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Vegetation Classification and Mapping at Sagamore Hill National Historic Site, New York

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Cover photo: Boardwalk across salt marsh at Sagamore Hill National Historic Site.
Photograph by: Gregory J. Edinger, NY Natural Heritage Program.

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Technical Report NPS/NER/NRTR—2008/124

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Executive Summary

Vegetation classification and mapping of U.S. National Vegetation Classification associations were conducted at the Sagamore Hill National Historic Site, creating current digital geospatial databases for the park.

This study of the Sagamore Hill National Historic Site identified and characterized 10 U.S. National Vegetation Classification associations in detail. The diversity and distribution of vegetation associations is primarily a result of the following four factors: 1) the geologic history of the region, especially the effect of glaciation; 2) the park's position on the northeastern U.S. coastal plain within a temperate climate; 3) proximity to Long Island Sound and maritime ecological processes, such as diurnal tides, storm overwash, salt spray, and high winds; and 4) the park's setting within a suburban landscape with a moderately intensive human land use history, along with its associated problems, such as invasive species, fragmentation, habitat loss, and pollution.

In 2003, a preliminary vegetation map of Sagamore Hill National Historic Site was created showing NY ecological communities (Edinger et al. 2002) and was used to plan the vegetation plot sampling strategy. After plot sampling in 2003, statistical analyses were conducted on these data in order to refine the classification and map. Prior to accuracy assessment (AA) field sampling, a revised preliminary map was created showing U.S. National Vegetation Classification (USNVC) vegetation associations and Anderson Level II land cover categories. This revised map was used in spring 2006 to plan the thematic AA strategy. Thematic AA for the vegetation association map was calculated with a contingency matrix. The Kappa index for the 2006 preliminary association map was 0.664, with the overall percent accuracy calculated as 71%±21.1%. The confidence intervals indicate that this accuracy is not statistically different than the USGS/NPS vegetation mapping protocol requirement of 80%. After AA field sampling in summer 2006, a final map was created in 2007 showing corrected USNVC associations and Anderson Level II land cover categories.

The 2006 revised preliminary map and the final 2007 post-AA maps were created following the USGS/NPS Vegetation Mapping Program protocols (TNC and ESRI 1994a, b; ESRI et al. 1994). All map polygons, vegetation sampling plots, and AA sampling points were labeled with the USNVC vegetation association code and NY ecological community name, or Anderson Level II land cover category and code. A detailed appendix was created with global and local descriptions and other relevant information for each USNVC association surveyed or mapped at the park. A dichotomous field key was developed for these vegetation associations to assist with field recognition and classification. A CD with all plot and accuracy assessment point photographs taken during this project was compiled. In addition, a separate map of palustrine and estuarine wetlands of the park was created from the final vegetation association map.

Despite the degraded landscape and developed areas in and around the park, Sagamore Hill National Historic Site has several vegetation associations that may have conservation value at the local level. The Mid-Atlantic Mesic Mixed Hardwood Forest, or oak - tulip tree forest, on the east facing slope is likely the best remaining example of this type on Cove Neck. In addition, the associations that comprise the salt marsh and maritime dune complex serve as a good remnant

example of what was likely more common around the periphery of Cold Spring Harbor. All of the vegetation associations at the park provide habitat for wildlife and present opportunities for nature study for visitors.

Keywords: vegetation association, vegetation classification, vegetation mapping, Sagamore Hill National Historic Site.

Introduction

General Background

One of the goals of the National Park Service's Inventory and Monitoring Program is to provide current and accurate information for effective, long-term management of the natural resources held in trust (NPS 2003). The Inventory and Monitoring Program recommends that 12 basic natural resource inventories be developed for each park that contains significant natural resources. These park inventories provide crucial baseline information for the proper stewardship of natural and cultural resources. A map of each park's vegetation, based on aerial photography less than five years old, is one of the 12 inventories recommended by the program (NPS 2003).

To ensure that vegetation mapping is standardized across the National Park Service (NPS), The Nature Conservancy (TNC), and Environmental Systems Research Institute (ESRI), in conjunction with NatureServe, the Federal Geographic Data Committee, and the Ecological Society of America Vegetation Subcommittee, developed a protocol for creating vegetation maps in national parks. This protocol included the standardized U.S. National Vegetation Classification (TNC and ESRI 1994a), Field Methods for Vegetation Mapping (TNC and ESRI 1994b), and Accuracy Assessment Procedures (ESRI et al. 1994). This protocol was adopted by the United States Geological Survey (USGS)/NPS Vegetation Mapping Program as the standard and has been implemented at Sagamore Hill National Historic Site.

The goal of the vegetation mapping effort at Sagamore Hill National Historic Site was to produce an up-to-date digital geospatial vegetation database for the park and to provide a vascular plant species list, a dichotomous key for U.S. National Vegetation Classification associations, and descriptions of the vegetation associations in the park. Baseline information on plant community structure and composition is critical to developing desired conditions and park management goals relating to native plant communities, nonnative plant and insect species, and effects of other disturbances. The identification and description of plant communities also provide habitat information important to understanding associated organisms, including animals, protozoans, bacteria, and fungi. A map of vegetation associations may allow inferences about the location and abundance of species that are associated with each community.

US National Vegetation Classification

This report also describes the park's vegetation in the context of a national and regional vegetation classification. The Nature Conservancy, in conjunction with NatureServe, the Federal Geographic Data Committee, and the Ecological Society of America Vegetation Subcommittee, developed the U.S. National Vegetation Classification (USNVC) in order to standardize vegetation classification and facilitate the comparison of vegetation types throughout the United States and internationally. The USNVC is a systematic approach to classifying existing natural vegetation using physiognomics and floristics. This classification system has a hierarchical structure (Grossman et al. 1998).

The USNVC was developed by ecologists of the Natural Heritage Program network and The Nature Conservancy after many years of literature review, data collection, and data analysis.

This collaborative effort culminated in the publication of International Classification of Ecological Communities: Terrestrial Vegetation of the United States (Grossman et al.1998). The International Classification of Ecological Communities, now known as the International Vegetation Classification (IVC), of which the USNVC is a subset, has been revised and refined since 1998, and is now managed by NatureServe in continued collaboration with the network of Natural Heritage Programs. The classification is housed in the NatureServe Biotics 4.1 database (NatureServe 2007) and is updated regularly. The upper levels of the USNVC were adopted as a standard by the Federal Geographic Data Committee to support the production of uniform statistics on vegetation at the national level (FGDC 1996). The USGS/NPS Vegetation Mapping Program adopted the alliance level and, where possible, the association level, as the mapping unit for national parks. This portion of the NVCS is referred to as the U.S. National Vegetation Classification (USNVC).

The association is the basic unit of vegetation classification in the USNVC. An association is defined as a plant community type that is relatively homogeneous in composition and structure, and occurs in a uniform habitat. Each association is assigned a unique Community Element Global code, or CEGL code, by NatureServe. For example, the American Beachgrass - Beach Pea Herbaceous Vegetation Association (CEGL006274) is a common maritime dune grassland type along the Atlantic coast from Maine to New Jersey. Associations are also assigned global rarity ranks that indicate their conservation status and relative risk of extirpation (Grossman et al.1998). Associations from the USNVC are often equivalent to communities in state-specific vegetation classifications such as Ecological Communities of New York State (Edinger et al. 2002). USNVC associations can usually be crosswalked with communities in state classifications.

Several associations that share one or more dominant or characteristic species can be grouped to form an alliance. Alliances are generally more wide-ranging geographically than associations, covering multiple habitats and broader species composition. For example, the American Beachgrass - Beach Pea Herbaceous Vegetation Association (CEGL006274), mentioned previously, is grouped with other similar beachgrass-dominated dune grassland associations into the Northern Beachgrass Herbaceous Alliance. An association with unique species composition or environmental niche can be assigned to its own alliance, such that the alliance only contains one association instead of multiple associations.

One level above alliance is the formation, representing vegetation types that share a common physiognomy within broadly defined environmental factors (Grossman et al.1998). For example, Medium-tall sod temperate or subpolar grassland is a common formation that encompasses numerous grassland types in the northeastern and midwestern United States, including the Northern Beachgrass Herbaceous Alliance mentioned above.

Park-specific Information

Sagamore Hill National Historic Site was established in 1963 and was the former home of Theodore Roosevelt, 26th President of the United States, from 1885 until his death in 1919. The site now covers about 33.5 ha (83 ac) of land and water. Over 90,000 people visit the park each year to enjoy nature-viewing, photography, and hiking, and to learn about Theodore Roosevelt (NPS 1992, 2005). Its 83 acres contain successional and mature forests, fields, and a section of

maritime communities including beach, dunes, and salt marsh. More than a hundred species of birds use these habitats at Sagamore Hill, including 26 confirmed breeding species and an additional 24 probable breeding species (http://www.nps.gov/sahi/naturescience/animals.htm).

A detailed account of the climate, physiography and geology, hydrology, and land use history of Nassau County, including Cove Neck and Sagamore Hill, can be found in the Soil Survey of Nassau County, New York (USDA, SCS 1987). Additional information on the vegetation, climate, and glacial history of the site is included in the annotated vascular plant checklist (Stalter 2000). General information on the cultural and natural history of Sagamore Hill National Historic Site can also be found in NPS park brochures as well as NPS official Web sites (e.g., http://www.nps.gov/sahi/index.htm).

Project Area

Location and Regional Setting

Sagamore Hill National Historic Site is located at about the midpoint of Cove Neck, a one mile wide by three miles long peninsula that extends into and divides Cold Spring Harbor and Oyster Bay Harbor on the North Shore of Long Island, NY. The site is roughly rectangular in shape and has an east–west orientation. The eastern-most edge touches Cold Spring Harbor and includes small patches of salt marsh, maritime beach, and maritime dunes. The site continues west, uphill through a relatively mature oak - tulip tree forest, then grades into the more-developed central and western half of the park that includes Roosevelt's home and other park facilities. The park is located in the town of Oyster Bay in Nassau County and covers a small portion of two 1:24,000 USGS topographic quadrangle maps: Bayville to the west and Lloyd Harbor to the east (Figure 1).

Park Environmental Attributes

Ecoregions

The distribution of plant and animal species in New York state closely corresponds with ecoregional boundaries. Areas of ecological homogeneity are defined by similarities in soil, physiography, climate, hydrology, geology, and vegetation. The ecoregions are based on The Nature Conservancy (TNC) classifications for the U.S. and are modified from USDA Forest Service ecoregions (Bailey 1995). There are seven TNC Ecoregions and 34 Ecoregion Subsections in New York state. Sagamore Hill National Historic Site is within the Long Island Coastal Lowland and Moraine Subsection of the North Atlantic Coast Ecoregion (Figure 2).

Geology

A general overview of the geology of Nassau County can be found in the Soil Survey of Nassau County, New York (USDA, SCS 1987); Western Long Island Geology (Sirkin 1996) contains additional geologic information for the region.

The bedrock at Sagamore Hill National Historic Site consists of Cretaceous-age strata, including the Monmouth Group, the Matawan Group, and the Magothy Formation (all unconsolidated sediments) (Fisher et al. 1970). The surficial geology of the site is primarily glacial till (Cadwell 1989).

Topography

A general overview of the physiography of Nassau County can be found in the Soil Survey of Nassau County, New York (USDA, SCS 1987). The park's landscape is flat to moderately sloping and encompasses typical North Shore maritime and tidal terrain. Elevation ranges from zero to 48.8 m (160 ft) above sea level (USDA, SCS 1987).

Figure 1. Location of Sagamore Hill National Historic Site on 1:24,000 USGS topographic quadrangle maps in Nassau County, New York.

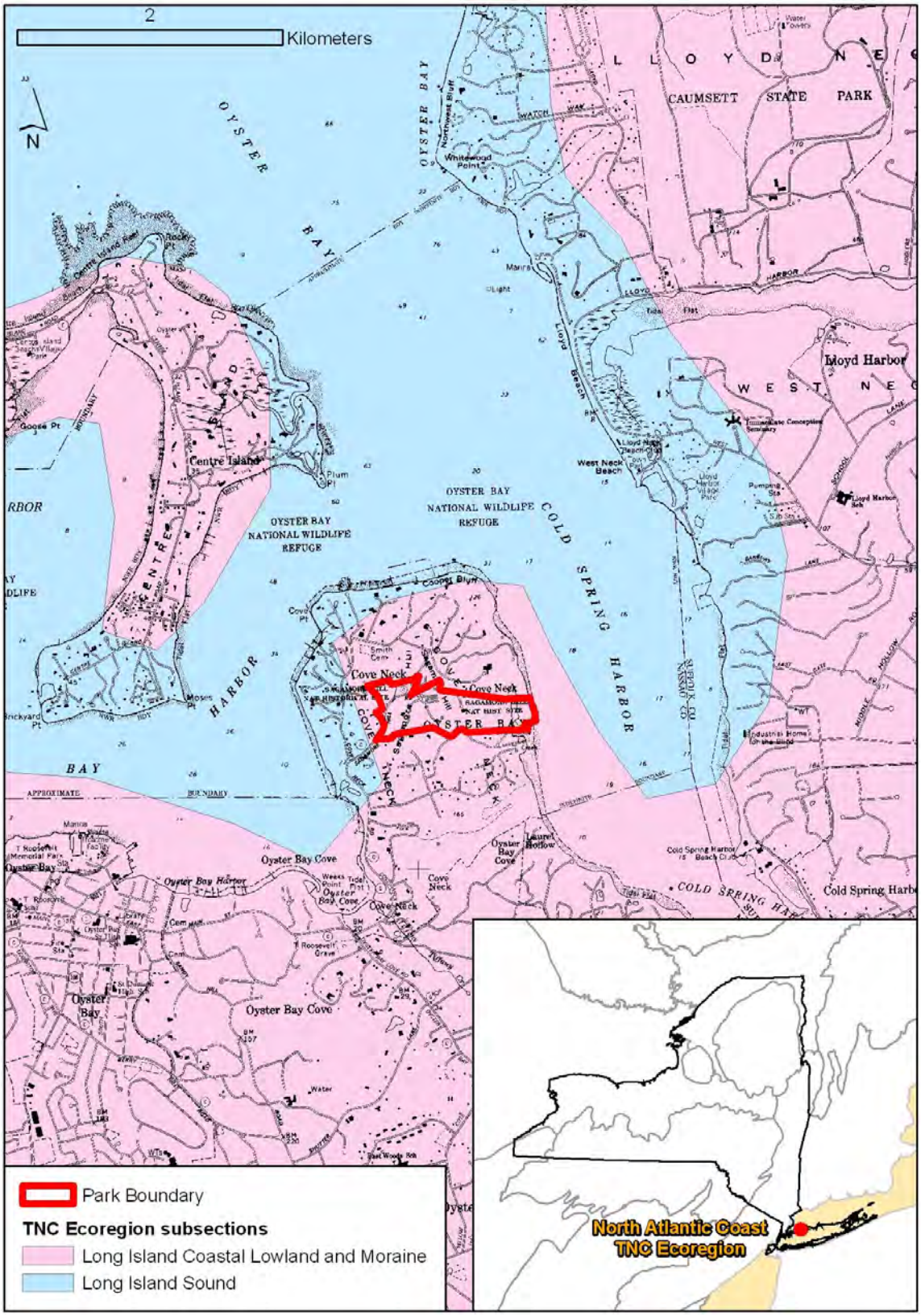

Figure 2. Ecoregion Sections and Subsections (Bailey 1995) of Sagamore Hill National Historic Site.

Soils

A detailed account of the park's soils can be found in the Soil Survey of Nassau County, New York (USDA, NRCS 2005, USDA, SCS 1987). Soil types are reported in the environmental description for each vegetation association in Appendix E.

There are seven prominent soil types (USDA, NRCS 2005; USDA, SCS 1987) within Sagamore Hill National Historic Site, listed below as they occur east to west through the site and depicted in Figure 3:

- (Bc) Beaches comprised of well-drained sand;
- (Pa) Very poorly drained Pawcatuck mucky peat;
- (MfC) Well-drained Montauk fine sandy loam, 8–15 percent slopes, comprised of loamy till over firm sandy till, derived mainly from crystalline rock;
- (RdD) Well-drained Riverhead sandy loam, 15–25 percent slopes, comprised of loamy glaciofluvial deposits overlying stratified sand and gravel;
- (MfB) Well-drained Montauk fine sandy loam, 3–8 percent slopes, comprised of loamy till over firm sandy till, derived mainly from crystalline rock;
- (PlC) Excessively drained Plymouth loamy sand, 8–15 percent slopes, comprised of acid sandy glaciofluvial or deltaic deposits; and
- (PrD) Excessively drained Plymouth-Riverhead complex, 15–35 percent slopes, comprised of loamy glaciofluvial deposits overlying stratified sand and gravel.

Hydrology

For estuarine communities, semidiurnal tides in Cold Spring Harbor and Eel Creek are the most important hydrological features at Sagamore Hill National Historic Site. There is one vernal pool in the park and it appears to be the only natural freshwater wetland at the site. There is also a farm pond/artificial pond along the north border of the site. The wetlands and water bodies at Sagamore Hill National Historic Site are predominately marine and estuarine communities dependent on the twice daily inundation of saltwater. A brief summary of the aquatic resources at the park can be found in the Sagamore Hill National Historic Site Resource Management Plan (NPS 1992).

Ecological Processes and Maritime Influence

The maritime plant associations at Sagamore Hill National Historic Site are moderately influenced by coastal processes, including salt spray, winds, and dune deposition, and shifting and occasional overwash processes. Maritime associations generally contain a few stunted "salt-pruned" trees and shrubs with contorted branches and wilted leaves. These communities often occur as narrow bands (e.g., <50 m [164 ft] wide) parallel to the shoreline and contain plants that are adapted to these conditions (Edinger et al. 2002).

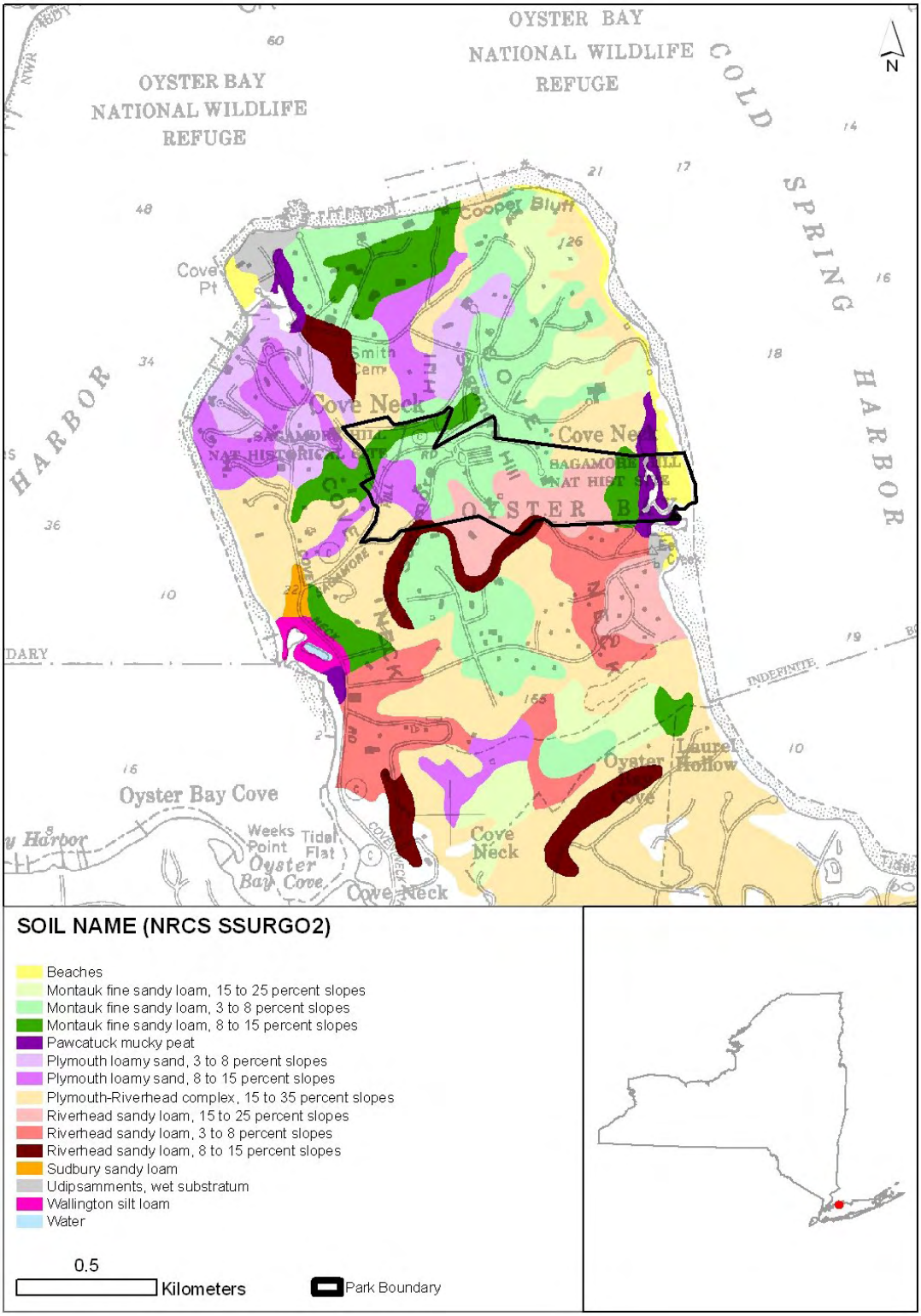

Figure 3. Soils of Sagamore Hill National Historic Site from SSURGO2 - County Soils Data from the Soil Conservation Service (USDA, NRCS 2005).

Materials and Methods

Planning and Scoping

Several steps were taken to prepare for the vegetation classification and mapping at Sagamore Hill National Historic Site. On September 16, 2003, NY Natural Heritage ecologist Aissa Feldmann met with Scott Gurney of Sagamore Hill National Historic Site. The project timeline, mapping product specifications, access issues, natural resource management needs, and applicable previous and current research conducted at the park were discussed. Afterwards, a reconnaissance tour of selected sites was undertaken in order to become familiar with broad ecological patterns and to determine field survey logistics.

Preliminary Data Collection and Review of Existing Information

Previous studies conducted at Sagamore Hill National Historic Site were obtained from the park's natural resource manager and NY Natural Heritage files and were reviewed for information pertinent to the park's vegetation (e.g., NPS 1992, 2005). These reports included previous vegetation classifications and floristic studies (Stalter 2000; Werier 2006). General information on the cultural and natural history of Sagamore Hill National Historic Site was obtained from various books, reports, and NPS park brochures, as well as NPS official Web sites (e.g., http://www.nps.gov/sahi/).

The following data layers were available to NY Natural Heritage via New York State Department of Environmental Conservation in digital and hard copy formats and were reviewed to refine photo interpretation: soil maps (USDA, NRCS 2005; USDA, SCS 1987), bedrock and surficial geology maps (Cadwell 1989; Fisher et al. 1970; and NYS Museum digital geology data), wetland maps (National Wetlands Inventory Data for NY State; NY State Regulatory Freshwater Wetland data), state tidal wetland maps (NY Department of State, Division of Coastal Resources), and the NY Natural Heritage Biotics 4.1 database (NatureServe 2007).

Preliminary Vegetation Map Production

The digital orthorectified photomosaics of Sagamore Hill National Historic Site were not completed in time to digitize the preliminary vegetation map prior to the 2003 field season. In order to complete the field work, the preliminary vegetation map was developed by using 1995 color infrared National Aerial Photography Program aerial photos and screen digitizing NY ecological community (Edinger et al. 2002) boundaries using 1994–99 digital orthophoto quarter quadrangles (DOQQs) (USGS 1994) as the base layer. The first set of deliverables for this project, including the preliminary community delineations on digital imagery for Sagamore Hill National Historic Site draft classification, were completed and provided to NPS on May 16, 2003 for review.

The NY ecological community types (Edinger et al. 2002) on the 2003 preliminary vegetation map were differentiated based on vegetation structure, leaf phenology, and hydrologic regime, because these characteristics easily identified on aerial photography. This map was developed as a guide for vegetation plot field sampling.

Photo Interpretation

The preliminary vegetation map and subsequent revised maps were created through aerial photograph interpretation. Aerial photograph interpretation is the act of examining aerial photographs in order to identify objects, in this case, vegetation types (Avery 1978). The photographs (color infrared, stereo pair, hard copy photographs) were examined through a stereoscope, which provides the viewer with a three-dimensional view. The DOQQs were also examined onscreen in ArcView 3.2 (ESRI 1992–2000). In addition, digital USGS topographic quadrangle maps were examined in ArcView 3.2. Using information gathered from aerial photographs, the DOQQs, and the topographic maps, polygons representing different ecological communities were digitized onscreen using ArcView 3.2. The screen digitizing process permitted the simultaneous use of aerial photography and supplemental digital data layers that are useful in delineating USNVC association boundaries, including Department of Transportation road coverages, hydrology coverages, and National Park Service boundaries.

Aerial Photography Acquisition and Processing

On April 28, 2003, William Frament, USDA Forest Service (Northeastern Area State and Private Forestry, Durham, NH) acquired leaf-off color infrared, stereo pair, 1:8,000 scale aerial photography of Sagamore Hill National Historic Site. Frament subsequently scanned the aerial photographs at 600 dpi and delivered the scanned image files, in TIFF format, and the hard copy photographs to the NPS Northeast Region Field Technical Support Center at North Carolina State University (NCSU). The photographs, the camera calibration certificate, and a shapefile of photo centers provided by Frament are temporarily stored in the archive that NCSU maintains for the NPS Northeast Region Inventory & Monitoring Program.

The photomosaic was produced from three color infrared aerial photographs. Scanned .tif images of the aerial photographs were imported into ERDAS IMAGINE Version 8.7 (Leica Geosystems Geospatial Imaging 2003) .img format where a photo block was created using a digital elevation model and digital orthophoto quarter quadrangles obtained from the U.S. Geological Survey (USGS) as reference. In preparation for this step, the digital elevation model was resampled from 30 meters to 10 meters and the digital orthophoto quarter quadrangles were compiled into a mosaic. The photo block was manipulated until it could be triangulated with a root mean square error of less than 1. Single frame orthophotos (one for each aerial photograph) were then generated within IMAGINE and exported to .lan format. The .lan files were imported into ER Mapper's native (.ers) format and ER Mapper Version 6.4 (Earth Resource Mapping Ltd. 2003) was used to define cutlines, color balance and mosaic the images, generate band interleaved by line (.bil) image and header files for the photomosaic, and convert the .bil image to IMAGINE .img format. The .img image was compressed using MrSID Version 1.4 (LizardTech, Inc. 2000) software with a 20:1 compression ratio. The final photomosaic, in both .img and MrSID formats, is stored in the NCSU archive.

Photomosaics Metadata

A metadata record for the digital orthorectified photomosaic was prepared in accordance with the current Federal Geographic Data Committee standards (FGDC 1998a). Metadata were produced in Microsoft Notepad and parsed using the USGS metadata compiler (USGS 2004). After all

errors and omissions identified by the parser were corrected, the metadata compiler was used to generate final TXT, HTML, and XML versions of the metadata record which are stored in the data archive at NCSU. Key information for the Sagamore Hill National Historic Site photomosaic is summarized in Appendix A.

