

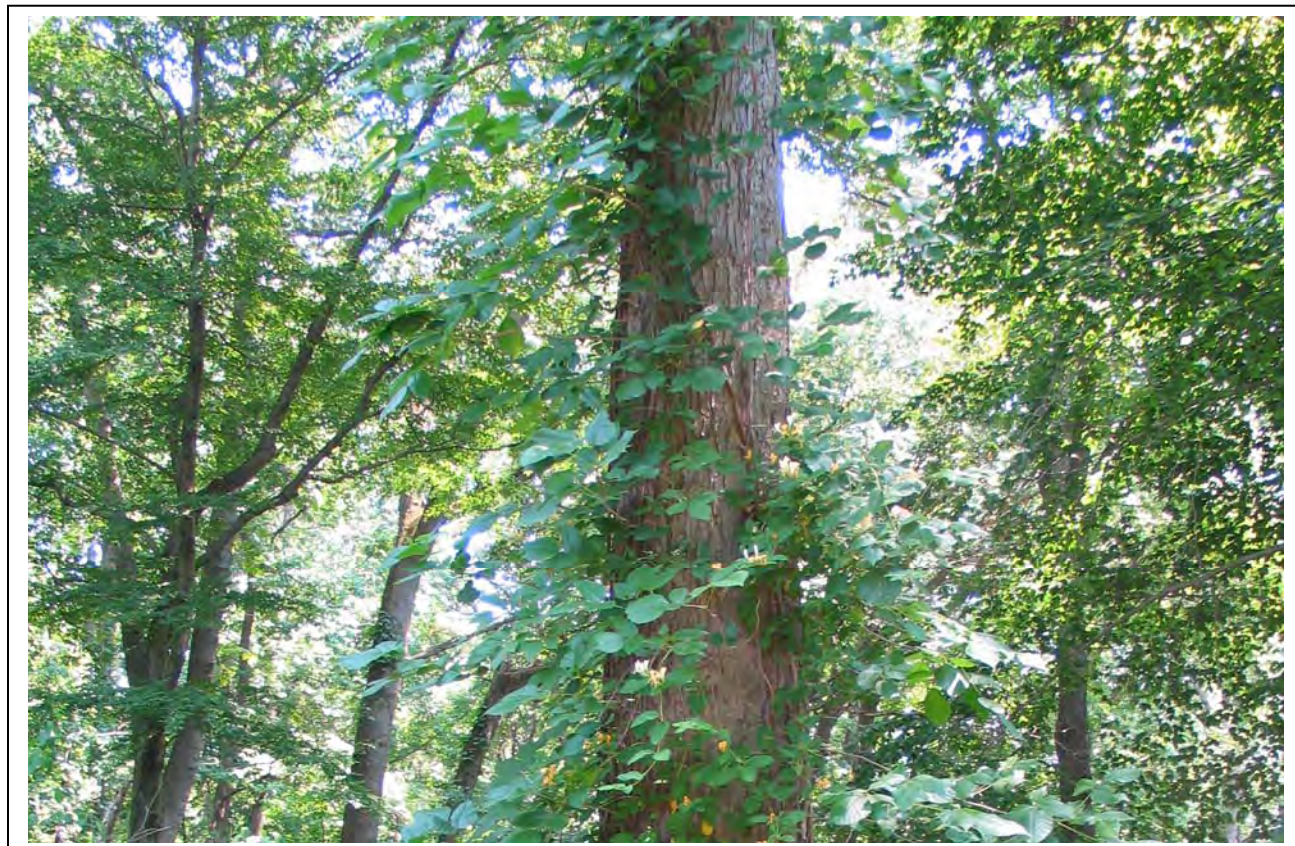
National Park Service
U.S. Department of the Interior

Northeast Region
Boston, Massachusetts



Sagamore Hill National Historic Site Invasive Non-native Plant Management Plan

Technical Report NPS/NER/NRTR--2006/045



ON THE COVER

Japanese Honeysuckle (*Lonicera japonica*)

Photograph by: David Werier

Sagamore Hill National Historic Site Invasive Non-native Plant Management Plan

Technical Report NPS/NER/NRTR--2006/045

David Werier

New York Natural Heritage Program
625 Broadway, 5th Floor
Albany, New York 12233

Current Address:

30 Banks Road
Brooktondale, New York 14817

July 2006

U.S. Department of the Interior
National Park Service
Northeast Region
Boston, Massachusetts

The Northeast Region of the National Park Service (NPS) comprises national parks and related areas in 13 New England and Mid-Atlantic states. The diversity of parks and their resources are reflected in their designations as national parks, seashores, historic sites, recreation areas, military parks, memorials, and rivers and trails. Biological, physical, and social science research results, natural resource inventory and monitoring data, scientific literature reviews, bibliographies, and proceedings of technical workshops and conferences related to these park units are disseminated through the NPS/NER Technical Report (NRTR) and Natural Resources Report (NRR) series. The reports are a continuation of series with previous acronyms of NPS/PHSO, NPS/MAR, NPS/BOS-RNR, and NPS/NERBOST. Individual parks may also disseminate information through their own report series.

Natural Resources Reports are the designated medium for information on technologies and resource management methods; "how to" resource management papers; proceedings of resource management workshops or conferences; and natural resource program descriptions and resource action plans.

Technical Reports are the designated medium for initially disseminating data and results of biological, physical, and social science research that addresses natural resource management issues; natural resource inventories and monitoring activities; scientific literature reviews; bibliographies; and peer-reviewed proceedings of technical workshops, conferences, or symposia.

Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the National Park Service.

This report was accomplished under Cooperative Agreement H4525020034, Task/Supplemental Agreement Number 2 with assistance from the NPS. The statements, findings, conclusions, recommendations, and data in this report are solely those of the author, and do not necessarily reflect the views of the U.S. Department of the Interior, National Park Service.

Reports in these series are produced in limited quantities and, as long as the supply lasts, may be obtained by sending a request to the address on the back cover. When original quantities are exhausted, copies may be requested from the NPS Technical Information Center (TIC), Denver Service Center, PO Box 25287, Denver, CO 80225-0287. A copy charge may be involved. To order from TIC, refer to document D-352.

This report may also be available as a downloadable portable document format file from the Internet at <http://www.nps.gov/nero/science/>.

Please cite this publication as:

Werier, D. July 2006. Sagamore Hill National Historic Site Invasive Non-native Plant Management Plan. Technical Report NPS/NER/NRTR--2006/045. National Park Service. Boston, MA.

Abstract

Invasive non-native plants are currently threatening natural and cultural resources at Sagamore Hill National Historic Site (SAHI) on Long Island, New York. This plan follows adaptive weed and integrated plant management strategies for protecting these resources from the threat of invasive non-native plants. A total of 30 invasive non-native plants were identified as occurring at SAHI. Seventeen of these are considered highly invasive and are targeted in this management plan. Populations of these targeted species were mapped and prioritized for management. Five natural areas within SAHI were identified as having a high priority for conservation. These areas contain old forests and one NY State endangered species. They are a significant part of the natural and cultural resources at SAHI. Where feasible, this plan calls for the eradication or containment of the targeted species in the high priority areas. Preventing new infestations of the targeted species is also critical. Control techniques are outlined for the targeted invasive plant species in the areas of high conservation priority. Ongoing monitoring protocols are presented to assess management actions and to assist in ongoing modifications of this plan.

Table of Contents

	Page #
Introduction	1
Context	1
The Problem with Non-native Invasive Species	1
Policy and Law	2
Adaptive Weed Management	5
Integrated Pest Management	7
Objectives	9
Materials and Methods	11
Initial Inventory Work at SAHI	11
Herbarium Work	12
Initial Prioritization of Invasive Non-native Species	12
Mapping	14
Boundaries	15
Statistics on Mapped Invasive Species	15
GPS and GIS Specifications	15
Prioritization of Management Actions	16
Results	17
Species Present at SAHI	17
Rare Species	17
Exceptional Areas	19
Significant Cultural Features/Areas	27
Conservation Priorities	28
Conservation Goals	29
Invasive Species	30
Targeted Invasive Species	30
Mapped but not Targeted Invasives.	44
Not Targeted or Mapped Invasives	46
Prioritization of Targeted Invasive Species	47
Discussion	51
Preventing the Spread of Invasive Species	51
Invasive Species Management at SAHI	53
Management Actions	54
Note Taking	61
Monitoring	61
Monitoring Protocols	61
Review and Modification of Management Plan	67
Conclusions	69
Acknowledgments	71
Literature Cited	73

Tables

	Page #
1. Integrating Integrated Pest Management into Exotic Plant Management at SAHI	8
2. List of most problematic invasive species present at SAHI with those chosen for targeting and/or mapping	13
3. Statistics on non-native invasive species which were mapped at SAHI	31
4. Results of Alien Plant Ranking System (APRS) ver. 7.11.	49
5. Final priority rank for the 15 targeted species/species pairs.	50
6. Targeted species populations (polygons) that are monitored using monitoring protocol A.	63

Figures

	Page #
1. Adaptive Weed Management Strategy	6
2 and 3. Giant ironweed (<i>Vernonia gigantea</i>) at SAHI	18
4 and 5. Eastern edge of exceptional area #1	20
6, 7, and 8. Exceptional area #2	21
9 and 10. Exceptional area #3	23
11, 12, 13, and 14. Large trees in exceptional area #3.	24
15 and 16. Exceptional area #4 spring time	26
17 and 18. Exceptional area #4 in September	27
19. Norway maple (<i>Acer platanoides</i>)	32
20. Tree-of-heaven (<i>Ailanthus altissima</i>)	33
21. Garlic mustard (<i>Alliaria petiolata</i>)	34
22 and 23. Japanese barberry (<i>Berberis thunbergii</i>)	34
24 and 25. Oriental bitter sweet (<i>Celastrus orbiculata</i>)	35
26. Burning bush (<i>Euonymus alata</i>)	36
27 and 28. English ivy (<i>Hedera helix</i>)	37
29. Border privet (<i>Ligustrum obtusifolium</i>)	38
30 and 31. Japanese Honeysuckle (<i>Lonicera japonica</i>)	39
32. Japanese stilt grass (<i>Microstegium vimineum</i>)	41
33 and 34. Japanese pachysandra (<i>Pachysandra terminalis</i>)	42
35. Common reed (<i>Phragmites australis</i> ssp. <i>australis</i>)	43
36 and 37. Chinese wisteria (<i>Wisteria sinensis</i>) and Japanese wisteria (<i>W. floribunda</i>)	44
38. Japanese snowball (<i>Viburnum plicatum</i>), arrowwood (<i>Viburnum dentatum</i> var. <i>lucidum</i>) and linden arrowwood (<i>Viburnum dilatatum</i>).	46
39. Cleared area just south of SAHI northern boundary in exceptional area #3.	52
40 and 41. Area south-southwest of new barn that was disturbed by management actions in 2005.	52
42. Schematic for protocol A	64
43. Schematic for protocol B	66

Appendixes

	Page #
A. Questions from the Alien Plant Ranking System used to prioritize targeted species	79
B. Answers to Alien Plant Ranking System (APRS) questions.	83
C. List of plants seen during 2005 survey work.	85
D. List of plants not seen growing at SAHI in 2005 that were seen as voucher specimens in the SAHI herbarium.	95
E. Some methods of control for Tree-of-heaven (<i>Ailanthus altissima</i>)	97

Maps

	Page #
1. Zones used to help survey SAHI	99
2. Exceptional areas and rare plants	100
3. Japanese maple (<i>Acer palmatum</i>)	101
4. Norway maple (<i>Acer platanoides</i>)	102
5. Tree-of-heaven (<i>Ailanthus altissima</i>)	103
6. Garlic mustard (<i>Alliaria petiolata</i>)	104
7. Wild chervil (<i>Anthriscus sylvestris</i>)	105
8. Japanese barberry (<i>Berberis thunbergii</i>)	106
9. Oriental bitter sweet (<i>Celastrus orbiculata</i>)	107
10. Crown vetch (<i>Coronilla varia</i>)	108
11. Burning bush (<i>Euonymus alata</i>)	109
12. English ivy (<i>Hedera helix</i>)	110
13. Border privet (<i>Ligustrum obtusifolium</i>)	111
14. Japanese honeysuckle (<i>Lonicera japonica</i>)	112
15. Morrow and Amur honeysuckle (<i>Lonicera morrowii</i> and <i>L. maackii</i>)	113
16. Japanese stilt grass (<i>Microstegium vimineum</i>)	114
17. Japanese pachysandra (<i>Pachysandra terminalis</i>)	115
18. Princess tree (<i>Paulownia tomentosa</i>)	116
19. Common reed (<i>Phragmites australis</i> ssp. <i>australis</i>)	117
20. Multiflora rose (<i>Rosa multiflora</i>)	118
21. Black locust (<i>Robinia pseudoacacia</i>)	119
22. Periwinkle (<i>Vinca minor</i>)	120
23. Japanese snowball and linen arrowwood (<i>Viburnum plicatum</i> and <i>V. dilatatum</i>)	121
24. Japanese and Chinese wisteria (<i>Wisteria floribunda</i> and <i>W. sinensis</i>)	122

Introduction

“Alas! the blight has now destroyed the chestnut trees, and robbed our woods of one of their distinctive beauties” (Roosevelt 1913).

Sagamore Hill (SH) is the former home and property of President Theodore Roosevelt. He bought the land on Cove Neck, Long Island in 1880 and had a home built. At the time of his purchase the land consisted of forests, maritime areas, and fields. The name Sagamore Hill was given to this property by Roosevelt after the Native American Chief Sagamore Mohannis from centuries past. Sagamore Hill served as Roosevelt’s family home. It also functioned as his Summer White House from 1902-1908. Parts of the property were actively farmed during his tenure. Sagamore Hill was a place where Roosevelt studied and enjoyed the natural world, including the plant life. He lived at Sagamore Hill until his death in 1919 (Roosevelt 1913, Bellavia and Curry 2003, National Park Service 2005). Sagamore Hill is currently preserved as a National Historic Site in public ownership and managed by the National Park Service (NPS) of the Department of Interior of the United States.

Context

The Sagamore Hill National Historic Site (SAHI) invasive non-native plant management plan fits within a context of national and park derived policy and law aiming to preserve and protect native species, functioning ecosystems, and cultural and historical resources.

The Problem with Non-native Invasive Species

Non-native invasive plants are currently negatively impacting and/or threatening native species and ecosystems worldwide (Tu et al. 2001). When these native species or native ecosystems are part of a cultural landscape setting then these non-native invasive species can also threaten cultural and historical resources.

Non-native plant species are plant species that have been intentionally or accidentally dispersed via human activities to areas beyond their historical range. For example, weeping forsythia (*Forsythia suspensa*) is considered non-native in North America. The historical or native range of this species is China, but it has been grown as an ornamental in North America from as early as 1833 (Rheder 1987). The key here is the “historical range.” For example, in New York black locust (*Robinia pseudoacacia*) is considered non-native because it was brought to New York from its historical range, which is the southeastern US.

If a non-native plant is able to maintain itself outside of cultivation in its new environment it is then considered naturalized. For example, dandelions (*Taraxacum officinale*) are considered naturalized in North America (Gleason and Cronquist 1991). They were brought to North America from Europe (probably accidentally via human activities) and now occur throughout this continent without assistance of humans.

If a naturalized species becomes extremely vigorous or grows aggressively, dominating large areas in a short period of time in its new range, it is called a non-native invasive species. Most non-native species do not become aggressive. Characteristics that describe invasive plant species include: rapid and vigorous vegetative growth; abundant seed production; able to disperse long distances easily; lack of pathogens; ability to grow in a wide range of habitats and/or soil conditions; significantly altering ecosystems; and out competing native plants. An invasive species does not need to exhibit all of these characteristics but often has many of them.

Sagamore Hill National Historic Site currently has many species of invasive non-native plants. These are discussed in detail later on in this report. The invasive plants present at SAHI are probably a result of past events on and near SH. Some of the invasive plants that occur at SAHI were cultivated by the Roosevelts or their neighbors and escaped from these plantings into the natural areas. Disturbance events including clearing land, cutting of trees, and even the creation of trails can create ideal conditions for invasive plants to establish themselves. As SH has become surrounded by other houses and residential development, the amount of land in the general area that has had some sort of large disturbance event has increased. Additionally, with increased residential housing an increase in landscaping has occurred. Some of this landscaping has clearly included invasive species which have escaped into adjacent natural areas. Roosevelt protected a large portion of the land at SH. These lands had minimal disturbance (Bellavia and Curry 2003). A result of this is that these areas have significantly less invasive species present than more disturbed areas. Overall, the presence and distribution of invasives at Sagamore Hill is not a result of random chance but of a clear land use history pattern.

Policy and Law

The 1916 Organic Act established the National Park Service (NPS). This law helped to outline the role of the NPS in regard to resource protection. “The service [NPS] thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified, ... by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations” (US Congress 1916). Invasive non-native plant species are threatening native species and ecosystems, as well as cultural and historical landscapes (National Park Service 1996). Invasive species are therefore capable of degrading NPS lands and leaving them impaired if left unchecked.

The NPS Strategic Plan of 2001-2005 (National Park Service 2000) sets out some goals which relate to invasive plant management. Mission Goal (a goal that lasts indefinitely) Ia states that “natural and cultural resources and associated values are protected, restored, and maintained in good condition and managed within their broader ecosystem.” To help achieve the “mission goals” long term goals were also created. These goals are meant to be accomplished in a five year period ending on September 2005. Long term goals include Ia1 - Disturbed Lands/Exotic Plant Species: Ia1B - exotic vegetation on 6.3% of targeted acres of parkland (167,500 of 2,656,700) acres is contained. Although this long term goal period has ended it can be expected that future long term goals will contain similar language.

Executive Order 13112 was signed in 1999 (Clinton 1999). Section 2 states that each “Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law, (1) identify such actions; (2) subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them; and (3) not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.”

A Strategic Plan for Managing Invasive Non-native Plants on National Park System Lands was developed in 1996 (National Park Service 1996). This plan describes “the impacts of invasive non-native plants on the National Park System's natural resources and outlines strategies and tactics to help prevent and manage their spread on National Park System lands.” Some strategies, targets, and actions outlined in the plan include:

Strategy: Prevent invasion.

Target: Develop and implement a park-based prevention program.

Actions:

- Develop an early warning system to identify and eradicate new infestations of non-native plants in the park. Train appropriate personnel to identify invasive non-native plants.
- Create and maintain a park-based list of plant species that have not yet invaded the park but that are known to occur in the region and are likely to invade.
- Work with the Denver Service Center and the Natural Resource Conservation Service to develop 'Best Management Practices' for ground-disturbing activities.

Target: Educate National Park Service employees and commercial users (permittees, concessioners, rights-of-way holders, etc.) about invasive non-native plant impacts on park resources.

Strategy: Inventory and monitor non-native plants.

Target: Assess the distribution and extent of invasive non-native plant populations.

Actions:

- Work with the Service-wide Inventory and Monitoring Program to initiate inventories that would gather information needed to make invasive non-native plant management decisions.

- Ensure that site-specific monitoring is included in plans for construction, habitat manipulation, and other activities that might increase the risk of non-native plant infestations.

Target: Base species management priorities on scientific and other resource-related information.

Actions

- Classify non-native plants based on potential impacts to the ecosystem.

Strategy: Manage invasive non-native plants.

Target: Reduce populations of invasive non-native plants through an integrated pest management program that incorporates chemical, biological, cultural, and physical (mechanical) operations.

Sagamore Hill National Historic Site is in the process of developing a General Management Plan which will “provide guidance for management decisions that affect park resources and visitor experience over the next 20 years” (National Park Service 2005). The purpose of SAHI is set out as follows: “Sagamore Hill preserves in public ownership and interprets the structures, landscape, collections, and other cultural resources associated with Theodore Roosevelt’s home in Oyster Bay, New York to ensure that future generations understand and appreciate the life and legacy of Theodore Roosevelt, his family, and the significant events associated with him at Sagamore Hill.”

Resource protection goals at SAHI are “park resources are preserved and maintained in good condition and in a manner that supports a balanced approach to cultural and natural resource management” (National Park Service 2005).

Additionally the National Park Service has “recognized the need to portray the landscape of Sagamore Hill as it existed during Theodore Roosevelt’s lifetime, much as it does the house” (Bellavia and Curry 2003). The landscape represents the cultivated areas around Roosevelt’s house as well as the natural areas that exist at SH.

The landscape that existed when Roosevelt resided at SH is relevant to appreciating the life and legacy of the man. Roosevelt was an astute student of the natural environment that surrounded him at SAHI. In his autobiography, Roosevelt (1913) exhibits his knowledge, familiarity, and appreciation of the natural world that existed close by at SH. “Most of the birds in our neighborhood are the ordinary home friends of the house and the barn, the wood lot and the pasture; but now and then the species make queer shifts. The cheery quail, alas! are rarely found near us now; and we no longer hear the whip-poor-wills at night. But some birds visit us now which formerly did not. When I was a boy neither the black-throated green warbler nor the purple finch nested around us, nor were bobolinks found in our fields. The black-throated green warbler is now one of our commonest summer warblers; there are plenty of purple finches; and, best of all, the bobolinks are far from infrequent.”

Roosevelt also goes on to mention the flowers that blossom throughout the year. “Long Island is not as rich in flowers as the valley of the Hudson. Yet there are many. Early in April there is one hillside near us which glows like a tender flame with the white of the bloodroot. About the same time we find the shy mayflower, the trailing arbutus; and although we rarely pick wild

flowers, one member of the household always plucks a little bunch of mayflowers to send to a friend working in Panama, whose soul hungers for the Northern spring. Then there are shadblow and delicate anemones, about the time of the cherry blossoms; the brief glory of the apple orchards follows; and then the thronging dogwoods fill the forests with their radiance; and so flowers follow flowers until the springtime splendor closes with the laurel and the evanescent, honey-sweet locust bloom. The late summer flowers follow, the flaunting lilies, and cardinal flowers, and marshmallows, and pale beach rosemary; and the goldenrod and the asters when the afternoons shorten and we again begin to think of fires in the wide fireplaces” (Roosevelt 1913). What is striking about this paragraph in his autobiography, is that he mentions at least 14 species of native plants most of which would only be found in the areas not in cultivation or development. He clearly paid attention, studied, and enjoyed not only the natural world but the native environments at SH. Understanding and appreciating Roosevelt’s life and particularly his life at SH is certainly enhanced by preserving the natural areas as it occurred during his lifetime.

Even in his time Roosevelt was aware of how invasive non-native species can negatively impact the natural environment that he so treasured. “Alas! the blight has now destroyed the chestnut trees, and robbed our woods of one of their distinctive beauties” (Roosevelt 1913).

Adaptive Weed Management

This plan is developed around the concept of adaptive weed management (see diagram below; Tu et al. 2001). For this plan this means 1: cultural and natural resources are assessed and prioritized. Goals are set around preserving these resources. 2: Non-native species that are present at SAHI are identified. These species are prioritized for control based on their current or potential impacts on the resources of SAHI. 3: Specific control methods are analyzed for their ability to achieve the stated goals. These are presented along with other issues and concerns related to achieving the stated goals. 4: This plan is implemented. Management actions are conducted. 5: This plan presents recommendations for ongoing monitoring to assess the success of the management actions. 6: This management plan is then reassessed and modified. The process then starts all over again. This plan can be used as the guiding document related to invasive plant management at SAHI until it is modified. No specific time frame is set out for the life of this plan but probably 5-10 years, after implementation, is appropriate.

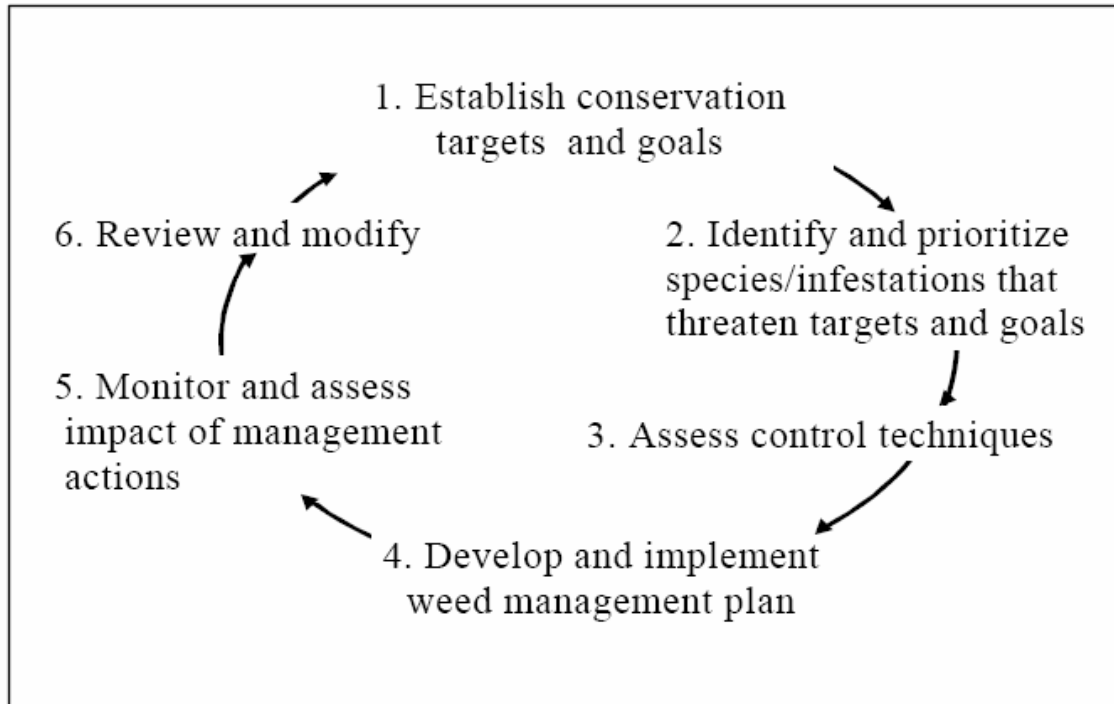


Figure 1. Adaptive weed management strategy (taken from Tu et al. 2001).

Integrated Pest Management

This plan follows an integrated pest management approach to controlling the invasive plants that are threatening SAHI's resources. This approach is mandated under section 4.4.5.2 of National Park Service Policy (National Park Service 2001), which states that "each park unit will use an IPM approach to address pest issues."

"IPM is a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while posing the least possible risk to people, resources, and the environment" (National Park Service 2001). In the case of invasive vegetation, IPM strives to prevent new introductions, determine whether a given non-native plant is indeed an invasive pest, and preferentially use non-chemical means of control over chemical methods where indicated by professional best management practices.

Table 1. Integrating integrated pest management into exotic plant management at SAHI.

Integrated Pest Management Process Steps	Invasive Non-native Plant Management Plan Actions
1. Identify specific pests	Refer to “invasive species” in the results section, page 32.
2. Build consensus on stated problems and treatments	This Plan and ongoing communications are required elements
3. Review appropriate Federal & State laws and NPS policy	Refer to “policy and law” in the introduction section, page 6.
4. Establish action thresholds	Refer to “conservation priorities” and “conservation goals” in the results section, page 29 and 31.
5. Establish priorities	Refer to “prioritization of targeted invasive species” in the results section, page 49.
6. Monitor pests and the environment	Refer to “monitoring” in the discussion section, page 61.
7. Apply indirect/direct suppression as needed: Apply non-chemical methods as the first course of action where professional literature and experience indicate feasibility and practicality Obtain prior approval and apply pesticides if they are warranted	Refer to “management actions” in the discussions section, page 55. This Plan and specific communications with the NPS-NER IPM Coordinator are required.
8. Evaluate effectiveness	Refer to “review and modification of management plan” in discussions section, page 65.
9. Keep records of pesticide use for annual reporting and the public's "right to know."	Refer to “management actions” in the discussions section, page 55.

Objectives

The purpose of the Invasive Non-native Plant Management Plan is to create a framework to help reduce or eliminate the current and potential negative impacts that invasive non-native plants are or could have on the natural and cultural landscape at SAHI. In doing so, the plan is meant to assist the NPS in achieving its aforementioned goals and policies related to SAHI.

Specific objectives for this plan include:

1. Catalog the native plant species, search for and document rare plant species, and document areas of high biological value (exceptional areas).
2. Set conservation goals.
3. Catalog the non-native plants that currently occur at SAHI.
4. Identify the most problematic non-native invasive plant species present at SAHI (targeted species) and prioritize these for control efforts.
5. Map populations at SAHI and provide basic information on targeted non-native invasive plant species.
6. Analyze and prioritize management actions for dealing with targeted species.
7. Analyze control methods for targeted species and provide recommendations for control.
8. Provide recommendations for monitoring targeted species.

Materials and Methods

The general method employed for inventorying, and identifying and mapping populations of targeted non-native invasive plant species at SAHI was a comprehensive survey of the entire park. Therefore, any follow-up to compare conditions will also need to be a full park survey.

Initial Inventory Work at SAHI

Surveys of SAHI were conducted by the author from June 23rd to the 28th and from September 3rd to the 8th of 2005. During the first three days of the period in June and the first day of the period in September, the focus was on inventorying SAHI for non-native plants, native plants, and exceptional natural areas. During the remainder of the survey periods, inventory work continued but the focus shifted to mapping targeted species (see below). The inventory work focused on plants outside of cultivation but in a few cases notes were taken on species that were or could have been in cultivation.

An aerial photo of SAHI was used to divide the entire property into numerous zones. These zones were initially based on a draft ecological community map (a variable assemblage of interacting plant and animal populations that share a common environment; Edinger et al. 2002) created by Aissa Feldman of the New York Natural Heritage Program (in preparation). The author modified these zones to assist in survey work (see Map 1). For the inventory, each zone was covered by walking parallel belt transects approximately 25 meters in width. The belt transects were used as a general guideline to help cover most of SAHI but deviations from these transects were made frequently to investigate areas and plants of interest.

All plant species seen were recorded following the taxonomy of Weldy and Werier (2005). A single common name was chosen to represent each species in this report. All listings of common names are referable to a particular scientific name in this report (see Appendix C and D). Some specimens were collected to help in identification and to provide voucher references. Collected specimens were pressed, dried, and labels were made with information on location, habitat, and date. These specimens will be deposited at the herbarium at SAHI. Species determination was done by the author or in a few cases determination and/or confirmation was done with the help of other botanists.

Plants that are rare in New York were sought during the survey periods. Rare plants include all those currently ranked as an S1, S2, or S3 by the New York Natural Heritage Program (Young and Weldy 2005). These ranks refer to a species rarity in New York. S1 means critically imperiled in New York State with generally 5 or fewer sites, S2 means imperiled in New York State with generally 6-20 sites, and S3 means rare in New York State with generally 21-35 sites. One rarity was found during the surveys. For the population of this species various details were recorded including location information, population size in number, population area, habitat, threats, management needs, etc. (see results section).

Areas of exceptional ecological significance (exceptional areas) were documented. Areas sought for this category had a high percentage of native species, appeared to be functioning in a native

state, and had other outstanding qualities such as old trees or unique habitats. Full habitat descriptions including plant species present were recorded. Each area was also mapped.

Mapping for these areas occurred in one of two ways. For areas that correlated with the delineated zones (see Map 1) these zones were used to create a map of the exceptional area. For areas that did not correlate well with these zones the perimeters were walked with a GPS unit (see GPS specifications).

Herbarium Work

Stalter (2000) listed a few plants in his checklist of plants that occur at SAHI which are rare in New York. Voucher specimens for these rarities were sought in the herbarium at SAHI. The herbarium was also examined to help clarify additional published records (Dutton 1998, Stalter 2000) of non-native plants that were not found during survey work in 2005.

Initial Prioritization of Invasive Non-native Species

It was initially determined that 10-15 of the most invasive or problematic non-native species would be targeted for this plan. Previous species lists made for SAHI (Dutton 1998, Stalter 2000) were consulted and a list of all non-native species was made. Initial prioritization of this non-native list was made by the author in consultation with Sheila Colwell, Betsy Lyman, and Scott Gurney of the NPS. In addition, invasive species lists created by the Invasive Plant Atlas of New England (Mehrhoff et al. 2003d), Invasive Plant Council of New York State (Invasive Plant Council of New York State no date), and the Plant Conservation Alliance Alien Plant Working Group (Plant Conservation Alliance Alien Plant Working Group 2006) were used to help in the prioritization. An initial targeted species list was created based on species that were considered the most invasive by most if not all of the aforementioned people and sources (see Table 2).

After the initial inventory work in June the targeted species list was modified in consultation with Betsy Lyman and Scott Gurney of the NPS (see Table 2). Four species were added: Japanese pachysandra (*Pachysandra terminalis*), English ivy (*Hedera helix*), border privet (*Ligustrum obtusifolium*), and Japanese wisteria (*Wisteria floribunda*). These species were added because they appeared to be widespread and/or problematic especially in the natural areas. Amur honeysuckle (*Lonicera maackii*) was also chosen but lumped together with Morrow honeysuckle (*Lonicera morrowii*) because these two honeysuckles are similar in growth form and impact. In a similar fashion, Chinese wisteria (*Wisteria sinensis*) was chosen but was lumped with Japanese wisteria (*Wisteria floribunda*). Black locust (*Robinia pseudoacacia*) and porcelain berry (*Ampelopsis brevipedunculata*) were removed from the target list because their impact / potential impact although not small seemed less than the other species targeted. Purple loosestrife (*Lythrum salicaria*) was removed from the list because it was not seen at SAHI.

Table 2. List of most problematic invasive non-native species present at SAHI with those chosen for targeting and/or mapping.

