vegetation
000509D1P4.jpg	Northern Beach Grass Dune	May-00	vegetation
000509D3P2.jpg	Northern Beach Grass Dune	May-00	vegetation
000509D3P3.jpg	Northern Beach Grass Dune	May-00	vegetation

000510D2P2.jpg	Northern Beach Grass Dune	May-00	vegetation
AMBR_PRMA.jpg	Northern Beach Grass Dune	May-00	vegetation
beach grass & pea.jpg	Northern Beach Grass Dune	Oct. 1999	vegetation
00924d22p1	Northern Beach Grass Dune	Sep. 2000	vegetation
00924d22p2	Northern Beach Grass Dune	Sep. 2000	vegetation
000927d2p4	Northern Beach Grass Dune	Sep. 2000	vegetation
00927d4p1	Northern Beach Grass Dune	Sep. 2000	vegetation
00928d5p2	Northern Beach Grass Dune	Sep. 2000	vegetation
Northern Beach Grass Dune 2.jpg	Northern Beach Grass Dune	Sep. 2001	vegetation
Northern Beach Grass Dune.jpg	Northern Beach Grass Dune	Sep. 2001	vegetation
maritime_dune3.jpg	Northern Beach Grass Dune	TNC	vegetation
maritime_dune4.jpg	Northern Beach Grass Dune	TNC	vegetation
canopyEarlyMaritimeFor.jpg	Northern Dune Shrubland	Jun-99	vegetation
000506D2P5.jpg	Northern Dune Shrubland	May-00	vegetation
000507D2P1.jpg	Northern Dune Shrubland	May-00	vegetation
000507D2P2.jpg	Northern Dune Shrubland	May-00	vegetation
000508D4P3.jpg	Northern Dune Shrubland	May-00	vegetation
000509D1P2.jpg	Northern Dune Shrubland	May-00	vegetation
000510D1P2.jpg	Northern Dune Shrubland	May-00	vegetation
000510D1P3.jpg	Northern Dune Shrubland	May-00	vegetation
000510D2P1.jpg	Northern Dune Shrubland	May-00	vegetation
000510D2P3.jpg	Northern Dune Shrubland	May-00	vegetation
000510D2P5.jpg	Northern Dune Shrubland	May-00	vegetation
000510D3P1.jpg	Northern Dune Shrubland	May-00	vegetation
000511D14P1.jpg	Northern Dune Shrubland	May-00	vegetation
000511D15P2.jpg	Northern Dune Shrubland	May-00	vegetation
000511D15P4.jpg	Northern Dune Shrubland	May-00	vegetation
000515D1P3.jpg	Northern Dune Shrubland	May-00	vegetation
000515D8P1.jpg	Northern Dune Shrubland	May-00	vegetation
BayBerry.jpg	Northern Dune Shrubland	May-00	vegetation
FireCherry.jpg	Northern Dune Shrubland	May-00	vegetation
Unk_Shrub.jpg	Northern Dune Shrubland	May-00	vegetation
Bayberrys.jpg	Northern Dune Shrubland	Oct. 1999	vegetation
MyricaPennsylvanica2.jpg	Northern Dune Shrubland	Oct. 1999	vegetation
MyricaPennsylvanica.jpg	Northern Dune Shrubland	Oct. 1999	vegetation
00923d21p5	Northern Dune Shrubland	Sep. 2000	vegetation
00923d21p6	Northern Dune Shrubland	Sep. 2000	vegetation
00924d22p3	Northern Dune Shrubland	Sep. 2000	vegetation
00925d13p4	Northern Dune Shrubland	Sep. 2000	vegetation
000927d2p3	Northern Dune Shrubland	Sep. 2000	vegetation
00927d3p5	Northern Dune Shrubland	Sep. 2000	vegetation
maritime_shrubland1.jpg	Northern Dune Shrubland	TNC	vegetation
maritime_shrubland2.jpg	Northern Dune Shrubland	TNC	vegetation
000511D13P1.jpg	Northern Interdunal Cranberry Swale	May-00	vegetation
000511D13P3.jpg	Northern Interdunal Cranberry Swale	May-00	vegetation
Blueberry Swamp.jpg	Northern Interdunal Cranberry Swale	Sep. 2001	vegetation
Cranberry Closeup.jpg	Northern Interdunal Cranberry Swale	Sep. 2001	vegetation
Cranberry Swale Overview.jpg	Northern Interdunal Cranberry Swale	Sep. 2001	vegetation
Baccharis.jpg	Northern Salt Shrub	Jun-99	vegetation
000509D2P1.jpg	Northern Salt Shrub	May-00	vegetation
000509D2P2.jpg	Northern Salt Shrub	May-00	vegetation
000509D4P2.jpg	Northern Salt Shrub	May-00	vegetation
000509D5P3.jpg	Northern Salt Shrub	May-00	vegetation
000509D5P4.jpg	Northern Salt Shrub	May-00	vegetation
BaccharisHalimilfolia.jpg	Northern Salt Shrub	Oct. 1999	vegetation

