The Rhode Island

Forest Health Works Project

November 2009 - November 2011



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RHODE ISLAND NATURAL HISTORY SURVEY
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A partnership of the Rhode Island Natural History Survey and the Rhode Island Department of Environmental Management Division of Forest Environment and Fish & Wildlife

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Over the course of this project, the RINHS staff grew (and kept growing). The staff's contributions were innumerable and critical to the FHWP's success. Much credit is due to Hope Leeson, Grace Lentini, Mike Bradley, Jackie VanSant, Deanna Levanti, Juliana Berry, Wes Shean, Tess Duggan, Cindy Maynard, Ryan Kleinert, Christine Weiss, Molly Alves, the entire FHWP YCC and RIYCL Crews, and the most wonderful Kira Stillwell. Lastly thanks to Audrey Barnes for FHWP logo design, cover page design, and moral support.

Abbreviations

AMC: Appalachian Mountain Club
AMA: Arcadia Management Area
ARRA: The American Recovery and Reinvestment Act
ASRI: Audubon Society of Rhode Island
BMP: Best Management Practices
CISMA: Cooperative Invasive Species Management Area
CRMC: Coastal Resources Management Council
DEM: RI Department of Environmental Management
EDRR: Early Detection Rapid Response
FHWP: The Forest Health Works Project
FTE: Full-time equivalent employee
GIS: Geographic Information Systems
LULC: Land Use/Land Cover
MaM: Mile-a-minute vine (*Persicaria perfoliata*)
NRCS: Natural Resources Conservation Service
TPMA: Tillinghast Pond Management Area
TNC: The Nature Conservancy of Rhode Island
QDMA: Quality Deer Management Association
RFP: Request for Proposals
RINHS: Rhode Island Natural History Survey
RINLA: RI Nursery and Landscaping Association
RIYCL: Rhode Island Youth Conservation League
URI: University of Rhode Island
USF&WS: U.S. Fish and Wildlife Service
USFS: U.S. Forest Service
WHIP: Wildlife Habitat Incentives Program
WMA: Wildlife Management Area
YCC: Youth Conservation Corps

RHODE ISLAND FOREST HEALTH WORKS PROJECT

Cover Images left to right: Deer images captured through motion sensor cameras, The FHWP YCC, Rhody Native plant founder plots, a FHWP contractor controlling Japanese barberry, Japanese barberry (background image)

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EXECUTIVE SUMMARY

In 2009, the U.S. enacted the American Recovery and Reinvestment Act (ARRA). The Rhode Island Natural History Survey (RINHS), in close partnership with the Rhode Island Department of Environmental Management (DEM), was competitively awarded a $673,000 ARRA grant through the U.S. Forest Service (USFS) to meet ARRA's dual goal of job creation and strategic investment in national interests. The purpose of this grant was to control non-native invasive plants that threaten priority forests in Rhode Island by training "green industry" professionals such as landscapers and arborists. With this once in a lifetime funding, RINHS and DEM sought to create a lasting legacy of improved forest resources and increased capacity to address invasive species in the state.

The project was named The Forest Health Works Project (FHWP). "Forest Health" is a multidimensional concept that describes the sustainability of forests. It includes ecological, economic and social components. Invasive plants were the principal forest health issue addressed through the FHWP. Other aspects of forest health were incorporated into the project, including wildlife management, native plant propagation and marketing, recreational usage, environmental education, and most importantly, the livelihood of forest-related industries in Rhode Island.

The term *Works Project* is a reference to job creation. At the time of the ARRA award, Rhode Island's unemployment was 2nd highest in the nation. This problem was particularly acute in the nursery, landscaping, and related industries – industries which have historically defined much of the state. The FHWP's goal was to provide workers in these fields with financial support and new professional experiences during the economic downturn as a means of expanding local capacity and business opportunities. The FHWP provided job training to interested industry professionals. From this pool of certified contractors, invasive plant treatment projects and other projects were implemented through a competitive bid process.

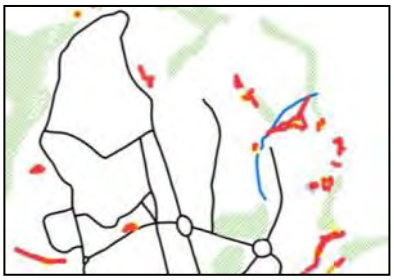
The FHWP was successful at meeting or exceeding the expected outcomes (see p. 5). Intensive field work resulted in the most comprehensive inventory of invasives plants ever conducted in RI, and most likely southern New England. Efforts were concentrated in the western region of the state, based on stakeholder input and innovative GIS analysis. As a result, over 166 acres were treated for invasives across over 40 sites. 15.5 FTE jobs were created and 16 green industry companies received contracts. A pilot Rhode Island Youth Conservation Corps (YCC) was run under the auspices of FHWP. Deer exclosures were built to demonstrate over time the relationship between invasives, deer, and forest health. Finally, *Rhody Native*™ was developed as a groundbreaking approach to promote locally-sourced native plants in the consumer and restoration markets in alliance with the nursery industry.

New funding and partnerships have since been leveraged for many of these initiatives (e.g. the YCC and *Rhody Native*™) and they will continue beyond the FHWP. The nature of this stimulus funding has been truly stimulative. Perhaps most importantly yet difficult to measure, the FHWP has elevated the issue of forest health, especially invasive plants, in the public conscious. The project was well received by all, and RINHS and DEM are well-positioned into the future.

FINAL DELIVERABLES SYNOPSIS

Environmental

1063	Transect miles inventoried
60,000	Estimated acres inventoried
37	% of RI conserved areas inventoried
33	Number of species mapped
2228	Acres of invasive plants mapped
3081	Point locations of invasive plants mapped
166	Acres treated
41	Properties treated



Economic

$673,000	Federal funds spent into the economy
3.5	FTE permanent jobs created
12	FTE seasonal jobs created
$285,000	Directed to green industry contractors
16	Green industry companies employed
12	Nurseries receiving in-kind *Rhody Native*™ support

2010 & 2011 Youth Conservation League

205	High school student applicants
14	Students employed
42	Acres cleared by crew
4.5	Miles of trail built/improved by crew

Public Outreach

21	Local conservation organizations partnered with
51	FHWP public outreach events
2,300	Estimated # of attendees
14	News stories in local media
30	Estimated # of unique outreach materials created

Major Leveraged Opportunities

$122,335	Sustainable Agriculture Research & Education grant
$27,623	National Fish & Wildlife Foundation grant
$29,233	Non-federal NFWF match
$5,120	U.S. Fish & Wildlife Service in-kind staff time
$12,000	RI CSC invasive preparedness grant
23	Leveraged jobs for contractors due to FHWP
$62,000	Value of these new invasives jobs for contractors

FINAL REPORT RECOMMENDATIONS SYNOPSIS

The FHWP was a unique conservation endeavor in Rhode Island due to the project's scale and complexity. A wide array of projects, systems, and institutional relationships were developed, and from these -- many valuable lessons were learned. The following are recommendations for relevant stakeholders. Further discussion of these recommendations can be found on pg. 42.

1. **Reconvene the RI Invasive Species Council**
   This council has been defunct since 2005 due to lack of funding. In its absence there has not been a clear set of statewide policies for invasive species and this has broad implications.

2. **Closer coordination between Conservation Organizations on Invasives and/or Forest Health**
   In a period of declining financial resources, but increasing environmental challenges, cooperation and partnership between stakeholders (inter and intra-state) is critical for success.

3. **Dedicate resources to follow-up treatment on FHWP-treated sites and others across the state**
   Invasive plant control is long-term management activity that requires follow-up. A fund should be established (estimated $15,000/annually) to re-treat FHWP sites and address new areas.

4. **Monitor and manage deer to improve Forest Health**
   Deer densities have surpassed levels for sustainable forest regeneration in many areas of the state, which promotes many invasive plants, Lyme disease, and other issues.

5. **Permanently establish the RI Youth Conservation League**
   Establishment would meet 3 goals: cost-effective natural area maintenance, environmental opportunities for youth in a state that has few, and improved public image of conservation.

6. **Expand and Promote *Rhody Native*™**
   Rhody Native has proven a great potential as unique conservation agency/nursery industry partnership and should be prioritized in plant restoration and consumer outreach efforts.

7. **Continue Green Industry Workforce Development**
   FHWP has trained a cohort of landscapers, arborists, nurserymen and others. This workforce should be utilized whenever possible and future trainings held.