Field Data Collection and Classification

All vegetation plot sampling followed the USGS/NPS Vegetation Mapping Program and NY Natural Heritage protocols (TNC and ESRI 1994b; Edinger et al. 2000). The preliminary vegetation map was used as a guide to determine the number of plots to be sampled. The number of vegetation cover types and the number of polygons per cover type were both considered (Table 1). The USGS/NPS Vegetation Mapping Protocol suggests that each vegetation association should have been sampled at least three times in order to capture the naturally occurring variation within the park (TNC and ESRI 1994b). Therefore, at least three polygons of each vegetation cover type were selected for sampling. Six plots were sampled in the Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075), even though it only had two polygons, in order to capture the variation observed on the ground, and because it represents the largest forest association in the park. For vegetation cover types with less than three polygons, each polygon was selected for sampling. Polygons that represented cultural types labeled with Anderson Level II land cover categories (Anderson et al. 1976) were not intentionally sampled.

Within each polygon selected for sampling, a plot was established in an area that most represents the existing vegetation association (Mueller-Dombois and Ellenberg 1974). All vegetation data were collected following NatureServe's accepted natural heritage sampling protocols (TNC and ESRI 1994b; Edinger et al. 2000), with 20×20-m (65.6×65.6 ft) plots in forests and woodlands, and 10×10-m (32.8×32.8 ft) plots in shrublands and herbaceous vegetation. The vegetation was visually divided into eight strata: emergent trees (variable height), tree canopy (variable height), tree subcanopy (>5 m [16.4 ft]), tall shrub (2–5 m [6.5–16.4 ft]), short shrub (<2 m [6.5 ft]), herbaceous, non-vascular, and vines. The percent cover was estimated for each species in each stratum. Specimens of species that were not identifiable in the field were collected for later identification. The diameter at breast height (dbh, 1.3 m) was measured with a dbh tape for all trees larger than 10 cm (3.9 in) in diameter that were rooted in the plot. The diameters were recorded by species and strata.

In addition to floristic information, the following environmental variables were recorded at each plot following NatureServe's accepted natural heritage sampling methods (TNC and ESRI 1994b; Edinger et al. 2000): slope, aspect, topographic position, hydrologic regime, soil stoniness, average soil texture, and soil drainage. Any unvegetated area of the plot was characterized by the exposed substrate. Notes were taken on the plot's representativeness of the surrounding vegetation and any other significant environmental information, such as landscape context, herbivory, stand health, recent disturbance, or evidence of historic disturbance. Plot data and reference observation point data were collected digitally in the field using an iPAQ hand-held computer with software (Hand-Held Database – HHDB) and imported to the Field Form Database (FFDB) developed by NY Natural Heritage. Prior to the development of the

Table 1. Number of polygons, mapped hectares, and number of plots and reference observation points sampled in 2003 by U.S. National Vegetation Classification association and Anderson Level II land cover categories on the 2006 revised preliminary vegetation map (pre-accuracy assessment) of Sagamore Hill National Historic Site.

	Number of Polygons	Mapped Hectares Within the Park Boundary	Number of Plots Sampled 2003	Number of Reference Observation Points Sampled 2003
USNVC Vegetation Association (USNVC code)				
Eastern Woodland Vernal Pool (CEGL006453)	1	0.06	0 [b]	0
Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075)	2	9.38	6	3
North Atlantic High Salt Marsh (CEGL006006)	1	0.21	1	0
North Atlantic Low Salt Marsh (CEGL004192)	4	1.16	0 [b]	0
North Atlantic Upper Ocean Beach (CEGL004400)	1	0.34	1	0
Northeastern Dry Oak - Hickory Forest (CEGL006336)	2	1.66	3	1
Northeastern Modified Successional Forest (CEGL006599)	1	2.48	2	0
Northern Beachgrass Dune (CEGL006274)	2	1.47	1	0
Norway Maple Forest (CEGL006407)	2	4.29	2	0
Subtotal	16	21.07	16	4
Anderson Level II land cover categories				
11. Residential	1	0.07		
12. Commercial and Services	1	12.48		
21. Cropland and Pasture [a]	0	0.00		1
22. Orchards	1	1.46		1
53. Reservoirs	1	0.05		1
54. Bays and Estuaries	2	0.69		
Subtotal	6	14.75		3
Grand Total	22	35.82	16	7

[a] Land cover categories with zero polygons and zero mapped hectares were not represented on the 2006 revised preliminary map. Once the plots were properly reclassified after accuracy assessment, the polygons were relabeled on the 2007 final vegetation association map (Figure 7).

[b] Two associations were missed during plot sampling. Eastern Woodland Vernal Pool (CEGL006453) was not a recognized vegetation association in the U.S. National Vegetation Classification in 2003. In addition, this type is best surveyed in early spring to confirm the presence of obligate vernal pool fauna and not best captured via our late summer vegetation plot sampling. Despite having four polygons on the preliminary vegetation map, North Atlantic Low Salt Marsh (CEGL004192) was unintentionally missed during plot sampling. Fortunately, this association is easily recognizable from air photos and was sufficiently sampled during accuracy assessment.

HHDB and FFDB plot data were collected on paper forms. A sample plot form and screen shots from the HHDB used for this project are included in Appendix B.

A digital photograph was taken at most of the plot sampling locations. The location of each plot was recorded with a Garmin 12 Map GPS unit. The datum on the GPS unit was set to North American Datum 1983 (Conus) and the coordinate system was set to Universal Transverse-Mercator (UTM) zone 18N.

In addition to the detailed vegetation sampling plots, quick observation points (Edinger et al. 2000) were surveyed to help improve the accuracy of the vegetation map. These are called “reference points” in this study in order to distinguish them from the plots. Most of the reference

points include minimal vegetation cover data and are frequently used to record the spatial extent of a vegetation association. In other cases reference points are used to record landmarks (e.g,, trails, small ponds, large trees, patches of invasive species, etc.) that may be difficult to see on aerial photos.

Plot sampling was conducted on September 16 and 17, 2003 by Aissa Feldmann (NY Natural Heritage). In total, 16 plots and 7 reference observation points were sampled throughout the park (Figure 4). The distribution of plots by USNVC vegetation association is shown in Table 1.

Vegetation Classification and Characterization

Data from the 16 vegetation plots in NY Natural Heritage Field Form Database (FFDB) were edited for accuracy and exported into an Excel spreadsheet format compatible with PC-ORD version 4.0 Multivariate Analysis software (McCune and Mefford 1999). The FFDB export program automatically assigns standardized codes based on the PLANTS 3.5 Database developed by the Natural Resource Conservation Service in cooperation with the Biota of North America Program (USDA, NRCS 2004). The common and scientific names of plants observed during the vegetation plot sampling are listed alphabetically by family in Appendix C. Some tree and shrub seedlings and immature herbaceous plants could only be identified to the genus level and are therefore listed in the appendix as such. Taxonomic nomenclature follows the PLANTS 3.5 Database developed by the Natural Resource Conservation Service in cooperation with the Biota of North America Program (USDA, NRCS 2004).

Within PC-ORD, Non-metric Multidimensional Scaling (NMS), Hierarchical Cluster Analysis (CA), and Two-Way Indicator Species Analysis (TWINSPAN) procedures were used to group and classify the dataset. Local, park-specific descriptions were developed for the preliminary vegetation associations based on the results of these quantitative classification methods. The associations were then crosswalked to the U.S. National Vegetation Classification (USNVC) by searching for alliances sharing similar dominant species, physiognomy, and environmental setting. Total floristic composition was used to determine appropriate associations within each alliance. Global information on the associations from the USNVC was then appended to the local descriptions to provide resource managers with a broader context for the vegetation in the park. During spring 2006, Ery Largay and Lesley Sneddon of NatureServe assisted with labeling plots with correct USNVC association codes.

A park-specific dichotomous key to the USNVC associations was created (Appendix D) to accompany the classification and vegetation associations descriptions (Appendix E) and for use by park natural resource managers and others. A dichotomous key is a tool for identifying unknown entities, in this case, vegetation associations. It is structured by a series of couplets, two statements that describe different, mutually exclusive characteristics of the associations. Choosing the statement that best fits the association in question leads the user to the correct association. The dichotomous key should be used in conjunction with the detailed vegetation association descriptions to confirm that the association selected with the key is appropriate.

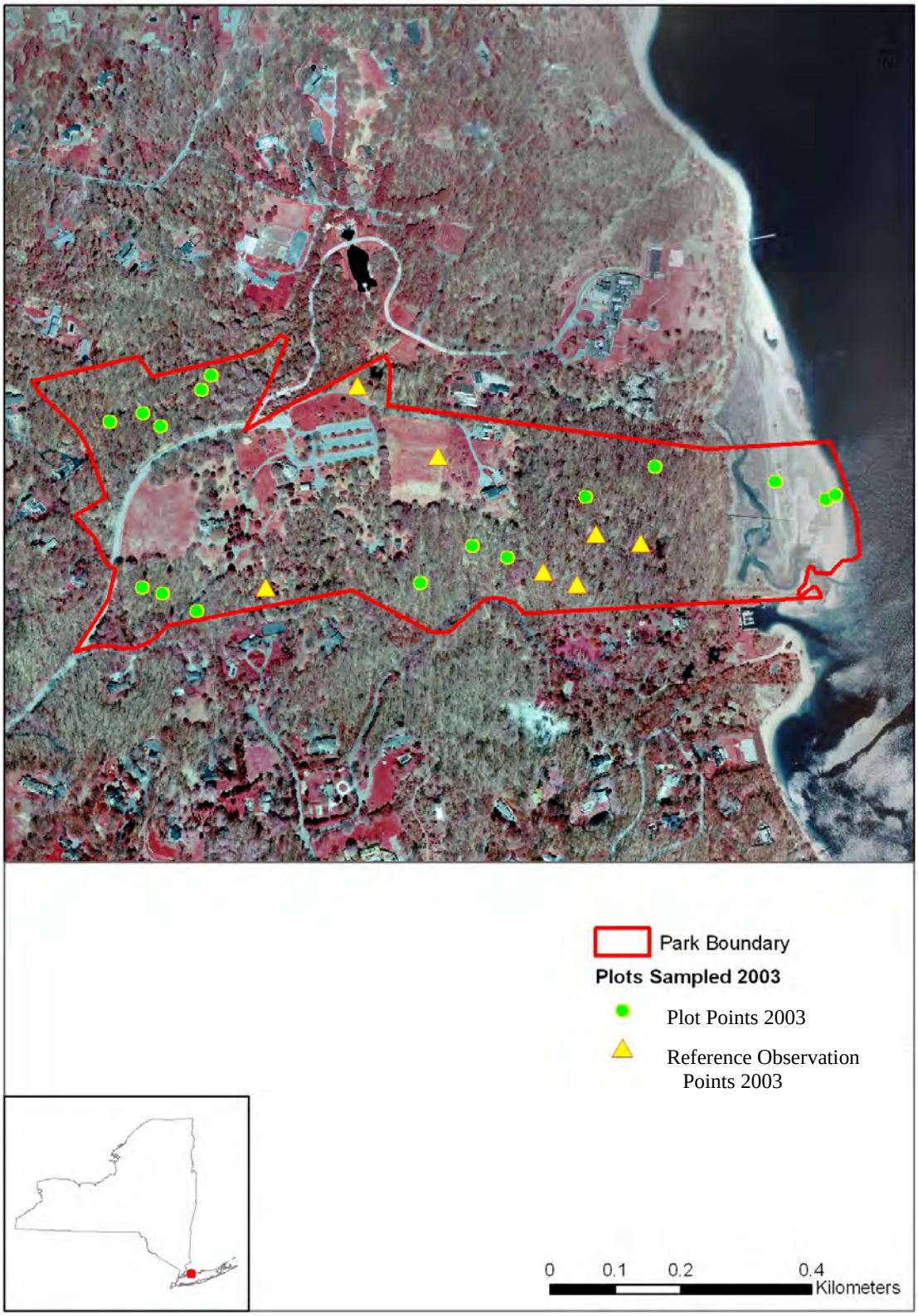

Figure 4. Location of 16 vegetation plots and seven reference observation points sampled in 2003 at Sagamore Hill National Historic Site.

2006 Revised Preliminary Vegetation Map (Pre-accuracy Assessment)

Following the vegetation plot data analysis, the preliminary vegetation map was edited and refined to produce a revised preliminary vegetation map prior to thematic accuracy assessment. Using ArcMap 9.2 (ESRI 1999–2006), polygon boundaries were revised on screen based on the plot data, field observations, classification analyses, aerial photography signatures, and topographic maps. Each polygon was assigned the USNVC Community Element Global (CEGL) code of a preliminary vegetation association based on the information sources listed above. Second, third, and fourth CEGL code choices were entered in cases of uncertainty, or for polygons representing mosaics of two or more types.

Accuracy Assessment

Two sources of potential error in the vegetation map include: 1) horizontal positional accuracy, in which a location on the photomosaic does not accurately align with the same location on the ground due to errors in orthorectification or triangulation; and 2) thematic accuracy, in which the vegetation type assigned to a particular location on the map does not correctly represent the vegetation at the same location in the park due to mapping error. The USGS/NPS Vegetation Mapping Program protocols (ESRI et al. 1994) were followed to assess the positional accuracy of the digital photomosaic and the thematic accuracy of the 2006 revised preliminary vegetation map.

Photomosaic Positional Accuracy Assessment

The horizontal positional accuracy of the ortho photomosaic was assessed using guidelines of the USGS/NPS Vegetation Mapping Program (ESRI et al. 1994). Well-defined positional accuracy ground control points were placed throughout all quadrants of the photomosaic in ArcMap. Ground control points and zoomed-in screenshots of each point were plotted on hard copy maps with the photomosaic as a background. These maps and plots were used to locate the ground control points in the field. Field staff recorded the ground control point coordinates with a Trimble Pro XR/XRS GPS unit. Mapped ground control points that were physically inaccessible were also noted. The field crew collected accuracy assessment data at 27 ground control points. The coordinate data were collected with real time GPS and post processed with differential correction using Pathfinder Office software. Prior to calculating accuracy, two ground control points were identified as outliers with SAS's JMP program and removed. The field-collected GPS coordinates for the remaining 25 points were compared to the coordinates obtained from the photomosaic viewed in ArcMap. Both pairs of coordinates for each point were entered into a spreadsheet in order to calculate horizontal accuracy (in meters). The accuracy calculation formula is based on root mean square error (FGDC 1998b; Minnesota Governor's Council on Geographic Information and Minnesota Land Management Information Center 1999). Figure 5 shows the distribution of the ground control points within the park and surrounding area.

Thematic Accuracy Assessment

The thematic accuracy of the 2006 revised preliminary map was assessed by NY Natural Heritage. A stratified random sampling approach was used (see below), distributing the sampling effort across the revised preliminary vegetation association map (Table 1).

Level II land cover categories (Anderson et al. 1976) were not included in the thematic accuracy assessment sampling.

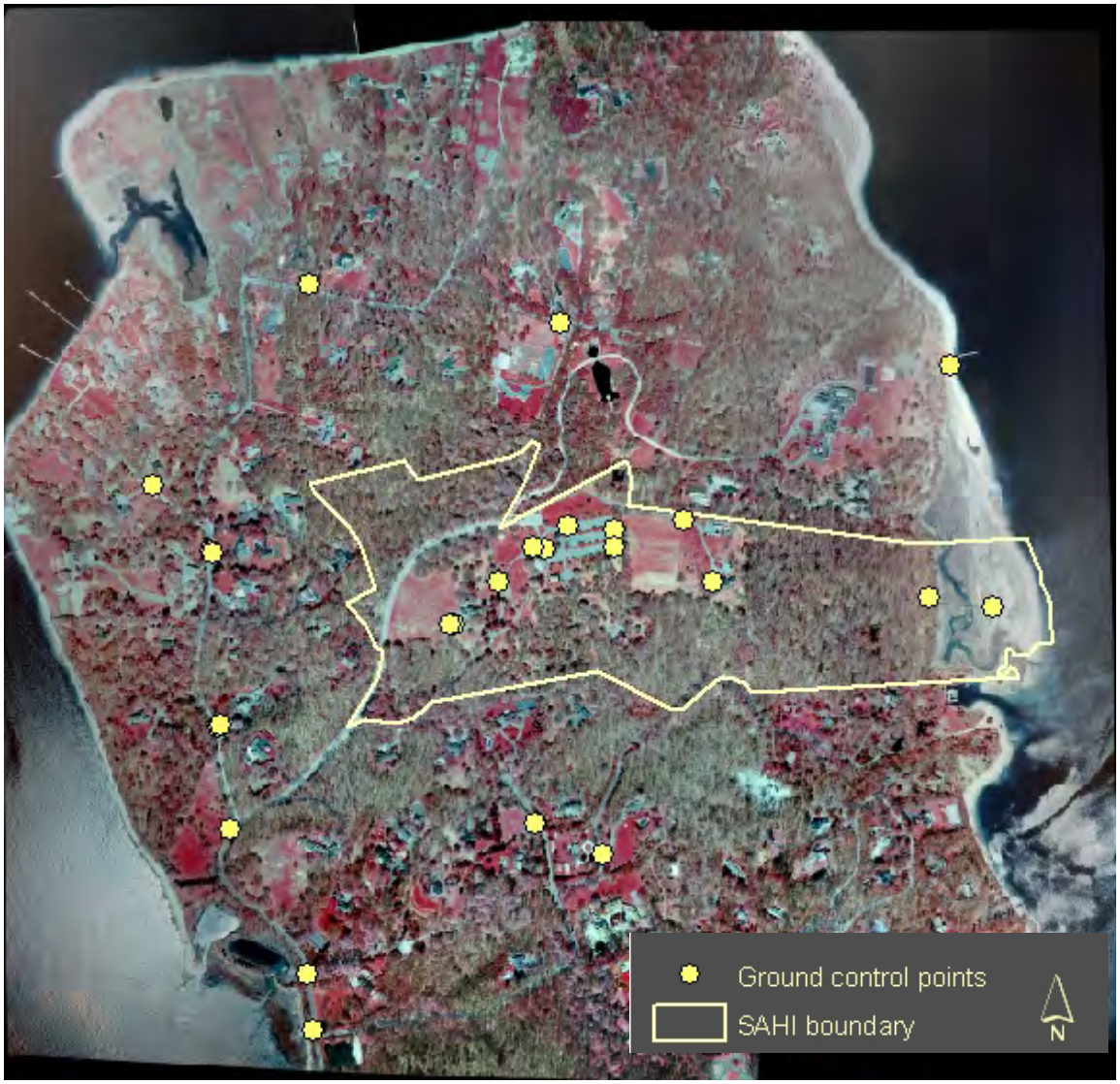

Figure 5. Ground control points (25) used to calculate horizontal positional accuracy of the Sagamore Hill National Historic Site color infrared orthorectified photomosaic.

The vegetation associations listed in Table 1 were determined before thematic accuracy assessment. Several changes were made to the classification after accuracy assessment; therefore, the preliminary association names in Table 1 do not fully match the final list of associations in Table 2 and the descriptions presented in Appendix E.

In the stratified random sampling approach, the number of samples per association varied according to the rarity of the vegetation association, both in terms of number of polygons and polygon size. The following rules were used to determine the number of points assigned to each association (ESRI et al. 1994):

Scenario A: The class is abundant. It covers more than 50 ha (123.5 ac) in total area and consists of at least 30 polygons. In this case, it is recommended that 30 polygons be selected at random from the set of the association's polygons. One sampling point will be assigned to each of the 30 selected polygons.

Scenario B: The association is relatively abundant. It covers more than 50 ha (123.5 ac) in total area but consists of fewer than 30 polygons. In this case, it is recommended that 20 polygons be selected at random from the set of the association's polygons, and that one sampling point be assigned to each of the 20 selected polygons. If the association contains less than 20 polygons, some polygons will contain multiple sampling points. The number of sampling points assigned to each polygon is determined by the relative area of that polygon compared with the other polygon in that association.

Scenario C: The association is relatively rare. It covers less than 50 ha (123.5 ac) in total area but consists of more than 30 polygons. In this case, it is recommended that 20 polygons be selected at random from the set of the association's polygons. One sampling point will be assigned to each of the 20 selected polygons.

Scenario D: The class is rare. It has 5–30 polygons and covers less than 50 ha (123.5 ac). In this case, it is recommended that five polygons be selected at random from the set of the association's polygons. One sampling point will be assigned to each of the five selected polygons.

Scenario E: The association is very rare. It has fewer than five polygons and occupies less than 50 ha (123.5 ac) of the total area. In this case, it is recommended that one sampling point be assigned to each polygon.

All of the associations at Sagamore Hill National Historic Site fell into Scenario E. The Generate Random Points tool in Hawth's Analysis Tools in ArcGIS 9.2 (Beyer 2006; ESRI 1999–2006) was used to randomly determine the location of the Accuracy Assessment Destination Points in each polygon.

Table 2. Number of polygons, mapped hectares, number of accuracy assessment destination points, and number of accuracy assessment points and reference observation points sampled in 2006 for each U.S. National Vegetation Classification association and Anderson Level II land cover category on the 2007 final vegetation map (post-accuracy assessment) of Sagamore Hill National Historic Site.

	Number of Polygons	Mapped Hectares Within the Park Boundary	Number of Accuracy Assessment Destination Points [a]	Number of Accuracy Assessment Points Sampled 2006	Number of Reference Observation Points Sampled 2006
USNVC Vegetation Association (USNVC code)					
Eastern Woodland Vernal Pool (CEGL006453)	1	0.11	0	0	0
Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075)	4	11.89	2	1	0
North Atlantic High Salt Marsh (CEGL006006)	3	0.48	1	2	0
North Atlantic Low Salt Marsh (CEGL004192)	4	1.16	5	4	0
North Atlantic Upper Ocean Beach (CEGL004400)	1	0.22	1	1	2
Northeastern Dry Oak - Hickory Forest (CEGL006336)	3	2.98	2	4	0
Northeastern Modified Successional Forest (CEGL006599)	3	2.58	1	1	0
Northern Beachgrass Dune (CEGL006274)	3	0.65	2	1	2
Norway Maple Forest (CEGL006407)	3	2.55	3	2	0
Overwash Dune Grassland (CEGL004097) [b]	1	0.54	0	0	1
Subtotal	26	23.16	17	16	5
Anderson Level II land cover categories					
11. Residential	3	0.26	1[c]	0	0
12. Commercial and Services	2	10.04	1[c]	0	0
21. Cropland and Pasture	1	1.24	0	1[d]	0
22. Orchards	1	0.25	1[c]	0	0
53. Reservoirs	1	0.05	0	0	0
54. Bays and Estuaries	2	0.69	0	0	0
72. Beaches	1	0.12	0	0	1
Subtotal	11	12.67	3	1	1
Grand Total	37	35.82	20	17	6

[a] Number of Accuracy Assessment Destination Points determined by USGS/NPS Vegetation Mapping Program protocol (ESRI et al. 1994). These numbers were determined using the 2006 revised preliminary map with the number of polygons and mapped hectares presented in Table 1. This table shows number of polygons and hectares for the 2007 final vegetation map (post-accuracy assessment).

[b] Overwash Dune Grassland (CEGL004097) was identified as new to the park based on accuracy assessment data collection, and thus not included in the original list of types to be assessed.

[c] Three Accuracy Assessment Destination Points were erroneously selected for Anderson Level II land cover categories along with the 17 generated for USNVC Vegetation Associations. The error was discovered in the field after two were sampled; we did not attempt to sample the point located in the "Residential" cover category.

[d] One accuracy assessment point was reclassified as an Anderson Level II land cover category.

Before random accuracy assessment (AA) destination points were determined, a transition zone was created 15 m (49 ft) in from the polygon boundary to serve as a "buffer" to prevent the placing of random AA destination points too close to the polygon boundaries and to avoid ecotones. The value of 15 m (49 ft) was established because it is the recommended average error of the GPS units used by staff for this project. Therefore, no AA destination points were placed within 15 m (49 ft) of a polygon boundary unless the transition zone completely subsumed the polygon, which occurred in a few situations, because a given polygon was either too small or too narrow to support a 15 m (49 ft) transition zone. In these cases, the entire polygon was used as the sample "point" with the exact location of the field survey left to the discretion of the ecologist performing the accuracy assessment. These AA destination points are spatially represented by the centroid of each of these polygons in the accuracy assessment shapefile, and differentiated by unique identification in the attribute table. A total of 20 AA destination points were generated prior to conducting field sampling in 2006 (Figure 6; Table 2).

On October 18, 2006, NY Natural Heritage Chief Ecologist Greg Edinger attempted to navigate to as many of the 20 GIS generated accuracy assessment destination points as possible using a Magellan SporTrak GPS unit. The datum on the GPS units was set to North American Datum 1983 (Conus) and the coordinate system was set to Universal Transverse Mercator (UTM) zone 18N. In most cases, three vectors (i.e., bearing and distance) were used to get within 10 m (32.8 ft) of destination points for open communities, or 20 m (65.6 ft) for forested communities, while remaining entirely within the target polygon as best as possible. These cut-off levels were selected based on the plot size recommended for those types. Accuracy assessment data were collected digitally in the field using an iPAQ hand-held computer with data entry software (NY Natural Heritage Hand-Held Database [HHDB]) and imported to the NY Natural Heritage Field Form Database. Sample screen shots from the HHDB used for the accuracy assessment part of this project are included in Appendix B. A total of 17 accuracy assessment points and six reference observation points were sampled at Sagamore Hill National Historic Site in 2006 (Figure 6; Table 2).

In addition to the accuracy assessment sampling points, quick observation points (Edinger et al. 2000) were surveyed to help improve the accuracy of the vegetation map. These are called "reference points" in this study in order to distinguish them from the accuracy assessment sampling points. These were collected in addition to the set of 20 GIS generated accuracy assessment destination points. Most of the reference points include minimal vegetation cover data and are frequently used to record the spatial extent of a vegetation association, or locate the line between two vegetation types. In other cases reference points are used to record landmarks (e.g., trails, small ponds, large trees, patches of invasive species, etc.) that may be difficult to see on aerial photos. In a few cases, a reference point was taken if we noticed a misclassified vegetation association in the field that was excluded from the accuracy assessment, or if the vegetation association was overlooked entirely on previous surveys.