baha.jpg	Northern Salt Shrub	Oct. 1999	vegetation
00923d20p6	Northern Salt Shrub	Sep. 2000	vegetation
00925d13p1	Northern Salt Shrub	Sep. 2000	vegetation
Baccharis Halmifolia.jpg	Northern Salt Shrub	Sep. 2001	vegetation
maritime_dune5.jpg	Northern Salt Shrub	TNC	vegetation
shrub_swamp1.jpg	Northern Salt Shrub	TNC	vegetation
VaCreeper1.jpg	Old Field Red-Cedar Forest	Oct. 1999	vegetation
VACreeperWCedar.jpg	Old Field Red-Cedar Forest	Oct. 1999	vegetation
645F	Old Field Red-Cedar Forest	Sep. 2001	vegetation
647F	Old Field Red-Cedar Forest	Sep. 2001	vegetation
cedar1.jpg	Old Field Red-Cedar Forest	TNC	vegetation
00925d14p3	Overwash Dune Grassland	Sep. 2000	vegetation
PineBarrensFloyd.jpg	Pitch pine - Oak Forest	Jun-99	vegetation
000929d2p1	Pitch pine - Oak Forest	Sep. 2000	vegetation
000508D4P4.jpg	Pitch Pine Dune Woodland	May-00	vegetation
000508D5P2.jpg	Pitch Pine Dune Woodland	May-00	vegetation
000509D13P3.jpg	Pitch Pine Dune Woodland	May-00	vegetation
000509D2P4.jpg	Pitch Pine Dune Woodland	May-00	vegetation
000515D8P2.jpg	Pitch Pine Dune Woodland	May-00	vegetation
000927d1p2	Pitch Pine Dune Woodland	Sep. 2000	vegetation
000927d2p1	Pitch Pine Dune Woodland	Sep. 2000	vegetation
Pinus rigida.jpg	Pitch Pine Dune Woodland	Sep. 2001	vegetation
pitch_pine1.jpg	Pitch Pine Dune Woodland	TNC	vegetation
pitch_pine2.jpg	Pitch Pine Dune Woodland	TNC	vegetation
pitch_pine3.jpg	Pitch Pine Dune Woodland	TNC	vegetation
pitch_pine4.jpg	Pitch Pine Dune Woodland	TNC	vegetation
Marsh.jpg	Reedgrass Marsh	Jun-99	vegetation
PhragmitesWetlandinSunkFor.jpg	Reedgrass Marsh	Jun-99	vegetation
000508D5P3.jpg	Reedgrass Marsh	May-00	vegetation
000509D2P3.jpg	Reedgrass Marsh	May-00	vegetation
000509D4P3.jpg	Reedgrass Marsh	May-00	vegetation
000509D6P2.jpg	Reedgrass Marsh	May-00	vegetation
000511D14P3.jpg	Reedgrass Marsh	May-00	vegetation
000515D1P4.jpg	Reedgrass Marsh	May-00	vegetation
phragmites in the sun.jpg	Reedgrass Marsh	Oct. 1999	vegetation
00928d5p4	Reedgrass Marsh	Sep. 2000	vegetation
00928d5p5	Reedgrass Marsh	Sep. 2000	vegetation
glass wort.jpg	Salt Panne	Oct. 1999	vegetation
00923d20p4	Salt Panne	Sep. 2000	vegetation
00927d3p4	Dune Overview	Sep. 2000	scenery
00927d4p2	Dune Overview	Sep. 2000	scenery
BeachComplex.jpg	Overview	Jun-99	scenery
BeachEcotones.jpg	Overview	Jun-99	scenery
000506D2P4.jpg	Overview	May-00	scenery
000509D14P4.jpg	Overview	May-00	scenery
000509D5P2.jpg	Overview	May-00	scenery
000510D1P4.jpg	Overview	May-00	scenery
000511D14P4.jpg	Overview	May-00	scenery
000512D1P1.jpg	Overview	May-00	scenery
000512D1P4.jpg	Overview	May-00	scenery
000512D1P5.jpg	Overview	May-00	scenery
000512D4P1.jpg	Overview	May-00	scenery
000512D6P1.jpg	Overview	May-00	scenery
000512D6P2.jpg	Overview	May-00	scenery
000512D6P3.jpg	Overview	May-00	scenery

000515D1P5.jpg	Overview	May-00	scenery
000515D8P3.jpg	Overview	May-00	scenery
aster swamp.jpg	Overview	Oct. 1999	scenery
GrassShrub.jpg	Overview	Oct. 1999	scenery
ManyCommunities.jpg	Overview	Oct. 1999	scenery
Meadow2.jpg	Overview	Oct. 1999	scenery
OldInletGrassland.jpg	Overview	Oct. 1999	scenery
Shrubland.jpg	Overview	Oct. 1999	scenery
Overview.jpg	Overview	Sep. 2001	scenery
Phragmities inv. No Dune Shrub.jpg	Overview	Sep. 2001	scenery
maritime_dune1.jpg	Overview	TNC	scenery
maritime_dune2.jpg	Overview	TNC	scenery
maritime_dune6.jpg	Overview	TNC	scenery
BeachAtTalisman.jpg	Scenery	Jun-99	scenery
BeachRoadinShrubs.jpg	Scenery	Jun-99	scenery
FIISmarina.jpg	Scenery	Jun-99	scenery
InterduneOldInlet.jpg	Scenery	Jun-99	scenery
SailorsHavenMarina.jpg	Scenery	Jun-99	scenery
SunkForBoardwalk.jpg	Scenery	Jun-99	scenery
WmFloydHouse.jpg	Scenery	Jun-99	scenery
Bay_Side_View.jpg	Scenery	May-00	scenery
Ocean.jpg	Scenery	May-00	scenery
Old_Pier.jpg	Scenery	May-00	scenery
BackForDune.jpg	Scenery	Oct. 1999	scenery
BeachAccess.jpg	Scenery	Oct. 1999	scenery
browse line.jpg	Scenery	Oct. 1999	scenery
BrowseLineatFloyd.jpg	Scenery	Oct. 1999	scenery
buckrub.jpg	Scenery	Oct. 1999	scenery
BuckRubTree.jpg	Scenery	Oct. 1999	scenery
dune overlook.jpg	Scenery	Oct. 1999	scenery
RMMonument.jpg	Scenery	Oct. 1999	scenery
RMMonumentFar.jpg	Scenery	Oct. 1999	scenery
SmithPointLeft.jpg	Scenery	Oct. 1999	scenery
SmithPointLeftBackground.jpg	Scenery	Oct. 1999	scenery
SmithPointRight.jpg	Scenery	Oct. 1999	scenery
SunsetLighthouse.jpg	Scenery	Oct. 1999	scenery
TallLighthouse vert.jpg	Scenery	Oct. 1999	scenery
00923d21p1	Scenery	Sep. 2000	scenery
00923d21p2	Scenery	Sep. 2000	scenery
00924d22p5	Scenery	Sep. 2000	scenery
00925d14p2	Scenery	Sep. 2000	scenery
010912d17p2	Scenery	Sep. 2001	scenery
Panorama 2.jpg	Scenery	Sep. 2001	scenery
Panorama 3.jpg	Scenery	Sep. 2001	scenery
Panorama.jpg	Scenery	Sep. 2001	scenery
Sunset 2.jpg	Scenery	Sep. 2001	scenery
Sunset 3.jpg	Scenery	Sep. 2001	scenery
Sunset 4.jpg	Scenery	Sep. 2001	scenery
Sunset.jpg	Scenery	Sep. 2001	scenery
PineGrassWoodland.jpg	Transition	Oct. 1999	scenery
Transition Zone 2.jpg	Transition	Sep. 2001	scenery
Transition Zone.jpg	Transition	Sep. 2001	scenery
JimGreg.jpg	Field Crew	Jun-99	people
000509D6P4.jpg	Field Crew	May-00	people
000510D2P4.jpg	Field Crew	May-00	people