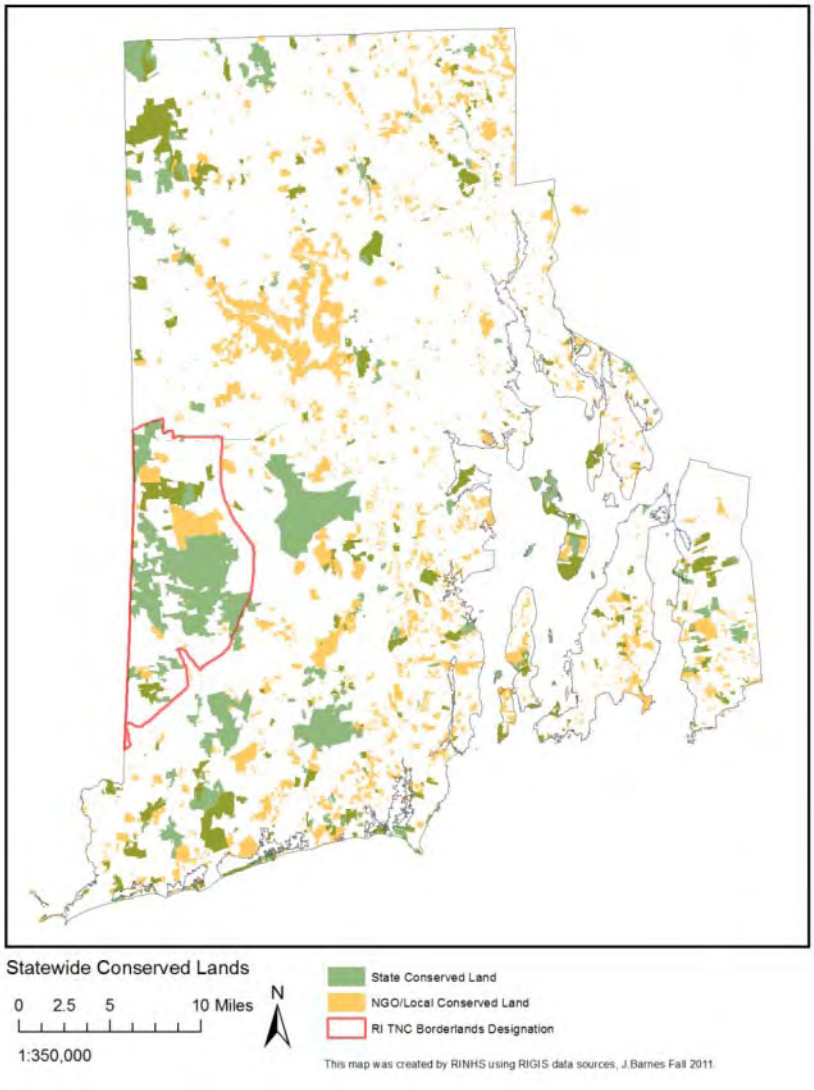
8. **Analyze the FHWP GIS dataset**
   The FHWP has generated an extremely comprehensive geodatabase which should be used for research and management purposes.

PROJECT DEVELOPMENT AND PROCESS

Environmental and Economic Context of Rhode Island

Land Stewardship in Rhode Island

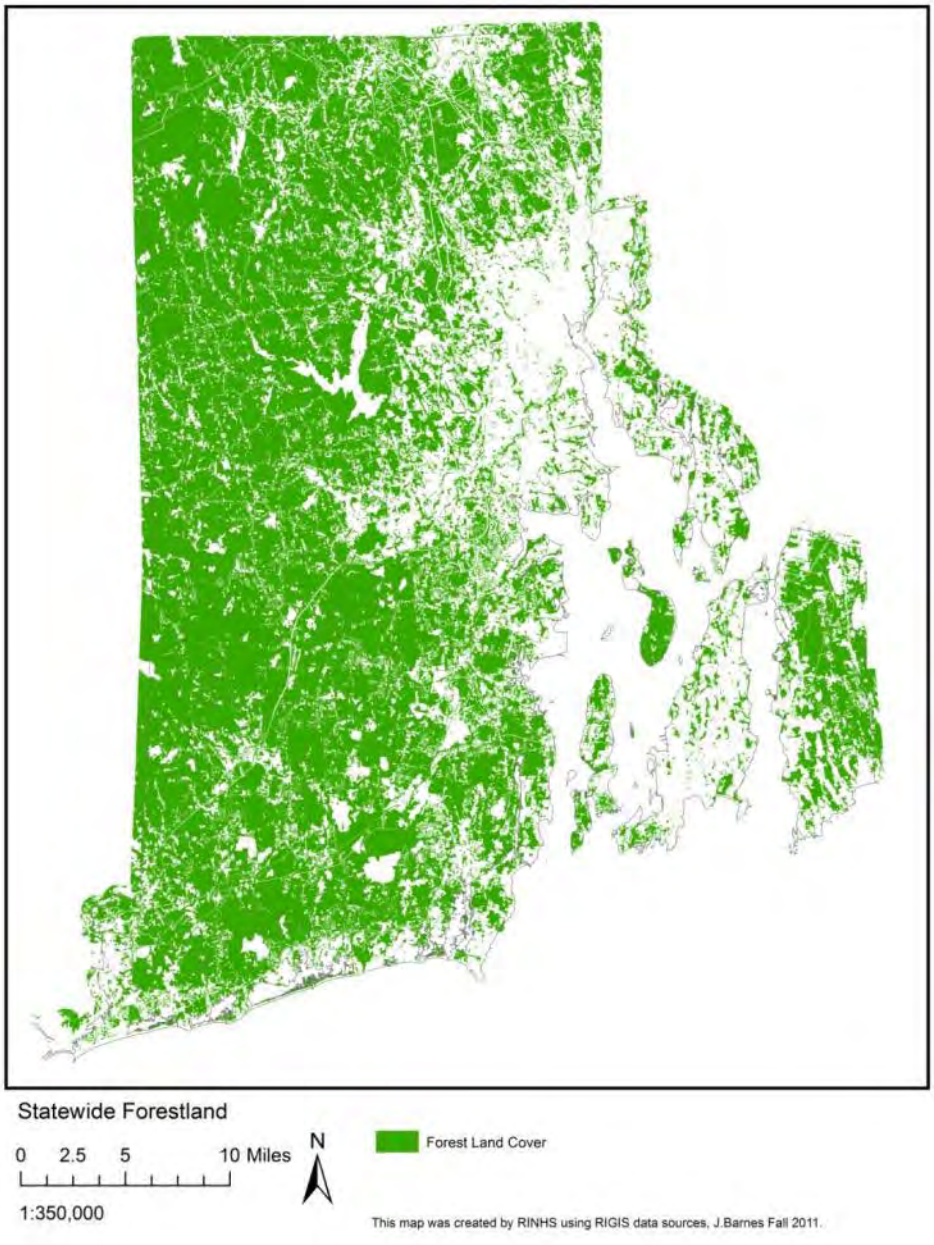
Rhode Island's natural landscapes stand at a cross roads. The state has had a long history of active conservation organizations that have been instrumental at conserving important natural resources. Today, due to successful conservation efforts in the 20th century, an era of land acquisition is transitioning to an era of land stewardship. There is an enormous need for land stewardship in the state, but also many challenges. Rhode Island is the smallest state and the 2nd most densely populated[1]. At the same time, resources for environmental work have been dramatically curtailed in recent years due to budget cuts. Future stewardship success will undoubtedly come from increased strategic cooperation among the many stakeholders in the state and region.



[1] U.S. Census, http://www.census.gov/, 2000.

Forests and Forest Health in Rhode Island

Rhode Island is a forested state. Even though it is the 2nd most urban state in the nation, over 56% of the land area is forested -- approximately 400,000 acres[2]. From a landscape perspective, these forests don't stop at the state line, but rather form a much larger matrix of forest land across the east coast. **These forests provide tremendous economic benefit to citizens of the state.** 126,000 cords of firewood are produced annually from our woods. Hunting and freshwater sport fishing industries in the state are valued at over $48.3M per year[3]. Beyond economics, Rhode Island's forests contribute immensely to the state's rich environmental heritage and biodiversity.



[2]Dupree, T.et. al, *The Forests of Rhode Island*, 2002.

[3] DEM Personal Communication, 2010.

Forest health is a measure of how well a forest provides for both the ecological and social needs that a person or group values. For this reason, it is a subjective term: forest health may mean different things to a forester, to a recreational hiker, or to a hunter. However, among these diverse groups are common values. Any healthy forest should balance the needs of society with the needs of forest organisms in a way that is sustainable over long time scales. It should support a wide diversity of species, ecosystems, and processes. A healthy forest should be resilient to change and threats. Typically, larger, more contiguous forests are considered healthier than smaller, more fragmented forests.

Threats to forest health include the biotic (e.g. insects, diseases, plants, etc.), abiotic (e.g. drought, air pollution, etc.), and human actions (e.g. development, etc.). Rhode Island's forests face many threats: invasive plants, introduced invasive insect pests like the Asian longhorned beetle (not yet found in RI), habitat fragmentation, fire, and climate change – just to name a few. It was in this context that RINHS and DEM sought to make a positive impact on forest resources and the problem of invasive plants in Rhode Island.

Trained contractor treating Japanese barberry (*Berberis thungbergii*) in a remote core forest area

Economics in Rhode Island

In the years prior to the current recession, the state was already economically challenged. When the FHWP began, unemployment in Rhode Island stood at 12.9%[4]. The current recession has negatively affected the green industry (nurserymen, landscapers, arborists, etc.) with many businesses closing, even though this industry has long been associated with the state.

[4] Rhode Island Department of Labor, (http://www.dlt.ri.gov/News_Releases/NR_112009.htm) 2009

Project Genesis and Steering Committee

The Forest Health Works Project began with the awarding of a $673,000 ARRA grant (# 09-DG-11420004-607) to the RINHS, in partnership with DEM. This grant was competitively awarded by the USFS. RINHS and DEM signed a memorandum of understanding to outline partner responsibilities.

