National Park Service
Fire Island National Seashore

INVASIVE PLANT INVENTORY AND CONTROL PROGRAM

2008 REPORT

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INTRODUCTION

Fire Island National Seashore (FIIS) was established as a unit of the National Park Service (NPS) on September 11, 1964, as authorized by United States Congress (Public Law 88-587) to protect and preserve the natural resources on the island for future generations. Fire Island is a barrier island that stretches east and west off the southern coast of Long Island, NY (Figure 1 and 2). It is 55 kilometers (32 miles) in length from Democrat Point on the west to Moriches Inlet on the east. FIIS occupies 21 miles of the island including four major National Seashore visitor-use areas. The remaining land is comprised of 17 private communities and incorporated villages predominately on the western end and a county park at its easternmost end. Bordered on the south by the Atlantic Ocean and on the north by the Great South Bay, the shape of Fire Island is directly a product of littoral drift, which has caused it to "migrate" westward about a mile every 25 to 30 years. Park land includes the federal Otis W. Pike High Dune Wilderness Area (OPWA), which is a seven-mile stretch located on the eastern half of the Seashore and is the only federally designated wilderness area in New York State. FIIS also manages the 613-acre William Floyd Estate (WFE), a valuable cultural site, which is located in Mastic Beach, NY on Long Island.

Over the past decades, general concern for preserving natural resources has greatly increased. The island's bay-marshes, forests, ocean dunes and wide beaches are home to diverse flora and fauna. The nesting area and activities of a few threatened and endangered shorebirds, which include, the piping plover (*Charadrius melodus*), least tern (*Sternula antillarum)*, and common tern (*Sterna hirundo*), are monitored and protected by the park. Nonetheless, one of the main issues recently being addressed is native habitat degradation caused by invasive species infestations, including exotic plants. Invasives pose myriad threats to otherwise intact endemic ecosystems. Moreover, controlling pervasive exotic species has proved to be problematic due to their ability to thrive and spread aggressively. Also, not having any local predators that can naturally control these species' populations, invasive plants simply out-compete natives. Consequently, they rapidly and seriously disrupt quality of wildlife habitat, reducing biodiversity, and at times displacing threatened or endangered species in some areas.

Invasive plants are introduced to areas in a wide variety of ways. Humans, both knowingly (e.g. ornamentals) and un-knowingly (e.g. transportation), are the main contributing factor. Some exotic plants are not as pervasive as others, so they may not spread as quickly or dominate large areas. However, they still affect natural resources of the area and compromise the native landscape aesthetics. Per our management policies, the National Park Service has an obligation to protect the delicate native biota from anthropogenic effects. All invasive species fall under this criteria.

In response, Fire Island National Seashore (FIIS) began to inventory and map invasive plant species in 2002, continued in the spring and summer of 2007 thanks to a funding opportunity. Utilizing these data collected during the spring and summer of 2007, the park initiated control and management of areas for invasive plants 2008 and continued inventory of other areas in and adjacent to park land. These efforts were the second year of the park's three-year effort. Work accomplished in 2002 by Kathy L. Schwager, now the Invasive Species Management Specialist for The Nature Conservancy of Long Island, served as a foundation and baseline for the program. This year, the extent of inventory and maps developed from spring and summer of 2007 has been increased and updated for land property of FIIS.

As it pertains to invasive plants, FIIS has some unique challenges. This logistics of the private communities and other parks on NPS land bring challenges in managing the importation of exotic, potentially invasive species. Eventually the Park will need to address this issue and develop a management and enforcement strategy. Also, the William Floyd Estate has an exceptional circumstance due to its historical significance. As guided by the Development Concept Plan and the Interpretive Prospectus, the integrity of the WFE's cultural landscape is to be stabilized to protect the historical and cultural resources (buildings, landscape, etc.). Under the NPS List of Classified Structures, the House and landscape are rated as a category 1A, which mandates that these properties must be preserved. Additionally, FIIS is charged with "conserving and preserving for the use of future generations certain relatively unspoiled and undeveloped beaches, dunes, and other natural features within Suffolk County, New York" (FIIS Enabling Legislation, 1964). Invasive plants at the WFE are currently negatively impacting both cultural and natural resources, largely by modifying the landscape and habitats, and displacing native plant species. Careful consideration is needed when developing

an Invasive Plant Management approach in order to meet both Park-wide and site-specific objectives.

However, developing a collaborative effort between the Park's Natural Resources Management and Cultural Resources staffs is imperative to the success of the program. Likewise, the Park will have to encourage community involvement and cooperation in managing invasive species.

METHODS

Control Areas

The survey team for 2008 carried out control initiatives based on data and temporal guidelines from the Fire Island National Seashore Invasive Plant Inventory and Control Program 2007 report. For the months of May and June, control was executed on areas inventoried the previous year at the William Floyd Estate and Otis Pike Wilderness Area. For the months of July and August inventory took place starting at the western edge of FIIS [Lighthouse] and continued eastward down the island to Watch Hill.

OPWA is the only designated Wilderness Area in the state of New York and one of only a few in the Northeastern U.S. This area is chiefly characterized by an extensive saltmarsh and reedgrass marsh network, which has been historically ditched for mosquito abatement that were maintained from the 1930's to about 1964. These mosquito ditches still have a strong presence in the marshes and are clearly visible in recently documented aerial photographs. This site is also vegetated by northern dune shrubland, northern beach grass dune, pitch pine dune woodland, maritime deciduous scrub forest, highbush blueberry shrub forest, beach heath dune, northern salt shrub vegetation; and on the bay side (north) there are features of reedgrass marsh, brackish meadow and low and high saltmarsh (Klopfer et al. 2002). The Wilderness Area is bordered on the east by Smith Point County Park and on the west by Watch Hill, a FIIS site with amenities to accommodate large numbers of Park staff and visitors. OPWA is bisected (nearly in half) by a very small seasonal village, Bellport Beach, consisting of only a few amenities including a dock and restroom.

The historic William Floyd Estate, though not located on the barrier island, is also managed by FIIS. The Estate consists of 613 acres and is located in Mastic Beach, NY on Long Island. It is dominated by coastal oak-heath forest and also characterized by cultivated pastures, pitch pine-oak forest, maritime deciduous scrub forest, acidic red maple basin swamp forest (red maple-tupelo dominant), northern sandplain and northern salt shrub vegetation; and to the south, reedgrass marsh and low and high saltmarsh are dominant features (Klopfer et al. 2002). There are also two or more inland, permanent freshwater pools. The Estate is surrounded by two fairly densely-populated communities – Mastic Beach and Shirley. Due to the over-growth of vegetation at the William Floyd Estate, only fields and main trails were selected for inventory, with the exception of a few forested areas that had under-story vegetation. On average, however, the perimeter of wooded areas were inventoried to about 5 meters in, before the brush became too thick to walk through.

Inventory Areas

Inventoried National Park Service land includes: the Fire Island Lighthouse, Sailors Haven [Sunken Forest], Talisman [Barret Beach], Blue Point Beach, Watch Hill and various portions of park land that is interspersed with privately own tracts of land. A buffer zone of approximately 20m was inventoried within private land that bordered federal land in order to gain information about potential future threats from invasive plants.

The Fire Island Lighthouse stands near the western end of the island on 119 acres, commonly referred to as the Lighthouse Tract. This parcel of land, managed by FIIS, lies between the eastern end of Robert Moses State Park and the Fire Island community of Kismet. The Fire Island Lighthouse is most commonly accessible by automobile across the Robert Moses Causeway through Robert Moses State Park. A single gravel road extends from the eastern edge of Robert Moses State Park to the western edge of Kismet. Facilities at the Lighthouse include an apartment and dormitory for several park employees, the Fire Island Lighthouse and associated maritime museum and visitor center, and the Kismet fire station. This area is primarily characterized by northern beach grass dune, interdune beach grass, beach heather mosaic, northern dune shrub land, maritime deciduous shrub forest, brackish meadow and northern salt shrub.

Nestled between the communities of Atlantique and Corneille Estates lies two un-named plots of land that the National Park owns. These small tracts are characterized by reed grass marsh, northern salt shrub, maritime deciduous scrub forest, northern sand plain grassland, northern beach grass dune, northern dune shrub land and high bush blueberry scrub forest. Although there are no amenities at these locations, there is still heavy foot and ATV traffic due to a gravel path that connects the communities to each other.

Sailors Haven is accentuated by a 300 year old-growth maritime forest, known as the Sunken Forest. Here, under a diverse canopy of leaves, a 1.5 mile boardwalk meanders through freshwater bogs filled with a variety of trees and shrubs. The maritime forest is accented by American holly, juneberry, sasafrass and catbriar; and the swale, between the dunes, with its grasses and low-growing evergreens. On the bayside near the marina and ferry dock lies a National Seashore visitor center with nature exhibits, a snack bar and a gift shop. There are benches at various overlooks and at several intervals along the boardwalk trail. Other facilities include housing for a few park employees and a bathhouse. The land is bordered on the east by the community of Cherry Grove and to the west is Oakleyville and Point O' Woods.

Situated on six and a half acres on the westernmost edge of the Fire Island Pines community lies another small tract of NPS land which holds the 87-year-old Carrington House, a two-story expanded beach cottage. The structure was once a home of Frank Carrington, a Broadway producer. The property once included a boathouse, a grape arbor and gardens along Great South Bay. A guest house remains on the property, but since 2002, after being used as seasonal park employee housing, the buildings have been vacant and condemned due to structural concerns. The vegetation surrounding the house is very similar to that of Sailors Haven, with the exception of the maritime holly forest.

The Barrett Beach/Talisman area is located near the center of Fire Island National Seashore. It is across the Great South Bay from Bayport and Sayville, Long Island. At this time, it is only accessible by private boat and foot or by charter ferry service with limited service during summer weekends. Barrett Beach/Talisman offers a dock for boaters to load and unload only, a boardwalk trail leading across the island to the ocean beach, restrooms, and a picnic area. This site is distinguished by Talisman is bordered to the west by the largest community on Fire Island, the Fire Island Pines. To the east is the community of Water Island, which is less than 1/4 of a

mile wide. Just east of Water Island is another parcel of NPS land, known as Blue Point Beach. This tract of land contains no amenities and is composed of mostly native trees and shrubs, similar to that of Sailors Haven.

Watch Hill is unique because it is bordered by the Davis park community on one side and OPWA on the other side. This site's vegetation cover is similar to that found in the Wilderness area, chiefly characterized by an extensive saltmarsh and reedgrass marsh network. This site is also vegetated by northern dune shrubland, northern beach grass dune, pitch pine dune woodland, highbush blueberry shrub forest, and beach heath dune, (Klopfer et al. 2002). Watch Hill supports the largest park employee housing facilities in the park. It also hosts a ranger and maintenance station, visitor center, multi-use buildings (e.g education programs), self-guided nature trail and camping for visitors.