Anne_GPS.jpg	Field Crew	May-00	people
Leslie_in_Field.jpg	Field Crew	May-00	people
AndyGPS.jpg	Field Crew	Oct. 1999	people
GarrettAndy.jpg	Field Crew	Oct. 1999	people
PaulwithGPS.jpg	Field Crew	Oct. 1999	people
TruckOnBeach.jpg	Field Crew	Oct. 1999	people
GarretPhrag.jpg	Field Crew	Oct. 1999	people
mosquito ditch.jpg	Field Crew	Oct. 1999	people
00923d20p1	Field Crew	Sep. 2000	people
00923d20p2	Field Crew	Sep. 2000	people
00923d21p3	Field Crew	Sep. 2000	people
000927d1p3	Field Crew	Sep. 2000	people
000927d1p4	Field Crew	Sep. 2000	people
00928d5p3	Field Crew	Sep. 2000	people
000929d1p3	Field Crew	Sep. 2000	people
010912d18p3	Field Crew	Sep. 2001	people
010912d17p3	Field Crew	Sep. 2001	people
Beach Driving.jpg	Field Crew	Sep. 2001	people
Field work.jpg	Field Crew	Sep. 2001	people
Tyler and Deet.jpg	Field Crew	Sep. 2001	people
000507D1P3.jpg	Other	May-00	other
000508D5P1.jpg	Other	May-00	other
000508D5P4.jpg	Other	May-00	other
000509D15P2.jpg	Other	May-00	other
000509D4P1.jpg	Other	May-00	other
000515D8P4.jpg	Other	May-00	other
FIIS_Sign.jpg	Other	May-00	other
Inlet_Pond.jpg	Other	May-00	other
Unk_Grass.jpg	Other	May-00	other
Unk_Grass2.jpg	Other	May-00	other
Unknown.jpg	Other	May-00	other
Fisherman.jpg	Other	Oct. 1999	other
NoPets.jpg	Other	Oct. 1999	other
VT-CMI.jpg	Other	Oct. 1999	other
CedarWoodland.jpg	Other	Oct. 1999	other
GoldenRod.jpg	Other	Oct. 1999	other
GS&ARWhiteCedar.jpg	Other	Oct. 1999	other
hightide bush.jpg	Other	Oct. 1999	other
Smilax.jpg	Other	Oct. 1999	other
unknown3.jpg	Other	Oct. 1999	other
UnknownNo1.jpg	Other	Oct. 1999	other
UnknownNo1_2.jpg	Other	Oct. 1999	other
UnkShrub.jpg	Other	Oct. 1999	other
000929d2p3	Other	Sep. 2000	other
Scirpus Marsh.jpg	Other	Sep. 2001	other
RWBBonShrub.jpg	Birds	Jun-99	fauna
000507D1P4.jpg	Birds	May-00	fauna
000512D1P6.jpg	Birds	May-00	fauna
000512D4P4.jpg	Birds	May-00	fauna
Albatross_Flying.jpg	Birds	May-00	fauna
Albatross1.jpg	Birds	May-00	fauna
Albatross2.jpg	Birds	May-00	fauna
Albatross3.jpg	Birds	May-00	fauna
Canada_Geese.jpg	Birds	May-00	fauna
Canada_Geese2.jpg	Birds	May-00	fauna

Dead_Bird.jpg	Birds	May-00	fauna
Dove_Anne.jpg	Birds	May-00	fauna
Dove_Fledgling.jpg	Birds	May-00	fauna
Dove_Julie.jpg	Birds	May-00	fauna
Goose_Closeup.jpg	Birds	May-00	fauna
Mute_Swans.jpg	Birds	May-00	fauna
Red-Wing_Blackbird.jpg	Birds	May-00	fauna
Towhee.jpg	Birds	May-00	fauna
black-backedgull.jpg	Birds	Oct. 1999	fauna
CanadaGeese.jpg	Birds	Oct. 1999	fauna
HeronTracks.jpg	Birds	Oct. 1999	fauna
HerringGulls.jpg	Birds	Oct. 1999	fauna
PerigranFalcon.jpg	Birds	Oct. 1999	fauna
Bank Swallow 2.jpg	Birds	Sep. 2001	fauna
Bank Swallow 3.jpg	Birds	Sep. 2001	fauna
Bank Swallow 4.jpg	Birds	Sep. 2001	fauna
Bank Swallow 5.jpg	Birds	Sep. 2001	fauna
Bank Swallow 6.jpg	Birds	Sep. 2001	fauna
Bank Swallow 7.jpg	Birds	Sep. 2001	fauna
Bank Swallow 8.jpg	Birds	Sep. 2001	fauna
Bank Swallow.jpg	Birds	Sep. 2001	fauna
Beachcombing_peregrin.jpg	Birds	Sep. 2001	fauna
Cormorant etc.jpg	Birds	Sep. 2001	fauna
Mvc-718l.jpg	Birds	Sep. 2001	fauna
Mvc-720l.jpg	Birds	Sep. 2001	fauna
Mvc-721l.jpg	Birds	Sep. 2001	fauna
peregrin.jpg	Birds	Sep. 2001	fauna
DeerinShrub.jpg	Deer	Jun-99	fauna
WTDinSmilax.jpg	Deer	Jun-99	fauna
WTDinSmilax2.jpg	Deer	Jun-99	fauna
000511D13P2.jpg	Deer	May-00	fauna
2bigbucks.jpg	Deer	Oct. 1999	fauna
2bigbucks2.jpg	Deer	Oct. 1999	fauna
2bigbucks3.jpg	Deer	Oct. 1999	fauna
3deersinarow.jpg	Deer	Oct. 1999	fauna
4deer.jpg	Deer	Oct. 1999	fauna
BigBuck.jpg	Deer	Oct. 1999	fauna
BigBuck1.jpg	Deer	Oct. 1999	fauna
BuckDoe1.jpg	Deer	Oct. 1999	fauna
BuckDoe2.jpg	Deer	Oct. 1999	fauna
deer feed.jpg	Deer	Oct. 1999	fauna
Deer2.jpg	Deer	Oct. 1999	fauna
DeerInFloydWoods.jpg	Deer	Oct. 1999	fauna
FeedingDeer.jpg	Deer	Oct. 1999	fauna
00925d13p5	Deer	Sep. 2000	fauna
00927d4p4	Deer	Sep. 2000	fauna
Deer1	Deer	Sep. 2001	fauna
Deer2	Deer	Sep. 2001	fauna
Deer.jpg	Deer	Sep. 2001	fauna
Deer2.jpg	Deer	Sep. 2001	fauna
Sea_Robbin.jpg	Wildlife	May-00	fauna
Striped_Bass.jpg	Wildlife	May-00	fauna
skate.jpg	Wildlife	Oct. 1999	fauna

7.12 Accuracy Assessment Spatial Correction Procedure

7.12.1 Introduction

This procedure was developed to correctly and appropriately complete the accuracy assessment phase of the Fgire Island National Seashore Vegetation Mapping Project. By following this set of steps, we will ensure that the points we use to assess map accuracy are the best interpretations of what was observed in the field and what is know about errors inherent to this type of analysis.

