Invasive Plant Control Demonstration Plots

July, 2006 - August, 2007
W. Alton Jones Campus, West Greenwich, RI
Pojac Point Road, North Kingstown, RI

Prepared by: Hope D. Leeson, for the Rhode Island Natural History Survey

Plots 4 (Control) across to Plot 5; April 2006

Plot 5 (Basal Spray Pathfinder) across to Plot 4; April 2007

W. Alton Jones, *Berberis thunbergii:*

Plot 1; July 2006

Plot 1 (Mechanical treatment –girdling and Pulling); May 2007

Pojac Point, *Phellodendron amurense:*

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Introduction and Acknowlegements

The Rhode Island invasive plant control demonstration plots were part of the Rhode Island Natural History Survey's 2006 invasive species program, which included numerous other features:

- an invasive species web portal at www.rinhs.org/invasives
- a workshop in invasive species preparedness for land conservation organizations
- outreach and field training for land trust volunteers
- sponsorship of four public lectures on invasive species topics
- Ecology of RI conference themed on invasive species
- aquatic invasive species training for volunteer water quality monitors
- leadership, with CRMC and URI, of the RI Aquatic Nuisance Species Working Group
- hosting a Rhode Island invasive summit with IPANE
- invasive species control project at a rare plant site

Funding for RINHS's 2006 invasive species program came from the U.S. Forest Service, the University of Rhode Island College of the Environment and Life Sciences, the Rhode Island Agricultural Experiment Station, the Rhode Island field office of The Nature Conservancy, the Rhode Island Foundation, the Sharpe Family Foundation, and private donors. Additional thanks are due to Cathy Sparks, Chief of the Rhode Island Department of Environmental Management Division of Forest Environments, URI Coastal Institute, URI Watershed Watch, Marc Tremblay and the Rhode Island Forest Conservator's Organization, and Largess Forestry, Inc.

The Rhode Island Natural History Survey (RINHS) is a non-profit organization founded in 1994 to facilitate communication among the many people, agencies, and organizations interested in the ecology of Rhode Island; to gather and disseminate information on Rhode Island's animals and plants, geology, and ecosystems; to foster the preservation of Rhode Island natural history collections; and to engage in educational outreach. RINHS commands the most current and comprehensive information on the distribution and viability of animals, plants, and natural communities in Rhode Island, including rare and endangered species and invasive species. It hosts events to highlight biodiversity and the work of researchers and naturalists. It assists partners such as URI, the Rhode Island office of The Nature Conservancy, and local land trusts to undertake ecological research, inventory, and stewardship projects. RINHS encourages the activities and contributions of avocational naturalists including students. Our Boards include representatives from governmental agencies, academic institutions, non-profit organizations, professional organizations, private companies, and the interested public. Membership in RINHS is open to anyone with an interest in Rhode Island's animals and plants, geology, and ecosystems. More information is available at www.rinhs.org.

David W. Gregg, Ph.D.
Executive Director, RINHS

Pojac Point Invasive Species Management Demonstration Site

North Kingstown, Rhode Island

Site Description

Populations of Amur corktree (*Phellodendron amurense*) have been located within unmanaged forested habitat within the geographical area known as Pojac Point in North Kingstown, Rhode Island. One population, located on private property, was selected to determine an effective management technique for the species. The population is located within a depressional area west of Summer Pond. Amur corktree has become established in all layers of the forested habitat, which is otherwise dominated by a closed canopy of oak (*Quercus spp.*) and shagbark hickory (*Carya ovata*). White pine (*Pinus strobus*), big-toothed aspen (*Populus grandidentata*) and red maple (*Acer rubrum*) are also present as native components of the system. Based on tree ring data, obtained from core samples, it appears the species arrived at the site in 1936. The shrub understory contains several non-native invasive species, common to Rhode Island's suburban forested habitats, such as multiflora rose (*Rosa multiflora*), Asiatic bittersweet (*Celastrus orbiculatus*), winged euonymus (*Euonymus alatus),* and bird buckthorn (*Rhamnus frangula*). Two additional species, linden viburnum (*Viburnum dilatatum)* and black jetbead (*Rhodotypos scandens*), were also found at the Pojac Point site. Both species are emerging as potentially invasive on the New England landscape.

***Phellodendron amurense* in fruit.**

***Phellodendron* seedling.**

***Rhodotypos scandens* in flower.**

***Viburnum dilatatum* in fruit.**

Area of Study

To investigate the effectiveness of various treatment methods on the non-native tree *Phellodendron amurense*, three 20 meter square treatment plots were established within the nucleus of the population. Prior to treatment, all plant species present within the plots were documented, and their densities estimated.

Plot 3 looking east towards Summer Pond.

Due to the proximity to freshwater wetlands, permission to carry out the proposed treatment methods was required from the Rhode Island Department of Environmental Management, Freshwater Wetlands Section, and the RIDEM, Water Quality and Wetland Restoration Team. The site is located just outside of the jurisdiction of the RI Coastal Resources Management Council, thus not requiring review from that State entity.

Three treatment methods were applied late in the fall of 2006, after leaves had dropped from the trees. Monitoring for effectiveness of the treatments and responses of remaining vegetation to the release of canopy cover, took place in early May and late June of 2007. All three treatments had an effect on the target plant, *Phellodendron amurense*. The only method to remove 100% of the individual trees targeted was the cut stem application of herbicide (applied in Plot 2). The resulting release of canopy cover however, has the potential to encourage the rapid growth of additional species of the non-native species already present in the understory, as well as rapid growth of pioneer native species. The site should now be considered for replanting with native species and removal of the additional non-native species.