Invasive Species of Concern

A comprehensive list of inventoried species can be found in Table 1. The Lighthouse tract was a largest concern for inventory this year because of the number of invasive plant species found in this area. Of the species surveyed, Japanese Black Pine *(Pinus thunbergiana*), autumn olive (*Elaeagnus umbellata*) and mugwort (*Artemesia vulgaris*) were found to be the most widespread on Fire Island. Other invasive plant of concern include: garlic mustard (*Alliaria petiolata*), Oriental bittersweet (*Celastrus orbiculatus*), spotted knapweed (Centaurea maculosa), Japanese honeysuckle (*Lonicera japonicus*), multiflora rose (*Rosa multiflora*), common mullein (*Verbascum thapsus*), Japanese barberry (*Berberis thunbergii*), Chinese/Japanese wisteria (*Wisteria spp.*), lesser celandine (*Ranunculus ficaria*), Japanese knotweed (*Polygonum cuspidatum*) and tree of heaven (*Ailanthus altissima*), Canada thistle (*Cirsium arvense*), Chinese lespedeza (*Lespedeza cuneata*) and Chinese/Japanese wisteria (*Wisteria spp.*).

Common reed (*Phragmites australis*) is found to be very extensive in Fire Island, especially on the eastern end such as the Wilderness. However, this species was not inventoried due to time and staff limitations and a lack of a management plan that can address such a widespread infestation in a sensitive habitat and a salt marsh, where they are chiefly found. The park would also have to conduct genetic analysis to determine whether there are any native genotypes of

Phragmites spp. reed. If so, this occurrence should be mapped and preserved. Using aerial photography, it is estimated that 7-8% of OPW is covered with common reed.

Geographical Data Collection and Mapping

The methodology used in 2008 to collect geographical spatial data associated with inventory and control was consistent with methods applied by The Nature Conservancy (TNC) nation-wide. To familiarize staff in plant identification, GPS (Global Positioning System) units and GIS (geographic information system) invasive plant data collection programs, TNC presented a hands-on training program. The training included field work with GPS units, learning the essential GIS software, data storage and management.

The GPS data was compiled using a 2003 Hewlett Packard iPAQ hx2750. The application software used to collect data was ArcPad 7.1.1. The iPAQ operating system ran Windows Mobile™ 2003 Second Edition Version 4.21 Coordinates were collected and projected in Universal Transverse Mercator (UTM) coordinate system, World Geodetic System (WGS 84) datum and the altitude reference was set to mean sea level (MSL). All recorded measurements were in meters.

A weed management database was obtained from TNC. Weed Information Management System (WIMS) is a Microsoft Access-based relational database application that is designed to assist natural resource managers in maintaining and organizing weed data. WIMS can keep track of weed occurrences, assessments, and any management treatments applied to those infestations. Once entered into the database, data can be easily exchanged between multiple users, managed in accordance to NAWMA (North American Weed Management Association) standards, exported as shapefiles that can be applied to any standard GIS application program (e.g. ArcGIS), and captured in variety of charts can be instantly generated using features. Additionally, WIMS can be used on a Pocket PC with an attached GPS unit to facilitate weed mapping and data collected in the field. This enables the site manager to export data from the Access database onto a handheld unit, bring those data into the field, see imagery directly on the screen, map and collect field data, then immediately upload those new data into the Access database.

When a weed infestation is found, the first step in the mapping procedure is to create a weed occurrence. An occurrence is the basic unit of mapping and assessing a singular weed or weed infestation within WIMS. It can be seen simply as a record of presence or absence of a weed. Occurrence location is stored as a point, hence has no spatial information in and of itself. However, each occurrence represents a patch or population of plants covering an area. Therefore the primary purpose each occurrence is to define the presence of a single species. Associated data are then linked to the corresponding occurrence. Supplementary data such as location (recorded in latitude and longitude or UTM units), occurrence code name and/or description of its location, and the specified area(s) in which the occurrence is found. The initial occurrence can also specify land ownership, township, range, vegetation type, etc. is collected. Depending on management and monitoring objectives, large extensive infestations may be recorded as either one occurrence or as several smaller occurrences. After a particular occurrence has been recorded, the WIMS database can be used to track spatial changes in the infestation such as size or extent over time, its treatment history and the success of those treatments.

In the WIMS database, survey and monitoring of individual weeds and weed populations are recorded as individual assessments. WIMS keeps track of how the weed occurrence changes over time (monitoring), with or without any treatment action. Assessments are recorded as polygons or linear polygons, and some type of quantitative measure (cover, density, etc.) is necessary to determine change in condition. Each assessment relates to one specific occurrence, while each occurrence can accrue a series of assessments over time. Assessments can be used to create a weed inventory for an entire managed area or a subset of that area and assessments over time can be used to determine if weed populations are increasing or decreasing and if treatments are having the desired effects.

A treatment is any weed management activity or management intervention that occurs at a specific time over a defined geographical area. WIMS can keep track of all invasive plant management activities applied, including any manual and mechanical methods used, biological control agents (microbes, fungi, insects, etc.), prescribed fire and chemical treatments. For efficiency purposes, one treatment may be applied and linked to more than on occurrence in a given area. Information attached to each treatment includes: species and area treated, resources expended (staff and volunteer time), percent of occurrence treated, information on the specific herbicide and adjuvant used, environmental conditions at time of application, etc. As with

assessments, there may be a series of treatments for each occurrence, if for example the prior treatment was unsuccessful and re-treatment was necessary.

Cover class is an estimate of ground area that an infestation covers. For weed points that mapped individual plants, cover class was considered one hundred percent coverage. However, polygons and some lines were cataloged using cover class adopted from TNC. This system has a designated rating accounting for the infestation level in a Trace (<1%), Class 1 (1-10%), Class 2 (11-25%), Class 3 (26-50%), or Class 4 (51-100%). The field staff also estimated and collected data on weed distribution/consistency. This qualitative measurement ranges from the infestation being isolated, linear, monoculture, satellite, uniform or other coverage. Lastly, information on the weeds phenology was recorded.

After an area was inventoried, the data was transferred from the GPS units on to a desktop computer running Microsoft Windows XP® and Microsoft Access® software. The initial accuracy was somewhere between 3m and 15m. Using WIMS, files were then exported as ArcGIS shapefiles and the final maps were created in ESRI® ArcMap™ 9.2. Aerial ortho-photographs of park lands were obtained from the Park's GIS database. Maps were produced to depict extent of infestation and control efforts. The mapped results can be found in attached maps at the end of this document.

Invasive Plant Control and Management

Different control methods were implemented for each target species. As little herbicide was used as feasibly possible, but with the consideration of limited resources and removal alternatives being more time-consuming and labor-intensive, herbicides were necessary in some instances. To increase effectiveness, some mechanical control methods were coupled with chemical control. Plant control was prioritized by month, based on optimum control guidelines (Table 2). Priority was given to species that have narrow treatment windows (e.g. garlic mustard), with highest priority at the beginning of said windows of opportunity.

For control in the Wilderness, a Minimum Requirements assessment was completed by the Park, as per Wilderness regulations. As part of this assessment, a Minimum Tool Analysis is required in order to determine the appropriate tool(s) to accomplish the project or proposed activity with the least impact to the wilderness resource. It was determined that it

would have the least impact when implementing limited spot treatment with herbicides on the larger plants (e.g. Japanese black pine), in tandem with manual and mechanical techniques. This was concluded using the understanding that more people and traffic at these sites (if manual methods are used, for example) would have a greater impact on the soil and thus native plants around infested areas by compacting soil and inadvertently creating social trails, which could have lasting aesthetic and ecological effects on the Wilderness character.

The following are invasive plant control methods implemented in the Wilderness area, organized by species.

Autumn olive was removed using a Weed Wrench®, loppers, hand pruners and manual pulling. No herbicides have been used in the Wilderness to control this species. However, it has been recommended to use a cut stump treatment on the larger plants that can be very difficult and time-consuming to remove and may have undesired effects on the surrounding environment. At the William Floyd Estate, the most common technique used to treat autumn olive was a foliar spray with 10% Garlon 3A®. This was used because of limited time and staffing and the well documented effectiveness of this method.

Canada thistle was treated only using 10% Roundup® or 12% Accord XT® (glyphosate). The reason for this method is due to the concern of spreading the infestation vegetatively through the fibrous root system when using mechanical or manual methods.

Common mullein, has shallow roots and was simply removed by hand pulling and using spades. Because mullein is not a major threat in the Northeast and does not seem to be pervasive at FIIS, there was no centralized effort to remove it from the Wilderness area. Rather, it was pulled up in a more passive approach; the crew removed it when they came across while in the process of treating or inventorying species of higher priority.

Garlic mustard is best treated in the spring before it sets seed, and efforts should focus on the larger plants rather than the seedlings or rosettes. The main method used for this plant was simply hand pulling. In cases where extra herbicide was already mixed, garlic mustard was treated with 10% Roundup® or 12% Accord XT®

Japanese barberry was mostly controlled using a medium and large Honeysuckle Popper®, accompanied by loppers and hand pruners. Hand pulling was used on smaller

plants, as well as limited foliar spray with Garlon 3A® at 10% on both small and large plants.

Japanese black pine was treated using a variety of methods. Small seedlings were simply hand pulled. Larger seedlings were uprooted using a Weed Wrench, followed by hand pulling once the roots were loosened. Larger trees (Diameter Breast Height greater than 3 inches) were treated using "hack-and-squirt" method—a combination of manual and herbicide treatment. First, the bark at the base of the tree is removed using a hatchet, exposing the cambium layer. Then a small amount of 25% Garlon 4® is applied to the exposed inner layer, and the herbicide is absorbed and transported to various parts of the tree. The treatment takes weeks to months to affect the plant. Because it is a direct application, this method reduces the possibility of non-target effects.

Japanese knotweed was first controlled using 10% Roundup®, but this proved ineffective. In response, a retreatment with 12% Accord XT® was implemented. Prior to the first chemical treatment, non-motorized hedge trimmers were used to reduce plant height for easier spraying and to induce stress.

Multifloral rose is a hardy plant, and because of the presence of thorns is difficult to remove with manual methods. Therefore, it was treated using a foliar spray of 12% Accord XT®.

Spotted knapweed, as with the common mullein, was simply removed by hand pulling and using spades due to its shallow roots and prevalence in sandy soils.

RESULTS AND DISCUSSION

Control and management methods of invasive plants were implemented in areas that were inventoried during the 2007 season at the Wilderness Area and the William Floyd Estate. Inventory was accomplished in areas that were not surveyed last year, mainly in federally-owned land on the western end of Fire Island National Seashore from the Lighthouse Tract to Watch Hill.

Control and Management

Otis Pike Wilderness Area

Due to time and staff limitations as well as adverse field conditions in the OPWA during the summer season (e.g. mosquitoes, ticks, heat, etc.), the control efforts were not as extensive as would have been desired. However, much work was completed, despite the limited resources. Overall, the staff feels proud of what our accomplishments this season.

Control efforts were limited to Japanese black pine, spotted knapweed, autumn olive and common mullein. Focus was emphasized around more disturbed areas with larger infestations, particularly in the vicinity of Bellport Beach and the Wilderness Visitor Center (Maps 1 and 2, respectively). In total, roughly 2 acres were treated at OPWA. The largest control efforts were targeted toward Japanese black pine and spotted knapweed. To conserve time and resources, common mullein treatments were not recorded due to its non-pervasiveness and the passivity of the control approach implemented with this species (i.e. it was not targeted specifically for control). Some autumn olive plants were treated, but most were too large to control with only hand tools which we were limited to at the beginning of the season prior to the completion of the Minimum Requirements assessment. Time constraints did not allow for us to return to these infestations later in the season.