There are several known sources of error in field accuracy assessment they fall into 3 broad categories; spatial, observer, and thematic. Spatial errors can come from the GPS units used in the field, the map itself, or a combination of those two. This results in points falling in non-target polygons or interpretation of a non-target polygon in the field. Observer errors are those associated with using a key or inexact judgements of species dominance in the field. They can also result from misidentification of species in the field by the observer although this is a rarity with trained personnel. Thematic error is the result of an incorrect photointerpretation of a vegetation polygon as assessed on the ground. This error is real is the objective of the accuracy assessment.

Our goal with this step of the AA is to reduce the contributions of spatial and observer error in the accuracy assessment point dataset. This will allow a much more accurate estimate of map accuracy.

7.12.2 Procedure

The following is an outline of the procedure that will be followed to control the quality of the accuracy assessment point set.

Step 1. – Examine each point

Compare the location of the point in the field to its target location in the GIS. Use the digital photoset to determine how close the point collected was to the actual. Determine if the point on screen is A) offset [look at comments to ensure the point is where it was intended to be] B) within error polygon [look at the polygon of standard deviation]. If the point requires spatial adjustment, move the point to the most appropriate location.

Step 2. – Examine the classification

Look at the classification of the field point. Does it match the map? If so, double check the spatial location to protect against a false positive. If not, make sure that the point is located on a representative portion of the polygon (i.e, not in a smaller polygon within the larger target polygon). If the point is apparently within the target polygon type then the point is valid. If the point is located in a smaller, non-representative polygon then it should be removed.

Step 3. – Examine the notes

Most points have some notes taken in the field. Check these notes to gain additional knowledge about why these points were described as they were. Sometimes there was confusion on the ground that accounts for the discrepancy. If there is information on why a point was described a certain way, use that information to re-classify the point. Use the fuzzy error matrix to make corrections.

Step 4. – Examine the parameters

Field workers took specific notes on their confidence in the classification at particular locations. Pay special attention to point listed as “Low” or “Medium” confidence. Why were they listed as such? Remove points where the field worker had problems accurately assigning a vegetation type.

Step 5. – Code the point

Once corrections have been made, we should attribute each point with a correction code so we can trace it’s corrections backwards later on. Use the following numeric code:

1. No corrections/modifications
2. Spatial Modifications – point was moved by interpreter
3. Thematic modification – veg. type was changed
4. Spatial and Thematic Change – both were modified
5. Point removed – for whatever reason the point was deemed not useful

These codes will allow us to track changes to the dataset.

Once all these points have been revisited and adjusted we will have removed as much of the spatial and observer error as possible. This will allow us top proceed with the fuzzy set classification and appropriately assess the accuracy of the map.

7.13 Fuzzy Set Justification and Description

This is a brief description of my thought behind some of the fuzzy classifications as listed in the matrix. They are by no means final and I welcome discussion on them. With the large number of classes, I thought this would be the best way for everyone to "get up top speed" before our discussion on Thursday.

7.13.1 Background

After completing the accuracy assessment trip at Fire Island this fall we observed some surprisingly low accuracy numbers. There are likely many reasons for these discrepancies such as misclassification, scale issues, observer/key errors, and spatial errors in the field.

Our thinking is that the classification and the vegetation map is quite good, and that perhaps our methods of assessing accuracy, although sound, may be introducing some errors that are lowering the map accuracies below their actual (and as of yet unknown) levels.

7.13.2 Accuracy Assessment

An accuracy assessment effort was completed for FIIS in accordance with the NPS vegetation mapping specifications.

7.13.3 Data Collection

The accuracy assessment phase was carried out similar to other NPS vegetation mapping projects. We used guidelines from The Nature Conservancy (1994) to determine the number of accuracy assessment points needed for Fire Island. The target number of points was obtained by examining the number of polygons mapped at Fire Island, the area of the polygon itself, an expected 10% loss of points in the field, and the total area of each type mapped on the Island.

Because many of the discernable polygons at Fire Island were below the 0.25 ha MMU, we opted to further divide the assessment into polygons at or above the 0.25 ha MMU and to those below. An additional 10 points were added in polygons below the MMU in an attempt to assess whether the map accuracy was diminished by the presence of these smaller units. The result was a maximum of 43 points for vegetation types falling into Scenario A. This includes 30 points for polygons grater than 0.25 ha, 3 additional points to account for unattainable points in the field, and 10 points in polygons below the MMU. The list of accuracy assessment points by vegetation class is given in Table X.

Once the target number of points per class were established, we employed the GIS to randomly select the actual accuracy assessment point location. Each individual vegetation class was selected from the map. Then a systematic grid of points spaced 60 m apart was generated for the entire area. Points that intersected the vegetation type were selected and the rest were deleted. These points were subdivided into points that intersected vegetation polygons greater than the MMU or less than. For the larger polygon set, all points that fell within 10 m of the delineated edge of the polygon were removed. The resulting points (if greater that the target number) were randomized and the target number of points was selected. The set of smaller polygon points were randomized and the target number was selected. These points were inspected and moved to the approximate center of their respective polygon to avoid confusion in the field. In either case, if not enough points met the above criterion polygons were randomly selected for visitation and points were added to their approximate geographic center to reach the target number of points.

A total of 665 accuracy assessment points were established. These locations were divided into routes that could be gathered in a single field day (approximately 40 per day) and loaded into field GPS software. This allowed the field crews to navigate to accuracy assessment points with their GPS units.

The accuracy assessment mission was conducted in September of 2001. CMI and NPS staff who were not familiar with the vegetation map and had no previous experience at Fire Island served as assessors. The vegetation key (see Appendix 7.6) was used to classify the vegetation surrounding each assessment team. Assessors were instructed to establish the polygon boundary on the ground then assign a vegetation class from the key. In addition, the assessor was asked to provide a categorical confidence value to their assignment of low, medium, or high confidence. The navigator, suing the GPS, recorded which class was observed and the confidence category. They also recorded the position of the point, the spatial confidence of the navigator, as well as any other notes the assessor or navigator deemed important. The completed accuracy assessment routes were loaded onto a laptop computer and post-processed to ensure spatial accuracy.

7.13.4 Fuzzy Classifications

Our fuzzy classification values are based on the following criterion:

Level 5- **Exact Match** - mapped type is the same as observed in the field.

Level 4 - **Acceptable Error** - mapped type has minor differences than type bserved in the field; possibly due to observer error (e.g., judgement on dominance), key error, or description of smaller polygons in a larger type (scale issue).

Level 3 - **Understandable Error** - mapped class does not match field point; types have structural or ecological similarity, have similar species associates, or PI delineation issue (e.g., rare type in field confused with a common type on the map)

Level 2 - **Vague Similarity** - types seen in the field and on map match in Formation and structure, but species or ecological conditions are not similar.

Level 1 - **Complete Error** - map and point are of different formations; due to other than spatial or temporal error.