Scientific Name	Common Name	Initial Target List	Final Target List	Species Mapped but not Targeted	Others not Targeted or Mapped
<i>Acer palmatum</i>	Japanese maple			X	
<i>Acer platanoides</i>	Norway maple	X	X		
<i>Ailanthus altissima</i>	tree of heaven	X	X		
<i>Alliaria petiolata</i>	garlic mustard	X	X		
<i>Ampelopsis brevipedunculata</i>	porcelain-berry	X			X
<i>Anthriscus sylvestris</i>	wild chervil			X	
<i>Aralia elata</i>	Japanese angelica tree				X
<i>Artemisia vulgaris</i>	mugwort				X
<i>Berberis thunbergii</i>	Japanese barberry	X	X		
<i>Celastrus orbiculata</i>	Oriental bittersweet	X	X		
<i>Coronilla varia</i>	crown vetch			X	
<i>Euonymus alata</i>	burning bush	X	X		
<i>Hedera helix</i>	English ivy		X		
<i>Ligustrum obtusifolium</i>	border privet		X		
<i>Lonicera japonica</i>	Japanese honeysuckle	X	X		
<i>Lonicera maackii</i>	Amur honeysuckle		lumped w/ Morrow honeysuckle		
<i>Lonicera morrowii</i>	Morrow honeysuckle	X	X		
<i>Lythrum salicaria</i>	purple loosestrife	X			not seen at SAHI in 2005
<i>Microstegium vimineum</i>	Japanese stilt grass	X	X		
<i>Pachysandra terminalis</i>	Japanese pachysandra		X		
<i>Paulownia tomentosa</i>	princess tree			X	
<i>Phragmites australis</i> ssp. <i>australis</i>	common reed	X	X		
<i>Robinia pseudoacacia</i>	black locust	X		X	
<i>Rosa multiflora</i>	multiflora rose	X	X		
<i>Rubus phoenicolasius</i>	wineberry				X
<i>Taxus ? cuspidata</i>	Japanese yew				X
<i>Viburnum dilatatum</i>	linden arrowwood			lumped w/ Japanese snowball	
<i>Viburnum plicatum</i>	Japanese snowball			X	
<i>Vinca minor</i>	periwinkle			X	
<i>Wisteria floribunda</i>	Japanese wisteria		X		
<i>Wisteria ? sinensis</i>	Chinese wisteria		lumped w/ Japanese wisteria		

Mapping

All targeted species and some other invasive non-native plant species were mapped (see Table 2). Some species not on the targeted species list were mapped because these species although not the highest priority for control are still a problem at SAHI. The four exceptional areas and the one rare plant that was found were also mapped. Mapping was conducted during both the June and September survey periods. Mapping was done in one of four ways (also see GPS and GIS specifications in the methods section).

1. The perimeters of populations of species to be mapped or exceptional areas were walked with a GPS unit. Initially the perimeters were going to be flagged first and then walked. It was observed that flagging perimeters first was very time consuming and was not going to yield more accurate assessments of population boundaries. So, flagging was discontinued.
2. Some very small populations were marked as a point with a GPS unit and buffered to a specified distance.
3. A few populations occur adjacent to buildings or structures. The GPS unit was unable to acquire satellites at these areas. These populations were drawn on a hard copy aerial photo map and later drawn directly on screen to a digital aerial photo map in Arc View 3.3.
4. A few species and populations to be mapped did not occur as discrete isolated populations. Instead, they occurred throughout all available habitats for the species such as forests or fields. For these species, zones (see Map 1) where they were found occurring throughout were noted and maps were created for each of these species using these zones. A similar process was used for exceptional areas that correlated well with specified zones.

For Norway maple (*Acer platanoides*) and Oriental bittersweet (*Celastrus orbiculata*) additional points where a particularly large individual occurred were marked using a GPS unit.

For polygons representing a population of a particular plant species, the canopy cover (“infested area”) of the species excluding the spaces between the individuals was determined. This was done in one of two ways.

1. The percent of the polygon that was covered by the species in question, excluding spaces between the individuals, was estimated. These estimates were often difficult to make because the polygons were large, the species rarely occurred evenly throughout the polygons, and some of the species are trees or vines with their canopy high above the ground. Therefore, these percent covers should be assumed to be inaccurate but they give a relative sense of the cover. “Infested area” of the species for each polygon was then calculated by multiplying the percent cover by the area of the polygon. The total “infested area” for each species was calculated by summing these individual amounts.
2. Sometimes it was easier and more accurate to directly estimate the actual “infested area” of a species in a polygon. This was particularly true for small polygons. Percent covers were later calculated by dividing the “infested area” by the area of the polygons.

Boundaries

During survey work, places were encountered where the SAHI boundaries were unclear. Scott Gurney of the NPS gave the author some guidance but boundaries were still not always apparent. During survey and mapping work the author tried to stay within the boundaries of the park but occasionally may have inadvertently been off of SAHI property.

An accurate GIS layer of the boundaries of SAHI was not available for this project. The boundaries that were used are the same ones that the New York Natural Heritage Program has been using for an ecological community assessment of SAHI (in preparation; see GIS project for more details). While these boundaries are fairly accurate it is apparent that they are slightly off in some areas.

Due to the above two issues regarding boundaries at SAHI some mapped populations of plants (polygons) appear just outside of the boundaries shown on the maps. The conservative approach was taken with those polygons and they were included in all analysis used in this plan. A priority should be placed on clearly marking the boundaries of the park and creating a GIS layer which accurately reflects these boundaries.

Statistics on Mapped Invasive Plant Species

For each invasive plant species that was mapped, a number of populations (or sub-populations) were mapped individually. Statistics were calculated on each species and these are described below.

Sum of Polygons Area: The area of each polygon representing where a particular invasive species population (sub-population) occurred was calculated using ArcView 3.3. The areas of all the polygons representing a particular species were summed and represent the “sum of polygons area.”

Gross Infested Area: The gross infested area is defined as the general perimeter of the infestation. Gross infested areas contain the target species and the spaces between populations or individuals. For each mapped species a polygon was drawn to encompass all the populations (sub-populations) documented at SAHI. The area of this polygon was then calculated in ArcView 3.3.

Infested Area: The actual cover of the species excluding areas between individuals was calculated for each polygon where the species occurs as mentioned in the section above. The sum of these covers was calculated and represents the “infested area.”

GPS and GIS Specifications

The GPS used for mapping was a Trimble Geo Explorer 3. Maximum PDOP (Position Dilution of Precision) was set to 6.0; minimum SNR (signal to noise ratio) was set to 4.0; a minimum of four satellites were used; for points, a minimum of 60 positions were collected and averaged; and

an antennae was used at a height of two meters above the ground. Such a high PDOP and low SNR mask were used to make it possible to do mapping in closed canopy situations. Still mapping was difficult at times. Mapping was done using UTM (Universal Transverse Mercator) coordinates with the North American Datum (NAD) 1983 in zone 18 north.

GPS data was downloaded to a computer using Pathfinder Office. The data was then differentially corrected using base station information from the Lamont Earth Observatory (LAMT) in Palisades, New York. Data was cleaned by not allowing polygons to have lines crossing. The data was then imported into ArcView 3.3.

Attribute Tables were created and populated. Attributes include: common name; scientific name; a unique number to help identify polygons; the date the mapping was done in the field; how polygons were mapped (see mapping in the methods section); zone id (for polygons that were mapped by correlating a species to a particular zone); percent canopy cover; infested area; how canopy cover was estimated (see mapping in the methods section); and area.

Metadata was created for each theme in the ArcView project. The ArcView project along with shapefiles, a base map, and the metadata is attached as a supplement to this management plan.

Prioritization of Management Actions

Removing all non-native species or even all invasive non-native species from all of SAHI is an impossible task as well as one that is not necessary to preserve the natural and cultural resources of the site. In order to prioritize management actions into a more do able task a series of analysis were done.

1. Identify areas of special natural or cultural significance.
2. Set conservation goals for these areas
3. Prioritize for control the 15 targeted non-native invasive species (see below)
4. Identify actions to help prevent the spread of non-natives at SAHI
5. Combine these three components into one comprehensive plan.

Prioritizing Among the 15 Targeted Species or Species Complexes

For each of the targeted species literature was reviewed on their biology, invasiveness, and management techniques. Targeted species were prioritized using the Alien Plant Ranking System ver. 7.11 (ALIEN PLANT RANKING SYSTEM Implementation Team 2001). This system ranks species on three categories: level of impact; potential to be invasive; and feasibility of control. For each species a series of 24 questions are answered (see Appendix A). A weight or number is given to each of the three categories depending on the answers to the questions. The answers are based on field work and on literature review.

Results

Species Present at SAHI

A total of 343 species were seen at SAHI during field work in 2005. Voucher specimens were collected for 77 of these species (see Appendix B). An additional 20 species that were not seen growing in 2005 were seen as voucher specimens in the SAHI herbarium (see Appendix C). Of these 363 total species ten were either planted, may have been planted, or have only spread slightly from where they were cultivated. In other words, their status as a truly naturalized species at SAHI is not conclusive. This leaves a total of 353 native or naturalized species known from SAHI.

Of these 353 species 180 are native; 170 are non-native; and 3 are probably non-native but a clear determination is not currently possible. Previous species lists for SAHI had considerably lower numbers. Stalter (2000) reported only 232 species with 139 native and 93 non-native. Dutton (1998) reported 258 species without indicating native and non-native numbers. Since all of these lists were created in the past 15 years the flora probably has not changed as much as the differences in these lists indicate. More thorough surveys as well as each list building upon previous list's vouchered specimens has probably led to the increase numbers of species reported.

This plan lists 30 species currently known from SAHI as the top invasive non-native plants (see Table 1). This is 18% of all the non-natives present. Of the 180 native plant species known from SAHI only one is considered rare by the New York Natural Heritage Program (Young and Weldy 2005). The other 179 native species although not rare, represent a significant part of the natural resources present at SAHI and management actions should work to protect these. Most are very common species and will do well without much effort, while others may become more limited or locally extirpated due to competition with the invasive non-native plant species present at SAHI.

Rare Species

During survey work in 2005 one individual of giant ironweed (*Vernonia gigantea* ssp. *gigantea*) was found at SAHI. This species is listed as "endangered" in New York and is given the rank of S1 [critically imperiled in New York State because of extreme rarity (5 or fewer sites or very few remaining individuals) or extremely vulnerable to extirpation from New York State due to biological factors] by the New York Natural Heritage Program (Young and Weldy 2005). In New York, giant ironweed is currently known only from Chautauqua County but is historically known or reported from Cattaraugus, Herkimer, Lewis, Monroe, Oneida, Ulster, and Wayne Counties (Young and Weldy 2005). Some of these county records are only reports (i.e. not based on vouchered specimens) and may be incorrect. This species has never been reported or documented from Long Island prior to this finding in 2005 (Weldy and Werier 2005, Young and Weldy 2005, Eric Lamont personal communication). Giant ironweed is mostly a mid-western and southern species ranging from New York west to southern Michigan and eastern Nebraska, south to South Carolina, Florida, and Texas (Gleason and Cronquist 1991).



Figure 2 and 3. Giant ironweed (*Vernonia gigantea*) at SAHI

The plant was found on the seventh of September, 2005. There was only one individual with four main stems. Some flowers were fully opened while others were in bud. The plant occurs in the field between the parking lot and the orchard less than 10 meters south of the small road just north of this field (see Map 2). According to Scott Gurney of the NPS (personal communication 2005), the field gets mowed once a year prior to July 4th and after the mowing there is a “rough riders” living history event on the field. The plant showed evidence of being cut earlier in the year and re-sprouting from below where it had been cut. In 1993, the field was apparently mowed weekly and maintained as a lawn (Bellavia and Curry 2003). During Roosevelt’s time and continuing through 1948 it was a “cow pasture (a daisy and clover field).” After 1948 it was no longer grazed and became overgrown with vegetation (Bellavia and Curry 2003).

The area where the plant occurs is flat. The soils are sandy with perhaps some silt mixed in. In September, the soils were dry but Scott Gurney (personal communication) indicated that this area of the field is often seasonally flooded especially in the spring. Dominant species near the giant ironweed include two grasses: yellow bristle grass (*Setaria pumila*) and tall purple-top (*Tridens flavus*). Other species present here include common violet (*Viola ? sororia*), orchard grass (*Dactylis glomerata*), Schreber muhly (*Muhlenbergia schreberi*), slender copperleaf (*Acalypha gracilens*), narrowleaf plantain (*Plantago lanceolata*), porcelain-berry (*Ampelopsis brevipedunculata*), Oriental bitter-sweet (*Celastrus orbiculata*), woodbine (*Parthenocissus vitacea*), white panicle aster (*Symphyotrichum lanceolatum*), little bluestem (*Schizachyrium scoparium*), and upright yellow wood-sorrel (*Oxalis stricta*). Mugwort (*Artemisia vulgaris*) occurs nearby along the fence marking the edge of the field.

Giant ironweed can apparently be “weedy in pastures” Gleason and Cronquist (1991). It is possible that this species has occurred at this site since or before Roosevelt resided at SH since the area where the giant ironweed currently is known was a pasture for many years (Bellavia and Curry 2003). The weekly mowing regime that apparently occurred in the early 1990’s (Bellavia and Curry 2003) may have caused the population to decline. There is also the possibility that this species has only recently been introduced at SAHI. Since it is a species that can occur in fields and pastures it may have been accidentally brought in with hay as a feed for the horses involved in the “rough riders” event.

With only one individual present, this population is threatened by any type of disturbance event, natural or human created, that would kill the plant such as trampling, disease, and/or competition from adjacent plants. Invasive plants that occur nearby include porcelain berry and Oriental bitter-sweet. Both of these plants occur throughout, but in small amounts, all of the open fields at SAHI. The porcelain-berry becomes a dominant plant in some of the areas of the fields that are mowed less frequently such as the south end of the same field where the giant ironweed occurs.

Three additional species that are rare in New York were previously reported to occur at SAHI (Stalter 2000). These are dwarf glasswort (*Salicornia bigelovii*), southern sea-blite (*Suaeda linearis*), and dwarf hawthorn (*Crataegus uniflora*). All three appear to be errors.

A specimen collected by Stalter and originally labeled *Salicornia bigelovii* (dwarf glasswort) was found in the SAHI herbarium. It is in fact *S. depressa* (glasswort) a species found in the maritime areas of SAHI. This specimen has now been annotated to *S. depressa* by the author.

No specimen of southern sea-blite (*Suaeda linearis*) was found in the herbarium. This species was also not found during survey work at SAHI in 2006 although, two closely related species, horned sea-blite (*Suaeda calceoliformis*) and white sea-blite (*Suaeda maritima*), were found. Sea-blites can be difficult to identify especially when they are immature. Stalter (personal communication) stated that horned sea-blite is the most common sea-blite at SAHI and his record of southern sea-blite may have been a misidentification. It is assumed that the record of southern sea-blite reported by Stalter (2000) is an error.

No specimen of dwarf hawthorn (*Crataegus uniflora*) was found in the SAHI herbarium or during survey work in 2005 at SAHI. Stalter (personal communication) could not recall where he had collected this species. Stalter (2000) states that, the dwarf hawthorn occurs in disturbed sites and is infrequent (5-15 occurrences or stands known). During survey work in 2005 the author found only one species of hawthorn, the one-seed hawthorn (*Crataegus monogyna*) which is a non-native species. Only a few individuals were found of the one-seeded hawthorn and they may have been planted. It is likely that the record of dwarf hawthorn is an error.

Exceptional Areas

Four areas at SAHI were found to be or have some elements of a high quality natural area. These four “exceptional areas” are described below. They have also been mapped (see Map 2).

#1

Exceptional area #1 occurs in the southwest area of SAHI. It occurs just south of the big field west of Teddy Roosevelt’s house (see Map 2). It is roughly circular in shape and is relatively small (0.510 hectares in area). This area consists of a small gully, a flat area north of the gully, and the top of a steep slope facing west looking down on the old carriage road. The soils are sandy with a small amount of gravel.

The entire area is forested. It appears that at least most of this area has been in forest since at least Roosevelt resided at SH. The eastern most part of this area may have been open in the past (Bellavia and Curry 2003). This part of the area has younger trees, less shrubs, and a dense layer of the native grass, wavy hair grass (*Deschampsia flexuosa*).



Figures 4 (left) and 5 (right). Eastern edge of exceptional area #1. Figure 5 shows area that is dominated by wavy hair grass and was mowed.

In the forest there is a tall canopy layer, a sub-canopy layer, a shrub and sapling layer, and an herbaceous layer. Red oak (*Quercus rubra*) and black oak (*Quercus velutina*) are dominant in the tall canopy. Some individuals of these two species are quite large and old. Other tall canopy species here include sweet birch (*Betula lenta*), mockernut hickory (*Carya alba*), eastern white pine (*Pinus strobus*), wild black cherry (*Prunus serotina*), and black locust (*Robinia pseudoacacia*). Sub-canopy and sapling trees are dominated by wild black cherry. Other trees present in these layers include the species listed as occurring in the tall canopy and Norway maple (*Acer platanoides*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), flowering dogwood (*Cornus florida*), European beech (*Fagus sylvatica*), apple (*Malus pumila*), scotch pine (*Pinus sylvestris*), and sassafras (*Sassafras albidum*). Although there are some non-native trees present here, their extent is limited and the dominants are native species. The most problematic tree in natural areas at SAHI is clearly Norway maple. This tree is present in this area but it is not in the tall canopy yet.

The shrub layer ranges from fairly dense to quite open and is dominated by mapleleaf viburnum (*Viburnum acerifolium*). Other shrubs present include Japanese barberry (*Berberis thunbergii*), burning bush (*Euonymus alatus*), Japanese holly (*Ilex crenata*), border privet (*Ligustrum obtusifolium*), Japanese yew (*Taxus cuspidata*), arrowwood (*Viburnum dentatum* var. *lucidum*), and Japanese snowball (*Viburnum plicatum*). Again, although there are numerous non-natives here including some highly invasive ones, the native species are currently dominant.

The herb/vine layer is dominated by roundleaf greenbrier (*Smilax rotundifolia*). In the eastern end of this area is a section where the shrub layer is quite sparse and wavy hair grass (*Deschampsia flexuosa*) becomes dominant in the herb layer. Other herbs and vines present include: lady fern (*Athyrium filix-femina* ssp. *angustum*), bellow-beaked sedge (*Carex albicans*

var. *albicans*), swan sedge (*Carex swanii*), enchanter's nightshade (*Circaea lutetiana*), white wood-aster (*Eurybia divaricata*), Japanese honeysuckle (*Lonicera japonica*), Solomon's-plume (*Maianthemum racemosum*), Indian-pipe (*Monotropa uniflora*), sensitive fern (*Onoclea sensibilis*), woodbine (*Parthenocissus vitacea*), jumpseed (*Persicaria virginiana*), common Solomon's-seal (*Polygonatum biflorum*), downy Solomon's-seal (*Polygonatum pubescens*), Christmas fern (*Polystichum acrostichoides*), Allegheny blackberry (*Rubus allegheniensis*), eastern poison ivy (*Toxicodendron radicans*), and summer grape (*Vitis aestivalis*). Notable is the lack of garlic mustard in the herbaceous layer. The very eastern end of this area was mowed sometime prior to the author's September survey period. The mowing went into the dirt in places and disturbed some of the soils.

This small area is dominated by native species in all layers and is amazingly devoid of garlic mustard. The perimeter of the area especially to the south and west become weedier with the non-native species mentioned above becoming more common. The areas adjacent especially to the south and west are very weedy with many aggressive invasive plants. Due to its small size and proximity to very weedy areas this exceptional area is given the lowest priority in comparison to the other three exceptional areas listed.

#2

Exceptional area #2 is located in the northwest part of SAHI. Part of this area is bounded by SAHI's property line (see Map 2). This area consists of a wide east-west trending ridge, a gentle north facing slope north of this ridge, a steep south-southwest-west facing slope south of the ridge, a small gully at the base of this steep slope, and a steep north facing slope south of the gully. It is 0.779 hectares in area.

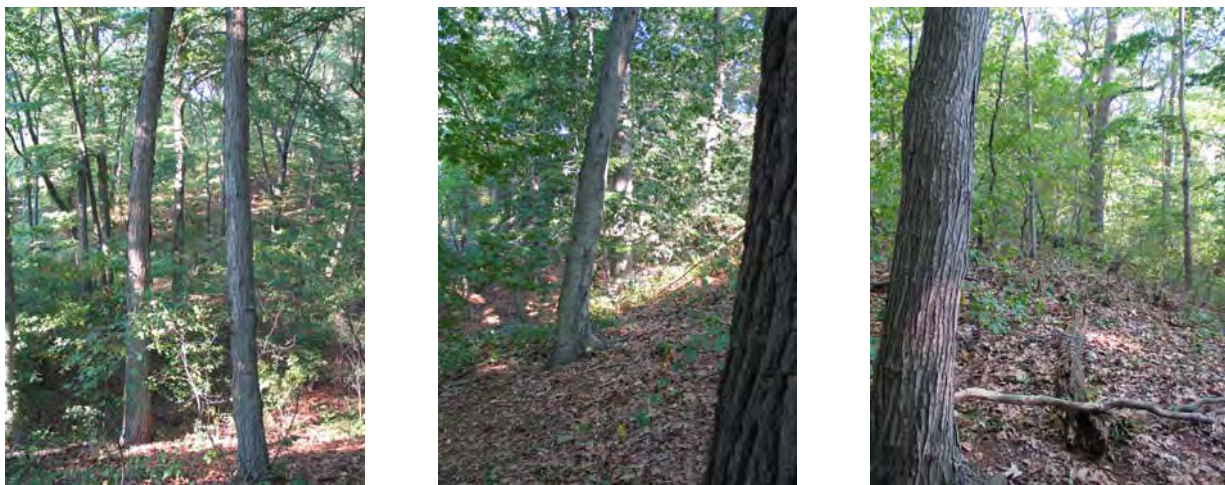


Figure 6 (left), 7 (middle), 8 (right). Exceptional area #2

The entire area is forested. The area appears to have recovered from past pasture land and probably was never tilled. This is suspected because there are abundant old dead red cedars (*Juniperus virginiana*); there are abundant fairly large early successional trees: sassafras

(*Sassafras albidum*) and sweet birch (*Betula lenta*); there are some old fence lines that traverse part of the area; and there are some very old and large mockernut hickory (*Carya alba*), red oak (*Quercus rubra*), and black oak (*Quercus velutina*) which, were probably present when this area was being grazed. There is evidence of past cutting of the red cedar. From historical information it appears that this area had tree cover since at least when Roosevelt resided at SH.

The overstory is dominated by sweet birch (*Betula lenta*), red oak (*Quercus rubra*), and black oak (*Quercus velutina*). The understory tree layer is dominated by sassafras (*Sassafras albidum*). Some of these sassafras trees are very large. Other trees present include Norway maple (*Acer platanoides*), red maple (*Acer rubrum*), tree-of-heaven (*Ailanthus altissima*), Japanese angelica tree (*Aralia elata*), mockernut hickory (*Carya alba*), flowering dogwood (*Cornus florida*), sweet cherry (*Prunus avium*), and wild black cherry (*Prunus serotina*). The invasive trees present here are limited in distribution and are not dominant.

The shrub layer is moderate in density with mapleleaf viburnum (*Viburnum acerifolium*) dominant. Other shrubs present include spicebush (*Lindera benzoin*) and linden arrowwood (*Viburnum dilatatum*).

The herb layer is fairly sparse. There are also scattered vines throughout the area. The dominant herbs and vines include: common Solomon's-seal (*Polygonatum biflorum*) and roundleaf greenbrier (*Smilax rotundifolia*). The roundleaf green brier becomes quite thick and dense just west of this exceptional area. Perhaps the area where the roundleaf green brier is dense should be included in this exceptional area. It was excluded because there are some large tree-of-heavens present where the green brier is dense. Other herbs and vines present in this exceptional area include: white wood-aster (*Eurybia divaricata*), Canada may-flower (*Maianthemum canadense*), downy Solomon's-seal (*Polygonatum pubescens*), and eastern poison ivy (*Toxicodendron radicans*).

Exceptional area #2 is a significant natural resource at SAHI because it is dominated by native plant species in all layers and there are some very large old trees present. The area is also interesting due to the large sassafras trees present. The area is relatively small, is surrounded by areas that are weedier, and is adjacent to private property. For these reasons, this area, like exceptional area #1 is given a low priority compared to exceptional areas #3 and 4.

#3

Exceptional area #3 is a relatively large area (11.095 hectares). It represents most of the forested area in the eastern part of SAHI. It occurs east and south of the Old Orchard museum and west of the maritime area. It is bordered on the north and south by SAHI's boundaries. The forested area just east of the Old Orchard museum is excluded from this exceptional area. There is a fence on or near the north boundary line constructed by the neighbor (Scott Gurney personal communication). In 2005, the NPS staff began to clear an approximately 4 meter wide swath just south of this fence. Most of the vegetation in the swath appears to have been cut and brush hogged. See Map 2 for more details on location.

This area slopes gently down to the east as well as to the south. In the eastern part of this area there are a few east-west trending broad ridges and valleys. In the southwestern part of this area there are a few north-south trending ridges and valley. There is a vernal pool present (Lower Lake) in the southeastern part of this area. The area is mostly dominated by old forests with some very old trees and snags present. A looped walking trail goes through this area and leads from the Old Orchard Museum to the maritime area. This exceptional area has been in forest since at least Roosevelt resided at SH (Bellavia and Curry 2003).



Figure 9 (left), 10 (right). Exceptional area #3

Tree species in the canopy are very diverse with numerous native species dominant. All of the dominant species in the canopy have at least some individuals that are quite large. There are also numerous large snags and some down logs present. Dominants in the canopy layer at least in part include: red maple (*Acer rubrum*), tulip tree (*Liriodendron tulipifera*), white oak (*Quercus alba*), chestnut oak (*Quercus montana*), red oak (*Quercus rubra*), black oak (*Quercus velutina*), and sassafras (*Sassafras albidum*). Although not dominant, there are also some very large mockernut hickory (*Carya alba*) in the canopy. Other trees present in the canopy and sub-canopy layer include: Norway maple (*Acer platanoides*), sugar maple (*Acer saccharum*), buckeye (*Aesculus sp.*), downy serviceberry (*Amelanchier arborea*), Japanese angelica tree (*Aralia elata*), sweet birch (*Betula lenta*), pignut hickory (*Carya glabra*), American chestnut (*Castanea dentata*), flowering dogwood (*Cornus florida*), American beech (*Fagus grandifolia*), black walnut (*Juglans nigra*), red cedar (*Juniperus virginiana*), umbrella magnolia (*Magnolia tripetala*), cork tree (*Phellodendron sp.*), Norway spruce (*Picea abies*), eastern white pine (*Pinus strobus*), sweet cherry (*Prunus avium*), wild black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), Japanese yew (*Taxus cuspidata*), American basswood (*Tilia americana*), and American elm (*Ulmus americana*). Norway maple is becoming a problem in this exceptional area but mostly a little east of the Old Orchard Museum and south of gray cottage. In these areas Norway maple has reached the canopy.



Figure 11 (left), 12(left center), 13 (right center), 14 (right). Large trees in exceptional area #3.
11: Red oak; 12: Sassafras; 13 and 14: Tulip trees

The shrub layer is fairly dense, at least in part, with a large number of species present although most of these are very limited in distribution or sparsely distributed throughout. Dominants at least in part include spicebush (*Lindera benzoin*) and linden arrowwood (*Viburnum dilatatum*). Other shrubs present include: alternate-leaf dogwood (*Cornus alternifolia*), burning bush (*Euonymus alatus*), forsythia (*Forsythia x intermedia*), black huckleberry (*Gaylussacia baccata*), Japanese holly (*Ilex crenata*), winter berry (*Ilex verticillata*), Mountain laurel (*Kalmia latifolia*), border privet (*Ligustrum obtusifolium*), Morrow honeysuckle (*Lonicera morrowii*), Siberian crabapple (*Malus baccata*), multiflora rose (*Rosa multiflora*), common elderberry (*Sambucus nigra* ssp. *canadensis*), highbush blueberry (*Vaccinium corymbosum*), early lowbush blueberry (*Vaccinium pallidum*), mapleleaf viburnum (*Viburnum acerifolium*), arrowwood (*Viburnum dentatum* var. *lucidum*), Japanese snowball (*Viburnum plicatum*), and black-haw (*Viburnum prunifolium*).

Vines are mostly not dominant although in places they become somewhat dense. Vines present include: Oriental bitter-sweet (*Celastrus orbiculata*), English ivy (*Hedera helix*), Japanese honeysuckle (*Lonicera japonica*), Boston-ivy (*Parthenocissus tricuspidata*), woodbine (*Parthenocissus vitacea*), wild sarsaparilla (*Smilax glauca*), roundleaf greenbrier (*Smilax rotundifolia*), eastern poison ivy (*Toxicodendron radicans*), and summer grape (*Vitis aestivalis*). Some Oriental bitter-sweet vines have gotten quite large and are in the canopy.

The herb layer is quite dense in places although not throughout. Dominants at least in part include garlic mustard (*Alliaria petiolata*), spotted jewelweed (*Impatiens capensis*), and lopseed (*Phryma leptostachya*). The herb layer is relatively species rich with most species being native. The most problematic herbaceous species is garlic mustard which occurs almost throughout the entire area. The northeast portion of this exceptional area is currently devoid of garlic mustard. Other herbs present include: wild sarsaparilla (*Aralia nudicaulis*), Parlin's pussytoes (*Antennaria* ? *parlinii*), Jack-in-the-pulpit (*Arisaema triphyllum*), lady fern (*Athyrium filix-femina* ssp. *angustum*), bellow-beaked sedge (*Carex albicans* var. *albicans*), slender wood sedge (*Carex digitalis*), Pennsylvania sedge (*Carex* ? *pensylvanica*), swan sedge (*Carex swanii*), ribbed sedge (*Carex virescens*), greater celadine (*Chelidonium majus*), spotted wintergreen (*Chimaphila maculata*), enchanter's nightshade (*Circaea lutetiana*), Canada horse-balm (*Collinsonia canadensis*), wavy hair grass (*Deschampsia flexuosa*), evergreen woodfern (*Dryopteris*

intermedia), marginal wood fern (*Dryopteris marginalis*), white wood-aster (*Eurybia divaricata*), wild geranium (*Geranium maculatum*), panicled hawkweed (*Hieracium paniculatum*), tall blue lettuce (*Lactuca biennis*), common woodrush (*Luzula multiflora*), Canada may-flower (*Maianthemum canadense*), Solomon's-plume (*Maianthemum racemosum*), Indian-pipe (*Monotropa uniflora*), sensitive fern (*Onoclea sensibilis*), longstyle sweetroot (*Osmorhiza longistylis*), Japanese pachysandra (*Pachysandra terminalis*), jumpseed (*Persicaria virginiana*), pokeweed (*Phytolacca americana*), common Solomon's-seal (*Polygonatum biflorum*), downy Solomon's-seal (*Polygonatum pubescens*), Christmas fern (*Polystichum acrostichoides*), American wintergreen (*Pyrola americana*), Allegheny blackberry (*Rubus allegheniensis*), wineberry (*Rubus phoenicolasius*), silverrod (*Solidago bicolor*), bluestem goldenrod (*Solidago caesia*), rough-leaf goldenrod (*Solidago rugosa*), calico aster (*Symphotrichum lateriflorum*), New York fern (*Thelypteris noveboracensis*), periwinkle (*Vinca minor*), and common violet (*Viola sororia*).

The small vernal pool in the southeast portion of this exceptional area was known as Lower Lake (Bellavia and Curry 2003). It is seasonally flooded and the soils are probably always saturated. The vernal pool is oval in shape and at highest water is about 40 x 15 meters. The edges and some of the interior portions of the pool have shrubs dominant. Shrubs present include winter berry (*Ilex verticillata*), multiflora rose (*Rosa multiflora*), and European gray willow (*Salix ? cinerea*). The herbaceous layer is thick and fills all of the pool at least late in the season. A species of beggar-tick (*Bidens sp.*) dominates the herbaceous layer. Other herbs and vines include: porcelain berry (*Ampelopsis brevipedunculata*), false nettle (*Boehmeria cylindrica*), shallow sedge (*Carex lurida*), fowl mannagrass (*Glyceria striata*), spotted jewelweed (*Impatiens capensis*), marsh seedbox (*Ludwigia palustris*), sensitive fern (*Onoclea sensibilis*), and summer grape (*Vitis aestivalis*).

This forest represents the oak-tulip tree forest ecological community (Edinger et al. 2002). Overall this exceptional area is a fairly high quality old forest with a small vernal pool. The area is relatively large, is contiguous, mostly has native plants dominant, and has a large number of old trees present. The area is becoming degraded by invasive species but is currently still dominated by native plants (except garlic mustard and Norway maple in a few places).

#4

Exceptional area #4 is the maritime area at the eastern edge of SAHI. It consists of a tidal creek (Eel Creek), salt marsh, maritime dunes, maritime beach, and is adjacent to Cold Spring harbor. The entire area is 3.876 hectares in size (see Map 2).



Figure 15 (left), 16 (right). Exceptional area #4 spring time

The tidal creek that meanders through the maritime area does not contain any plants. A salt marsh lines the edges of the tidal creek and is dominated by dense herbaceous vegetation in particular the grasses saltwater cordgrass (*Spartina alterniflora*) and saltmeadow cordgrass (*Spartina patens*). On the upper edge of the saltmarsh there are areas where inland saltgrass (*Distichlis spicata*) is dominant. In other parts of the upper edge of the saltmarsh, sea-lavender (*Limonium carolinianum*), horned sea-blite (*Suaeda calceoliformis*), and white sea-blite (*Suaeda maritima*) dominate. Other plants in the saltmarsh include: crested saltbush (*Atriplex cristata*), halberd-leaf saltbush (*Atriplex patula*), creeping saltbush (*Atriplex prostrata*), groundsel tree (*Baccharis halimifolia*), salt-marsh bulrush (*Bolboschoenus robustus*), wildrye (*Elymus virginicus* var. *halophilus*), marsh elder (*Iva frutescens*), common reed (*Phragmites australis* ssp. *australis*), glasswort (*Salicornia depressa*), and perennial glasswort (*Sarcocornia pacifica*). Most of these other plants occur sparsely throughout the saltmarsh or are restricted to the upper edges of the saltmarsh.

Up slope from the saltmarsh the area transitions into maritime dunes. The plant cover on the dunes as well as the adjacent maritime beach varies from dense to fairly sparse. Dominants vary quite a lot. Species that are dominant at least in part include sea-beach grass (*Panicum amarum*) and switchgrass (*Panicum virgatum*). Other species are mostly sparsely distributed throughout the area or occur in small dense patches. Other species present here include tree-of-heaven (*Ailanthus altissima*), silk tree (*Albizia julibrissin*), American beachgrass (*Ammophila breviligulata*), garden asparagus (*Asparagus officinalis*), five-horn smother-weed (*Bassia hyssopifolia*), American searocket (*Cakile edentula*), sea-beach sedge (*Carex silicea*), Oriental bitter-sweet (*Celastrus orbiculata*), lambs-quarters (*Chenopodium album*), Gray's flatsedge (*Cyperus grayi*), sand-heather (*Hudsonia tomentosa*), red cedar (*Juniperus virginiana*), Mexican summer-cypress (*Kochia scoparia*), Canada lettuce (*Lactuca canadensis*), beach pinweed (*Lechea maritima*), green carpet-weed (*Mollugo verticillata*), northern bayberry (*Myrica pensylvanica*), common evening-primrose (*Oenothera biennis*), narrowleaf plantain (*Plantago lanceolata*), coastal jointweed (*Polygonella articulata*), common purslane (*Portulaca oleracea*), smooth sumac (*Rhus glabra*), black locust (*Robinia pseudoacacia*), rugosa rose (*Rosa rugosa*), Russian thistle (*Salsola kali* ssp. *pontica*), seaside goldenrod (*Solidago sempervirens*), and sand dropseed (*Sporobolus cryptandrus*).