For Japanese black pine, there were three large, two medium and approximately a dozen small/single plant treatments (typically seedlings) removed with a total of about 2 acres treated. For spotted knapweed, there were two medium and one large-sized treatment, all adjacent to each other around the Visitor Center with a total of about 0.3 acres. For autumn olive there were only two small treatments at Bellport Beach, within a few meters of each other for a total of less than 0.1 acres treated. Common mullein treatments were not thoroughly documented, but it is estimated that roughly 0.1 acres of this species were treated.

William Floyd Estate

The WFE has much higher invasive plant abundance, containing sixteen documented species that are considered ecologically and biologically invasive. Since the extent of infestation and richness of invasive plants in this area were so great, it would have been

unfeasible to target all species of concern and priorities had to be set for control at the Estate. The factors involved in setting priority are: size of infestation, especially in the case that an infestation would be considered isolated for Early Detection Rapid Response (EDRR); timing of control; invasiveness of species; whether natural sites of priority are being affected; and feasibility of control. Based on our analysis of these factors, treatment efforts centered around Japanese knotweed (EDRR), Canada thistle (EDRR), tree of heaven (EDRR), garlic mustard (extremely pervasive), Japanese barberry (pervasive and feasible to control), autumn olive (pervasive and disturbing natural sites of priority) and multifloral rose (pervasive). Common mullein was not targeted in this area because it is of low priority (non-pervasive) and it is believed that they serve as a source of nutrition for migrating monarch butterflies. In total, approximately 3.5 acres were treated in this area (Maps 3-5).

The species that were mainly addressed are Japanese barberry and autumn olive. Both of these species are both highly pervasive and feasible to control, given the right tools. For Japanese barberry, there were two large, two medium and approximately over a dozen small treatments, with a total of about 1.75 acres treated. For autumn olive, there were two large and one small treatment, with a total of about 1 acre treated.

Other species were treated on a smaller scale. For garlic mustard, there were two small and one medium treatments, all in the northeastern corner of the Estate, with a total of 0.25 acres treated. For multifloral rose, there was only one medium-sized treatment, with a total of 0.2 acres treated. Japanese knotweed and tree of heaven both had only one small treatment with a total of less than 0.1 acres treated for each. For Canada thistle, there were four small treatments, with a total of 0.1 acres treated.

Inventory of Western Portions of FIIS

The FIIS areas below were inventoried from west to east (Maps 6-10). Though time was extremely limited, most of the land area that was expected to be inventoried was. It was already understood that the Lighthouse Tract contained the highest number of invasive plants and largest extent of land affected. Therefore, inventory started in the western end of FIIS land and continued east toward Watch Hill, a more natural area that seemed less

affected by invasive plants via anthropogenic disturbance and habitat fragmentation. Efforts were also made to survey and inventory a buffer zone of approximately 20m within private lands that border federal land. This is reflected in the data presented below.

Lighthouse Tract

The crew was able to thoroughly inventory the Lighthouse Tract. A total of 9 different invasive plant species were documented in this area. A total of 157 occurrences were recorded, with an estimated 23.7 gross acres infested, making this the area with the most affected land of the western areas inventoried in 2008 (Map 6).

The predominate invasive plant species documented in the Lighthouse Tract were as follows: mugwort with 25 occurrences recorded, covering approximately 8.8 gross acres; Japanese black pine with 20 occurrences, covering 6.6 acres; autumn olive with the most occurrences recorded at 48, covering 3.1 acres; and common mullein with 18 occurrences, covering 2.3 acres. Other species found at the Lighthouse Tract were: Oriental bittersweet with 13 occurrences, covering approximately 1.2 gross acres; Japanese honeysuckle with 16 occurrences, covering 0.5 acres; spotted knapweed with 14 occurrences, covering 0.3 acres; wisteria with 1 occurrence, covering 0.1 acres; and multifloral rose with 2 occurrences, covering less than 0.1 acres.

SPECIES (# of occurrences)	EST. GROSS ACRES
Mugwort (25)	8.82999992
Oriental bittersweet (13)	1.170000007
Spotted knapweed (14)	0.2676
Autumn olive (48)	3.140000004
Japanese honeysuckle (16)	0.479999997
Japanese black pine (20)	6.619999979
Multiflora rose (2)	0
Common mullein (18)	2.270000063
Wisteria (1)	0.9
TOTAL	**23.67759997**

Robbins Rest: Atlantique to Corneille Estates

The crew was also able to thoroughly inventory this area. A total of 6 different invasive plant species were documented in the vicinity of the Robbins Rest area (between the communities of Atlantique and Corneille Estates). A total of 68 occurrences were recorded, with an estimated 14 gross acres infested (Map 7).

The most predominate species found in this area is Japanese black pine with only 8 occurrences, but covering approximately 12.3 gross acres. Autumn olive was also found in high abundance with 32 occurrences, covering 1 acre. Other species found in this area were: Japanese honeysuckle with 8 occurrences, covering 0.4 acres; mugwort with 13 occurrences, covering 0.3 acres; Oriental bittersweet with 6 occurrences, covering 0.1 acres; and common mullein with 2 occurrences, covering less than 0.1 acres.

SPECIES (# of occurrences)	EST. GROSS ACRES
Mugwort (13)	0.3
Oriental bittersweet (6)	0.07
Autumn olive (32)	0.95997
Japanese honeysuckle (8)	0.36
Japanese black pine (8)	12.32
Common mullein (2)	0
TOTAL	**14.00997**

Sailors Haven

The crew thoroughly inventoried Sailors Haven. A total of 7 invasive plant species were documented in this area. A total of 77 occurrences were recorded, with approximately 12.3 gross acres infested, indicating a relatively moderate infestation (Map 8).

As with the other areas mentioned above, Japanese black pine was found to be very pervasive in this area with 47 occurrences recorded, covering 12.2 acres. Species that were found in relatively moderate abundance in this area were common mullein with 19 occurrences and Japanese honeysuckle with 7 occurrences. Both these species each covered less than 0.1 acres. Other species found in Sailors Haven were Norway maple,

Canada thistle, autumn olive and Japanese knotweed. These species were documented to have only 1 occurrence and cover less than 0.1 acres each.

SPECIES (# of occurrences)	EST. GROSS ACRES
Norway maple(1)	0
Canada thistle (1)	0
Autumn olive (1)	0
Japanese honeysuckle (7)	0
Japanese black pine (47)	12.21000015
Japanese knotweed (1)	0
Common mullein (19)	0.039999999
TOTAL	**12.25000015**

Talisman (including Barrett Beach)

Due to time constraints the crew was not able to thoroughly inventory the Talisman area. Rather, only the western-most portion of this tract of land was surveyed. To date, a total of 47 occurrences were recorded, with approximately 2 gross acres infested (Map 9).

The invasive species found to be affecting the most area of land in Talisman was Japanese black pine with 7 occurrences, covering 1.2 gross acres. Garlic mustard was found in moderate abundance with 22 occurrences, covering 0.7 acres. Other species found in this area were: Japanese honeysuckle with 7 occurrences, covering less than 0.1 acres; common mullein with 7 occurrences, covering less than 0.1 acres; mugwort with 2 occurrences, also covering less than 0.1 acres; and tree of heaven with 1 occurrence, covering less than 0.1 acres.

SPECIES (# of occurrences)	EST. GROSS ACRES
Tree of heaven (1)	0.0432
Garlic mustard (22)	0.71
Mugwort (2)	0
Japanese honeysuckle (7)	0.04
Japanese black pine (7)	1.23
Common mullein (7)	0
TOTAL	**2.0232**

Blue Point Beach

Blue Point Beach was thoroughly inventoried, and a total of 4 species were documented in this area. A total of 6 occurrences were recorded, with approximately 0.2 gross acres infested, making this the least infested area in the western portion of the island inventoried in 2008 (Map 10).

The most abundant species found here are garlic mustard and common mullein. Each of these species had 2 occurrences covering approximately 0.1 gross acres. Other species found in Blue Point Beach are mugwort and autumn olive, each with only 1 occurrence, covering less than 0.1 acres.

SPECIES (# of occurrences)	EST. GROSS ACRES
Garlic mustard (2)	0.09
Mugwort (1)	0
Autumn olive (1)	0.02
Common mullein (2)	0.09
TOTAL	**0.2**

Watch Hill

Due to time constraints, this area was not thoroughly inventoried and insufficient data was collected to produce a map depicting the extent of invasive plant infestation. However, it should be noted that based on numerous observations and informal surveys, this area has had relatively low abundance and distribution of invasives. This is likely due to the fact that it is only bordered by 1 community (Davis Park) and there is no heavy vehicle traffic in this area. A total of 2 species were recorded (Japanese black pine and common mullein), with less than 0.1 acres infested and one occurrence each.

SPECIES (# of occurrences)	EST. GROSS ACRES
Japanese black pine (1)	0
Common mullein (1)	0
TOTAL	**<0.1**

LIMITATIONS OF INVENTORY AND CONTROL

Common reed (*Phragmites australis*) was the predominant invasive species found throughout OPWA, and possibly the entire island. Though large areas of common reed completely cover the islands bayside, this species was not mapped during this inventory because of its expansiveness and the Park's lack of current resources to inventory and control its population. Also, there is insufficient knowledge about the population of this species' native genotype (*Phragmites australis* ssp. *americana*) on FIIS land to determine a desired management approach.

There were some technical difficulties with the new GPS units used this year. They needed to be reset numerous times, taking time away from the inventory of more lands. The iPAQ does not have the accuracy of the Trimble GeoXT units that were used last year; instead of sub-meter accuracy, iPAQ's are accurate between 3 and 15 meters. However, this slight compromise in accuracy was not outweighed by the efficiency acquired in post-processing the data collected. The WIMS database made it easier to store and retrieve data in a more expedited manner relative to last year.

Only one staff member in the park, the Park Biologist, was certified to apply the herbicides used to control invasive plants. Therefore, the rest of the crew had to rely on using manual and mechanical methods for control. Though more sensitive to the surrounding environment and non-target species, these techniques are more labor-intensive and require more time and energy to perform.

CONTROL AND MANAGEMENT

A comprehensive list of recommended control methods, optimum timing, and other useful information is summarized in Table 2 and 3 for most documented invasive plant species. Control methods for observed species were researched utilizing resources from various organizations and online databases. The Nature Conservancy's Global Invasive Species Team website/database is where most of our information regarding management and biological information was acquired.

There are several suggested approaches to control such as mechanical, manual, controlled burns, chemical, and biological treatments. Success rates vary depending on the type or combination of controls and surrounding conditions. In most instances, it is effective to apply multiple methods. Due to the historical value and uniqueness of the WFE, a number of control methods are not applicable to this site in order to avoid impacting the cultural landscape. The most practical methods that can be implemented are manual, mechanical and/or some chemical.

Most species can be best controlled if treatment is implemented during a certain time of the year. In general, the optimal time for control is the growing season, before the invasive plant sets seed—ranging from early spring through early fall. However, some species may be controlled throughout the whole year. For chemical applications, fall is usually most beneficial, but treatment can also be accomplished in the spring for certain species and in the summer, if impacts to non-target species are expected to be minimal.