I will summarize the reasons for labeling level 3 and level 4 relationships below.

Types:

Ilex opaca/Myrica pensylvanica Forest (6376)

4 – with 6145 (*Prunus serotina-Sassafras albidum-Amelanchior canadensis/Smilax rotundifolia* Shrubland)

~ these types are separated by dominance of *Ilex opaca* but are otherwise very similar. It is very difficult to judge stand dominance in the field without quantitative investigation.

Juniperus virginiana Forest (707 or 6024)

3 - with 802, 6381, and 6117 (*Pinus thunbergi* Forest, *Pinus rigida – Quercus coccinea* Forest, and *P. rigida/Hudsonia tomentosa* Woodland)

~ these types are all coniferous and may cause PI confusion.

Quercus stellata - Quercus velutina/Myrica pensylvanica/Deschampsia flexuosa Forest (6373)

3 - with 6375 and 6381 (*Quercus coccinea - Quercus velutina/Sassafras albidum/Vaccinium palladium* Forest and *Pinus rigida - Quercus /Sassafras albidum/Vaccinium palladium* Forest)

~ all these types are found on the Floyd Estate and have significant oak dominance.

Quercus coccinea - Quercus velutina/Sassafras albidum/Vaccinium palladium Forest (6375)

4 - with 6381 (*Pinus rigida - Quercus /Sassafra salbidum/Vaccinium palladium* Forest

~ these types are very similar and differ only in the amount of *P. rigida* in the canopy.

Acer rubrum - Nyssa sylvatica/Rhododendron viscosum - Clethra alnifolia Forest (6156)

3 - with 6145 and 6371 (*Prunus serotina-Sassafras albidum-Amelanchior canadensis/Smilax rotundifolia* Shrubland and *Vaccinium corymbosum – Rhododendron viscosum - Clethra alnifolia* Shrubland)

~ these types are all woody-species dominated and found in wet areas. *Vaccinium corymbosum* is typical of all 3 types.

Pinus thunbergii Forest (802 or 6012)

4 - with 6117 (*Pinus rigida/ Hudsonia tomentosa* Woodland)

~ these types are difficult to tell apart from photos (although *P. thunbergii* tends to be found closer to the foredune in planted stands).

3 - with 6381 (*Pinus rigida - Quercus /Sassafras albidum/Vaccinium palladium* Forest)

~ both coniferous types (although confusion between the types is highly unlikely).

Pinus rigida - Quercus /Sassafras albidum/Vaccinium palladium Forest (6381)

3 – with 6117 (*Pinus rigida/ Hudsonia tomentosa* Woodland)

~ both coniferous types (confusion unlikely due to separation between Floyd Estate and Fire Island)

Pinus rigida/ Hudsonia tomentosa Woodland (6117)

3 – with 6295 and 6134 (*Myrica pensylvanica - Rosa rugosa* Shrubland and *Hudsonia tomentosa - Arctostaphylos uva-ursi* Dwarf-shrubland)

~ *Myrica pensylvanica* often dense and easily seen under *Pinus rigida*. Same for *Hudsonia tomentosa* type which can be very similar depending on the number of *Pinus rigida* in the stand.

Myrica pensylvanica - Rosa rugosa Shrubland (6295)

4 - with 6145 (*Prunus serotina-Sassafras albidum-Amelanchior canadensis/Smilax rotundifolia* Shrubland)

~ stands of *Prunus serotina* below 2 m were often observed in the field during accuracy assessment. This caused some confusion when using the vegetation key because the first determining factor was in height above or below 2 m. In this instance, the confusion was noted in the field so points with this particular difficulty could be identified later.

3 - with 3886, 6145, and 6063 (*Smilax glauca* - *Toxicodendron radicans* Vine-Shrubland, *Prunus serotina-Sassafras albidum-Amelanchior canadensis/Smilax rotundifolia* Shrubland, and *Baccharis halimifolia - Iva frutescens/ Panicum virgatum* Shrubland)

~ *Myrica pensylvanica* is an associate in all of these types and is found widely within them on Fire Island.

Prunus serotina-Sassafras albidum-Amelanchior canadensis/Smilax rotundifolia Shrubland (6145)

3 - with 6371 and 6063 (*Vaccinium corymbosum - Rhododendron viscosum – Clethra alnifolia* Shrubland and *Baccharis halimifolia - Iva frutescens/ Panicum virgatum* Shrubland)

~ these types tend to be found on more moist swales on the bay side of Fire Island, often spatially intermixed with each other. *Baccharis* is found more predominantly in the wetter areas and is confused with 6145 when topography is undulating.

Vaccinium corymbosum - Rhododendron viscosum – Clethra alnifolia Shrubland (6371)

3 - with 6063 (*Baccharis halimifolia - Iva frutescens/ Panicum virgatum* Shrubland)

~ *Baccharis* is also a wet shrub species often found along with *Vaccinium* on Fire Island.

Baccharis halimifolia - Iva frutescens/ Panicum virgatum Shrubland (6063)

4 – with 4187 (*Phragmites australis* Tidal Herbaceous)

~ nearly every stand of 6063 on Fire Island has significant coverage of *Phragmites* in it easily causing confusion during PI and field classification.

3 – with 6150 (*Panicum virgatum - Carex silicea* Herbacous)

~ *Panicum virgatum* is a component of both 6063 and 6150 and is often found in and around the interdune side of stands of 6063.

Hudsonia tomentosa - Arctostaphylos uva-ursi Dwarf-shrubland (6143)

5 - with 6243 (*Ammophila brevigulata/Hudsonia tomentosa* Herbaceous/

Dwarf-shrubland Mosaic)

~ type 6143 is a type included in the 6243 mosaic, so any accuracy assessment point classified in 6243 is considered exactly correct.

3 - with 6274 (*Ammophila brevigulata - Lathyrus japonicus* Herbaceous)

~ these 2 types are very often found amongst each other (hence the mosaic type 6243) or transitioning between the types.

Vaccinium macrocarpon - Myrica pensylvanica Dwarf Shrubland (6141)

3 - with 6371 (*Vaccinium corymbosum - Rhododendron viscosum - Clethra alnifolia* Shrubland)

~ these swale cranberry bogs are often ringed with *Vaccinium corymbosum* which may extend out over the dwarf-shrubs.

Ammophila brevigulata - Lathyrus japonicus Herbaceous (6274)

5 - with 6243 (*Ammophila brevigulata/Hudsonia tomentosa* Herbaceous/ Dwarf-shrubland Mosaic)

~ type 6274 is a type included in the 6243 mosaic, so any accuracy assessment point classified in 6243 is considered exactly correct.