Figure 17 (left), 18 (right). Exceptional area #4 in September

The maritime area is dominated by native species and is contiguous and fairly undisturbed. In addition the maritime area represents habitat that is limited in distribution in New York as well as Long Island. Therefore this area has a high priority for conservation.

Significant Cultural Features/Areas

The forests and maritime areas at SAHI were used, appreciated, and studied by Roosevelt. These areas “were virtually untouched with the exception of narrow paths created for bird watching, walking, horse-back riding, and leading to the beach. To Roosevelt, the woodlands and beach were prized possessions for enjoyment and education of natural processes” (Bellavia and Curry 2003). Therefore, the forests and the maritime area that existed during Roosevelt’s time and still persist today are not only a natural resource of SAHI but a cultural one.

What condition these areas are in is relevant to SAHI’s purpose, which includes having “future generations understand and appreciate the life and legacy of Theodore Roosevelt” (National Park Service 2005). For example, the forests are and were during Roosevelt’s life, dominated by numerous native species of trees, shrubs, and herbs. If invasive plant species are allowed to continue their infestation, they will likely in a relatively short period of time, crowd out the native plant species. The numerous species of native trees including red oak, black oak, tulip tree, hickory, red maple, beech, sugar maple, black birch, sassafras, and others could easily all be replaced by the highly invasive non-native tree, Norway maple (*Acer platanoides*) (see Fang 2005). Not only would the obvious structure of the forest change because Norway maples create a much darker, more heavily shaded environment, the overall diversity and splendor of the forests would be changed. The landscape would be dramatically different to the landscape that Roosevelt admired and appreciated during his life. Additionally, Roosevelt, who was disparaged by the loss of one species of tree, the American chestnut, from the forests at SH by an invasive non-native pathogen (see quote from Introduction), likely would be shocked by the loss of numerous species of trees as well as other plant species from the landscape at SH.

The more manipulated areas of SH such as the fields and pastures during Roosevelt’s time are also a significant part of the cultural resources currently at SAHI (Bellavia and Curry 2003).

Some of these areas are still maintained as open manipulated fields (field east of the parking lot and field west of Roosevelt's house). Birds that Roosevelt observed and enjoyed at SAHI during his tenure including the bobolink, grasshopper-sparrow, and vesper sparrow (vesper finch of Roosevelt; Roosevelt 1913) are birds that rely on open fields.

The buildings, structures, and immediate surroundings at SAHI are of course a very important cultural resource. These features will not be impacted by invasive plant species anymore than they would be by all/any vegetation. These areas are maintained and highly manipulated. For example, a small patch of the invasive targeted species tree of heaven (*Ailanthus altissima*) was found growing immediately adjacent to the Old Orchard Museum (see Map 5 polygon 60). This tree will most certainly be removed from this area in order to protect the building as would any species of tree (native, non-native, or invasive) that was found growing in such a situation.

Conservation Priorities

Conservation goals are outlined below. The purpose here is to identify what resources need to be conserved from the threat of invasive species. The various areas at SAHI are analyzed from this perspective and identified as being of high or low conservation value. It is important to remember that areas that get a low conservation priority may still be significant resources at SAHI. They are simply resources that do not need to be conserved against the threat of invasive species.

The forests and maritime areas identified as being of cultural significance correlate to the four exceptional areas. This is logical, as part of what makes the forested exceptional areas outstanding is the presence of many old trees which could only be present if they were present during Roosevelt's time. The forests are also fairly intact in terms of possessing mostly native species and this is probably a result of lack of historical human disturbance. The four exceptional areas are of high priority for conservation. If further prioritization is necessary, exceptional areas 3 and 4 have highest priority. These two areas are relatively large and contiguous, together representing over 40% of the area of SAHI. They therefore have the greatest possibility of being preserved as healthy functioning native ecosystems. In addition, exceptional area #4, the maritime area, has the highest priority because it is a unique habitat at SAHI and is also a habitat that contains ecological communities with a more limited distribution in New York (Edinger et al. 2002).

Some areas that are currently forested were fields during Roosevelt's life. These areas were not clearly delineated in this plan but mostly correspond to all the forested areas outside of the exceptional areas. For example, the area south and southwest of the new barn as well as the area south of the parking lot were fields during Roosevelt's time and are currently young forests (Bellavia and Curry 2003). These areas have limited native species present and are highly disturbed. In addition, they do not reflect the character of the landscape during Roosevelt's time. They are therefore of low priority for conservation.

As described, a tiny population of the NYS endangered plant, giant ironweed was found in the field east of the parking lot. A full management plan for this species is beyond the scope of this management plan. The fact that there is only one individual present in this "population" lowers

the conservation value of this species at SAHI. This is because it is very possible that the giant ironweed may become extirpated due to some event as simple as the plant reaching the end of its life, trampling, disease, and/or competition from adjacent plants. There is also some question as to the native status of this species here. This information should be fully explored and a plan outlined. In the mean time, for this management plan to be on the conservative side, the population of giant ironweed is considered of high priority for conservation.

The fields that currently exist at SAHI are of cultural significance. Besides for the one rare plant found (see discussion above) these fields were not determined to be of outstanding ecological significance mostly because they are dominated by non-native plant species (mostly European grasses). At the same time, they do possess some native plants that don't occur anywhere else such as various goldenrods and asters. They also add to the diversity of natural, although not necessarily native, habitats present at SAHI and may harbor interesting animals. Bellavia and Curry (2003) establish these areas as high priority for "treatment". Treatment in this case means to work toward restoring the area to reflect the condition during Roosevelt time at SH. Some management changes have occurred since Bellavia and Curry's (2003) report. Still, there are no clear objectives established by the NPS of exactly how to manage these areas except to keep them open and in the case of the field east of the parking lot to cut parts of it for an event on the fourth of July (Scott Gurney, NPS personal communication). Since these fields are dominated by non-native plants conserving these fields from invasive species is a low priority (but see discussion above about giant ironweed). In addition, the historical character of the field most likely was dominated by non-native plant species. Still, these fields are an important cultural and natural resource and should be managed appropriately.

A brief note is made here regarding Woodpile Pond (see Map 1). The pond and its hydrologic features have been significantly altered since Roosevelt's life (Bellavia and Curry 2003). Most of this is beyond repair as the changes in hydrology are a result of work done on the neighbor's property. In addition, the area is mostly devoid of native plant species. The area does represent an open water source for animals and although it is of low priority for conservation it should still be maintained as a wetland.

In summary, the areas deemed of high conservation priority are

1. The four exceptional areas (see Map 2).
2. The area surrounding the population of giant ironweed (see Map 2).

Conservation Goals

For the four exceptional areas the conservation goal is preserving these regions as high quality natural areas. A high quality natural area is defined as being dominated by native species and functioning as a native ecosystem. To this end, most populations of targeted invasive species that occur in these areas should be eradicated or reduced and maintained at levels that do not impinge on the native plant species present. Since these targeted species are quite aggressive it might be difficult to eradicate them. Where it becomes impossible to achieve this goal or where resources are not available, targeted species should at a minimum be contained and prevented from increasing in cover. Other invasive species that are not targeted are of lower priority for

management. Where feasible, populations of these non-targeted invasive non-native species should be contained or eradicated but it is important that priority is put on the targeted invasives.

There may be cases where intervention is necessary outside of the areas of high conservation priority. For example, if a new invasive species is found growing anywhere at SAHI it might be appropriate to target this infestation before it spreads into a high priority area. Also, in some cases, controlling populations of targeted invasive species outside of high priority areas might help to prevent infestations of these species into the high priority areas. For example, controlling Norway maple outside of the high priority areas may help prevent deposition of seeds in the high priority areas.

Some of the species on the targeted invasive species list are species that were in cultivation during Roosevelt's time, such as wisteria. In the invasive species section below, notes are made where relevant if the species being reviewed was in cultivation during Roosevelt's time. In addition, any individual plants that are considered historical are also mentioned. Some targeted invasive plants are in cultivation around the houses. This does not conflict with the goals set out in this plan but these plants should not be allowed to grow beyond their intended locations. Additionally, only targeted species that have a historical reason for being in cultivation should be cultivated.

For the area around the population (1 individual) of giant ironweed, the main conservation goal for this management plan is preventing invasive non-native species from facilitating this species' extirpation. Preservation of giant ironweed at SAHI is really an issue related to other threats beyond invasive species. Conservation of this species will need to be outlined in a plan. In the mean time, the population should not get mowed more than once a year and ideally should be mowed only after the plant fruits which may not be until late October.

Invasive Species

A total of 30 non-native plant species that occur at SAHI are considered invasive (see Table 2). Based on the initial winnowing process described in the methods section, five of the 30 invasives are considered the lowest priority for management and were not mapped or fully targeted. Eight species were considered a slightly higher priority and were mapped but not fully targeted. Seventeen species were mapped and are targeted in this plan (see Table 2).

Targeted invasive species

Gross infested area, sum of polygons area, and infested area (see methods section for description of these terms) for each of the species/species complexes targeted is summarized in Table 3. Each of the targeted species/species pairs is discussed briefly.

Table 3. Statistics on non-native invasive species which were mapped at SAHI.

Common name	Scientific name	Sum of polygons area (in hectares)	Gross infested area (in hectares)	Infested area (in hectares)
Japanese maple	<i>Acer palmatum</i>	0.714	17.100	0.107
Norway maple	<i>Acer platanoides</i>	22.264	33.551	1.242
tree-of-heaven	<i>Ailanthus altissima</i>	1.303	29.952	0.404
garlic mustard	<i>Alliaria petiolata</i>	16.505	33.027	1.130
wild chervil	<i>Anthriscus sylvestris</i>	0.029	0.029	0.025
Japanese barberry	<i>Berberis thunbergii</i>	0.983	21.445	0.008
Oriental bitter sweet	<i>Celastrus orbiculata</i>	26.672	33.313	0.280
crown vetch	<i>Coronilla varia</i>	0.006	0.006	0.005
burning bush	<i>Euonymus alata</i>	21.219	26.986	0.471
English ivy	<i>Hedera helix</i>	1.113	27.337	0.848
border privet	<i>Ligustrum obtusifolium</i>	21.584	30.013	0.331
Japanese honeysuckle	<i>Lonicera japonica</i>	26.686	31.894	0.225
Morrow and Amur honeysuckle	<i>Lonicera morrowii</i> and <i>L. maackii</i>	3.414	18.950	0.442
Japanese stilt grass	<i>Microstegium vimineum</i>	2.731	13.236	0.643
Japanese pachysandra	<i>Pachysandra terminalis</i>	0.132	0.132	0.130
Princess tree	<i>Paulownia tomentosa</i>	0.036	10.336	0.024
common reed	<i>Phragmites australis</i> ssp. <i>australis</i>	0.045	0.563	0.039
multiflora rose	<i>Rosa multiflora</i>	25.204	32.166	0.395
black locust	<i>Robinia pseudoacacia</i>	1.676	11.056	0.098
periwinkle	<i>Vinca minor</i>	0.087	13.607	0.073
Japanese snowball and linden	<i>Viburnum plicatum</i> and <i>V.</i>			
arrowwood	<i>dilatatum</i>	21.219	27.753	0.320
Chinese and Japanese wisteria (also includes one small cultivated summer wisteria)	<i>Wisteria sinensis</i> and <i>W.</i> <i>floribunda</i> (also includes one small cultivated <i>W. japonica</i>)	0.710	15.796	0.317

Norway Maple (*Acer platanoides*): Norway maple is a full sized deciduous tree. There are a few other maples that occur at SAHI. Norway maple most resembles sugar maple (*Acer saccharum*) and sycamore maple (*Acer pseudoplatanus*). Sugar maple is a native tree at SAHI. Norway maple can be distinguished from sugar maple by its mostly 7-lobed leaves compared to 5-lobed leaves of sugar maple. All lobes should be counted including the tiny lobes at the base of the leaves (see Figure 19). Other differences include, Norway maple has rounded buds (vs. pointy for sugar maple), often white colored sap (vs. always clear colored sap for sugar maple), and closely furrowed bark on older trees (vs. bark with plates or widely spaced furrows for sugar maple) (Haines and Vining 1997). Sycamore maple is a non-native tree that is very rare at SAHI. It differs from Norway maple by having numerous teeth along the edges of the leaf blades (vs. only a few large teeth for Norway maple).



Figure 19. Norway maple (*Acer platanoides*) leaf.

Norway maple can germinate and grow in the shade. Its seedlings are considered shade tolerant to very shade tolerant. Once in the canopy Norway maple creates a densely shaded forest which prevents native plants, including trees, from growing. It spreads primarily by seeds (Munger 2003). Recent work in Nassau County has shown that Norway maple stands invade adjacent undisturbed native forests (Fang 2005). At SAHI, Norway maple occurs throughout the forested areas (see Map 4). In some of these areas it is not yet in the upper canopy of the forest. Other areas, especially polygons 31 and 47, are densely infested and Norway maple is in the canopy. Norway maple is also present and perhaps planted in part of the landscaped part of SAHI (polygon 32, 33, and 34). Polygons that occur in the exceptional areas at least in part include polygons 31, 40, 41, 46, and 49.

While some maple species occurred in the cultural part of SAHI during Theodore Roosevelt's time it is not clear what species these were and if they were planted. No current individual maple trees at SAHI are believed to be of historical significance (Bellavia and Curry 2003).

Tree-of-heaven (*Ailanthus altissima*): Tree-of-heaven is a medium to full sized deciduous tree. It is a very distinctive tree. The leaves superficially resemble sumac (*Rhus* sp.), cork trees (*Phellodendron*), and even wisteria vines (*Wisteria* sp.) because the leaves of all of these species are pinnately compound. The leaves of tree of heaven have a strong unpleasant peanut like odor

when crushed. This character is an easy way to distinguish tree of heaven from all of these other species.



Figure 20. Tree-of-heaven (*Ailanthus altissima*)

Tree-of-heaven is a very fast growing tree and can out-compete native vegetation. It is also suspected of being allelopathic. It spreads both by seeds and from sprouting from the rootstock (Howard 2004). At SAHI, tree-of-heaven occurs throughout the site although it is patchy in distribution (see Map 5). It occurs mostly in disturbed or open areas including fields but also persists or spreads into older forests. There are some small patches on the maritime dunes (polygons 23, 24, and 25). There are also individuals that occur along fences and buildings (polygons 60 and 10). Polygons that occur in the exceptional areas at least in part include 6, 20, 21, 22, 23, 24, and 25.

Garlic Mustard (*Alliaria petiolata*): Garlic mustard is a biennial herbaceous plant. It is a very distinctive herb and does not resemble any other plant at SAHI. It forms dense patches in the understory of forests and is suspected of causing the number of species present in an area to decline. It spreads by seeds which remain viable in the seed bank for up to 4-6 years (Munger 2001, Blossey et al. 2002).



Figure 21. Garlic mustard (*Alliaria petiolata*): Vegetative growth carpeting forest floor at SAHI.

At SAHI garlic mustard occurs throughout most of the forested areas although there are some sections of forest that are apparently devoid of this species (see Map 6). Of particular note in this regard is the area northeast of polygon 40, the area encircled by polygon 5, and the area north of polygon 4. It is unclear why these areas are devoid of garlic mustard but some possibilities include that garlic mustard does better in disturbed areas, in richer soils, and/or in moister soils. The area northeast of polygon 40 appears to be on the edge of an invasive front of garlic mustard. It is suspected that over time if no management is conducted, garlic mustard will continue to spread into areas that are currently devoid of this plant. Polygons that occur in the exceptional areas at least in part include 5 (just on the edges) and 40.

Japanese Barberry (*Berberis thunbergii*): Japanese barberry is a medium sized deciduous shrub. It is a distinctive plant and is not similar to any other species at SAHI. Japanese barberry is shade tolerant and can become dense in forest understories (Rhoads and Block 2002).



Figure 22 (left), 23 (right). Japanese barberry (*Berberis thunbergii*)

At SAHI, this species is scattered throughout a large part of the property although it is patchy in distribution (see Map 8). The patches are mostly small in area. Since Japanese barberry occurs

in small patches at SAHI some additional patches may have been missed during survey work. It appears that Japanese barberry was planted in the gardens and perhaps around Roosevelt's house, when Roosevelt resided at Sagamore Hill. Currently there are no individuals of Japanese barberry at SAHI that are considered of historical significance (Bellavia and Curry 2003). Since this species occurs in such low densities and it has been around Sagamore Hill since Roosevelt's time there is a possibility that the habitat at SAHI is not ideal for this species.

Oriental Bitter Sweet (*Celastrus orbiculata*): Oriental bitter sweet is a deciduous perennial vine which can grow high into the canopy. It is closely related to the native vine American bitter sweet (*Celastrus scandens*) which is not known from SAHI. The two are fairly similar in appearance and are known to hybridize (Mehrhoff et al 2003, Howard 2005). Oriental bitter sweet has groups of two or three flowers/fruits growing from the axils of the leaves vs. numerous flowers/fruits growing from the ends of the branches in American bitter sweet (Gleason and Cronquist 1991). These character states can intergrade and individuals can sometimes be hard to determine.



Figure 24 (left), 25 (right). Oriental bitter sweet (*Celastrus orbiculata*). 24: Sprouting from cut vines. 25: Close up of leaves.

Oriental bitter sweet grows in both open and shaded habitats and is completely shade tolerant. It grows fast and can out-compete native species. It can also change forest structure and plant succession by girdling and shading trees. Oriental bitter sweet may also be negatively impacting its native congener, American bitter sweet. Oriental bitter sweet spreads via seeds and root sprouting (Howard 2005). At SAHI, Oriental bitter sweet occurs throughout the entire property from the fields and disturbed forests, to the more pristine forests, to the maritime area (see Map 9). There are some large vines scattered throughout the forests as well as abundant small individuals. Although this species is common throughout the property it is mostly not dominant. This may be a little hard to assess because the extent of the growth in the canopy is hard to determine. In the maritime area there is currently only one small patch (polygon 29). Other polygons that occur in the exceptional areas at least in part include 21, 40, 41, 51, 53, and 54. Oriental bitter sweet was introduced to SAHI by the Theodore Roosevelt Association during their tenure of SH (Bellavia and Curry 2003).

Burning Bush (*Euonymus alata*): Burning bush is a medium sized deciduous shrub. It is a very distinctive shrub and should not easily be confused with any other shrub at SAHI. It can grow very dense in understories of forests resulting in shading and crowding of native species. It is spread by its seeds which are produced in large quantities (Mehrhoff et al. 2003b).



Figure 26. Burning bush (*Euonymus alata*): close up of winged stem

At SAHI, burning bush is distributed throughout all of the forested areas (see Map 11). It is fairly evenly distributed throughout and is mostly not very dense. There are some areas where it becomes denser. Polygons that occur in the exceptional areas, at least in part, include 40, 41, 44, and 47. There is no evidence that burning bush was in cultivation during the Roosevelt's tenure of Sagamore Hill (Bellavia and Curry 2003).

English Ivy (*Hedera helix*): English ivy is an evergreen vine. It can creep extensively along the ground and also climbs high in the canopy using trees as support. There are a number of closely related taxa (Stace 1997) and it is unclear which if any others occur in New York. Also many cultivars occur and these cultivars obscure the distinctions between these other taxa (Stace 1997). Using Stace (1997), the material at SAHI keys nicely to *Hedera helix* ssp. *helix*.



Figure 27 (left), 28 (right). English ivy (*Hedera helix*). 27: Dense ground cover (polygon 14). 28: Close up of leaves.

English ivy can create a dense ground cover crowding out native species. It also can climb, shade, and lead to trees falling. It spreads by seeds as well as vegetatively (Morisawa 1999, Soll 2005). At SAHI this species is fairly widespread but it is mostly limited to disturbed areas in forests and forest edges. Where it occurs, it forms very dense and sometimes very extensive patches. To some degree it also occurs in less disturbed forested areas. It grows on and adjacent to buildings (polygon 60, 61, and 62). Where it occurs on the buildings there are often other vines present as well including Boston ivy (*Parthenocissus tricuspidata*). English ivy was apparently not a vine that was in cultivation during historical times at SAHI (Bellavia and Curry 2003) and it is unknown if the vines currently growing on the buildings were planted or came in on their own. Polygons that occur in the exceptional areas at least in part include 2, 9, 14, 20, and 21. In addition, polygons 3 and 17 are adjacent to an exceptional area.

Border Privet (*Ligustrum obtusifolium*): Border privet is a medium sized deciduous shrub. There are a few other privets that are considered naturalized in New York including Amur privet (*Ligustrum amurense*), California privet (*Ligustrum ovalifolium*) and European privet (*Ligustrum vulgare*) (Weldy and Werier 2005). Both Amur and California privet are quite rarely naturalized in New York and are more often found cultivated (personal observation). European privet differs primarily in the flowers which have the corolla tubes about as long as the corolla lobes vs. corolla tubes twice as long as the corolla lobes for border privet (Gleason and Cronquist 1991). European privet was reported to occur at SAHI by Stalter (2000). European privet was not found during survey work in 2005 at SAHI. In addition, a specimen originally labeled as European privet by Stalter from SAHI was seen at the SAHI herbarium by the author. The specimen had been annotated to border privet by Bryan Dutton. Therefore, it appears that the report of European privet from SAHI is an error. During survey work in 2005, California privet was not seen naturalized at SAHI but, was seen as a planted hedge.



Figure 29. Border privet (*Ligustrum obtusifolium*)

Privets in general can grow in fields, woodlands, and forests. They can form dense thickets and out-compete native species. They spread by seed which are consumed by birds (Batcher 2000, Munger 2003b). At SAHI, border privet occurs throughout all of the forested areas (see Map 13). It generally occurs in moderately dense patches, although in some areas, it occurs only as thinly scattered individuals. It appears to be doing best in openings or disturbed areas in the forests. Polygons that occur in the exceptional areas at least in part include 40, 41, 45, and 48.

California privets were purchased by the Roosevelt's when they resided at SH and unknown privet species were in cultivation around the property during this time. Some of the privets currently in cultivation at SAHI are potentially historical (Bellavia and Curry 2003).

Japanese Honeysuckle (*Lonicera japonica*): Japanese honeysuckle is a perennial, woody, mostly deciduous vine. It is very distinctive and likely should not be confused with other species at SAHI. Japanese honeysuckle prefers open early successional habitats like fields and forest edges but also occurs in shaded forests. It out-competes native vegetation by shading and crowding. It also climbs trees and facilitates trees falling changing the vertical structure of forested areas (Munger 2002).



Figure 30 (left), 31 (right). Japanese Honeysuckle (*Lonicera japonica*). 31: Growing up a tree with some native vines

At SAHI, Japanese honeysuckle occurs throughout most of the property. It occurs in all of the fields and forests (see Map 14). It was not found in the maritime area or in the regularly mowed lawns. It is fairly evenly distributed throughout the site although it is a little more prevalent in disturbed areas as well as forest opening. Polygons that occur in the exceptional areas at least in part include 40, 41, 51, and 54.

Japanese honeysuckle was bought by the Roosevelts to “plant on a road cutting.” In addition, 12 2-5 foot tall honeysuckles were bought by Mrs. Roosevelt in 1914 (letters and receipts reprinted in Bellavia and Curry 2003). It is unknown if the latter “honeysuckles” were bush honeysuckles (such as Morrow or Amur honeysuckle) or Japanese honeysuckle. No individual honeysuckles are considered historical (Bellavia and Curry 2003).

Morrow and Amur Honeysuckle (*Lonicera morrowii* and *L. maackii*): Morrow and Amur honeysuckle are both deciduous shrubs. There are numerous shrubby or bush honeysuckles that are naturalized or native to New York (Weldy and Werier 2005). Morrow and Amur honeysuckle along with Bell’s honeysuckle (*Lonicera x bella*) and tartarian honeysuckle (*Lonicera tatarica*) are the most common in New York with Morrow and Bell’s honeysuckle being the most problematic (personal observation). Bell’s honeysuckle is a hybrid between Morrow and tartarian honeysuckle and can be found in the absence of both its parents (Rehder 1987). Bell’s, Morrow, and tartarian honeysuckle are fairly similar in appearance. Tartarian honeysuckle has leaves without hairs while the other two have some amount of pubescence. Bell’s and Morrow honeysuckle can most reliable be separated only when in flower. Bell’s honey suckle has bracteoles half as long as the ovaries they subtend when in flower and flowers at least somewhat pink fading to yellow vs. bracteoles greater than half as long as the ovaries they subtend when in flower and flowers white fading to yellow for Morrow honeysuckle. Bell’s honeysuckle also has leaves somewhat less hairy than Morrow honeysuckle. Amur honeysuckle differs from all the rest by having flower cluster stalks very short, shorter than the flower stalks they subtend and leaf tips drawn out and pointed vs. flower cluster stalks long, longer than the flower stalks they subtend and leaves abruptly rounded at the tip for Bell’s, Morrow, and tartarian honeysuckle.

During the 2005 survey period, most of the honeysuckles encountered appeared to be Morrow or Amur honeysuckle, but one individual encountered is perhaps Bell's honeysuckle. Since the one individual encountered was not in flower it was impossible to determine if it was truly Bell's honeysuckle. It may in fact be more Morrow honeysuckle. A specimen was made of this individual (DW 2844) and will be deposited at the SAHI herbarium.

Stalter (2000) reported the presence of tartarian honeysuckle at SAHI. A specimen was seen in the SAHI herbarium that was initially labeled tartarian honeysuckle by Stalter. This specimen had been annotated to Morrow honeysuckle by Brian Dutton. It is believed that the report of Tartarian honeysuckle from SAHI is an error.

Morrow and Amur honeysuckle can grow in open as well as shaded habitats. They can form dense thickets and out-compete native species via shading and crowding (Munger 2005). These two species were lumped together for purposes of mapping and prioritization in this plan because the two species are relatively closely related, their impact on the landscape is similar, and management actions to control them are also similar.

At SAHI, the bush honeysuckles occur mostly in young or disturbed forests, along fences, and in disturbed areas. In addition there are some small infestations in the more mature forests. Overall there are large areas where they do not currently occur. Polygons that occur in exceptional areas at least in part include 4, 20, 21, 22, and 23. Morrow honeysuckle is much more prevalent than Amur honeysuckle and many of the polygons (20, 21, 22, 23, 24, 25, and 27) contain only Morrow honeysuckle. Polygon 26 contains the one suspected Bell's honeysuckle seen.

Twelve 2-5 foot tall honeysuckles were bought by Mrs. Roosevelt in 1914 (letters and receipts reprinted in Bellavia and Curry 2003). It is unknown if these were bush honeysuckles (such as Morrow or Amur honeysuckle) or the vine Japanese honeysuckle. There is no other evidence indicating that any bush honeysuckles were in cultivation when Roosevelt resided at SH (Bellavia and Curry 2003).

Japanese Stilt Grass (*Microstegium vimineum*): Japanese stilt grass is an annual grass. It superficially resembles white grass (*Leersia virginica*) (Mehrhoff et al. 2003c, Howard 2005b) which is not known from SAHI. Japanese stilt grass differs in being an annual, having nodes without hairs, and fibrous roots vs. being a perennial, having hairy nodes, and scaly rhizomes for white grass (Gleason and Cronquist 1991, Mehrhoff et al. 2003c).



Figure 32. Japanese stilt grass (*Microstegium vimineum*): The light green grass in the photo.

Japanese stilt grass grows in open as well as shaded environments. It can form dense monospecific thickets to the exclusion of most other plants and also leads to soil chemistry changes. It can germinate in even heavily shaded environments and therefore does well in forest understories. Japanese stilt grass often comes into sites that have been disturbed (Mehrhoff et al. 2003c, Howard 2005b).

At SAHI, Japanese stilt grass is mostly confined to the edges of fields and forests as well as open habitats. It also occurs extensively in the disturbed young forest southeast of Roosevelt's house (see Map 16). It has a great potential of getting into the more mature forests as it occurs adjacent to these areas. Currently it is not or is just barely present in any of the exceptional areas. Polygons 10, 11, and 21 are adjacent or just in an exceptional area.

Japanese Pachysandra (*Pachysandra terminalis*): Japanese pachysandra is an evergreen perennial sub-woody plant. It is not easily mistaken for any other plant at SAHI or in New York. Japanese pachysandra is cultivated widely as a ground cover. It persists from cultivation and escapes into adjacent forests. It is difficult to eradicate and forms a dense ground cover, out-competing native vegetation (Weakley 2006, USDA Forest Service no date). In New England, Mehrhoff (2003d) includes Japanese pachysandra in a group of plants that are "seemingly invasive non-native species [but] ... usually do not disperse far from site of original intentional introduction."



Figure 33 (left), 34 (right). Japanese pachysandra (*Pachysandra terminalis*). 33: completely dominating forest floor. 34: edge of the front.

At SAHI, Japanese pachysandra is limited to one distinct relatively large polygon (0.132 hectares in area; see Map 17) in the understory of an old forest. There is also some that occurs along the road just to the south of this polygon which is apparently not owned by the NPS. The Japanese pachysandra that occurs at SAHI probably spread for this roadside planting. Although this species apparently does not disperse far, it is known for its rapid growth (USDA Forest Service no date) and at SAHI it has completely dominated the herbaceous layer within the polygon that it occurs in. The polygon is circular in shape which may indicate that this polygon started from a single introduction probably via rhizomes. The plants look extremely healthy and there does not appear to be anything limiting its spread outward. This one polygon occurs in exceptional area #3.

Common Reed (*Phragmites australis* ssp. *australis*): Common reed is a perennial wetland grass. Recent work has shown that there is a native (*P. australis* ssp. *americanus*) and a non-native (*P. australis* ssp. *australis*) common reed in New York (Saltonstall et al. 2004). The native common reed differs in having ligules 1.0-1.7 mm long and leaf sheaths that fall off by winter vs. ligules 0.4-0.9 mm long and leaf sheaths that remain on the stems throughout the winter for the non-native reed (Saltonstall 2005). All material examined during survey work in 2005 at SAHI is clearly the non-native species. A specimen (DW 2829) was collected and will be deposited at the SAHI herbarium.



Figure 35. Common reed (*Phragmites australis* ssp. *australis*) at SAHI (polygon 20). Tall grass forming dense stand in middle of photo.

The non-native common reed occurs in fresh and brackish tidal marshes, marshes, roadsides, and disturbed areas (Saltonstall 2005). It often grows in dense monospecific patches that exclude all other species. It spreads via rhizomes and seed. At SAHI common reed occurs in two relatively small dense patches in the maritime area (see Map 19). The northern patch (polygon 21) extends into an extensive dense patch on the property of the neighbor to the north. Both of the polygons that occur at SAHI are in exceptional area #4.

Multiflora rose (*Rosa multiflora*): Multiflora rose is a perennial deciduous shrub. It is a very distinctive species and it should not be confused with any other species that occur at SAHI. Multiflora rose occurs in fields, roadsides, forest edges, open forests, and forest openings. It does not do well in heavily shaded sites (Amrine 2002, Munger 2002b). It can form impenetrable thickets which crowd out native species (Munger 2002b).

At SAHI, this species occurs throughout the site in fields, forests, and disturbed areas (see Map 20). It occurs even in the most mature forests at SAHI but in these forests it is fairly thin except in tree fall gaps and other more open or disturbed areas. For example, it is quite dense around Lower Lake (the vernal pool in the southeastern part of exceptional area #3) where there is more light available. Polygons that occur in exceptional areas at least in part include 20, 40, 41, 49, and 54.

Apparently “rambler roses (*Rosa* sp.)” were growing on the arched arbor near the pet cemetery (Bellavia and Curry 2003). Rambler rose is only very infrequently used as a common name for multiflora rose (*Rosa multiflora*) (Eckardt and Martin 2001). It is unclear if the rose growing on the pet cemetery arbor was multiflora rose. There is no other evidence that multiflora rose was in cultivation or occurred at Sagamore Hill during historical times (Bellavia and Curry 2003).

Chinese and Japanese Wisteria (*Wisteria sinensis* and *W. floribunda*): Chinese and Japanese wisteria are perennial deciduous vines. Chinese wisteria has leaves with 7-13 leaflets while Japanese wisteria has leaves with 13-19 leaflets (Rheder 1987). The two species hybridize complicating identification of vegetative material (Lawrence Stritch, USDA Forest Service personal communication). All populations of wisteria seen at SAHI except one cultivated

individual adjacent to the Old Orchard Museum (Map 24, polygon 20) were completely vegetative. The planted individual by Old Orchard Museum is actually summer wisteria (*Wisteria japonica*). Summer wisteria is not known outside of cultivation in New York or North America. Most of the populations seen of wisteria had at least some leaves with over 13 leaflets. Therefore, although a definitive determination can not be made these populations may be Japanese wisteria. The one large population that occurs on the edge of the forest south of the Old Orchard Museum (polygon 6) has most leaves with 13 or under leaflets. This population might be Chinese wisteria or perhaps even summer wisteria (*Wisteria japonica*). Since Chinese and Japanese wisteria are difficult to separate vegetatively and behave somewhat similar in the landscape they were lumped together for purposes of this plan. More research is needed to determine if *W. japonica* is truly naturalized as well.



Figure 36 (left), 37 (right). 36: ? Chinese wisteria (*Wisteria ? sinensis*). 37: Japanese wisteria (*W. floribunda*), vine pulled up and stretched out along sidewalk.

Chinese and Japanese wisteria are shade tolerant but prefer full sun. They are cultivated and escape to disturbed areas, forest edges, and openings in forests (Martin no date). Wisteria climbs trees and shrubs. It can girdle and shade these trees and shrubs leading to their toppling. Wisteria can also form dense thickets out-competing native vegetation (Swearingen et al. 2002, Remaley 2005). At SAHI, wisteria is mostly confined to disturbed areas in and on the edges of forests (see Map 24). It is also currently in cultivation (polygons 20 and 60). Polygon 20 is actually summer wisteria (*Wisteria japonica*). These plantings appear to be contained. Polygons that occur in exceptional areas at least in part include 1, 5, and 6.

Wisteria (*Wisteria* sp.) was planted around Roosevelt's house although none of the plants present now are considered historical. Wisteria, along with other vines, are considered important to the historical character of the property (Bellavia and Curry 2003).

Mapped but Not Targeted Invasives

A number of species that did not make the targeted invasive species list at SAHI but are still problematic or potentially so at SAHI were mapped (Table 2). These species are Japanese maple (*Acer palmatum*), wild chervil (*Anthriscus sylvestris*), crown vetch (*Coronilla varia*), princess tree (*Paulownia tomentosa*), black locust (*Robinia pseudoacacia*), linden arrowwood (*Viburnum*

dilatatum), Japanese snowball (*Viburnum plicatum*), and periwinkle (*Vinca minor*). Each of these species is briefly discussed below. Statistics for each of these species is summarized in Table 3.