In the OPWA, most species should be controlled in spring/early summer with the exception of common reed *(Pragmites australis)* which is best controlled in the fall. Also, there were no standard control methods found specifically for Japanese black pine (*Pinus thunbergiana*). Cutting down these trees as a possible control method should be researched further for effectiveness, along with basal bark and hack-and-squirt treatments.

At the WFE, recommended control for most species recorded should start in early spring and then retreated in the fall if needed. Generally, season-long mechanical/manual controls are most appropriate for species found at this site; possibility of chemical application will be determined by timing of control.

The ideal control for all species is early detection and rapid response. At the WFE, the team observed a small tree of heaven infestation and steps for control were taken in May 2008. Under the guidance of the Northeast EPMT, a basal bark treatment of Garlon 4™ was applied using hand-held sprayers. As of August 2008 treatment seems promising but there will be repeated monitoring to confirm eradication.

Encouraged by success, it is recommended that the single infestation of Japanese knotweed at the WFE be continually surveyed until the infestation has been completely eradicated. This is a highly invasive plant that is difficult to control as a moderate

infestation and practically impossible if it heavily pervades. Fortunately, it remains a very small infestation and has been treated twice with herbicides. Given its size and number of treatments already implemented, it may still be eliminated completely with these persistent efforts.

Replanting of native species is something that should seriously be considered to complement invasive removal. Several factors, however, need to be taken into account prior to replanting. First, investigation of the surrounding soil is required. The moisture, pH, consistency and quality of the soil are important to the survival of reintroduced plants. Once implanted, however, the native species have opportunity to thrive because they survive well in their native habitat. Species to be planted should be investigated and plant dealers should be researched to make sure that plants are legitimate. Also, in some cases it is recommended that native species be ordered 2 years in advance. Because the area will be disturbed, making it highly vulnerable to invasive plants, the re-established area needs to be monitored closely to prevent re-infestation. Although this will be a very involved project, requiring large amounts of work and resources, the reward of having native species restored will be worth the efforts. As the program develops and the Park is able secure the necessary funding, this treatment should strongly be considered.

Re-seeding native grasses and wildflowers should also be strongly considered. This is a relatively effortless and cost-efficient method of re-vegetating areas that would become barren after large areas of invasive plants are removed. Doing so would provide habitat for native wildlife and at least partially resist the potential for re-infestation of exotic plants.

Through productive collaboration with the Cultural Resources staff, special consideration has also been taken for plant species that are part of the cultural landscape at the Estate (refer to Appendix A). A tentative management approach has been agreed upon and will continually be developed as this program persists. Also, natural sites of priority have been identified at the WFE. Because of their value, invasive plant control should be priority at these locations (refer to Appendix B).

CONCLUSIONS

Relative to other areas of Long Island, relatively low number of invasive plant species were recorded on National Park Service land. The most abundant species documented were autumn olive (*Elaeagnus umbellata*), Japanese black pine (*Pinus thunbergiana*), mugwort (*Artemesia vulgaris*), and Japanese honeysuckle (*Lonicera japonicus*). Out of the areas surveyed, the Lighthouse would require the most attention due to higher infestation and management complexities related to high visitation in this area, which creates heavy vehicle and pedestrian traffic.

Fire Island is characterized by sandy, nutrient-poor soils and an almost constant salt spray on the ocean side that may be a factor limiting the number of exotic species that are able to colonize. This is very fortunate, but as the number of visitors and residents increases each year, there is an increase in the pedestrian, bicycle, and vehicular traffic along the island. These activities all provide an avenue for exotic plant species to be introduced and spread.

Unfortunately, the disturbance caused by the traffic may also contribute to the spread of exotics, while degrading native vegetation. Autumn olive and Japanese black pine are prime examples of exotics that spread in this way. Given their current abundance, management measures need to be taken promptly if their spread is to be curtailed. This is also the case with species like Oriental bittersweet, mugwort and Japanese honeysuckle, which are primarily found in high traffic areas. Their ability to spread rapidly and choke existing native vegetation warrants concern, especially in these targeted areas.

Research emphasizes that it is much easier to treat infestations in the early stages. Therefore, continuous monitoring for current invasive exotic species and new infestations is extremely crucial for early response. Data collected from monitoring efforts will allow management decisions to be based off of current, accurate information so that control methods can be implemented to preserve the extant native landscape. Together with constructive communication between all stake holders and other staff members, perhaps

this problem can be kept under control and the native biological integrity of the Park may be protected from further disturbance.

FUTURE RECOMMENDATIONS

This program is currently financed through the Project Management Information System (PMIS), a service-wide intranet application within the NPS to manage information about requests for project funding. It enables parks and NPS offices to submit project proposals to be reviewed, approved and prioritized at park units, regional directorates, and the Washington Office levels. Through this system, the Park has secured funding for this program for only three years total at $20,000 per year. Invasive plant management requires large amounts of resources, especially when addressing highly pervasive exotic plant populations, such as those found within Park lands. Though the current funding is useful, it is only sufficient for managing just a fraction of the invasive species found on Fire Island. Therefore, the opportunity for more future funding should be identified and pursued in order to sustain the program. Failure to do so will result in an unsuccessful program and the efforts accomplished during these three years would have been largely done in vain.

Because control of most species is recommended for the spring/early summer, SCA interns should start as early as mid-March. In 2007 three 3-month SCA interns were hired for this program. However, this year, two interns were hired for four months specifically for this project and a general biology SCA intern was hired to assist with this program early in the season before helping with other projects. The control of invasive species is something that should be monitored throughout the growing season, and manual and mechanical treatments often need to be done repeatedly to show effective results. Therefore, a 3 month internship is not adequate time to acquire all of the training and actually participate in the control. A longer internship proved to be more beneficial for doing both inventory and control, and we had great results from this overall change in schedule and staffing. Control in the first half of the season was implemented, while still leaving time to do inventory in the latter half of the season.

Field conditions are also important. Starting the work, especially control and removal, before the summer season in areas known for high numbers of mosquitoes would allow

greater productivity and comfort. Although, working in the hot and humid conditions is inevitable, starting earlier in the year will reduce this experience. Lastly, before starting the actual field work, SCA interns should continue to be provided with practice and experience actually identifying the target species with hands-on training. Sending training materials to selected interns a few weeks prior to the start of the season is strongly recommended.

Due to the time constraints, not all FIIS land has been inventoried, particularly in the western portion of Fire Island. Inventory of Watch Hill and Talisman should be of high priority next season so that all Park would be surveyed over these two years. As with this year, control should be implemented early in spring, especially for species with short time frames for control such as garlic mustard.

More efforts should be made towards educating visitors and residents about invasive plants and the damage they can cause if left unabated. It is recommended that an educational program be developed to help provide public awareness of this issue. TNC has some good resources and may even have some presentations that can be used as a template. Collaborative efforts between the Park and agencies like this would be beneficial to the overall mission to reduce the impacts that exotic plants have on the native biota.

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Table 1. Species Inventory List and Areas Found

Species	Scientific Name
Autumn Olive	*Elaeagnus umbellata*
Black Locust	*Robinia pseudoacacia*
Chinese Lespedeza	*Lespedeza cuneata*
Chinese/Japanese Wisteria	*Wisteria spp.*
Common Mullein	*Verbascum thapsus*
Common Reed	*Phragmites spp.*
Garlic Mustard	*Alliaria petiolata*
Japanese Barberry	*Berberis thunbergii*
Japanese Black Pine	*Pinus thunbergiana*
Japanese Honeysuckle	*Lonicera japonicus*
Japanese Knotweed	*Polygonum cuspidatum*
Lesser Celandine	*Ranunculus ficaria*
Mugwort	*Artemesia vulgaris*
Multiflora Rose	*Rosa multiflora*
Norway Maple	*Acer platanoides*
Oriental Bittersweet	*Celastrus orbiculatus*
Spotted Knapweed	*Centaurea maculosa*
Tree of Heaven	*Ailanthus altissima*

Table 2: Recommended Control Methods (The Nature Conservancy, Global Invasive Species Team webpage, October 2007)

Species (Common Name)	Possible Control Methods	Timing	Considerations
Acer platanoides (Norway Maple)	Basal bark or cut stump	Pretty much anytime	
Ailanthus altissima (Tree-of-Heaven)	-Hand pulling after rain, when soil is loose. Must remove rooting system. Cutting above ground portion allows access to base. Digging only suitable for small infestations. -Cutting best when plants begin to flower. Several cuts needed for effect (re-sprouts if not treated with herbicides). -Broadcast herbicide application applied when in full leaf. -Cut stump application -Basal/stem spraying (effective when mixed with oil)	Spring-Fall (Mechanical) Late Spring/Early Summer (broadcast herbicide) Late Spring (Cut Stump) Fall (Basal/Stem spray)	
Alliaria petiolata (Garlic Mustard)	-The best management is to pull it out of the ground in early spring. -Cutting when plants are in full bloom. Pulling throughout growing season. -Glyphosate in late fall or early spring. Triclopyr applied in spring. Bentazon applied during growing season.	Early Spring-Late Fall (see individual methods)	*2,4-D is not recommended for control of *Alliaria petiolata*. This is a highly invasive species, which releases a chemical that could kill other plants for competition.
Artemesia vulgaris (Mugwort)	-Mowing 2-3 times per year. -Herbicide treatment for 2 years.	Early Spring-Fall	
Berberis thunbergii (Japanese Barberry)	-Uproot entire bush. -Difficult plants can be treated with glyphosate.	Early Spring (Mechanical)	
Celastrus orbiculata (Oriental Bittersweet)	-Cut to the ground and allow resurging. One month later apply foliar application of triclopyr mixed at 1% to 2% in water.	Early Spring (Mechanical part)	*Herbicides should only be applied when temperature is above 55 degrees Fahrenheit and when rain is not expected for a period of 24 hours. *Foliar applications of glyphosate and amitrole are both ineffective
Centaurea maculosa (Spotted Knapweed)	-Hand-pulling or digging, with a spade in less dense areas (0 to 10 plants per m^2). -In denser areas (>10 plants per m^2) repeated spot-burning	Summer (by August)	*Gloves should be worn when hand-pulling due to the plant's allelopathic compounds that are thought to be

	with trained individuals is more effective and efficient. -Mowing after flowering has ended but before seeding begins		toxic in large quantities.
Cortaderia jubata (Pampas Grass)	-Roundup sprayed during early morning.	Early Spring-Fall	
Elaeagnus umbellate (Autumn Olive), *Elaeagnus angustifolia* (Russian Olive)	-Hand pulling with moist soil. Continual mowing is effective. -Herbicide most effective during the growing season. Foliar and basal bark applications and cut stump method all report success -Cut stump method shows Glyphosate the most effective. -Basal bark application of triclopyr.	Late Summer (Cut stump) March (Basal bark)	
Lespedeza cuneata (Chinese Lespedeza)	-Mowing followed by herbicide application is most effective.	Herbicides should be applied in Early-Mid Summer, during flower budding stage.	
Ligustrum spp. (Privet)	-Mowing or cutting at least once during the growing season. Plants can be hand pulled as soon as they are big enough to grasp. -Foliar spray method. Cut stump and basal bark method effective when ground isn't frozen.	Spring-Summer (Mechanical) Early Spring or Late Fall (Chemical)	
Lonicera japonica (Japanese Honeysuckle)	-The most effective treatment is a foliar application of glyphosate and Dichloroprop mixed with 2,4-D. Treated plants should be re-examined at the end of the second growing season, as plants can recover from herbicide application	October (After native vegetation is dormant and when temperatures are near and preferably above freezing. Applications within 2 days of the first killing frost are more effective than applications later in the winter.)	
Phragmites australis (Common Reed)	-Cut just before the end of July. Will eliminate if carried on for several years.	Mid-July	
Pinus thunbergiana (Japanese Black Pine)	No Control has been identified, will try basal bark treatment.		
Polygonum cuspidatum (Japanese Knotweed)	-Spray herbicide approved for use near water that contains glyphosate or glyphosate with imazapyr on the leaves and stems. To avoid spraying very tall plants, cut	Summer or early fall (Chemical) [w/ mechanical precursor in May or June]	* It is extremely difficult, if not impossible, to eradicate large established stands of *Polygonum cuspidatum*.