Mapped and observed vegetation associations were tabulated into a contingency matrix to evaluate the thematic accuracy of the vegetation association map. Overall percent accuracy and Kappa index (ESRI et al. 1994) were calculated to assess overall thematic accuracy. Percent accuracy was calculated by dividing the number of correctly classified accuracy assessment points by the total number of accuracy assessment points. Formulas by Foody (1992, in ESRI et al. 1994) were followed for the calculation of the Kappa index. The Kappa index accounts for

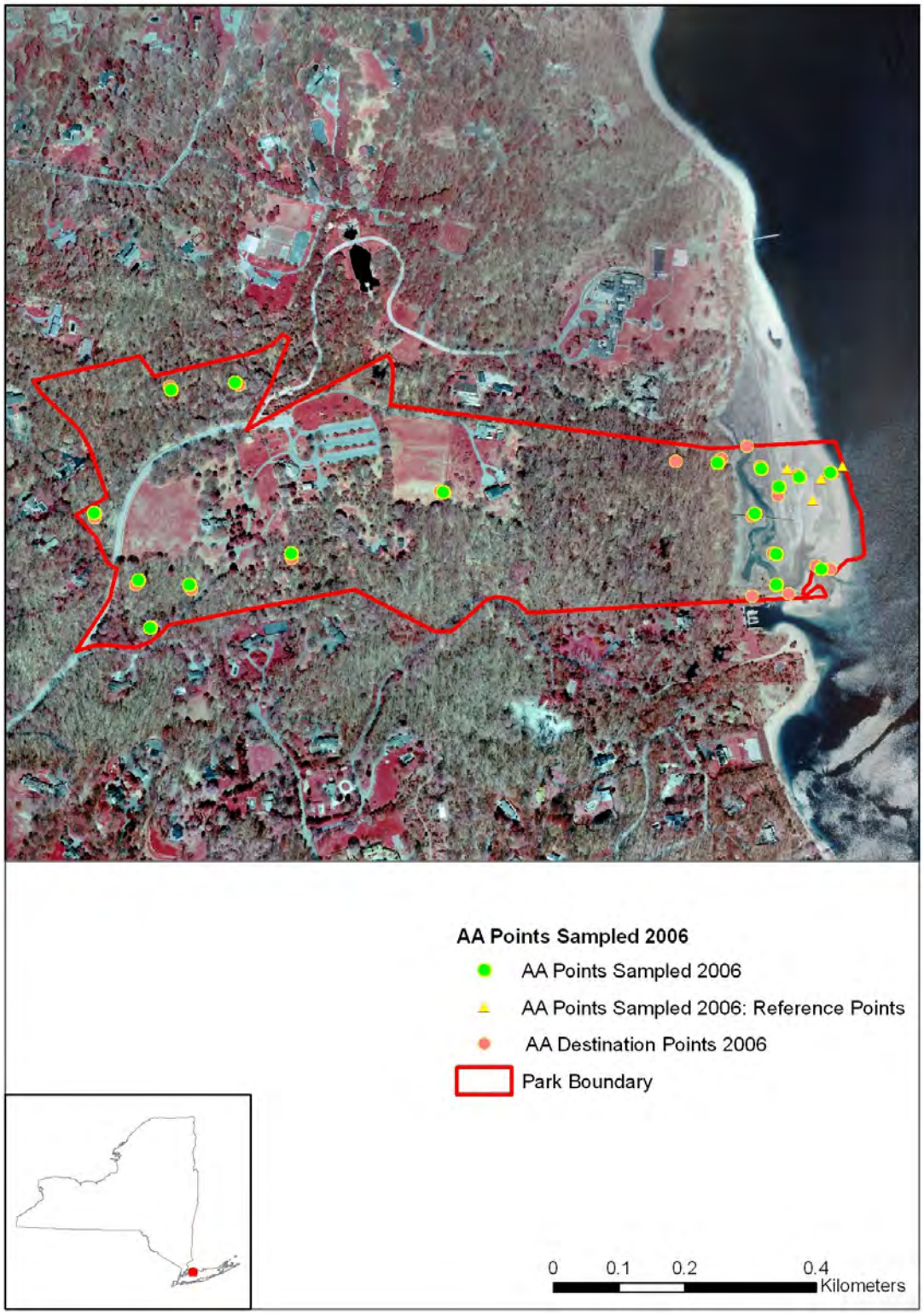

Figure 6. Location of accuracy assessment (AA) destination points (20), AA points sampled (17), and reference observation points sampled (six) in 2006 at Sagamore Hill National Historic Site.

the fact that a certain number of correct classifications will occur by chance (Foody 1992) and is preferred over the simpler overall accuracy estimate. The USGS/NPS vegetation mapping protocol sets a standard of 0.80 or better for the Kappa index of vegetation associations maps (ESRI et al. 1994).

Errors of omission and errors of commission were calculated for each map unit. Both of these errors are calculated by dividing the number of correctly classified points in one vegetation unit by the total number of points sampled in that vegetation unit. Errors of omission indicate the probability that an accuracy assessment point classification will be correct and are calculated by sampled vegetation type. Errors of commission indicate the probability that a mapped vegetation type actually represents the vegetation on the ground and are calculated by mapped vegetation type. The errors of omission and errors of commission for mapped vegetation associations should be less than 20% (e.g., mapping should exceed 80% correct), according to the USGS/NPS Vegetation Mapping Protocol (ESRI et al. 1994). We evaluated whether each mapped vegetation type and each observed vegetation type met the 80% standard, as well as the percentage of vegetation types, overall, that met the standard.

Results

Vegetation Classification and Characterization

The vegetation associations of the Sagamore Hill National Historic Site were classified using PC-ORD version 4.0 Multivariate Analysis package (McCune and Mefford 1999). Plot data were exported from the NY Natural Heritage Field Form Database and transferred into a Microsoft Excel spreadsheet for data preparation prior to PC-ORD analyses. The following four datasets were created for Sagamore Hill National Historic Site:

- all plots/species separated by strata;
- all plots/species separated by strata/no exotics;
- all plots/species lumped (i.e., not separated) across strata; and
- all plots/species lumped across strata/no exotics.

The following three programs with indicated settings were run from PC-ORD software package for all datasets (12 total results, Table 3):

- NMS: Non-metric Multidimensional Scaling (Kruskal and Wish 1978; Clarke 1993), Autopilot mode, Medium Speed vs. Thoroughness, and Sorensen (Bray-Curtis) distance measure;
- CA: Hierarchical Cluster Analysis, Relative Euclidian linkage method, and Ward's Method distance measure;
- TWINSPAN: Two-Way Indicator Species Analysis (Hill and Gauch 1979) with default settings.

The results of these classification analyses were evaluated against each other and compared to Ecological Communities of New York State (Edinger et al. 2002) and the U.S. National Vegetation Classification. For a detailed discussion of the statistical techniques used in this study, please refer to McCune and Grace (2002). Based on this evaluation, a revised list of preliminary vegetation associations were identified, and in spring 2006 a revised preliminary vegetation map was created. These preliminary vegetation associations are listed in Table 1.

Table 3. Statistical methods and datasets used to classify USNVC associations at Sagamore Hill National Historic Site.

	All plots/ Separate strata	All plots/ Separate strata/ No exotics	All plots/ Lumped strata	All plots/ Lumped strata/ No exotics
NMS	16 plots x 67 species	16 plots x 57 species	16 plots x 43 species	16 plots x 34 species
CA	16 plots x 67 species	16 plots x 57 species	16 plots x 43 species	16 plots x 34 species
TWINSPAN	16 plots x 67 species	16 plots x 57 species	16 plots x 43 species	16 plots x 34 species

Each preliminary vegetation association was assigned a common name based on the Ecological Communities of New York State (Edinger et al. 2002). If no appropriate name existed in Edinger et al. (2002), the U.S. National Vegetation Classification common name was used, or a park-specific common name was created in the case of successional and cultural vegetation types not easily handled by Edinger et al. (2002) or the USNVC.

Accuracy Assessment

Positional Accuracy

The horizontal positional accuracy of the orthorectified photomosaic is 2.77 meters, which meets the Class 2 National Map Accuracy Standard (FGDC 1998b). A copy of the spreadsheet containing the x and y coordinates for each ground control point and the accuracy calculation formula is stored in the NCSU archive.

Thematic Accuracy

Thematic accuracy assessment for the vegetation association map was calculated with a contingency matrix (Table 4). Anderson Level II land cover categories were not intentionally included in the sampling. They are provided in Table 4 for completeness and the two samples erroneously taken in these cover types are included in the overall accuracy calculations but accuracy for individual Anderson Level II categories were not assessed. Two types were inexplicably missed during AA sampling and could not be evaluated in this standard way. These are Northeastern Modified Successional Forest (CEGL006599) and Eastern Woodland Vernal Pool (CEGL006453). Thus, errors of commission and errors of omission were calculated for seven of the nine initially mapped vegetation associations.

Based on the contingency matrix (Table 4), the Kappa index for the preliminary association map was 0.664, with the overall percent accuracy calculated as 71%±21.1%. The confidence intervals indicate that this accuracy is not statistically different than the USGS/NPS vegetation mapping protocol requirement of 80%. Additionally, the errors of commission for all seven mapped vegetation associations for which assessment points were collected conform to the USGS/NPS vegetation mapping protocol requirement of 80% correct, or less than 20% error. The errors of omission for all seven vegetation associations for which accuracy assessment points were collected conformed to the USGS/NPS vegetation mapping protocol requirement of 80% correct (less than 20% error). Accuracy assessment points were not collected for two of the associations and thus their errors of commission and omission could not be evaluated.

The thematic accuracy assessment data were used to correct and revise the preliminary vegetation association map and create a final vegetation association map. Thus, our final vegetation association map (Figure 7) has a much higher thematic accuracy than what is reported above for the preliminary vegetation association map. Re-assessing the thematic accuracy of the final vegetation association map, however, would require another round of field sampling. The costs of a second round of sampling do not seem justified simply to quantify the level of increased accuracy in the final map.

Table 4. Contingency matrix and calculated errors for the thematic accuracy assessment of the U.S. National Vegetation Classification association map of Sagamore Hill National Historic Site. *The cells highlighted in green show the number of sampling points that were correct. Errors of commission and omission could not be calculated for the associations highlighted in orange because destination points were not created for these types. Accuracy assessment destination points were erroneously selected for Anderson Level II land cover types; two of these were visited before the mistake was caught.

	Mapped Vegetation Association															
Accuracy Assessment Observation	4192	4400	6006	6075	6274	6336	6407	6599	6453	12	21	22	sample size	error of omission	90% CI	conforms to 80% accuracy?
North Atlantic Low Salt Marsh (4192)	4												4	0%	0.13	yes
North Atlantic Upper Ocean Beach (4400)		1											1	0%	0.50	yes
North Atlantic High Salt Marsh (6006)			1		1								2	50%	0.83	yes
Mid-Atlantic Mesic Mixed Hardwood Forest (6075)				1									1	0%	0.50	yes
Northern Beachgrass Dune (6274)					1								1	0%	0.50	yes
Northeastern Dry Oak-Hickory Forest (6336)				1		2	1						4	50%	0.54	yes
Norway Maple Forest (6407)							2						2	0%	0.25	yes
Northeastern Modified Successional Forest (6599)												1	1	N/A		
Eastern Woodland Vernal Pool (6453)														N/A		
12. Commercial and Services														N/A		
21. Cropland and Pasture										1			1	N/A		
22. Orchards														N/A		
sample size	4	1	1	2	2	2	3			1		1	17			
error of commission	0%	0%	0%	50%	50%	0%	33%	N/A	N/A	N/A	N/A	N/A				

90% confidence interval (2-tailed)	0.13	0.50	0.50	0.83	0.83	0.25	0.61
conforms to 80% accuracy requirement	yes	yes	yes	yes	yes	yes	yes

percent mapped associations conforming (7 of 7)	100%
percent observed associations conforming (7 of 7)	100%

total observations	17
total correctly classified	12
Overall accuracy	**71% ± 21.1% (meets 80% accuracy goal)**
Kappa index	**0.664**

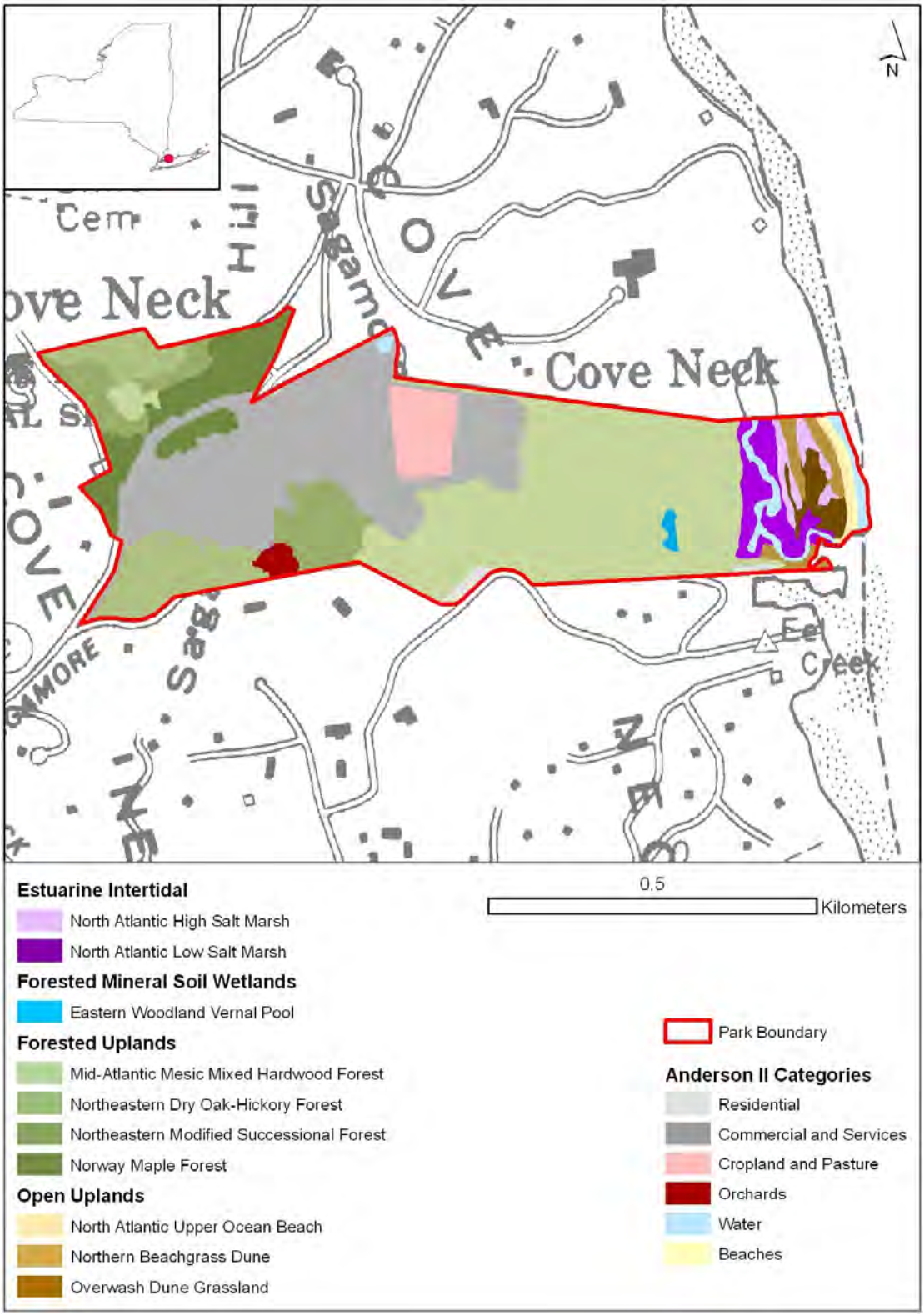

Figure 7. Distribution of U.S. National Vegetation Classification associations and Anderson Level II land cover categories at Sagamore Hill National Historic Site.

Errors in the map depicting associations and land cover types were caused by several factors. The largest source of error was the difficulty in distinguishing between types with very similar air photo signatures. For example, North Atlantic High Salt Marsh (CEGL006006) was misclassified as Northern Beachgrass Dune (CEGL006274) (Table 4). These two associations occur together in the landscape and are dominated by grasses that are nearly impossible to distinguish on air photos. Furthermore, the signature for these types can be "bleached out" under high light conditions and look pure white. The deciduous forests types were also misclassified due to similarity or air photo signatures. Patches of Norway Maple Forest (CEGL006047) and Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075) turned out to be Northeastern Dry Oak - Hickory Forest (CEGL006336) (Table 4).

Overall, the accuracy assessment produced very good results with four of the seven assessed associations having zero percent error of commission (100% accuracy) and five of the seven assessed associations having zero percent error of omission (100% accuracy; Table 4). The relatively small size of the park and low number of associations may have contributed to the higher accuracy.

Vegetation Association Descriptions

Detailed local descriptions for 10 vegetation associations were written based on plot data, compositional statistics, photographs of each plot, thematic accuracy assessment data, the ecologists' field observations, and the other research cited in the local descriptions (Appendix E). These vegetation associations were then crosswalked to the USNVC which contains range-wide global descriptions for each association. Detailed local and global descriptions of the vegetation associations are contained in Appendix E. Each association is also crosswalked to Ecological Communities of New York State (Edinger et al. 2002).

A dichotomous key was also developed for the vegetation associations of the Sagamore Hill National Historic Site (Appendix D). The dichotomous key should be used in conjunction with the detailed vegetation association descriptions to confirm that the association selected with the key is appropriate. This key and the detailed vegetation association descriptions may be used by park resource managers and others to identify vegetation associations in the park.

Vegetation Map Production

Based on the accuracy assessment sampling data and the final classification of 10 vegetation associations, the association level map was revised again to correct errors and create more accurate vegetation association polygon boundaries. In this final revision, accuracy assessment data, plot data, field observations, aerial photography signatures, and topographic maps were used to revise polygon boundaries and attributes.

The resulting final vegetation association map is shown in Figure 7 and a summary of the vegetation association distribution and abundance is provided in Table 2. Polygons that were attributed with Anderson Level II land cover categories (Anderson et al. 1976) retained their attributes in the final map.

Project Deliverables

Final products of the vegetation mapping project are shown in Table 5. All products are delivered to the National Park Service by NY Natural Heritage with this report.

Table 5. Summary of products resulting from the vegetation classification and mapping at Sagamore Hill National Historic Site.

Product	FGCD-compliant spatial metadata
Aerial photos, including flight line map and photoindex	Yes
Photomosaic digital format	Yes
Vegetation plot sampling data in the PLOTS 2.0 database	Not applicable
GPS locations of vegetation plots	Yes
Thematic accuracy assessment data in the PLOTS 2.0 Database	Not applicable
GPS locations of thematic accuracy assessment sampling points	Yes
CD with digital photographs of all plots and accuracy assessment points taken	Not applicable
Final map of vegetation associations as paper copy and in digital format	Yes
Palustrine and Estuarine wetland map as paper and in digital format	Yes
Final report as paper copy and in digital format	Not applicable

Discussion

Vegetation Classification, Characterization, and Mapping

This study of the Sagamore Hill National Historic Site identified and characterized 10 U.S. National Vegetation Classification associations in detail (Figure 7, Appendix E). The diversity and distribution of vegetation associations is primarily a result of the following four factors: 1) the geologic history of the region, especially the effect of glaciation; 2) the park's position on the northeastern U.S. Coastal Plain within a temperate climate; 3) proximity to Long Island Sound and maritime ecological processes, such as diurnal tides, storm overwash, salt spray, and high winds; and 4) the park's setting within a suburban landscape with a moderately intensive human land use history along with its associated problems, such as invasive species, fragmentation, habitat loss, and pollution.

Natural and semi-natural vegetation types comprise 65% of the site (23.159 ha [57.227 ac]) and cultural types comprise 35% (12.665 ha [31.296 ac]) (Table 2). The Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075), known as oak - tulip tree forest in NY, covers the largest area at Sagamore Hill National Historic Site. The four polygons of this type total about 12 ha (29.5 ac) which accounts for over half of the total natural vegetation mapped at the site (Table 2). Interestingly, the remainder of the vegetation associations are spread out fairly evenly in terms of number of polygons (avg. 2.5 polygons per type) and area covered (avg. 1.25 ha [3.09 ac] per type) (Table 2).

Five (50%) of the 10 associations at Sagamore Hill National Historic Site are created and/or maintained by maritime influence and oceanic derived processes. However, they only comprise 8.5% of the site (3.0626 ha [7.568 ac]) and are listed below, under the Maritime Estuarine and Maritime Terrestrial Association headings (Cowardin et al. 1979; Edinger et al. 2002).

Maritime Estuarine Associations

The estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that have open, partly obstructed, or sporadic access to open ocean water which is at least occasionally diluted by freshwater runoff. They extend from the upstream limit of tidal influence seaward to an imaginary line closing the mouth of a river or bay. Salinity is usually less than 30.0 parts per thousand (ppt) ocean-derived salts, but can range from hyperhaline (>40 ppt) to oligohaline (0.5–5 ppt) (Cowardin et al. 1979; Edinger et al. 2002).

There are two estuarine vegetation associations at Sagamore Hill National Historic Site: North Atlantic Low Salt Marsh (CEGL004192) and North Atlantic High Salt Marsh (CEGL006006). These two associations are located at the eastern end of the site adjacent to Cold Spring Harbor (Figure 7).

Maritime Terrestrial Associations

Terrestrial maritime associations are generally in immediate proximity to marine or estuarine communities. They are heavily influenced by coastal processes including strong salt spray, high winds and dune deposition, shifting, and overwash processes. These communities often occur as narrow bands under 50 m (164 ft) wide (Edinger et al. 2002).

There are three maritime terrestrial associations at Sagamore Hill National Historic Site: North Atlantic Upper Ocean Beach (CEGL004400), Northern Beachgrass Dune (CEGL006274), and Overwash Dune Grassland (CEGL004097). These three associations are located at the eastern end of the site adjacent to Cold Spring Harbor (Figure 7).

Human Modified Associations

Of the ten associations described in this classification (Appendix E), only two (20%) are "successional" types that become established after forest clearing or after the cessation of agricultural activities: Northeastern Modified Successional Forest (2.5796 ha [6.3743 ac]) and Norway Maple Forest (2.5458 ha [6.2908 ac]). Within Sagamore Hill National Historic Site these two successional associations account for 16% of the mapped polygons (6 polygons) and 14% of the mapped area (5.1254 ha [12.6651 ac]) (Table 2).

Associations with Invasive Species

Nearly all of the associations at Sagamore Hill National Historic Site have invasive, nonnative plants to some degree. The distribution and extent of these species is thoroughly described in Werier's (2006) Invasive Nonnative Plant Management Plan for the site. Norway maple (*Acer platanoides*) seems to be one of the most pervasive invaders and is a component of nearly all of the forested associations at Sagamore Hill. Its dominance in the canopy, subcanopy, and shrub layers characterizes the Norway Maple Forest association (CEGL006407), a highly disturbed type that also contains Japanese maple (*Acer palmatum*), Chinese wisteria (*Wisteria sinensis*), English ivy (*Hedera helix*), Japanese honeysuckle (*Lonicera japonica*), and other nonnative species. Norway maple is also strongly dominant in the subcanopy layers of both Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075) and Northeastern Modified Successional Forest (CEGL006599). Without management to reduce or remove the species, it will likely overtake the canopy layers and convert these communities to Norway Maple Forest (CEGL006407).

Werier (2006) also mapped (Map 19) a patch of common reed (*Phragmites australis*) with 95% cover in the southwest corner of the salt marsh/maritime dune complex. This patch was apparently missed by the vegetation mapping effort and is currently mapped as Northern Beachgrass Dune (CEGL006274) and North Atlantic Low Salt Marsh (CEGL004192). The common reed patch reportedly covers about 393 m^2 (0.04 ha [4230 ft^2 {0.097 ac}]) and falls far below the 0.5 ha (1.235 ac) minimum mapping unit of this vegetation mapping project. However, if this patch were to be mapped as a separate association it would likely be classified as Reedgrass Tidal Marsh (CEGL004187) and would be a new type for the park.

Locally Significant Associations

Despite the degraded landscape and developed areas in and around the park, Sagamore Hill National Historic Site has several vegetation associations that may have conservation value at the local level and perhaps at the regional level. The Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075), or oak - tulip tree forest, on the east-facing slope is likely the best remaining example of this type on Cove Neck. This association corresponds to Werier's (2006) Exceptional Area #3. It appears to be a mature second-growth forest similar to other remnant patches in Nassau County. This forest type was likely the matrix forest that historically blanketed most of the northern half of western Long Island.

In addition, the associations that comprise the salt marsh and maritime dune complex serve as a good remnant example of what was likely more common around the periphery of Cold Spring Harbor. These associations correspond to Werier's (2006) Exceptional Area #4. All of the vegetation associations at the park provide habitat for wildlife and present opportunities for nature study for visitors.

Palustrine and Estuarine Wetland Maps

As an additional task to this vegetation mapping project, NPS requested that NY Natural Heritage produce wetland maps for Sagamore Hill National Historic Site based on classification and mapping of vegetation under this project. The idea was to indicate the existence of wetlands at a finer scale than would be provided on a 1:24,000 scale, U.S. Fish and Wildlife Service National Wetlands Inventory map. All vegetation association polygons have been labeled with USNVC that uses, in part, the Cowardin Wetland Classification Systems (Cowardin et al. 1979) and Subsystems following Ecological Communities of NY State (Edinger et al. 2002). Figure 8 depicts the palustrine and estuarine wetlands at Sagamore Hill National Historic Site. These wetland maps are not intended to replace existing federal and state regulatory wetland maps.

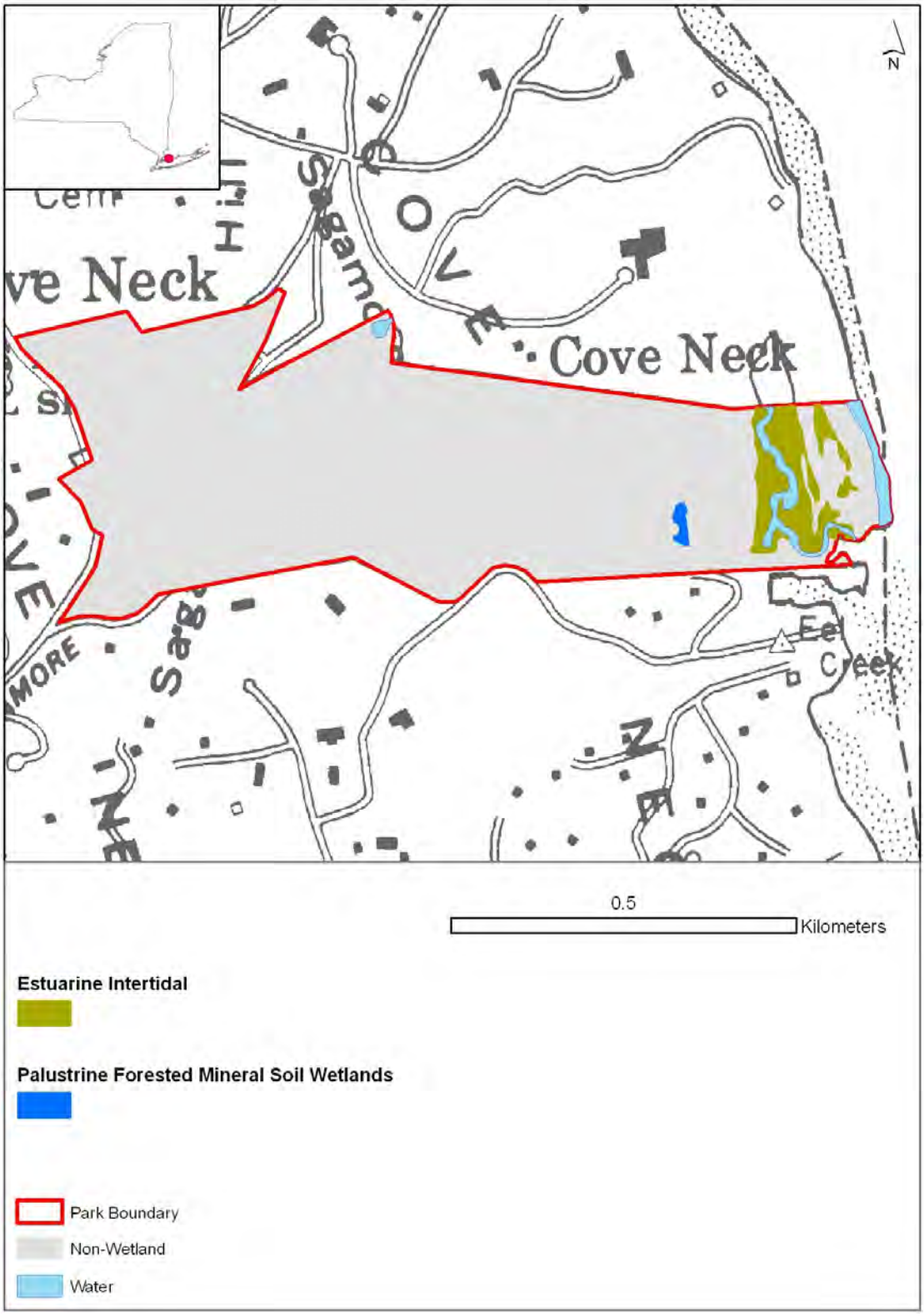

Figure 8. Palustrine and estuarine wetlands of Sagamore Hill National Historic Site. Vegetated wetland polygons have been labeled with Systems (Cowardin et al. 1979) and Subsystems following Ecological Communities of NY State (Edinger et al. 2002).