The FHWP was advised by a steering committee of stakeholders to ensure that the project was relevant, strategic, and effective. The topics discussed at these meetings included overall project direction, site selection criteria, community outreach strategies, and more. This group typically met every other month and was chaired by the DEM Chief of Forest Environment/Fish and Wildlife. Leadership from the following stakeholder groups were part of this committee:

- The Rhode Island Natural History Survey
- DEM Division of Forest Environment/Fish and Wildlife
- DEM Division of Parks and Recreation
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- Natural Resources Conservation Service / RI Resource Conservation and Development Council
- The Audubon Society of Rhode Island
- The Nature Conservancy of Rhode Island
- Rhode Island Nursery and Landscaping Association
- The University of Rhode Island: College of the Environment and Life Sciences

Project Priorities

The proposed dual goals of the FHWP ARRA grant were 1) invasive plant control in forests and 2) job creation. However, *forest health* is much larger and more complicated than just invasive plants or employment. For example, there is a growing understanding of the relationship between deer herbivory and invasive success. Additionally, in many instances there is a need for re-vegetation where invasive plants have been removed. The Forest Health Works Project therefore approached the concept of forest health and invasive plants more holistically and addressed issues such as native plant restoration, wildlife-forest interactions, community outreach, and more. A summary of key FHWP priorities included:

- **Inventory and Control of Non-Native Invasive Plants**
  - Early Detection Rapid Response Species
  - Core Forest Regions
  - Community Outreach Sites

- **"Green Industry" Economic Development**
  - Invasive Plant Control Training and Contracting (see pg. 20)
  - Native Plant/Nursery Industry Partnership (see pg. 23)

- **Public Outreach/Other**
  - Invasive Plant Community Outreach (see pg. 18)
  - Youth Conservation Corps Engagement (see pg. 27)
  - Deer-Invasive Research and Outreach (see pg. 32)

A community outreach treatment site where invasives were removed and replaced with *Rhody Native*™ plants

Species of Concern

Currently there are approximately 2000 known plant species in RI, of which approximately 400 are naturalized and 38 considered invasive in the state[5]. Based on this of non-native invasives, a shorter list of species with the potential to threaten forest resources was created, with an emphasis on terrestrial species. **The term "forest resources" was defined broadly and included any natural area within a forest matrix: early successional habitat, riparian areas, and other habitats were included.** Aquatic species were mapped if noted. However they were not explicitly part of the FHWP because 1) other RI organizations are currently addressing aquatics in the state and 2) their control was beyond the scope of this project. The following is a list of all species mapped through the FHWP. Additionally species currently for sale in Rhode Island nurseries and garden centers were surveyed (see pg. 40)

Some of the species inventoried through the FHWP (Clockwise from top left): garlic mustard, Asian bittersweet, mile-a-minute vine, winged euonymus, bush honeysuckle, & Japanese barberry

[5] Gould, L. et. al. *Vascular Flora of Rhode Island*, 1998

FHWP Invasive Species of Concern

Scientific Name	Common Name	USDA Code
Acer platanoides	Norway Maple	ACPL
Acer pseudoplatanus	sycamore Maple	ACPS
Ailanthus altissima	tree-of-heaven	AIAL
Alliaria petiolata	Garlic Mustard	ALPE4
Ampelopsis brevipedunculata	porcelainberry	AMBR7
Berberis thunbergii	Japanese barberry	BETH
Berberis vulgaris	common barberry	BEVU
Celastrus orbiculatus	Asian bittersweet	CEOR7
Centaurea biebersteinii	spotted knapweed	CESTM
Cynanchum louiseae	black swallow-wort	CYLO11
Cynanchum rossicum	pale swallow-wort	CYRO8
Cytisus scoparius	Scotch broom	CYSC4
Elaeagnus umbellata	autumn olive	ELUM
Euonymus alatus	winged euonymus/ burning bush	EUAL13
Frangula alnus	glossy buckthorn	FRAL4
Galium odoratum	sweet woodruff	GAOD3
Ligustrum obtusifolium	border privet	LIOB
Ligustrum vulgaris	European privet	LIVU
Lonicera japonica	Japanese honeysuckle	LOJA
Lonicera morrowii	morrow's honeysuckle	LOMO2
Lonicera mackii	amur honeysuckle	LOMA6
Lythrum salicaria	purple loosestrife	LYSA2
Microstegium vimineum	Japanese stiltgrass	MIVI
Phragmites australis	common reed	PHAU7
Polygonum cuspidatum	Japanese knotweed	POCU6
Persicaria perfoliata	mile-a-minute vine	POPE10
Prunus avium	sweet cherry	PRAV
Rhamnus cathartica	common buckthorn	RHCA3
Rosa multiflora	multiflora rose	ROMU
Robinia pseudoacacia	black locust	ROPS
Rubus phoenicolasius	wineberry	RUPH
Salix atrocinerea	European grey willow	SAAT2
Wisteria sinensis	Chinese wisteria	WISI

Early Detection Rapid Response Species

Early detection rapid response (EDRR) species should be of high priority in any invasives management effort. EDRR species are in the early stages of introduction to a geographic area or perhaps totally absent. The potential for eradication and/or prevention is therefore possible. Any sites with EDRR species were considered high priority for invasive treatment. For the purposes of the FHWP, non-forest EDRR species were mapped if noted and outreach efforts were focused on these species. For outreach posters developed for EDRR species, pease visit www.rinhs.org

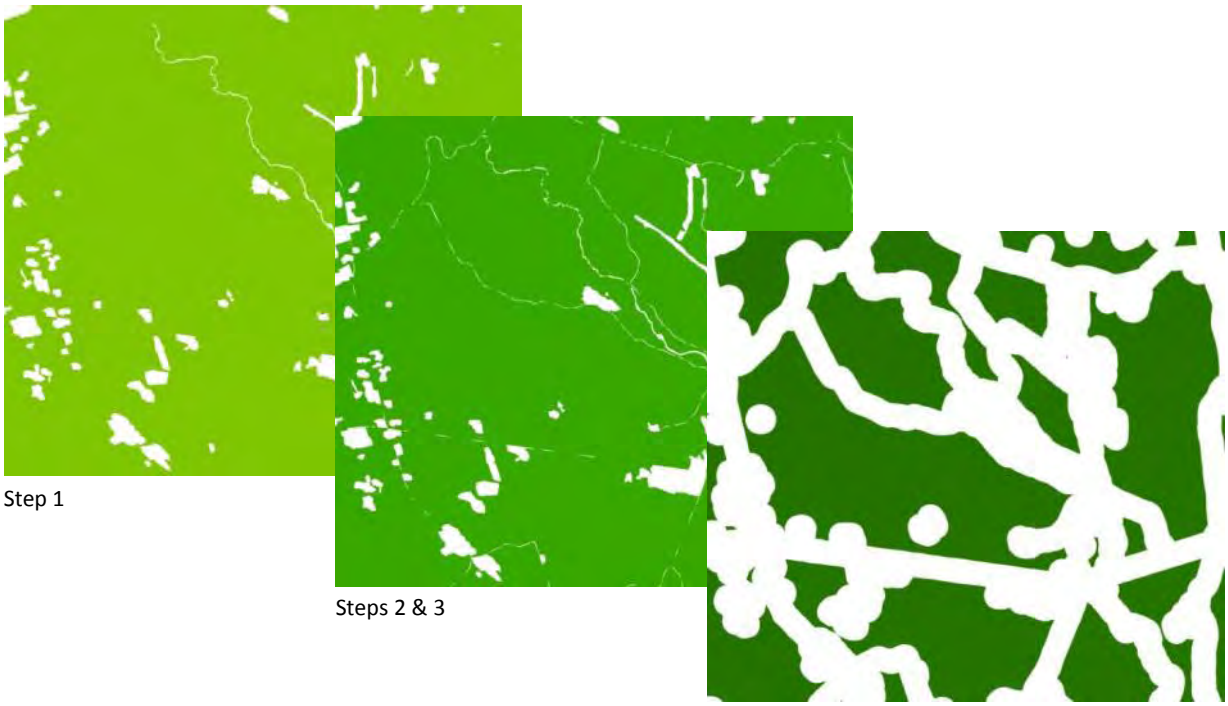
Japanese stitgrass (*Microstegium vimineum)*, an EDRR species for RI, infestation at state campground

Core Forest

The FHWP prioritized core forest regions for inventory and potential treatment using the EDRR principle. Many species that are considered widespread and common in much of Rhode Island are anecdotally uncommon in the large intact areas. Intuitively, core forests usually have less invasive plant issues since they are not typically as disturbed. Core forest is typically defined as forestland a certain distance from non-forest land-use/land cover (LULC). For the FHWP, this was established as 100m from non-forest LULC. From a forest health perspective, larger, less fragmented forest blocks are considered healthier than smaller forests because they are typically more diverse, productive, and resilient.

The project conducted GIS analysis to determine the largest core forest blocks statewide. This was done using the NOAA Habitat Priority Planning GIS program. A summary of the analysis protocol:

1. Create a subset of 2004 RI LULC (only forest and wetland classes)
2. Buffer 10m from all RI roads (converts these line road features into polygon road features)
3. Intersect new LULC and roads features (removes road footprint)
4. Buffer this LULC by 100m to create core forest feature
5. Select 1) largest core forest blocks and 2) blocks with smallest Perimeter/Area Ratio