Pojac Point Fall 2006 Treatments:

- Plot 1 mechanical – Depending on tree diameter, different methods were applied. Following leaf fall, two people girdled and pulled from the ground all Amur corktrees within the plot. Trees that were less than 3" in diameter, and greater than 1" in diameter, were girdled using wide blade pocket knife. For trees greater than 3" in diameter, a hatchet was used. Small trees and saplings (those under 1" in diameter) were pulled from the ground using a weed wrench.
- Plot 2 cut stem – A two person team cut all Amur corktrees less than 2" in diameter with hand held loppers, and cut down all trees greater than 2" in diameter with an 18" Husquevarna chainsaw. Immediately following cutting, the stump surfaces were treated with a 50% solution of RoundUp Pro, applied with a backpack sprayer and brass cone nozzle. The treatment was applied after leaf fall.
- Plot 3 basal spray – A two-person team applied a pre-mixed solution of trichlopyr (sold as Pathfinder II) with a backpack sprayer and brass cone nozzle to the basal bark surface of all Amur corktrees. The treatment was applied after leaf fall. For trees less than 2" in diameter, herbicide was applied within a zone, 6 to 10"above the ground down to the root collar. In order to penetrate the thick cork layer on larger trees, chainsaw marks were cut into the bark, every 6 inches around the circumference of each tree. Chainsaw cuts were made within a zone 12 - 24" above the ground surface. Herbicide was then applied to the cut surface as well as on the outer bark, down to the root collar. This technique is known as frailing.

Pojac Point Treatment Results, June 26, 2007:

- Plot 1 - The girdling method was moderately successful. A count of trees dead and alive indicated that 49% of the small diameter trees were killed by girdling. The remaining 51% show re-sprouting just below the girdle. Initially it appeared that the location of the girdle could be a factor. Most small trees were girdled to within an inch of the root crown, the girdle on some that survived was farther from the root crown, however that did not prove to be a consistent factor, and one large diameter tree was killed by a girdle located approximately 12 inches above the root crown. The method is easy to apply and trees are left to stand in place. No herbicide is required. The moderate success with girdles applied after leaf fall, suggests the method should be tried when trees are actively growing. Within Plot 1, *Phellodendron* occupied primarily the mid-canopy layers (5 to 10 meters: 5-12.5%, and 1-5 meters: 12.5-25%), with the larger individuals occurring at the edge of the plot, adjacent to Summer Pond. Thus light conditions on the forest floor, remained relatively constant following removal of the Amur corktrees. The presence of mature *Rhamnus frangula* and *Viburnum dilatatum* shrubs leaves the possibility for these shade tolerant species to increase in density.
- Plot 2 – Monitoring of the three plots, during the first growing season after treatment, has shown the cut stem method to be the most successful for this species. The kill rate is 100%. Trees of all diameters were cut, with herbicide applied to the freshly cut surface. As of June 26, 2007, no trees had re-sprouted, and the stumps were beginning to dry. In dealing with large trees, the effort then required for clean-up is greater; though there is the possibility of firewood. Within the 5 and 10 meter zones, canopy coverage provided by the *Phellodendron* trees was close to 25%. The species occupied 5% of the 15 meter zone, and 25-50% of the tall shrub (1-5 meters) zone. The effect of removing the leaf cover provided by all *Phellodendron* plants within these zones has resulted in a substantial increase in the amount of sunlight reaching the forest floor. Species such as *Rosa multiflora, Euonymus alata* and

Parthenocissus quinquefolia have been quick to respond with increased growth. Additional species such as *Viburnum dilatatum, Celastrus orbiculatus* and *Toxicodendron radicans* will also benefit from increased light. The percentage of *Phellodendron* seedlings in the herbaceous layer remains at 12-25%.

- Plot 3 – Prior to applying the basal spray herbicide, the bark of trees greater than 2 inches in diameter was removed with a chainsaw to the cambium layer in roughly four spots around the circumference of the tree. Of these trees, approximately 75% have not leafed out, or re-sprouted below the cambium cuts. Trees smaller than 2 inches in diameter received herbicide directly to the outer surface of the bark, as a basal spray. Approximately 2% of these have not leafed out or re-sprouted. For this species, it appears that success of a basal bark herbicide application depends on the cuts to the cambium. Even with trees less than 2 inches in diameter, it appears the spongy outer bark serves as a barrier to the herbicide. As with Plot 2, a release of the herbaceous layer has occurred as a result of the removal of leaf cover in the canopy. The following species showed increased growth: *Rosa multiflora, Parthenocissus quinquefolia, Euonymus alata, Circaea lutetiana,* and *Acer platanoides.* There was a decrease in coverage of *Phellodendron* seedlings from 5-12.5% to 1-2%. This could reflect the natural rate of attrition over the course of a year.

Pojac Point; Plot 1

Management Log

Location: Plot 1 (PP)
Description: Mechanical girdling, pulling
Date: November 13, 2006
Weather: 56 degrees F.; light rain
Tools used: Wide blade pocket knives, hatchet
Chemical Used: none
Amount used: n/a
Time: 3 hours
Number of people: 2 (H.L. & M.P.)
Notes:

- Cuts were made just above the base of the tree, and were 4-6” high around the circumference of the tree. The outer (somewhat corky in trees 2 ½ -3”) bark and inner yellow bark were cut away to expose the whitish cambium layer.
- The distribution of Amur corktrees along the slope of Plot 1 increased closer to the base of the slope.
- Several small trees (1-2” in diam.) were noted to be dead.
- Where *Celastrus orbiculatus* was entwined with the girdled Amur corktree, the *C. orbiculatus* was also girdled. Otherwise all other invasive species were left untreated.