3 - with 4097 (*Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous)

~ this type has very limited distribution on Fire Island and is similar to 6274 in PI. These types also share associates such as *Solidago sempervirens.*

Spartina patens - Schoenoplectus pungens - Solidago sempervirens Herbaceous (4097)

3 - with 6342 and 6006 (*Spartina patens - Eleocharis parvula* Herbaceous and *Spartina patens - Dictilis spicata - Plantago maritima* Herbaceous)

~ *Spartina patens* is a major component of all these types. Although position on the island (north to south) tends to assist in classification, the distribution is very limited leading to misclassification.

Spartina patens - Eleocharis parvula Herbaceous (6342)

3 - with 6150, 4187, and 6006 (*Panicum virgatum - Carex silicea* Herbacous, *Phragmites australis* Tidal Herbaceous, and *Spartina patens - Dictilis spicata - Plantago maritima* Herbaceous)

~ all of these types are herbaceous wetland types. They are found amongst each other. *Phragnmites* tends to occur in any low-salinity wetland on Fire Island and leads to misclassification through PI.

Eleocharis rostellata - Spatina patens Herbaceous (6611)

3 - with 4187 (*Phragmites australis* Tidal Herbaceous)

~ this is a rare type (one known location), but as with other wetland types is likely confused with the vastly more prevalent *Phragmites*.

Panicum virgatum - Carex silicea Herbacous (6150)

3 - with 4187 (*Phragmites australis* Tidal Herbaceous)

~ although *Panicum virgatum* is commonly found it does not occur in larger stands frequently. Often *Phragmites* tends to overtop it even where it is fairly continuous in a stand.

Spartina alterniflora/(Ascophyllum nodosum) Tidal Herbaceous (4192)

4 - with 6006 (*Spartina patens - Dictilis spicata - Plantago maritima* Herbaceous)

~ the salt-marsh types in Fire Island occur in both large and small stands. These stands are often difficult to separate through PI (although *Spartina alterniflora* tends to be found on the wetter portions of the marsh). These two types should perhaps be combined to form a complex.

7.14 Accuracy Assessment Tables

FINALCODE	3886	4187	4192	4201	6006	6012	6024	6063	6117	6143	6145	6150	6156	6243	6274	6295	6342	6371	6373	6375	6376	6381	6517	Grand Total	# Level 5	# Level 4	# Level 3
6024							2																	2	2	2	2
6012						2			9		2				1									14	2	11	11
3886	1														1	2								4	1	1	3
4097										2					1									3	0	0	1
4187	1	10	1		3			1								1								17	10	11	11
4192			20		3																			23	20	23	23
6006			16		23																			39	23	39	39
6063				1	3			11			1		1			2								19	11	11	15
6067										1														1	0	0	0
6517																							17	17	17	17	17
6117						1			4								1							6	4	5	5
6141		1																						1	0	0	1
6143									1	19						2								22	19	19	20
6145								2	1		11					2		1						17	11	11	16
6150		3								1		1												5	1	1	4
6156													1											1	1	1	1
6243										3				5	9	2								19	17	17	17
6274	1							1	1	1					19	2		1						26	19	19	20
6295						1		1			2				1	20					1			26	20	20	23
6342		2															2							4	2	2	4
6371	1	1		1				4			3					2		3						15	3	3	12
6375													2						1	24				27	24	24	25
6376											6										8			14	8	14	14
6381																		1		3		3		7	3	6	6
Grand Total	4	17	37	2	32	4	2	20	16	27	25	1	4	5	32	35	3	6	1	27	9	3	17	329	218	257	290
# Level 5	1	10	20	0	23	2	2	11	4	22	11	1	1	5	28	20	2	3	0	24	8	3	17	218	218		
# Level 4	1	10	36	0	26	3	2	12	13	22	17	1	1	5	28	20	2	3	0	27	8	3	17	257		257	
# Level 3	1	17	36	2	26	3	2	19	14	23	23	1	1	5	29	26	2	4	1	27	8	3	17	290			288

7.14.1 Assessment Tables for Polygons Equal to or Larger than the minimum mapping unit

Count of AA_code	AA-code																	
Final Code	4187	4192	6006	6012	6063	6067	6117	6141	6143	6145	6156	6274	6295	6371	6375	6376	6381	Grand Total
802				4					1	1								6
3886													3					3
4097						1												1
4187	4	1	1															6
4192	1	3	1															5
6006		3	5		1													9
6063					3													3
6117							7											7
6141					1			2					1	1				5
6143									2				1					3
6145	1									4			1					6
6150	1				1													2
6156											1			1				2
6243												2	3					5
6274					1		1					5	1					8
6295										1			5			1		7
6342	2				2													4
6371							1							3				4
6375											1				3			4
6376										1						5		6
6381															1		2	3
Grand Total	9	7	7	4	9	1	9	2	3	7	2	7	15	5	4	6	2	99
# Level 5	4	3	5	4	3	0	7	2	2	4	1	7	5	3	3	5	2	60
# Level 4	4	6	6	4	3	0	7	2	2	5	1	7	5	3	4	5	2	66
# Level 3	7	6	6	4	4	0	7	2	2	5	1	7	9	5	4	5	2	76
% Level 5	44.4%	42.9%	71.4%	100.0%	33.3%	0.0%	77.8%	100.0%	66.7%	57.1%	50.0%	100.0%	33.3%	60.0%	75.0%	83.3%	100.0%	60.6%
% Level 4	44.4%	85.7%	85.7%	100.0%	33.3%	0.0%	77.8%	100.0%	66.7%	71.4%	50.0%	100.0%	33.3%	60.0%	100.0%	83.3%	100.0%	66.7%
% Level 3	77.8%	85.7%	85.7%	100.0%	44.4%	0.0%	77.8%	100.0%	66.7%	71.4%	50.0%	100.0%	60.0%	100.0%	100.0%	83.3%	100.0%	76.8%