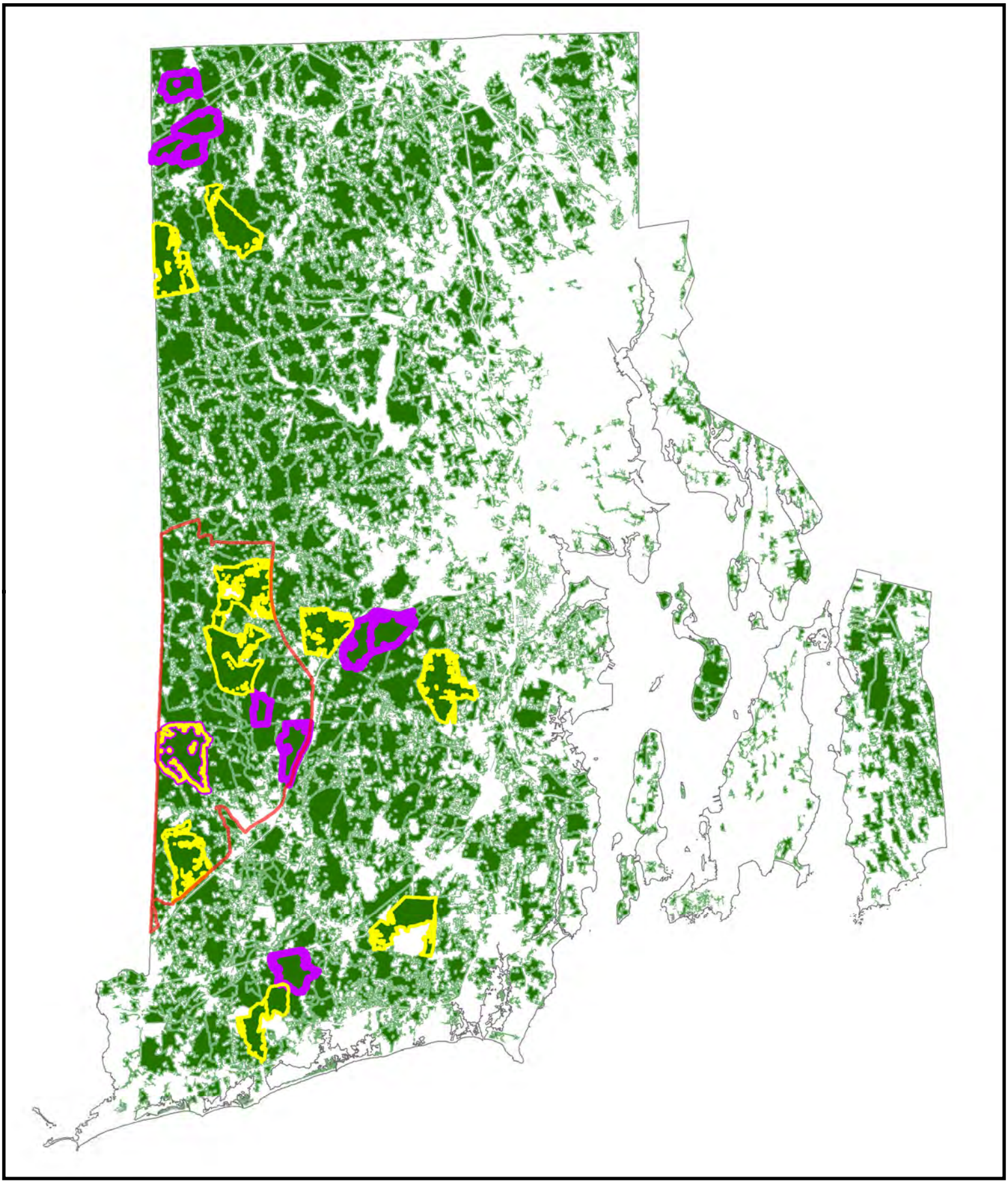


Step 1

Steps 2 & 3

Step 4

From this analysis, the western region of RI was found to be an important area of core forest in the state. Contiguous forest blocks cluster around two main regions of state. This is logical since large conservation holdings exist there. The size of these large blocks are likely underestimated since different road classes were not separated; in rural areas where core forest is prevalent, historic roads are often mapped but do not exist anymore. From this analysis, inventory efforts were directed in this region. This analysis was presented to the Northeast ARC Users Group Conference and received 1st prize.



This map was created by RINHS using FHWP & RIGIS data sources, J.Barnes & M. Bradley Fall 2011.

Community Outreach Sites

The FHWP recognized that since a large majority of the awarded ARRA funds would be directed to less populated areas of the state, some resources should be directed to non-core forest areas to engage the larger public. These sites would serve a community outreach function and build local capacity to treat invasives. In August 2010, the FHWP developed a request for proposals (see RFP, pg.148) where towns, land trusts, and other local conservation-related organizations could apply for invasive plant control assistance through the FHWP contracting process. These sites need to be primarily forested, 1-4 acres in size, and have an ecological, economic or recreational resource threatened by invasives plants. Most importantly, the applying organization had to commit to continue the control efforts after the FHWP control efforts were completed. Lastly, organizations were required to hold some type of outreach event on the project for their local constituency.

The RFP process was very successful with 17 organizations submitting applications in the short application window. Of this list, five sites were selected state wide based on merit and geographical diversity:

- City of Providence/Blackstone Parks Conservancy – Blackstone Park
- Cumberland Land Trust – High Rock Farm
- Tiverton Open Space Commission – Fort Barton
- Scituate Conservation Commission – Lawton Memorial Farm
- Westerly Land Trust – Grills Preserve

Community outreach site partners from the Cumberland Land Trust, along with the hired contractors

Inventory and Treatment Process

Inventory Protocol

The FHWP conducted rapid inventories for invasive plants across the state. This method was modified from a USFS Green Mountain National Forest protocol (see pg. 144). Survey efforts focused on large blocks of contiguous forested areas based on the core forest analysis (see pg. 16). Within these blocks, public land was prioritized for ease of access. "Intuitive transects" were completed at sites by scouting. In other words, surveyors prioritized areas with disturbance (e.g. trails), areas with resources of concern (e.g. rare plants), or areas with vectors (e.g. waterways).

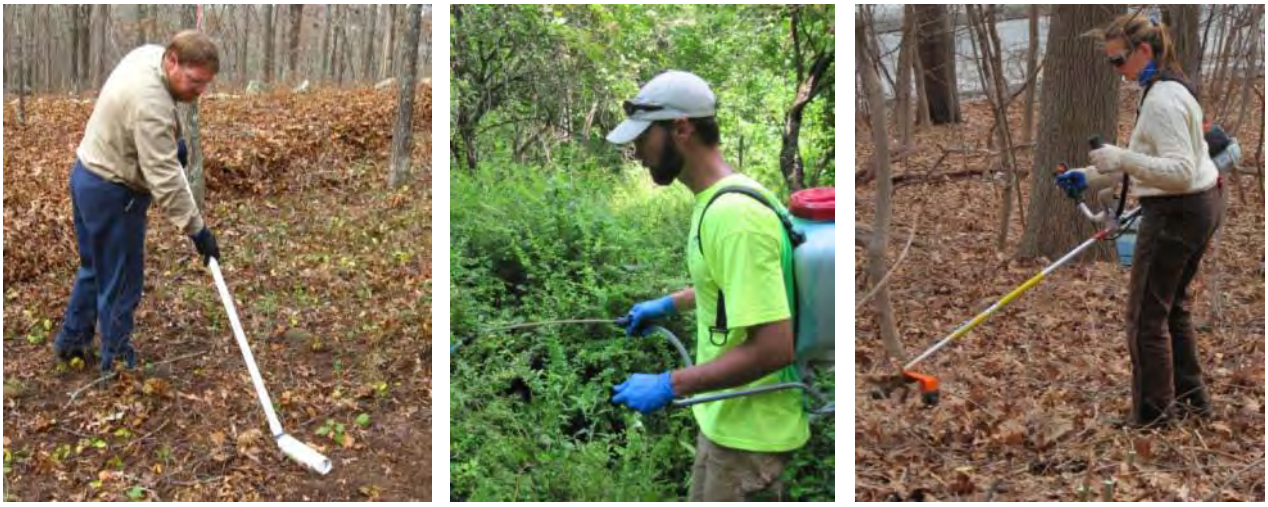
Garmin GPSMap 60CSx GPS units were used for data collection along with datasheets. A GPS track log was kept during all surveys, which recorded where field staff hiked. Once an invasive plant was encountered, the size of the plant population was determined. Populations of invasive plants that were less than 20' in diameter were mapped as a ArcMap point shape file and were recorded by standing in the center of the population and taking a GPS point. Populations of invasive plants that were greater than 20' in diameter were considered to be a polygon shape file and were recorded by taking GPS points around the boundary of the invasion. These boundary points were later used as references to create a polygon shape file in ArcMap using high resolution ortho-photography. Photographs were an integral part of data collection and spatially referenced by point shape files.

Treatment Site Selection

Due to the limited timeframe of the ARRA grant, which originally allowed for only one complete field season, a comprehensive inventory and ranking of all potential sites for invasive treatment was not possible. Instead, sites were selected for treatment balancing a "shovel-ready" approach with the three priority site guidelines (see pg. 11). Natural resource concern, suitability for contractors, and potential for follow-up also factored heavily in the decision process.

Control Techniques

A variety of control techniques (manual, mechanical, and chemical) were used for control projects, depending on site, season, and contractor.



Some of the control techniques used by FHWP Contractors

OUTREACH AND ECONOMIC DEVELOPMENT

Invasive Manager Workforce Training

An important goal of the FHWP was to build the local capacity of the green industry for invasive control in the state. By providing arborists, landscapers, nurserymen and others with invasive control training, these individuals could diversify their businesses and meet the needs of public and private landowners. This was done directly through job training and contracted projects, as well as development of educational materials.

This training was held in coordination with the Coastal Resources Management Council (CRMC) Invasive Manager (IM) Program. The CRMC IM program certifies contractors to work in the RI coastal buffer zone. The audience is broad and includes anyone from landscape architects to foremen. However, it does not provide any in-the-field context for the on-site worker. In partnering with CRMC, the FHWP incorporated several in-the-field training workshops held by regionally respected experts in invasive ecology and control. Through this partnership, the FHWP was able to pre-qualify contractors to bid on control projects with the assurance that they were trained in invasive control techniques in field conditions. The FHWP heavily subsidized this training for applicants who submitted a brief application. The event was very well attended with 79 participants.

An invasive plant management training session for green industry contractors and land managers

Contracting Process

The Forest Health Works Project established a request for proposals (RFP) for treatment sites to select contractors. Only contractors that were pre-qualified could bid on the FHWP RFPs (see example RFP and contract requirement pg.130). Qualifications included:

- On-site foreman certification: "CRMC invasives manager", "FHWP forest invasive manager", or similar certification/experience
- Resume and professional references for the business
- Mandatory site walk attendance
- Detailed proposal including work plans and costs

The control of invasive plants requires diligence and attention. If done poorly, invasive vegetation control can result in indirect impacts that outweigh the benefits of control. These include: spreading invasive material between work sites, impacting non-target organisms and resources during treatment, and creating disturbance during treatment that promotes re-invasion. To reduce the potential for negative impacts, contractors agreed to follow FHWP Management Practices (BMPs). This list of BMPs was not exhaustive and situations were contextually specific. Specific FHWP RFPs contain additional site-specific requirements.