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Appendix A. Sagamore Hill National Historic Site ortho photomosaic key attributes.

Photomosaic attributes	Metadata
Title of metadata record:	Sagamore Hill National Historic Site Color Infrared Orthorectified Photomosaic; (leaf-on); (ERDAS IMAGINE 8.7 .img and MrSID 1.4 formats)
Publication date of mosaic (from metadata):	October 5, 2004
Date aerial photography was acquired:	April 28, 2003
Vendor that provided aerial photography:	William Frament, USDA Forest Service (Northeastern Area State and Private Forestry, Durham, NH)
Scale of photography:	1:8,000
Type of photography:	Color infrared, stereo pairs
Number of air photos in mosaic:	5 (3 included in the mosaic)
Archive location of air photos, airborne GPS/IMU files and camera calibration certificate:	North Carolina State University, Center for Earth Observation
Scanning specifications:	600 dpi
Horizontal positional accuracy of mosaics:	2.77 meters, meets Class 2 National Map Accuracy Standard
Number of ground control points upon which estimated accuracy is based:	25
Method of calculating positional accuracy:	Root mean square error
Archive location of mosaics and metadata:	North Carolina State University, Center for Earth Observation
Format(s) of archived mosaics:	.img (uncompressed) and MrSID (20:1 compression)

Appendix B. NY Natural Heritage vegetation plot form and hand-held database (HHDB) screen shots.

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:_____ 9. State:
10. Surveyors:_____

B. ENVIRONMENTAL DESCRIPTION

11. **Community name** _____
12. National Association_____

13. Transect/observation point #

14. Image annotation #

15. Elevation:

16. Topographic position:
__Interfluve __Toeslope
__High slope __Low level
__High level __Channel wall
__Midslope __Channel bed
__Backslope __Basin floor
__Step in slope __Other:
__Lowslope

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 __Very dry
__Dry __Well drained
__Somewhat moist __Moist
__Somewhat wet __Wet
__Permanently inundated __Very wet
__Periodically inundated
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 __Intermittently flooded
__Seasonally flooded __Permanently flooded
__Saturated __Tidally flooded
__Temporarily flooded __Unknown
__Never Inundated

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 __ loamy sand
__ loam __ sandy loam
__ silt loam __ sandy clay loam
__ clay loam __ silty clay loam
__ silt __ sandy clay
__ clay __ silty clay

30. Average organic soil texture:
__muck
__peat

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

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

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)
__Forest
__Semi-deciduous
__Mixed deciduous-evergreen
__Semi-evergreen
__Evergreen
__Perennial
__Annual

39. Physiognomic type:
__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.

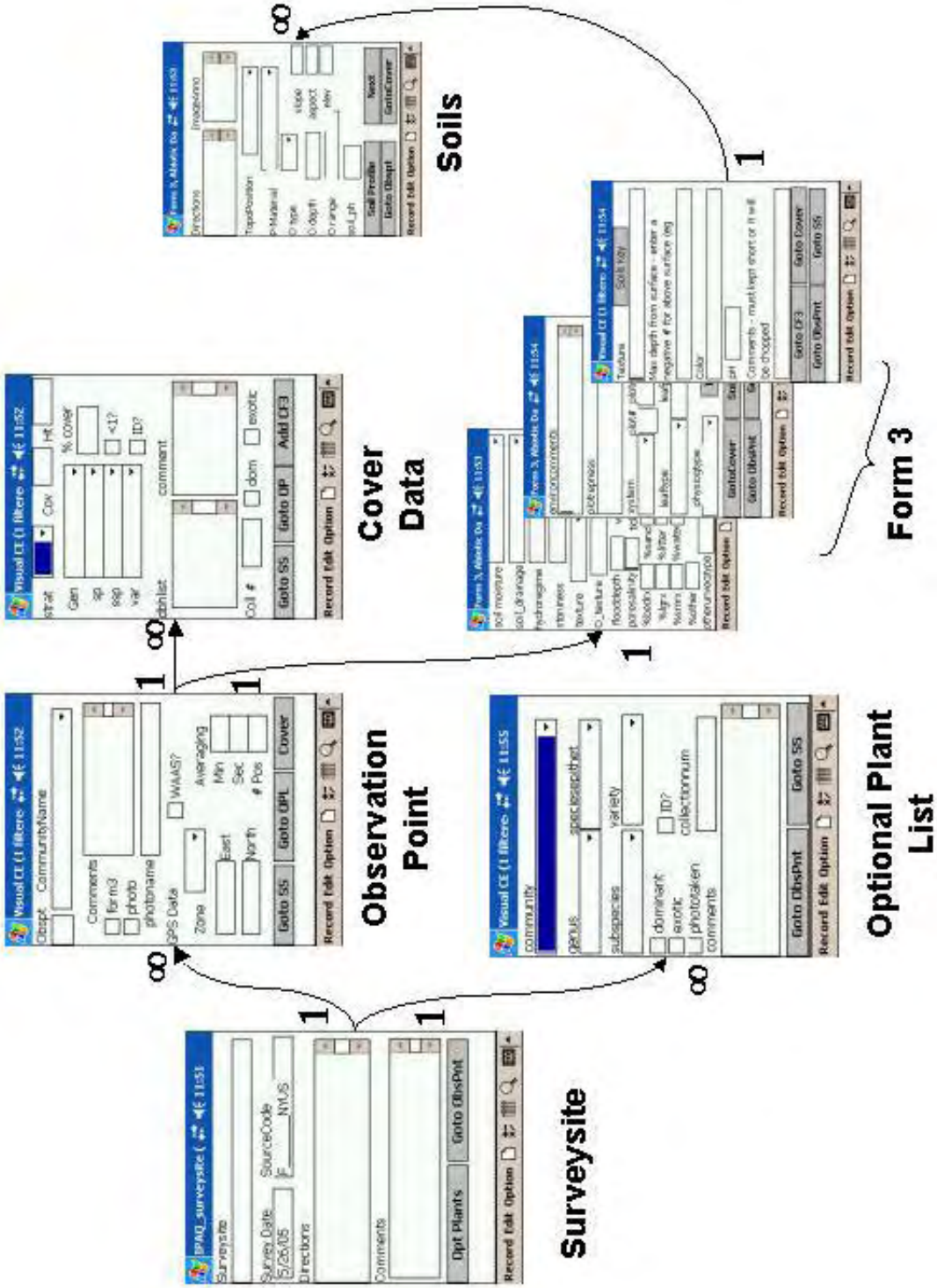

Figure B1. Screen shots of NY Natural Heritage hand-held database (HHDB). Vegetation plot data and accuracy assessment point data were digitally collected in the field using this software.

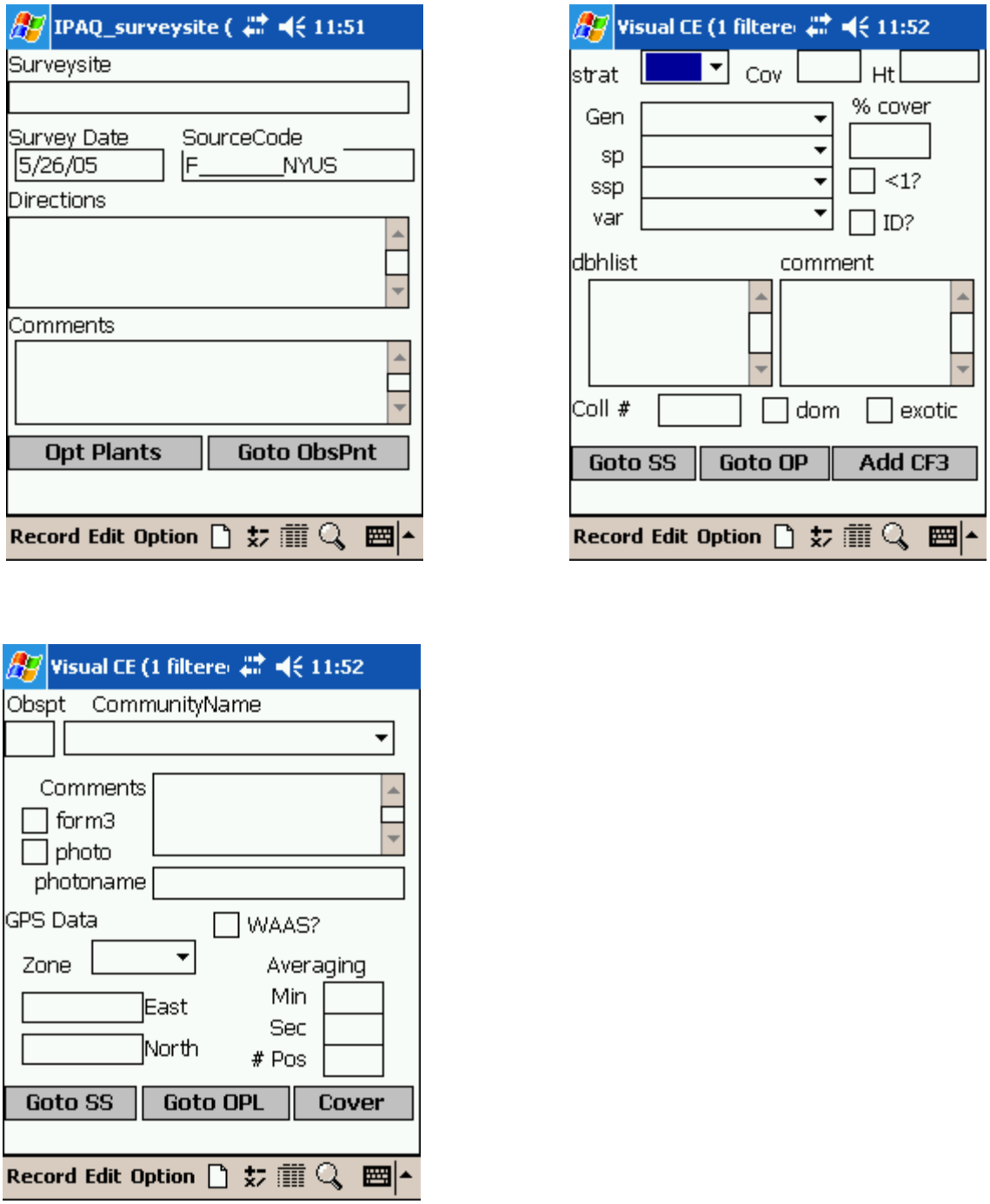

Figure B2. Screen shots of NY Natural Heritage hand-held database (HHDB). Survey site information, plot and point spatial data, and vegetation cover data were digitally collected in the field using this software.

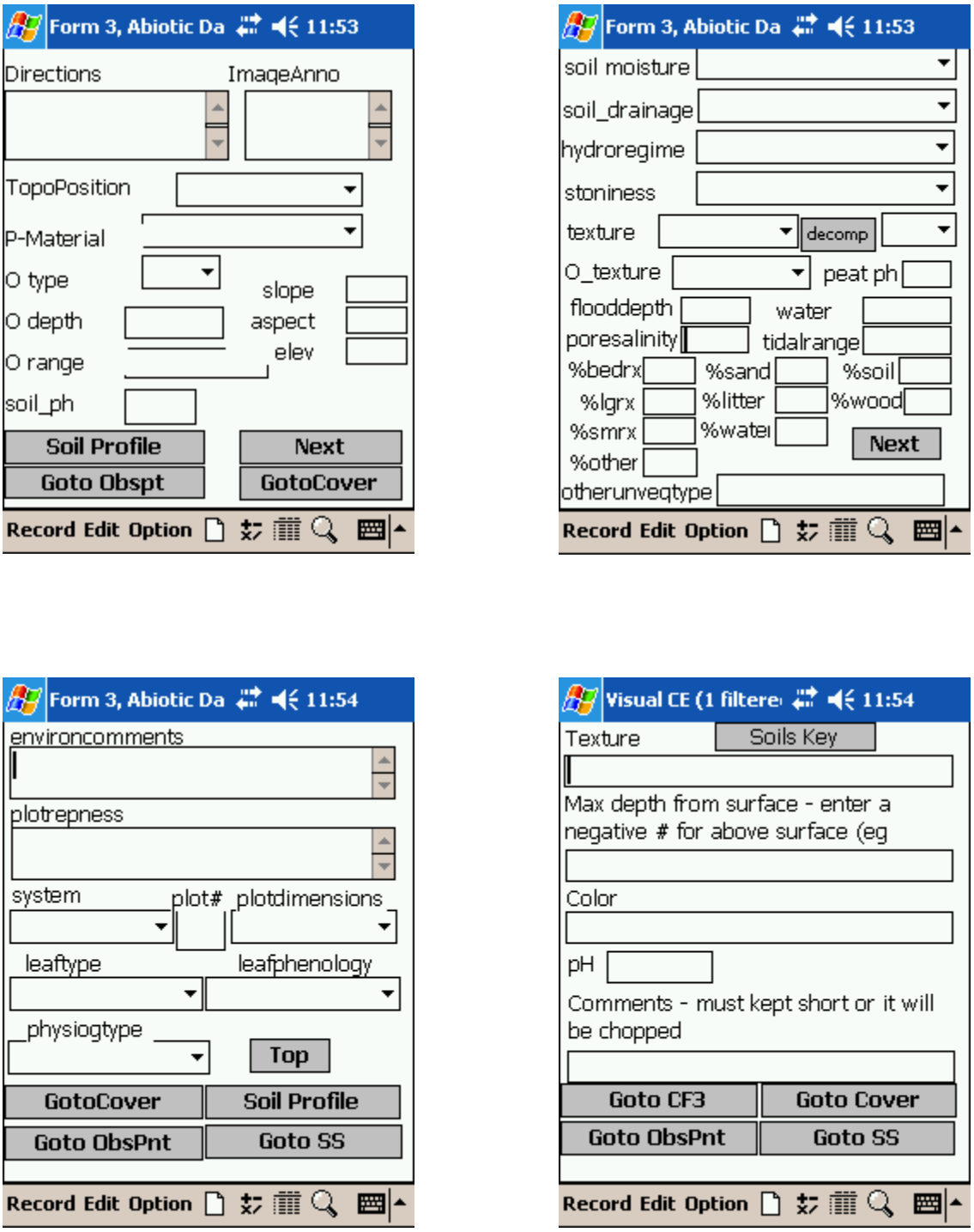

Figure B3. Screen shots of NY Natural Heritage hand-held database (HHDB). Data on the physical characteristics and soils for plots were digitally collected in the field using this software.

Appendix C. Plants observed in Sagamore Hill National Historic Site during vegetation plot and thematic accuracy assessment sampling.

Nomenclature follows the PLANTS 3.5 Database developed by the Natural Resource Conservation Service in cooperation with the Biota of North America Program (USDA, NRCS 2004) and the USDA PLANTS online database (plants.usda.gov). For this report, some common names listed in the PLANTS database were changed to reflect the common names typically used by ecologists and resource managers in this region. The common and scientific names of plants observed during the vegetation plot and thematic accuracy assessment sampling are listed below. Taxa denoted with an asterisk (*) were not measured in quantitative plot sampling, but noted during polygon observations.Taxa denoted with a dagger (†) denote exotic species.

Family	Scientific Name	Common Name
Aceraceae	*Acer palmatum*†	Japanese maple
	Acer platanoides†	Norway maple
	Acer rubrum	red maple
	Acer saccharum	sugar maple
Anacardiaceae	*Rhus typhina*	staghorn sumac
	Toxicodendron radicans	eastern poison ivy
Araliaceae	*Aralia elata*†	Japanese angelica tree
	*Aralia spinosa**	devil's walking stick
	Hedera helix†	English ivy
Asteraceae	*Baccharis halimifolia*	eastern baccharis
	Bidens sp.*	beggarticks
	Eurybia divaricata	white wood aster
	Iva frutescens	Jesuit's bark
	Solidago caesia	wreath goldenrod
	Solidago sempervirens	seaside goldenrod
Balsaminaceae	*Impatiens capensis*	jewelweed
Betulaceae	*Betula alleghaniensis*	yellow birch
	Betula lenta	sweet birch
Bignoniaceae	*Catalpa speciosa*†	northern catalpa
Brassicaceae	*Alliaria petiolata*†	garlic mustard
	Cakile edentula	American searocket
Caprifoliaceae	*Lonicera japonica*†	Japanese honeysuckle
	Viburnum sp.	viburnum
	Viburnum acerifolium	mapleleaf viburnum
	Viburnum dilatatum†	linden arrowwood
Celastraceae	*Euonymus obovata*	running strawberry bush
	Celastrus orbiculata†	Asian bittersweet
Chenopodiaceae	*Atriplex patula*	spear saltbush
	Chenopodium album†	lambsquarters
	Salsola kali†	Russian thistle
	Suaeda sp.	seepweed
Cornaceae	*Cornus alternifolia*	alternateleaf dogwood
	Cornus florida	flowering dogwood
Cupressaceae	*Juniperus virginiana*	eastern redcedar
Cyperaceae	*Carex pensylvanica*	Pennsylvania sedge
Dryopteridaceae	*Athyrium filix-femina*	common ladyfern
	*Onoclea sensibilis**	sensitive fern
	Polystichum acrostichoides	Christmas fern

Family	Scientific Name	Common Name
Fabaceae	*Robinia pseudoacacia*†	black locust
	Wisteria sinensis†	Chinese wisteria
Fagaceae	*Fagus grandifolia*	American beech
	Quercus sp.	oak
	Quercus coccinea	scarlet oak
	Quercus montana	chestnut oak
	Quercus rubra	northern red oak
	Quercus velutina	black oak
Juglandaceae	*Carya* sp.	hickory
	Carya alba	mockernut hickory
	Juglans nigra	black walnut
Lauraceae	*Lindera benzoin*	northern spicebush
	Sassafras albidum	sassafras
Liliaceae	*Maianthemum canadense*	Canada mayflower
	Maianthemum racemosum	feathery false lily of the valley
	Polygonatum biflorum	smooth Solomon's seal
Magnoliaceae	*Liriodendron tulipifera*	tuliptree
Onagraceae	*Ludwigia palustris*	marsh seedbox
Phytolaccaceae	*Phytolacca americana*	American pokeweed
Pinaceae	*Pinus strobus*	eastern white pine
	Pinus sylvestris	Scotch pine
Plumbaginaceae	*Limonium carolinianum*	Carolina sealavender
Poaceae	*Ammophila breviligulata*	American beachgrass
	Distichlis spicata	inland saltgrass
	Eragrostis spectabilis	purple lovegrass
	Panicum amarum	bitter panicgrass
	Paspalum sp.	crowngrass
	*Phragmites australis**†	common reed
	Poa pratensis†	Kentucky bluegrass
	Spartina alterniflora	smooth cordgrass
	Spartina patens	saltmeadow cordgrass
	Tridens flavus	purpletop tridens
Polygonaceae	*Persicaria maculosa*†	spotted ladysthumb
	Persicaria virginiana	jumpseed
	Polygonella articulata	coastal jointweed
Rosaceae	*Amelanchier canadensis*	Canadian serviceberry
	Prunus serotina	black cherry
	Rosa multiflora†	multiflora rose
	Rubus sp.	blackberry
	Rubus allegheniensis	Allegheny blackberry
Simaroubaceae	*Ailanthus altissima*†	tree of heaven
Smilacaceae	*Smilax rotundifolia*	roundleaf greenbrier
Taxaceae	*Taxus cuspidata*†	Japanese yew
Thelypteridaceae	*Thelypteris noveboracensis*	New York fern
Urticaceae	*Boehmeria cylindrica*	smallspike false nettle
Verbenaceae	*Phryma leptostachya*	American lopseed
Vitaceae	*Ampelopsis brevipedunculata*†	Amur peppervine
	Parthenocissus quinquefolia	Virginia creeper

Appendix D. Dichotomous field key to the U.S. National Vegetation Classification associations of Sagamore Hill National Historic Site.

1. Association is dominated by herbaceous or graminoid species. Woody species cover less than 25% of the area. ..... HERBACEOUS GROUP

    2. Upland associations: associations that are well-drained and never regularly flooded; or in soils that are usually well-drained and not hydric, lack predominantly hydrophytic vegetation, but may be regularly flooded for a short time each year. ..... HERBACEOUS TERRESTRIAL SUBGROUP

    2. Wetland associations: communities that are in water all year, or have wet soils all year; or are regularly flooded every day (such as flooded by tidal waters); or are regularly flooded at one or more seasons of the year (such as flooded in spring) and have predominantly hydrophytic vegetation and hydric soils. ..... HERBACEOUS WETLAND SUBGROUP

1. Trees (woody species greater than 5 meters tall) cover greater than 60% of the area. ..... FOREST GROUP

FOREST GROUP

1. Vegetation of small, partially shaded depressional openings in upland forest with standing water in spring in most years and saturated soils throughout the year. The shrubs common winterberry (*Ilex verticillata*) and multiflora rose (*Rosa multiflora*) surround the depression, which is dominated by beggarticks (*Bidens* sp.). Additional herbaceous species, present in lesser abundance, are smallspike false nettle (*Boehmeria cylindrica*), jewelweed (*Impatiens capensis*), marsh seedbox (*Ludwigia palustris*), and sensitive fern (*Onoclea sensibilis*). ..... Eastern Woodland Vernal Pool Sparse Vegetation **(CEGL006453)**
Eastern Woodland Vernal Pool

1. Vegetation not as above

    2. Canopy, subcanopy, and shrub layers strongly dominated by the invasive, exotic Norway maple (*Acer platanoides)* tree. Canopy and subcanopy species that are present in low abundance relative to Norway maple (*Acer platanoides*), are black cherry (*Prunus serotina*), sugar maple (*Acer saccharum*), sweet birch (*Betula lenta*), scarlet oak (*Quercus coccinea*), and sassafras (*Sassafras albidum*). ..... *Acer platanoides* Forest **(CEGL006407)**
    Norway Maple Forest

    2. Canopy not as above

        3. This forest is dominated by early successional, weedy species, such as black cherry (*Prunus serotina*) and sweet birch (*Betula lenta*) with associated Norway maple (*Acer platanoides).* Black locust (*Robinia pseudoacacia*), tree of heaven (*Ailanthus altissima*), and invasive shrubs and vines such as multiflora rose (*Rosa multiflora*), English ivy (*Hedera helix*), and Japanese honeysuckle (*Lonicera japonica*) are characteristic and can be abundant. Occurs on lands that have been cleared by human activity. ..... *Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest **(CEGL006599)**
        Northeastern Modified Successional Forest

        3. Forest not as above

4. Canopy dominated by dry oak species, primarily scarlet oak (*Quercus coccinea*) and black oak (*Quercus velutina*); mesic indicators, such as American Beech (*Fagus grandifolia*) and tuliptree (*Liriodendron tulipifera*), are absent or present in low abundance. ..... *Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest **(CEGL006336)**
Northeastern Dry Oak - Hickory Forest

4. Canopy dominated by a mix of deciduous species with mesic indicators present. Species include black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), sweet birch (*Betula lenta*), red maple (*Acer rubrum*), tuliptree (*Liriodendron tulipifera*), and American beech (*Fagus grandifolia*). ..... *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca* var. *opaca) / Polystichum acrostichoides* Forest **(CEGL006075)**
Mid-Atlantic Mesic Mixed Hardwood Forest

HERBACEOUS GROUP

Herbaceous Terrestrial Subgroup

1. Vegetation of beaches occurring above the wrack line on well-drained sand and gravel but flooded irregularly by storm tides, sparsely vegetated and dominated by annuals such as American searocket (*Cakile edentula*). ..... *Cakile edentula* ssp. *edentula* – *Chamaesyce polygonifolia* Sparse Vegetation **(CEGL004400)**
North Atlantic Upper Ocean Beach

1. Vegetation of dunes, perennial forbs and grasses predominant; may be very sparse.

    2. Vegetation of overwashed or breached dunes characterized by past or recent ocean storm overwash and sand deposition. Carolina sealavender (*Limonium carolinianum*), saltmeadow cordgrass (*Spartina patens*), and inland saltgrass (*Distichlis spicata)* are dominant and characteristic, with lesser amounts of lambsquarters (*Chenopodium album*) and seaside goldenrod *(Solidago sempervirens).* ..... *Spartina patens – Schoenoplectus pungens – Solidago sempervirens* Herbaceous Vegetation **(CEGL004097)**
    Overwash Dune Grassland

    2. Vegetation of foredunes dominated by American beachgrass (*Ammophila breviligulata*) with seaside goldenrod (*Solidago sempervirens*) often present; bitter panicgrass (*Panicum amarum*) absent or present at low abundance. ..... *Ammophila breviligulata – Lathyrus japonicus* Herbaceous Vegetation **(CEGL006274)**
    Northern Beachgrass Dune

Herbaceous Wetland Subgroup

1. Vegetation of freshwater wetlands. Vegetation of small, partially shaded depressional openings in upland forest with standing fresh water in spring in most years and saturated soils throughout the year. The shrubs common winterberry (*Ilex verticillata*) and multiflora rose (*Rosa multiflora*) surround the depression, which is dominated by beggarticks (*Bidens* sp.). Additional herbaceous species, present in lesser abundance, are smallspike false nettle (*Boehmeria cylindrica*), jewelweed (*Impatiens capensis*), marsh seedbox (*Ludwigia palustris*), and sensitive fern (*Onoclea sensibilis*). ..... Eastern Woodland Vernal Pool Sparse Vegetation **(CEGL006453)**
Eastern Woodland Vernal Pool

1. Vegetation of saline or brackish tidal wetlands with some direct hydrological connection to the open ocean

   2. Vegetation of low, regularly flooded salt marshes and flats. Smooth cordgrass (*Spartina alterniflora)* strongly dominant, often forming a monoculture. ..... *Spartina alterniflora* / (*Ascophyllum nodosum*) Acadian / Virginian Zone Herbaceous Vegetation **(CEGL004192)**
   North Atlantic Low Salt Marsh

   2. Vegetation of high salt marshes; irregularly flooded by tides. Graminoids dominant. This association is characterized by codominance of saltmeadow cordgrass (*Spartina patens)* and inland saltgrass (*Distichlis spicata)*, which can form extensive meadows or linear features at the upper edge of the low salt marsh. ..... *Spartina patens* - *Distichlis spicata* - (*Juncus gerardii*) Herbaceous Vegetation **(CEGL006006)**
   North Atlantic High Salt Marsh

Appendix E. Local and global descriptions of U.S. National Vegetation Classification associations.