Girdled *Phellodendron amurense*

Plot 1 several girdled stems

Plot 1 Pulling *Phellodendron* with the Weed Wrench.

Location: Plot 1 (PP)
Description: Mechanical pulling
Date: November 16, 2006
Weather: 50 degrees F.; raining
Tools used: Medium sized weed wrench
Chemical Used: none
Amount used: n/a
Time: 4 hours
Number of people: 1 (H.L.)
Notes:

- The weed wrench worked well on this species. The roots are relatively shallow, and run laterally. It was noted that the pith of unhealthy trees was brittle. A consistent pulling motion of the weed wrench helped to prevent breakage in these individuals. Trees greater than 1" have a lengthy root system, and so resulted in greater soil disturbance. Care was taken to tamp down loose soil, and to cover disturbed areas with leaf litter.

Pojac Point; Plot 1

Monitoring Log

Date: September 11, 2006
Weather: 65 degrees F.; overcast
Time: 1.5 hours
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- The density of *Phellodendron* followed the contour of the slope, with trees being most dense toward the base where soil moisture and nutrient content are higher.
- Also present within the plot were large shrubs of the ornamental viburnum, *Viburnum dilatatum*, as well as *Rhamnus frangula*.

Plot 1 re-sprouts below the girdle.

Plot 1 an effective girdle.

Date: May 8, 2007
Weather: 75 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? No
Observations:

- Leaf-out is beginning (leaf length 3cm) on living trees outside the treatment plots. Approximately 50% of the girdled trees appear dead at this point. Those which were not killed by the girdling process have 5mm long leaf buds emerging from the stem below the girdle. On these trees, the girdle did not reach down to the root collar. The majority of the dead trees had girdle cuts to the root collar, though a few (including one that measured 9.3 inches dbh) did not.
- Pulled plants are all dead; stacked in several piles. There is no evidence of re-sprouting.
- *Phellodendron amurense* seedlings were not yet in evidence.
- *Viburnum dilatatum* has leafed out, no flower buds formed.

Date: June 26, 2007
Weather: 85 degrees F.; sunny
Time: 30 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- Leaf-out is complete on living trees outside the treatment plots. Approximately 50% of the girdled trees appear dead. Those which were not killed by the girdling process have 6 inch leaf stems emerging from the main stem below the girdle. Re-sprouts have occurred at all levels of slope, on trees girdled to the root collar as well as those where the girdle did not reach the root collar.
- The larger tree located at the edge of the pond remains unchanged e.g. no stump sprouts.
- Pulled plants are all dead; stacked in several piles. There is no evidence of re-sprouting.
- *Phellodendron amurense* seedlings occupy 1-2% of the herbaceous layer.

Plot 1 June 2007 re-sprouted *Phellodendron* stems.

Pojac Point; Plot 2

Management Log

Description: Cut stem application
Date: November 27, 2006
Weather: 60 degrees F.; sunny
Tools used: Hand held Felco loppers, 18" Husquevarna chainsaw, 4 gallon backpack sprayer with adjustable brass cone nozzle
Chemical Used: 50% Glyphosate solution (RoundUp Pro); Blue marking dye
Amount used: 32 oz herbicide; 45ml marking dye
Time: 3 hours
Number of people: 2 (H.L. & M.L.)
Notes:

- Stems were cut 6-12" above the surface of the ground. Cut surfaces were treated immediately after being cut, or within 5 minutes. The ability to adjust the brass spray nozzle resulted in very little overspray.
- Individual plants of *Berberis thunbergii* and *Euonymus alatus*, noted within the vicinity of Amur corktree, were also treated. A single Privet (*Ligustrum sp*.) was also noted, cut and treated.

Plot 2 Cut stem treated with 50% Glyphosate.

Plot 2 *Phellodendron amurense* cut and treated.

Plot 2 Matt Largess applying herbicide to cut stems.

Pojac Point; Plot 2

Monitoring Log

Date: September 18, 2007
Weather: 70 degrees F.; sunny
Time: 1.5 hours
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- Plot 2 contains the highest density of small diameter stem of *Phellodendron*, particularly at the base of the slope, and adjacent to the pond. As with Plot 1, density decreases upslope.

Date: May 8, 2007
Weather: 75 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? No
Observations:

- Cut trees of all diameters appear dead at this point. No re-sprouts were observed at the base of any of the cut stems. Kill appears to have been 100%.
- Due to the density of *Phellodendron* in this plot, some replanting with natives may be necessary. Young plants in the herbaceous layer are primarily non-native species.

Plot 2 Cut stem in April 2007.

Plot 2 View toward Summer Pond, April 2007.

Date: June 26, 2007
Weather:85 degrees F.; sunny
Time: 20 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- Cut trees of all diameters appear dead. No re-sprouts were observed at the base of any of the cut stems. Kill appears to have been 100%.
- Due to the density of *Phellodendron* in this plot, some replanting with natives may be necessary. Young plants in the herbaceous layer are primarily non-native species. Several species show evidence of responding to increased sunlight.

Plot 2 Understory released by reduced canopy cover

Pojac Point; Plot 3

Management Log

Description: Basal bark treatment
Date: November 27, 2006
Weather: 60 degrees F.; sunny
Tools used: 18" Husquevarna chainsaw; 4 gallon backpack sprayer with adjustable brass cone nozzle.
Chemical Used: 20% Trichlopyr solution, pre-mixed as Pathfinder II; Blue marking dye
Amount used: 64 oz; 15ml
Time: 2 hours
Number of people: 2 (H.L. & M.L.)
Notes:

- The blue marking dye did not work well to color the outer bark, but worked well enough to stain the cut surfaces of each tree. Cuts made into the bark of the larger (>2") trees, were 2-3" x 3-4", and numbered about 4 to 5 cuts per tree. The cuts were all made down to the white cambium layer, and were located on the lower portion of the stem, approximately 12 to 24 inches above the ground. Trees < 2" received basal spray along the lower 8-10 inches of the stem, including the root collar.