	the stems once in May or June and allow the plant to re-grow to about waist height. (Dispose of cut stems where they will not re-sprout. Most patches require more than one year of treatment.) -Manually pull or dig surface roots of plants in loose soil. Check often for new sprouts and repeat. Or, cut the stems close to the ground every two weeks throughout the growing season.	Spring-Fall (Mechanical) [Continuous]	
Ranunculus ficaria (Lesser celandine, fig buttercup)	No effective control methods have been identified.		
Robinia pseudoacacia (Black Locust)	-Glyphosate as a band or direct spray.	September	
Rosa multiflora (Multiflora Rose)	-Application of Glyphosate or triclopyr -Repeated mowing results in controlling the spread, but not eradication.	Late June (Chemical)	
Verbascum thapsus (Common Mullein)	-Hand pulling before they seed. -Cutting when it just begins to flower. -Basal/Stem applications of chemicals in high concentrations.	Late Spring-early Summer (Mechanical) Fall (Chemical)	
Wisteria spp. (Wisteria)	-Cut every two weeks throughout growing season. Use a weed wrench to remove. -Cut stump as long as ground isn't frozen. Foliar application more effective at warmer temperatures.	Late Spring-Fall	

Table 3. Recommended Timeline for Control using various methods. Adapted from Table 2.

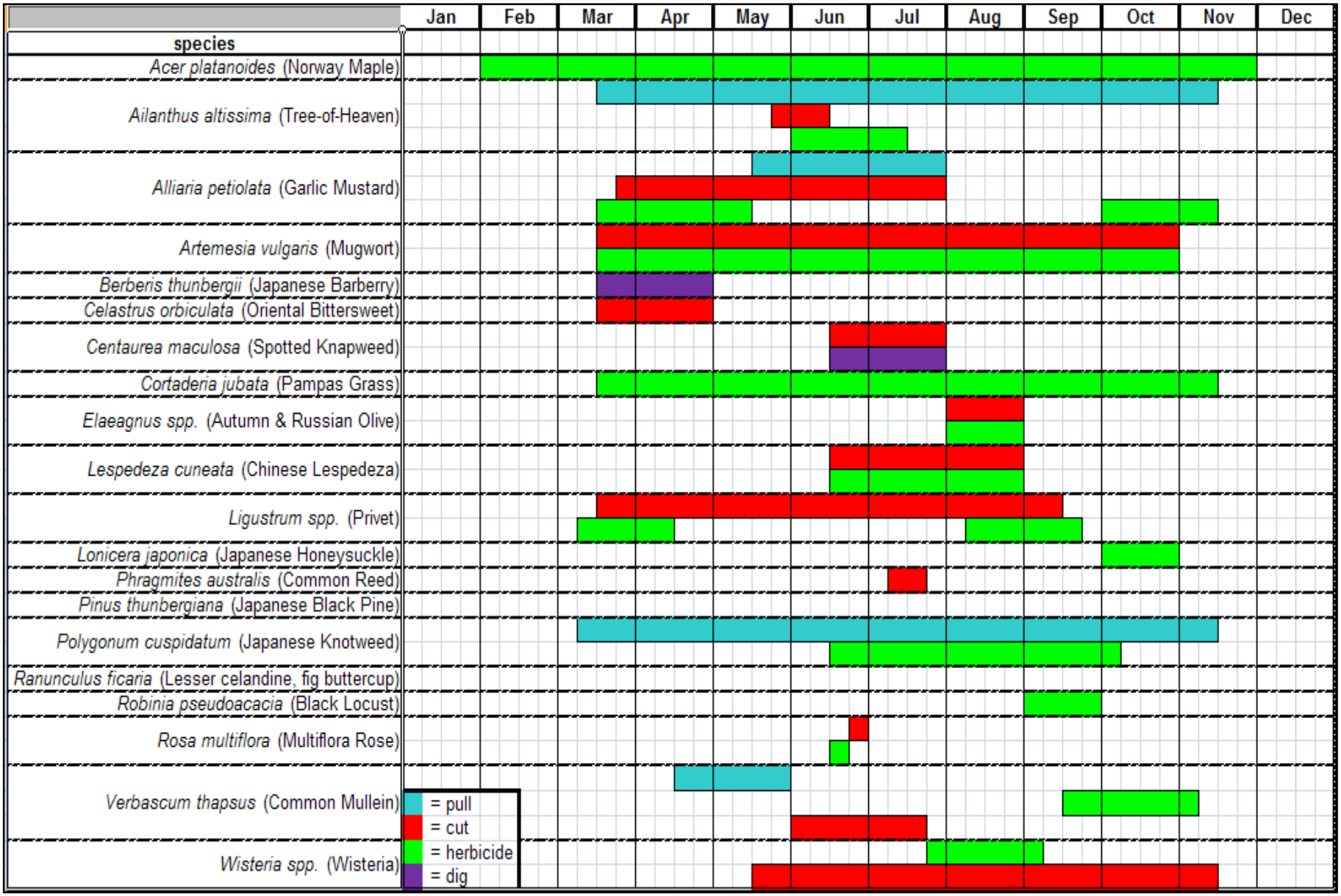
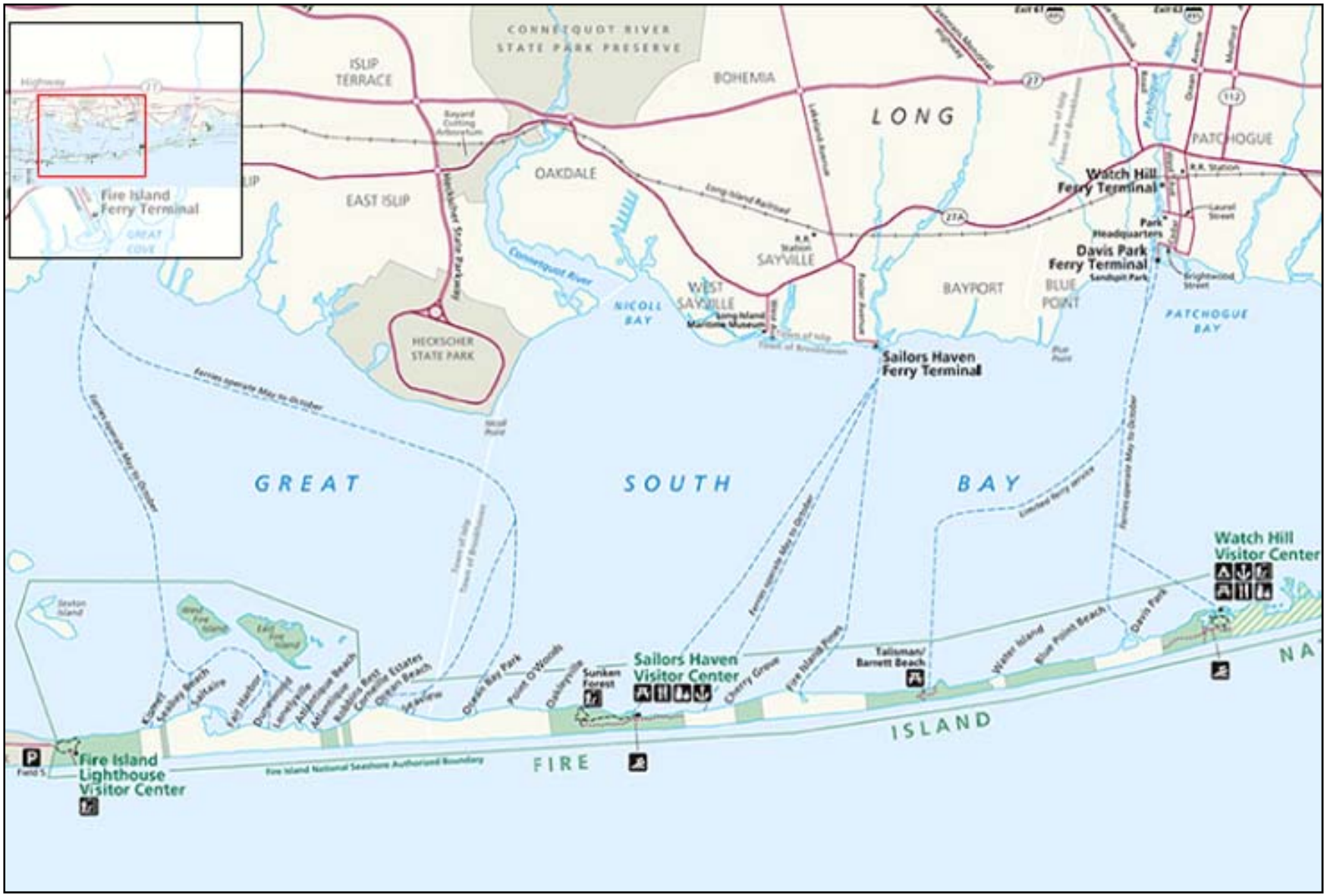
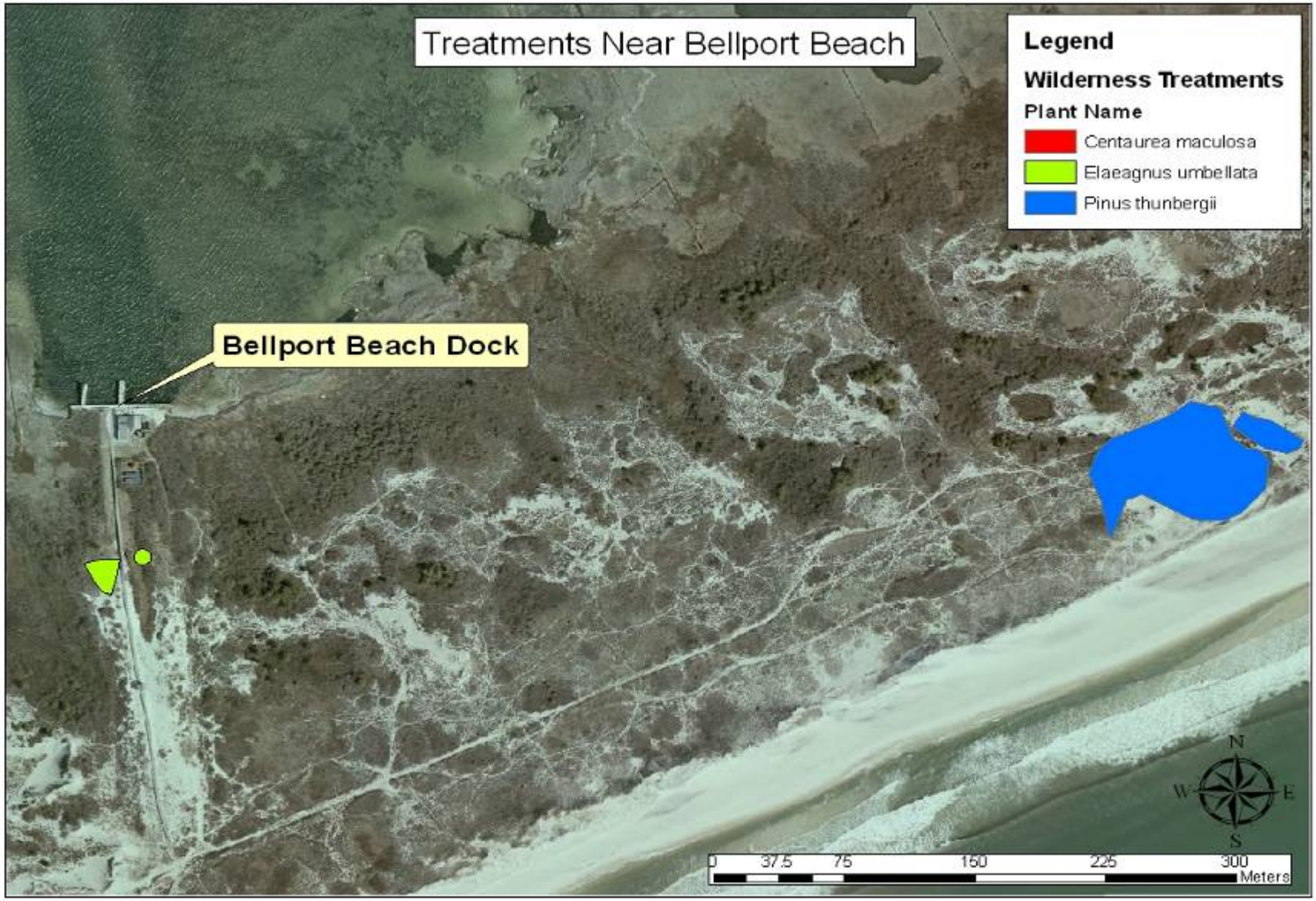