This appendix contains detailed local descriptions for the map classes present at Sagamore Hill National Historic Site, written based on information collected within the Park boundary. Of the 17 map classes used to map Sagamore Hill National Historic Site, ten were cross-walked to the finest level of the USNVC (association) and seven were cross-walked to Anderson Level II land cover categories (Anderson et al. 1976).

All map classes cross-walked to the association level of the USNVC also include range wide descriptions (i.e., global descriptions). Information in the global descriptions of the associations was extracted from the August 20, 2007 version of the USNVC (NatureServe 2007).

A bibliography for the sources cited in the global vegetation descriptions from the USNVC is included following the descriptions.

Each association is cross-walked to Ecological Communities of New York State (Edinger et. al 2002). The state/subnational conservation rank (S Rank) and global conservation rank (G Rank) for each association are provided, if available.

The dichotomous key to the Sagamore Hill National Historic Site map classes is presented in Appendix D. The dichotomous key should be used in conjunction with the detailed vegetation community descriptions.

Vascular plant species nomenclature within the local and global descriptions follows the nationally standardized list of Kartesz (1999), with very few exceptions. This nomenclature differs from PLANTS 3.5 Database (USDA, NRCS 2004) in only a very few cases, and when this difference occurs, synonymy is indicated parenthetically in the local description information. Nomenclature for nonvascular plants follows Anderson (1990) and Anderson et al. (1990) for mosses, Egan (1987, 1989, 1990, 1991) and Esslinger and Egan (1995) for lichens, and Stotler and Crandall-Stotler (1977) for liverworts/hornworts. English names for associations and alliances use NatureServe Central Ecology-accepted names and may differ slightly from PLANTS 3.5 Database (USDA, NRCS 2004) common names that are used within the local description information and throughout the rest of the report. Sources cited in the local and global vegetation descriptions are included in the literature section at the end of this appendix. Representative photographs of the vegetation types are provided after the descriptions when available.

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COMMON NAME (PARK-SPECIFIC): NORWAY MAPLE FOREST

SYNONYMS
USNVC English Name: **Norway Maple Forest**
USNVC Scientific Name: **Acer platanoides Forest**
USNVC Identifier: **CEGL006407**

LOCAL INFORMATION

Environmental Description: This association is found on upper slopes in the northwest portion of the park and borders the entrance road along part of its length. It occurs on gentle west/northwest-facing slopes at elevations ranging from 30–49 m (100–160 ft). Soils are strongly acidic loamy sand to fine sandy loam in the Montauk and Plymouth series. They are very deep, well-drained to excessively well-drained, and were formed in loamy glacial till and sandy glacial outwash deposits (Soil Conservation Service 1987).

Vegetation Description: This forest is characterized by dominance of the invasive, exotic tree *Acer platanoides* (Norway maple) in the canopy, subcanopy, and shrub layers. It has outcompeted most native species and, thereby, obscured the pre-invasion forest type. A sparse emergent tree layer is present and still largely intact; species are *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), and *Prunus serotina* (black cherry) with *Acer platanoides* (Norway maple). Emergent trees stand nearly 33 m (108 ft) tall and have up to 6% cover. Canopy and subcanopy species that are present in low abundance, relative to *Acer platanoides* (Norway maple), are *Prunus serotina* (black cherry), *Acer saccharum* (sugar maple), *Betula lenta* (sweet birch), *Quercus coccinea* (scarlet oak), *Sassafras albidum* (sassafras), *Quercus velutina* (black oak), *Quercus prinus* (chestnut oak), *Carya alba* (mockernut hickory), *Cornus florida* (flowering dogwood), and *Acer palmatum* (Japanese maple). The tree canopy is over 20 m (65 ft) tall and has over 40% cover; the subcanopy (12 m [39 ft] tall) is denser with over 50% cover. In combination, tree cover is nearly complete. Tall shrubs and saplings (2–5 m [6.5–16 ft]) have nearly 20% cover and, in addition to the strongly dominant *Acer platanoides* (Norway maple), include *Viburnum* (viburnum) spp., *Acer palmatum* (Japanese maple), *Taxus cuspidata* (Japanese yew), *Viburnum dilatatum* (linden arrowwood), and *Quercus rubra* (northern red oak). Short shrubs and saplings (to 2 m [6.5 ft] tall) are sparse (5% cover) and are also dominated by *Acer platanoides* (Norway maple) with lesser amounts of *Rubus allegheniensis* (Allegheny blackberry), *Quercus rubra* (northern red oak), *Euonymus obovatus* (running strawberry bush), *Aralia spinosa* (devil's walkingstick), *Viburnum acerifolium* (mapleleaf viburnum), *Carya* (hickory) sp., *Acer palmatum* (Japanese maple), *Prunus serotina* (black cherry), and *Sassafras albidum* (sassafras). Vines are sparse (7% cover) and are dominated by *Wisteria sinensis* (Chinese wisteria) and *Hedera helix* (English ivy) with *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), and *Lonicera japonica* (Japanese honeysuckle). *Eurybia divaricata* (white wood aster) is the most abundant of the sparse herbaceous species; *Maianthemum canadense* (Canada mayflower), *Thelypteris noveboracensis* (New York fern), *Polygonatum biflorum* (smooth Solomon's seal), and *Maianthemum racemosum* (feathery false lily of the valley) are also present.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer platanoides* (Norway maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Acer platanoides* (Norway maple)
Herb (field)	Vine/Liana	*Wisteria sinensis* (Chinese wisteria)
Herb (field)	Forb	*Eurybia divaricata* (white wood aster)

Characteristic Species: *Acer platanoides* (Norway maple).

Other Noteworthy Species:

Species	GRank	Type	Note
Acer platanoides (Norway maple)	-	plant	invasive exotic
Hedera helix (English ivy)	-	plant	invasive exotic
Lonicera japonica (Japanese honeysuckle)	-	plant	invasive exotic
Wisteria sinensis (Chinese wisteria)	-	plant	invasive exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NY	SNA	.	.	[not crosswalked]	.

Local Range: This association is found in the northwest portion of the park and borders the entrance road along part of its length.

Classification Comments: The suite of associated species in this association (*Quercus rubra* [northern red oak], *Quercus velutina* [black oak], *Quercus coccinea* [scarlet oak], *Acer saccharum* [sugar maple], *Betula lenta* [sweet birch]) indicate that the pre-invasion forest type could have been either Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075) or Northeastern Dry Oak - Hickory Forest (CEGL006336), but it could not be conclusively determined because of the overwhelming dominance of *Acer platanoides* (Norway maple).

Other Comments: None.

Local Description Authors: G. J. Edinger and A. L. Feldmann.

Plots: 1a, 2a, 0, 8.

Sagamore Hill National Historic Site Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Acer saccharum - Betula alleghaniensis - (Fagus grandifolia)* Forest Alliance (A.216)
Alliance (English name)	Sugar Maple - Yellow Birch - (American Beech) Forest Alliance
Association	*Acer platanoides* Forest
Association (English name)	Norway Maple Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This association represents forests in the northeastern United States strongly dominated by the invasive tree *Acer platanoides* (Norway maple), often to the exclusion of virtually all other canopy species. Most documented stands are at low elevations, on flat or rolling topography both above and below the glacial boundary. *Acer platanoides* (Norway maple) is the overwhelmingly dominant tree, typically forming a closed or nearly closed canopy. In some stands native trees, including *Fraxinus americana* (white ash) and *Acer saccharum*

(sugar maple) (the latter especially susceptible to exclusion by Norway maple), may be present in very limited amounts. Other stands may have nonnative associates, including *Pinus nigra* (Austrian pine), *Pinus sylvestris* (Scotch pine), or *Robinia pseudoacacia* (black locust). The deep shade cast by *Acer platanoides* (Norway maple) limits understory growth, aside from regeneration of *Acer platanoides* (Norway maple), or incursions by nonnative shrubs such as *Rosa multiflora* (multiflora rose), *Berberis vulgaris* (common barberry), *Lonicera japonica* (Japanese honeysuckle), or *Lonicera morrowii* (Morrow's honeysuckle). Native herbs are few, especially compared to more natural deciduous forests in similar settings. A few native or exotic herbaceous species or vines may occupy the ground layer, such as *Alliaria petiolata* (garlic mustard), *Eurybia divaricata* (white wood aster), *Toxicodendron radicans* (eastern poison ivy), and *Vinca minor* (common periwinkle). This is a very species-poor vegetation type.
Environmental Description: Most documented stands are at low elevations, on flat or rolling topography both above and below the glacial boundary.
Vegetation Description: This association represents forests in the northeastern United States strongly dominated by the invasive tree *Acer platanoides* (Norway maple), often to the exclusion of virtually all other canopy species. *Acer platanoides* (Norway maple) is the overwhelmingly dominant tree, typically forming a closed or nearly closed canopy. In some stands native trees, including *Fraxinus americana* (white ash) and *Acer saccharum* (sugar maple) (the latter especially susceptible to exclusion by Norway maple), may be present in very limited amounts. Other stands may have nonnative associates, including *Pinus nigra* (Austrian pine), *Pinus sylvestris* (Scotch pine), or *Robinia pseudoacacia* (black locust). The deep shade cast by *Acer platanoides* (Norway maple) limits understory growth, aside from regeneration of *Acer platanoides* (Norway maple), or incursions by nonnative shrubs such as *Rosa multiflora* (multiflora rose), *Berberis vulgaris* (common barberry), *Lonicera japonica* (Japanese honeysuckle), or *Lonicera morrowii* (Morrow's honeysuckle). Native herbs are few, especially compared to more natural deciduous forests in similar settings. A few native or exotic herbaceous species or vines may occupy the ground layer, such as *Alliaria petiolata* (garlic mustard), *Eurybia divaricata* (white wood aster), *Toxicodendron radicans* (eastern poison ivy), and *Vinca minor* (common periwinkle). This is a very species-poor vegetation type.
Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer platanoides* (Norway maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rosa multiflora* (multiflora rose)
Herb (field)	Forb	*Alliaria petiolata* (garlic mustard)

Characteristic Species: *Acer platanoides* (Norway maple).
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This association is found in the northeastern United States, perhaps extending into southern Ontario, Canada. Its westward extent has not been determined, but it may extend to Wisconsin.
States/Provinces: CT?, MA, MD?, NJ, NY, ON?, PA?, VA?
Federal Lands: NPS (Boston Harbor Islands, Minute Man, Sagamore Hill).

CONSERVATION STATUS
Rank: GNA (invasive) (6-Dec-2005).
Reasons: This is a nonnative vegetation type dominated by an invasive tree species.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 - Weak.
Comments: This association is intended for those forests so invaded by *Acer platanoides* (Norway maple) that the pre-invasion forest type cannot be distinguished. Forests that have been invaded, but where sufficient native trees and other flora still exist to determine the pre-invasion forest type, are classified as degraded examples of those pre-invasion types.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: S. C. Gawler.
References: Anderson 1999c, Eastern Ecology Working Group n.d., Elliman 2003, Soil Conservation Service 1987, Thompson and Jenkins 1992, Wyckoff and Webb 1996.

Figure E1. Norway Maple Forest in Sagamore Hill National Historic Site (Accuracy Assessment Point 0, photo no. 1422). 10/18/2006. NAD 1983 / UTM easting 626314, northing 4527348.

COMMON NAME (PARK-SPECIFIC): MID-ATLANTIC MESIC MIXED HARDWOOD FOREST

SYNONYMS

USNVC English Name:	**American Beech - (White Oak, Northern Red Oak) - Tuliptree / (American Holly) / Christmas Fern Forest**
USNVC Scientific Name:	***Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca var. opaca) / Polystichum acrostichoides* Forest**
USNVC Identifier:	**CEGL006075**

LOCAL INFORMATION

Environmental Description: This association is found at two locations within the park: in the patch of forest northwest of the park's entrance road in a gently sloping, west-facing drainage at elevations of 18–42 m (60–140 ft) and in the eastern portion of the park on the south/southeast-facing slope down to the maritime complex at elevations of 0–37 m (0–120 ft). Soils are fine sandy loams, sandy loams, and loamy sands in the Montauk, Plymouth-Riverhead, and Riverhead series. They are strongly acidic, very deep, well-drained to excessively well-drained and were formed in loamy glacial till and glacial outwash deposits (Soil Conservation Service 1987).

Vegetation Description: The tree canopy of this mesic forest is dominated by *Liriodendron tulipifera* (tuliptree) with *Quercus velutina* (black oak), *Betula lenta* (sweet birch), *Acer rubrum* (red maple), and *Quercus rubra* (northern red oak). *Fagus grandifolia* (American beech) is a diagnostic associate; additional canopy species present at low abundance include *Quercus coccinea* (scarlet oak), *Juniperus virginiana* (eastern redcedar), *Juglans nigra* (black walnut), *Betula alleghaniensis* (yellow birch), and *Catalpa speciosa* (northern catalpa). The subcanopy is strongly dominated by the invasive exotic *Acer platanoides* (Norway maple), which is expected to overtake the canopy and convert the community to Norway Maple Forest (CEGL006407). Subcanopy associates are *Acer rubrum* (red maple), *Sassafras albidum* (sassafras), *Carya alba* (mockernut hickory), *Fagus grandifolia* (American beech), *Betula lenta* (sweet birch), and *Cornus florida* (flowering dogwood). The canopy can reach over 30 m (98 ft) tall and have nearly 75% closure; the subcanopy is about 14 m (46 ft) tall with over 25% closure. Tall shrubs and saplings (2–5 m [6.5–16 ft] tall) cover more than 12% of the stand and are dominated by *Lindera benzoin* (northern spicebush) with lesser amounts of *Prunus serotina* (black cherry), *Acer rubrum* (red maple), *Viburnum* (viburnum) sp., *Sassafras albidum* (sassafras), *Acer platanoides* (Norway maple), *Betula lenta* (sweet birch), *Taxus cuspidata* (Japanese yew), and *Cornus florida* (flowering dogwood). Short shrubs and saplings (to 2 m [6.5 ft] tall) have 20% cover and are dominated by *Viburnum acerifolium* (mapleleaf viburnum) with *Lindera benzoin* (northern spicebush) and *Sassafras albidum* (sassafras). Associated species are *Prunus serotina* (black cherry), *Acer platanoides* (Norway maple), and *Cornus alternifolia* (alternateleaf dogwood). *Toxicodendron radicans* (eastern poison ivy) is the most abundant vine species; additional vines are *Lonicera japonica* (Japanese honeysuckle), *Parthenocissus quinquefolia* (Virginia creeper), and *Rosa multiflora* (multiflora rose). *Eurybia divaricata* (white wood aster) is the most abundant of the sparse herbaceous species. Additional herbs are *Thelypteris noveboracensis* (New York fern), *Alliaria petiolata* (garlic mustard), *Phryma leptostachya* (American lopseed), *Impatiens capensis* (jewelweed), *Polystichum acrostichoides* (Christmas

fern), *Phytolacca americana* (American pokeweed), *Maianthemum racemosum* (feathery false lily of the valley), and *Solidago caesia* (wreath goldenrod).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple), *Betula lenta* (sweet birch), *Liriodendron tulipifera* (tuliptree), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak)
Tree subcanopy	Broad-leaved deciduous tree	*Acer platanoides* (Norway maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush)
Short shrub/sapling	Broad-leaved deciduous shrub	*Viburnum acerifolium* (mapleleaf viburnum)
Herb (field)	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)
Herb (field)	Forb	*Eurybia divaricata* (white wood aster)

Characteristic Species: *Fagus grandifolia* (American beech), *Lindera benzoin* (northern spicebush), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), *Toxicodendron radicans* (eastern poison ivy), *Viburnum acerifolium* (mapleleaf viburnum).

Other Noteworthy Species:

Species	GRank	Type	Note
Acer platanoides (Norway maple)	-	plant	invasive exotic
Alliaria petiolata (garlic mustard)	-	plant	invasive exotic
Lonicera japonica (Japanese honeysuckle)	-	plant	invasive exotic
Rosa multiflora (multiflora rose)	-	plant	invasive exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NY	SNR	=	1	Oak - tuliptree forest	Edinger et al. 2002

Local Range: This association is found at two locations in the park: in the patch of forest northwest of the park's entrance road and in the eastern portion of the park on the slope down to the maritime complex.

Classification Comments: This association was used to classify forests dominated by a mix of *Quercus* (oak) species with associated *Liriodendron tulipifera* (tuliptree) and/or *Fagus grandifolia* (American beech). Forests without American beech and tuliptree (mesic species) mixed with oak species are classified as Northeastern Dry Oak - Hickory Forest (CEGL006336).

Other Comments: None.

Local Description Authors: G. J. Edinger and A. L. Feldmann.

Plots: 4a, 6b, 7b, 9b, 17b, 18b, 5.

Sagamore Hill National Historic Site Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Fagus grandifolia - Quercus rubra - Quercus alba* Forest Alliance (A.229)
Alliance (English name)	American Beech - Northern Red Oak - White Oak Forest Alliance
Association	*Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca var. opaca) / Polystichum acrostichoides* Forest
Association (English name)	American Beech - (White Oak, Northern Red Oak) - Tuliptree / (American Holly) / Christmas Fern Forest

Ecological System(s): Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242).
Northern Atlantic Coastal Plain Hardwood Forest (CES203.475).

GLOBAL DESCRIPTION

Concept Summary: This forest of mesic to submesic, well-drained soils occurs in the Piedmont and Coastal Plain of Virginia and Maryland, extending north to southern New England on the Coastal Plain. It also occurs occasionally at low elevations of the Blue Ridge and adjacent Ridge and Valley in Virginia and Maryland. It is characteristically a mixed forest dominated by *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), and *Liriodendron tulipifera* (tuliptree) in various proportions. Overstory associates over the range include *Quercus velutina* (black oak), *Quercus falcata* (southern red oak), *Quercus coccinea* (scarlet oak), *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), and *Fraxinus americana* (white ash). The subcanopy is characterized by young *Fagus grandifolia* (American beech), *Acer rubrum* (red maple), *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), and *Sassafras albidum* (sassafras). *Ilex opaca* (American holly) is particularly characteristic and abundant on the Coastal Plain. The shrub layer varies from very sparse to well-developed and can include *Asimina triloba* (pawpaw), *Viburnum acerifolium* (mapleleaf viburnum), *Viburnum dentatum* (southern arrowwood), and *Euonymus americanus* (strawberry bush). Heath shrubs, such as *Vaccinium corymbosum* (highbush blueberry) and *Vaccinium pallidum* (Blue Ridge blueberry), may be common but not abundant. Vines are common, including *Parthenocissus quinquefolia* (Virginia creeper), *Smilax glauca* (cat greenbrier), and *Toxicodendron radicans* (eastern poison ivy). In the southern part of the range, *Oxydendrum arboreum* (sourwood) and *Vitis rotundifolia* (muscadine) may be conspicuous members of the understory. The herb layer is comprised of *Polystichum acrostichoides* (Christmas fern), *Thelypteris noveboracensis* (New York fern), *Uvularia perfoliata* (perfoliate bellwort), *Cypripedium acaule* (moccasin flower), *Mitchella repens* (partridgeberry), *Tipularia discolor* (crippled cranefly), *Goodyera pubescens* (downy rattlesnake plantain), *Eurybia divaricata* (white wood aster), *Chimaphila maculata* (striped prince's pine), *Carex swanii* (Swan's sedge), *Medeola virginiana* (Indian cucumber), *Athyrium filix-femina* (common ladyfern), *Carex digitalis* (slender woodland sedge), *Carex willdenowii* (Willdenow's sedge), *Epifagus virginiana* (beechdrops), *Maianthemum canadense* (Canada mayflower), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Polygonatum biflorum* (smooth Solomon's seal), *Podophyllum peltatum* (mayapple), *Arisaema triphyllum* (Jack in the pulpit), and *Maianthemum racemosum* (feathery false lily of the valley).

Environmental Description: This forest association occurs on mesic to submesic slopes or gentle gradients. Ravines in dissected topography are particularly typical sites in the Piedmont and parts of the Inner Coastal Plain. The type also occupies rolling uplands with deep soils. Soils are typically well-drained, acidic sandy and silt loams derived from parent material of low to moderate fertility. This association is found throughout the Piedmont from south-central Virginia to New Jersey and Pennsylvania, and on the Mid-Atlantic Coastal Plain from southeastern Virginia northward.

Vegetation Description: Rangewide, this vegetation type is characteristically a mixed mesophytic forest dominated by *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), and *Liriodendron tulipifera* (tuliptree) in various proportions. Overstory associates over the range include *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Quercus velutina* (black oak), *Quercus falcata* (southern red oak), *Quercus*

coccinea (scarlet oak), *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), and *Fraxinus americana* (white ash). The subcanopy is characterized by young *Fagus grandifolia* (American beech), *Acer rubrum* (red maple), *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), *Ilex opaca* (American holly), and *Sassafras albidum* (sassafras). The shrub layer varies from very sparse to well-developed and can include *Asimina triloba* (pawpaw), *Viburnum acerifolium* (mapleleaf viburnum), *Viburnum dentatum* (southern arrowwood), and *Euonymus americanus* (strawberry bush). Heath shrubs, such as *Vaccinium corymbosum* (highbush blueberry) and *Vaccinium pallidum* (Blue Ridge blueberry), may be common but not abundant. Vines are common, including *Parthenocissus quinquefolia* (Virginia creeper), *Smilax glauca* (cat greenbrier), and *Toxicodendron radicans* (eastern poison ivy). The herb layer is comprised of *Polystichum acrostichoides* (Christmas fern), *Uvularia perfoliata* (perfoliate bellwort), *Cypripedium acaule* (moccasin flower), *Mitchella repens* (partridgeberry), *Tipularia discolor* (crippled cranefly), *Goodyera pubescens* (downy rattlesnake plantain), *Eurybia divaricata* (white wood aster), *Chimaphila maculata* (striped prince's pine), *Carex swanii* (Swan's sedge), *Medeola virginiana* (Indian cucumber), *Athyrium filix-femina* (common ladyfern), *Carex digitalis* (slender woodland sedge), *Carex willdenowii* (Willdenow's sedge), *Epifagus virginiana* (beechdrops), *Maianthemum canadense* (Canada mayflower), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Polygonatum biflorum* (smooth Solomon's seal), *Podophyllum peltatum* (mayapple), *Arisaema triphyllum* (Jack in the pulpit), and *Maianthemum racemosum* (feathery false lily of the valley).

Several intergrading compositional variants have been noted in regional and local landscape analyses. On more submesic, convex slopes, *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Cornus florida* (flowering dogwood), and *Vaccinium pallidum* (Blue Ridge blueberry) tend to be prominent, while pronounced mesophytes such as *Carpinus caroliniana* (American hornbeam) and herbaceous species in general are usually sparse. Coastal Plain stands tend to have understories heavily dominated by *Ilex opaca* (American holly), while Piedmont stands generally have only scattered *Ilex opaca* (American holly) as well as slightly higher herbaceous richness.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), *Quercus alba* (white oak)
Tree subcanopy	Broad-leaved deciduous tree	*Cornus florida* (flowering dogwood)
Tree subcanopy	Broad-leaved evergreen tree	*Ilex opaca* (American holly)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Viburnum acerifolium* (mapleleaf viburnum)
Shrub/sapling (tall & short)	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper)
Herb (field)	Forb	*Podophyllum peltatum* (mayapple), *Polygonatum biflorum* (smooth Solomon's seal)
Herb (field)	Fern or fern ally	*Polystichum acrostichoides* (Christmas fern)

Characteristic Species: *Carex laxiculmis* var. *laxiculmis*, *Fagus grandifolia* (American beech), *Ilex opaca* (American holly), *Quercus alba* (white oak), *Viburnum acerifolium* (mapleleaf viburnum).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association is currently described from Virginia northward to Long Island, New York. The type is characteristic of the Coastal Plain throughout its range and of the Piedmont from south-central Virginia through much of Maryland. Small outliers of this vegetation occur at low elevations on both flanks of the Blue Ridge in Virginia and Maryland.
States/Provinces: DC, DE:S5, MD, NJ:S3, NY, PA:S1, VA:S5.
Federal Lands: DOD (Fort A.P. Hill, Fort Belvoir, Kerr Reservoir, Yorktown); NPS (Appomattox Court House, C&O Canal, Colonial, Fredericksburg-Spotsylvania, George Washington Parkway, National Capital-East, Petersburg, Prince William, Richmond, Rock Creek, Sagamore Hill, Shenandoah, Thomas Stone); USFWS (James River, Prime Hook).

CONSERVATION STATUS

Rank: G5 (31-Jan-2007).
Reasons: This association is common and widespread on the northeastern Coastal Plain and the Piedmont in Virginia and Maryland.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 - Moderate.
Comments: The regional circumscription of this type is very robust and supported by 170 plots from Virginia, Maryland, and the District of Columbia. These were analyzed by VDNH with a 1300-plot regional dataset compiled for the NCR and Mid-Atlantic national parks vegetation mapping projects.
Similar Associations:
Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana Forest (CEGL006921).
Fagus grandifolia - Quercus alba - (Acer barbatum) / Mixed Herbs Forest (CEGL007206).
Fagus grandifolia - Quercus alba - Quercus rubra Forest (CEGL006377).
Fagus grandifolia - Quercus rubra / Cornus florida / Polystichum acrostichoides - Hexastylis virginica Forest (CEGL008465).
Quercus alba - Carya glabra / Mixed Herbs Coastal Plain Forest (CEGL007226).
Related Concepts:
Fagus grandifolia - Liriodendron tulipifera - Quercus (alba, rubra) / Polystichum acrostichoides - Aster divaricatus Forest (Fleming 2001) ?
Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / Ilex opaca var. opaca - (Asimina triloba) Forest (Patterson pers. comm.) ?
Fagus grandifolia - Quercus alba - Liriodendron tulipifera - Liquidambar styraciflua Forest (Bartgis 1986) ?
Quercus spp. - *Carya* spp. / *Cornus florida - Ilex opaca* Mesic Forest (Clancy 1993b) ?
CNE Mesic hardwood Forest on acidic bedrock / till (Rawinski 1984) ?
Coastal Plain Forest (Smith 1983) B
Maritime forest (Rawinski 1984) ?
Mesic Coastal Plain mixed oak forest, mixed oak - beech forest subtype (Breden 1989) ?
Mixed oak forest of the south Jersey mesic uplands (Robichaud and Buell 1973) ?
Southern New England oak / pine forest on sandy / gravelly soils (Rawinski 1984) ?

SOURCES

Description Authors: S. L. Neid, mod. G. Fleming and L. A. Sneddon.

References: Bartgis 1986, Berdine 1998, Bernard and Bernard 1971, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993b, Clancy 1996, Davis et al. 1992, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming 2001, Fleming et al. 2001, Fleming pers. comm., Harrison 2004, Lea 2003, McCoy and Fleming 2000, Metzler and Barrett 2001, Patterson pers. comm., Rawinski 1984, Robichaud and Buell 1973, Smith 1983, Soil Conservation Service 1987.

Figure E2. Mid-Atlantic Mesic Mixed Hardwood Forest in Sagamore Hill National Historic Site (Accuracy Assessment Point 5, photo no. 1446). 10/18/2006. NAD 1983 / UTM easting 627050, northing 4527226.