Japanese Maple (*Acer palmatum*): Japanese maple is a small to medium sized tree. It grows well in shaded forested areas at SAHI. It is scattered throughout a large part of SAHI (see Map 3) but is mostly limited to a few large populations. Polygon 1 is a particularly dense infestation. The species is also in cultivation adjacent to Teddy Roosevelt's house (polygon 61). There is no evidence that this species was in cultivation when Roosevelt resided at SH. This species is not a top priority for management but is becoming problematic and should be controlled if resources are available beyond the priority species.

Wild Chervil (*Anthriscus sylvestris*): Wild chervil is a biennial or short lived perennial herbaceous plant (Gleason and Cronquist 1991). At SAHI, it is only found growing in one relatively small patch in a disturbed young forest (see Map 7). In this patch it was moderately dense but other mostly weedy plants were seen growing with it.

Crown Vetch (*Coronilla varia*): Crown vetch is a perennial herbaceous plant (Gleason and Cronquist 1991). At SAHI, it is found in only one small path in a disturbed area (see Map 10). In this patch it is growing very dense to the exclusion of most other vegetation.

Princess Tree (*Paulownia tomentosa*): Princess tree is a tree growing to 15 meters in height (Gleason and Cronquist 1991). At SAHI, it is found scattered in only a few locations (see Map 18). All of the locations have at most a few plants present. Some of these are seedlings while others are full grown trees. Polygon 20 is one full sized tree growing in exceptional area #3. Polygon 3 represents a seedling near the base of the fallen "Cousin Beech" tree (it was pulled during survey work).

Black Locust (*Robinia pseudoacacia*): Black locust is a tree that is considered native south of NY. It was planted extensively on Long Island. Black locust was present at SH when Roosevelt resided there (Bellavia and Curry 2003). At SAHI, it currently occurs scattered in a few large patches (see Map 21). Most of the black locust occurs along the current entrance road into SAHI. Polygon 3, a relatively small population, occurs in exceptional area #1. Polygon 20 and 21 occur in the maritime area (exceptional area # 4). There is no evidence that black locust occurred in the maritime area during Roosevelt's tenure (Bellavia and Curry 2003). The black locust in the maritime area is not very robust but does cover a fairly large area of dune habitat.

Periwinkle (*Vinca minor*): Periwinkle is an evergreen perennial ground cover. It is scattered at a few locations at SAHI (see Map 22). Polygon 60 is apparently in cultivation adjacent to Roosevelt's house. All occurrences of periwinkle at SAHI occur in forested environments and represent dense patches. Polygons 20 and 21 occur in exceptional area #3.

Japanese Snowball and Linden Arrowwood (*Viburnum plicatum* and *V. dilatatum*): Japanese snowball and linden arrowwood are tall shrubs or small trees to 3 meters in height (Rheder 1987). Nine different species of *Viburnum* were seen at SAHI during survey work in 2005 (see Appendix C). Some are native, some are rare naturalized species, and a few are more common

naturalized species. Japanese snowball and linden arrowwood are both fairly common non-natives. The three most similar species are Japanese snowball with leaves with 8-12 pairs of veins and numerous teeth; the native arrowwood (*Viburnum dentatum* var. *lucidum*) with leaves with 6-10 pairs of veins and only a few large teeth; and linden arrowwood with leaves with 5-8 pairs of veins and numerous small teeth (Rheder 1987; (see Figure 38)



Figure 38. Left: Japanese snowball (*Viburnum plicatum*). Middle: arrowwood (*Viburnum dentatum* var. *lucidum*). Right: linden arrowwood (*Viburnum dilatatum*).

At SAHI, Japanese snowball and linden arrowwood appeared to be fairly common and occur in the understory of mature and young forests. The two species were lumped together for purposes of mapping because of initial confusion between the two species They also occupy in the same niche. At SAHI, they occur throughout all of the forested areas (see Map 23). Mostly they do not form dense thickets but they have become fairly common members of the forest understory.

Not Targeted or Mapped Invasives

There are five plant species, porcelain berry (*Ampelopsis brevipedunculata*), Japanese angelica tree (*Aralia elata*), mugwort (*Artemisia vulgaris*), wineberry (*Rubus phoenicolasius*), and Japanese yew (*Taxus ? cuspidata*) which although invasive are of the lowest priority for management compared to the other invasive species present at SAHI (Table 2). They are not mapped and are not being targeted in this plan. Some brief comments are made here about these species.

Porcelain Berry (*Ampelopsis brevipedunculata*): Porcelain berry is a perennial deciduous vine. The leaves can be similar in appearance to native grapes (*Vitis* spp.) although the only grape seen at SAHI, summer grape (*Vitis aestivalis*) has leaves that are white (glaucous) underneath vs. green underneath for porcelain berry. In addition, all the grapes have mature vines with peeling bark vs. without peeling bark for porcelain berry. Although this species did not get mapped it is pretty widespread in the open and disturbed areas of SAHI. In the southern 1/5th of the field

between the parking area and the Old Orchard Museum this species is dominant. It is also fairly abundant in the disturbed young forest south of the new barn. It does not occur in the more mature and less disturbed forests although; it was seen by Lower Lake.

Japanese Angelica Tree (*Aralia elata*): Japanese angelica tree is a tall shrub or a small tree (Rehder 1987). In the past this species has been confused with the native species, Hercules Club (*Aralia spinosa*) (Stalter 2000). At SAHI it forms relatively small clonal patches. It is found mostly in areas where the soils have been disturbed. It occurs in both shaded and open areas. Since it can occur in forested situations and is fairly widespread at SAHI it potentially could have a negative impact on the forested habitats.

Mugwort (*Artemisia vulgaris*): Mugwort is a perennial herbaceous plant. It is fairly limited in distribution and occurs only in open habitats at SAHI. It is rhizomatous (Gleason and Cronquist 1991) and can form dense clonal patches. A small patch occurs along the fence row just north of where the one individual of the rare plant, giant ironweed (see Map 2) was found. Mowing two or three times a year for three consecutive years was successful in eliminating mugwort on the Hempstead Plains on Long Island (Jordan et al. 2002). Mowing should be easy to implement, inexpensive, and effective on the small patch of mugwort found near the giant ironweed.

Wineberry (*Rubus phoenicolasius*): Wineberry is a perennial plant. Above ground stems last for two years and then dye back to the ground level. Wineberry is thinly scattered throughout but is not particularly dense or common anywhere at SAHI.

Japanese Yew (*Taxus ? cuspidata*): Japanese yew is a tall shrub or small tree. This plant occurs thinly scattered throughout most of SAHI. It is not very dense anywhere at SAHI but of concern is that it appears to do well in dense shade of forested areas. Although perhaps not currently having much of a negative impact on the natural resources of SAHI this species should be kept on the radar screen for evaluation when this plan gets revised.

Prioritization of Targeted Invasive Species

A total of 17 species (13 species and two species pairs) were targeted for this plan. These were ranked and prioritized using the Alien Plant Ranking System (APRS) ver. 7.11 (Alien Plant Ranking System Implementation Team 2001). The APRS uses a set of questions to determine how much impact an invasive species is having on natural areas at a site (“level of impact”); what the potential is for a particular species to negatively impact natural areas at a site (“potential to be invasive”); and how difficult or feasible it is to control a particular invasive species in a natural area (“feasibility of control”). The questions posed in the APRS are listed in Appendix A. Points are assigned for each species for each of the three categories (level of impact, potential to be invasive, and feasibility of control) based on the answers to each question posed in the APRS. For example, question 14 deals with the length of time seeds of a species remain viable in the soil. If a particular species has seeds that can remain viable in the soil for more than 5 years answer C is chosen and 0 points are given to “level of impact”, 5 points are given to “potential to be invasive”, and 5 points are given to “feasibility of control”. Appendix A lists the points given to each of the three categories for each answer to a question. Appendix B shows the answers chosen for each targeted species in this plan. For some species, no information was

available for some of the questions. For these questions a range of points was given to the species for each category based on the lowest and highest possible points assignable for those questions.

For each species a total point value or rank was given for each of the three categories (level of impact, potential to be invasive, and feasibility of control) by summing up the points assigned for each answer. For species that had a range of points for a particular category, an average was also determined and is presented in parenthesis. The ranks are displayed in Table 4 along with a column for the sum of the points given to “level of impact” and “potential to be invasive”.

Each targeted species was given a final priority rank based on their “level of impact” + “potential to be invasive,” and “feasibility of control” (see Table 5). Final priority ranks were assigned, from highest to lowest priority, in the following order:

1. High level of impact + invasive potential, and easy to control
2. High level of impact + invasive potential, and hard to control
3. Low level of impact + invasive potential, and easy to control
4. Low level of impact + invasive potential, and hard to control

The high and low level of impact + invasive potential is relative. So, a species that is listed as having a low level of impact and invasive potential is still a threat to the natural areas at SAHI but is relatively less of a threat than species that are listed as having a high level of impact + invasive potential. In a similar fashion, a species that is listed as being easy to control may still be difficult to control but relatively easier than a species that is listed as being difficult to control. Although the species are each given a precise final priority rank, these ranks are a little flexible.

Table 4. Results of Alien Plant Ranking System (APRS) ver. 7.11. Numbers correspond to values given to answers of questions in the APRS (see Appendix A and B).

Species	level of impact	potential to be invasive	Impact + invasive potential	feasibility of control
Japanese pachysandra (<i>Pachysandra terminalis</i>)	56	32-41 (36.5)	88-97 (92.5)	52-60 (56)
Japanese barberry (<i>Berberis thunbergii</i>)	42	57-62 (59.5)	99-104 (101.5)	53-58 (55.5)
Japanese stiltgrass (<i>Microstegium vimineum</i>)	18	51	69	59
Multiflora rose (<i>Rosa multiflora</i>)	47	54	101	55
Japanese and Chinese wisteria (<i>Wisteria floribunda</i> and <i>W. sinensis</i>)	35	29-34 (31.5)	64-69 (66.5)	52-60 (56)
Morrow and Amur honeysuckle (<i>Lonicera morrowii</i> and <i>L. maackii</i>)	40	62	102	56
Border privet (<i>Ligustrum obtusifolium</i>)	45	46	91	68
Norway maple (<i>Acer platanoides</i>)	73	52	125	71
Japanese honeysuckle (<i>Lonicera japonica</i>)	47	65	112	71
Garlic mustard (<i>Alliaria petiolata</i>)	82	62	144	81
Tree-of-heaven (<i>Ailanthus altissima</i>)	42	56	98	47
Burning bush (<i>Euonymus alata</i>)	51	52-57 (54.5)	103-108 (105.5)	68-73 (70.5)
Common reed (<i>Phragmites australis</i> ssp. <i>australis</i>)	47	68	115	49
English ivy (<i>Hedera helix</i>)	47	59-64 (61.5)	106-111 (108.5)	56-61 (58.5)
Oriental bitter-sweet (<i>Celastrus orbiculata</i>)	76	62	138	68

Table 5. Final priority rank for the 15 targeted species/species pairs.

Final Priority Rank	Species	Impact + Invasive Potential	Control
1	Common reed (<i>Phragmites australis</i> ssp. <i>australis</i>)	high	easy
2	English ivy (<i>Hedera helix</i>)	high	easy
3	Oriental bitter sweet (<i>Celastrus orbiculata</i>)	high	difficult
4	Burning bush (<i>Euonymus alata</i>)	high	difficult
5	Norway maple (<i>Acer platanoides</i>)	high	difficult
6	Japanese honeysuckle (<i>Lonicera japonica</i>)	high	difficult
7	Garlic mustard (<i>Alliaria petiolata</i>)	high	difficult
8	Tree-of-heaven (<i>Ailanthus altissima</i>)	low	easy
9	Multiflora rose (<i>Rosa multiflora</i>)	low	easy
10	Japanese barberry (<i>Berberis thunbergii</i>)	low	easy
11	Morrow and Amur honeysuckle (<i>Lonicera morrowii</i> and <i>L. maackii</i>)	low	easy
12	Japanese pachysandra (<i>Pachysandra terminalis</i>)	low	easy
13	Japanese and Chinese wisteria (<i>Wisteria floribunda</i> and <i>W. sinensis</i>)	low	easy
14	Japanese stiltgrass (<i>Microstegium vimineum</i>)	low	difficult
15	Border privet (<i>Ligustrum obtusifolium</i>)	low	difficult

Discussion

Preventing the Spread of Invasive Species

Eradication of the targeted species in the areas of high priority is a major focus of this plan. At the same time the underlying causes of how these infestations began also needs to be addressed. Many invasive non-native species begin or increase their infestations with disturbance events including soil disturbance and canopy gaps in forested areas (Nuzzo 1997, Batchner and Stiles 2000, Webb et al. 2001, Howard 2004, Bergman and Swearingen 2005, Munger 2005). This is not to say that disturbances are the sole means for infestation. For example, Norway maple has been shown to invade undisturbed native habitat (Fang 2005) from adjacent infested areas. At the same time, Norway maple is believed to be an “efficient colonist of disturbed soils” (Webb et al. 2001).

Disturbance events should be kept to a minimum. In the exceptional areas, this is especially important. All management work that is done in these exceptional areas, such as maintenance of trails, should be done with extreme care to prevent soil or canopy disturbances. Additionally, disturbance events should also be kept to a minimum in all the forested areas at SAHI. Not creating disturbances is very cheap compared to the expensive and resource demanding task of managing and monitoring invasives.

During survey work at SAHI in 2005 some management practices were observed that caused disturbed soils and canopy openings in natural areas. These are described below. While clearly not intended to help disperse and increase infestations of invasive species these actions will lead to just this. The projects that were being implemented that triggered these management activities are not being called into question. Instead, attention is being drawn to minimize disturbances in the natural area and in particular the areas of conservation priority. Disturbances in the areas of high conservation priority will lead to higher costs and greater efforts needed to eradicate invasive species.

Along the circular loop trail through the forests east of the Old Orchard Museum (exceptional area #3) there was a place which appears to have been used as a staging area for dumping wood chips to be spread along the trail. The staging area was adjacent to the trail in the forest. A bunch of native shrubs in the area were killed and the soils were disturbed.

Along the north boundary of SAHI in the forested area east of the Old Orchard Museum (exceptional area #3), just south of the fence marking the boundary line, an approximately 4 meter wide swath was being cleared. Only very large trees were being left. A full sized flowering dogwood (*Cornus florida*) was cut and many native shrubs [mostly spice bush (*Lindera benzoin*)] appeared to have been bulldozed. The area also appears to have been brush hogged or mowed down to the soil. Much soil was exposed. This swath goes through an area that has a very steep slope (ca. 40%) and on this steep slope soils were showing signs of eroding.



Figure 39. Cleared area just south of SAHI northern boundary in exceptional area #3.

In the eastern edge of exceptional area #1 there is a full although relatively young tree canopy. Under the tree canopy is a full covering of the native grass, wavy hair grass (*Deschampsia flexuosa*). This area was mowed down to the dirt. The soils were extremely disturbed and the native plant cover removed.

In the disturbed forested area south-southwest of the new barn, extensive soil disturbance was occurring. Soil and plants had been bulldozed and areas had been mowed down into the soil. Clearing was being done adjacent to the boundary line where an old fence line occurs. The clearing that was done along the fence line appears to have involved bulldozing and mowing into the soil. While this area is not of high priority for conservation this type of management will lead to an explosion of invasive plants. The invasive plants that get established in this area will easily be able to spread into the adjacent areas of high conservation priority.



Figure 40 (left), 41 (right). Area south-southwest of new barn that was disturbed by management actions in 2005.

Just inside the forested area southwest of the orchard, dumping of landscape refuse was occurring. This forested area is part of the exceptional area #3. Some of this dumping was adjacent to a very old red oak (*Quercus rubra*). Dumping in this area causes disturbance and will lead to infestations of invasive plants.

In an area just south of the Old Orchard Museum an area with some wisteria was mowed “clean” within the recent past. This means it was cut to the ground leaving no vegetation (personal communication Scott Gurney). The area now is a dense thicket of wisteria with 100% cover. Wisteria is known to sprout vigorously from the roots and so this outcome is logical. The intention to scale back the wisteria invasion is a good one but in order for it to be successful it needs to happen within a comprehensive plan that has looked at the impacts of control measures.

Invasive Species Management at SAHI

Successful management of invasive species at SAHI will take ongoing and consistent effort. Actions taken once will require follow up effort and time. If control actions are taken once or twice and then stopped, there is the possibility that infestations will spread or become worse, as illustrated with the cutting of the wisteria patch near the Old Orchard Museum (discussed in “preventing the spread of invasives” in the discussion section). While implementation of this plan is important to preserve the natural and cultural resources present at SAHI, implementation should be done only with a commitment to ongoing efforts.

Within the areas of high priority for conservation, targeted species should be controlled. Emphasis should be put on species that are ranked higher in the prioritized targeted species list. In general control efforts should move from areas of least infestation to areas of greatest infestation in line with the “Bradley method” (Fuller and Barbe 1985). For example, efforts should first focus on outliers of a population. Large infestations should initially be contained and slowly reduced in size by working to remove plants on the edges.

Species that are not targeted in this plan but were identified as being non-native invasives present at SAHI are of lower priority for control. If control of these species does not take away time from dealing with the targeted invasives they should be controlled. Otherwise, efforts should focus on the higher priority species. It is expected that plenty of effort will be needed just for the targeted species and the lower priority species will be left alone.

More than one species at a time should be controlled in a particular area. This will be more efficient and should lead to better success in terms of repopulation of native species. For example when treating an infestation of English ivy (ranked 2nd in priority) other invasives present in the area such as border privet (ranked 15th in priority) should also be treated. Even though border privet has a much lower priority ranking it should be treated in these situations because any opening that is created by treatment of one invasive can become ideal habitat for other invasives to spread.

Disturbance of soils should be kept to an absolute minimum. SAHI is filled with numerous highly invasive species and disturbed soils will lead to prime conditions for many of these invasives. Therefore, where possible, cutting of plants verse pulling is encouraged.

Creation of large gaps in the canopy should also be avoided if possible. As with soil disturbance this type of change in the structure of the forest is known to lead to increased potential for infestation by invasive plants (Webb et al. 2001). This will mostly be an issue with trees and in particular Norway maple (*Acer platanoides*). Trees should ideally be removed before they get into the canopy. If a canopy gap is created, extra time and effort should be allocated for return visits in the following years to allow for control of any increased infestations that occur.

All areas that have had plants eradicated in one fashion or another should be revisited; ideally the same year or at least the following year. This point is extremely important because eradication may lead to sprouting of roots or germination of seeds of the plant that were removed or other invasives. This means that in addition to removing plants, areas that have had some eradication effort should be carefully marked to facilitate re-visitation.

Part of the goal of this plan, as stated earlier, is to preserve native species present in the areas of high conservation priority. Therefore, removing targeted invasive species is a means to allowing re-vegetation of native species. It is of utmost importance that native species present nearby or even mixed in with invasive species be allowed to survive. Additionally, close attention should be paid to species that repopulate areas cleared of invasives. At least one staff member that is involved in management actions should be knowledgeable about the identification of plants that occur at SAHI. The species list of all species currently documented at SAHI (Appendix C) should be consulted. When there are doubts about species identification, which there always are, a botanist should be consulted. This is critical because further infestations of invasive species will occur unless native species are allowed to re-vegetate areas cleared of invasives.

Ideally in areas that have had invasives removed, native species will begin to repopulate these areas. The areas that are of highest conservation priority mostly have native species dominant so when invasives are removed natives propagules should be present to repopulate the opened areas. In a few instances this may not be the situation as with some dense infestations of English ivy. In these cases, native species are present but perhaps a little further away. Extra time and effort should be designated to revisit these sites and deal with any re-infestations of invasive plant species. If native species are not repopulating opened habitat some sort of re-vegetation effort should be investigated.

Management Actions

A review was conducted of various control options for each of the targeted plant species. When reviewing the different control options attention was paid to how these techniques impact the surrounding native vegetation and how much disturbance they cause either in the soils or in the structure of the habitat.

For each species some control options are outlined below that appear to be the most appropriate in achieving the goals laid out in this plan. These are meant to be guidelines and are not the only techniques that should be used. If another technique is discovered that has been shown to be effective and is appropriate for SAHI then this technique should be compared to the ones presented below.

The use of herbicides should only be used where other control techniques are not feasible and when they will not negatively impact the native plants present on the site. If the native plants are eliminated while the invasives are being controlled the chances that the area will be repopulated by natives will be diminished. Additionally, herbicides should not be used if they will harm other aspects of the ecosystem. It should be clear that any proposed herbicide usage “will do more conservation good than harm” (Tu et al. 2001).

If herbicides are used they should be used in a fashion that puts the least amount of damage on adjacent native vegetation. For example, cut-stem treatments are generally less destructive to the adjacent vegetation than foliar spraying. Additionally, if herbicides are to be used various actions should be taken to assure safety to the environment as well as the herbicide applicators and others involved in the project. The Weed Control Methods Handbook (Tu et al. 2001) outlines in detail protocols and procedures to be taken when using herbicides. The specific protocols and procedures are not outlined in this management plan. They are the responsibility of those that implement this management plan. Some protocols and procedures to be developed or followed are mentioned below following Tu et al. (2001).

1. “Develop safety protocols for storing, mixing, transporting, handling spills, and disposing of unused herbicides and containers before obtaining herbicides.”
2. Understand and follow all laws governing the usage of herbicides. Herbicide labels are legal documents and should be read.
3. Contact state and/or county agricultural officials around details regarding applicator permits and posting requirements.
4. Make sure all applicators have appropriate state and local certificates and licenses.
5. Protective gear required on labels or by other laws and regulations should be provided and used by all applicators.
6. Keep records of all pesticide use. Follow NPS, federal, and local laws and regulations related to record keeping and reporting.

Norway Maple (*Acer platanoides*)

Very little information is available regarding controlling this species (Munger 2003). A study by Webb et al (2001) demonstrated that removal of trees by felling or girdling of all trees over 1.5 meters in height reduced Norway maple seedling recruitment and increased native tree seedling recruitment. Trees stump sprouted after cutting or girdling. The sprouts from older trees died within two years while sprouts from younger trees removed appeared to be persisting. Pulling of seedlings led to an increase in seedling recruitment. This was hypothesized to be a result of soil disturbance. Killing large canopy trees appears to have increased the invasion of other invasive species.

In the forested exceptional areas most Norway maples are not yet in the canopy. These should be removed by cutting or girdling before they get into the canopy. This process will need to be repeated to remove stump sprouts. Mervosh et al. (no date) indicates that stump sprouting can be prevented by the application of the following herbicides: undiluted Brush B-Gon (triclopyr 8%) or Round Up (glyphosate) diluted with equal part water.

The trees that are already in the canopy should be removed as well. This will lead to large canopy gaps which will probably lead to an increased infestation potential of other invasives. Therefore, extra effort should be allocated to ongoing follow up treatments in these gaps.

Soil disturbance should be kept to a minimum. It will also be important to remove seed sources from trees nearby by killing these trees. In some of these nearby areas Norway maple is dominant in the canopy. Removal of these trees will likely cause an increase in the infestation of other invasives, and follow up treatment of these invasives will be necessary.

Tree-of-heaven (*Ailanthus altissima*)

Control of tree-of-heaven will take ongoing repeated effort. This tree can vigorously sprout from its rootstock or base when cut or damaged (Swearingen and Pannill 2005) so all control methods should be done in a methodical ongoing fashion. Disturbance in all high priority areas should be kept to a minimum and new infestations in these areas should be immediately treated. If the infestation is discovered early enough hand pulling can be effective if the entire root is removed (Swearingen and Pannill 2005). Follow up should be conducted to ensure all re-sprouting is controlled. In most case some sort of herbicide application will be necessary to effectively deal with this species. Swearingen et al. (2005) gives detailed and elaborate control methods for large infestations (see Appendix E). These control methods should be consulted and the most appropriate one chosen for particular situations.

Garlic Mustard (*Alliaria petiolata*)

Sites with large established populations of garlic mustard and/or low quality natural areas are considered of low priority for treatment (Nuzzo 2000). Cutting of flower stems while labor intensive is most effective in areas with new infestations. In high priority areas that are devoid of garlic mustard, areas should be inspected annually in the spring and new infestation should be removed. Plants should be cut at ground level while plants are in full bloom or in immature fruit. Since garlic mustard is a biennial this will be in the second season of growth. This method has been shown to be 99% effective in killing the plants (Nuzzo 2000). Cutting as opposed to pulling is preferred at SAHI because this will minimize soil disturbance which can lead to further infestations of invasive plants. Cut plants should be removed from the site and destroyed because seeds can be produced from cut flower stems (Nuzzo 2000).

A biological control program for garlic mustard has been started although currently it is still in the research phase. No biological control agents have been released to date and it is unknown if this program will be successful (Blossey et al. 2002). Biological control may be the only long term solution to the massive infestation of garlic mustard at SAHI.

Japanese Barberry (*Berberis thunbergii*)

Japanese barberry can effectively be pulled or mechanically removed with tools such as the Weed Wrench. Roots should be fully removed to prevent sprouting (Brunelle and Lapin 1996, Swearingen 2005). This method should be feasible at SAHI because the number of plants

present is relatively small. The systemic herbicides glyphosate and triclopyr have also been shown to be effective (Swearingen 2005) but can probably be avoided.

Oriental Bitter Sweet (*Celastrus orbiculata*)

Oriental bitter sweet is another very difficult to eradicate invasive present at SAHI. Large vines should be cut. These should be cut as close to the root crown as possible (Howard 2005). Sprouts will appear from roots, rhizomes, and lower stems if no further treatment is done. Control of sprouts requires cutting every two weeks although this is not feasible at SAHI. Occasional cutting is discouraged as this simply encourages root sprouting (Howard 2005). Herbicide application can be effective on cut surfaces to kill the root system but follow up may still be necessary. Triclopyr has been shown to be effective on cut surfaces (Bergmann and Swearingen 2005, Howard 2005). Throughout a large part of the forested areas of high priority there are many small infestations of Oriental bitter sweet. If feasible these can be pulled with an attempt to remove the roots. Roots and rhizomes should be disposed of off site. Still these areas will need to be monitored frequently and treated if sprouting occurs (Howard 2005).

Burning Bush (*Euonymus alata*)

Individuals of this species can be manually dug or pulled if not too large. Larger individuals should be removed with tools such as the Weed Wrench or cut at the base. Re-sprouting will occur if roots are left behind. Follow up will need to be conducted to deal with sprouting. New sprouts can be clipped. If needed and appropriate cut stumps can be painted with glyphosate (Martin 2000). Soil disturbance should be minimized.

English Ivy (*Hedera helix*)

Populations of English ivy at SAHI are predominately ground infestations without much if any vines reaching into the canopy. Pulling of vines has been shown to very effective with follow up manual treatment increasing the effectiveness although this process is very labor intensive (Soll 2005). Pulling of vines is not always easily achieved (Swearingen and Dietrich 2005). Pulling should involve removal of as much root as possible and the least amount of soil disturbance as feasible. Once initial infestations have been pulled twice, ongoing treatment will still be necessary but the amount of time should be significantly less (see Soll 2005 for more details on effort required). At SAHI most infestations are quite dense. Removal of English ivy will lead to an increased threat of invasion by other invasives. Therefore areas where English ivy have been removed must be revisited to assess the need for further control. Herbicide use for controlling English ivy has had mixed results and attention needs to be paid to treatment timing and care in application (Soll 2005). For discussion on herbicide treatments see Soll (2005).

Border Privet (*Ligustrum obtusifolium*)

Smaller plants and seedlings can be hand pulled or cut. If roots are left behind they will sprout (Munger 2003b). Return visits to cut or pulled plants should be conducted annually and sprouts cut or pulled. Repeated cutting may or may not be enough to cause eradication but will help control the spread of border privet (Bartlow et al. 1997, Batcher 2000). Larger plants can be cut

or pulled using a tool such as the Weed Wrench (Batcher 2000). Again sprouting is likely and return visits on an annual basis are necessary (Munger 2003b).

If deemed appropriate herbicide treatment may be effective. Foliar application of herbicide is recommended for areas where dense thickets exist (Bartlow et al. 1997). Since border privet currently does not grow in dense thickets at SAHI and is mixed with desired native species, foliar application should not be used at SAHI. Pulled or cut plants can be stump painted. Bartlow et al. 1997 recommends stump painting for shrubs that have been cut at or near ground level and when the ground is not frozen. Recommendations include: applying a 25% solution of glyphosate and water to the cut stump making sure to cover the entire surface or applying a 25% solution of triclopyr and water to the cut stump making sure the entire surface is covered.

Japanese Honeysuckle (*Lonicera japonica*)

This species can be difficult to control and will take ongoing and repeated efforts to effectively manage (Munger 2002). In the forested areas of high priority at SAHI, Japanese honeysuckle mostly occurs in low densities in the understory. This species does best in high light situations and often does well in canopy openings (Munger 2002). Therefore, all canopy openings encountered need to be monitored for this species and perhaps efforts to control this species can focus in these areas.

Pulling or mechanical removal of mature plants leads to sprouting and will only be effective if repeated over long periods of time. Hand pulling of less than 2 year old individuals can lead to eradication (Munger 2002). Therefore, as mentioned above, monitoring of areas where seedlings are likely to begin such as in canopy gaps and disturbed areas is critical.

Herbicide use for Japanese honeysuckle can be difficult. Certain herbicides have been shown to be ineffective (Nuzzo 1997). Additionally, timing of application is important. A foliar application of 1.5% glyphosate shortly after the first frost appears to be an effective treatment (Nuzzo 1997). Still resprouting can occur and a one time treatment is unlikely to eradicate the plant (Munger 2002). Sites of herbicide application need to be revisited.

Morrow and Amur Honeysuckle (*Lonicera morrowii* and *L. maackii*)

Plants can be pulled with a tool such as the Weed Wrench or cut at the base although the wood is tough (Batcher and Stiles 2000). Cutting will cause less soil disturbance and is recommended. Roots will sprout but repeated cutting annually for 3-5 consecutive years of shrubs that occur in shaded settings will lead to eradication (Batcher and Stiles 2000, Munger 2005). The timing of cutting is not clear but should not be done in the winter (Munger 2005). Since these honeysuckles are quite limited in distribution in the forested high priority areas at SAHI mechanical removal may be feasible. Painting of cut stumps with glyphosate or triclopyr can be effective and may be an alternative to annual cutting. Application of herbicides should be done immediately after cutting (Munger 2005).

Japanese Stilt Grass (*Microstegium vimineum*)

Currently Japanese stilt grass is not present in any of the high priority areas although it is widespread in open lawns and periodically mowed areas. It occurs adjacent to some of the exceptional areas and occurs in some forested areas but these are areas that are highly disturbed and/or are young forests reverting from fields.

Pulling can be effective but is very time consuming and needs to be done annually for up to five years until the seed bank is gone. Pulling should be done late enough in the season that new plants will not germinate from the seed bank and early enough that mature seed is not produced (Tu 2000). At SAHI this would be from mid-August till late September. Pulling will be a good technique if new small infestations are found in the areas of high priority.

Herbicide can be effective in eradication but since Japanese stilt grass grows in dense patches re-establishment of a native plant community can be difficult (Howard 2005b). Mowing once, late in the season can also be effective. Mowing more frequently causes plants to resprout and produce seeds lower on the plants (Tu 2000). At SAHI the most important strategy is preventing incursion of this species into the high priority areas. This will entail keeping disturbance in these areas to an absolute minimum as well as early detection and removal of any infestations that are found.

Japanese Pachysandra (*Pachysandra terminalis*)

There is relatively little information available on controlling this species. USDA Forest Service (no date) claims that hand pulling has been effective. This would clearly be quite labor intensive. Scott Gurney (NPS personal communication) had a group of volunteers try to pull this plant. The volunteers got frustrated and tried mowing the population. This did not prove to be effective. There is only one population known at SAHI. It occurs in exceptional area #3. Pulling might be useful, done periodically in order to keep the population contained and perhaps slowly reduce its size. Any new infestation of this species in a high priority area should be immediately dealt with.

Glyphosate is also apparently an effective means of eradicating this species (USDA Forest Service no date). It is unclear when and at what concentrations applications of this herbicide should be done. The population of Japanese pachysandra at SAHI is dense and mostly devoid of other species. Negatively impacting non-target species is therefore not a significant issue for this population. Reestablishment of native understory species could be a problem. The understory in the general surroundings has native species present but invasives may take advantage of a large opening in the understory. Therefore, removal of Japanese pachysandra at this site should be monitored for additional invasives.

Common Reed (*Phragmites australis* ssp. *australis*)

Currently there are only two relatively small patches of common reed present at SAHI. These are the highest priority for control and should be relatively easy to eradicate. Containing the population is also a possibility but this plant is aggressive and it is likely that eradication may prove less resource intensive in the long term. The marsh should be monitored over time and any new infestation of common reed should be eradicated immediately. The small patch at the

north boundary of SAHI (polygon 21) is connected to a much larger patch on the neighbor's property to the north. If feasible, working with this property owner to control common reed on their property would be beneficial to the whole salt marsh in this region.

There appears to be mixed result with simply cutting plants once a year. Some evidence shows that repeated cutting a few years in a row in late July or early August may be effective in containing the population and perhaps to some degree eradicating it (Marks et al. 1993, Saltonstall 2005). Cutting in combination with applying herbicide to the cut stem appears to be very effective but labor intensive (Marks et al 1993, Tu no date). This method may be ideal for SAHI because the populations are relatively small and there are non-target plants adjacent and to some degree mixed in with the common reed. Glyphosate that is acceptable to be used near water applied after plants have produced tassels is effective (Saltonstall 2005, Tu no date). Monitoring should continue for a few years after treatment and may require some additional control. Abundant saltmarsh vegetation is adjacent and mixed in with the common reed. Other studies have shown that native vegetation does return after treatment although burning to remove the duff layer has been used to facilitate this process (Marks et al. 1993, Saltonstall 2005, Tu no date). See Marks et al (1993) and Tu (no date) for additional studies and techniques on controlling common reed.

Multiflora Rose (*Rosa multiflora*)

Although multiflora rose occurs throughout all three of the forested exceptional areas it occurs in fairly low densities in these sites. This species does best in more open environments. Control should be focused on the more open areas in these forested sites such as tree fall gaps. Focus should also occur in the area around Lower Lake (Map 20, polygon 20).

There are biological control agents that are already present in North America. It is expected that over the next few decades as these agents spread, multiflora rose will be reduced to low levels in the environment (Amrine 2002). Some of these agents may already occur at SAHI.