Contractors submitted bids that were evaluated by the FHWP Project Coordinator with support from other RINHS staff. Due the sensitive ecological nature of these sites, contractor selection was not a low bid process. Company experience and "fit" were strongly considered. Additionally many projects required congruent, tight timetables, making low bid not always possible since contractors might be awarded simultaneous bids. However, cost factored heavily in all selections.

Contractors trained and employed through the FHWP

Contractor Post-FHWP survey results

Through the FHWP bidding process, 8 different contractors were employed in 22 different invasive plant control jobs. At the end of the project, the FHWP requested that contractors provide feedback based on their experience with the FHWP through a short survey (pg. 152). 6 contractors returned the surveys:

Total number of new invasive plant control jobs obtained due to FHWP experience: 22

Total value of these new invasives jobs for contractors: $62,000

In what ways has working through the FHWP potentially improved your business?

"Our experience with the FHWP has allowed us to further diversify the invasive species control services that we provide as a company. This will allow us to more effectively pursue a greater variety of projects in this expanding niche market."

"Having the knowledge (from the FHWP) is invaluable"

"This has led to other contracts with different municipalities in controlling invasive plant species. It has also opened the door through our certifications to be able to teach the public about how negatively these plants affect our landscapes."

"The biggest improvement is obviously the revenue, but more so the education and to be able to see the damage first hand. When you have this knowledge and you relay this to the customer they see your commitment to this battle and then are willing to jump on board and do their part."

"My exposure to FHWP has resulted in revitalizing my company"

Excluding bidding new contracts, in what ways can RINHS, DEM, and other regional conservation organizations provide support in helping your business develop capacity in invasives management and other related land management activities?

"Upgrade it (CRMC IM/FHWP IM)" from a certification to a license."

"Provide specific effectiveness of herbicides on specific species."

"We feel that the RINHS and DEM must continue to actively increase public awareness about the presence of invasive species and the ecological threats they pose to our local landscapes. An educated public on the issues of invasive species not only provides an excellent network for early detection, but also a group that is energized and motivated for the maintenance and restoration of native plant communities through invasives control. And that is certainly helpful to our business."

"RINHS, DEM and other regional conservation organizations can best help my fledgling business by actively promoting and publicizing the great need and benefits of more extensive and coordinated invasive management and control that is needed across all the spectrum of all open lands; especially highways, utilities, and land conservation/stewardship entities."

"Could benefit from [ ] continuing to receive newsletters containing information about relevant project work occurring in our region. It is always valuable to possibly learn about new techniques or products that are being incorporated into our industry. Any information about how to obtain continuing education credits for towards the forestry category of our RI license is also useful."

Rhody Native™

Habitat restoration is often seen as a fundamental part of invasive species management. For example, state organizations, such as the RI Coastal Resources Management Council, require a 1:1 replacement of invasive species with those native to Rhode Island under permits issued for invasive species management in the coastal buffer. However, it is often necessary for homeowners and habitat management practitioners to source native plants from states outside of New England. To address the lack of availability of native plants grown in Rhode Island, the FHWP sought to initiate a program to develop the capacity of the nursery industry to produce locally sourced native plants. The initiative was given the name *Rhody Native*™, reflecting the growing interest around the state for goods produced in Rhode Island[6]

There is a growing body of evidence which suggests that genotypic differences among plants of the same species, grown in different parts of the country, are expressed in plant phenology[7]. Implications for these differences range from negative impacts to local gene pools in terms of imported plants being less adapted to the local climate or pathogens, to plants which express slightly different life cycles than native populations. This can cause disruptions to native insect populations whose life cycles are tied to those of the plant species. Additionally, much of the native plant material that is available through the nursery trade has been sourced from single populations, and propagated by stem cuttings and therefore genetically identical. The benefit of this to the nursery industry is that by producing clones of plant species, they can reliably produce plants which reflect a preferred characteristic. However from an ecological standpoint, the practice produces populations of plants with very restricted sets of DNA, and reduced abilities to adapt to environmental stresses.

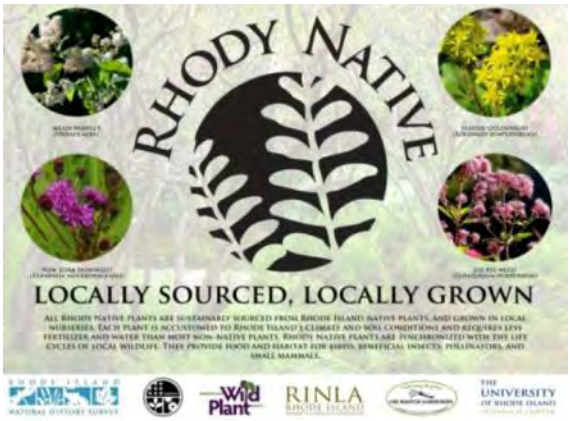
To guide the development of *Rhody Native*™, input was sought from multiple experts and stakeholders. Bi-monthly meetings were held to discuss development of the program and future directions. Individuals representing the following organizations were consulted and/or were present at meetings.

- The University of Rhode Island: Department of Plant Sciences, Outreach Center, and Master Gardeners Association
- Rhode Island Nursery and Landscaping Association
- Nursery owners, plant propagators, and landscape designers
- Natural Resources Conservation Service
- The Rhode Island Wild Plant Society
- The New England Wildflower Society
- The Rhode Island Department of Transportation
- The Audubon Society of Rhode Island
- The Nature Conservancy of Rhode Island

Rhody Native™ seedlings ready for founder plots

[6] Rhody Fresh: http://www.rhodyfresh.com/ & Rhody Warm: http://www.risheep.org/, 2011.
[7] Lesica P. and Allendorf, .F. W. "Ecological Genetics and the Restoration of Plant Communities: Mix or Match?" *Restoration Ecology* 7:1, 42-50. 1999.
N.J. Ouborg, P. Veeger, and C. Mix. "The Rough Edges of the Conservation Genetics Paradigm for Plants" *Journal of Ecology 94*: 1233 – 1248. 2006.

A logo was designed, and the name "*Rhody Native*" trademarked, to create an identity for the initiative. Plant tags and signage were developed as marketing materials for nursery centers carrying plants propagated through the program.



Rhody Native™ promotional material

Since 2010, *Rhody Native*™ plant material has been sourced primarily from seed material following protocols developed by the New England Wildflower Society and the US Department of the Interior, Bureau of Land Management Seeds of Success Program. The protocols instruct seed collectors to collect from a minimum of 30 plants (10 for woody species) within a population, and to collect seeds over the course of the time period when seeds are dispersing to capture as much of the genetic diversity of the population as possible. The protocol also stipulates collecting no more than 20% of the population to allow for sustainable harvest from native plant populations. In 2010, a small amount of material was sourced from stem cuttings, in an effort to produce woody plants that would be available sooner than could be through seed production.

Seed and cut-stem material, collected and cleaned in 2010, was distributed to five local nurseries for propagation. Plants were grown, under contract, by two of the nurseries; three others declined contract indicating their intention to benefit through sales of plants successfully grown. Collections were made from a total of 36 species. In 2011, over 5,000 plants of twelve different species were distributed for sale to eight garden centers and placed into six demonstration gardens. Additional species were allocated for restoration of two sites following invasive species removal as a part of the FHWP. In cooperation with the URI Plant Sciences Agronomy Station, four species were planted for the establishment of founder plots for future use in experiments under contract with RIDOT for research into native plant use in roadside plantings.

A 2011 MOU between the URI Outreach Center, Master Gardener Association, RINHS, and the Rhode Island Wild Plant Society, set into motion the formation of a volunteer seed collection and cleaning program as a mechanism for providing seed material to Rhode Island growers in the years to come. The volunteer program is part of activities being conducted through a Sustainable Agriculture Research and Education grant to further the development of *Rhody Native*™ through workshops targeting the nursery and landscape design industries. Through RINHS oversight of the volunteer program, seed has been collected and cleaned from 41 native species, and will be distributed to local growers, with a portion of these being grown under contract in 2012. Organization and coordination of *Rhody Native*™ in 2012 will involve the collaborative efforts of the RINHS, the URI Outreach Center and the Rhode Island Nursery and Landscape Association.