Plot 3 *Phellodendron amurense* basal bark treatment.

Pojac Point; Plot 3

Monitoring Log

Date: September 18, 2006
Weather: 70 degrees F.; sunny
Time: 1.5 hours
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- *Phellodendron* occurs beneath a canopy of *Populous grandidentata*.
- *Rhodotypos scandens* is present just outside the plot.

Date: May 8, 2007
Weather: 75 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? No
Observations:

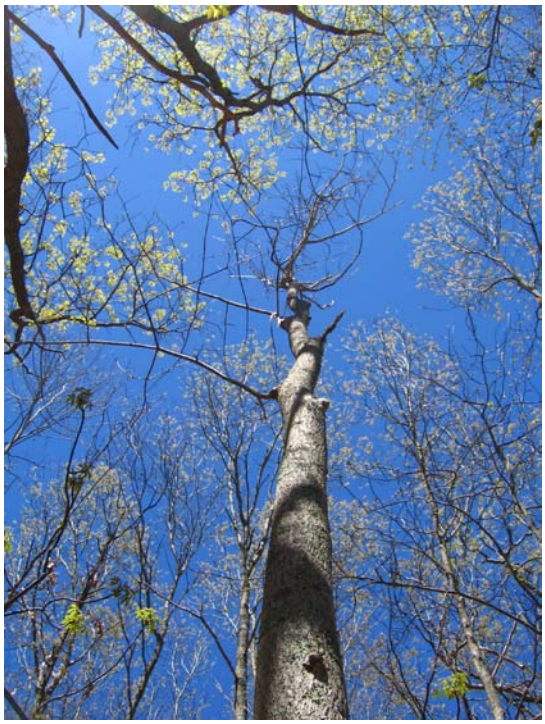
- Trees that were > 2" in diameter received the herbicide primarily through cuts into the bark within the lower portion of the stem. Of these trees, about 90% appear dead. Trees that were < 2" in diameter, received the herbicide directly on the bark surface. Of these, only about 10% appear dead. Living trees are leafing out incompletely (some buds still appear dormant).
- Kill of adjacent natives appears negligible; one seedling of *Juniperus virginiana* observed.
- *Rhodotypos scandens* has leafed out and is in bloom.

Plot 3 *Phellodendron amurense* leaf scar.

Plot 3 Treated *Phellodendron* stem June 2007.

Date: June 26, 2007
Weather: 85 degrees F.; sunny
Time: 30 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- Trees that were > 2" in diameter received the herbicide primarily through cuts into the bark within the lower portion of the stem. Of these trees, about 75% appear dead. The remaining have leafed out on portions of the upper branches. Trees that were < 2" in diameter, received the herbicide directly on the bark surface. Of these, only about 2% are dead. Living trees have leafed out completely.
- Several herbaceous species show increased growth due to increased sunlight.



Plot 3 Aerial view of Dead *Phellodendron.*

***Phellodendron amurense* seedlings in herbaceous layer Plot 2.**

***Viburnum dilatatum* understory in Plot 1**

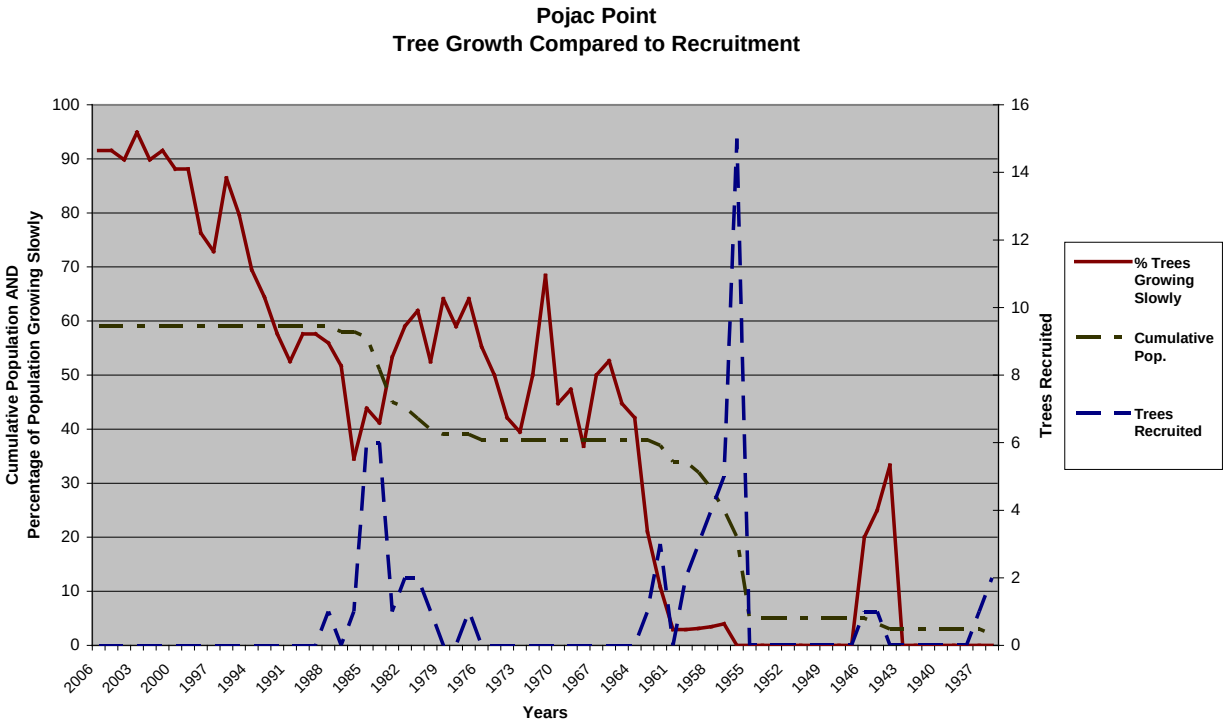
***Phellodendron amurense*: population history at Pojac Point, North Kingstown, RI**