Cutting of individuals can be successful in eradicating this species but needs to be done 3 to 6 times a year for 2 to 4 consecutive years because roots sprout (Munger 2002b). This is quite labor intensive but may be feasible for some relatively small infestations. Pulling of small plants to remove the entire root is also possible but still need follow up to control any resprouting. Also, soil disturbance caused by the pulling of roots may lead to other invasives infesting the area. Herbicide application to cut stumps can help to prevent sprouting. Late season applications are recommended (Munger 2002b). Glyphosate has been used successfully in cut stump treatments although other herbicides are effective as well (Munger 2002b, Bergmann and Swearingen 2005b). It is likely that seeds of multiflora rose will germinate or other invasives will start to infest areas after removal of large multiflora infestations (Amrine 2002) so follow up monitoring will need to occur.

Chinese and Japanese Wisteria (*Wisteria sinensis* and *W. floribunda*)

Currently wisteria mostly occurs on the very edge of the forested exceptional areas. These populations should be contained and if feasible reduced in size.

Polygon 5 (Map 24) is a very small population that appears to be a new infestation. This population may be able to be removed via pulling or cutting. Eradication using this technique while possible will be difficult because any roots left behind will sprout (Remaley 2005). Cutting is recommended starting early in the season and repeated throughout the growing season every few weeks. Cutting is preferred to limit soil disturbance but this will require frequent revisits.

Cut stem treatment with herbicide is also effective. Stems should be cut close to the ground. A 25% solution of glyphosate or triclopyr can then be applied to the stem. Sprouting may still continue so follow up will need to be conducted (Remaley 2005).

Note Taking

Detailed notes should be taken for all control actions implemented. Notes should contain what species were controlled, techniques used, specific areas that management took place, date, weather, people involved in the control efforts, and any additional observations. These notes should be used to determine where follow up visits should occur. The notes should also be used when this management plan is reevaluated and modified.

Monitoring

Ongoing monitoring is an important part of this plan because it provides the data to assess success of management actions. Information from monitoring should be used to review decisions regarding management actions and to help modify this plan. Specifically, monitoring should be used to 1) detect new invasive species and 2) determine the trend of infestations of targeted invasive species within areas of high conservation concern. Items 2 should also help answer the question of whether management actions have been successful. No protocols are listed for monitoring the one individual of giant ironweed that occurs at SAHI. As mentioned earlier, a simple management plan should be written to work with this species. Invasive plants are not the main threat to this species at SAHI.

Monitoring Protocols

All targeted species will be monitored in the exceptional areas as outlined in the protocols below. The protocols are designed to help answer the points stated above but are also designed to take a relatively short period time. This is done because the staff at SAHI does not have a lot of extra resources available to dedicate to this project. If more time is available the protocols should be made more rigorous by adding additional sampling points or transects (see specifics in protocols described below).

When implementing any of the protocols listed below clear and precise notes should be taken. Data sheets should be created to collect the data listed in these protocols. Data sheets should also collect information such as: date, weather, and people collecting data.

Protocol A: Protocol A is used for populations of targeted species which are not widespread throughout a particular exceptional area (see Table 6).

At least half of all polygons that occur in exceptional areas for each targeted species will be surveyed. For species that have less than four polygons in exceptional areas all polygons should be surveyed. Polygons should be selected at random. If additional polygons are found over time, these should be added to the polygons surveyed. For each polygon to be surveyed transect lines will be set up every 10 meters in a north south direction (see Figure 42). A permanent point on the south end of the western most transect line should be marked in the field and the coordinates noted, to allow for easy relocation. This point will be used in subsequent monitoring efforts to help replicate the placement of transect lines. Each transect will then be walked from south to north. Every 2 meters a pole will be placed perpendicular to the transect line so that it extends out to the east 1 meter. If the species in question occurs anywhere along that meter long section then a presence mark is indicated. Plant material that occurs above or below the meter pole is counted as a presence. If the species in question does not occur along the 1 meters pole, an absence mark is made. This is continued till the edge of the polygon is reached. Then the next transect line 10 meters to the east; will be walked in a similar fashion. This is continued until all the transect lines have been walked. For very small polygons this might result in only a few marks being made. For larger polygons there may be many marks being made although this process should move along relatively fast.

This protocol is used for trees, shrubs, vines, and herbs. All stages of growth are counted from seedling to mature individuals. Plant material that occurs above or below the meter pole is counted as a presence.

If a polygon is only partly in an exceptional area only the part that is in the exceptional area should be surveyed. If a polygon appears to no longer exist for a particular species that should be noted. If polygons change in size between monitoring times then the most recent extent of the polygon should be used.

Table 6. Targeted species populations (polygons) that are monitored using monitoring protocol A.

Targeted species	Polygon number for polygons that occur in exceptional areas
Tree of heaven	2 (in part), 20, 21, 22, 23, 24, 25
Garlic mustard	5 (a tiny part)
Japanese barberry	2 (in part), 3, 20, 21, 22, 23, 24, 25
English ivy	2, 9, 14, 20, 21
Morrow and Amur honeysuckle	20, 21, 22, 23
Japanese stilt grass	1 (in part), 10 (in part)
Japanese pachysandra	20
Common reed	20, 21
Japanese and Chinese Wisteria	1 (in part), 5, 6 (in part)
Oriental bittersweet in exceptional area #4 only	29

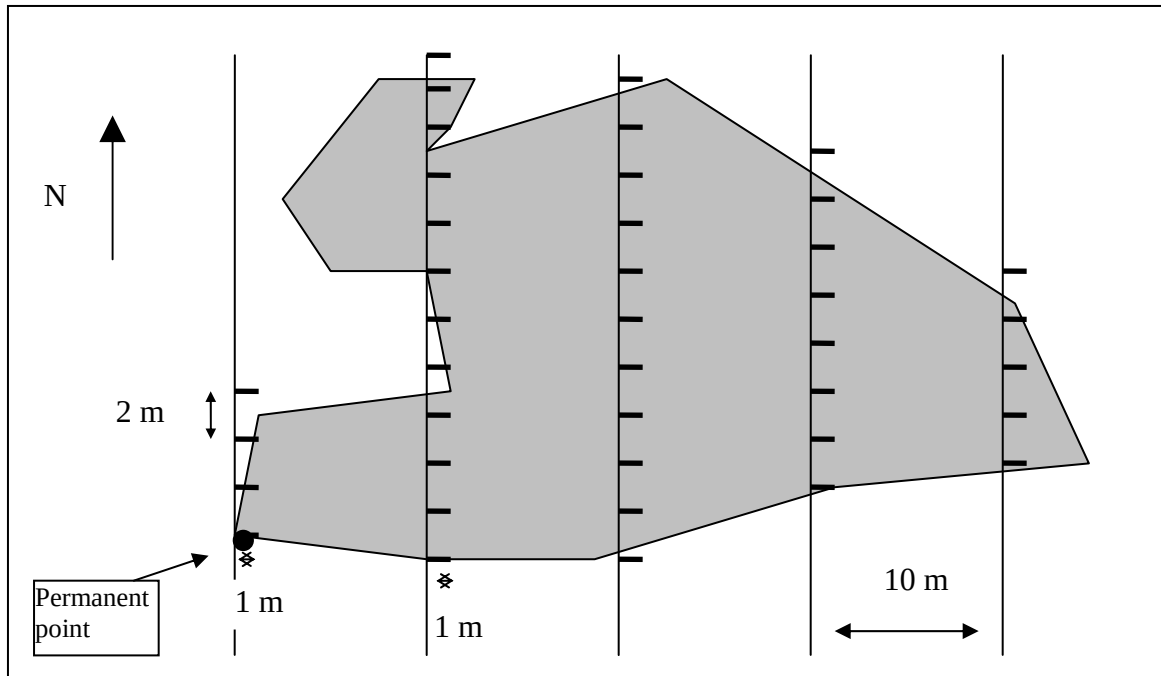


Figure 42. Schematic for protocol A. Gray polygon = polygon to be surveyed. North/south lines = transect lines. Short east/west lines = 1 meter long pole. Black dot = permanent point.

Protocol B: To help capture trend information related to species that occur throughout exceptional areas, protocol B should be used. Species this protocol will help collect information on includes: Norway maple, garlic mustard, Oriental bitter sweet, burning bush, border privet, Japanese honeysuckle, and multiflora rose. This protocol looks at each exceptional area as a whole. Since exceptional area #4 (the maritime area) does not have any targeted species that occur throughout the entire area it is not monitored using protocol B.

For each exception area (except #4) a number of restricted random permanent transects will be set up. To establish these transects, east-west lines will be placed on an outline of each exceptional area (see Figure 43). These east-west lines will be placed 25 meters apart. For each east-west line one restricted random point on the line should be determined. This point must not be less than 25 meters from a particular line's eastern edge with the exceptional area. If the east-west line is less than 25 meters in length, the point should be on the western most end of the east-west line. These points represent the starting point of permanent transects. They should be marked in the field and the coordinates noted, to allow for easy relocation.

Permanent transect lines go east from these point for 25 meters (see Figure 43). If a transect line comes to a gap where the east-west line runs temporarily out of the exceptional area, the transect line should be continued where the east-west line is back within the exceptional area (see Figure 43).

The transect line is walked from west to east. Every one meter a pole will be placed perpendicular to the transect line so that it extends out to the south 1 meter. All targeted species that occur along the meter pole are noted. Plant material that occurs above or below the meter pole is counted. If no targeted species is present then an absence mark is indicated for that meter section.

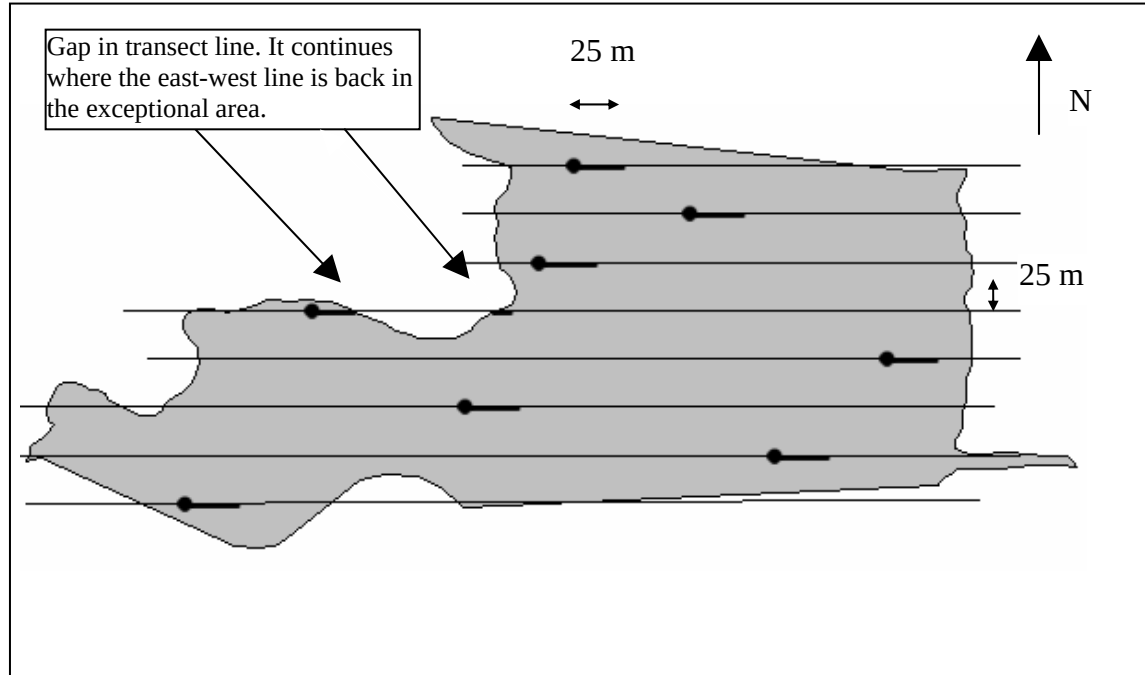


Figure 43. Schematic for protocol B. Gray polygon is one of the exceptional areas. Black dots = start of permanent transects. Short black lines = permanent transects.

Protocol C: This protocol is used to help detect new infestations of targeted species in the exceptional areas.

While implementing protocol A and B, if any new infestations of a targeted species are encountered in one of the exceptional areas it should be marked. A GPS coordinate should be taken as well. If time allows while the monitoring program is being implemented these new infestations should be mapped using a GPS unit following the protocols used during the original mapping done for this plan. If mapping does not happen during the monitoring time it should happen sometime within the rest of the growing season.

Protocol D: During the implementation of the monitoring program or during other times in the year if any new non-native plants are encountered they should be identified. If NPS staff can not easily identify them, a botanist should be contacted to help with identification. Areas that are newly disturbed are a good place to pay attention to as these may be the points where new invasive species first show themselves. The list of all species seen at SAHI (Appendix C and D) to date should be consulted. Species to keep an eye out for at present include Japanese knotweed (*Fallopia japonica*) and Bohemian knotweed (*Fallopia x bohemica*). Over time other highly invasive species might potentially become a problem on Long Island as well as SAHI. Updated information should be sought periodically on new invasive species to monitor for at SAHI.

Review and Modification of Management Plan

Data collected from monitoring protocols should be reviewed and analyzed. This analysis should be used to help evaluate this management plan. Some questions to consider when evaluating this plan include:

- 1) Are the goals of this plan being accomplished?
- 2) If not, are the goals reasonable and attainable?
- 3) Are infestations of targeted invasive species increasing, decreasing, or remaining the same?
- 4) Are monitoring protocols sufficient in evaluating the trend of the targeted invasive plants?
- 5) Is the invasive non-native plant management plan currently outdated and should it be modified and/or redone.

Conclusions

Sagamore Hill has some outstanding natural and cultural resources. A large portion of the forested lands at SAHI are old forests with numerous large old trees. Native plant species are plentiful in these older forests and in many cases are dominant. The maritime area is mostly dominated by native plant species and is part of an ecosystem that is unique and limited in distribution. Many of the native plants that occur in the maritime area although not rare are species with restricted distribution. One NYS endangered plant species is known from SAHI. The fact that SAHI has such outstanding natural areas and resources is partly the result of the stewardship that Roosevelt took while he resided at SH.

Still, the resources at SAHI are clearly at a brink. If no management is done to preserve these resources the native ecosystems will be lost to invasive plant species. As time goes on it will get more and more difficult and more time consuming to restore the resources back to a native state. Controlling the most invasive non-native species will require ongoing, consistent, and diligent work yet the rewards will be appreciated for generations to come.

Acknowledgments

I thank Scott Gurney for helping with various aspect of this project as well as assisting with field work; Sheila Colwell, Scott Gurney, and Betsy Lyman for reviewing the initial invasive plant list and commenting on various aspects of my report ; Mark Adams, Roland Duhaime, Nigel Shaw, and Elaine Westbrooks for helping with various aspects of the GIS project; Sheila Colwell for helping with various aspects of my project including being my primary contact with the NPS; Aissa Feldman and Nick Conrad for assistance with maps and GIS information; Troy Weldy for overseeing my project at the NYNHP; Richard Stalter and Brian Dutton for help with historical botanical information related to SAHI; Eric Lamont, Steve Clements, and Larry Stritch for assistance with identifications of specimens; and Ron Hiebert for assistance with the Alien Plant Ranking System. I also thank the staff at SAHI for accommodating me while I was working at SAHI.

Literature Cited

- Amrine, J.W. Jr. 2002. Multiflora rose. In: R. Van Driesche et al., eds., Biological Control of Invasive Plants in the Eastern United States, USDA Forest Service Publication FHTET-2002-04. Pp. 265-292. Available online at <http://www.invasive.org/eastern/biocontrol/22MultifloraRose.html>.
- Alien Plant Ranking System Implementation Team. 2001. Alien plants ranking system version 7.1. Flagstaff, AZ: Southwest Exotic Plant Information Clearinghouse. Available online at <http://www.usgs.nau.edu/swepic/>.
- Bartlow, J., K. Johnson, M. Kertis, T. Remaley, S. Ross, E. Simet, T. Smith, D. Soehn, and G. Taylor. 1997. Tennessee Exotic Plant Management Manual. Tennessee Exotic Pest Plant Council. Available online at http://www.tneppc.org/Manual/Management_Manual.htm.
- Batcher, M.S. 2000. Element Stewardship Abstract for *Ligustrum* spp. Privet. The Nature Conservancy, Arlington, VA. Available online at http://tncweeds.ucdavis.edu/esadocs/documnts/ligu_sp.pdf.
- Batcher, M.S. and S.A. Stiles. 2000. Element Stewardship Abstract for *Lonicera maackii* (Rupr.) Maxim (Amur honeysuckle), *Lonicera morrowii* A. Gray (Morrow's honeysuckle), *Lonicera tatarica* L. (Tatarian honeysuckle), *Lonicera x bella* Zabel (Bell's honeysuckle), The bush honeysuckles. The Nature Conservancy, Arlington, VA. Available at http://tncweeds.ucdavis.edu/esadocs/documnts/loni_sp.pdf.
- Bellavia, R.M. and G.W. Curry. 2003. Cultural Landscape Report For Sagamore Hill National Historic Site. Cultural Landscape Publications, No. 8, Boston, MA.
- Bergmann, C. and J.M. Swearingen. 2005. Oriental bittersweet. Plant Conservation Alliance, Alien Plant Working Group. Available online at <http://www.nps.gov/plants/alien/fact/ceor1.htm>.
- Bergmann, C. and J.M. Swearingen. 2005b. Multiflora rose. Plant Conservation Alliance, Alien Plant Working Group. Available online at <http://www.nps.gov/plants/alien/fact/romu1.htm>.
- Blossey, B, V.A. Nuzzo, H.L. Hinz, and E. Gerber. 2002. In: R. Van Driesche et al., eds., Biological Control of Invasive Plants in the Eastern United States, USDA Forest Service Publication FHTET-2002-04. Pp 365-372. Available online at <http://www.invasiveplants.net/invasiveplants/biologicalcontrol/29GarlicMustard.html>.
- Brunelle, H. and B. Lapin. 1996. Invasive Plant Fact Sheet. *Berberis thunbergii*. Japanese barberry. The Nature Conservancy Connecticut Chapter in cooperation with The Natural Diversity Data Base of the Connecticut Department of Environmental Protection. Available online at <http://tncweeds.ucdavis.edu/moredocs/berthu01.pdf>.

- Clinton, W. 1999. Executive Order. 13112. Available online at http://www.epa.gov/owow/invasive_species/EO13112.pdf.
- Dutton, B.E. 1998. Sagamore Hill National Historic Site. Vascular plant survey. Unpublished 2 pp.
- Eckardt, N. and T. Martin. 2001. Element Stewardship Abstract for *Rosa multiflora*. The Nature Conservancy, Arlington, VA. Available online at <http://tncweeds.ucdavis.edu/esadocs/documnts/rosamul.pdf>.
- Edinger, G.J, D.J. Evans, S. Gebauer, T.G. Howard, D.M. Hunt, A.M. Olivero. Editors. 2002. Ecological Communities of New York State. 2nd Edition. Draft version. New York Natural Heritage Program, Albany, NY.
- Fang, W. 2005. Spatial analysis of an invasion front of *Acer platanoides*: dynamic inferences from static data. *Ecography* 28: 283-294.
- Fuller, T.C. and G.D. Barbe. 1985. The Bradley Method of Eliminating Exotic Plants from Natural Reserves. *Fremontia* 13: 24-25.
- Gleason, H.A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. 2nd Edition. The New York Botanical Garden, Bronx, NY.
- Howard, J.L. 2004. *Ailanthus altissima*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available online at <http://www.fs.fed.us/database/feis/>.
- Howard, J.L. 2005. *Celastrus orbiculatus*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available online at <http://www.fs.fed.us/database/feis/>.
- Howard, J.L. 2005b. *Microstegium vimineum*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available online at <http://www.fs.fed.us/database/feis/>.
- Invasive Plant Council of New York State. No date. Invasive species list. Available at <http://www.ipcnys.org/>.
- Jordan, M.J., B. Lund, and W.A. Jacobs. 2002. Effects of mowing, herbicide and fire on *Artemisia vulgaris*, *Lespedeza cuneata*, and *Euphorbia cyparissias* at the Hempstead Plains grassland, Long Island, New York. Text of poster prepared for the Northeast Natural History Conference, New York State Museum, Albany N.Y., April 25-26, 2002.
- Marks, M., B. Lapin and J. Randall. 1993. Element Stewardship Abstract for *Phragmites australis* Common Reed. The Nature Conservancy, Arlington, VA. Available online at <http://tncweeds.ucdavis.edu/esadocs/documnts/phraaus.pdf>.

- Martin, T. No date. Weed notes. *Wisteria sinensis* (Chinese Wisteria), *Wisteria floribunda* (Japanese Wisteria). The Nature Conservancy, Arlington, VA. Available at <http://tncweeds.ucdavis.edu/moredocs/wisspp01.pdf>.
- Martin, T. 2000. Weed Alert! *Euonymus alatus* (Thunb.) Siebold. The Nature Conservancy, Arlington, VA. Available online at <http://tncweeds.ucdavis.edu/alert/alrteuon.html>.
- Mehrhoff, L.J., J.A. Silander, Jr., S.A. Leicht, E.S. Mosher and N.M. Tabak. 2003. *Celastrus orbiculatus* (Oriental bitter sweet). In: Mehrhoff, L.J., J.A. Silander, Jr., S.A. Leicht, E.S. Mosher and N.M. Tabak. IPANE: Invasive Plant Atlas of New England. Department of Ecology & Evolutionary Biology, University of Connecticut, Storrs, CT, USA. Available online at <http://webapps.lib.uconn.edu/ipane/browsing.cfm?descriptionid=27>.
- Mehrhoff, L.J., J.A. Silander, Jr., S.A. Leicht, E.S. Mosher and N.M. Tabak. 2003b. *Euonymus alata* (Winged Euonymus) In : Mehrhoff, L.J., J.A. Silander, Jr., S.A. Leicht, E.S. Mosher and N.M. Tabak. IPANE: Invasive Plant Atlas of New England. Department of Ecology & Evolutionary Biology, University of Connecticut, Storrs, CT, USA. Available online at <http://webapps.lib.uconn.edu/ipane/browsing.cfm?descriptionid=20>.
- Mehrhoff, L.J., J.A. Silander, Jr., S.A. Leicht, E.S. Mosher and N.M. Tabak. 2003c. *Microstegium vimineum* (Japanese Stilt Grass). In : Mehrhoff, L.J., J.A. Silander, Jr., S.A. Leicht, E.S. Mosher and N.M. Tabak. IPANE: Invasive Plant Atlas of New England. Department of Ecology & Evolutionary Biology, University of Connecticut, Storrs, CT, USA. Available online at <http://webapps.lib.uconn.edu/ipane/browsing.cfm?descriptionid=12>.
- Mehrhoff, L.J., J.A. Silander, Jr., S.A. Leicht, E.S. Mosher and N.M. Tabak. 2003d. IPANE: Invasive Plant Atlas of New England. Department of Ecology & Evolutionary Biology, University of Connecticut, Storrs, CT, USA. Available online at <http://invasives.eeb.uconn.edu/ipane/index.htm>.
- Mervosh, T., L. Benoit, D. Ellis, A. Johnson, B. Robinson, and K. Saltonstall. No date. Invasive Plant Management Guide. Connecticut Invasive Plant Working Group. Available online at http://www.hort.uconn.edu/cipwg/art_pubs/GUIDE/guideframe.htm.
- Morisawa, T. 1999. Weed Notes: *Hedera helix* L. The Nature Conservancy, Arlington, VA. Available online at <http://tncweeds.ucdavis.edu/moredocs/hedhel01.pdf>.
- Munger, G.T. 2001. *Alliaria petiolata*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available online at <http://www.fs.fed.us/database/feis/>.
- Munger, G.T. 2002. *Lonicera japonica*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available online at <http://www.fs.fed.us/database/feis/>.

- Munger, G.T. 2002b. *Rosa multiflora*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available online at <http://www.fs.fed.us/database/feis/>.
- Munger, G.T. 2003. *Acer platanoides*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available online at <http://www.fs.fed.us/database/feis/>.
- Munger, G.T. 2003b. *Ligustrum* spp. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available online at <http://www.fs.fed.us/database/feis/>.
- Munger, G.T. 2005. *Lonicera* spp. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available online at <http://www.fs.fed.us/database/feis/>.
- National Park Service. 1996. A Strategic Plan for Managing Invasive Nonnative Plants on National Park System Lands. U. S. Department of the Interior, National Park Service, Washington DC.
- National Park Service. 2000. Strategic Plan. National Park Service. FY 2001-FY 2005. U.S. Department of Interior, National Park Service, Washington, DC.
- National Park Service. 2001. National Park Service Management Policies, 2001 Edition. U.S. Department of the Interior, National Park Service, Washington, DC.
- National Park Service. 2005. Sagamore Hill National Historic Site Preliminary Management Alternatives Winter/Spring 2005. National Park Service, Washington, D.C.
- Nuzzo, V. 1997. Element Stewardship Abstract for *Lonicera japonica*, Japanese Honeysuckle. The Nature Conservancy, Arlington, VA. Available online at <http://tncweeds.ucdavis.edu/esadocs/documnts/lonijap.pdf>.
- Nuzzo, V. 2000. Element stewardship abstract for *Alliaria petiolata*. Garlic mustard. The Nature Conservancy, Arlington, VA. Available online at <http://tncweeds.ucdavis.edu/esadocs/documnts/allipet.pdf>.
- Plant Conservation Alliance Alien Plant Working Group. 2006. Alien plant invaders of natural areas. Available online at <http://www.nps.gov/plants/alien/factmain.htm#p1lists>
- Remaley, T. 2005. Exotic wisterias. Plant Conservation Alliance, Alien Plant Working Group. Available online at <http://www.nps.gov/plants/alien/fact/wist1.htm>.
- Rheder, A. 1987. Manual of Cultivated Trees and Shrubs Hardy in North America. 2nd Edition. Dioscorides Press, Portland, OR.

- Rhoads, A.F. and T. Block. 2002. *Berberis thunbergii*. Japanese Barberry. Morris Arboretum, University of Pennsylvania. Available online at <http://tncweeds.ucdavis.edu/moredocs/berthu01.pdf>.
- Roosevelt, T. 1913. Theodore Roosevelt, An Autobiography. Macmillan, NY.
- Saltonstall, K. 2005. Common Reed. Plant Conservation Alliance, Alien Plant Working Group. Available at <http://www.nps.gov/plants/alien/fact/phau1.htm>.
- Saltonstall, K., P.M. Peterson, and R.J. Soreng. 2004. Recognition of *Phragmites australis* subsp. *americanus* (poaceae: arundinoideae) in North America: evidence from morphological and genetic analyses. *Sida* 21(2): 683–692.
- Soll, J. 2005. Controlling English Ivy (*Hedera helix*) in the Pacific Northwest. The Nature Conservancy, Arlington, VA. Available online at <http://tncweeds.ucdavis.edu/moredocs/hedhel02.pdf>.
- Stace, C. 1997. New Flora of the British Isles. 2nd Edition. Cambridge University Press, Cambridge, UK.
- Stalter, R. 2000. Annotated checklist of the vascular plants of Sagamore Hill National Historic Site, New York. *Bartonia* 60: 97-104.
- Swearingen, J.M. 2005. Japanese Barberry. Plant Conservation Alliance, Alien Plant Working Group. Available online at <http://www.nps.gov/plants/alien/fact/beth1.htm>.
- Swearingen, J.M. and S. Diedrich. 2005. English Ivy. Plant Conservation Alliance, Alien Plant Working Group. Available online at <http://www.nps.gov/plants/alien/fact/hehe1.htm>.
- Swearingen, J.M. and P. Pannill. 2005. Tree of Heaven. Plant Conservation Alliance, Alien Plant Working Group. Available online at <http://www.nps.gov/plants/alien/fact/aial1.htm>.
- Swearingen, J., K. Reshetiloff, B. Slattery, and S. Zwicker. 2002. Plant Invaders of Mid-Atlantic Natural Areas. National Park Service and U.S. Fish & Wildlife Service, 82 pp. Available online at <http://www.invasive.org/eastern/midatlantic/wist.html>.
- Tu, M. 2000. Element Stewardship Abstract for *Microstegium vimineum* The Nature Conservancy, Arlington, VA. Available at <http://tncweeds.ucdavis.edu/esadocs/documnts/micrvim.pdf>.
- Tu, M. (Editor). No date. Techniques from TNC Stewards for the eradication of *Lythrum salicaria* purple loosestrife) and *Phragmites australis* (common reed) in wetlands. Wildland Invasive Species Program. The Nature Conservancy, Arlington, VA. Available online at <http://tncweeds.ucdavis.edu/moredocs/lytsa01.pdf>.

- Tu, M., C. Hurd, and J.M. Randall. 2001. Weed Control Methods Handbook, The Nature Conservancy. Available online at <http://tncweeds.ucdavis.edu>.
- USDA Forest Service, Forest Health Staff. No date. Weed of the week. Japanese Pachysandra (*Pachysandra terminalis*). USDA Forest Service, Newtown Square, PA. Available at http://www.na.fs.fed.us/fhp/invasive_plants/weeds/japanese-pachysandra.pdf.
- U.S. Congress. 1916. National Park Service Organic Act. August 25, 1916, 16 USC 1-4, chapter 408; 39 Stat. 535.
- Weakley, A.S. 2006. Flora of the Carolinas, Virginia, Georgia, and surrounding areas. Working draft of 17 January 2006. University of North Carolina Herbarium (NCU), North Carolina Botanical Garden, University of North Carolina at Chapel Hill, Chapel Hill, NC.
- Webb, S.L., T.H. Pendergast IV, and M.E. Dwyer. 2001. Response of native and exotic maple seedling banks to removal of the exotic, invasive Norway maple (*Acer platanoides*). Journal of the Torrey Botanical Society. 128(2): 141-149.
- Weldy, T. and D. Werier. 2005. New York Flora Atlas. [S.M. Landry, K.N. Campbell, and L.D. Mabe (original application development), Florida Center for Community Design and Research. University of South Florida]. New York Flora Association, Albany, New York. Available on the web at <http://atlas.nyflora.org/>
- Young, S.M. and T.W. Weldy. Eds. 2005. New York Rare Plant Status List. June 2005. New York Natural Heritage Program, Albany, NY.

Appendix A. Questions from the Alien Plant Ranking System used to prioritize targeted species
(Alien Plant Ranking System Implementation Team 2001).

Below each question are the possible answers with the first number in brackets used for “level of impact” weight, the second for “potential to be invasive” weight, and the third for “feasibility of control” weight.