						Users											
Final Code	# Level 5	# Level 4	# Level 3		% Level 5	% Level 4	% Level 3	(pr*Pc)	np value level 5	n(1-p) level 5	np value level 4	n(1-p) level 4	np value level 3	n(1-p) level 3	Level 5 80% met	Level 4 80% met	Level 3 80% met
802	4	4	4		66.7%	66.7%	66.7%	24.0000	4	2	4	2	4	2			
3886	0	0	3		0.0%	0.0%	100.0%	0.0000	0	3	0	3	3	0			
4097	0	0	0		0.0%	0.0%	0.0%	0.0000	0	1	0	1	0	1			
4187	4	4	4		66.7%	66.7%	66.7%	54.0000	4	2	4	2	4	2			
4192	3	4	4		60.0%	80.0%	80.0%	35.0000	3	2	4	1	4	1			
6006	5	8	8		55.6%	88.9%	88.9%	63.0000	5	4	8	1	8	1	no	no	no
6063	3	3	3		100.0%	100.0%	100.0%	27.0000	3	0	3	0	3	0			
6117	7	7	7		100.0%	100.0%	100.0%	63.0000	7	0	7	0	7	0	no	no	no
6141	2	2	3		40.0%	40.0%	60.0%	10.0000	2	3	2	3	3	2			
6143	2	2	2		66.7%	66.7%	66.7%	9.0000	2	1	2	1	2	1			
6145	4	4	5		66.7%	66.7%	83.3%	42.0000	4	2	4	2	5	1	no	no	no
6150	0	0	2		0.0%	0.0%	100.0%	0.0000	0	2	0	2	2	0			
6156	1	1	2		50.0%	50.0%	100.0%	4.0000	1	1	1	1	2	0			
6243	2	2	2		40.0%	40.0%	40.0%	0.0000	2	3	2	3	2	3			
6274	5	5	5		62.5%	62.5%	62.5%	56.0000	5	3	5	3	5	3	no	no	no
6295	5	5	5		71.4%	71.4%	71.4%	105.0000	5	2	5	2	5	2	no	no	no
6342	0	0	2		0.0%	0.0%	50.0%	0.0000	0	4	0	4	2	2			
6371	3	3	3		75.0%	75.0%	75.0%	20.0000	3	1	3	1	3	1			
6375	3	3	3		75.0%	75.0%	75.0%	16.0000	3	1	3	1	3	1			
6376	5	6	6		83.3%	100.0%	100.0%	36.0000	5	1	6	0	6	0	no	no	no
6381	2	3	3		66.7%	100.0%	100.0%	6.0000	2	1	3	0	3	0			
Grand Total	60	66	76		60.6%	66.7%	76.8%	570.0000									
# Level 5																	
# Level 4		60															
# Level 3			66														
				76													
% Level 5				% Corr	60.6%												
% Level 4				Kappa	0.58	66.7%											
% Level 3						0.65	76.8%										
							0.75										

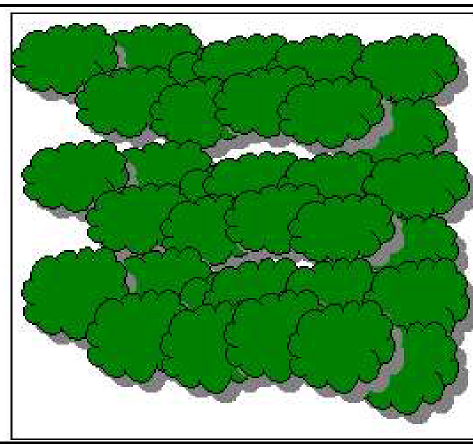
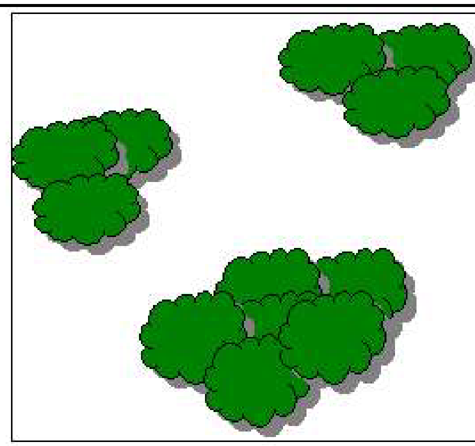
7.14.2 Assessment Tables for Polygons smaller than the minimum mapping unit