To determine the age of the *Phellodendron* population at Pojac Point, we cored representative trees within each of the three plots, and counted the annual growth rings visible within each core sample. Two trees, located outside of the study plots, appeared older in age than those within the plots, so they were also cored to determine when the species became established at the site. Tree ring counts indicated that the oldest trees dated back to 1936 and 1937. These trees are located outside the study plots on the southwestern pond shore, and within Plot 2, west of the pond.

Blue flagging marks cored *Phellodendron* trees within Plot 3.

A review of historic aerial photographs of the area showed that in 1939, the area surrounding Summer Pond was an uncultivated open field. The signature suggests the area had not been mowed in the previous growing season, and scattered shrubs are evident. The land along the southern edge of Summer Pond is vegetated by shrubs and low trees. White pines are present on the hill top to the west. No houses are evident within the vicinity of the pond. The arrival of the species remains a mystery. *Phellodendron* was possibly planted as an ornamental along the shore of the pond.

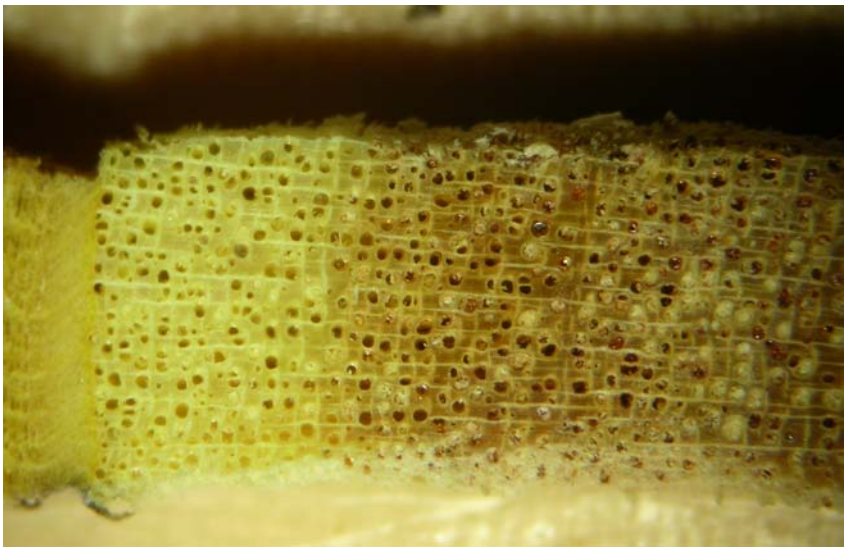
Core samples indicated that the next expansion of the population occurred from 1956 to 1957. The dates were derived from core samples taken from trees located within the lower elevations of Plot 2, and the portions of Plot 3 which lie at the same topographic elevation. This area forms a swale that appears to be an extension of the pond basin. This age group comprises 42% of the Amur Cork-trees sampled. We looked for a correlation to weather patterns, specifically major hurricane events. Hurricane Carol did have a significant impact on Rhode Island in 1954. However, review of aerial photographs was not conclusive. The next available photograph, following the 1939 photo, dates to 1951. Trees are present in the drainage basin immediately west of the pond (the location of Plot 2). A signature for *Acer rubrum* is distinct. The area immediately north of the pond (Plot 1) is still an open field. Two houses have been constructed; one across the road from Summer Pond, and one to the west. The next available photograph dates to 1962. Cover within the area is similar to that depicted in 1951, except that the forested areas are more mature. The drainage basin to the west still shows a signature for *Acer rubrum*, although at the time, *Phellodendron* had become established in that area. A house had been constructed at the eastern end of Summer Pond.



The population has continued to expand upslope, (to the north) in Plots 1 and 3. Annual ring counts date from the early 1960's and as recent as 1980. The correlation between tree age and diameter is deceptive in this population. For example, tree sample 1-1, located in Plot 1, dates from 1956 and measures 9.3 inches dbh (diameter at breast height). The 1951 and 1962 aerial photographs show the hillside to have been still an open field. While tree sample 3-8, located in Plot 3, which has been forested since 1951, dates to 1958 with a dbh of 2.1 inches.

Phellodendron's invasive nature is clearly due in part to its ability to remain alive and slowly growing in the understory of a forest dominated by another species, in the case of Pojac Point, largely oaks but also Aspen. At the extreme, *Phellodendron* specimens with heights of between one and two meters and stem diameters of less than one inch had almost thirty annual growth rings. Even with highly repressed growth in the understory, *Phellodendron* at Pojac Point was able to fruit at around two meters height (although at ages of between 22 and 29 years).

Several trees can be found scattered along Pojac Point Road, and a second population is located within a drainage basin along Schoolhouse Road to the southeast. The ages of these trees is not known.



Micrograph of tree ring core from Plot 3 with some 40 annual rings in less than 1 inch, showing *Phellodendron's* ability to remain slowly growing while in understory.