I. Significance of Threat or Impact (Site Characteristics)

1. Distribution relative to disturbance regime

[0][0][0] A. found only within sites disturbed within the last 3 years or sites regularly disturbed

[1][0][0] B. found in sites disturbed within the last 10 years

[2][0][0] C. found in mid-successional sites disturbed 11 to 50 years before present (BP)

[5][0][0] D. found in late-successional sites disturbed 51 to 100 years BP

[10][0][0] E. found in high quality natural areas with no known major disturbance for 100 years

2. Areal extent of populations (answer in per cent or hectares)

[0][0][0] A. not in site, but in adjacent areas

[1][0][1] B. found in less than 5% of site

[2][0][2] C. found in between 5% and 10% of site

[3][0][5] D. found in between 10% and 25% of site

[5][0][10] E. found in more than 25% of site

3. Numerical dominance of species within a community

[0][0][0] A. not found on site

[1][0][1] B. usually observed as a single individual (or fewer than 5 per 5 square meters)

[2][0][3] C. usually observed in numbers less than the 2 or 3 most common native species in the community (but more than 5 per 5 square meters)

[3][0][5] D. usually observed in numbers approximately equivalent to the most common native species in the community

[5][0][10] E. usually observed in numbers greater than the most common native species in the community

4. Association with native community

[0][0][0] A. associated with weedy (early successional) species

[3][0][0] B. associated with midsuccessional species

[6][0][0] C. associated with dominant (late-successional) species

[10][0][0] D. displaces native plant community

5. Hybridization with native species

[0][0][0] A. not known to hybridize with native species

[5][0][0] B. known to hybridize with native species

6. Degree of threat and impact

☐ ☐ ☐ ☐ A. little or no increase in numbers of individuals and populations and no invasion of native communities

☐ ☐ ☐ ☐ B. present in native communities, but static or decreasing

☐ ☐ ☐ ☐ C. moderate rate of increase in numbers of individuals and populations; little or no invasion of native communities

☐ ☐ ☐ ☐ D. moderate rate of increase in numbers of individuals and populations; invading native plant communities

☐ ☐ ☐ ☐ E. high rate of increase of numbers of individuals and populations; invading and replacing or highly modifying native plant communities

7. Effects on management goals

☐ ☐ ☐ ☐ A. no effect

☐ ☐ ☐ ☐ B. little impact on site management goals

☐ ☐ ☐ ☐ C. moderate impact on site management goals

☐ ☐ ☐ ☐ D. large impact on site management goals

II. Innate Ability to be a Pest (Species Characteristics)

8. Mode of reproduction

☐ ☐ ☐ ☐ A. rarely, if ever, reproduces in area

☐ ☐ ☐ ☐ B. reproduces almost entirely by vegetative means

☐ ☐ ☐ ☐ C. reproduces only by seeds

☐ ☐ ☐ ☐ D. reproduces vegetatively and by seeds

9. Vegetative reproduction

☐ ☐ ☐ ☐ A. no vegetative reproduction

☐ ☐ ☐ ☐ B. vegetative reproduction rate maintains population

☐ ☐ ☐ ☐ C. vegetative reproduction rate results in moderate increase in population size

☐ ☐ ☐ ☐ D. vegetative reproduction rate results in rapid increase in population size

10. Frequency of sexual reproduction for mature plant

☐ ☐ ☐ ☐ A. almost never reproduces sexually in area

☐ ☐ ☐ ☐ B. once every five or more years

☐ ☐ ☐ ☐ C. every other year

☐ ☐ ☐ ☐ D. one or more times a year

☐ ☐ ☐ ☐ E. bursts of sexual reproduction in response to environmental stimulus, e.g., rain in the desert

11. Number of seeds per plant

☐ ☐ ☐ ☐ A. rarely, if ever, produces seeds in area

☐ ☐ ☐ ☐ B. few (0-10)

☐ ☐ ☐ ☐ C. moderate (11-1000)

☐ ☐ ☐ ☐ D. many (>1000)

12. Dispersal ability

- ☐ ☐ ☐ ☐ A. little potential for long-distance dispersal
☐ ☐ ☐ ☐ B. great potential for long-distance dispersal

13. Germination requirements

- ☐ ☐ ☐ ☐ A. requires open soil and disturbance to germinate
☐ ☐ ☐ ☐ B. can germinate in vegetated areas but in a narrow range or in special conditions
☐ ☐ ☐ ☐ C. can germinate in existing vegetation in a wide range of conditions

14. Seed banks

- ☐ ☐ ☐ ☐ A. seeds remain viable in the soil for less than 1 year
☐ ☐ ☐ ☐ B. seeds remain viable in the soil for 1 to 5 years
☐ ☐ ☐ ☐ C. seeds remain viable in the soil for more than 5 years

15. Competitive ability

- ☐ ☐ ☐ ☐ A. poor competitor
☐ ☐ ☐ ☐ B. moderately successful competitor
☐ ☐ ☐ ☐ C. highly successful competitor

16. Ecological effects (select all that apply)

- ☐ ☐ ☐ ☐ A. produces persistent litter or shade that affects germination or growth of native species
☐ ☐ ☐ ☐ B. produces allelochemicals
☐ ☐ ☐ ☐ C. affects availability of soil nutrients, e.g., a nitrogen fixer
☐ ☐ ☐ ☐ D. affects water availability to native plants
☐ ☐ ☐ ☐ E. changes natural fire regime
☐ ☐ ☐ ☐ F. none of the above

17. Known level of impact in natural areas

- ☐ ☐ ☐ ☐ A. not known to cause impacts in any other natural area
☐ ☐ ☐ ☐ B. known to cause impacts in natural areas, but with different habitats and climate zones
☐ ☐ ☐ ☐ C. known to cause low impact in natural areas with similar habitats and climate zones
☐ ☐ ☐ ☐ D. known to cause moderate impact in natural areas with similar habitats and climate zones
☐ ☐ ☐ ☐ E. known to cause high impact in natural areas with similar habitats and climate zones and/or on the list of most invasive alien plants for the region

III. Difficulty of Control

18. Likelihood of successful control

- ☐ ☐ ☐ ☐ A. this species has been eradicated in a natural area
☐ ☐ ☐ ☐ B. control (populations declining) of this species has been achieved in a natural area
☐ ☐ ☐ ☐ C. limited control (species is no longer spreading, but persists near pre-control levels) of this species has been achieved in a natural area

[0][0][10] D. control of this species has never been achieved in a natural area

19. Saturation in surrounding region

[0][0][0] A. not present in areas surrounding the site

[0][0][1] B. present in few areas surrounding the site

[0][0][3] C. present in several areas but not entirely surrounding the site

[0][0][5] D. present in most areas surrounding the site

20. Effectiveness of community management

[0][0][0] A. protection from disturbance effectively controls target species

[0][0][2] B. cultural techniques (burning, flooding) can be used to control target species

[0][0][5] C. restoration or preservation practices effectively control target species

[0][0][10] D. the above options are not effective

21. Vegetative regeneration

[0][0][0] A. no resprouting following removal of aboveground growth

[0][0][5] B. sprouts from roots or stumps

[0][0][10] C. any plant part is a viable propagule

22. Biological control

$\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$ A. biological control feasible

[0][0][5] B. potential may exist for biological control

[0][0][10] C. biological control not feasible (not practical, possible, or probable)

23. Side effects of control measures

[0][0][0] A. control measures have little potential to affect native communities

[0][0][3] B. control measures are likely to cause moderate impacts on community

[0][0][5] C. control measures are likely to cause major impacts on community

[0][0][5] D. side effects of control unknown

24. State Noxious Weed

[0][0][0] A. not considered a State Noxious Weed

[0][0][0] B. considered a State Noxious Weed

Appendix B. Answers to Alien Plant Ranking System (APRS) questions. See Appendix A for questions.

question #	Targeted invasive species														
	Norway Maple (<i>Acer platanoides</i>)	Tree-of-heaven (<i>Ailanthus altissima</i>)	Garlic mustard (<i>Alliaria petiolata</i>)	Japanese barberry (<i>Berberis thunbergii</i>)	Oriental bitter-sweet (<i>Celastrus orbiculata</i>)	Burning bush (<i>Euonymus alata</i>)	English ivy (<i>Hedera helix</i>)	Border privet (<i>Ligustrum obtusifolium</i>)	Japanese honeysuckle (<i>Lonicera japonica</i>)	Morrow and Amur honeysuckle (<i>Lonicera morrowii</i> and <i>maackii</i>)	Japanese stiltgrass (<i>Microstegium vimineum</i>)	Japanese pachysandra (<i>Pachysandra terminalis</i>)	Common reed (<i>Phragmites australis</i> ssp. <i>australis</i>)	Multiflora rose (<i>Rosa multiflora</i>)	Japanese and Chinese wisteria (<i>Wisteria floribunda</i> and <i>sinensis</i>)
1	D	C	D	D	D	D	C	C	D	D	B	D	A	D	C
2	E	B	E	B	E	E	B	E	E	C	C	B	B	E	B
3	E	C	E	B	C	C	E	C	D	C	E	E	E	D	E
4	D	B	D	C	D	C	B	C	B	B	A	D	D	B	B
5	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A
6	D	E	E	D	D	D	D	D	D	D	C	D	D	D	D
7	D	C	D	C	D	C	D	C	C	C	A	C	C	C	B
8	C	D	C	C	D	C	D	C	D	C	C	D	D	D	D
9	A	C	A	A	C	A	C	A	C	A	A	C	D	B	C
10	D	D	D	D	D	D	D	D	D	D	D	D	D	D	A
11	D	D	D	D	D	D	A	D	C	D	C	B	C	D	A
12	A	A	A	B	B	B	B	B	B	B	A	A	B	B	A
13	C	B	C	C	C	C	C	B	C	C	B	U	B	B	A
14	A	A	B	U	A	U	U	A	B	B	B	U	B	C	U
15	C	C	C	B	C	C	C	B	B	B	C	C	C	B	C
16	A	B	AB	A	F	A	A	A	A	A	A	A	A	F	A
17	E	E	E	E	E	D	E	D	E	E	E	B	E	D	D
18	B	B	D	D	D	D	B	D	D	C	C	U	B	B	U
19	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
20	C	C	D	C	C	C	C	C	C	C	C	C	C	C	C
21	B	B	B	B	B	B	B	B	B	B	A	B	B	B	B
22	C	C	B	C	C	C	C	C	C	C	C	C	B	A	C
23	C	B	B	B	B	B	B	B	A	B	B	B	A	B	B
24	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

Appendix C. List of Plants Seen During 2005 Survey Work.

Numbers in parentheses represents collection numbers of David Werier for voucher specimens. An “x” in the final column represents non-native species.

Scientific Name	Common Name	Notes	Non-native
<i>Acalypha gracilens</i>	slender copperleaf		
<i>Acer palmatum</i> (2656)	Japanese maple		x
<i>Acer platanoides</i>	Norway maple		x
<i>Acer pseudoplatanus</i>	sycamore maple		x
<i>Acer rubrum</i> var. <i>rubrum</i>	red maple		
<i>Acer saccharinum</i>	silver maple		
<i>Acer saccharum</i> var. <i>saccharum</i>	sugar maple		
<i>Achillea millefolium</i>	common yarrow		x
<i>Aesculus hippocastanum</i>	horse chestnut	Perhaps old planting.	x
<i>Aesculus</i> sp.	buckeye	One small sapling in understory.	x
<i>Aesculus</i> sp. (2639)	buckeye	Appears to have been planted near pet cemetery. Low rhizomatous shrub, not naturalizing but patch large in size.	x
<i>Ageratina altissima</i>	white snakeroot		
<i>Agrostis capillaris</i>	colonial bentgrass		x
<i>Agrostis gigantea</i>	black bentgrass		x
<i>Agrostis perennans</i>	perennial bentgrass		
<i>Ailanthus altissima</i>	tree-of-heaven		x
<i>Ajuga</i> sp.	bugle		x
<i>Albizia julibrissin</i> (2650)	silk tree		x
<i>Alliaria petiolata</i>	garlic mustard		x
<i>Allium vineale</i>	wild garlic		x
<i>Amaranthus blitum</i> (2798)	purple amaranth		x
<i>Amaranthus</i> ? <i>hybridus</i>	smooth amaranth		x
<i>Amaranthus retroflexus</i>	redroot pigweed		
<i>Ambrosia artemisiifolia</i>	annual ragweed		x
<i>Amelanchier arborea</i>	downy serviceberry	Some with leaves a little elongate.	
<i>Amelanchier laevis</i>	Allegheny serviceberry		
<i>Ammophila breviligulata</i>	American beachgrass		
<i>Ampelopsis brevipedunculata</i> (2623)	porcelain-berry		x
<i>Antennaria</i> ? <i>parlinii</i>	Parlin's pussytoes	Either <i>A. plantaginifolia</i> or <i>A. parlinii</i> ssp. <i>fallax</i>	
<i>Anthoxanthum odoratum</i>	sweet vernal grass		x
<i>Anthriscus sylvestris</i>	wild chervil		x
<i>Apocynum cannabinum</i>	clasping-leaf dogbane		

<i>Aralia elata</i> (2836)	Japanese angelica tree		x
<i>Aralia nudicaulis</i>	wild sarsaparilla		
<i>Arctium</i> sp.	burdock		x
<i>Arenaria serpyllifolia</i>	thyme-leaf sandwort		x
<i>Arisaema triphyllum</i> ssp. <i>triphyllum</i>	Jack-in-the-pulpit		
<i>Arrhenatherum elatius</i> (2636)	tall oatgrass	Form with long bent awn on second lemma.	x
<i>Artemisia vulgaris</i>	mugwort		x
<i>Asclepias syriaca</i>	common milkweed		
<i>Asclepias tuberosa</i>	butterfly-weed		
<i>Asparagus officinalis</i>	garden asparagus		x
<i>Athyrium filix-femina</i> ssp. <i>angustum</i>	lady fern		
<i>Atriplex cristata</i> (2804)	crested saltbush	Synonyms: <i>A. arenaria</i> , <i>A. mucronata</i> .	
<i>Atriplex</i> ? <i>patula</i>	halberd-leaf saltbush		
<i>Atriplex</i> ? <i>prostrata</i> (2815)	creeping saltbush	Fruits still not mature enough. May just be <i>A. patula</i> .	x
<i>Baccharis halimifolia</i>	Groundsel-tree		
<i>Barbarea vulgaris</i>	yellow rocket		x
<i>Bassia</i> ? <i>hyssopifolia</i> (2806)	five-horn smother-weed	Plants immature but appear to be <i>B. hyssopifolia</i> .	x
<i>Berberis thunbergii</i>	Japanese barberry		x
<i>Betula lenta</i>	sweet birch		
<i>Betula populifolia</i> (2640)	gray birch	Appears to be planted in cultural area but some also growing at edge of field.	
<i>Bidens frondosa</i>	devil's beggar-tick		
<i>Bidens</i> sp.		Still not in flower during Sept. survey. Perhaps <i>B. connata</i> .	
<i>Boehmeria cylindrica</i>	false nettle		
<i>Bolboschoenus robustus</i> (2830)	salt-marsh bulrush		
<i>Bromus</i> ? <i>commutatus</i>	hairy brome		x
<i>Cakile edentula</i>	American searocket		
<i>Calamagrostis epigeios</i> (2635)	feathertop		x
<i>Calystegia sepium</i> ? ssp.	hedge-bindweed		?x
<i>Carex albicans</i> var. <i>albicans</i>	bellow-beaked sedge		
<i>Carex annectens</i>	yellow-fruited sedge		
<i>Carex appalachica</i>	Appalachian sedge		
<i>Carex blanda</i>	woodland sedge		
<i>Carex debilis</i> var. <i>rudgei</i>	white-edge sedge		
<i>Carex digitalis</i>	slender wood sedge		
<i>Carex laxiflora</i>	loose flowered sedge		
<i>Carex lurida</i> (2649)	shallow sedge		

<i>Carex ? pensylvanica</i>	Pennsylvania sedge	If not <i>C. pensylvanica</i> then <i>C. lucorum</i> .	
<i>Carex radiata</i>	stellate sedge		
<i>Carex silicea</i> (2653)	sea-beach sedge		
<i>Carex swanii</i>	swan sedge		
<i>Carex virescens</i>	ribbed sedge		
<i>Carya alba</i>	mockernut hickory		
<i>Carya glabra</i>	pignut hickory		
<i>Castanea dentata</i>	American chestnut		
<i>Catalpa speciosa</i>	northern catalpa		x
<i>Celastrus orbiculata</i> (2813, 2837)	oriental bitter-sweet	Some maritime individuals approach the native <i>C. scandens</i> but this is probably due to the harsh maritime conditions.	x
<i>Centaurea biebersteinii</i>	spotted knapweed		x
<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	big chickweed		x
? <i>Chamaecyparis</i> sp. (2630)		Possibly planted. In woods.	x
<i>Chamaesyce maculata</i>	spotted spurge		
<i>Chelidonium majus</i>	greater celandine		x
<i>Chenopodium album</i>	lambs-quarters		x
<i>Chimaphila maculata</i>	spotted wintergreen		
<i>Cichorium intybus</i>	chicory		x
<i>Circaea lutetiana</i>	enchanter's nightshade		
<i>Cirsium arvense</i>	creeping thistle		x
<i>Clematis terniflora</i> (2644)	Japanese virgin's-bower		x
<i>Collinsonia canadensis</i>	Canada horse-balm		
<i>Commelina communis</i>	Asiatic dayflower		x
<i>Convallaria majalis</i>	European lily-of-the-valley		x
<i>Conyza canadensis</i> ? var.	Canadian horseweed		
<i>Cornus alternifolia</i>	alternate-leaf dogwood		
<i>Cornus florida</i>	flowering dogwood		
<i>Coronilla varia</i> (2645)	common crown-vetch		x
<i>Corylus americana</i>	American hazelnut		
<i>Crataegus monogyna</i> (2642)	One-seed hawthorn	Possibly planted.	x
<i>Cyperus esculentus</i> (2797)	yellow nut-grass		x
<i>Cyperus grayi</i> (2811)	Gray's flatsedge		
<i>Cyperus lupulinus</i> ssp. <i>macilentus</i>	great plains flatsedge		
<i>Dactylis glomerata</i>	orchard grass		x
<i>Danthonia spicata</i>	poverty oatgrass		
<i>Daucus carota</i>	wild carrot		x
<i>Deschampsia flexuosa</i>	wavy hair grass		

<i>Deutzia scabra</i> (2622)	fuzzy deutzia	Some double flowered ones present as well.	x
<i>Dianthus armeria</i>	deptford pink		x
<i>Dichanthelium acuminatum</i> (2633)	panic grass	Doesn't key to a var. or ssp.	
<i>Dichanthelium dichotomum</i> (2634)	small-fruited panic grass		
<i>Digitaria ischaemum</i>	smooth crabgrass		x
<i>Dryopteris carthusiana</i>	spinulosa shield fern		
<i>Dryopteris intermedia</i>	evergreen wood fern		
<i>Dryopteris marginalis</i>	marginal wood fern		
<i>Duchesnea indica</i>	Indian mock-strawberry		x
<i>Elymus repens</i>	creeping wild rye		x
<i>Elymus virginicus</i> var. <i>halophilus</i> (2821)	wildrye	Must be this var. but doesn't conform to Fernald's interpretation.	
<i>Eragrostis cilianensis</i> (2795)	stinkgrass		x
<i>Erigeron annuus</i>	white-top fleabane		
<i>Erigeron philadelphicus</i>	Philadelphia fleabane		
<i>Erigeron strigosus</i>	prairie fleabane		
<i>Euonymus alatus</i>	burning bush		x
<i>Euonymus fortunei</i> var. <i>radicans</i>	winter creeper		x
<i>Euphorbia cyparissias</i>	cypress spurge		x
<i>Eurybia divaricata</i>	white wood-aster		
<i>Fagus grandifolia</i> (2835)	American beech		
<i>Fagus sylvatica</i> (2629)	European beech		x
<i>Festuca rubra</i> (2637)	red fescue		x
<i>Forsythia suspensa</i> (2625)	weeping forsythia	Probably planted and persisting or spreading slightly.	x
<i>Forsythia x intermedia</i> (2819)	forsythia	A few small shrubs possibly naturalized but may be persisting from plantings.	x
<i>Galinsoga quadriradiata</i>	fringed quickweed		x
<i>Galium aparine</i>	cleavers		
<i>Galium triflorum</i>	sweet-scented bedstraw		
<i>Gaylussacia baccata</i>	black huckleberry		
<i>Geranium maculatum</i>	wild geranium		
<i>Geum canadense</i>	white avens		
<i>Glyceria striata</i>	fowl mannagrass		
<i>Hedera helix</i> (2800, 2833)	English ivy	There are some questions regarding taxonomy of this taxon but it all appears to be <i>H. helix</i> (sensu stricto).	x
<i>Hemerocallis fulva</i>	orange daylily		x
<i>Hieracium paniculatum</i>	panicked hawkweed		
<i>Holcus lanatus</i>	common velvetgrass		x
<i>Hudsonia tomentosa</i>	sand-heather		

<i>Hydrangea</i> sp. (2641)	hydrangea	Probably planted at this location. Also may be naturalizing or spreading a small amount.	x
<i>Hypericum perforatum</i>	Saint John's-wort		x
<i>Hypochaeris radicata</i>	spotted cat's-ear		x
<i>Ilex</i> ? <i>crenata</i> (2626, 2817)	Japanese holly		x
<i>Ilex opaca</i>	American holly		
<i>Ilex verticillata</i> (2826)	winter berry	Most in normal wet habitat but I found some growing in dry sandy soil.	
<i>Impatiens capensis</i>	spotted jewelweed		
<i>Iva frutescens</i> ssp. <i>oraria</i> (2807)	marsh elder		
<i>Juglans nigra</i>	black walnut		
<i>Juncus tenuis</i>	path rush		
<i>Juniperus virginiana</i>	red cedar		
<i>Kalmia latifolia</i>	mountain laurel	Probably native but perhaps also planted.	
<i>Kochia scoparia</i> (2802)	Mexican-fireweed	Is very similar to <i>B. hyssopifolia</i> .	x
<i>Lactuca biennis</i>	tall blue lettuce		
<i>Lactuca canadensis</i>	Canada lettuce		
<i>Lapsana communis</i>	common nipplewort		x
<i>Lechea maritima</i> (2809)	beach pinweed		
<i>Lemna minor</i>	lesser duckweed		
<i>Leonurus cardiaca</i>	common motherwort		x
<i>Lepidium virginicum</i>	wild peppergrass		
<i>Leucanthemum vulgare</i>	ox-eye daisy		x
<i>Ligustrum obtusifolium</i> (2619)	border privet		x
<i>Ligustrum ovalifolium</i>	California privet	Planted as hedge only.	x
<i>Limonium carolinianum</i>	sea-lavender		
<i>Linaria vulgaris</i>	butter-and-eggs		x
<i>Lindera benzoin</i>	spicebush		
<i>Liquidambar styraciflua</i>	sweet gum		
<i>Liriodendron tulipifera</i>	tulip tree		
<i>Lolium perenne</i>	perennial ryegrass		x
<i>Lonicera japonica</i>	Japanese honeysuckle		x
<i>Lonicera maackii</i> (2620)	Amur honeysuckle		x
<i>Lonicera morrowii</i>	Morrow honeysuckle		x
<i>Lonicera</i> ? x <i>bella</i> (2844)	Bell's honeysuckle	One individual was found in Sept. that is a little less pubescent on the abaxial surface of the leaves but it is hard to confirm that it is <i>L. x bella</i> without flowering material.	x
<i>Lotus corniculatus</i>	birdfoot deervetch		x
<i>Ludwigia palustris</i>	marsh seedbox		
<i>Luzula multiflora</i> ssp. <i>multiflora</i>	common woodrush		

<i>Magnolia ? tripetala</i> (2820)	umbrella magnolia	Probably naturalized but very sparse.	x
<i>Maianthemum canadense</i>	Canada may-flower		
<i>Maianthemum racemosum</i>	Solomon's-plume		
<i>Malus ? baccata</i>	Siberian crabapple	Possibly a hybrid with either <i>M. prunifolia</i> or <i>M. floribunda</i> .	x
<i>Malus pumila</i>	apple		x
<i>Melilotus officinalis</i>	yellow sweet-clover		x
<i>Mentha ? x rotundifolia</i>	peppermint		x
<i>Microstegium vimineum</i>	Japanese stilt grass		x
<i>Mitchella repens</i>	partridgeberry		
<i>Mollugo verticillata</i>	green carpet-weed		x
<i>Monotropa uniflora</i>	Indian-pipe		
<i>Morus alba</i>	white mulberry		x
<i>Muhlenbergia schreberi</i>	Schreber muhly		
<i>Myrica pensylvanica</i>	northern bayberry		
? <i>Narcissus</i> sp.	daffodil		x
<i>Oenothera biennis</i>	common evening-primrose		
<i>Onoclea sensibilis</i>	sensitive fern		
<i>Osmorhiza longistylis</i>	long-style sweetroot		
<i>Osmunda claytoniana</i>	interrupted fern		
<i>Oxalis stricta</i>	upright yellow wood-sorrel		
<i>Pachysandra terminalis</i>	Japanese pachysandra		x
<i>Panicum amarum</i> (2814)	sea-beach grass		
<i>Panicum virgatum</i> (2810)	switchgrass		
<i>Parthenocissus tricuspidata</i> (2824)	Boston-ivy	Clearly naturalized but only a little.	x
<i>Parthenocissus vitacea</i>	woodbine		
<i>Paspalum setaceum</i> var. <i>muehlenbergii</i> (2839)	thin paspalum		
<i>Paulownia tomentosa</i> (2654)	princess tree		x
<i>Penstemon digitalis</i>	tall white beard-tongue		x
<i>Persicaria longiseta</i>	creeping smartweed		x
<i>Persicaria maculosa</i>	lady's-thumb		x
<i>Persicaria virginiana</i>	jumpseed		
<i>Phellodendron</i> sp. (2655, 2823)	cork tree		x
<i>Philadelphus coronarius</i>	sweet mock-orange		x
<i>Phleum pratense</i>	Timothy		x
<i>Phlox paniculata</i>	fall phlox	Just a few. Probably escaped from nearby cultivation.	x
<i>Phragmites australis</i> ssp. <i>australis</i> (2829)	common reed		x
<i>Phryma leptostachya</i>	lopseed		
<i>Phytolacca americana</i>	pokeweed		

<i>Picea abies</i> (2646)	Norway spruce		x
<i>Pilosella caespitosa</i>	meadow hawkweed		x
<i>Pilosella x flagellaris</i>	hawkweed		x
<i>Pinus strobus</i>	eastern white pine		
<i>Pinus sylvestris</i> (2799)	Scotch pine		x
<i>Plantago lanceolata</i>	narrow-leaf plantain		x
<i>Plantago major</i>	common plantain		x
<i>Plantago rugelii</i>	American plantain		
<i>Poa annua</i>	annual bluegrass		x
<i>Poa compressa</i> (2643)	Canada bluegrass		x
<i>Poa pratensis</i>	bluegrass		x
<i>Poa trivialis</i>	rough bluegrass		x
<i>Poaceae</i> (2627, 2801)		An interesting grass that appear to be missing from northeastern North American floras.	?
<i>Poaceae</i> (2651)	bamboo	Clearly planted. May be spreading from planting as patch is large.	x
<i>Polygonatum biflorum</i>	common Solomon's-seal		
<i>Polygonatum pubescens</i>	downy Solomon's-seal		
<i>Polygonella articulata</i>	coastal jointweed		
<i>Polygonum aviculare</i>	common knotweed		x
<i>Polystichum acrostichoides</i>	Christmas fern		
<i>Portulaca oleracea</i>	common purslane		x
<i>Potentilla recta</i>	sulphur cinquefoil		x
<i>Potentilla simplex</i>	old-field cinquefoil		
<i>Prenanthes</i> sp.	rattlesnake root		
<i>Prunella vulgaris</i>	self-heal		x
<i>Prunus avium</i>	sweet cherry		x
<i>Prunus serotina</i>	wild black cherry		
<i>Pteridium aquilinum</i> var. <i>latiusculum</i>	bracken fern		
<i>Pyrola americana</i>	American wintergreen		
<i>Quercus alba</i>	white oak		
<i>Quercus montana</i>	chestnut oak		
<i>Quercus rubra</i>	red oak		
<i>Quercus velutina</i>	black oak		
<i>Ranunculus acris</i>	tall butter-cup		x
<i>Ranunculus hispidus</i> var. <i>hispidus</i>	hispid buttercup		
<i>Ranunculus repens</i>	creeping butter-cup		x
<i>Rhus copallinum</i>	winged sumac		
<i>Rhus glabra</i>	smooth sumac		
<i>Rhus typhina</i>	staghorn sumac		
<i>Ribes rubrum</i>	northern red currant	Just a few. Might not persist.	x

<i>Robinia pseudoacacia</i>	black locust		x
<i>Rosa multiflora</i>	multiflora rose		x
<i>Rosa rugosa</i>	rugosa rose		x
<i>Rubus allegheniensis</i>	Allegheny blackberry		
<i>Rubus occidentalis</i>	black raspberry		
<i>Rubus phoenicolasius</i>	Wineberry		x
<i>Rudbeckia hirta</i> var. <i>pulcherrima</i>	black-eyed Susan		x
<i>Rumex acetosella</i>	sheep sorrel		x
<i>Rumex crispus</i>	curly dock		x
<i>Rumex obtusifolius</i>	broad-leaf dock		x
<i>Sagina procumbens</i>	procumbent pearlwort		x
<i>Salicornia depressa</i> (2822)	glasswort		
<i>Salix ? cinerea</i> (2648)	European gray willow	Check against <i>S. bebbiana</i>	x
<i>Salsola kali</i> ssp. <i>pontica</i> (2816)	Russian thistle		x
<i>Sambucus nigra</i> ssp. <i>canadensis</i>	common elderberry		
<i>Sarcocornia pacifica</i>	perennial glasswort		
<i>Sassafras albidum</i>	sassafras		
<i>Schedonorus arundinaceus</i>	tall fescue		x
<i>Schizachyrium scoparium</i>	little bluestem		
<i>Setaria faberi</i>	giant foxtail		x
<i>Setaria pumila</i>	yellow bristle grass		x
<i>Setaria viridis</i>	green bristle grass		x
<i>Silene latifolia</i>	bladder campion		x
<i>Sisymbrium officinale</i>	hairy-pod hedgemustard		x
<i>Sisyrinchium angustifolium</i>	narrow-leaf blue- eyed grass		
<i>Smilax glauca</i> (2618)	wild sarsaparilla		
<i>Smilax rotundifolia</i>	roundleaf greenbrier		
<i>Solanum dulcamara</i>	bittersweet nightshade		x
<i>Solanum ptychanthum</i> (2795)	black nightshade		
<i>Solidago bicolor</i>	silverrod		
<i>Solidago caesia</i>	bluestem goldenrod		
<i>Solidago canadensis</i> var. <i>harger</i>	Harger's goldenrod		
<i>Solidago juncea</i>	early goldenrod		
<i>Solidago rugosa</i>	rough-leaf goldenrod		
<i>Solidago sempervirens</i>	seaside goldenrod		
<i>Solidago speciosa</i>	showy goldenrod		
<i>Sonchus</i> sp.	sow thistle		x
<i>Spartina alterniflora</i>	saltwater cordgrass		
<i>Spartina patens</i>	saltmeadow cordgrass		

<i>Sporobolus cryptandrus</i> (2812)	sand dropseed		x
<i>Stellaria graminea</i>	little starwort		x
<i>Stellaria media</i>	common chickweed		x
<i>Suaeda calceoliformis</i> (2805, 2808, 2840, 2843)	horned sea-blite		
? <i>Suaeda maritima</i> (2803, 2841, 2842)	white sea-blite	Some of this may not be <i>S. maritima</i> . This species is considered to be both native and non-native in North America.	?
<i>Symphotrichum cordifolium</i>	heart-leaf aster		
<i>Symphotrichum lanceolatum</i> var. <i>lanceolatum</i> (2838)	white panicle aster	The collection made (2838) was of an odd individual that Eric Lamont thinks maybe var. <i>interior</i> . Other more normal individuals were present.	
<i>Symphotrichum lateriflorum</i> var. <i>lateriflorum</i>	calico aster		
<i>Symphotrichum undulatum</i>	waxy-leaved aster		
<i>Taraxacum officinale</i>	common dandelion		x
<i>Taxus</i> ? <i>cuspidata</i> (2632)	Japanese yew	Clearly naturalized. Could be hybrid with <i>T. baccata</i> (<i>T</i> x <i>media</i>).	x
<i>Thelypteris noveboracensis</i>	New York fern		
<i>Tilia americana</i>	American basswood	Just a few	
<i>Tilia</i> sp. (2652)		Check <i>T. tomentosa</i> . Leaves are stellate pubescent beneath but not tomentose. May just be <i>T. americana</i> . One tree by trail near ocean.	x
<i>Toxicodendron radicans</i> ssp. <i>radicans</i>	eastern poison ivy		
<i>Tridens flavus</i>	tall purple-top		
<i>Trifolium arvense</i>	rabbit-foot clover		x
<i>Trifolium dubium</i>	suckling clover		x
<i>Trifolium pratense</i>	red clover		x
<i>Trifolium repens</i>	white clover		x
<i>Triodanis perfoliata</i>	clasp-leaved Venus'-looking-glass		
<i>Ulmus americana</i>	American elm		
<i>Vaccinium corymbosum</i> (2825)	highbush blueberry		
<i>Vaccinium pallidum</i>	early lowbush blueberry	Only a little in forest near maritime area.	
<i>Verbascum blattaria</i>	white moth mullein		x
<i>Verbascum thapsus</i>	great mullein		x
<i>Verbena urticifolia</i>	white verain		
<i>Vernonia gigantea</i> ssp. <i>gigantea</i> (2845)	giant ironweed	NYS listed species. Only one plant seen.	
<i>Veronica arvensis</i>	corn speedwell		x
<i>Veronica</i> ? <i>filiformis</i>	slender speedwell		x

<i>Veronica officinalis</i>	common speedwell		x
<i>Viburnum acerifolium</i>	mapleleaf viburnum		
<i>Viburnum dentatum</i> var. <i>lucidum</i> (2647, 2628)	arrowwood		
<i>Viburnum dilatatum</i> (2827, 2831)	linden arrowwood		x
? <i>Viburnum lentago</i>	nannyberry	Just one stump sprout seen so perhaps something else.	
<i>Viburnum opulus</i> var. <i>opulus</i>	highbush cranberry		x
<i>Viburnum plicatum</i> (2624, 2631, 2828, 2834)	Japanese snowball		x
<i>Viburnum prunifolium</i>	black-haw		
<i>Viburnum</i> ? <i>setigerum</i> (2847)	tea viburnum	Only one small patch, probably naturalized.	x
<i>Viburnum sieboldii</i> (2621)	Siebold viburnum		x
<i>Vicia cracca</i>	cow vetch		x
<i>Vicia tetrasperma</i>	lentil vetch		x
<i>Vinca minor</i>	periwinkle		x
<i>Viola sororia</i>	common violet		
<i>Vitis aestivalis</i>	summer grape	Don't cut these vines.	
<i>Vulpia myuros</i> (2638)	rat's-tail six-weeks grass		x
<i>Wisteria floribunda</i> (2628, 2850)	Japanese wisteria	Some naturalized and some apparently in cultivation.	x
<i>Wisteria japonica</i> (2848)	summer wisteria	One planted individual near Old Orchard Museum.	x
<i>Wisteria</i> ? <i>sinensis</i> (2849)	Chinese wisteria	Some naturalized. May be hybrid with <i>W. floribunda</i> or perhaps is <i>W.</i> <i>japonica</i> .	x

Appendix D. List of Plants Not Seen Growing at SAHI in 2005 That Were Seen as Voucher Specimens in the SAHI Herbarium by the Author.

Scientific Name	Common Name	Notes	Non-native
<i>Acalypha rhomboidea</i>	common copperleaf		
<i>Aethusa cynapium</i>	fool's-parsley		x
<i>Artemisia stelleriana</i>	hoary sagebrush		x
<i>Capsella bursa-pastoris</i>	common shepherd's purse		x
<i>Catalpa bignonioides</i>	southern catalpa		x
<i>Chamaesyce polygonifolia</i>	seaside spurge	As <i>Euphorbia polygonifolia</i>	
<i>Epilobium coloratum</i>	purple-leaf willow-herb		
<i>Erechtites hieraciifolia</i>	fireweed		
<i>Helianthus annuus</i>	common sunflower		x
<i>Lamium amplexicaule</i>	henbit deadnettle		x
<i>Lepidium densiflorum</i>	common pepperweed		x
<i>Lythrum salicaria</i>	purple loosestrife	In garden and in dump. [Probably not truly naturalized].	x
<i>Malva neglecta</i>	common mallow		x
<i>Medicago lupulina</i>	black medick		x
<i>Oenothera parviflorum</i>	northern evening primrose	Sensu stricto. As <i>O. parviflorum</i> var. cf. <i>parviflorum</i> .	
<i>Ornithogalum umbellatum</i>	common star-of-Bethlehem		x
<i>Potentilla argentea</i>	silvery cinquefoil		x
<i>Rubus flagellaris</i>	northern dewberry		
<i>Setaria parviflora</i>	bristly foxtail	As <i>S. geniculata</i>	
<i>Sisyrinchium atlanticum</i>	eastern blue-eyed grass		

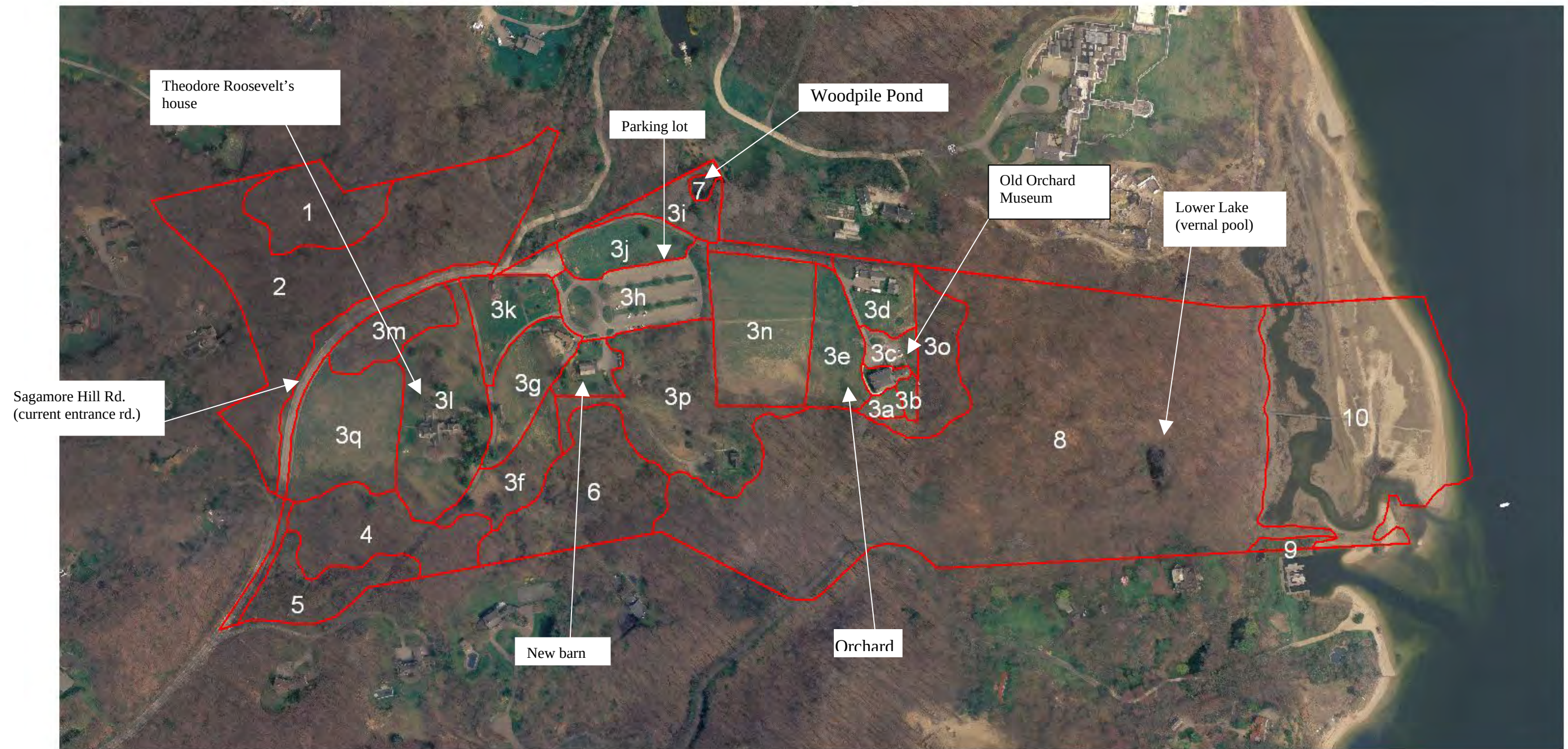
Appendix E. Some Methods of Control for Tree-of-heaven (*Ailanthus altissima*).