Figure 1. The eastern section of FIIS that was treated, showing the Wilderness Area, the WFE and surrounding areas.

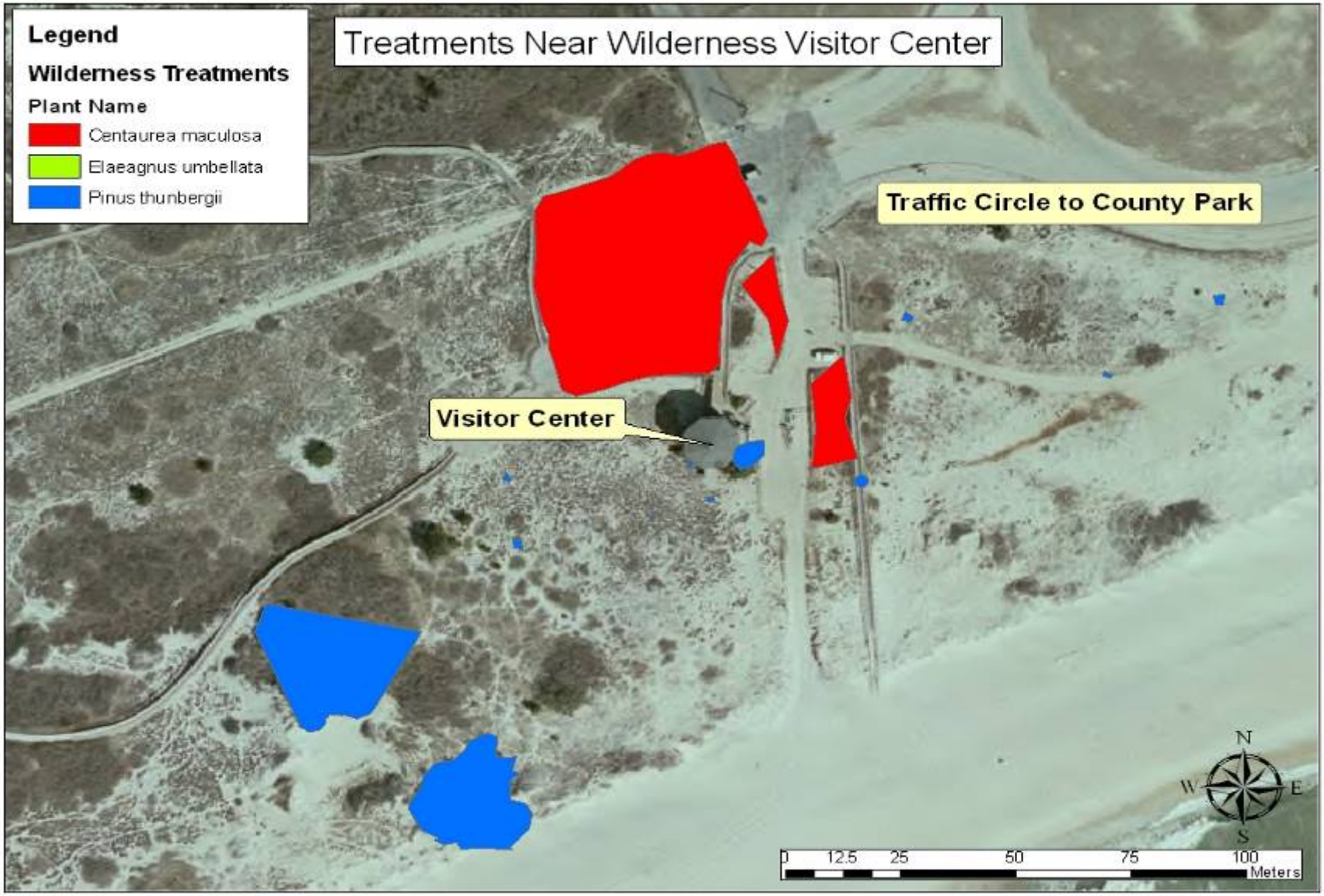
Figure 2. The western Fire Island that was inventoried, the Lighthouse Tract to Watch Hill, in relation to surrounding areas.



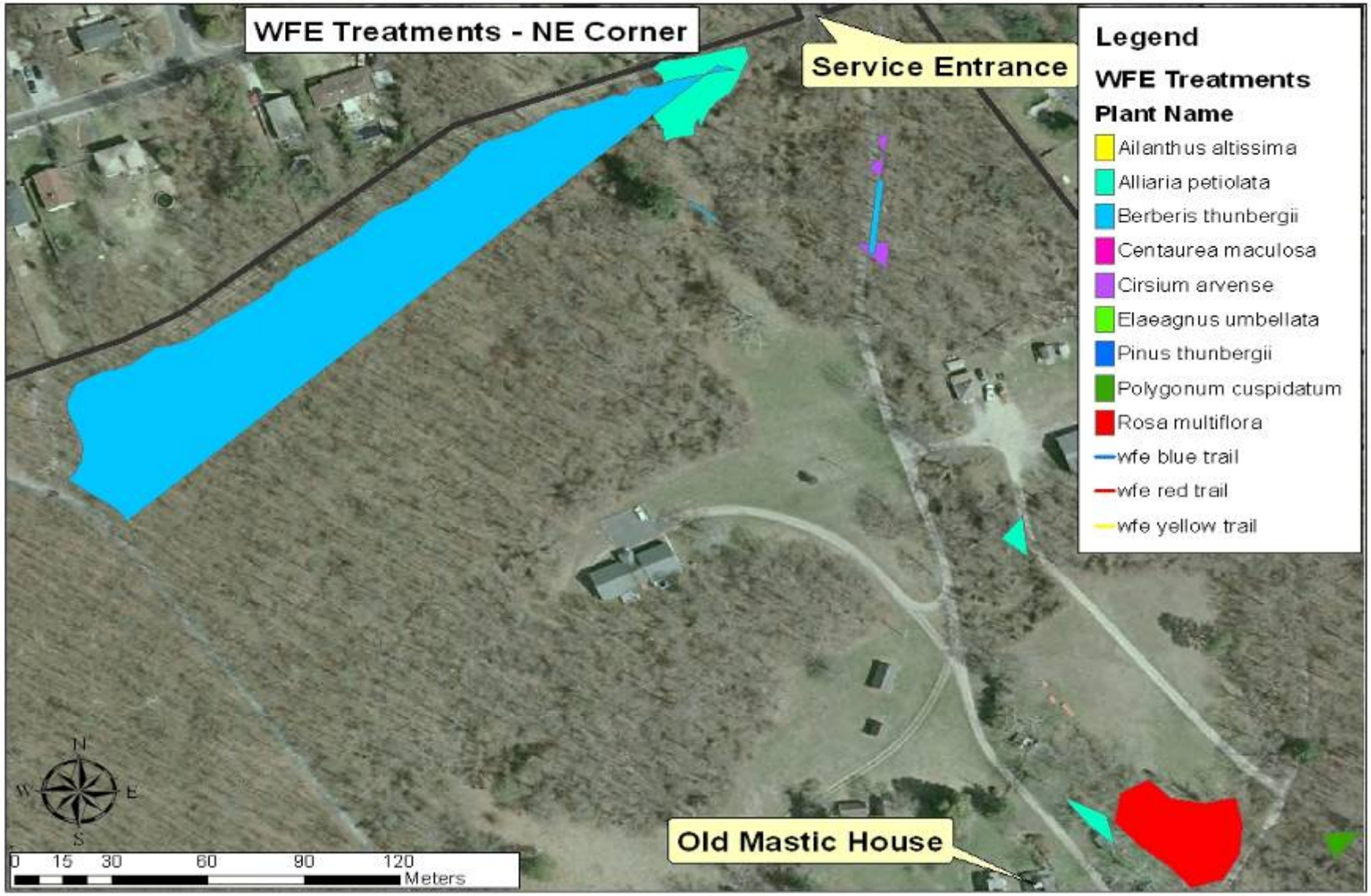
Map 1. Treatments completed in the Wilderness, in the vicinity of Bellport Beach.