David Gregg and Peggy Sharpe examine a *Quercus* core sample.

Following is a summary of the Core Sample data. Complete data sheets are located at the end of this report.

Core Sample Data (see tree core data files)

Date: September 11, 2006
Weather: 65 degrees F.; overcast
Time: 30 minutes
Number of people: 3 (D.G., E.E., H.L.)

Plot 1

Species	ID#	DBH	#Annual Rings	Recruitment Yr.	Notes
P. amurense	*1-1*	*9.3*	*50*	*1956*	*single stem*
P. amurense	*1-2*	*3.9*	*43*	*1963*	*single stem*
Quercus velutina	*1-3*	*10.2*			*single stem*
P. amurense	*1-4*	*2.2*	*26*	*1977*	*single stem*
P. amurense	*1-5*	*2.0*	*25*	*1980*	*single stem*
P. amurense	*1-6*	*3.2*			*single stem*
Carya ovata	*1-7*	*7.7*	*49*	*1956*	*single stem*

Plot 2

Species	ID#	DBH	#Ann. Rings	Recr Yr.	Notes
P. amurense	*2-1*	*9.7*	*58*	*1945*	*double trunk (fork 12" above ground)*
P. amurense	*2-2*	*10.4*	*65*	*1937*	*double trunk (fork 36" above ground)*
P. amurense	*2-3*	*6.2*	*55*	*1946*	*double trunk (1 dead)*
P. amurense	*2-4*	*3.8*			*single stem*
P. amurense	*2-5*	*4.0*	*50*	*1956*	*#2-5 thru 2-8 appear as 1 individual*
P. amurense	*2-6*	*3.4*	*49*	*1957*	*" "*
P. amurense	*2-7*	*3.2*	*50*	*1956*	*" "*
P. amurense	*2-8*	*3.0*	*50*	*1956*	*" "*
P. amurense	*2-9*	*4.7*	*50*	*1956*	*triple trunk @ ground (1 is dead)*
P. amurense	*2-10*	*4.5*	*50*	*1956*	*single stem*
P. amurense	*2-11*	*4.7*	*50*	*1956*	*single stem*
P. amurense	*2-12*	*2.6*	*45*	*1958*	*single stem*
P. amurense	*2-13*	*4.3*	*50*	*1956*	*#2-13 thru 2-15 & #3-1 thru 3-3 appear*
P. amurense	*2-14*	*4.0*	*50*	*1956*	*as 1 individual (7 trunks; 1 dead)*
P. amurense	*2-15*	*5.9*	*48*	*1956*	*" "*
P. amurense	*2-16*	*2.4*	*48*	*1957*	*single stem*
Quercus alba	*2-17*	*8.8*			*single stem*

Plot 3

Species	ID#	DBH	#Ann. Rings	Recr. Yr.	Notes
P. amurense	*3-1*	*7.4*	*50*	*1956*	*#3-1 thru 3-3 & #2-13 thru 2-15 appear*
P. amurense	*3-2*	*5.5*	*50*	*1956*	*as I individual (7 trunks; 1 dead)*
P. amurense	*3-3*	*4.7*	*49*	*1957*	*" "*
P. grandidentata	*3-4*	*15.8*			*single stem*
P. amurense	*3-5*	*4.6*	*39*	*1962*	*single stem*
P. amurense	*3-6*	*4.7*	*50*	*1956*	*single stem*
P. amurense	*3-7*	*7.6*	*45*	*1957*	*single stem*
P. amurense	*3-8*	*2.1*	*48*	*1958*	*single stem*
P. amurense	*3-9*	*3.5*	*44*	*1962*	*single stem*
P. amurense	*3-10*	*3.6*	*42*	*1962*	*single stem*
P. amurense	*3-11*	*4.0*	*46*	*1959*	*single stem*
P. amurense	*3-12*	*3.4*	*46*	*1959*	*single stem*
P. amurense	*3-13*	*2.4*	*46*	*1960*	*single stem (may connect to 3-1 etc.)*

P. amurense	*3-14*	*8.5*	*46*	*1956*	*#3-14 thru 3-17 appear as 1 individual*
P. amurense	*3-15*	*4.4*	*47*	*1957*	*“ “*
P. amurense	*3-16*	*2.7*	*46*	*1956*	*“ “*
P. amurense	*3-17*	*3.5*	*44*	*1958*	*“ “*
P. amurense	*3-18*	*2.7*	*47*	*1959*	*single stem*
Carya ovata	*3-19*	*7.7*	*49*	*1956*	*single stem*
P. grandidentata	*3-20*	*15.2*			*single stem*

Outside Study Plots

Species	ID#	DBH	#Ann. Rings	Recr Yr.	Notes
P. amurense	*0-1*	*14.3*	*70*	*1936*	*double trunk*
P. amurense	*0-2*		*68*	*1936*	*double trunk*

Oldest (1936) *Phellodendron amurense* cored in the Pojac Point study area.

Alton Jones Invasive Species Management Demonstration Site

West Greenwich, Rhode Island

Site Description

Portions of the forested understory at the University of Rhode Island's Alton Jones Campus, and specifically the area known as the Nettie Marie Jones Nature Preserve, are dominated by mature stands of Japanese barberry (*Berberis thunbergii).* Within the nature preserve, the hillside west of the farm has become dominated by sugar maple (*Acer saccharum*). Additional native species in the canopy include oaks (*Quercus spp.*), and hickories (*Carya spp.*). Within mesic areas, *Berberis* covers 75-90% of the shrub understory. Additional invasive species, such as multiflora rose (*Rosa multiflora*), Asiatic bittersweet (*Celastrus orbiculatus*) and winged euonymus (*Euonymus alatus)* are also present. A single vine of porcelain berry (*Ampelopsis brevipedunculata*) was also found. Several rare and uncommon native species, such as downy yellow violet (*Viola pubescens*) and broad beech fern (*Phagopteris hexagonoptera*) occupy the herbaceous layer. The site represents a botanically unique community for southern Rhode Island, and there was interest on the part of the University of Rhode Island to determine an effective management technique for the invasive species present in an effort to preserve the diversity of the native species.