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN MODIFIED SUCCESSIONAL FOREST

SYNONYMS
USNVC English Name: **Black Cherry - Tuliptree - Red Maple - White Ash Forest**
USNVC Scientific Name: ***Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest**
USNVC Identifier: **CEGL006599**

LOCAL INFORMATION

Environmental Description: This successional forest is found on upper slopes at two locations in the park and is heavily influenced by land-use history. It can be found in the patch of forest northwest of the park's entrance road on gentle west/northwest-facing slopes at elevations of 18–49 m (60–160 ft), as well as south of the New Barn in the south-central portion of the park on south- and east-facing slopes between 30–43 m (100–140 feet) in elevation. These stands likely occur on sites from which the formerly dominant oak species (*Quercus* (oak) spp.) have been harvested or on previous agricultural land that has developed into forest. Soils are fine sandy loam, sandy loam, and loamy sands in the Montauk, Plymouth-Riverhead, and Riverhead series. They are strongly acidic, very deep, well-drained to excessively drained, and were formed in glacial outwash deposits and in glacial loamy glacial till (Soil Conservation Service 1987). Adjacent natural communities are Norway Maple Forest (CEGL006407) in more heavily disturbed areas, Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075) on lower slopes, and Northeastern Dry Oak - Hickory Forest (CEGL006336).
Vegetation Description: The canopy of this successional forest is generally dominated by *Betula lenta* (sweet birch) and *Prunus serotina* (black cherry) with associated *Acer platanoides* (Norway maple), *Liriodendron tulipifera* (tuliptree), and *Sassafras albidum* (sassafras). *Quercus velutina* (black oak) can also be nearly codominant, depending on land-use history. The subcanopy is strongly dominated by the invasive exotic *Acer platanoides* (Norway maple), which is expected to overtake the canopy and convert the community to Norway Maple Forest (CEGL006407). Subcanopy associates are *Betula lenta* (sweet birch), *Rhus typhina* (staghorn sumac), and *Robinia pseudoacacia* (black locust) with scattered *Juniperus virginiana* (eastern redcedar) and *Cornus florida* (flowering dogwood). The canopy can reach 26 m (85 ft) in height and is nearly 65% closed, while subcanopy trees are over 12 m (39 ft) in height and cover just over 30% of the stand. Tall shrubs and saplings (2–5 m [6.5–16 ft] tall) have about 13% cover and are dominated by *Prunus serotina* (black cherry) with the invasive associates *Rosa multiflora* (multiflora rose) and *Acer platanoides* (Norway maple). Short shrubs and saplings (0–2 m [0–6.5 ft] tall) have about 10% cover and are also dominated by *Prunus serotina* (black cherry) with associates that include *Acer platanoides* (Norway maple), *Rubus allegheniensis* (Allegheny blackberry), *Acer palmatum* (Japanese maple), *Ailanthus altissima* (tree of heaven), *Sassafras albidum* (sassafras), and *Quercus* (oak) spp. Vines can be abundant (nearly 40% cover in parts) and are dominated by *Ampelopsis brevipedunculata* (Amur peppervine), *Hedera helix* (English ivy), and *Toxicodendron radicans* (eastern poison ivy) with lesser amounts of *Lonicera japonica* (Japanese honeysuckle) and *Parthenocissus quinquefolia* (Virginia creeper). Herbaceous species are sparse and scattered; they include *Eurybia divaricata* (white wood aster), *Alliaria petiolata* (garlic mustard), *Polygonatum biflorum* (smooth Solomon's seal), *Phytolacca*

americana (American pokeweed), *Polygonum virginianum* (jumpseed), and *Polygonum persicaria* (spotted ladysthumb).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Betula lenta* (sweet birch)
Tree canopy	Broad-leaved deciduous tree	*Prunus serotina* (black cherry), *Quercus velutina* (black oak)
Tree subcanopy	Broad-leaved deciduous tree	*Acer platanoides* (Norway maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Prunus serotina* (black cherry)
Herb (field)	Vine/Liana	*Ampelopsis brevipedunculata* (Amur peppervine), *Hedera helix* (English ivy), *Toxicodendron radicans* (eastern poison ivy)
Herb (field)	Forb	*Eurybia divaricata* (white wood aster)

Characteristic Species: *Betula lenta* (sweet birch), *Prunus serotina* (black cherry).

Other Noteworthy Species:

Species	GRank	Type	Note
Acer platanoides (Norway maple)	-	plant	invasive exotic
Ailanthus altissima (tree of heaven)	-	plant	invasive exotic
Alliaria petiolata (garlic mustard)	-	plant	invasive exotic
Hedera helix (English ivy)	-	plant	invasive exotic
Lonicera japonica (Japanese honeysuckle)	-	plant	invasive exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NY	S5*	B	1	Successional southern hardwoods	Edinger et al. 2002

Local Range: This association can be found in the patch of forest northwest of the park's entrance road, as well as south of the New Barn in the south-central portion of the park.

Classification Comments: This community is characterized by *Prunus serotina* (black cherry) in association with early-successional or invasive species, including *Betula lenta* (sweet birch), *Sassafras albidum* (sassafras), *Robinia pseudoacacia* (black locust), and *Acer platanoides* (Norway maple). *Quercus* (oak) species are either absent or in low abundance.

Other Comments: None.

Local Description Authors: G. J. Edinger and A. L. Feldmann.

Plots: 3a, 1b, 9.

Sagamore Hill National Historic Site Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Prunus serotina - Acer rubrum - Amelanchier canadensis - Quercus* spp. Forest Alliance (A.237)
Alliance (English name)	Black Cherry - Red Maple - Canada Serviceberry - Oak species Forest Alliance
Association	*Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest
Association (English name)	Black Cherry - Tuliptree - Red Maple - White Ash Forest
Ecological System(s):	Central Appalachian Dry Oak - Pine Forest (CES202.591). Northeastern Interior Dry-Mesic Oak Forest (CES202.592).

GLOBAL DESCRIPTION

Concept Summary: This early-successional woody vegetation of the northeastern United States occurs on sites that are becoming reforested after having been cleared for agriculture. Environmental setting varies, but generally sites are dry-mesic to mesic, with small seepage inclusions in some examples. Physiognomy of this vegetation is highly variable, ranging from closed forest, open forest, tall dense shrubland, to more open tall shrubland. Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species often include some combination of *Prunus serotina* (black cherry), *Liriodendron tulipifera* (tuliptree), *Fraxinus americana* (white ash), *Robinia pseudoacacia* (black locust), and *Acer rubrum* (red maple). Other associates can include *Juglans nigra* (black walnut), *Sassafras albidum* (sassafras), *Betula populifolia* (gray birch), *Juniperus virginiana* (eastern redcedar), *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Ailanthus altissima* (tree of heaven), *Ulmus americana* (American elm), *Quercus* (oak) spp., *Betula lenta* (sweet birch), *Amelanchier* (serviceberry) spp., *Pinus strobus* (eastern white pine), and *Populus grandidentata* (bigtooth aspen). Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* (northern spicebush) and *Carpinus caroliniana* (American hornbeam). The low-shrub layer, if present, is usually characterized by the presence of *Rubus* (blackberry) spp. such as *Rubus flagellaris* (northern dewberry), *Rubus allegheniensis* (Allegheny blackberry), *Rubus phoenicolasius* (wine raspberry), or *Rubus hispidus* (bristly dewberry). This layer is often dominated by exotic species such as *Lonicera tatarica* (Tatarian honeysuckle), *Lonicera morrowii* (Morrow's honeysuckle), *Rhamnus cathartica* (common buckthorn), *Crataegus* (hawthorn) spp., *Rosa multiflora* (multiflora rose), and *Berberis thunbergii* (Japanese barberry). The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin. Common species include *Ageratina altissima var. altissima* (white snakeroot), *Polygonum persicaria* (spotted ladysthumb), *Impatiens capensis* (jewelweed), *Glechoma hederacea* (ground ivy), *Polystichum acrostichoides* (Christmas fern), *Calystegia sepium* ssp. *sepium* (hedge false bindweed), *Galium aparine* (stickywilly), *Oxalis stricta* (common yellow oxalis), *Polygonum virginianum* (jumpseed), *Dennstaedtia punctilobula* (eastern hayscented fern), *Arisaema triphyllum* (Jack in the pulpit), *Allium vineale* (wild garlic), and *Veronica officinalis* (common gypsyweed), among many others. The invasive species *Alliaria petiolata* (garlic mustard), *Microstegium vimineum* (Nepalese browntop), and *Polygonum caespitosum* (oriental ladysthumb) can be abundant in this disturbed forest type. Vines can be absent or abundant. In stands with high vine cover, the vegetation structure can be altered by the weight of the vines pulling down trees and shrubs. Common vines include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Vitis labrusca* (fox grape), and the invasive vines *Celastrus orbiculata* (Asian bittersweet) and *Lonicera japonica* (Japanese honeysuckle). These forests are often young and resulted from the colonization of old agricultural fields by woody species. Recent disturbance or abundant invasive species give these forest stands a weedy character. It is unlikely that these stands will succeed to a natural plant community dominated by native species.

Environmental Description: This vegetation occurs on sites that have been cleared for agriculture or otherwise heavily modified in the past. Generally sites are dry-mesic and may have small seepage inclusions in some examples. Occasionally this type may occur in formerly agricultural bottomlands, in which case the soils may be temporarily flooded or saturated.

Vegetation Description: Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species often include some combination

of *Prunus serotina* (black cherry), *Liriodendron tulipifera* (tuliptree), *Fraxinus americana* (white ash), *Robinia pseudoacacia* (black locust), and *Acer rubrum* (red maple). Other associates can include *Juglans nigra* (black walnut), *Sassafras albidum* (sassafras), *Betula populifolia* (gray birch), *Juniperus virginiana* (eastern redcedar), *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Ailanthus altissima* (tree of heaven), *Ulmus americana* (American elm), *Quercus* (oak) spp., *Betula lenta* (sweet birch), *Amelanchier* (serviceberry) spp., *Pinus strobus* (eastern white pine), and *Populus grandidentata* (bigtooth aspen). Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* (northern spicebush) and *Carpinus caroliniana* (American hornbeam). The low-shrub layer, if present, is usually characterized by the presence of *Rubus* (blackberry) spp. such as *Rubus flagellaris* (northern dewberry), *Rubus allegheniensis* (Allegheny blackberry), *Rubus phoenicolasius* (wine raspberry), or *Rubus hispidus* (bristly dewberry). This layer is often dominated by exotic species such as *Lonicera tatarica* (Tatarian honeysuckle), *Lonicera morrowii* (Morrow's honeysuckle), *Rhamnus cathartica* (common buckthorn), *Crataegus* (hawthorn) spp., *Rosa multiflora* (multiflora rose), and *Berberis thunbergii* (Japanese barberry). The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin. Common species include *Ageratina altissima var. altissima* (white snakeroot), *Polygonum persicaria* (spotted ladysthumb), *Impatiens capensis* (jewelweed), *Glechoma hederacea* (ground ivy), *Polystichum acrostichoides* (Christmas fern), *Calystegia sepium* ssp. *sepium* (hedge false bindweed), *Galium aparine* (stickywilly), *Oxalis stricta* (common yellow oxalis), *Polygonum virginianum* (jumpseed), *Dennstaedtia punctilobula* (eastern hayscented fern), *Arisaema triphyllum* (Jack in the pulpit), *Allium vineale* (wild garlic), and *Veronica officinalis* (common gypsyweed), among many others. The invasive species *Alliaria petiolata* (garlic mustard), *Microstegium vimineum* (Nepalese browntop), and *Polygonum caespitosum* (oriental ladysthumb) can be abundant in this disturbed forest type. Vines can be absent or abundant. In stands with high vine cover, the vegetation structure can be altered by the weight of the vines pulling down trees and shrubs. Common vines include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Vitis labrusca* (fox grape), and the invasive vines *Celastrus orbiculata* (Asian bittersweet) and *Lonicera japonica* (Japanese honeysuckle).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple), *Fraxinus americana* (white ash), *Liriodendron tulipifera* (tuliptree), *Prunus serotina* (black cherry), *Robinia pseudoacacia* (black locust)
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tall shrub/sapling	Broad-leaved deciduous tree	*Carpinus caroliniana* (American hornbeam)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush), *Rosa multiflora* (multiflora rose)
Herb (field)	Forb	*Alliaria petiolata* (garlic mustard), *Polygonum persicaria* (spotted ladysthumb)
Herb (field)	Graminoid	*Microstegium vimineum* (Nepalese browntop)

Characteristic Species: *Acer rubrum* (red maple), *Alliaria petiolata* (garlic mustard), *Berberis thunbergii* (Japanese barberry), *Elaeagnus umbellata* (autumn olive), *Fraxinus americana* (white ash), *Juglans nigra* (black walnut), *Liriodendron tulipifera* (tuliptree), *Microstegium vimineum* (Nepalese browntop), *Polygonum persicaria* (spotted ladysthumb), *Prunus serotina* (black cherry), *Robinia pseudoacacia* (black locust), *Rosa multiflora* (multiflora rose), *Rubus allegheniensis* (Allegheny blackberry).

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This vegetation is currently described from Pennsylvania, New York, and New Jersey but is of broader distribution in the northeastern U.S.
States/Provinces: CT, DE, MA, NJ, NY, PA.
Federal Lands: NPS (Allegheny Portage Railroad, Boston Harbor Islands, Delaware Water Gap, Fort Necessity, Friendship Hill, Gateway, Gettysburg, Johnstown Flood, Morristown, Sagamore Hill, Saratoga, Saugus Iron Works, Upper Delaware, Valley Forge, Weir Farm); USFWS (Erie, Great Meadows?, Prime Hook).

CONSERVATION STATUS

Rank: GNA (ruderal) (29-Nov-2004).
Reasons: This vegetation is modified by human activity and not of conservation concern.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 - Moderate.
Comments: This vegetation is broadly defined and varies widely in composition across its range, presenting a classification challenge at the alliance level.
Similar Associations:

Juglans nigra / Verbesina alternifolia Forest (CEGL007879).

Liriodendron tulipifera - Quercus spp. Forest (CEGL007221)--is more strongly dominated by *Liriodendron* and is generally in a later successional state as evidenced by taller trees and more closed canopy.

Prunus serotina - Sassafras albidum - (Fraxinus americana) / Juniperus virginiana Forest (CEGL004133).

Robinia pseudoacacia Forest (CEGL007279).

Related Concepts: Information not available.

SOURCES

Description Authors: L. A. Sneddon, mod. S. C. Gawler and E. Largay.
References: Eastern Ecology Working Group n.d., Ehrenfeld 1977, Fike 1999, NRCS 2001b, Perles et al. 2006, Podniesinski et al. 2007, Soil Conservation Service 1987.

Figure E3. Northeastern Modified Successional Forest in Sagamore Hill National Historic Site (Accuracy Assessment Point 9, photo no. 1429). 10/18/2006. NAD 1983 / UTM easting 626399, northing 4527087.

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN DRY OAK - HICKORY FOREST

SYNONYMS

USNVC English Name:	**(White Oak, Northern Red Oak, Black Oak) / Flowering Dogwood / Mapleleaf Viburnum Forest**
USNVC Scientific Name:	***Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest**
USNVC Identifier:	**CEGL006336**

LOCAL INFORMATION

Environmental Description: This dry oak - hickory forest occurs on upper slopes at two locations within the park: in the patch of forest northwest of the park's entrance road on gentle west/southwest-facing slopes at elevations of 18–43 m (60–140 ft) and in the southwest corner of the park on gentle west-facing slopes at elevations of 30–49 m (100–160 ft). The community is underlain by fine sandy loam, sandy loam, and loamy sand in the Montauk, Plymouth-Riverhead, Plymouth, and Riverhead series. Soils are strongly acidic, very deep, and well-drained to excessively drained; they were formed in glacial outwash and glacial till (Soil Conservation Service 1987). Patches of this forest type are bounded by Northeastern Modified Successional Forest (CEGL006599) and Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075).
Vegetation Description: The canopy layer of this deciduous forest is dominated by *Quercus coccinea* (scarlet oak) and *Quercus velutina* (black oak), accompanied by *Betula lenta* (sweet birch), *Prunus serotina* (black cherry), *Quercus rubra* (northern red oak), and *Acer platanoides* (Norway maple) in the canopy and subcanopy layers. Additional canopy and subcanopy species that occur at low abundance are *Carya alba* (mockernut hickory), *Sassafras albidum* (sassafras), *Carya alba* (mockernut hickory), *Acer palmatum* (Japanese maple), *Acer rubrum* (red maple), *Fagus grandifolia* (American beech), and *Cornus florida* (flowering dogwood). The canopy extends to 28 m (92 ft) in height and covers over 75% of the area, while subcanopy trees reach nearly 17 m (56 ft) in height and cover 30% of the stand. Both the tall- (2–5 m [6.5–16 ft] in height) and short- (0–2 m [0–6.5 ft] in height) shrub layers are open, with less than 10% cover each. Tall-shrub and sapling species include *Acer platanoides* (Norway maple), *Acer palmatum* (Japanese maple), and *Prunus serotina* (black cherry) with lesser amounts of *Pinus strobus* (eastern white pine), *Amelanchier canadensis* (Canadian serviceberry), *Betula lenta* (sweet birch), *Taxus cuspidata* (Japanese yew), *Rubus allegheniensis* (Allegheny blackberry), *Acer rubrum* (red maple), and *Pinus sylvestris* (Scotch pine). The most abundant short-shrub and sapling species are *Prunus serotina* (black cherry) and *Viburnum acerifolium* (mapleleaf viburnum) with scattered *Sassafras albidum* (sassafras), *Acer platanoides* (Norway maple), *Acer palmatum* (Japanese maple), *Aralia spinosa* (devil's walkingstick), *Quercus velutina* (black oak), and *Taxus cuspidata* (Japanese yew). Vines can be common, particularly in disturbed areas. Species include *Hedera helix* (English ivy), *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), *Wisteria sinensis* (Chinese wisteria), and *Lonicera japonica* (Japanese honeysuckle). The herbaceous layer is sparse, with low diversity, and is dominated by *Poa pratensis* (Kentucky bluegrass) with associates that include *Eurybia divaricata* (white wood aster), *Alliaria petiolata* (garlic mustard), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* (feathery false lily of the valley), *Carex pensylvanica* (Pennsylvania sedge), and *Athyrium filix-femina* (common ladyfern).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer platanoides* (Norway maple), *Betula lenta* (sweet birch)
Tree canopy	Broad-leaved deciduous tree	*Prunus serotina* (black cherry), *Quercus coccinea* (scarlet oak), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Prunus serotina* (black cherry)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer palmatum* (Japanese maple), *Acer platanoides* (Norway maple)
Short shrub/sapling	Broad-leaved deciduous shrub	*Viburnum acerifolium* (mapleleaf viburnum)
Herb (field)	Vine/Liana	*Hedera helix* (English ivy)
Herb (field)	Graminoid	*Poa pratensis* (Kentucky bluegrass)

Characteristic Species: *Betula lenta* (sweet birch), *Prunus serotina* (black cherry), *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), *Smilax rotundifolia* (roundleaf greenbrier).

Other Noteworthy Species:

Species	GRank	Type	Note
Acer palmatum (Japanese maple)	-	plant	invasive exotic
Acer platanoides (Norway maple)	-	plant	invasive exotic
Alliaria petiolata (garlic mustard)	-	plant	invasive exotic
Hedera helix (English ivy)	-	plant	invasive exotic
Lonicera japonica (Japanese honeysuckle)	-	plant	invasive exotic
Taxus cuspidata (Japanese yew)	-	plant	invasive exotic
Wisteria sinensis (Chinese wisteria)	-	plant	invasive exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NY	S4*	I	1	Appalachian oak - hickory forest	Edinger et al. 2002
NY	S3*	I	1	Coastal oak - hickory forest	Edinger et al. 2002
NY	S3	=	1	[gname]	Edinger et al. 2002

Local Range: This association occurs at two locations within the park: in the patch of forest northwest of the park's entrance road and in the southwest corner of the park.

Classification Comments: This association was used to classify forests dominated by a mix of dry oak species (*Quercus* spp.) with or without hickory (*Carya* spp.) and without mesic indicators such as *Fagus grandifolia* (American beech) and/or *Liriodendron tulipifera* (tuliptree). Forests with American beech and tuliptree mixed with oak species are classified as Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075).

Other Comments: Information not available.

Local Description Authors: G. J. Edinger and A. L. Feldmann.

Plots: 2b, 3b, 4b, 1, 11, 12XX, 13.

Sagamore Hill National Historic Site Inventory Notes: The two patches in the southwestern corner of the property were kept separate in the delineation because of severe invasion by *Hedera helix* (English ivy) in the southernmost patch south of the old carriage road.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)

Alliance	*Quercus alba - (Quercus rubra, Carya* spp.) Forest Alliance (A.239)
Alliance (English name)	White Oak - (Northern Red Oak, Hickory species) Forest Alliance
Association	*Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest
Association (English name)	(White Oak, Northern Red Oak, Black Oak) / Flowering Dogwood / Mapleleaf Viburnum Forest
Ecological System(s):	Northern Atlantic Coastal Plain Hardwood Forest (CES203.475). Northeastern Interior Dry-Mesic Oak Forest (CES202.592).

GLOBAL DESCRIPTION

Concept Summary: This oak - hickory forest occurs on well-drained loamy sand of midslopes in the northeastern United States. This vegetation is ecologically transitional between dry-rich oak - hickory forests of relatively high diversity and dry, acidic oak species-poor forests. *Quercus rubra* (northern red oak), *Quercus alba* (white oak), and *Quercus velutina* (black oak) are prominent in the canopy. *Quercus prinus* (chestnut oak) and *Quercus coccinea* (scarlet oak) are canopy associates in the southern portion of the range. Typical hickory species include *Carya glabra* (pignut hickory), *Carya ovata* (shagbark hickory), *Carya alba* (mockernut hickory), and *Carya ovalis* (red hickory). Other canopy associates may include *Acer rubrum* (red maple), *Sassafras albidum* (sassafras), and *Amelanchier arborea* (common serviceberry). At the northern range limit of this type, *Pinus strobus* (eastern white pine) and *Betula lenta* (sweet birch) also occur as minor associates. *Cornus florida* (flowering dogwood) is a characteristic understory tree in portions of the range. The shrub layer is characterized by *Viburnum acerifolium* (mapleleaf viburnum), with other frequent associates including *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Corylus cornuta* (beaked hazelnut), and *Corylus americana* (American hazelnut). A dwarf-shrub layer may be common, but is generally not abundant, and is characterized by *Vaccinium pallidum* (Blue Ridge blueberry) and *Gaylussacia baccata* (black huckleberry), with *Vaccinium angustifolium* (lowbush blueberry) occurring more frequently to the north. The herbaceous layer is characterized by *Carex pensylvanica* (Pennsylvania sedge), *Carex rosea* (rosy sedge), *Maianthemum racemosum* (feathery false lily of the valley), *Aralia nudicaulis* (wild sarsaparilla), *Hieracium venosum* (rattlesnakeweed), *Solidago bicolor* (white goldenrod), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Desmodium paniculatum* (panicledleaf ticktrefoil), *Melampyrum lineare* (narrowleaf cowwheat), *Chimaphila maculata* (striped prince's pine), *Eurybia divaricata* (white wood aster), *Danthonia spicata* (poverty oatgrass), *Aureolaria* (false foxglove) spp., *Pteridium aquilinum* (western brackenfern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Helianthemum canadense* (longbranch frostweed).

Environmental Description: This forest type occurs on well-drained loamy sand of midslopes and other dry-mesic sites.

Vegetation Description: This vegetation is ecologically transitional between dry-rich oak - hickory forests of relatively high diversity and dry, acidic oak-species-poor forests. *Quercus rubra* (northern red oak), *Quercus alba* (white oak), and *Quercus velutina* (black oak) are prominent in the canopy. Typical hickory species include *Carya glabra* (pignut hickory), *Carya ovata* (shagbark hickory), *Carya alba* (mockernut hickory), and *Carya ovalis* (red hickory). Other canopy associates may include *Acer rubrum* (red maple), *Quercus prinus* (chestnut oak), *Sassafras albidum* (sassafras), and *Amelanchier arborea* (common serviceberry). *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), and *Betula lenta* (sweet birch) may also occur as minor associates. *Cornus florida* (flowering dogwood) is a characteristic understory tree in portions of the range. The shrub layer is typically rather sparse and characterized by *Viburnum acerifolium* (mapleleaf viburnum), with other frequent associates

including *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Kalmia latifolia* (mountain laurel), *Corylus cornuta* (beaked hazelnut), and *Corylus americana* (American hazelnut). A dwarf-shrub layer may be common but generally not abundant, characterized by *Vaccinium pallidum* (Blue Ridge blueberry) and *Gaylussacia baccata* (black huckleberry), with *Vaccinium angustifolium* (lowbush blueberry) occurring more frequently to the north. The herbaceous layer is characterized by *Carex pensylvanica* (Pennsylvania sedge), *Maianthemum racemosum* (feathery false lily of the valley), *Dryopteris marginalis* (marginal woodfern), *Aralia nudicaulis* (wild sarsaparilla), *Hieracium venosum* (rattlesnakeweed), *Solidago bicolor* (white goldenrod), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Desmodium paniculatum* (panicledleaf ticktrefoil), *Melampyrum lineare* (narrowleaf cowwheat), *Chimaphila maculata* (striped prince's pine), *Eurybia divaricata* (white wood aster), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), *Dennstaedtia punctilobula* (eastern hayscented fern), *Aureolaria* (false foxglove) spp., *Pteridium aquilinum* (western brackenfern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Helianthemum canadense* (longbranch frostweed). The invasive species *Microstegium vimineum* (Nepalese browntop) and *Berberis thunbergii* (Japanese barberry) may also be present in this forest type.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus alba* (white oak), *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	*Cornus florida* (flowering dogwood)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Characteristic Species: *Aralia nudicaulis* (wild sarsaparilla), *Carex pensylvanica* (Pennsylvania sedge), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), *Cornus florida* (flowering dogwood), *Gaylussacia baccata* (black huckleberry), *Maianthemum racemosum* (feathery false lily of the valley), *Quercus prinus* (chestnut oak), *Vaccinium pallidum* (Blue Ridge blueberry), *Viburnum acerifolium* (mapleleaf viburnum).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association occurs from Maine to Maryland.

States/Provinces: CT, DE:S3?, MA, MD, ME, NH, NJ:S4S5, NY:S3, PA, RI, VT

Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Delaware Water Gap, Fort Necessity, Gettysburg, Minute Man, Morristown, Sagamore Hill, Saratoga, Upper Delaware, Weir Farm); USFWS (Assabet River, Great Meadows).

CONSERVATION STATUS

Rank: G4G5 (24-Jan-2005).

Reasons: This type is not naturally rare and has a wide geographic distribution. Mature stands, however, are uncommon and most stands are subject to logging disturbances or even complete destruction if located in rapidly developing suburban areas.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 - Moderate.
Comments: Information not available.
Similar Associations:

Acer saccharum - Betula alleghaniensis - Quercus rubra / Viburnum acerifolium Forest (CEGL006943).

Carya (glabra, ovata) - Fraxinus americana - Quercus spp. Forest (CEGL006236).

Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia Forest (CEGL006293)--can intergrade with this type in New England but is characterized by *Fagus grandifolia* (more or less absent in CEGL006336), a greater amount of *Pinus strobus* in the canopy (usually >20%), and little or no *Carya*.

Quercus alba - Quercus rubra - Carya (alba, ovata) / Cornus florida Acid Forest (CEGL002067)--also contains *Actaea racemosa* and can occur on cherty limestone, and *Quercus velutina* is not characteristic.