Rhody Native™ Seed Collection List (2010-2011)

Trees	Common Name	2010	2011
Carpinus caroliniana	American hornbeam		C
Cornus alternifolia	alternate-leaf dogwood		C
Cornus florida	flowering dogwood		C
Nyssa sylvatica	black gum	P	C
Quercus alba	white oak	D	
Quercus ilicifolia	scrub oak	DG	C
Quercus prinus	chestnut oak	D	
Sassafrass albidum	sassafras	DG	
Shrubs			
Aronia prunifolia	purple chokeberry	DG	
Baccharis halimifolia	groundsel tree	P	C
Hamamelis virginiana	American witch hazel		TBC
Ilex glabra	inkberry	P	TBC
Ilex verticillata	winterberry	TBP	C
Rhus copalinum	winged sumac	TBP	C
Spiraea alba var. latifolia	white meadowsweet	P	C
Spiraea tomentosa	steeplebush	P	C
Viburnum acerifoium	mapleleaf viburnum		C
Viburnum dentatum	southern arrowwood		C
Grasses			
Andropogon gerardii	big bluestem		TBC
Andropogon virginicus var. abbreviatus	bushy bluestem	P	TBC
Andropogon virginicus var. virginicus	broomsedge bluestem	P	TBC
Panicum virgatum	switchgrass	P	C
Schizachyrium scoparium	little bluestem	P	TBC
Sorghastrum nutans	yellow Indian grass	TBP	

P: Propagated

TBP: To be propagated

D: Did not survive propagation

DG: Did not germinate

C: Collected

TBC: To be collected

Herbs	Common Name	2010	2011
(Annuals)			
Chamaecrista fasciculata	partridge pea	P	C
Diodia teres	Poor-joe	P	
(Perennials)			
Aster divaricatus	woodland aster	P	C
Aster linariifolius	stiff aster	P	C
Aster undulatum	wavyleaf aster		C
ureolaria pedicularia	Fern-leaf yellow false foxglove	DG	
Baptesia tinctoria	yellow wild indigo	P	C
Coptis trifolia	Three-leaf goldthread		C
Desmodium sessilifolium	Sessile leaf tick-trefoil	P	
Eupatorium purpureum	Sweet scented joe pye weed	P	C
Euthamia tenuifolia var. tenuifolia	coastal plain flat-topped goldenrod	P	C
Gaultheria procumbens	American wintergreen		C
Hypoxis hirsuta	common goldstar		C
Iris prismatica	slender blue iris		C
Iris versicolor	harlequin blueflag		C
Lespedeza capitata	roundhead lespedeza		C
Medeola virginiana	Indian cucumber		C
Mitchella repens	partridgeberry	P	C
Pycnanthemum muticum	clustered mountain-mint	P	C
Pycnanthemum verticillatum	whorled mountain-mint		C
Sisyrhinchium atlanticum	eastern blue-eyed grass		C
Solidago caesia	wreath goldenrod		C
Solidago juncea	early goldenrod	P	
Solidago nemoralis	gray goldenrod	P	C
Solidago odora	anise scented goldenrod	P	C
Solidago sempervirens	seaside goldenrod	P	C
Thalictrum pubescens	king of the meadow	DG	C
Verbena hastata	swamp verbena	DG	
Vernonia noveboracencis	New York ironweed	P	C

Youth Engagement

FHWP High School Youth Crew

There is a long history of youth serving the environment in the United States beginning with the Civilian Conservation Corps of the 1930s. This original idea has been reinvented as state-level youth conservation corps (YCC) across the nation. Young people provide critical, yet economical physical labor to conservation areas and in exchange receive life experience and a modest stipend. They build trails, repair campgrounds, remove invasive plants, and more. Currently Rhode Island is one of the few Northeast states without a designated state youth conservation corps.

The FHWP piloted a RI YCC during the summer of 2010. This crew was open to 16-18 year olds, with a preference for applicants who wished to pursue an environmental career and that were from towns in the priority treatment areas. **Interest in crew positions was phenomenal with 137 applicants for only 8 positions**. They were led by a FHWP staff crew leader and a URI undergraduate assistant leader.

The 2010 FHWP Youth Conservation Corps in the Black spruce bog in Arcadia Management Area

The FHWP Youth Crew worked on invasive plant control, trail building, site cleanups, and more. Projects were selected by the FHWP Project coordinator (state lands) and by partner organizations. These were typically projects that would not or could not be completed without their effort. For example, in the wake of historic 2010 spring flooding in Rhode Island, the crew was instrumental in rebuilding washed

out trails in Arcadia Management Area (AMA). At other times, the team removed invasive plants in areas too remote for traditional invasives control contractors.

High School Crew Partners Projects included:

- The Appalachian Mountain Club
- DEM
- Friends of the Blackstone
- Narrow River Land Trust
- The Nature Conservancy of Rhode Island
- West Greenwich Land Trust

The FHWP youth crew season finished with a crew-led presentation/FHWP Open House for community members at the URI W. Alton Jones Campus. This event had 65 attendees and provided crew members with the opportunity to showcase their accomplishments. Overall the pilot Youth Crew was a resounding success. The crew cleared 22 acres and built or improved 2 miles of trial. The corps also proved a very effective community engagement tool for the larger FHWP project, with the crew acting as unofficial "ambassadors" to the general public. From this pilot initiative, RINHS and partners dedicated energies towards a follow-up crew in 2011.

Crew members engaged in a wide range of stewardship activities including invasive plant removal and trail construction

Rhode Island Youth Conservation League

With the success of the FHWP Youth Crew, the FHWP successfully leveraged ARRA resources and received a National Fish and Wildlife Foundation (NFWF) "Pulling Together" invasive grant ($27,633). An additional $29,223 in non-federal match was raised for a total of $56,856. The purpose of this grant was to continue the youth crew for a second year and make a measurable impact on mile-a-minute vine, an EDRR species of concern for the FHWP and known in only three locations.

The FHWP youth crew was rebranded the Rhode Island Youth Conservation League (RIYCL), with the hopes of continuing and expanding the youth crew model throughout the state in future years. Recruitment for RIYCL members was targeted towards towns surrounding current Mile-a-Minute (MaM) infestations. Regardless of the more focused effort, **68 applications were received for 6 positions.** Moreover, there was "experience consistency" between years with a returning crew member who became the Assistant Crew Leader.

The 2011 Rhode Island Youth Conservation League

In 2011, the RIYCL focused 50% of crew labor on manually removing the invasive plant Mile-a-Minute Vine in areas around East Greenwich High School, along the Furnace Hill and Meshanticut Brooks in Cranston, and in various areas on Block Island. This was part of a larger survey and outreach effort (see pg. 66). At the time, MaM was only known to occur in Rhode Island at these locations. It has tremendous potential to affect early successional habitat in the state because it forms dense thickets where other vegetation cannot grow (see pg. 15). Volunteers were a welcome addition to the Mile-a-Minute vine pulling effort with their hours accounting for approximately $1326 in match.

The other half of the RIYCL's time was spent giving back to the community through "Crew in Your Community" (CIYC) events. CIYC work days also serve the purpose of raising the profile of stewardship issues in local communities, which hopefully translates to more resources devoted to stewardship. CIYC enabled local land trusts and NGO's to competitively apply for an entire day of service from the RIYCL (see RFP pg. 150). During this day, conservation organizations could enlist the help of the RIYCL in projects ranging from trail building and maintenance to invasive plant removal. In addition, any conservation organization chosen was obligated to produce 24 hours of conservation work from their members during the work day. Member volunteer hours accounted for approximately $2404 in match. Organizations directly impacted by the RIYCL included:

- Richmond Rural Preservation Land Trust
- East Greenwich Land Trust
- Foster Land Trust
- Narrow River Land Trust
- Audubon Society of Rhode Island
- The Nature Conservancy
- East Greenwich High School
- Providence Water
- City of Cranston
- Town of East Greenwich
- National Grid
- Private landowners throughout Cranston and East Greenwich
- Bailey Farm
- RIDOT
- URI Master Gardeners Association

Overall the RIYCL helped local land trusts to clear two acres of invasive plants, maintain and create 2.3 miles of trails. Across public and private property, the crew manually removed 20 acres of Mile-a-Minute vine throughout the state. Without the help of local municipalities, state agencies, local land trusts, NGO's, and the incredible effort from volunteers, this project would not have been possible.

RIYCL members building a bridge for the Richmond Rural Preservation Land Trust

RIYCL members manually rolling up carpets of Mile-a-Minute vine.

Deer and Forest Health

Overview

White-tailed deer (*Odocoileus virginianus*) are an increasing concern to ecosystem health in the United States, rebounding from a population crash in the early 1900's due to overhunting[8]. Over-abundant deer can lead to negative environmental consequences such as degradation of forest health. During the past few decades, the population of white-tailed deer has grown tremendously in RI[9]. This trend is driven by many factors, but is primarily the result of changes in landscape changes that favor deer. Deer densities in many areas may have approached the point where they threaten many aspects of forest health including tree regeneration, rare and endangered plants, and resilience to invasive plants.

Deer impact native and invasive plants in several ways. First, they often prefer native plants over invasives for food[10]. For example, deer are very averse to browsing Japanese barberry. Given time, ecosystems are likely to become more dominated by invasives as they are selectively avoided. At the same time deer browse many native plants such as maple, oak, and ash seedlings[11]. Secondly, white-tailed deer can act as vectors for invasives whose seeds cling to their fur. For this reason, the FHWP devoted resources to understanding this growing concern in the state and communicating it to the public. A deer research study was conducted and deer exclosures constructed as part of this effort.

Methods

URI's W. Alton Jones Campus was selected as a site for research and demonstration. The campus is largely forested and is part of the single largest contiguous forest block in Rhode Island. Hunting has not been allowed on the property for many years. Anecdotal evidence suggests that the deer density is very high and is impacting forest resources. For example, many populations of rare plants that are preferred browse by deer have disappeared or been severely reduced[12]. At the same time, invasive plants have become increasingly common in the forest understory[13]. Some of these infested areas were treated by the FHWP and would therefore further elucidate the invasive plant/deer relationship. Finally, since the 2300-acre Alton Jones Campus functions as an environmental education camp and conference center, it was felt that the site would be an effective outreach tool.

The FHWP conducted a study of deer density and impacts at URI's W. Alton Jones Campus, in conjunction with invasive plant control (see pg. 101) and deer exclosure construction. Two 3-acre sampling sites were identified for camera trap sampling within an approximate 200 acre envelope of the education center and farm (Map pg. 33). Within each area, a 0.5 acre plot was selected for vegetation

[8] Ver Cauteren, K. The Deer Boom: Discussions on Population Growth and Range Expansion of the White-Tailed Deer, USDA National Wildlife Research Center Station Publications, 2003.

[9] http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/deer.pdf

[10] Knight, T. et al. Deer Facilitate Invasive Plant Success in a Pennsylvania Forest Understory, *Natural Areas Journal* 29(2) 2009.