***Berberis thunbergii* at Alton Jones**

***Phagopteris hexagonoptera* adjacent to study area.**

Study Area

To determine the effectiveness of various treatment methods, six 20 meter plots were set up within an area of dense *Berberis* infestation. A detailed inventory was taken of the plant species present in all strata. Due to the proximity to freshwater wetlands, permission to carry out the proposed treatment methods was required from the Rhode Island Department of Environmental Management, Freshwater Wetlands Section, and the RIDEM, Water Quality and Wetland Restoration Team.

Three treatment methods were applied late in the fall of 2006, after leaves had dropped from the trees. One method was applied after leaf out in late spring, and one remains to be applied in early fall. Monitoring for effectiveness of the treatments and for any negative impacts on the surrounding native vegetation took place in late March (bud break), early May and late June of 2007. All four treatment methods have had an effect on the target plant, *Berberis thunbergii.* The only method to remove 100% of the individual trees targeted was the cut stem application of herbicide (applied in Plot 2). The effect of manual treatment was temporary, and plants have re-sprouted. The removal of

a high percentage of Japanese Barberry within all chemically treated plots has resulted in a release of cover for the native herbaceous species, as well as the pre-existing non-native invasives. At this point, it is recommended that the remaining non-native species be removed manual, as primarily immature plants are present. In addition to Japanese barberry and multiflora rose, which are present in all plots, winged euonymus should specifically be targeted as this species remains present in the herbaceous layer of Plots 1, 4 and 5 in densities of 1-2%, and <1% in Plots 2,3 and 6.

Alton Jones Fall 2006 Treatments:

- Plot 1 mechanical application – One person cut with hand held loppers, all Japanese barberry plants within the plot, as close to the ground surface as possible. Small, single stem individuals were pulled by hand. Stems of winged euonymus and Asiatic bittersweet, measuring less than ½ inch in diameter were pulled up by hand. Larger (1 ½ "stems) of Asiatic bittersweet were cut at the base of the trees which they were climbing. Cut stems and uprooted individuals were laid on top of boulders within the plot to dry.
- Plot 2 cut stem-herbicide application – A two person team cut all Japanese barberry shrubs with hand held loppers and an 18" Husquevarna chainsaw. Immediately following cutting, the stump surfaces were treated with a 50% solution of Glyphosate (RoundUp Pro), applied

with a backpack sprayer and brass cone nozzle. In May of 2007, plants that were missed by the fall herbicide application in Plot 2, were treated with Garlon 3A Foliar spray.

- Plot 3 Trichlopyr (Garlon 3A) foliar spray application – Due to the lateness in the season, and lack of leaves on the Japanese barberry plants, one person, roughly cut all stems with an 18" Husquevarna chainsaw. Stems were left to dry in place within the plot. In late May 2007, a foliar spray of Garlon 3A was applied to all Berberis plants within Plot 3. Several plants of *Actaea alba* were located within the plot, and were covered with plastic buckets prior to the herbicide application. A population of *Diplazium acrostichoides* within the plot was covered with a sheet of 4ml. plastic.
- Plot 4 Control Plot – Plot 4 will serve as a comparison for the treated plots. No treatment was performed within the plot.
- Plot 5 basal bark application - One person applied a pre-mixed solution of Trichlopyr (Pathfinder II) with a backpack sprayer and brass cone nozzle to the basal bark surface of all Japanese barberry and winged euonymus shrubs, found within the plot. Herbicide was applied evenly to the lower 6-8" of each stem, including the root crown.
- Plot 6 Glyphosate foliar spray application – Due to the lateness in the season, and lack of leaves on the Japanese barberry plants, all stems were cut back to the ground by a two person team. Hand held loppers and a machete were used. All stems were piled to dry within the plot. In mid to late September, before leaf drop, an aquatic version of RoundUp (Rodeo) will be applied as a foliar spray.

Alton Jones Treatment Results, June 24, 2007:

- Plot 1 - *Berberis* shrubs that were pulled out by hand have not re-sprouted from root fragments that might have been left in the ground. Stem cutting was accomplished to the root crown, or 1 -2 inches above. Relative to untreated stems in the control plot, the cut stems were slow to leaf out. However, the June 24th vegetative survey showed that all cut stems had leafed out. New growth is larger and thinner than normal, perhaps in response reduced leaf surface under the heavy shading of the overstory. Numerous *Berberis* and *Euonymus* seedlings are present on the soil surface.
- Plot 2 - At first inspection, it appeared the cut stem application of RoundUp Pro had been 100% successful. However, as the growing season advanced, approximately 10% of the cut stems formed leaf buds at the base of the cut stems. Within another month, these too had died back. It was evident that several plants had been missed and some had only received partial treatment. Following the May 25th foliar treatment of Plot 3, the remaining herbicide solution was applied to Plot 2. The foliar application of Garlon 3A has resulted in 99% kill of all Berberis plants. A final vegetative survey was conducted on June 24, 2007. The survey showed that there still remain two immature plants and numerous seedlings. The plants that had been treated with the cut-stem application all appeared dead.
- Plot 3 – In the fall of 2006, a chainsaw was used to rough cut the *Berberis* stems; effectively cutting off the top third of the shrubs. Plants that were cut to this height fully leafed out in early April. Portions of the stems that were missed or only received partial cutting flowered. Stems that were cut within six inches of the ground also leafed out in early April. It was determined that as leaf-out was substantial, that a spring foliar application of trichlopyr (Garlon 3A) would be appropriate for this plot. The herbicide application successfully killed 95% of the plants. Several remained yellow and wilted at the June 24th survey. It is possible they did not receive the same coverage of herbicide to