Quercus alba - Quercus rubra - Carya alba / Cornus florida / Vaccinium stamineum / Desmodium nudiflorum Piedmont Forest (CEGL008475)--southern analogue of CEGL006336; is more diverse and occupies soils with slightly higher base status. *Quercus velutina* is not as characteristic of this type. A number of southern herbs such as *Aristolochia serpentaria* are not found in CEGL006336; northern species such as *Corylus cornuta, Vaccinium angustifolium,* and *Aralia nudicaulis* are not found in CEGL008475.

Quercus coccinea - Quercus velutina / Sassafras albidum / Vaccinium pallidum Forest (CEGL006375)--lacks *Viburnum acerifolium* and *Cornus florida* and in general is less diverse and occurring on relatively more nutrient-poor soils.

Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium Forest (CEGL006282).

Quercus velutina - Quercus alba - Carya (glabra, ovata) Forest (CEGL002076)--also contains *Quercus ellipsoidalis* or *Quercus macrocarpa* and is of shorter stature and more open canopy.

Quercus velutina / Carex pensylvanica Forest (CEGL002078)--is drier and more infertile, and lacks *Viburnum acerifolium, Hamamelis virginiana* and other shrubs.

Related Concepts:

Quercus (alba, rubra, velutina) / Cornus florida - Viburnum acerifolium Forest (Bartgis 1986) =

Quercus alba - Quercus coccinea - Carya glabra / Cornus florida / Viburnum acerifolium Forest (VDNH 2003) =

Mesic Coastal Plain mixed oak forest (Breden 1989) ?

SNE mesic central hardwood forest on acidic till (Rawinski 1984) ?

SOURCES

Description Authors: S. L. Neid and L. A. Sneddon, mod. S. C. Gawler.

References: Bartgis 1986, Berdine 1998, Breden 1989, Breden et al. 2001, Clancy 1996, Damman 1977, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Fleming et al. 2001, Fleming pers. comm., Gawler 2002, Harrison 2004, Hunt 1997a, MENHP 1991, McCoy and Fleming 2000, Metzler and Barrett 2001, Patterson pers. comm., Rawinski 1984, Soil Conservation Service 1987, Sperduto 1997b, Sperduto and Nichols 2004, Swain and Kearsley 2001, VDNH 2003.

Figure E4. Northeastern Dry Oak - Hickory Forest in Sagamore Hill National Historic Site (Accuracy Assessment Point 12XX, photo no. 1425). 10/18/2006. NAD 1983 / UTM easting 626166, northing 4527046.

COMMON NAME (PARK-SPECIFIC): NORTHERN BEACHGRASS DUNE

SYNONYMS
USNVC English Name: **American Beachgrass - Beach Pea Herbaceous Vegetation**
USNVC Scientific Name: ***Ammophila breviligulata - Lathyrus japonicus* Herbaceous Vegetation**
USNVC Identifier: **CEGL006274**

LOCAL INFORMATION

Environmental Description: This herbaceous dune vegetation is located in the far eastern portion of the park in the maritime complex adjacent to Cold Spring Harbor. It occurs on active maritime dunes, on both foredunes that are exposed to onshore winds and salt spray, as well as on more protected interdunes. The substrate is unstable and droughty and consists of coarse to fine sand with little to no soil profile development. Eolian processes cause active sand deposition and erosion. This community is bounded by a number of different associations within the maritime complex that include North Atlantic Upper Ocean Beach (CEGL004400), Overwash Dune Grassland (CEGL004097), North Atlantic High Salt Marsh (CEGL006006), and North Atlantic Low Salt Marsh (CEGL004192). Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075) is adjacent to a portion of the community as well.
Vegetation Description: This association is characterized and dominated by *Ammophila breviligulata* (American beachgrass), which can occur monotypically, especially on foredunes or other areas of active and rapid sand deposition. The most commonly associated herbaceous species are *Solidago sempervirens* (seaside goldenrod), *Panicum amarum* (bitter panicgrass), *Spartina patens* (saltmeadow cordgrass), *Polygonella articulata* (coastal jointweed), *Distichlis spicata* (inland saltgrass), and *Chenopodium album* (lambsquarters). *Salsola kali* (Russian thistle) and *Cakile edentula* (American searocket) can colonize the dunes as they border the North Atlantic Upper Ocean Beach (CEGL004400), but they occur in low abundance and are not diagnostic. *Robinia pseudoacacia* (black locust) has also colonized the dunes in areas that are more stabilized; it occurs sporadically in both stunted-tree (to 8 m [26 ft] tall) and low-shrub (1 m [3.25 ft] tall) forms. The vine *Toxicodendron radicans* (eastern poison ivy) is also a component of this community, but in low abundance.
Most Abundant Species:

Stratum	Lifeform	Species
Tree subcanopy	Broad-leaved deciduous tree	*Robinia pseudoacacia* (black locust)
Short shrub/sapling	Broad-leaved deciduous shrub	*Robinia pseudoacacia* (black locust)
Herb (field)	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)
Herb (field)	Forb	*Solidago sempervirens* (seaside goldenrod)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass), *Panicum amarum* (bitter panicgrass)

Characteristic Species: *Ammophila breviligulata* (American beachgrass), *Solidago sempervirens* (seaside goldenrod).
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NY	S3*	B	1	Maritime dunes	Edinger et al. 2002

Local Range: This community is located in the far eastern portion of the park in the maritime complex adjacent to Cold Spring Harbor.

Classification Comments: This association is characterized and dominated by *Ammophila breviligulata* (American beachgrass).
Other Comments: None.
Local Description Authors: G. J. Edinger and A. L. Feldmann.
Plots: 15b, 7YY, ref5.
Sagamore Hill National Historic Site Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Ammophila breviligulata* Herbaceous Alliance (A.1207)
Alliance (English name)	American Beachgrass Herbaceous Alliance
Association	*Ammophila breviligulata* - *Lathyrus japonicus* Herbaceous Vegetation
Association (English name)	American Beachgrass - Beach Pea Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264).

GLOBAL DESCRIPTION

Concept Summary: This dune grassland of maritime beaches occurs along the North Atlantic coast from New Jersey north to central Maine. This association primarily occurs on active maritime dunes, on both foredunes that are exposed to onshore winds and salt spray as well as more protected interdunes. The substrate is wind-deposited sand with no soil development. *Ammophila breviligulata* (American beachgrass) is the dominant species, often occurring monotypically. *Lathyrus japonicus* (beach pea) is a common associate and can be codominant. Other associated species include *Solidago sempervirens* (seaside goldenrod), *Lechea maritima* (beach pinweed), *Aristida tuberculosa* (seaside threeawn), *Schizachyrium scoparium* (little bluestem), *Carex silicea* (beach sedge), *Polygonella articulata* (coastal jointweed), and *Artemisia stelleriana* (oldwoman). Dwarf-shrubs, such as *Hudsonia tomentosa* (woolly beachheather), can occur sporadically and form locally dominant patches. Vegetation cover is often sparse, and bare sand is usually evident.
Environmental Description: This association primarily occurs on active maritime dunes, on both foredunes that are exposed to onshore winds and salt spray as well as more protected interdunes. This grassland generally occurs beyond the influence of storm tides. Substrate is sand with no soil profile development.
Vegetation Description: This association is characterized and dominated by *Ammophila breviligulata* (American beachgrass), which can occur monotypically, especially on foredunes or other areas of active and rapid sand deposition. *Lathyrus japonicus* (beach pea) is the most common associate and can be codominant. Other associated species include *Solidago sempervirens* (seaside goldenrod), *Lechea maritima* (beach pinweed), *Aristida tuberculosa* (seaside threeawn), *Schizachyrium scoparium* (little bluestem), *Carex silicea* (beach sedge), *Polygonella articulata* (coastal jointweed), and *Artemisia stelleriana* (oldwoman). Dwarf-shrubs, such as *Hudsonia tomentosa* (woolly beachheather), *Rosa rugosa* (rugosa rose), *Morella pensylvanica* (northern bayberry), or stunted *Prunus maritima* (beach plum), can occur sporadically and form locally dominant patches within the grassland.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Lathyrus japonicus* (beach pea)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)

Characteristic Species: *Ammophila breviligulata* (American beachgrass).
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association occurs along the northern Atlantic Coast from Maine to New Jersey.
States/Provinces: CT, DE, MA, ME:S2, NH:S1, NJ:S2S3, NY, RI.
Federal Lands: NPS (Acadia, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Muskeget Island, Sagamore Hill); USFWS (Monomoy, Nomans Land Island, Parker River).

CONSERVATION STATUS

Rank: G4? (1-Dec-1997).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 - Moderate.
Comments: The southern analog of this dune grassland association is *Ammophila breviligulata - Panicum amarum var. amarum* Herbaceous Vegetation (CEGL004043), which is differentiated by having *Panicum amarum* (bitter panicgrass) as a codominant species in addition to the presence of more southern species such as *Cenchrus tribuloides* (sanddune sandbur) and *Oenothera humifusa* (seabeach evening-primrose), plus the absence of *Lathyrus japonicus* (beach pea). These two *Ammophila breviligulata* (American beachgrass)-dominated associations overlap geographically in New Jersey. This association is often adjacent to *Hudsonia tomentosa* (woolly beachheather) dwarf-shrublands and they have much species overlap; when dwarf-shrub cover exceeds 25%, the community is considered *Hudsonia tomentosa - Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL006143).
Similar Associations:
Ammophila breviligulata - Panicum amarum var. *amarum* Herbaceous Vegetation (CEGL004043).
Hudsonia tomentosa - Arctostaphylos uva-ursi Dwarf-shrubland (CEGL006143).
Related Concepts:
Coastal dune community (Rawinski 1984) ?
Coastal dune grass community (Breden 1989) B
Dune grass community (Nelson and Fink 1980) =
Dunegrass (Martin 1959b) ?

SOURCES

Description Authors: S. L. Neid.
References: Breden 1989, Breden et al. 2001, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Gawler 2001, Gawler 2002, Johnson 1981b, Johnson 1985b, Martin 1959b, Metzler and Barrett 2001, Moul 1969, NRCS 2001b, Nelson and Fink 1980, Rawinski 1984, Reschke 1990, Sperduto 1997a, Swain and Kearsley 2001, Zaremba and Leatherman 1984.

Figure E5. Northern Beachgrass Dune in Sagamore Hill National Historic Site (Accuracy Assessment Reference Point ref5, photo no. 1436). 10/18/2006. NAD 1983 / UTM easting 627208, northing 4527201.

COMMON NAME (PARK-SPECIFIC): OVERWASH DUNE GRASSLAND

SYNONYMS

USNVC English Name: **Saltmeadow Cordgrass - Common Threesquare - Seaside Goldenrod Herbaceous Vegetation**

USNVC Scientific Name: ***Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation**

USNVC Identifier: **CEGL004097**

LOCAL INFORMATION

Environmental Description: Overwash Dune Grassland is characterized by vegetation that colonizes water-deposited sand caused by storm surges. It occurs in a mosaic with Northern Beachgrass Dune (CEGL006274), North Atlantic High Salt Marsh (CEGL006006), North Atlantic Low Salt Marsh (CEGL004192), and North Atlantic Upper Ocean Beach (CEGL004400). Substrate is well-drained fine to coarse sand with little to no soil profile development derived from marine overwash deposits.

Vegetation Description: This upland association is dominated by *Limonium carolinianum* (Carolina sealavender), a species more typically found in North Atlantic High Salt Marsh, that appears to be a primary colonizer of the overwash deposits in the park. Vegetative cover can vary widely from absent (bare, recently deposited sand) to moderately dense in patches (nearly 70% cover). *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), and *Chenopodium album* (lambsquarters) are common associated species, and *Solidago sempervirens* (seaside goldenrod) is also present at low frequency and abundance.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Limonium carolinianum* (Carolina sealavender)
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass), *Spartina patens* (saltmeadow cordgrass)

Characteristic Species: *Distichlis spicata* (inland saltgrass), *Limonium carolinianum* (Carolina sealavender), *Spartina patens* (saltmeadow cordgrass).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NY	S3*	B	1	Maritime dunes	Edinger et al. 2002

Local Range: Located in the far eastern portion of the park in the maritime complex adjacent to Cold Spring Harbor. The association occurs in a mosaic with Northern Beachgrass Dune (CEGL006274), North Atlantic High Salt Marsh (CEGL006006), North Atlantic Low Salt Marsh (CEGL004192), and North Atlantic Upper Ocean Beach (CEGL004400).

Classification Comments: North Atlantic High Salt Marsh (CEGL006006), although characterized by similar species, is notably dominated by the graminoids *Spartina patens* (saltmeadow cordgrass) and *Distichlis spicata* (inland saltgrass), which form a dense, cowlicked meadow underlain by thick peaty soil. Overwash Dune Grassland (CEGL004097), while densely vegetated in parts, is significantly more patchy and occurs in a drier upland setting.

Other Comments: None.

Local Description Authors: G. J. Edinger and A. L. Feldmann.

Plots: ref6.

Sagamore Hill National Historic Site Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Short sod temperate or subpolar grassland (V.A.5.N.e.)
Alliance	*Spartina patens - (Schoenoplectus pungens)* Herbaceous Alliance (A.1274)
Alliance (English name)	Saltmeadow Cordgrass - (Common Threesquare) Herbaceous Alliance
Association	*Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation
Association (English name)	Saltmeadow Cordgrass - Common Threesquare - Seaside Goldenrod Herbaceous Vegetation
Ecological System(s):	Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273). Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892). Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264).

GLOBAL DESCRIPTION

Concept Summary: This community is an upland dune grassland or overwash area of Atlantic barrier islands on embryo dunes or back sides of beaches forming from overwash terraces ranging from Massachusetts to North Carolina. It forms a drier, later successional phase beginning from water-deposited sand of storm overwash. Sand movement, plant burial, and dune formation rates are not so high as to form *Ammophila breviligulata* (American beachgrass)-dominated primary dunes, but can be found as a fringe around the outer edge of those dunes. *Spartina patens* (saltmeadow cordgrass) is dominant, ranging from quite sparse (25% cover) to dense, and can be monotypic in early-successional expressions. As the vegetation develops, common associated species can include *Schoenoplectus pungens* (common threesquare) or *Solidago sempervirens* (seaside goldenrod). Less common associates can include *Cyperus grayi* (Gray's flatsedge), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Festuca rubra* (red fescue), *Schizachyrium littorale* (shore little bluestem), *Pseudognaphalium obtusifolium* (rabbittobacco), and occasional scattered individuals of *Toxicodendron radicans* (eastern poison ivy) and seedlings of *Baccharis halimifolia* (eastern baccharis). Bare sand is often visible through the vegetation, and there is no soil profile development. *Ammophila breviligulata* (American beachgrass) or *Uniola paniculata* (seaoats) may invade from the surrounding dunes. This community appears to be a successional step between interdunal herbaceous wetlands and interdunal herbaceous/shrub uplands.

Environmental Description: This community is an upland dune grassland or overwash area of Atlantic barrier islands on embryo dunes or back sides of beaches forming from overwash terraces. The plants of this community are influenced by water-deposited sand caused by storm surges. They differ ecologically from dune grasslands dominated by *Ammophila breviligulata* (American beachgrass) or *Uniola paniculata* (seaoats), which are primarily impacted by wind-deposited sand. Storm overwash is a prevalent natural disturbance to this community.

Vegetation Description: *Spartina patens* (saltmeadow cordgrass) is dominant, ranging from quite sparse (25% cover) to dense, and can be monotypic in early successional expressions. As the vegetation develops, common associated species can include *Schoenoplectus pungens* (common threesquare) or *Solidago sempervirens* (seaside goldenrod). Less common associates can include *Cyperus grayi* (Gray's flatsedge), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Festuca rubra* (red fescue), *Schizachyrium littorale* (shore little

bluestem), *Pseudognaphalium obtusifolium* (rabbittobacco), and occasional scattered individuals of *Toxicodendron radicans* (eastern poison ivy) and seedlings of *Baccharis halimifolia* (eastern baccharis). *Ammophila breviligulata* (American beachgrass) or *Uniola paniculata* (seaoats) may invade from the surrounding dunes. This community is characterized by upland maritime dune grassland vegetation. *Spartina patens* (saltmeadow cordgrass), and sometimes *Schoenoplectus pungens* (common threesquare), or both are dominant on dunes or overwash terraces. Total vegetation cover is variable, ranging from quite sparse (25% cover) to dense. Bare sand is often visible through the vegetation, and there is no soil profile development. Species diversity is variable; although it may be quite low and confined to the nominate species in the northern part of the range, it may be of greater diversity, including *Strophostyles helvula* (trailing fuzzybean), *Solidago sempervirens* (seaside goldenrod), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Distichlis spicata* (inland saltgrass), *Sabatia stellaris* (rose of Plymouth), *Ammophila breviligulata* (American beachgrass), *Suaeda linearis* (annual seepweed), *Bassia hirsuta* (hairy smotherweed), *Atriplex patula* (spear saltbush), *Fimbristylis castanea* (marsh fimbry), and *Cakile edentula* ssp. *edentula* (American searocket).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Solidago sempervirens* (seaside goldenrod)
Herb (field)	Graminoid	*Schoenoplectus pungens* (common threesquare), *Spartina patens* (saltmeadow cordgrass)

Characteristic Species: *Schoenoplectus pungens* (common threesquare), *Solidago sempervirens* (seaside goldenrod), *Spartina patens* (saltmeadow cordgrass).
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This community is an upland dune grassland or overwash area of Atlantic barrier islands from Massachusetts to North Carolina.
States/Provinces: DE:S2S3, MA, MD, NC, NJ, NY, VA.
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Fire Island, Gateway, Sagamore Hill); USFWS (Back Bay?, Prime Hook).

CONSERVATION STATUS

Rank: G2G3 (4-Nov-1998).
Reasons: This dune grassland community is restricted to overwash areas of major maritime dune systems. It is typically small in extent, not usually more than a few acres in size. It is best developed on barrier islands of Delaware, Maryland, Virginia, and North Carolina; it extends sporadically farther north to Massachusetts. As part of a dynamic system, the community is in a sense ephemeral, being buried over time by sand deposition, and being formed anew in other areas subjected to overwash. Because of the dynamic forces structuring the community, it requires sufficient area in large dune systems to accommodate this shifting mosaic. Although not extremely rare (an estimated 100–200 occurrence exist rangewide), the community is restricted to a specialized habitat and is threatened by a number of activities, including dune stabilization, and outright destruction of habitat through human activities.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 - Moderate.

Comments: This community differs ecologically from dune grasslands dominated by *Ammophila breviligulata* (American beachgrass) or *Uniola paniculata* (seaoats), which are primarily impacted by wind-deposited sand. This community is impacted by wave-deposited sand. It is drier than brackish swales and vegetation that immediately colonizes water-borne sand from storm overwash, such as *Spartina patens - Eleocharis parvula* Herbaceous Vegetation (CEGL006342). *Spartina patens - Schizachyrium maritimum - Solidago sempervirens* Herbaceous Vegetation (CEGL008445) is a southern analog of this association that occurs along the Gulf Coast.

Similar Associations:

Spartina patens - Eleocharis parvula Herbaceous Vegetation (CEGL006342).

Spartina patens - Schizachyrium maritimum - Solidago sempervirens Herbaceous Vegetation (CEGL008445).

Related Concepts:

Dry community of barrier flats (Travis and Godfrey 1976) B
Dry maritime grassland (Lea 2002b) ?
Dunegrass community (Higgins et al. 1971) B
Grassland community (Baumann 1978b) =
Low dune community (Boule 1979) =
Maritime Dry Grassland (Typic Subtype) (Schafale 2000) ?
Secondary dunes (Klotz 1986) B
Wash (Hill 1986) =
Wash (Higgins et al. 1971) =

SOURCES

Description Authors: L. A. Sneddon.

References: Baumann 1978b, Berdine 1998, Boule 1979, Bowman 2000, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming et al. 2001, Harrison 2004, Harrison and Stango 2003, Higgins et al. 1971, Hill 1986, Klotz 1986, Lea 2002b, NRCS 2001b, Reschke 1990, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, TNC 1995c, Travis and Godfrey 1976, Zaremba and Leatherman 1984.

Figure E6. Overwash Dune Grassland in Sagamore Hill National Historic Site (Accuracy Assessment Reference Point ref6, photo no. 1441). 10/18/2006. NAD 1983 / UTM easting 627195, northing 4527168.

COMMON NAME (PARK-SPECIFIC): NORTH ATLANTIC LOW SALT MARSH

SYNONYMS

USNVC English Name:	**Saltmarsh Cordgrass / (Yellow Tang) Acadian/Virginian Zone Herbaceous Vegetation**
USNVC Scientific Name:	***Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation**
USNVC Identifier:	**CEGL004192**

LOCAL INFORMATION

Environmental Description: This low salt marsh occurs in the regularly flooded intertidal zone, approximately from mean high tide to mean sea level; it is diurnally flooded by tides and is classified as polyhaline (18–30 ppt). It fringes the saltwater tidal creeks in the maritime complex; landward and to the east it is bordered by North Atlantic High Salt Marsh (CEGL006006) and Overwash Dune Grassland (CEGL004097). Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075) is adjacent to the low salt marsh on the uplands to the west. The substrate consists of sandy loam overlain by very deep, very poorly drained mucky peat soils in the Pawcatuck series that formed in partially decomposed organic deposits derived from salt-tolerant herbaceous plants (Soil Conservation Service 1987).

Vegetation Description: This association is characterized and dominated by tall *Spartina alterniflora* (smooth cordgrass), which forms a nearly monotypic stand.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Spartina alterniflora* (smooth cordgrass)

Characteristic Species: *Spartina alterniflora* (smooth cordgrass).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NY	S3S4	=	1	Low salt marsh	Edinger et al. 2002

Local Range: This community is located in the far eastern portion of the park in the maritime complex adjacent to Cold Spring Harbor.

Classification Comments: Information not available.

Other Comments: None.

Local Description Authors: G. J. Edinger and A. L. Feldmann.

Plots: 6, 7XX, 10.

Sagamore Hill National Historic Site Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	*Spartina alterniflora* Tidal Herbaceous Alliance (A.1471)
Alliance (English name)	Saltmarsh Cordgrass Tidal Herbaceous Alliance
Association	*Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation

Association (English name)	Saltmarsh Cordgrass / (Yellow Tang) Acadian/Virginian Zone Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260). Acadian Coastal Salt Marsh (CES201.578). Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519).

GLOBAL DESCRIPTION

Concept Summary: This tall grassland dominated by *Spartina alterniflora* (smooth cordgrass) forms the low salt marsh of the north and mid-Atlantic coast. It is diurnally flooded by tides, occurring in the intertidal zone between mean high tide and mean sea level in protected inlets behind barrier beaches or in the seaward reaches of drowned river valleys. It forms a coarse peat over sandy substrate. The low salt marsh occurs elevationally between high marsh that occurs landward and subtidal communities that occur seaward. *Spartina alterniflora* (smooth cordgrass) is limited to the low marsh zone by interspecific competition and by moderate salinity; it can withstand longer submergence than other salt marsh grasses but still requires periodic exposure of the substrate. *Spartina alterniflora* (smooth cordgrass) forms nearly monotypic stands with little variation across the geographic range of the community. Tall form *Spartina alterniflora* (smooth cordgrass) occurs adjacent to salt water and colonizes unvegetated flats. This association also grades into short form *Spartina alterniflora* (smooth cordgrass) landward. Associated species occur in low abundance and commonly include *Limonium carolinianum* (Carolina sealavender), *Salicornia virginica* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Spergularia maritima* (media sandspurry), *Spergularia canadensis* (Canadian sandspurry), and *Suaeda maritima* (herbaceous seepweed). Brown algae can form extensive mats at the bases of the grass culms, especially *Ascophyllum nodosum*, *Fucus vesiculosus*, *Enteromorpha* spp., and *Ulva* (sea-lettuce) spp. Macroalgae associates may be sparse or absent at the southern edge of the range. This community occurs from Nova Scotia to Cape Hatteras, North Carolina. Low marshes at the northern edge of the geographic range are far less extensive in size than those farther south due to differences in geomorphology and time since last glaciation.

Environmental Description: This low salt marsh community occurs in the regularly flooded intertidal zone, approximately from mean high tide to mean sea level; it is diurnally flooded by tides and classified as polyhaline (18–30 ppt). This low marsh occurs in areas sheltered from direct wave action, such as behind barrier beaches, as pocket marshes at the heads of bays, or in the outer reaches of estuaries. Low salt marshes occur landward of intertidal flats and subtidal communities and seaward of high salt marsh communities. Low salt marshes dominated by *Spartina alterniflora* (smooth cordgrass) generally occur on mucky silt to silty coarse fibrous peat, often with high organic matter content. However, peat in the low marsh is generally less dense than farther landward (Bertness 1988). Peat depth ranges from a few feet, if the community formed over a mudflat, to 80 feet in drowned river valleys at the mouths of estuaries.

Vegetation Description: This community is a tall grassland dominated by *Spartina alterniflora* (smooth cordgrass) occurring in regularly flooded intertidal zones. *Spartina alterniflora* (smooth cordgrass) dominates this physically stressful zone due to limited competition and its ability to tolerate salinity and flooding. It also requires moderately high levels of iron (7–15 ppm) (Adams 1963). *Spartina alterniflora* (smooth cordgrass) is strongly dominant, forming a nearly monotypic tallgrass layer. There is little variation in vascular plant composition across the range. Tall-form *Spartina alterniflora* (smooth cordgrass) occurs adjacent to saltwater and colonizes unvegetated flats. This association also grades into short-form *Spartina alterniflora* (smooth

cordgrass) landward where tidal range is more restricted. Common associates, occurring in low abundance, include *Limonium carolinianum* (Carolina sealavender), *Salicornia virginica* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Spergularia maritima* (media sandspurry), *Spergularia canadensis* (Canadian sandspurry), and *Suaeda maritima* (herbaceous seepweed). *Distichlis spicata* (inland saltgrass), *Agalinis maritima* (saltmarsh false foxglove), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), and *Spartina patens* (saltmeadow cordgrass) can also sporadically occur, but are more common in the high salt marsh. Brown algae can form extensive mats at the bases of the grass culms, especially *Ascophyllum nodosum*, *Fucus vesiculosus*, and *Ulva* (sea-lettuce) spp. *Enteromorpha* spp. can occur early in the growing season. Macroalgae associates may be sparse or absent at the southern edge of the range. Microscopic algae, especially diatoms, can be abundant on the marsh surface (Teal 1986).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Spartina alterniflora* (smooth cordgrass)

Characteristic Species: *Spartina alterniflora* (smooth cordgrass).
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine.

DISTRIBUTION

Range: This association occurs along the Atlantic coastline from Nova Scotia and New Brunswick south to Cape Hatteras, North Carolina.
States/Provinces: CT, DE:S5, MA, MD:S5, ME, NB, NC, NH, NJ:S5, NS, NY:S3S4, RI, VA.
Federal Lands: NPS (Acadia, Assateague Island, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Muskeget Island, Sagamore Hill); USFWS (Back Bay?, Chesapeake Marshlands, Monomoy, Moosehorn?, Parker River, Prime Hook).