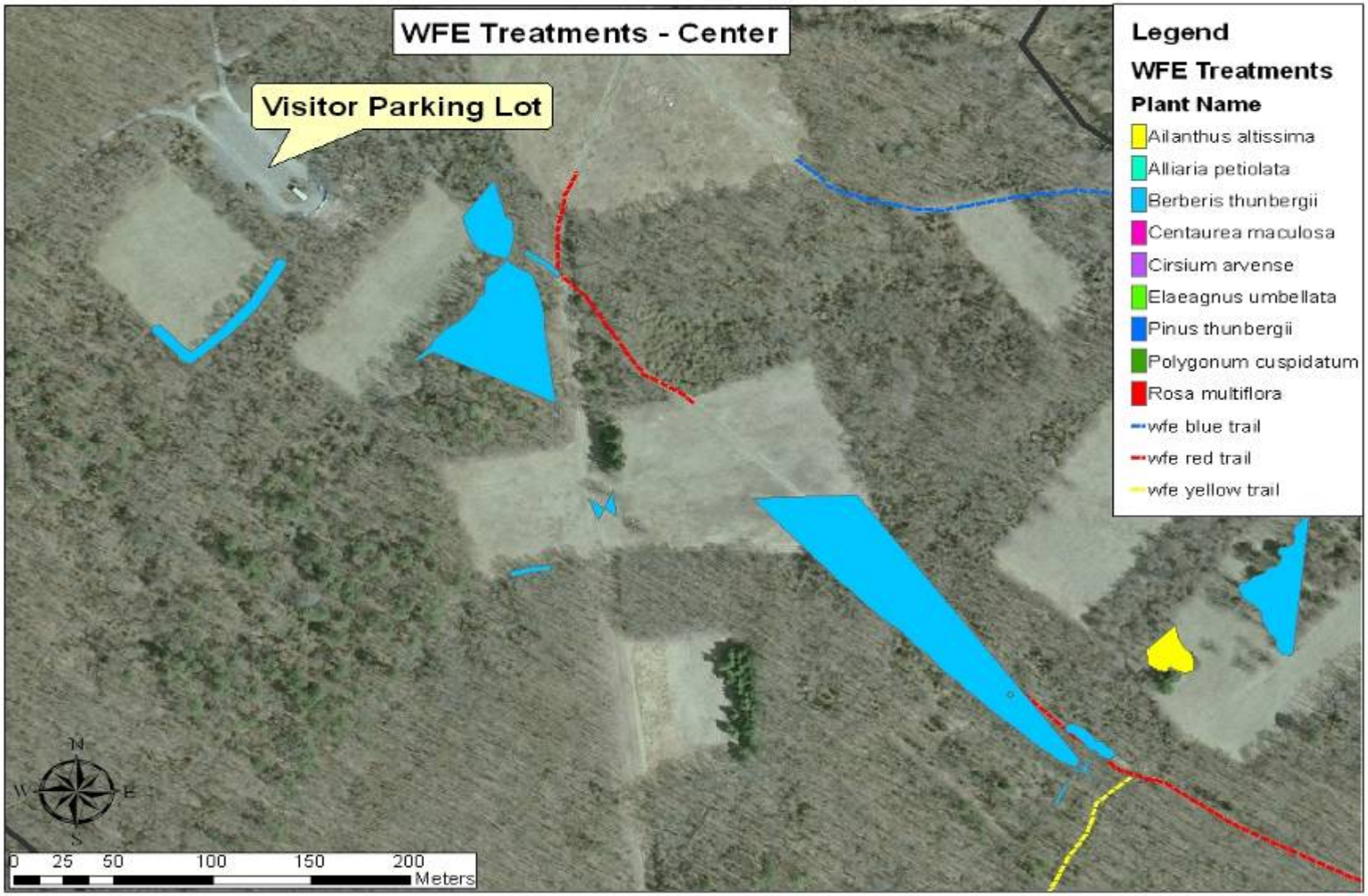
Map 2. Treatments completed in the Wilderness, in the vicinity of the Visitor Center.



Map 3. Treatments at the William Floyd Estate, northeast corner.

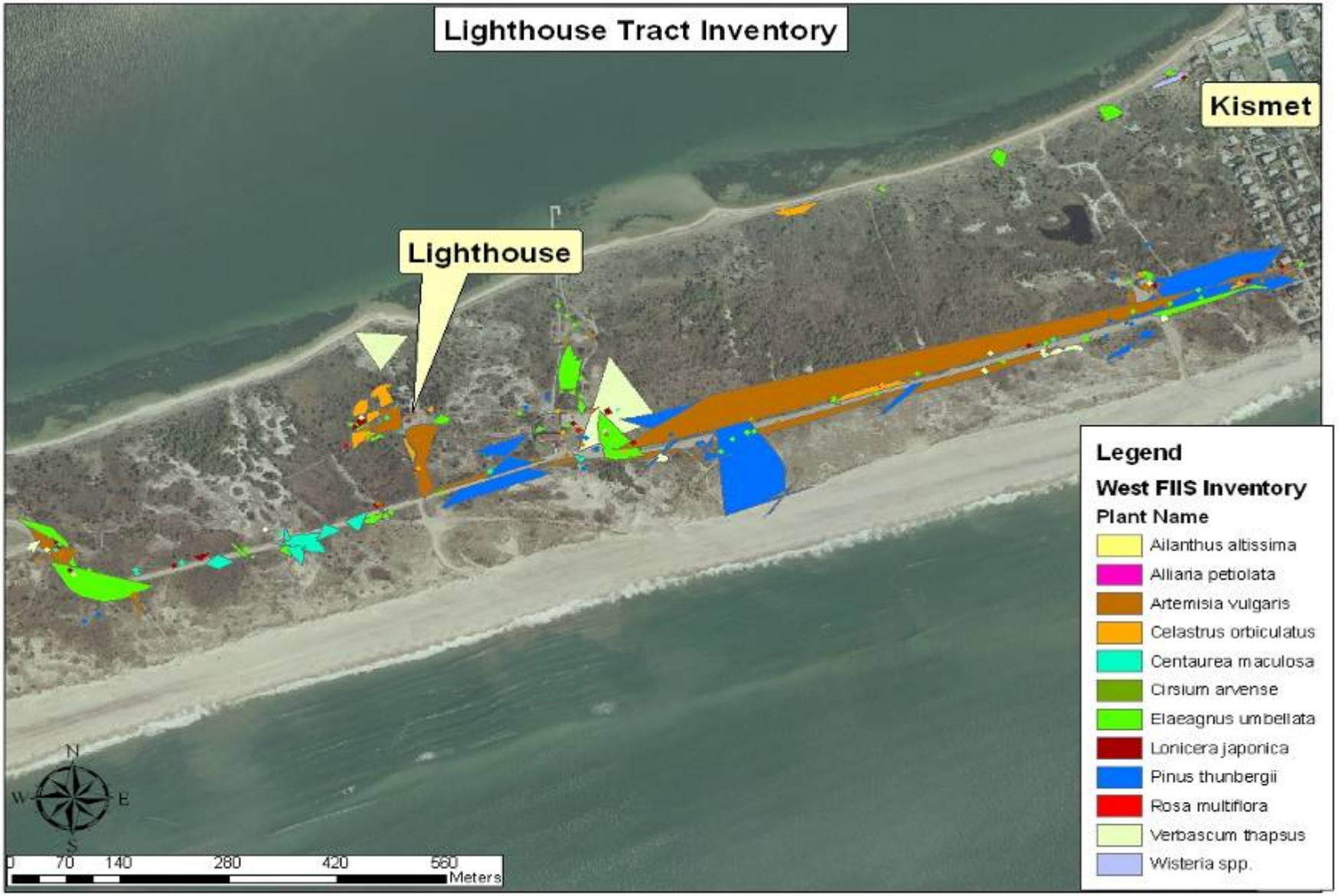


Map 4. Treatments at the William Floyd Estate, center of the estate.

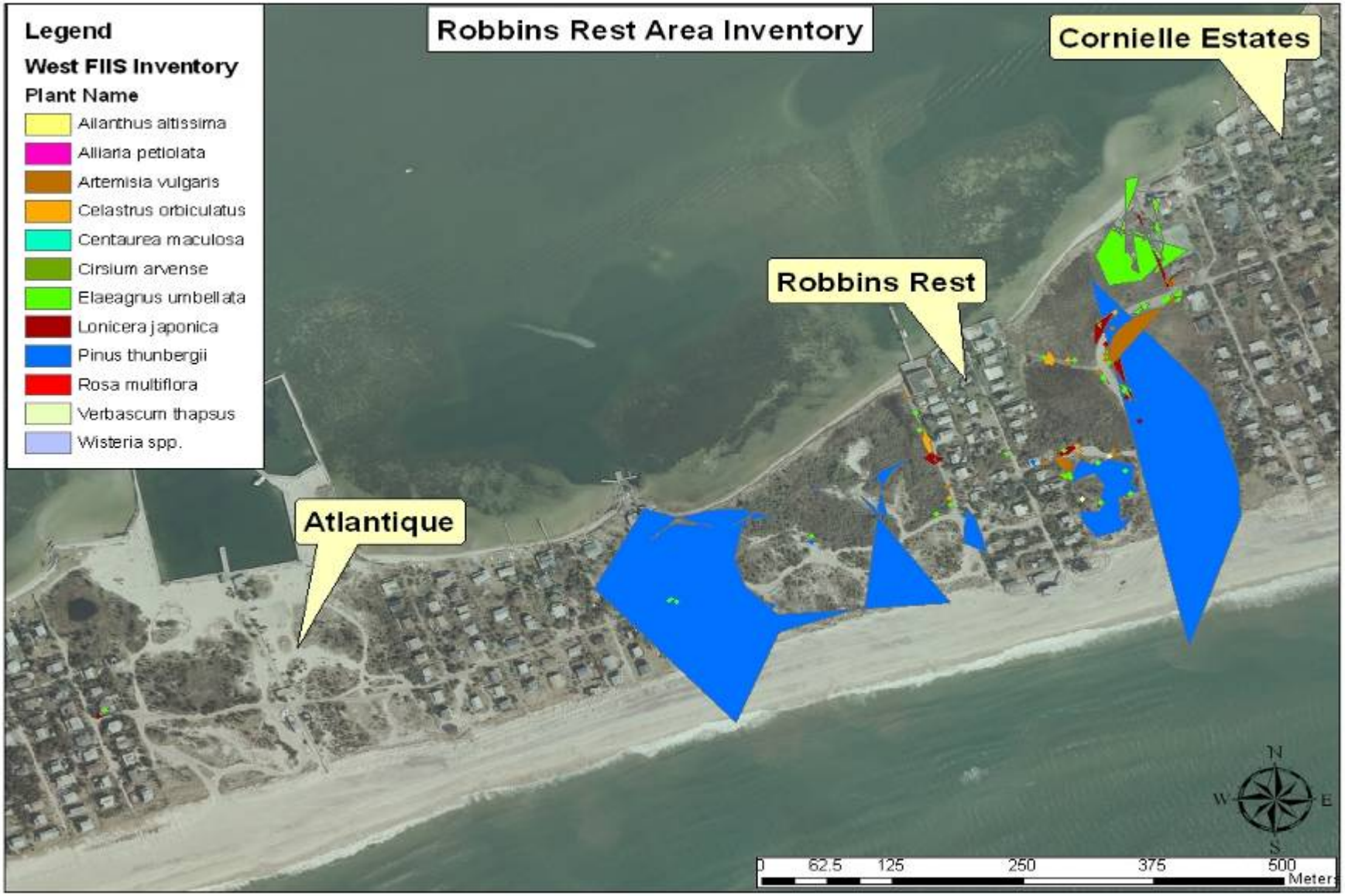


Map 5. Treatments at the William Floyd Estate, southwest corner.

Map 6. Inventory at the Lighthouse Tract.



Map 7. Inventory in the vicinity of Robbins Rest.



Map 8. Inventory at Sailors Haven.

Map 9. Inventory at Talisman.