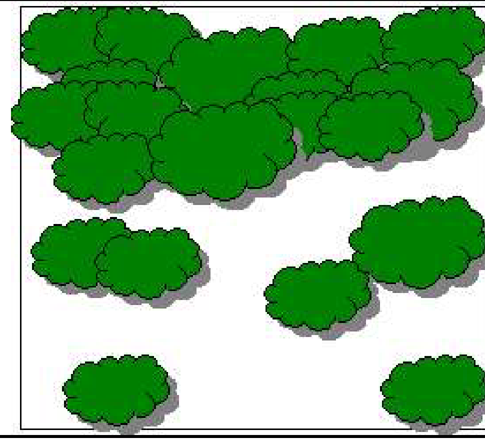
Count of AA_code	AA_code																									Users												
Final Code	3886	4187	4192	4201	6006	6012	6024	6063	6117	6143	6145	6150	6156	6243	6274	6295	6342	6371	6373	6375	6376	6381	6517	Grand Total	# Level 5	# Level 4	# Level 3		% Level 5	% Level 4	% Level 3	(pr*Pc)	CI Level 5	CI Level 5	CI Level 4	CI Level 4	CI Level 3	CI Level 3
707							2																	2	2	2	2		100.0%	100.0%	100.0%	4.0000	31.6%	100.0%	31.6%	100.0%	31.6%	100.0%
802						2			9		2				1									14	2	11	11		14.3%	78.6%	78.6%	56.0000	3.9%	36.5%	57.8%	91.9%	57.8%	91.9%
3886	1														1	2								4	1	1	3		25.0%	25.0%	75.0%	16.0000	2.6%	68.0%	2.6%	68.0%	32.0%	97.4%
4097										2					1									3	0	0	1		0.0%	0.0%	33.3%	0.0000	0.0%	53.6%	0.0%	53.6%	3.5%	80.4%
4187	1	10	1		3			1								1								17	10	11	11		58.8%	64.7%	64.7%	289.0000	36.4%	77.5%	43.2%	82.5%	43.2%	82.5%
4192			20		3																			23	20	23	23		87.0%	100.0%	100.0%	851.0000	72.6%	95.1%	88.9%	100.0%	88.9%	100.0%
6006			16		23																			39	23	39	39		59.0%	100.0%	100.0%	1248.0000	39.2%	78.8%	89.0%	100.0%	89.0%	100.0%
6063				1	3			11			1		1			2								19	11	11	15		57.9%	57.9%	78.9%	380.0000	38.6%	76.2%	38.6%	76.2%	61.3%	90.5%
6067										1														1	0	0	0		0.0%	0.0%	0.0%	0.0000	0.0%	90.0%	0.0%	90.0%	0.0%	90.0%
6107																							17	17	17	17	17		100.0%	100.0%	100.0%	289.0000	86.0%	100.0%	86.0%	100.0%	86.0%	100.0%
6117						1			4								1							6	4	5	5		66.7%	83.3%	83.3%	96.0000	33.3%	90.7%	45.8%	98.3%	45.8%	98.3%
6141		1																						1	0	0	1		0.0%	0.0%	100.0%	0.0000	0.0%	53.6%	0.0%	53.6%	3.5%	80.4%
6143									1	19						2								22	19	19	20		86.4%	86.4%	90.9%	594.0000	71.1%	94.9%	71.1%	94.9%	76.4%	97.6%
6145								2	1		11					2		1						17	11	11	16		64.7%	64.7%	94.1%	425.0000	43.2%	82.5%	43.2%	82.5%	77.5%	99.4%
6150		3								1		1												5	1	1	4		20.0%	20.0%	80.0%	5.0000	2.1%	62.1%	2.1%	62.1%	37.9%	97.9%
6156													1											1	1	1	1		100.0%	100.0%	100.0%	4.0000	10.0%	100.0%	10.0%	100.0%	10.0%	100.0%
6243										3				5	9	2								19	17	17	17		89.5%	89.5%	89.5%	95.0000	73.5%	97.2%	73.5%	97.2%	73.5%	97.2%
6274	1							1	1	1					19	2		1						26	19	19	20		73.1%	73.1%	76.9%	832.0000	58.1%	84.9%	58.1%	84.9%	62.3%	90.2%
6295						1		1			2				1	20					1			26	20	20	23		76.9%	76.9%	88.5%	910.0000	62.3%	90.2%	62.3%	90.2%	75.3%	95.7%
6342		2															2							4	2	2	4		50.0%	50.0%	100.0%	12.0000	14.3%	85.7%	14.3%	85.7%	50.0%	100.0%
6371	1	1		1				4			3					2		3						15	3	3	12		20.0%	20.0%	80.0%	90.0000	7.6%	32.6%	7.6%	32.6%	60.0%	92.4%
6375													2						1	24				27	24	24	25		88.9%	88.9%	92.6%	729.0000	76.1%	95.8%	76.1%	95.8%	79.6%	98.0%
6376											6										8			14	8	14	14		57.1%	100.0%	100.0%	126.0000	35.5%	77.6%	83.7%	100.0%	83.7%	100.0%
6381																		1		3		3		7	3	6	6		42.9%	85.7%	85.7%	21.0000	17.0%	72.1%	50.0%	100.0%	50.0%	100.0%
Grand Total	4	17	37	2	32	4	2	20	16	27	25	1	4	5	32	35	3	6	1	27	9	3	17	329	218	257	290		66.3%	78.1%	88.1%	7072.0000						
# Level 5	1	10	20	0	23	2	2	11	4	22	11	1	1	5	28	20	2	3	0	24	8	3	17	218	218													
# Level 4	1	10	36	0	26	3	2	12	13	22	17	1	1	5	28	20	2	3	0	27	8	3	17	257		257												
# Level 3	1	17	36	2	26	3	2	19	14	23	23	1	1	5	29	26	2	4	1	27	8	3	17	290			288											
% Level 5	25.0%	58.8%	54.1%	0.0%	71.9%	50.0%	100.0%	55.0%	25.0%	81.5%	44.0%	100.0%	25.0%	100.0%	87.5%	57.1%	66.7%	50.0%	0.0%	88.9%	88.9%	100.0%	100.0%	66.3%				% Overall	66.3%	78.1%	87.5%							
% Level 4	25.0%	58.8%	97.3%	0.0%	81.3%	75.0%	100.0%	60.0%	81.3%	81.5%	68.0%	100.0%	25.0%	100.0%	87.5%	57.1%	66.7%	50.0%	0.0%	100.0%	88.9%	100.0%	100.0%	78.1%				Kappa	0.64	0.77	0.87							
% Level 3	25.0%	100.0%	97.3%	100.0%	81.3%	75.0%	100.0%	95.0%	87.5%	85.2%	92.0%	100.0%	25.0%	100.0%	90.6%	74.3%	66.7%	66.7%	100.0%	100.0%	88.9%	100.0%	100.0%	88.1%														
np value level 5			20		23										28	20																						
n(1-p) level 5			17		9										4	15																						
np value level 4			36		26										28	20																						
n(1-p) level 4			1		6										4	15																						
np value level 3			36		26										29	26																						
n(1-p) level 3			1		6										3	9																						
Normal			**yes**		**yes**										**yes**	**yes**																						
Low CI Level 5	0.0%	0.0%	33.4%	0.0%	51.6%	14.3%	31.6%	35.8%	11.4%	67.3%	25.5%	10.0%	2.6%	62.1%	75.0%	36.0%	19.6%	20.1%	0.0%	76.1%	60.9%	46.4%	86.0%															
Upper CI Level 5	50.0%	77.5%	74.7%	68.4%	92.1%	85.7%	100.0%	74.5%	45.0%	90.7%	61.1%	1.0%	68.0%	100.0%	94.0%	78.3%	96.5%	79.9%	90.0%	95.8%	98.8%	100.0%	100.0%															
Low CI Level 4	0.0%	0.0%	90.0%	0.0%	63.5%	32.0%	31.6%	36.7%	61.9%	67.3%	50.0%	10.0%	2.6%	62.1%	75.0%	36.0%	19.6%	20.1%	0.0%	90.7%	60.9%	46.4%	86.0%															
Upper CI Level 4	50.0%	77.5%	100.0%	68.4%	99.0%	97.4%	100.0%	77.9%	92.9%	90.7%	84.1%	100.0%	68.0%	100.0%	94.0%	78.3%	96.5%	79.9%	90.0%	100.0%	98.8%	100.0%	100.0%															
Low CI Level 3	0.0%	86.0%	90.0%	31.6%	63.5%	32.0%	31.6%	79.7%	69.5%	70.9%	78.6%	10.0%	2.6%	62.1%	79.0%	55.5%	19.6%	33.0%	10.0%	90.7%	60.9%	46.4%	86.0%															
Upper CI Level 3	50.0%	100.0%	100.0%	100.0%	99.0%	97.4%	100.0%	99.5%	96.6%	93.4%	97.9%	100.0%	68.0%	100.0%	96.0%	93.1%	96.5%	90.7%	100.0%	100.0%	98.8%	100.0%	100.0%															
Level 5 80% met	no	no	no	no	yes	yes	yes	no	no	yes	no	no	no	yes	yes	no	yes	no	yes	yes	yes	yes	yes															
Level 4 80% met	no	no	yes	no	yes	yes	yes	no	yes	yes	yes	yes	no	yes	yes	no	yes	no	yes	yes	yes	yes	yes															
Level 3 80% met	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes															

7.15 Examples of Pattern

In addition to association, vegetation polygons were attributed with values for pattern. This additional information is useful to both the photointerpreter and the potential data user in qualifying how a particular vegetation polygon is arranged. Since the MMU of the Fire Island vegetation mapis fairly small, we were able to code many delineated polygons as continuous. There were, however, some polygons best described with other coverage patterns.

We provide examples of how these patterns appear. It is important to note that these examples depict an unambiguous, easily recognizable category for classification. Often, real examples are more difficult to classify.

Code	Pattern	Example
1	Evenly Dispersed	
2	Clumped/Bunched	

3	Gradational/Transitional	
4	Alternating