CONSERVATION STATUS

Rank: G5 (1-Dec-1997).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 1 - Strong.
Comments: The northern limit of this type occurs where there is a slower accumulation of silt and corresponding absence of algal species (Chapman 1937). The southern limit corresponds with the southern limit of the Virginian province of the American Atlantic Temperate Region, a transitional area harboring animal species of both southern and northern affinities (Gosner 1979, Cowardin 1979). Southern occurrences, where *Ascophyllum nodosum* (yellow tang) may be sparse or absent, are placed within this type because of the associated characteristic faunal assemblage, including *Uca pugnax* (Atlantic marsh fiddler), *Littorina saxatilis* (rough periwinkle), *Littorina obtusata* (smooth periwinkle), and *Brachidontes demissus* (ribbed mussel). Analogous low salt marsh associations in other geographic areas include *Spartina alterniflora* (smooth cordgrass) Carolinian Zone Herbaceous Vegetation (CEGL004191) and *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190) for the Atlantic Coast of the southeastern U.S. (Cape Hatteras, North Carolina, to Florida) and the Gulf Coast (Florida to Texas), respectively [see Cowardin (1979) for regional boundaries]. *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation

(CEGL004193) is a *Spartina alterniflora* (smooth cordgrass)-dominated association occurring in the mid-tidal range of tidal rivers that have a minimum tidal range of one meter.

Similar Associations:

Spartina alterniflora - *Juncus roemerianus* - *Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190)

Spartina alterniflora - *Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193)

Spartina alterniflora Carolinian Zone Herbaceous Vegetation (CEGL004191)

Related Concepts:

Spartina alterniflora Tidal Herbaceous Vegetation (Harrison 2001) =

Spartina alterniflora community (Metzler and Barrett 1992) ?

Spartina alterniflora salt marsh (Clancy 1993b) ?

Cordgrass saltmarsh community (MENHP 1991) ?

Low salt marsh (Reschke 1990) ?

Low salt marsh (Enser 1993) ?

Low salt marsh community (Sperduto 1994) ?

Salt Marsh (Rawinski 1984) ?

Salt Marsh (Virginian Subtype) (Schafale 2000) ?

Salt marsh (Higgins et al. 1971) B

Salt marsh community (Hill 1986) B

Salt marsh complex, low marsh (Breden 1989) ?

SOURCES

Description Authors: S. L. Neid

References: Adams 1963, Bell et al. 2002, Bertness 1988, Bowman 2000, Breden 1989, Breden et al. 2001, Chapman 1937, Clancy 1993b, Clancy 1996, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1993, Enser 1999, Fleming et al. 2001, Gawler 2001, Gawler 2002, Gosner 1979, Harrison 2001, Harrison 2004, Higgins et al. 1971, Hill 1986, MENHP 1991, Metzler and Barrett 1992, Metzler and Barrett 2001, Moul 1973, NRCS 2001b, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Soil Conservation Service 1987, Sperduto 1994, Sperduto 2000a, Sperduto 2000b, Stalter 1979, Swain and Kearsley 2001, Teal 1986.

Figure E7. North Atlantic Low Salt Marsh in Sagamore Hill National Historic Site (Accuracy Assessment Point 7XX, photo no. 1431). 10/18/2006. NAD 1983 / UTM easting 627106, northing 4527148.

COMMON NAME (PARK-SPECIFIC): NORTH ATLANTIC HIGH SALT MARSH

SYNONYMS

USNVC English Name: **Saltmeadow Cordgrass - Saltgrass - (Black-grass) Herbaceous Vegetation**

USNVC Scientific Name: ***Spartina patens - Distichlis spicata - (Juncus gerardii)* Herbaceous Vegetation**

USNVC Identifier: **CEGL006006**

LOCAL INFORMATION

Environmental Description: This community is found in a in a mosaic with North Atlantic Low Salt Marsh (CEGL004192), Overwash Dune Grassland (CEGL004097), and Northern Beachgrass Dune (CEGL006274) in the maritime complex in the eastern portion of the park. It occupies the irregularly flooded zone extending from mean high tide landward to the limit of spring tides. It is primarily underlain by tidally flooded Pawcatuck mucky peat, which consists of sandy loam overlain by very deep, very poorly drained mucky peat that formed in partially decomposed organic deposits derived from salt-tolerant herbaceous plants. The community has also developed on eolian and marine-derived sandy sediments (Soil Conservation Service 1987).

Vegetation Description: This association is characterized by codominance of *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), and *Limonium carolinianum* (Carolina sealavender), which form moderately dense (>70% cover), linear features at the upper edge of North Atlantic Low Salt Marsh. *Solidago sempervirens* (seaside goldenrod), *Chenopodium album* (lambsquarters), and *Suaeda* (seepweed) spp. are common associates that occur in low abundance. Woody species are generally absent, with the exception of *Iva frutescens* (Jesuit's bark) and *Baccharis halimifolia* (eastern baccharis), which can be present in low abundance, typically at the community's edge.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Iva frutescens* (Jesuit's bark)
Herb (field)	Forb	*Limonium carolinianum* (Carolina sealavender)
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass), *Spartina patens* (saltmeadow cordgrass)

Characteristic Species: *Distichlis spicata* (inland saltgrass), *Solidago sempervirens* (seaside goldenrod), *Spartina patens* (saltmeadow cordgrass).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NY	S3S4	=	1	High salt marsh	Edinger et al. 2002

Local Range: This community is found in a complex with North Atlantic Low Salt Marsh (CEGL004192), Overwash Dune Grassland (CEGL004097), and Northern Beachgrass Dune (CEGL006274) in the maritime complex in the eastern portion of the park adjacent to Cold Spring Harbor.

Classification Comments: This association is characterized by moderately dense patches dominated by the graminoid species *Spartina patens* (saltmeadow cordgrass) and/or *Distichlis spicata* (inland saltgrass).

Other Comments: None.

Local Description Authors: G. J. Edinger and A. L. Feldmann.

Plots: 14b, 4, 12YY.
Sagamore Hill National Historic Site Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	*Spartina patens - (Distichlis spicata)* Tidal Herbaceous Alliance (A.1481)
Alliance (English name)	Saltmeadow Cordgrass - (Saltgrass) Tidal Herbaceous Alliance
Association	*Spartina patens - Distichlis spicata - (Juncus gerardii)* Herbaceous Vegetation
Association (English name)	Saltmeadow Cordgrass - Saltgrass - (Black-grass) Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892). Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519). Acadian Coastal Salt Marsh (CES201.578).

GLOBAL DESCRIPTION

Concept Summary: This high salt marsh vegetation dominated by *Spartina patens* (saltmeadow cordgrass) or codominated by *Distichlis spicata* (inland saltgrass) forms distinct "cowlicked" meadows above low salt marsh communities. This high marsh association generally occurs behind barrier beaches along the north Atlantic coast from the Canadian maritime provinces south to New Jersey. It occupies the irregularly flooded zone extending from mean high tide landward to the limit of spring tides. The substrate is peat overlying sand, silt, or bedrock. Vegetation of this marsh community occurs in mosaics of patches generally dominated by a single graminoid species, *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), or *Juncus gerardii* (saltmeadow rush). Other characteristic associates that occur in low abundance include *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Limonium carolinianum* (Carolina sealavender), *Solidago sempervirens* (seaside goldenrod), *Symphyotrichum subulatum* (eastern annual saltmarsh aster), *Polygonum ramosissimum* (bushy knotweed), *Argentina anserina* (silverweed cinquefoil), *Atriplex patula* (spear saltbush), *Lythrum lineare* (wand lythrum), and *Panicum virgatum* (switchgrass). Salt pannes are often a prominent feature within this association.
Environmental Description: This high salt marsh association generally occurs behind barrier beaches, but also in the outer reaches of estuaries, occupying the zone extending from mean high tide landward approximately to the limit of spring tides. They are often adjacent to low salt marshes dominated by *Spartina alterniflora* (smooth cordgrass) (tall form), which are regularly flooded by diurnal tides. *Spartina patens* (saltmeadow cordgrass)-dominated high marshes form very dense peat with high organic matter content. Peat forms over sand, silt or bedrock.
Vegetation Description: Vegetation of this marsh community occurs in mosaics of patches generally dominated by a single graminoid species, *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), or *Juncus gerardii* (saltmeadow rush). Other characteristic associates that occur in low abundance include *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Limonium carolinianum* (Carolina sealavender), *Solidago sempervirens* (seaside goldenrod), *Symphyotrichum subulatum* (eastern annual saltmarsh aster), *Polygonum ramosissimum* (bushy knotweed), *Argentina anserina* (silverweed cinquefoil), *Atriplex patula* (spear saltbush), *Lythrum lineare* (wand lythrum), and *Panicum virgatum* (switchgrass).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass), *Juncus gerardii* (saltmeadow rush), *Spartina patens* (saltmeadow cordgrass)

Characteristic Species: *Distichlis spicata* (inland saltgrass), *Juncus gerardii* (saltmeadow rush), *Spartina patens* (saltmeadow cordgrass).
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine.

DISTRIBUTION
Range: This high salt marsh association occurs from the Canadian maritime provinces south to Delaware.
States/Provinces: CT, DE, MA, MD, ME, NH, NJ:S5, NY:S3S4, RI.
Federal Lands: NPS (Acadia, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Muskeget Island?, Sagamore Hill); USFWS (Moosehorn, Parker River?, Prime Hook).

CONSERVATION STATUS
Rank: G5 (1-Dec-1997).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 - Moderate.
Comments: This community is differentiated from *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197) to the south by the importance of *Juncus gerardii* (saltmeadow rush), *Plantago maritima* (goose tongue), and *Triglochin maritima* (seaside arrowgrass) and absence or relatively infrequent occurrence of species of southern distribution such as *Borrichia frutescens* (bushy seaside tansy), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Fimbristylis castanea* (marsh fimbry), and *Lythrum lineare* (wand lythrum).
Similar Associations:
Spartina patens - Agrostis stolonifera Herbaceous Vegetation (CEGL006365).
Spartina patens - Distichlis spicata - (Juncus roemerianus) Herbaceous Vegetation (CEGL004197).
Related Concepts:
Spartina patens - Distichlis spicata Herbaceous Vegetation (Harrison 2001) I
Salt Marsh (Rawinski 1984) ?
Salt marsh complex, high marsh (Breden 1989) ?

SOURCES
Description Authors: S. L. Neid.
References: Bell et al. 2002, Bertness et al. 1992, Breden 1989, Breden et al. 2001, Coulling pers. comm., Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001, Gawler 2001, Gawler 2002, Harrison 2001, Hill 1923, Metzler and Barrett 2001, Nixon 1982, Rawinski 1984, Reschke 1990, Soil Conservation Service 1987, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001.

Figure E8. North Atlantic High Salt Marsh in Sagamore Hill National Historic Site (Accuracy Assessment Point 12YY, photo no. 1432). 10/18/2006. NAD 1983 / UTM easting 627143, northing 4527189.

COMMON NAME (PARK-SPECIFIC): NORTH ATLANTIC UPPER OCEAN BEACH

SYNONYMS

USNVC English Name: **Sea-rocket - Northern Seaside Spurge Sparse Vegetation**

USNVC Scientific Name: ***Cakile edentula* ssp. *edentula* - *Chamaesyce polygonifolia* Sparse Vegetation**

USNVC Identifier: **CEGL004400**

LOCAL INFORMATION

Environmental Description: This association occurs on unstable sand and gravel just above mean high tide on the beach and foredunes at Sagamore Hill. It is washed over by spring and storm tides and impacted by wind erosion. Seaward, it is bounded by marine intertidal gravel/sand bar and landward, it is adjacent to Northern Beachgrass Dune (CEGL006274).

Vegetation Description: This maritime beach association is sparsely vegetated and characterized by *Cakile edentula* (American searocket), *Salsola kali* (Russian thistle), and *Atriplex patula* (spear saltbush).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Atriplex patula* (spear saltbush), *Cakile edentula* (American searocket), *Salsola kali* (Russian thistle)

Characteristic Species: *Atriplex patula* (spear saltbush), *Cakile edentula* (American searocket), *Salsola kali* (Russian thistle).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NY	S5	=	1	Maritime Beach	Edinger et al. 2002

Local Range: This association is found on the beach in the far eastern portion of the park adjacent to Cold Spring Harbor.

Classification Comments: None.

Other Comments: None.

Local Description Authors: G. J. Edinger and A. L. Feldmann.

Plots: 16b, 2XX, ref3, ref4.

Sagamore Hill National Historic Site Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Unconsolidated material sparse vegetation (VII.C.)
Physiognomic Group	Sparsely vegetated sand flats (VII.C.2.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated sand flats (VII.C.2.N.)
Formation	Sand flats (VII.C.2.N.a.)
Alliance	*Cakile edentula* Sparsely Vegetated Alliance (A.1861)
Alliance (English name)	Sea-rocket Sparsely Vegetated Alliance
Association	*Cakile edentula* ssp. *edentula* - *Chamaesyce polygonifolia* Sparse Vegetation
Association (English name)	Sea-rocket - Northern Seaside Spurge Sparse Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Sandy Beach (CES203.301). Central Atlantic Coastal Plain Sandy Beach (CES203.064).

GLOBAL DESCRIPTION

Concept Summary: This is a sparsely vegetated upper beach community occurring on unstable sands and often gravels and cobbles just above mean high tide on maritime beaches and foredunes along the middle and northern Atlantic coast. This association occurs at the wrack line; there is regular deposition of wave-deposited flotsam. They are irregularly flooded by spring or storm tides. Vegetation cover is variable, depending on the amount of exposure to wave and wind action, but is generally sparse and characterized by annuals and biennials. Species composition can change dramatically from year to year but frequently includes *Cakile edentula* ssp. *edentula* (American searocket), as well as *Salsola kali* ssp. *kali* (Russian thistle), *Chamaesyce polygonifolia* (seaside sandmat), *Honckenya peploides* (seaside sandplant), *Cenchrus tribuloides* (sanddune sandbur), *Amaranthus retroflexus* (redroot amaranth), *Chenopodium album* (lambsquarters), *Erechtites hieraciifolia* (American burnweed), *Xanthium strumarium* (rough cockleburr), and *Atriplex cristata* (crested saltbush). Globally rare species such as *Polygonum glaucum* (seaside knotweed) and *Amaranthus pumilus* (seaside amaranth) occur in this habitat. Sparse *Ammophila breviligulata* (American beachgrass) can occur sporadically as a common associate, colonizing from the adjacent beachgrass community. Diagnostic species are *Cakile edentula* ssp. *edentula* (American searocket), *Salsola kali* ssp. *kali* (Russian thistle), *Atriplex cristata* (crested saltbush), and *Chamaesyce polygonifolia* (seaside sandmat). This community occurs in maritime coastal areas from southern Maine to Cape Hatteras, North Carolina.

Environmental Description: This association occurs on unstable sands and often gravels and cobbles just above mean high tide on beaches and foredunes washed over by spring and storm tides and impacted by wind erosion.

Vegetation Description: This is a sparsely vegetated association characterized by annuals and biennials. Species composition is variable, but frequently includes *Cakile edentula* ssp. *edentula* (American searocket), *Honckenya peploides* (seaside sandplant), *Salsola kali* (Russian thistle), *Atriplex patula* (spear saltbush), *Cenchrus tribuloides* (sanddune sandbur), *Chamaesyce polygonifolia* (seaside sandmat), *Atriplex cristata* (crested saltbush), *Xanthium strumarium* (rough cockleburr), and *Chenopodium* (goosefoot) spp. Globally rare species such as *Polygonum glaucum* (seaside knotweed) and *Amaranthus pumilus* (seaside amaranth) occur in this habitat. *Ammophila breviligulata* (American beachgrass) can occur sporadically, colonizing from the adjacent beachgrass community. Additional infrequent species can include *Chenopodium rubrum* (red goosefoot), *Chenopodium album* (lambsquarters), *Chenopodium berlandieri var. macrocalycium* (pitseed goosefoot), *Cyperus filicinus* (fern flatsedge), *Triplasis purpurea* (purple sandgrass), and *Sesuvium maritimum* (slender seapurslane). Bare substrate can comprise greater than 95% cover in this association.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Atriplex cristata* (crested saltbush),
		Cakile edentula ssp. *edentula* (American searocket),
		Chamaesyce polygonifolia (seaside sandmat),
		Salsola kali ssp. *kali* (Russian thistle)

Characteristic Species: *Atriplex cristata* (crested saltbush), *Cakile edentula* ssp. *edentula* (American searocket), *Chamaesyce polygonifolia* (seaside sandmat), *Salsola kali* ssp. *kali* (Russian thistle).

Other Noteworthy Species:

Species	GRank	Type	Note
Amaranthus pumilus (seaside amaranth)	G2	plant	
Polygonum glaucum (seaside knotweed)	G3	plant	

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association ranges from southern Maine to North Carolina.
States/Provinces: CT, DE, MA:S3, MD, ME, NC, NH, NJ:S1S2, NY:S5, RI, VA.
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Muskeget Island, Sagamore Hill); USFWS (Back Bay, Chesapeake Marshlands, Monomoy, Parker River).

CONSERVATION STATUS

Rank: G4G5 (1-Dec-1997).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 - Moderate.
Comments: This community is common on maritime dunes of the Northeast but is vulnerable to development and shifting wave action due to jetties. J. Harrison (pers. comm. 2006): "In the Chesapeake Marshlands, in Maryland, a small patch of this vegetation was observed on South Marsh Island [see Observation Point CM-15]. Please note many of the associated "maritime" species are not present in the refuge. Although not as well-developed in estuarine environments, consider expanding concept to include narrow sandy shorelines on bay islands."
Similar Associations:
Cakile edentula Great Lakes Shore Sparse Vegetation (CEGL005162).
Cakile edentula ssp. *edentula* - *Mertensia maritima* Sparse Vegetation (CEGL006106).
Cakile edentula ssp. *harperi* Sparse Vegetation (CEGL004401).
Related Concepts:
Cakile edentula - *Chenopodium album* community (Metzler and Barrett 1992) =
Cakile edentula ssp. *edentula* - *Salsola caroliniana* Sparse Vegetation (Bartgis 1986) =
Cakiletum edentula (Conard 1935) =
Beach (Fender 1937) =
Beach (McDonnell 1979) =
Beach (Higgins et al. 1971) =
Beach community (Johnson 1985b) ?
Beach community (Hill 1986) =
Beach community (Baumann 1978b) =
Beach strand community (MENHP 1991) =
Beach vegetation (Moul 1973) =
Coastal beach strand (Sperduto 1994) =
Coastal beach strand community (Rawinski 1984) ?
Dune and swale community (Stalter 1990) B
Dune community (Jenkins 1974) =
Dune-strand area (Clovis 1968) =
Embryo dune (Klotz 1986) =
Marine intertidal gravel/sand beach community (Breden 1989) =

Marine sandy beach (Clancy 1993b) =
Maritime beach (Reschke 1990) =
Middle beach (Nichols 1920) =
Middle beach (Shreve et al. 1910) =
Pioneer beach community (Boule 1979) =
Sea-strand vegetation, beach formation (Harshberger 1900) =

SOURCES

Description Authors: S. L. Neid.

References: Bartgis 1986, Baumann 1978b, Berdine 1998, Boule 1979, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993b, Clovis 1968, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fender 1937, Fleming et al. 2001, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Harrison 2004, Harshberger 1900, Higgins et al. 1971, Hill 1986, J. Harrison pers. comm., Jenkins 1974, Johnson 1985b, Klotz 1986, MENHP 1991, McDonnell 1979, Metzler and Barrett 1992, Metzler and Barrett 2001, Moul 1973, Nichols 1920, Rawinski 1984, Reschke 1990, Schafale and Weakley 1990, Shreve et al. 1910, Sperduto 1994, Sperduto 2000a, Sperduto 2000b, Stalter 1990, Swain and Kearsley 2001.

Figure E9. North Atlantic Upper Ocean Beach in Sagamore Hill National Historic Site (Accuracy Assessment Point 2XX, photo no. 1435). 10/18/2006. NAD 1983 / UTM easting 627222, northing 4527211.

COMMON NAME (PARK-SPECIFIC): EASTERN WOODLAND VERNAL POOL

SYNONYMS

USNVC English Name:	**Eastern Woodland Vernal Pool Sparse Vegetation**
USNVC Scientific Name:	**Eastern Woodland Vernal Pool Sparse Vegetation [Provisional]**
USNVC Identifier:	**CEGL006453**

LOCAL INFORMATION

Environmental Description: This small-patch community is found at 6 m (20 ft) in elevation in the eastern portion of the park, embedded within Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075) on a step-in-slope down to the maritime complex. Soil is fine sandy loam in the Montauk series, which is very deep, well-drained , strongly acidic, and formed in loamy glacial till (Soil Conservation Service 1987). The pool is seasonally flooded and the soils likely remain saturated year-round.

Vegetation Description: This seasonally flooded vernal pool is embedded within Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075) and is partially shaded by its canopy species, including *Liriodendron tulipifera* (tuliptree), *Quercus velutina* (black oak), *Betula lenta* (sweet birch), *Acer rubrum* (red maple), and *Quercus rubra* (northern red oak). The shrubs *Ilex verticillata* (common winterberry) and *Rosa multiflora* (multiflora rose) surround the pool, which is dominated by *Bidens* (beggarticks) sp. Additional herbaceous species, present in lesser abundance, are *Boehmeria cylindrica* (smallspike false nettle), *Impatiens capensis* (jewelweed), *Ludwigia palustris* (marsh seedbox), and *Onoclea sensibilis* (sensitive fern). *Ampelopsis brevipedunculata* (Amur peppervine) is a common vine.

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Ilex verticillata* (common winterberry), *Rosa multiflora* (multiflora rose)

Characteristic Species: *Ilex verticillata* (common winterberry), *Rosa multiflora* (multiflora rose).

Other Noteworthy Species:

Species	GRank	Type	Note
Rosa multiflora (multiflora rose)	-	plant	invasive exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NY	SNR*	B	1	Vernal Pool	Edinger et al. 2002

Local Range: This small-patch community is found at 6 m (20 feet) in elevation in the eastern portion of the park, embedded within Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075) on a step-in-slope down to the maritime complex.

Classification Comments: None.

Other Comments: None.

Local Description Authors: G. J. Edinger and A. L. Feldmann.

Plots: None.

Sagamore Hill National Historic Site Inventory Notes: None.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Unconsolidated material sparse vegetation (VII.C.)
Physiognomic Group	Sparsely vegetated soil flats (VII.C.4.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated soil flats (VII.C.4.N.)
Formation	Seasonally / temporarily flooded mudflats (VII.C.4.N.c.)
Alliance	Non-tidal Mudflat Seasonally/Temporarily Flooded Sparsely Vegetated Alliance (A.1878)
Alliance (English name)	Non-tidal Mudflat Seasonally/Temporarily Flooded Sparsely Vegetated Alliance
Association	Eastern Woodland Vernal Pool Sparse Vegetation [Provisional]
Association (English name)	Eastern Woodland Vernal Pool Sparse Vegetation
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This association is characterized by seasonally fluctuating water levels; it may dry out completely in the summer. Hydrology may be affected by impermeable soils, seasonally high water tables, seasonal flooding in nearby streams and drainages, and/or impervious bedrock at or near the surface. The substrate is mineral soil with or without a layer of muck. The species composition is variable among sites, as well as annually and seasonally. Larger examples of this community type may exhibit strong zonation. Many smaller, shaded vernal ponds are unvegetated, their bottoms consisting of dead leaves and algae.

Environmental Description: This association is characterized by seasonally fluctuating water levels; it may dry out completely in the summer. Hydrology may be affected by impermeable soils, seasonally high water tables, seasonal flooding in nearby streams and drainages, and/or impervious bedrock at or near the surface. The substrate in most vernal pools is mineral soil with or without a layer of muck, but some are boulder-filled depressions. Boulder vernal pools may dry out completely in the summer, and their hydrology is controlled by impervious bedrock below the boulderfield.

Vegetation Description: The species composition is variable among sites, variable annually, and variable seasonally. Larger examples may exhibit strong zonation. Many smaller, shaded vernal ponds are unvegetated, their bottoms consisting of dead leaves and algae. Cover may be sparse and often varies through the season. Species composition is extremely variable, and of the species listed below, only a few are likely to be found on any one site. Typical representatives include *Dulichium arundinaceum* (threeway sedge), *Glyceria* (mannagrass) sp., *Leersia oryzoides* (rice cutgrass), *Scirpus cyperinus* (woolgrass), *Lycopus uniflorus* (northern bugleweed), *Polygonum* (knotweed) spp., *Thelypteris palustris* (eastern marsh fern), *Carex gynandra* (nodding sedge), *Carex crinita* (fringed sedge), *Carex leptonervia* (nerveless woodland sedge), *Carex stipata* (owlfruit sedge), *Carex canescens* (silvery sedge), *Carex vesicaria* (blister sedge), *Juncus effusus* (common rush), *Bidens* (beggarticks) spp., *Hypericum mutilum* (dwarf St. Johnswort), *Hypericum canadense* (lesser Canadian St. Johnswort), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern), *Agrostis scabra* (rough bentgrass), *Utricularia geminiscapa* (hiddenfruit bladderwort), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Sagittaria* (arrowhead) sp., and *Eleocharis* (spikerush) spp. Although this community type is predominantly herbaceous, shrubs and small trees may be present. Typical woody species include *Vaccinium corymbosum* (highbush blueberry), *Lyonia ligustrina* (maleberry), *Quercus palustris* (pin oak), *Nyssa sylvatica* (blackgum), *Acer rubrum* (red maple), *Salix* (willow) spp., *Cephalanthus occidentalis* (common buttonbush), and *Ilex verticillata* (common winterberry).

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ilex verticillata* (common winterberry), *Vaccinium corymbosum* (highbush blueberry)
Short shrub/sapling	Broad-leaved deciduous shrub	*Cephalanthus occidentalis* (common buttonbush)
Herb (field)	Forb	*Sagittaria latifolia* (broadleaf arrowhead)
Herb (field)	Graminoid	*Juncus effusus* (common rush), *Leersia oryzoides* (rice cutgrass)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

Characteristic Species: *Cephalanthus occidentalis* (common buttonbush), *Leersia oryzoides* (rice cutgrass), *Sagittaria latifolia* (broadleaf arrowhead), *Thelypteris palustris* (eastern marsh fern).

Other Noteworthy Species:

Species	GRank	Type	Note
Scirpus ancistrochaetus (barbedbristle bulrush)	G3	plant	

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association occurs in the northeastern U.S., and presumably in adjacent Canada, primarily in glaciated or periglacial areas, from Quebec and New Brunswick south through New York to northern Pennsylvania and northern New Jersey.

States/Provinces: CT, MA, ME, NH, NJ, NY, PA, RI, VT.

Federal Lands: NPS (Acadia, Delaware Water Gap, Sagamore Hill, Saratoga); USFWS (Erie, Great Swamp).

CONSERVATION STATUS

Rank: GNR (8-Feb-2006).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Provisional.

Confidence: 3 - Weak.

Comments: Recognition of vernal pool associations is complicated not only by the lack of good data but by the seasonal and spatial variability in composition. The largest factor, however, is that vernal pools are generally defined by their invertebrate and amphibian communities and often do not have characteristic suites of plant species. This type should be considered tentative pending more data.

Similar Associations: Information not available.

Related Concepts: Information not available.

SOURCES

Description Authors: S. C. Gawler.

References: Colburn 2004, Eastern Ecology Working Group n.d., Fike 1999, Soil Conservation Service 1987, Thompson and Sorenson 2000.

No photo available.

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