The following control methods are taken directly from Swearingen and Pannill 2005.

“Basal bark application is one of the easiest methods and does not require any cutting. It works best during late winter/early spring and in summer. The base of the tree stem must be free of snow, ice, or water on the bark from recent rainfall, though precipitation following application is inconsequential. Late winter/early spring (February 15 -April 15, Mid-Atlantic) is generally the most productive time, since vegetation near the base of the trees is usually absent or leafless. Late spring and early summer applications (April 15 - June 1, Mid-Atlantic), when plant fluids are moving upwards to support new growth, are questionable. Application during the summer (June 1 - September 15, Mid-Atlantic) works very well as long as vegetation is not a hindrance, and allows lower concentrations of herbicide to be used. Fall to mid-winter applications (October - January) have given poor results. Mix up a solution of 20% (as low as 10% in summer depending on objectives) concentration of oil-soluble triclopyr product (e.g., Garlon 4) in 80% oil (fuel oil, diesel, kerosene, mineral oil, or special vegetable oils). With these diluents some applicators add a pine oil based additive (e.g., Cide-Kick II) at the rate of 10%, which helps penetrate the bark and eliminate any unpleasant odor. Some companies market diluents based on mineral or vegetable oils specifically designed for basal bark application, which should be considered for use in sensitive areas. Another option is to use a pre-mixed, ready-to-use triclopyr product designed for basal bark (and cut stump) application (e.g., Pathfinder II). Using a handheld or backpack type sprayer, apply the mixture in a 12 inch wide band around the entire circumference of the tree base with no “skips”. The basal bark method is generally used for trees that are less than 6 inches in diameter, though slightly larger stems may also be treated effectively by thoroughly treating bark up to 24 inches in height. Follow up foliar herbicide application (see above) to basal sprouts and root suckers may be necessary. Another herbicide which has been shown to be effective for basal bark control of *ailanthus* is imazapyr (e.g., Chopper, Stalker). This is sometimes used in a combination with triclopyr at a concentration of 15% Garlon 4 and 5% Stalker in 80% oil diluent.

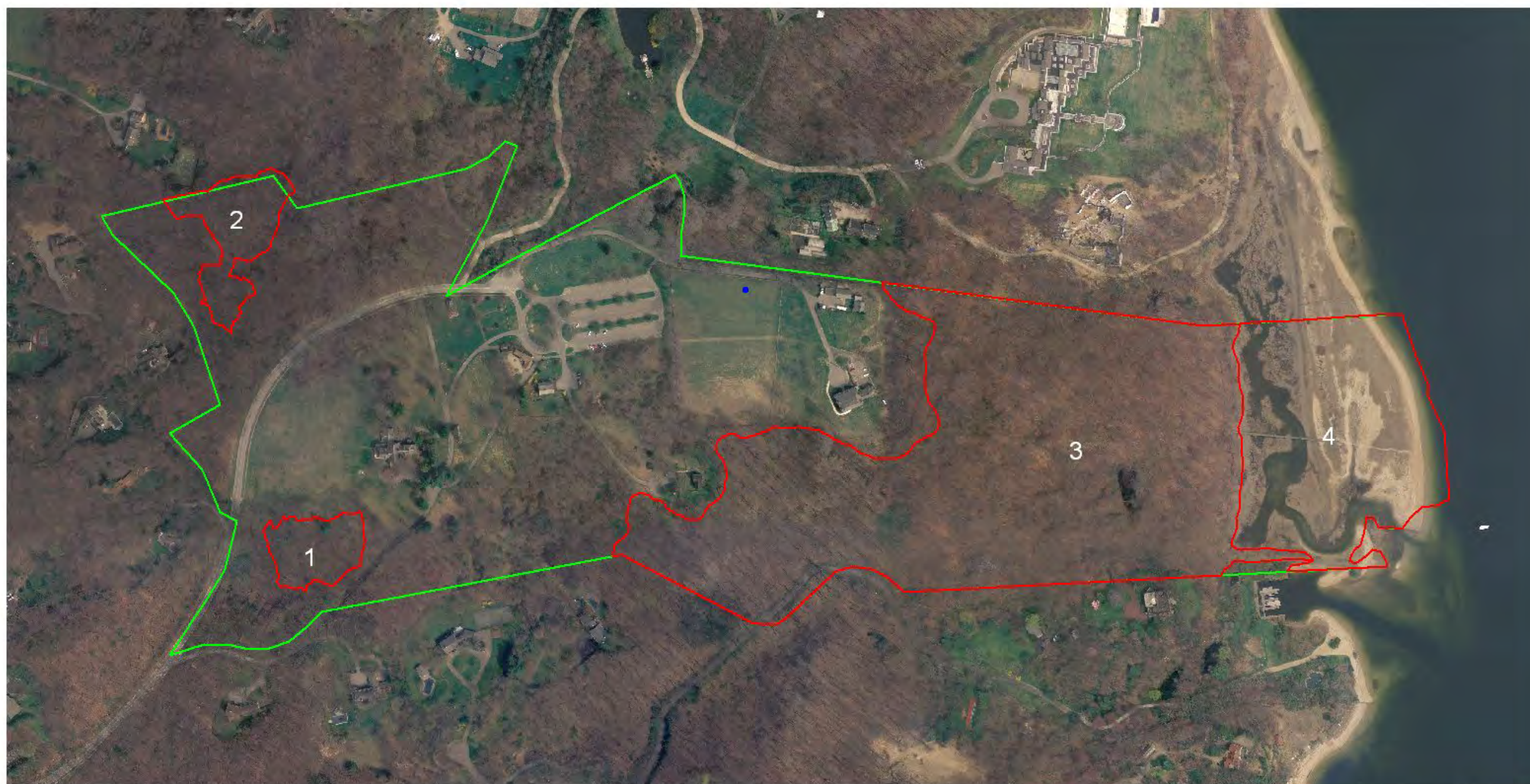
The hack-and-squirt or injection method is very effective and minimizes sprouting and suckering when applied during the summer. Root suckering will be an increasing problem in the fall, winter and spring. This method requires first making downward-angled cuts into the sapwood around the tree trunk at a comfortable height, using a hand ax. With spray bottle or wand in the other hand, squirt a straight (100%) concentration of a water-soluble triclopyr product (e.g., Garlon 3A) into the cuts within a minute or two, applying 1-2 milliliters into each cut (typically 1-2 squirts of a trigger squirt bottle) so that the bottom of the cut is covered, but liquid doesn't run out of it. Generally, you would make about 1 hack cut for each inch of diameter plus one (i.e., for a 10 inch diameter tree, make about 11 cuts). Space the cuts so that about 1-2 inches of uncut living tissue remains between them. A continuous line of cuts around the trunk would likely cause the tree to go into emergency response mode and react by producing basal sprouts and root suckers. For this reason, girdling or frilling (girdling followed by herbicide) is not highly recommended unless long term follow up treatment is possible. While spaced injection works well for *ailanthus*, it is not as effective on some other species. This method can be used with trees of any size, though it is most productive with stems over 2 inches in diameter. This

method is relatively easy for one person to do, with hatchet in one hand and spray bottle in the other, but should be done with a buddy nearby in case of an accident. Monitor the treatment area and be prepared to follow-up with a foliar application the next year to control any basal sprouts or root suckers that might emerge. Glyphosate products have sometimes been recommended for control of ailanthus using this method, but several field trials have shown consistently poor long-term control of basal sprouts and root suckers at any time of year. Other herbicides which have shown to be effective for hack-and-squirt control of ailanthus during the growing season are dicamba (e.g., Banvel, Vanquish), imazapyr (e.g., Arsenal A.C., Chopper), and 2,4-D + picloram (e.g., Pathway). Dicamba is particularly effective in October.”



Map 1: Zones used to help survey SHNHS





Map 2. Exceptional areas and rare plants
Red polygons = exception areas
Blue dot = giant ironweed (*Vernonia gigantea*)
Green lines = SHNHS boundaries

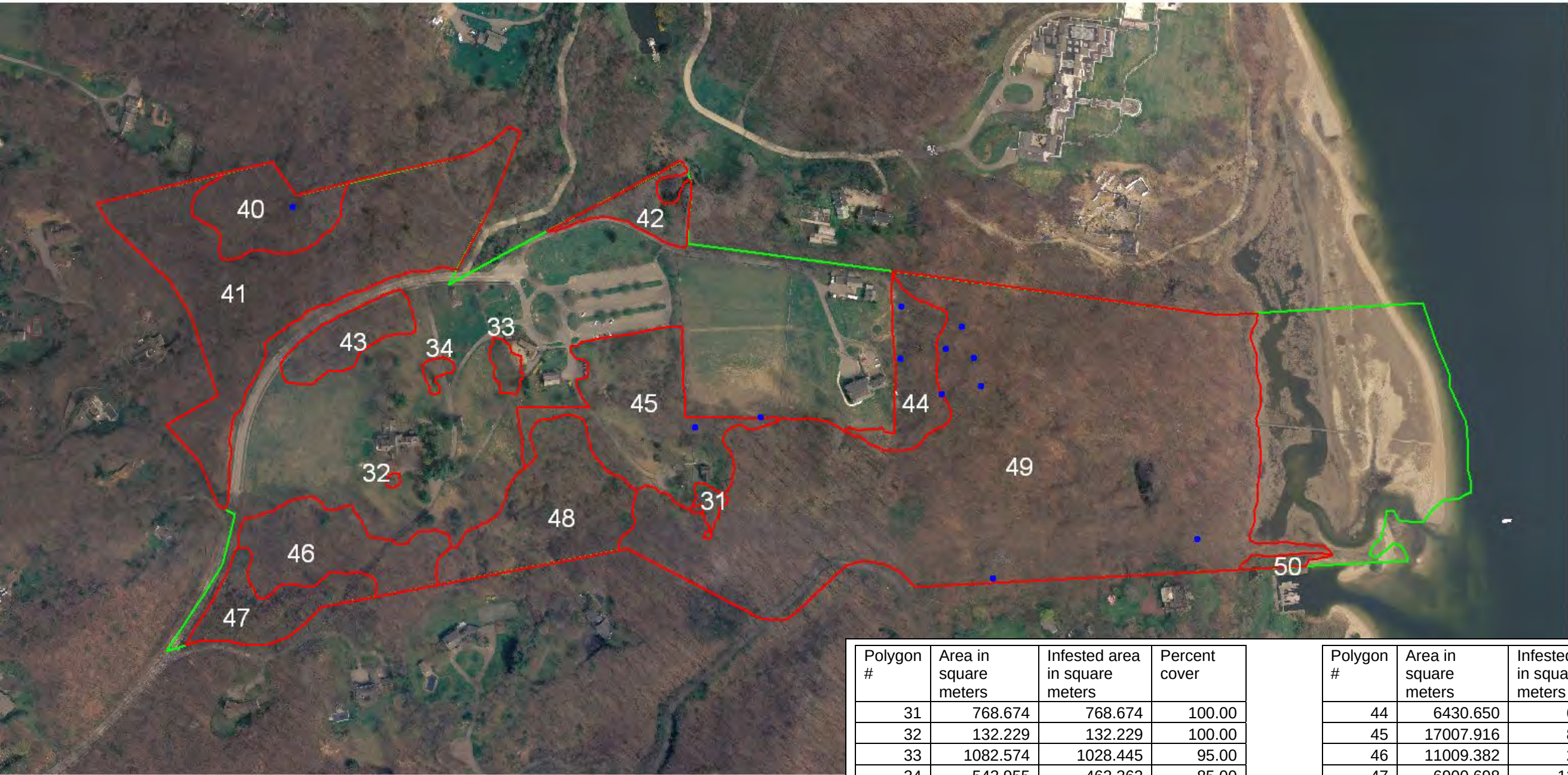
200 0 200 400 600 800 1000 Meters



Map 3. Japanese maple (*Acer palmatum*).
Red polygons = populations
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	4462.155	446.215	10.00
2	900.148	45.007	5.00
3	472.377	70.857	15.00
4	7.033	7.033	100.00
5	1032.112	361.239	35.00
20	12.503	10.000	79.98
21	7.033	6.000	85.31
61	243.191	121.596	50.00



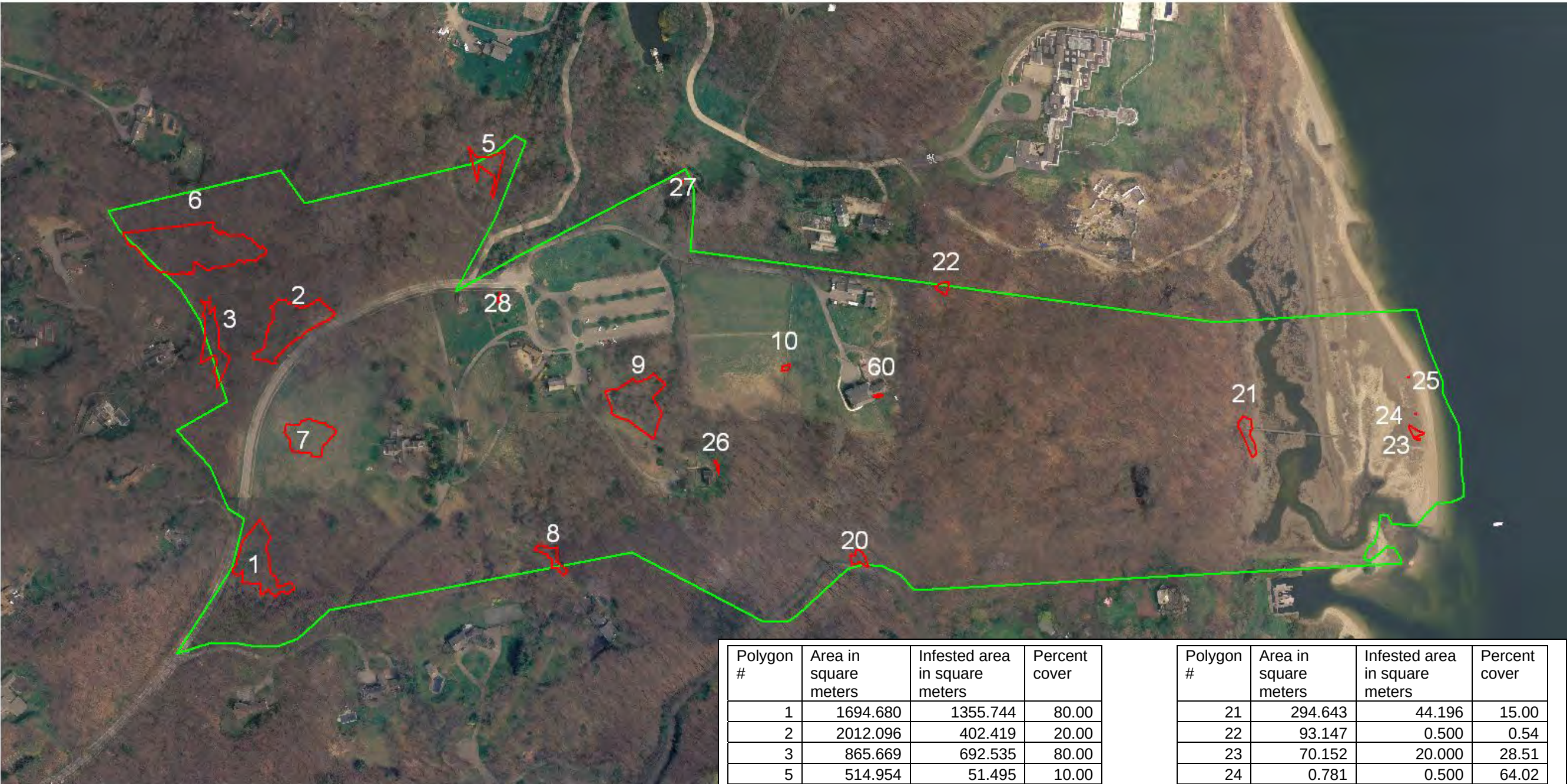


Map 4. Norway maple (*Acer platanoides*)
Red polygons = populations/areas where Norway maple occurs
Blue dots = pinpoints of large individuals (mostly in or near exceptional areas).
Green lines = SHNHS boundary

Polygon #	Area in square meters	Infested area in square meters	Percent cover
31	768.674	768.674	100.00
32	132.229	132.229	100.00
33	1082.574	1028.445	95.00
34	543.955	462.362	85.00
40	8134.695	81.347	1.00
41	36021.320	1801.066	5.00
42	3649.619	15.000	0.41
43	5041.025	1008.205	20.00

Polygon #	Area in square meters	Infested area in square meters	Percent cover
44	6430.650	643.065	10.00
45	17007.916	850.396	5.00
46	11009.382	220.188	2.00
47	6900.698	1380.140	20.00
48	14569.777	2913.955	20.00
49	110602.944	1106.029	1.00
50	745.845	7.458	1.00





Map 5. tree-of-heaven (*Ailanthus altissima*)
Red polygons = populations
green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover	Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	1694.680	1355.744	80.00	21	294.643	44.196	15.00
2	2012.096	402.419	20.00	22	93.147	0.500	0.54
3	865.669	692.535	80.00	23	70.152	20.000	28.51
5	514.954	51.495	10.00	24	0.781	0.500	64.02
6	4066.566	40.666	1.00	25	0.781	0.500	64.02
7	1085.594	21.712	2.00	26	15.666	5.000	31.92
8	247.922	24.792	10.00	27	0.781	0.500	64.02
9	1852.993	1297.095	70.00	28	17.865	0.500	2.80
10	34.183	8.000	23.40	60	14.841	1.000	6.74
20	145.259	72.629	50.00				





Map 6. garlic mustard (*Alliaria petiolata*)
red polygons = garlic mustard infested areas
green lines = boundaries of SHNHS

Polygon #	Area in square meters	Infested area in square meters	Percent cover	Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	3735.223	1494.089	40.00	11	84.515	42.258	50.00
2	571.786	114.357	20.00	21	0.781	0.500	64.02
3	342.538	68.508	20.00	22	947.143	94.714	10.00
4	3252.357	325.236	10.00	40	100646.434	5032.322	5.00
5	13823.131	138.231	1.00	41	745.845	37.292	5.00
6	2051.312	102.566	5.00	42	13921.939	2784.388	20.00
7	2.152	1.000	46.47	43	6430.650	321.533	5.00
8	14.446	1.000	6.92	44	17430.036	697.201	4.00
9	61.299	3.000	4.89	60	701.944	35.097	5.00
10	286.212	3.000	1.05				

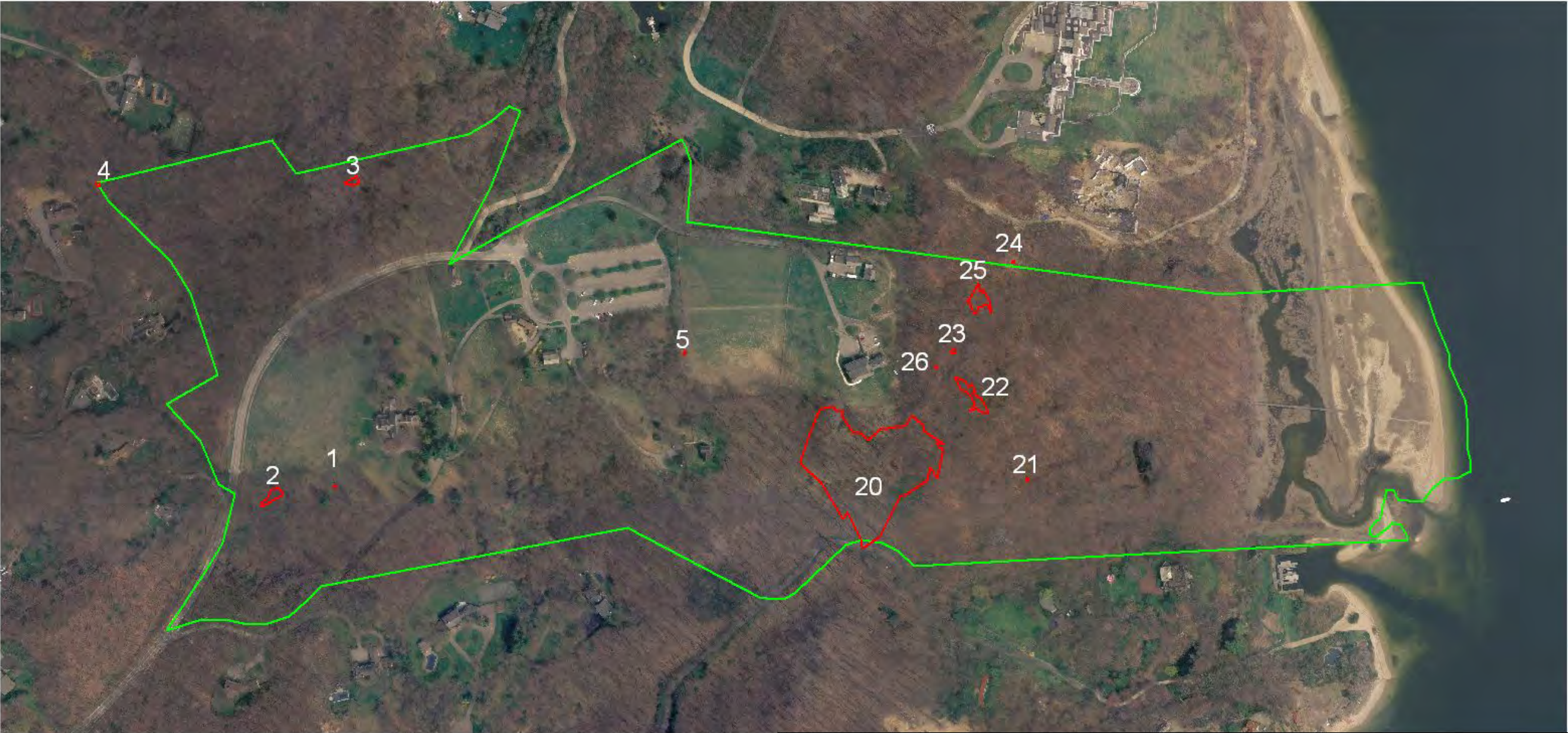




Map 7. *Anthriscus sylvestris*.
Red polygon = infested area
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	289.582	246.145	85.00



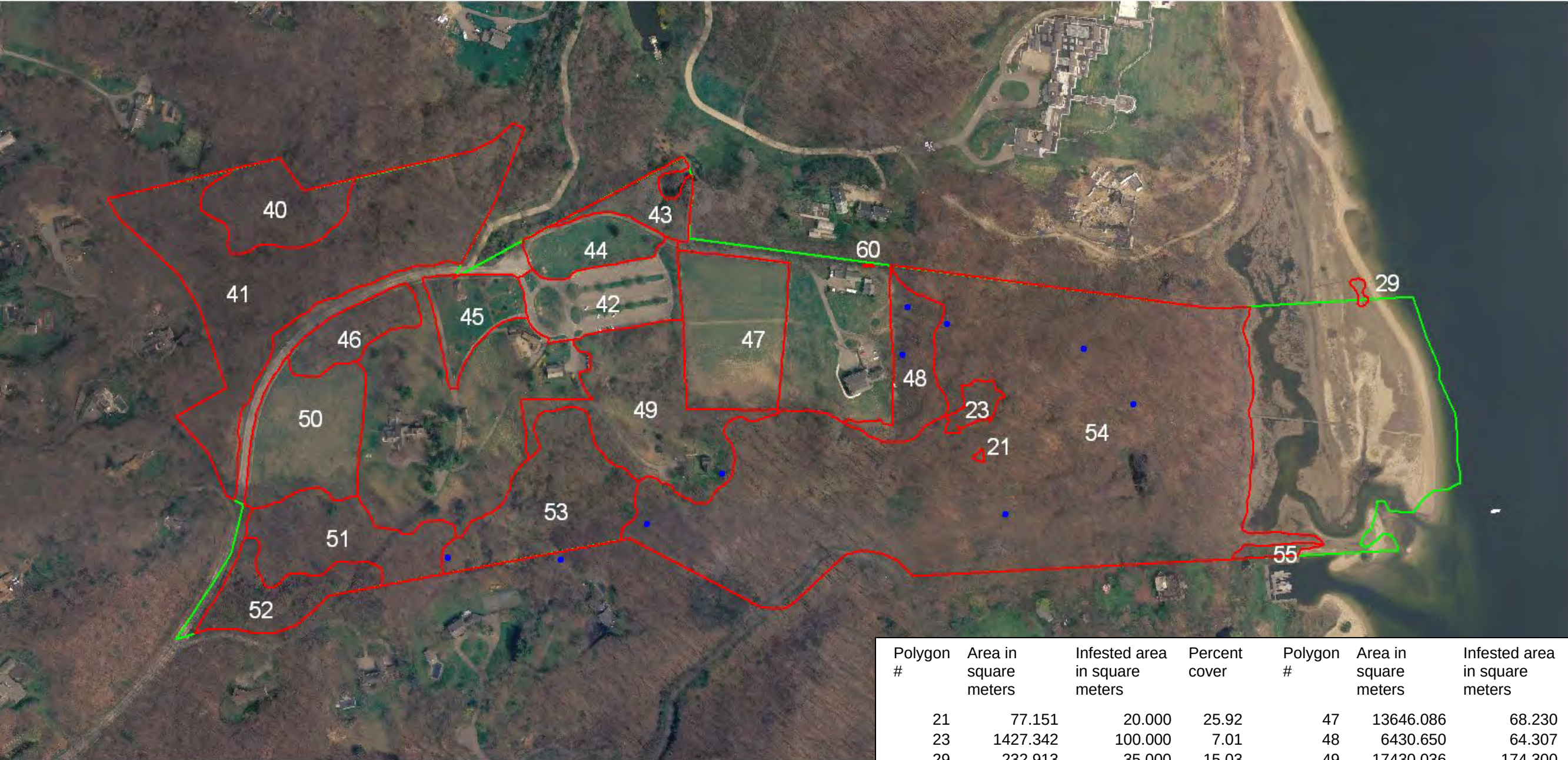


Map 8. Japanese barberry (*Berberis thunbergii*)
Red polygons = infested areas
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	3.126	1.000	31.99
2	134.337	3.000	2.23
3	63.268	2.000	3.16
4	9.555	4.000	41.86
5	3.126	1.000	31.99
20	9032.508	20.000	0.22

Polygon #	Area in square meters	Infested area in square meters	Percent cover
21	3.126	1.000	31.99
22	277.078	15.000	5.41
23	12.503	8.000	63.98
24	3.126	2.000	63.98
25	281.596	5.000	1.78
26	3.126	3.000	95.97





Map 9. Oriental bitter-sweet (*Celastrus orbiculata*)
Red polygons = infested areas
Blue dots = pinpoints of large individuals
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover	Polygon #	Area in square meters	Infested area in square meters	Percent cover
21	77.151	20.000	25.92	47	13646.086	68.230	0.50
23	1427.342	100.000	7.01	48	6430.650	64.307	1.00
29	232.913	35.000	15.03	49	17430.036	174.300	1.00
40	8134.695	81.347	1.00	50	12021.572	25.000	0.21
41	36021.320	360.213	1.00	51	11009.382	110.094	1.00
42	9018.331	0.500	0.01	52	6900.698	69.007	1.00
43	3649.619	2.000	0.05	53	14569.777	582.791	4.00
44	5390.459	1.000	0.02	54	109445.004	1094.450	1.00
45	5501.000	1.000	0.02	55	745.845	7.458	1.00
46	5041.025	4.000	0.08	60	15.429	1.000	6.48





Map 10. Crown vetch (*Coronilla varia*)
Red polygon = infested area
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	59.914	53.923	90.00

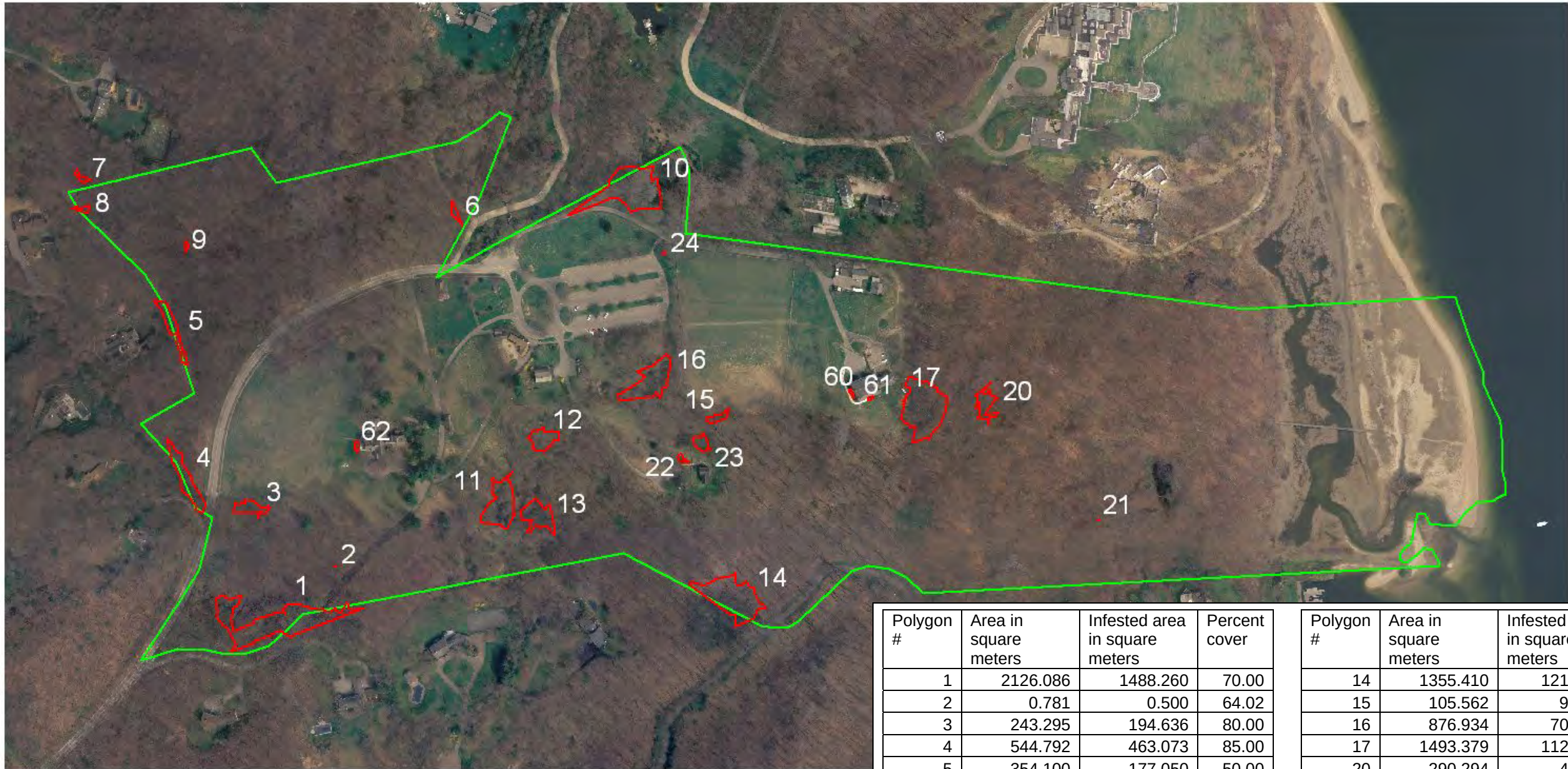




Map 11. burning bush (*Euonymus alata*)
Red polygons = infested areas
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
40	8134.695	81.347	1.00
41	36021.320	360.213	1.00
42	6430.650	192.919	3.00
43	17430.036	174.300	1.00
44	11009.382	110.094	1.00
45	6900.698	345.035	5.00
46	14569.777	100.000	0.69
47	110949.497	3328.485	3.00
48	745.845	22.375	3.00





Map 12. English ivy (*Hedera helix*)
Red polygons = infested area
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover	Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	2126.086	1488.260	70.00	14	1355.410	1219.869	90.00
2	0.781	0.500	64.02	15	105.562	95.006	90.00
3	243.295	194.636	80.00	16	876.934	701.547	80.00
4	544.792	463.073	85.00	17	1493.379	1120.034	75.00
5	354.100	177.050	50.00	20	290.294	43.544	15.00
6	58.538	5.854	10.00	21	0.781	0.500	64.02
7	58.930	3.000	5.09	22	31.816	30.225	95.00
8	45.940	36.752	80.00	23	131.831	118.648	90.00
9	15.958	15.958	100.00	24	3.126	1.000	31.99
10	1608.853	1287.082	80.00	60	12.664	10.000	78.96
11	843.810	717.238	85.00	61	10.696	10.000	93.49
12	350.279	315.251	90.00	62	27.508	1.000	3.64
13	533.750	427.000	80.00				