Map 10. Inventory at Blue Point Beach

APPENDIX A:

Management of Biologically Invasive Cultural Plantings

United States Department of Interior
National Park Service
Fire Island National Seashore

IN REPLY REFER TO:

February 14, 2008
N50 (FIIS-NH-IPM)
H3017 (FIIS-CR-IPM)

To: Files, Fire Island National Seashore (FIIS)

From: Fernando Villalba, Park Biologist, FIIS

Subject: Invasive plant management at the William Floyd Estate, in accordance with the cultural landscape management site objectives

On February 14, 2008 I met with MaryLaura Lamont (Museum Technician) and Steve Czarniecki (Cultural Resources Manager) to discuss management of invasive plants at the William Floyd Estate (WFE) in the context of the site's cultural landscape. Other invasive plant species not discussed in detail in this Memo have been addressed in the 2007 Invasive Plant Inventory and Control Report, including species found outside of the WFE.

As guided by the Development Concept Plan and the Interpretive Prospectus, the integrity of the WFE's cultural landscape is to be stabilized to protect the historical and cultural resources (buildings, landscape, etc.). According to the Cultural Landscape Inventory, which was concurred on August 31, 2006, the Period of Significance for this site is 1718-1977, while the Period of Treatment and Interpretation is 1975. The Floyd family terminated their use rights of the House and surrounding 613-acre land referred to as the William Floyd Estate in 1976, coinciding with the United States Bicentennial. Under the NPS List of Classified Structures, the House and landscape are rated as a category 1A, which mandates that these properties must be preserved. Additionally, FIIS is charged with "conserving and preserving for the use of future generations certain relatively unspoiled and undeveloped beaches, dunes, and other natural features within Suffolk County, New York" (FIIS Enabling Legislation, 1964). Invasive plants at the WFE are currently negatively impacting both cultural and natural resources, largely by modifying the landscape and habitats, and displacing native plant species. Careful consideration is needed when developing an Invasive Plant Management approach in order to meet both Park-wide and site-specific objectives.

Based on available resources, documents and conversations with the Cultural Resources staff at the WFE, most invasive plant species that are being considered for control in FIIS have no known cultural significance to the Park. Removal of these particular species will therefore be implemented accordingly for the protection of natural resources and stabilization of the cultural

landscape. This will include all species mentioned in the 2007 Invasive Plant Inventory and Control Program Report, with the exception of those mentioned below in the Memo. Removal of these species shall not affect the cultural integrity of the WFE. On the contrary, such efforts are intended to protect the valuable resources of this landscape. During the removal process of the invasive plants, care will be taken as to prevent impacts on non-target species, which may have cultural and/or natural significance.

Per conversations with MaryLaura and Steve, autumn olive (*Elaeagnus umbellata*), black locust (*Robinia pseudoacacia*), Japanese barberry (*Berberis thunbergii*) and Multifloral rose (*Rosa multiflora*) all are known to be cultural plantings, introduced by the early generations of the Floyd family for various reasons. This understanding largely comes from historic documents that were donated to the Park. No removal of these species will be implemented in areas surrounding the House and outbuildings, since they were purposely planted in these areas by the early Floyds. However, due to the ineffective landscape management by NPS and/or the more recent generations of the Floyds and the invasive nature of some of these non-native plant species, the original dimensions of the deliberate cultural plantings have expanded to the present-day characteristics.

Autumn olive was planted by the early Floyds in some of the maintained fields for hunting purposes (mainly pheasants and quails). It was planted as a food source for the birds, but some grew large enough to also provide cover for the hunters, as the birds that were being hunted foraged in the adjacent fields, which were largely characterized by native grasses. With this understanding, we have concluded that large extant autumn olive plants that were planted inside, and along the edges, of these fields will not be removed. These plants were probably planted in the 30's – possibly the 40's and are an asset to the cultural landscape.

However, autumn olive plants that have expanded and are growing beyond the intentional planting sites may be removed. It is easily distinguished what areas may be controlled, since these fields are still being mowed by the WFE staff annually. MaryLaura and I visited one of these fields and she suggested that the mowed areas were likely vegetated with native grasses and wildflowers, which produce seeds that are great food sources for pheasants and quails. Reseeding these fields with native grasses and wild flowers should be considered as a cost efficient means to reintroducing native grasses and to return a characteristic of the cultural landscape. MaryLaura concurred with this idea. Each field where autumn olive is growing will be assessed for management on a case-by-case basis in collaboration with the cultural resources staff.

Black locust was introduced to the Estate by the Floyds as well. It served as wood for fencing posts, other construction purposes and fire wood because it is extremely hard grained giving a long durability and resistance to decomposing into the soil. Black locust was mainly grown around the House and in the adjacent wood lots, but it was also possibly allowed to spread throughout the forested areas and harvested when the trees grew large enough. However, it is now growing in many of the mowed fields and lawns. Mowing has been slowing its spread, but every spring saplings are visible able grow rapidly, sometimes about 6 feet in a single season. Therefore, removal of black locust will not be implemented in the around the House and adjacent forested areas, but removal may occur in the fields and lawns where it was not intended to grow. Continual discussion and consultation would have to take place with the Cultural Resources staff

Japanese barberry and Multifloral rose were likely only planted as an ornamental and did not serve any recreational or harvesting purpose. Because of this, it was suggested by MaryLaura that these

species were only planted for aesthetic purposes around the House, the outbuildings, and the family cemetery. These two species have spread well beyond these areas. We concluded that it shall not be removed from the intended planting areas mentioned above, but may be controlled where it is has expanded beyond these areas.

Chinese and/or Japanese wisteria (*Wisteria* spp.) is also thought to possibly be a cultural planting. This is only based on the locations *Wisteria* spp. is found. For example, *Wisteria* spp. occurs in an area that historically has had a slave cabin. These plantings are now old, suggesting that they have been established in this area for a long time, likely during the early Floyd generations. To develop a more thought-out management decision for this species, the history of *Wisteria* spp. would have to be further investigated to better understand when and how these plants species were introduced. Otherwise, control of Chinese and/or Japanese wisteria shall occur on a case-by-case basis, removing only certain plants that have been introduced recently and/or they are young (e.g. if they are climbing over the boundary, saplings, etc.).

At least one more site visit shall take place before invasive plant control begins in the spring. More detailed objectives for specific fields and locations should be written in collaboration with the Cultural Resources staff, with the intentions to protect naturally and culturally significant land features.

Works cited:

Federal Register. Public Law 89-244, 1965; Public Law 88-587, 1964. Fire Island National Seashore Establishment. Legislative History of Fire Island National Seashore. September 11, 1965.

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APPENDIX B:

Identified Natural Sites of Priority for Control of Invasive Species at the William Floyd Estate, Fire Island National Seashore

Introduction

Four sites were chosen within the boundaries of the William Floyd Estate, these sites were selected as high priority areas because the invasive plant species found there could potential pose a threat to the park's natural resources and/or natural ecosystems (map attached below). Fields found at the Estate are great habitats for hunting hawks, particularly these fields can be (and are) critical wintering hunting habitats for hawks (e.g. Northern Harriers, *Circus cyaneus* -State threatened species), falcons (e.g. Peregrine falcons, *Falco peregrinus*) and owls.

Site Details

The sites were taken as buffered points completed using a Trimble Geo Explorer XT GPS unit (the size of the area was estimated). The GPS unit was set with the Universal Transverse Mercator (UTM) coordinate system, Zone 18 North, NAD 1983 datum and the altitude reference was set to mean sea level (MSL). Real-time deferential correction was used throughout the entire inventory, using the base station in Darien, CT. All recorded measurements were in meters.

Site #1

This site is located at the headwaters near "home creek" (Map 1). This area is where the Floyd's used to get their fresh water. It could be considered a high priority area because it is located within a fresh water spring and many native fresh water plant species grow in this area (i.e. wildflowers like violets). Invasive plant species such as Japanese knotweed (*Polygonum cuspidatum*), Japanese Barberry (*Berberis thunbergii*), multiflora rose (*Rosa multiflora*), mugwort (*Artemesia vulgaris*) and garlic mustard (*Alliaria petiolata*) are taking over much of this space and could threaten many of the native freshwater species.

This particular habitat has been characterized as a red maple-tupelo swamp forest; known for having plant species such as highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), and coastal sweetpepperbush (*Clethra alnifolia*). (Klopfer et at. 2002) swamp azalea is listed in New York State as exploitably vulnerable.

Site #2

This site is located near one of the fields with in the William Floyd Estate and could become a new tour trail area (Map 1). It could be an area of high priority because visitors and guest will see this part of the William Floyd Estate. From a natural resource stand point, this area has a lot of native species such as black oak (Quercus velutina), black cherry (*Prunus serotina*), and Pitch Pine (*Pinus rigida*). Some of the invasive plant species found here are oriental bittersweet (*Celastrus orbiculatus*), Japanese barberry (*Berberis thunbergii*), and multiflora rose (*Rosa multiflora*). These invasive plants look like they are suffocating many of these native trees. For example, much

of the oriental bittersweet (*Celastrus orbiculatus*) has climbed to the top of the native oak and pine trees.
This particular habitat has been characterized as a Coastal Oak-Health Forest; known for having plant species such as scarlet oak (*Quercus coccinea*), black oak (Quercus velutina), sassafras (*Sassafras albidum*), and blue ridge blueberry (*Vaccinium pallidum*). (Klopfer et at. 2002)

Site #3

In this area (Map 1), autumn olive (*Elaeagnus umbellate*) has taken up a big portion of a field. This field is huge and, if it can't be treated in its entirety, any form of abatement would be beneficial. This area serves as a potential habitat for many bird species such as grasshopper sparrow (*Ammodramus savannarum*), field sparrow (*Spizella pusilla*), northern bobwhite (*Colinus virginianus*), eastern bluebird (*Sialia sialis*) and the State endangered short-earred owl. Without proper nesting habitat and lack of quality food, these birds could have a hard time surviving in this area. Some native plant species include (but are not limited to) milkweeds (*Asclepias sp*.), blackberry (*Rubus sp*.) and grasses (*Andropogon sp*.)milkweed and blackberry.

Site #4

The area could be high priority because it has many native plant species (Map 1). However, invasive plants such as Japanese honeysuckle (*Lonicera japonicus*) and multiflora rose (*Rosa multiflora*) are starting to emerge. If these invasive plants can be controlled before they get too bad, it could help maintain this site's natural setting. This area can be a potential habitat for the narrow leaved sunflower (*Helianthus angustifolius*), which is a New York State listed threatened plant species.

This particular habitat has been characterized as a Maritime Deciduous Scrub Forest; known for having plant species such as black cherry (*Prunus serotina*), sassafras (*Sassafras albidum),* Canadian serviceberry (*Amelanchier canadensis*), and roundleaf greenbrier (*Smilax rotundifolia*) (Klopfer et at. 2002).

Work Cited:

Klopfer, Scott D., Adele Olivero, Lesley Sneddon, and Julie Lundgren. Final Report of the NPS Vegetation Mapping Project at Fire Island National Seashore. Virginia Tech, College of Natural Resources, GIS & Remote Sensing Division, Conservation Management Institute. April, 2002.

Map of the William Floyd Estate with the 4 priority treatment sites (in light blue).