[11] Rawinksi, T. J. Deer and Forests and the People who love them. Vol LX, number 1, *Massachusetts Wildlife*. 2010.

[12] Leeson ,H., Rawinksi, T., & Plunkett, G.,: personal communication

[13] Lesson, H. Invasive Plant Control Demonstration Plots Report July, RINHS, 2007.

surveys and deer fencing. The 3-acre sites were selected because they shared a similar 1) degrees of invasives infestation, 2) stages of forest succession, and 3) accessibility for research and outreach. Both sites have extensive Japanese barberry (*Berberis thunbergii*) populations. Site B was treated for invasives plants in 2010 and 2011 multiple times. This is an upland site dominated by mature sugar maples (*Acer saccharum*) and other hardwoods. Site C was treated once in fall 2011. This site is wetter, with red maple (*Acer rubrum*) dominating the area. The two locations are 2500' apart. Forest inventory data was collected on vegetation observed within each area during the summer of 2011. Data was collected following a USFS protocol[14] . All plant species observed in the herbaceous, understory and canopy layers were recorded, with cover abundance classes assigned. Subsequent inventories of the sites can be made in the future to observe changes in vegetative structure and density over time in the absence of deer.

At each site a passive infrared motion sensor camera (Reconyx Hyperfire HC500) was set for a total of 92 days (8/2010- 12/2010). During this time, camera traps were moved approximately every 3 weeks within each study site to obtain a more robust sampling of the area. These cameras have a maximum range of 100ft and field of view 40 degrees, with a theoretical detection area of 873 ft^2. Deer density was completed using camera trap methods outlined by the Quality Deer Management Association (QDMA). This protocol recommends setting cameras for 14-day periods. Since cameras were set for 92 days, this data was then normalized to 14 days. Additionally QDMA recommends baiting camera locations, but this was not done.

Motion Sensor Camera Results

	Site 1	**Site 2**	**Total**	**Conversion to 14-day survey period**	**Unique Buck Population Factor**	**Deer Population per 200 Acres: 14-day survey Correction Factor (1.11)**
#of Does	67	33	100	15.22	6.52	7.24
# of Fawns	43	18	61	9.28	3.98	4.42
# of Bucks	3	4	7			
# of Unique Bucks			3	0.46	0.46	0.51
Estimated Total Deer Population per 200 Acres						12.16
Estimated Deer per Square Mile						38.92

W. Alton Jones was estimated to have 39 deer per square mile based on the two study areas. Since camera traps were not baited, these numbers may be considered low estimates for the QDMA approach.

[14] Rawinski, T.J., USDA Forest Service, Durham, NH, April 2006.

Motion sensor camera trap images from W. Alton Jones

Vegetation Survey Results

Many factors can contribute to vegetation density and cover type in forested situations, including soil hydrology and fertility, canopy cover, and the presence of rock. Habitat conditions relative to hydrology, canopy cover, and presence of large boulders differ between the two sites. Density differences in vegetation were also documented between the two sites; however the predominant species found in the herbaceous layers are of similar plant types. Herbaceous cover in both areas is predominantly composed of the seedlings of invasive species, ferns, sedges, and grasses. Studies conducted utilizing deer exclosures to monitor deer browse preferences have shown that heavily browsed herbaceous layers become increasingly dominated by ferns, grasses, sedges and invasive species over time, as species within these groups comprise the less-preferred plant types[15][16]. Additionally, both areas showed a low density of forest trees in the sapling stage, which could reflect heavy deer presence in recent time. Base line data for the two areas is included in the appendix on pg. 153.

[15] Horsley, S.B., Stout, S.L., and Decalesta, D.S., "White-tailed deer impact on the vegetation dynamics of a northern hardwood forest". *Ecological Applications,* 13(1), 2003.

[16] Esctruth, A.K. and Battles, J.J. "Acceleration of Exotic Plant Invasion in a Forested Ecosystem by a Generalist Herbivore". *Conservation Biology* 23(2):388-99. 2009

Site A: Low density of herbaceous cover and trees in the sapling stage.

Site B: Predominance of ferns in herbaceous layer and low density of trees in sapling stage.

Discussion and Recommendations

Based on the camera data and vegetations surveys, deer densities are above sustainable levels for healthy forest regeneration at W. Alton Jones. Many sources recommend that deer density less than 20 deer per square mile is necessary for many forest health values[17]. The studied area had twice this threshold (39 deer/sq mile). Most likely, W. Alton Jones is acting as a local refugia for deer in the region because the area is bordered by several conservation areas where hunting is allowed. For example, deer show little fear of humans on the property. This has resulted in marked shifts in the ecology of the areas in question. Invasive plants such as Japanese barberry are becoming more common as native plant competition is preferentially browsed. Rare and unusual plant species are disappearing from the Nettie Marie Jones Nature Preserve. Perhaps most disconcerting, there is very little

[17] Managing Urban Deer in CT: A Guide for Residents and Communities http://www.ct.gov/dph/lib/dph/urbandeer07.pdf. 2007.

regeneration of the forest as seedlings. Future forests begin on the forest floor and overtime this has major implications for succession. At Site B, there are essentially two age classes of trees (mature trees ~80-100 years old and saplings ~10-15 years old). The abundance of saplings suggests this is when a tipping point occurred in deer density. Below this class there are virtually no seedlings. Additionally, there is anecdotal evidence that prevalence of ticks carrying Lyme disease has increased on the property as the deer population has grown[18]. It is strongly recommended that W. Alton Jones begin actively managing deer based on this research. Understandably, there are many potential challenges considering the multiple uses of the property, particularly with youth. However, there are several regional examples of similar analogous mixed-used properties engaging in effective deer management programs[19].

Deer Exclosures

The FHWP recognized an opportunity to provide outreach to landowners on the impacts of deer on forest regeneration. Deer exclosures can provide striking visuals on the longitudinal effects of over-browsing by deer. Over time, these exclosures will hopefully help guide management discussions at the campus itself. Deer exclosures were constructed at both sites in May 2011. At Site B, a ½ acre 900lb polypropylene, 7' fence with metal mesh bottom was constructed. At Site C, a ½ acre 8' woven wire fence with metal mesh bottom was built. The material selection was different at each site for several reasons. First, the uneven topography dictated a plastic fence at Site B. These sites could provide a comparison of different materials to landowners interested in fencing on their own properties. W. Alton Jones has agreed to maintenance of the fencing with support from RINHS.

Installation of deer fencing by FHWP contractors

[18] Jacques, J., Personal communication, 2011.
[19] Rawinski, T. Personal communication, 2010.

STATE-WIDE RESULTS AND ANALYSIS

GIS Summary

The FHWP has generated a large, detailed dataset on the distribution of over 20 invasive plant species across the state. This represents one of, if not the most, comprehensive and intense invasive plant inventories ever. With this dataset, there are great opportunities for landscape-level research on invasive plants. The following is a ranked list of the total polygon area for invasives mapped through the FHWP. It does not include species or locations mapped as points or lines.

Scientific Name	Common Name	Acres mapped
Rosa multiflora	multiflora rose	442
Celastrus orbiculatus	Asiatic bittersweet	405
Lonicera morrowii	morrow's honeysuckle	265
Berberis thunbergii	Japanese barberry	261
Euonymus alatus	winged euonymus/ burning bush	174
Lonicera japonica	Japanese honeysuckle	133
Ligustrum vulgaris	European privet	105
Elaeagnus umbellata	autumn olive	90
Frangula alnus	glossy buckthorn	84
Acer platanoides	Norway Maple	55
Ampelopsis brevipedunculata	porcelainberry	49
Ligustrum obtusifolium	border privet	47
Persicaria perfoliata	mile-a-minute vine	45
Polygonum cuspidatum	Japanese knotweed	35
Rhamnus cathartica	common buckthorn	16
Salix atrocinerea	European grey willow	13
Phragmites australis	common reed	5
Berberis vulgaris	common barberry	5
Ailanthus altissima	tree-of-heaven	3
Rubus phoenicolasius	wineberry	2
Centaurea biebersteinii	spotted knapweed	2
Robinia pseudoacacia	black locust	2
Microstegium vimineum	Japanese stiltgrass	1
Cynanchum louiseae	black swallow-wort	1
Wisteria sinensis	Chinese wisteria	0.06
Cytisus scoparius	Scotch broom	0.02
Xanthoceras sorbifolium	yellow horn	0.02
Cynanchum rossicum	pale swallow-wort	0.01
Total		**2241**

Core Forest /Invasive Plant GIS Correlation Analysis

Purpose

The distribution of invasive plants mapped through the FHWP can be correlated with any other geo-referenced dataset because the FHWP database has a GIS polyline log of where invasive plants were present and absent based on survey methods (see pg. 144). From this, there are many potential research questions. For example, does the distribution of certain invasive plants relate to the degree of landscape-level forest fragmentation? The following is an initial analysis to demonstrate this potential of the dataset. The distribution of five common invasive plants (Japanese barberry, glossy buckthorn, Japanese knotweed, Asian bittersweet, and autumn olive) was correlated with three LULC types: core forest, edge forest, and non-core/edge forest.

Methods

The existing contiguous forest layer was buffered inwards 20m to create the three classes: "core", "edge", and "other". To determine the study area, the inventory transect track file was buffered by 15 m (50ft) on each side and then converted to a raster (1m pixel size) for grid analysis. Areas within the 30 m (100 ft) buffered area were considered the study area. In other words, 30m was the estimated visual search width of a typical surveyor.

Polygons of invasive species (> 5% cover) were converted to a raster (1 m pixel). Using raster calculator, the tracks raster layer and the invasive species raster layer were added together to create one raster layer using the track raster layer as the output extent. Each pixel in this raster layer was then coded:

Pixels with code 0 = pixels outside the study area (outside of the 30 m buffer).
Pixels with code 1 = pixels within the search area and no invasive species mapped.
Pixels with code 10 = pixels outside of the study area and invasive species were mapped.
Pixels with code 11 = pixels within the search area and invasive species were mapped.