Map 13. border privet (*Ligustrum obtusifolium*)

Red polygons = infested area

Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
40	8142.167	81.422	1.00
41	36013.848	360.138	1.00
42	3649.619	2.000	0.05
43	6419.038	128.381	2.00
44	17430.036	174.300	1.00
45	11010.432	110.104	1.00
46	6900.515	69.005	1.00
47	14569.161	145.692	1.00
48	110961.349	2219.227	2.00
49	745.355	14.907	2.00

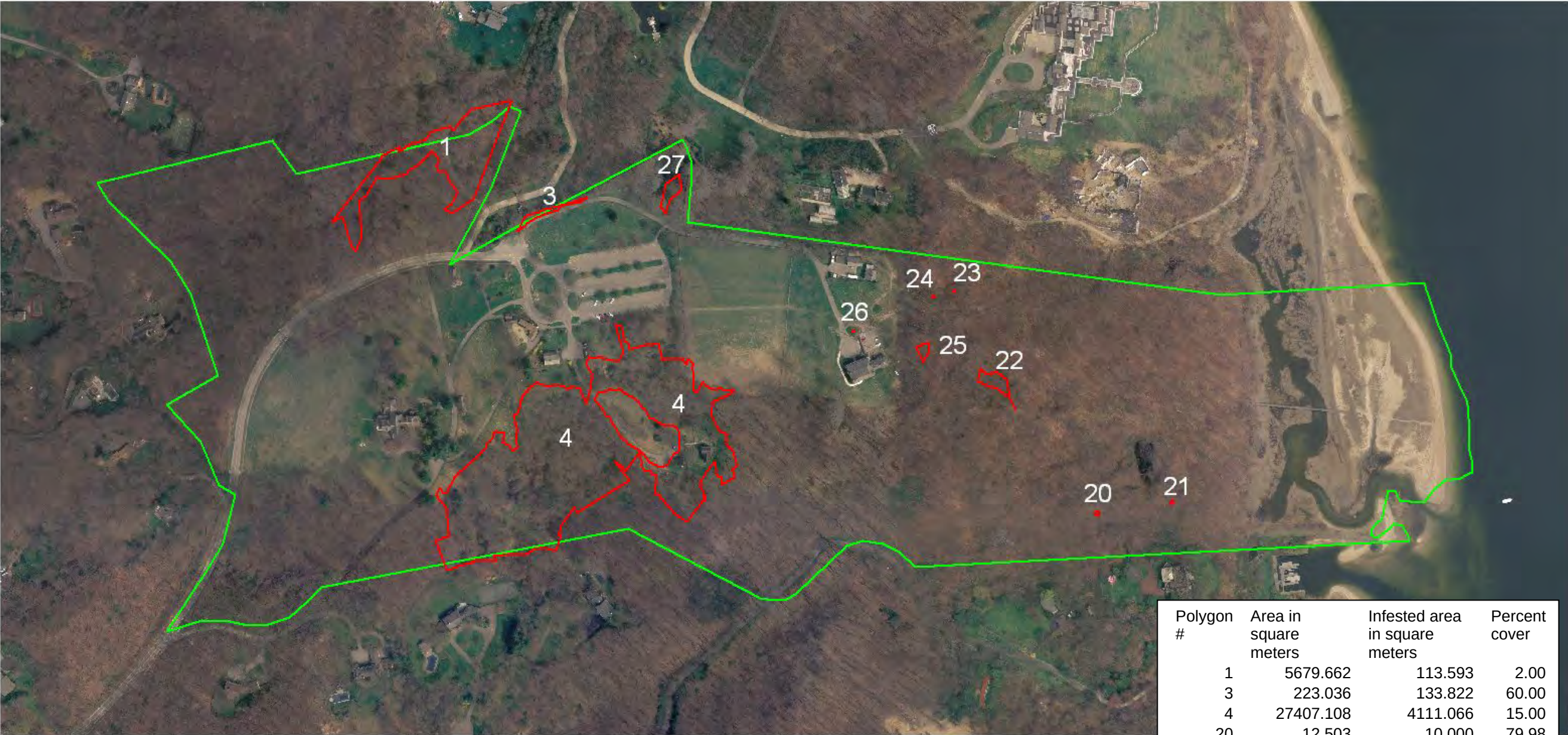
200 0 200 400 600 800 1000 Meters





Map 14. Japanese honeysuckle (*Lonicera japonica*)
Red polygons = infested areas
Green lines = SHNHS boundaries

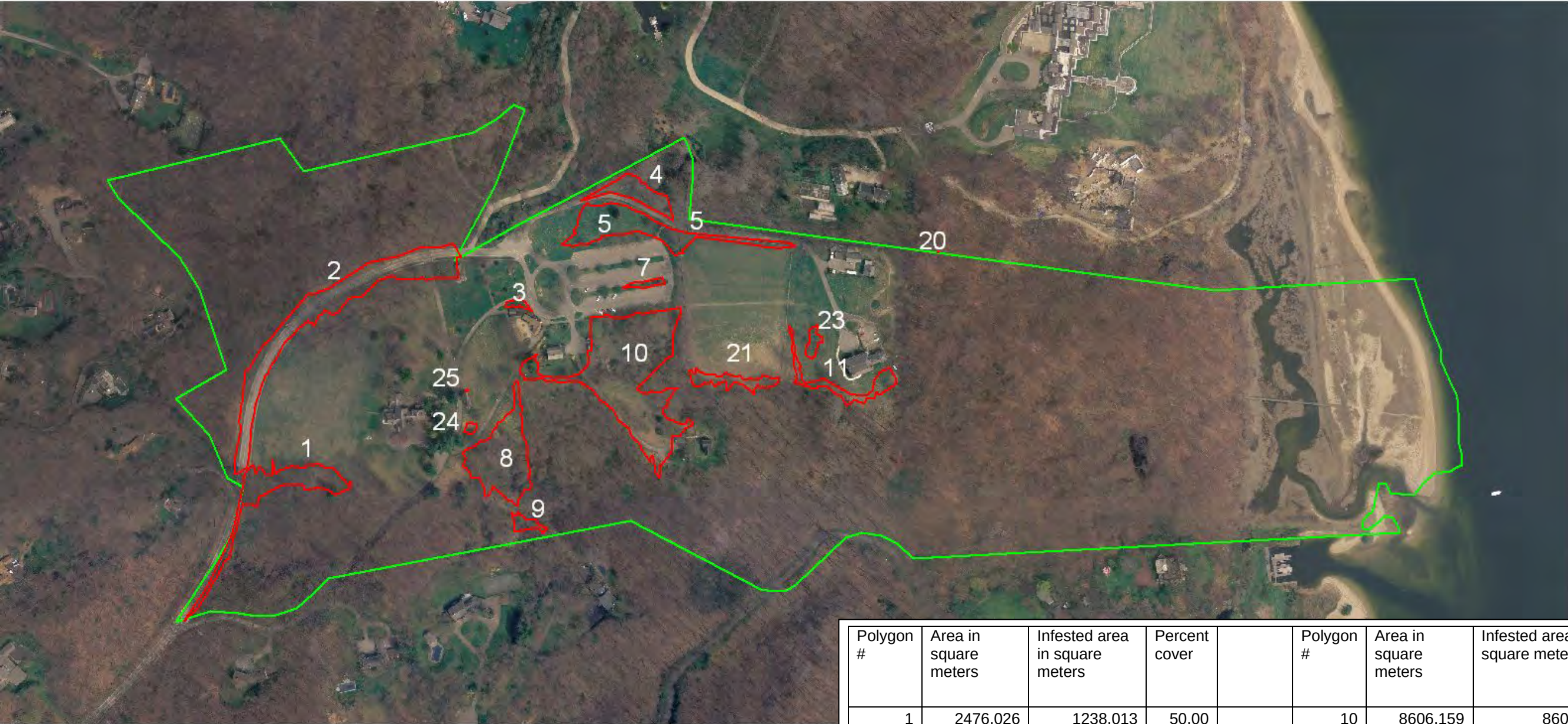
Polygon #	Area in square meters	Infested area in square meters	Percent cover	Polygon #	Area in square meters	Infested area in square meters	Percent cover
40	8134.695	81.347	1.00	48	6430.650	64.307	1.00
41	36021.320	360.213	1.00	49	17430.036	174.300	1.00
42	5897.784	5.000	0.08	50	12021.572	50.000	0.42
43	9018.331	1.000	0.01	51	11009.382	110.094	1.00
44	3649.619	2.000	0.05	52	6900.698	69.007	1.00
45	5390.459	1.000	0.02	53	14569.777	145.698	1.00
46	5041.025	2.000	0.04	54	110949.497	1109.495	1.00
47	13646.086	68.230	0.50	55	745.845	7.458	1.00



Map 15. Morrow and Amur honeysuckle (*Lonicera morrowii* and *L. maackii*)
Red polygons = infested areas
Green lines = SHNHS boundaries

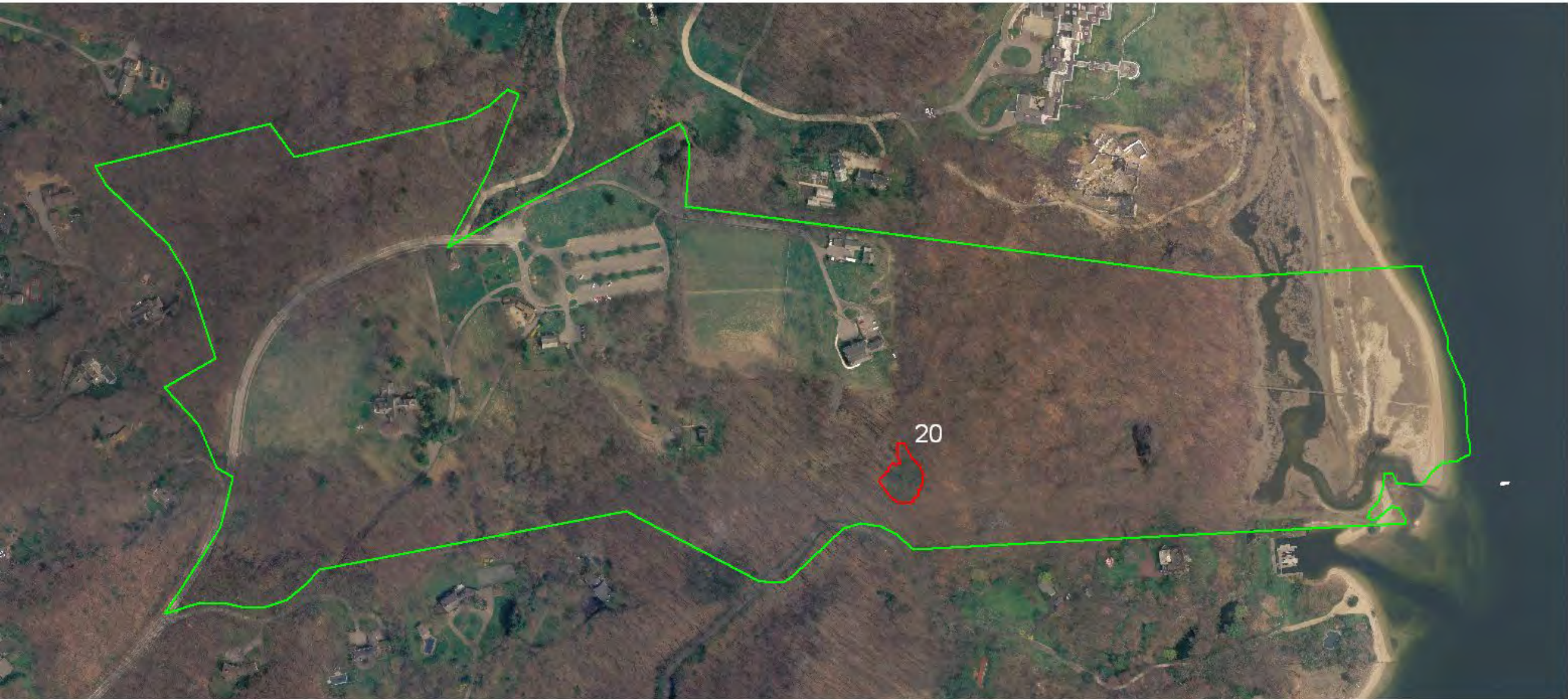
200 0 200 400 600 800 1000 Meters





Map 16. Japanese stilt grass (*Microstegium vimineum*)
Red polygons = areas infested
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover		Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	2476.026	1238.013	50.00		10	8606.159	860.616	20.00
2	5938.639	593.864	10.00		11	961.047	192.209	10.00
3	116.626	11.663	10.00		20	0.781	0.100	20.00
4	1139.892	569.946	50.00		21	729.571	583.657	80.00
5	3073.298	921.989	5.00		23	257.102	141.406	30.00
7	185.797	9.290	55.00		24	82.042	41.021	12.80
8	3448.332	1206.916	50.00		25	3.126	1.000	31.99
9	288.747	57.749	35.00					



Map 17. Japanese pachysandra (*Pachysandra terminalis*)
Red polygon = infested area
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
20	1315.336	1302.183	99.00





Map 18. princess tree (*Paulownia tomentosa*)
Red polygons or dots = infested areas
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	12.503	8.000	80.00
2	175.819	100.000	63.98
3	78.142	58.606	56.88
4	87.826	70.261	75.00
20	0.781	0.300	64.02
21	0.781	0.500	38.41

200 0 200 400 600 800 1000 Meters

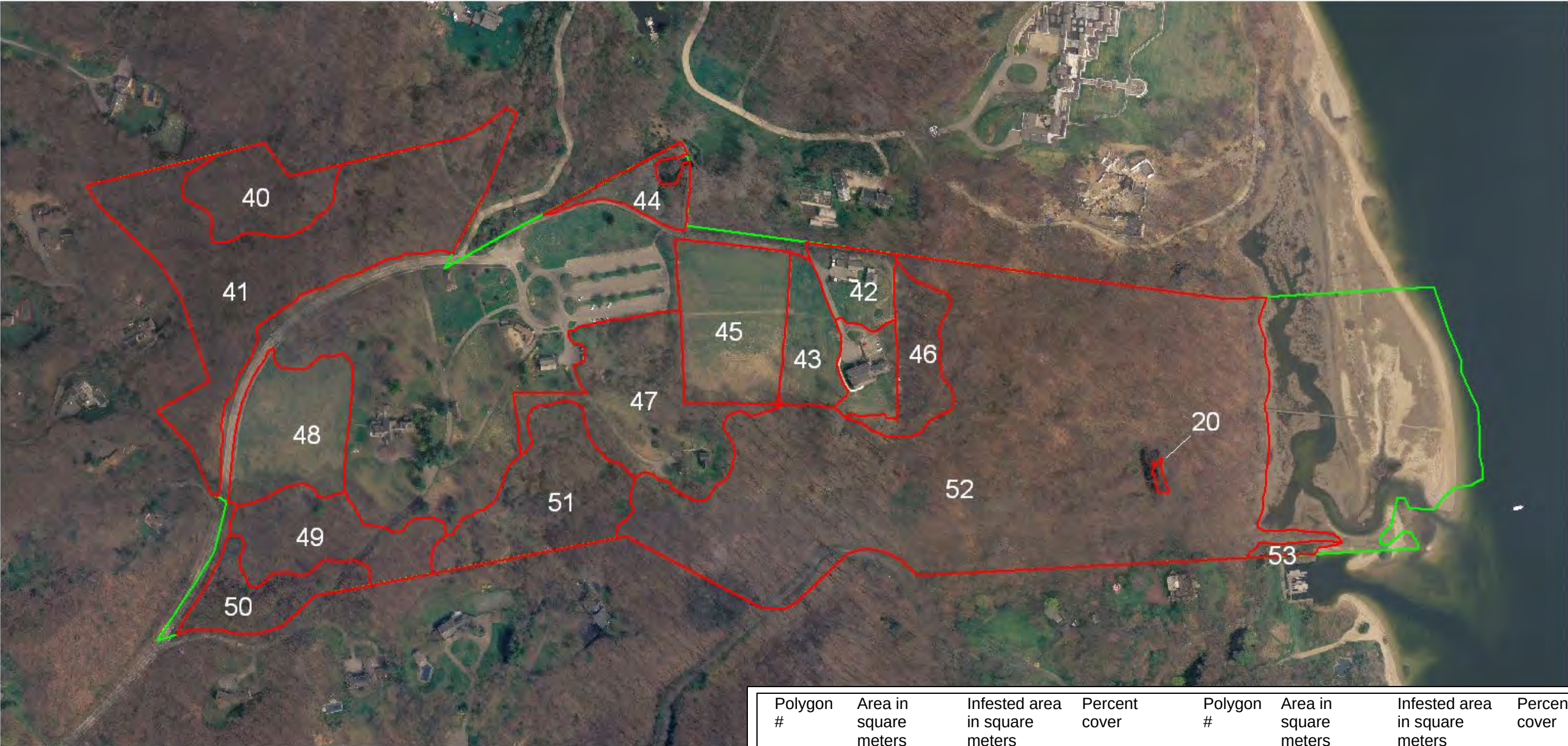




Map 19. common reed (*Phragmites australis* ssp. *australis*)
Red polygons = infested area
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
20	393.262	373.599	95.00
21	53.760	15.000	27.90

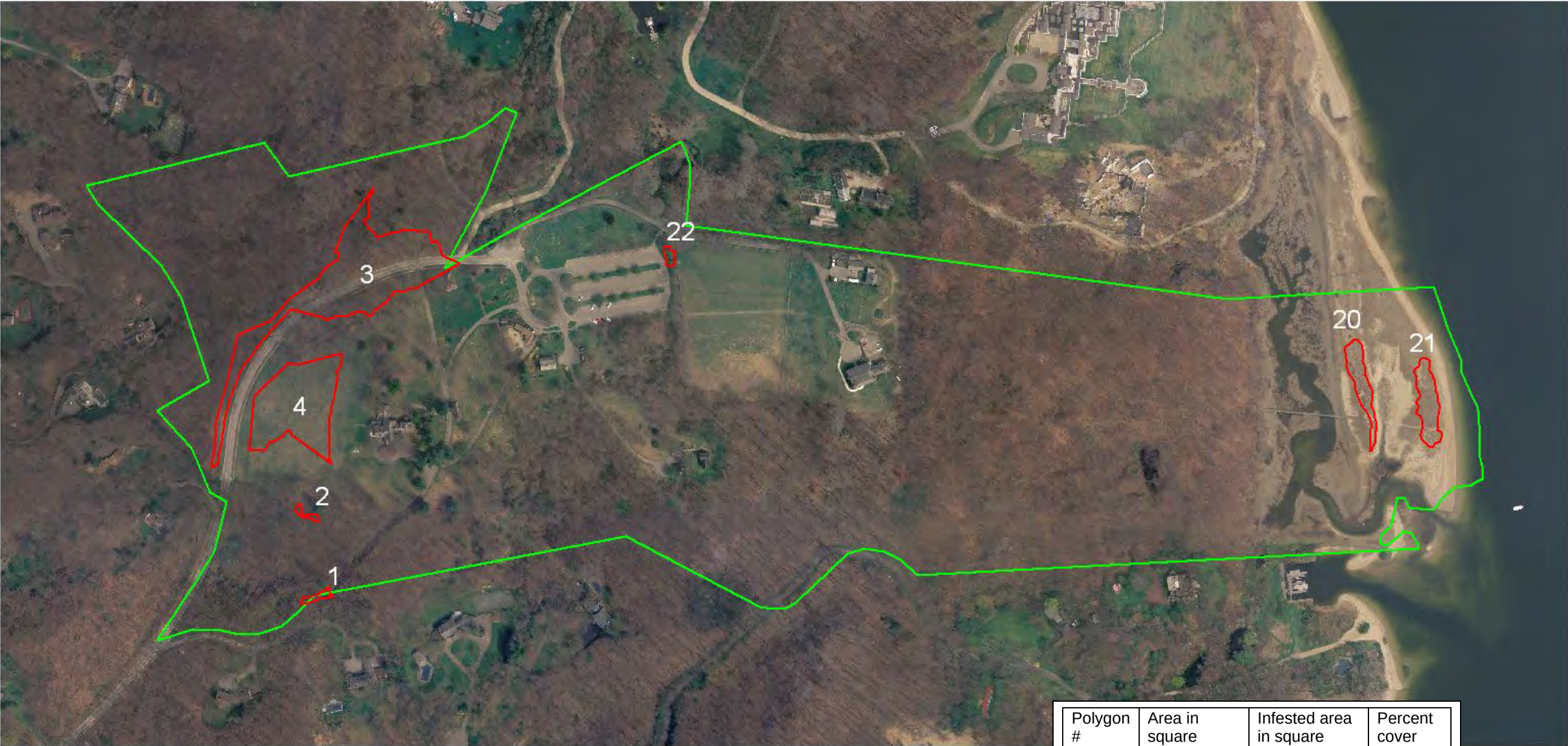




Map 20. multiflora rose (*Rosa multiflora*)
Red polygons = infested areas
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover	Polygon #	Area in square meters	Infested area in square meters	Percent cover
20	244.557	150.000	61.34	47	17426.983	174.270	1.00
40	8142.167	81.422	1.00	48	12021.572	200.000	1.66
41	36013.848	360.138	1.00	49	11010.432	110.104	1.00
42	4617.821	23.089	0.50	50	6900.515	69.005	1.00
43	5898.040	10.000	0.17	51	14569.161	1456.916	10.00
44	3649.619	3.000	0.08	52	110713.262	1107.133	1.00
45	13663.290	136.633	1.00	53	745.355	7.454	1.00
46	6421.584	64.216	1.00				

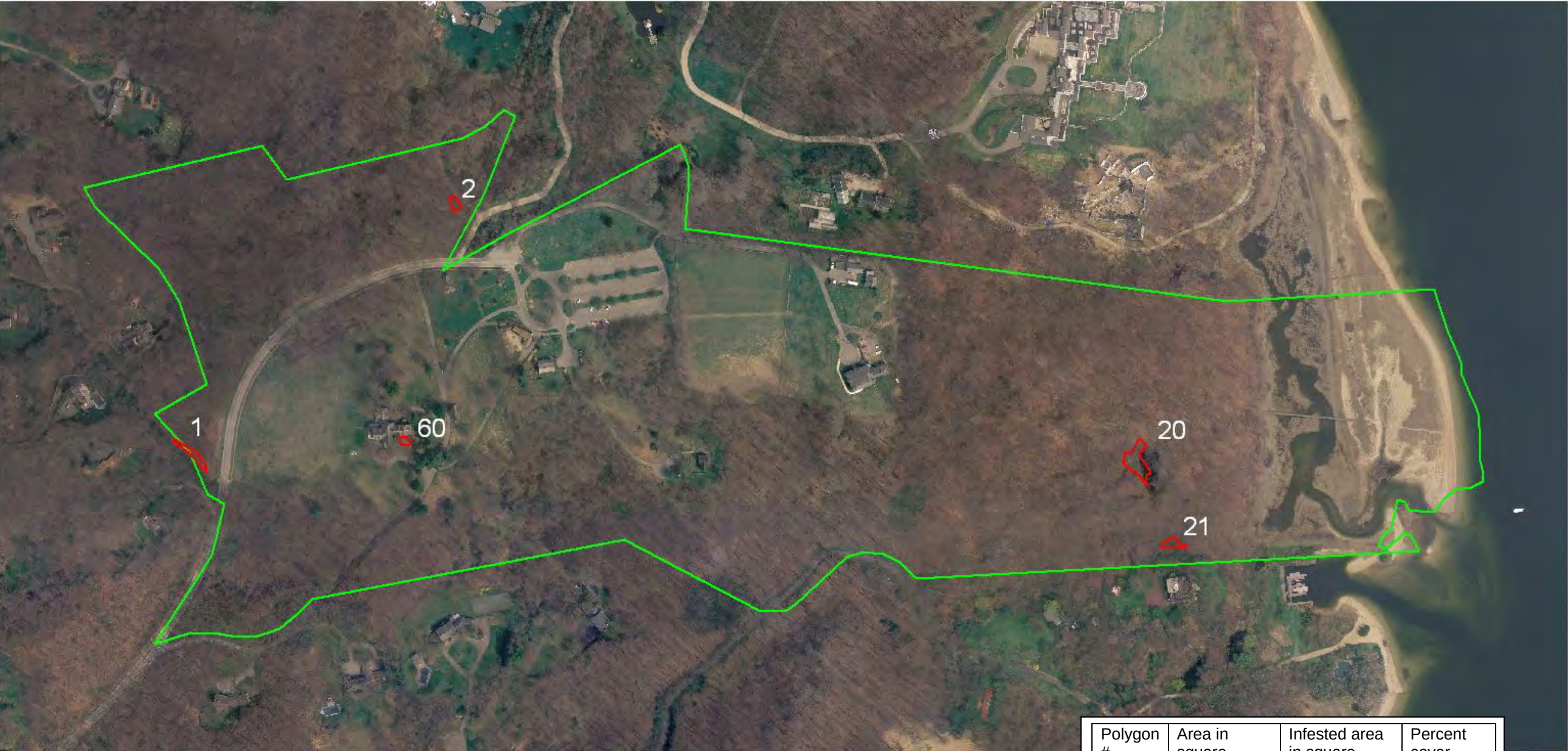




Map 21. black locust (*Robinia pseudoacacia*)
Red polygons = infested areas
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	149.198	2.984	2.00
2	108.070	21.614	20.00
3	9002.840	450.142	5.00
4	5124.137	51.241	1.00
20	1017.526	101.753	10.00
21	1223.589	244.718	20.00
22	134.268	107.414	80.00

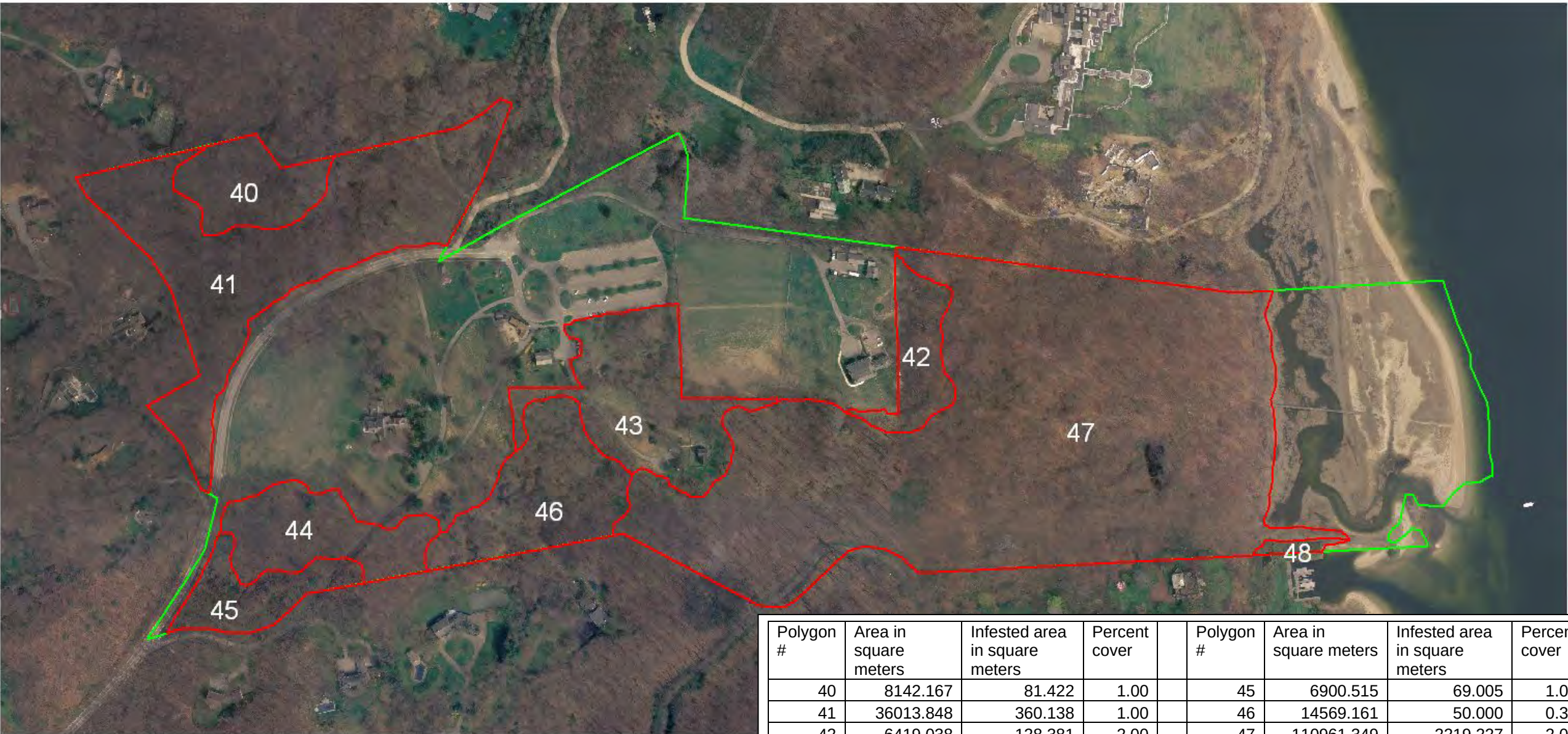




Map 22. periwinkle (*Vinca minor*)
Red polygons = infested areas
Green lines = SHNHS boundaries

Polygon #	Area in square meters	Infested area in square meters	Percent cover
1	170.361	136.289	80.00
2	80.619	60.464	75.00
20	438.961	417.013	95.00
21	125.593	106.754	85.00
60	57.514	8.000	13.91





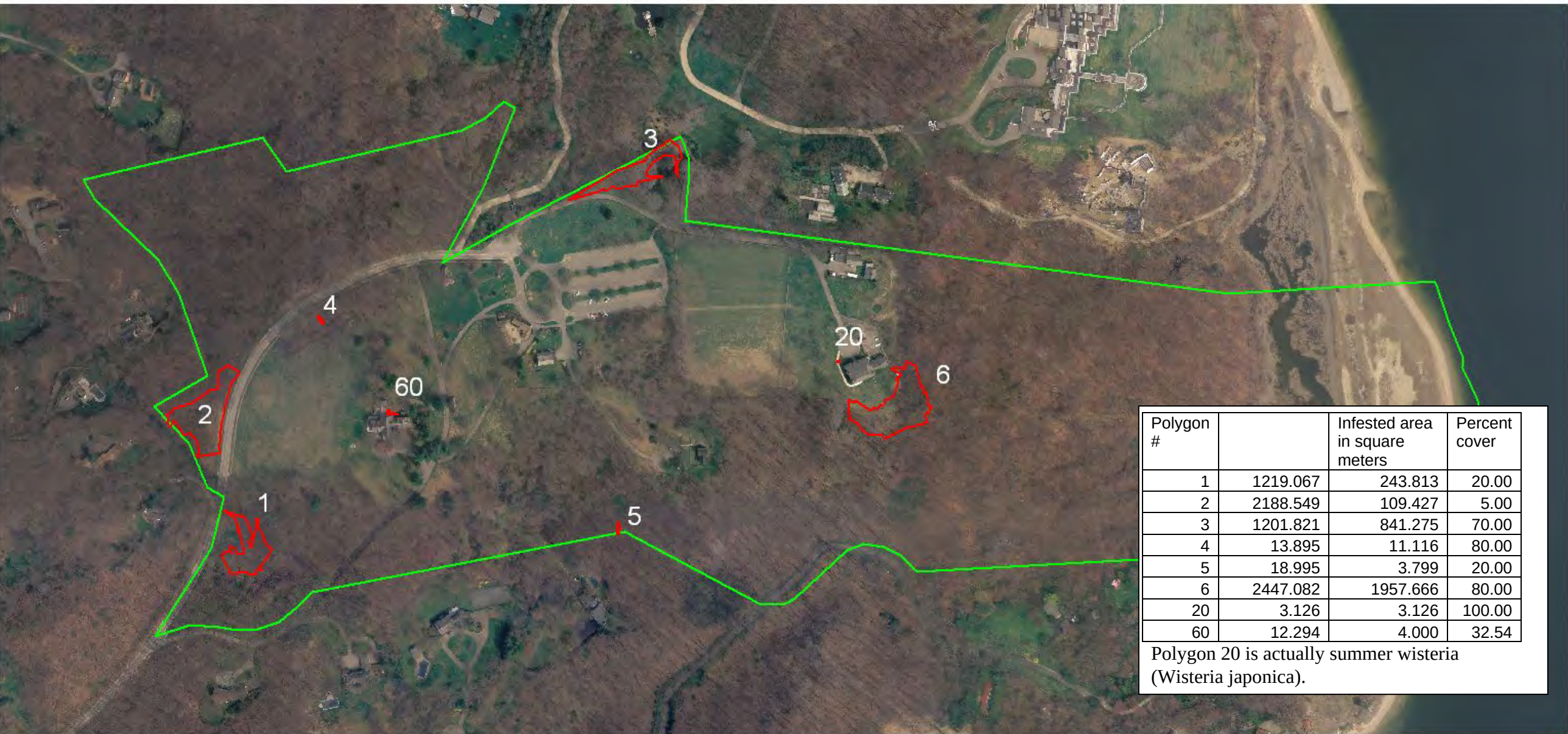
Polygon #	Area in square meters	Infested area in square meters	Percent cover	Polygon #	Area in square meters	Infested area in square meters	Percent cover
40	8142.167	81.422	1.00	45	6900.515	69.005	1.00
41	36013.848	360.138	1.00	46	14569.161	50.000	0.34
42	6419.038	128.381	2.00	47	110961.349	2219.227	2.00
43	17430.036	174.300	1.00	48	745.355	7.454	1.00
44	11010.432	110.104	1.00				

Map 23. Japanese snowball and linden arrow wood (*Viburnum plicatum* and *V. dilatatum*)

Red polygon = infested areas

Green lines = SHNHS boundaries





Map 24. Japanese and Chinese wisteria (*Wisteria floribunda* and *W. sinensis*)
Red polygons = areas infested
Green lines = SHNHS boundaries



As the nation's primary conservation agency, the Department of the Interior has responsibility for most of our nationally owned public land and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

National Park Service
U.S. Department of the Interior



Northeast Region
Natural Resource Stewardship and Science
15 State Street
Boston, Massachusetts 02109

<http://www.nps.gov/nero/science/>

EXPERIENCE YOUR AMERICA™