Zonal statistics were used to tabulate the area of the buffered contiguous forest layer when intersected with the merged raster layer (buffered tracks and invasive species). The result is the number of pixels (m^2) of each pixel code found within each of the contiguous LULC classes (edge, core forest, and other). A chi square analysis was run to determine any correlation between species and LULC classes.

Initial Results and Discussion

This initial analysis was completed with species whose expected distribution was hypothesized to be clearly known, such as autumn olive which is often found in "other" (i.e. open field) LULC. Some results confirmed this hypothesis. For example, autumn olive was 6X more likely to occur in "other" rather than in core forest ($p<0.0040$), as expected. Yet there are some interesting results that are not yet understood. There was no significant difference between core, edge, and other for Japanese barberry, even though it seems to be commonly associated with closed canopy habitat through FHWP surveys. Final results are still being analyzed.

Garden Center Invasive Plant Surveys

As with all invasive species control efforts, surveying and managing vectors of invasion outside of target areas is an important way to proactively keep invasives at bay. Along with inventorying core forested areas in Rhode Island, the FHWP surveyed garden centers across the state to gain information on what species of invasive concern are being sold in garden centers throughout the state. "Invasive Concern" was defined as being listed as invasive or potentially invasive in Rhode Island, Connecticut, or Massachusetts. In total, 24 plants were included. Eighteen garden centers were surveyed, ranging from locally owned to big box stores.

Sixteen out of eighteen garden centers sold at least one type of invasive plant. The mean and median number of "species of invasive concern" was 5.5 and 6 respectively. The two species most commonly found in stock were Japanese barberry (*Berberis thunbergii)* and winter creeper (*Euonymus fortuneii)*; both were found at 13 different centers. Information like this has broad implications for invasive plant management in the state. For more information, see Final Report Recommendations, pg.42.

FHWP Garden Center Invasive Species Survey

Species	Common Name	% of Stores with Plant in Stock
Trees		
Acer platanoides	Norway maple	6
Acer ginnala	amur maple	0
Paulownia tomentosa	paulownia	0
Phellodendron amurense (or other spp.)	Amur Cork Tree	0
Pyrus calleryana	Bradford Pear	56
Shrubs		
Berberis thunbergii	Japanese barberry	72
Euonymus alatus	burning bush	44
Lonicera spp.	non-native honeysuckles	33
Ligustrum spp.	privets	17
Rosa multiflora	multiflora rose	0
Rhodotypos scandens	black jetbead	0
Spiraea japonica	Japanese spirea	67
Viburnum dilatatum	linden arrowwood	0
Viburnum sieboldii	siebold arrowwood	0
Grasses		
Miscanthus sinensis	Chinese silvergrass	67
Miscanthus sacchariflorus	amur silvergrass	0
Calamagrostis epigeios	chee reedgrass	0
Herbaceous		
Aegopodium podagraria	goutweed	0
Vines		
Akebia quintata	chocolate/ raisin vine	0
Clematis terniflora	sweet autumn clematis	17
Euonymus fortunei	winter creeper	72
Aquatic		
Butomus umbellatus	flowering rush	0
Myriophyllum aquaticum	water milfoil	6
Nymphoides peltata	yellow floating heart	0

FINAL REPORT RECOMMENDATIONS

The FHWP was a unique conservation endeavor in Rhode Island due to the project's scale and complexity. A wide array of projects, systems, and institutional relationships were developed, and from these, many valuable lessons were learned. The following are a list of insights from the FHWP. These are presented as recommendations to relevant stakeholders.

1. **Reconvene the RI Invasive Species Council**
   The Rhode Island Invasive Species Council (RIISC) should be reconvened. This council has been defunct since spring 2005. Without it, there is no body to sanction or assess the status of nvasive species in Rhode Island. In public presentations, the FHWP was repeatedly asked why invasive plants are still for sale at nurseries and garden centers in Rhode Island. Both Connecticut and Massachusetts have existing bodies that analyze the threat of invasive species and regulate their sale. Rhode Island should at the very least update the existing, out-dated invasive species list to align with neighboring states. The council has never had regulatory power, but this should be explored.

   Recommended Actions:
   a. Reconvene the RIISC
   b. Update the existing Rhode Island invasive species list based on new data
   c. Coordinate policy efforts with neighboring CT and MA.

2. **Closer coordination between Conservation Organizations on Invasives and/or Forest Health**
   In a period of declining financial resources, but increasing environmental challenges, cooperation and partnership between stakeholders (inter and intra-state) is critical for success. A positive outcome of the FHWP was regular steering committee meetings on issues of forest health and invasive plants. These served as useful opportunities to share information and align efforts. Considering many of the differences between invasive species and forest health stakeholders, these should probably be two different groups.

   Recommended Actions:
   a. Schedule regular stakeholder meetings
   b. Collectively prioritize issues/sites/species of concern
   c. Organize invasive plant control efforts around a Cooperative Invasive Species Management Area (CISMA) model.

3. **Dedicate resources to follow-up on FHWP treated sites and others across the state**
   Invasive plant control is long-term management activity that requires follow-up. Without any follow-up many of the gains achieved through the FHWP will be lost. This is particularly acute for sites with potentially large invasive seed banks. A fund should be established (estimated $15,000/annually) to re-treat FHWP sites and address new areas.

4. **Monitor and manage deer to improve Forest Health**

   Deer densities have surpassed levels for sustainable forest regeneration in many areas of the state, which promotes many invasive plants, Lyme disease, and other issues. In some situations, addressing invasive plants must be coordinated with addressing deer populations. For example, they indirectly promote the success of many invasives plants by preferentially browsing native competition and not invasives. For more information on this see pg. 32. There remains a gap between the science of deer and forest health, public perception of deer, and on the ground management.

   Recommended Actions:

   a. Monitor FHWP deer exclosure sites to study ecosystem change and engage the public with these sites
   b. Encourage citizen science monitoring of deer through camera traps and other techniques
   c. Coordinate a state-wide/multi-state dialogue on the abundance and ecosystem impacts of deer

5. **Permanently establish the RI Youth Conservation League**

   Rhode Island is one of the few New England states without a state-level conservation corps. Establishment would meet 3 goals: cost-effective natural area maintenance, environmental opportunities for youth in a state that has few, and improved public image of conservation.

   Recommended Actions:

   a. Continue the RIYCL into its 3rd year in 2012.
   b. Explore partnerships with conservation organizations and neighboring states CT and MA as a means to coordinate and financially support a regional student employment and volunteer opportunities

6. **Expand and Promote *Rhody Native*™**

   Description: For *Rhody Native*™ to be sustainable in the future, the initiative must be carried by the stake holders. On-going collaboration between the RINHS, RINLA and the URI Outreach Center is seen as a commitment requiring a minimum of five years to formulate a sustainable model for the future of the initiative. By leveraging the work completed through the FHWP, collaborators will seek further funding to continue to develop *Rhody Native*™. Development of a competent grower base and market demand must occur concurrently. Maintaining quality standards and resource conservation through harvest protocols are integral to the outcome of the program. State and federal agencies could provide support for *Rhody Native*™ by requiring that restoration plantings be propagated from genetically diverse and locally sourced native plant material.

Recommended Actions:

a. Develop an on-line registry of restoration and large-scale native planting need and *Rhody Native*™ plant availability. Include a list of plants native to Rhode Island.
b. Encourage CRMC, NRCS, RIDEM, RIDOT, and USF&WS to specify native plants sourced from Rhode Island genotypes in their restoration and planting efforts.
c. Whenever contract growing is a possibility for restoration and landscaping projects, encourage state and federal agencies to utilize Rhode Island nurserymen.

7. Continue Green Industry Workforce Development

For invasive control at the scale of the FHWP to be sustainable in the future, the market and workforce for this work must be expanded. FHWP has trained a cohort of landscapers, arborists, nurserymen and others. This workforce should be utilized whenever possible and future trainings held. Contractors need both training opportunities and employment opportunities in invasive control to be willing to invest in this type of work. State and federal agencies could provide support in terms of new trainings/certifications and/or regulations.

Recommended Actions:

a. Develop a similar framework to CRMC Coastal Buffer Zone management process and invasive species training program for DEM wetland jurisdiction areas.
b. Encourage NRCS Standards and Practices to more closely align with invasive species control.
c. When possible, select local contractors for treatment projects. Based on experiences through the FHWP, local, smaller contractors were typically more reliable and committed than out of state contractors.

8. Analyze the FHWP GIS dataset

The FHWP has generated an extremely comprehensive geodatabase which should be used for research and management purposes. Because the database is scientifically robust, it opens up the possibility for landscape-level and site-level research questions. FHWP has begun this process (see pg. 38-39), but many opportunities are still untapped.

Recommended Actions:

a. Find research funding to continue landscape-scale correlative analysis of invasive plants and other spatial features (e.g. rare plants, soils, housing density, etc.).
b. Re-visit the treated sites in 2-5 years to monitor the longer-term effectiveness of FHWP control efforts.

TREATMENT SITE REPORTS

Site Reports Overview

The following are reports for FHWP treatment sites. Treatments occurred between April 2010 and November 2011. Almost all sites were treated at least twice, and in two different seasons. Photos were taken prior to treatment and spatially referenced when possible. Re-photos were taken between April-November of 2011. Maps provide general outlines of invasive plant populations *prior* to treatment. Unless otherwise noted, invasive plant populations were eradicated (95% control or greater) by the treatment regime.

A table of contractor control techniques, herbicide-usage, etc. for all sites can be found on pg. 126. For more detailed information about these sites contact RINHS.