their leaf surfaces. Wind conditions, on the day of application were not consistently ideal, and vegetation (primarily Berberis) at the fringes of the plot is yellowed. As a result of the foliar application of herbicide, there were negative impacts to the dicotyledonous herbaceous community. 100% of the *Acer saccharum* seedlings, which were scattered over 2% of the herbaceous surface, were all killed. *Euonymus alata* seedlings appeared unaffected, while those of *Berberis thunbergii* were somewhat wilted. The species which were covered by plastic were relatively unaffected. It appears that after the plastic was removed from the ferns, herbicide must have dripped onto portions of the leaf surfaces, which show browning. With the exception of *Arisaema* (which shows wilting), monocotyledonous species such as *Smilacena racemosa,* and *Carex rosea*, were unaffected.

- Plot 4 – All *Berberis* shrubs fully leafed out and flowered. Leaf buds broke dormancy on or about March 30th, 2007 and the shrubs were in flower by May 8th. A May 14th survey resulted in several native herbaceous species being recorded in higher densities than in the previous growing season. This is most likely due to seasonal timing of the surveys, as the herbaceous layer was easier to see before the *Berberis* had fully leafed out. The June 24th survey shows similar results to that conducted in mid summer, 2006.
- Plot 5 – On March 30, 2007, when leaf buds had just broken dormancy, there appeared to be no difference between the health of the *Berberis* plants in Plot 5 relative to those in Plot 4. However as the leaves continued to emerge, it became evident that the basal stem treatment of Pathfinder II had negatively affected the *Berberis.* Approximately 60% of the leaf buds have not continued to develop. The remaining 40% appear stunted. A mature *Euonymus alata* that was also treated responded similarly, and now appears dead. The June 24th vegetative survey showed the success rate to be about 95%. There remain several *Berberis* shrubs that are not completely dead. The two large *Euonymus* shrubs are dead. Negative impacts to the surrounding native vegetation have become evident as the season progress. *Arisaema* and *Actaea* have been uniformly impacted throughout the plot, and have shown wilting since emergence. Several of the *Acer saccharum* and *Ostrya virginiana* inadvertently received some of the herbicide and have died after leaf-out.
- Plot 6 – As with Plot 1, *Berberis* shrubs that were pulled out by hand did not re-sprout from root fragments that were left in the ground. Cut stems that were left to dry have not re-sprouted, except where they were in contact with the moist soil in the area of the seep at the northeast corner of the plot. Stem cutting was accomplished to within 1 -2 inches above the ground surface. Relative to untreated stems in the control plot, the cut stems have been slow to leaf out. However, leaf buds are forming at the base of all cut stems. At the June 24th survey, re-sprouted *Berberis* plants remained behind those in Plot 1, though are re-growing. Due to the slow re-growth of these stems, it was determined that a fall foliar application of glyphosate (Rodeo) would be appropriate.

Alton Jones; Plot 1

Management Log

Description: Mechanical
Date: December 11, 2006
Weather: 45 degrees F.; overcast
Tools used: Machete, Felco hand loppers
Chemical Used: none
Amount used: n/a
Time: 3 hours
Number of people: 1 (H.L.)
Notes:

- Several large Japanese barberry shrubs were present within Plot 1, however most were composed of single stems or groups of 4 to 5 stems. The machete worked very well to cut at the larger stems contained within one shrub. The loppers were more efficient with the smaller stems and for those shrubs with fewer stems.
- Single stems of Japanese barberry, as well as *Euonymus alatus* and *Celastrus orbiculatus* were hand pulled. All stems were laid on top of large boulders within the plot, to dry.
- It was noted that many of the lateral stems (outer stems within the group) had become rooted where they were in contact with soil. In many cases the stem roots were shallow on the surface of boulders.

Plot 1 mechanical treatment cutting

and pulling. Branches stacked to dry.

Monitoring Log

Date: August 7, 2006
Weather: 80 degrees F.; sunny
Time: 1 hour
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- In addition to the presence of *Berberis* seedlings, those of *Euonymus alata* were numerous.
- Despite the apparent dryness of the site, *Arisaema triphyllum* was also fairly abundant.

Date: March 30, 2007
Weather: 60 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? No
Observations:

- Rooted portion of *Berberis* stems, which were cut within plot show no growth on stem below cut.
- Cut stems left on boulders show no growth.

Plot 1 Leaf buds dormant on cut stems.

Date: April 24th, 2007
Weather: 70 degrees F.; sunny
Time: 15 minutes
Number of people: 2 (H.L. & T.R.)
Data sheets completed? No
Observations:

- Rooted portion of *Berberis* stems, which were cut within plot show bud growth (1 – 2 mm.) at base. Cut stems left on boulders show no growth.
- A cut *Berberis* plant was uprooted to examine root structure. Roots were yellow and resilient.

Date: May 14, 2007
Weather: 75 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- Rooted portion of cut *Berberis* stems have fully leafed out. Leaves are larger than normal.
- Cut stems left on boulders show no growth.

Plot 1 leaf buds on cut stems, May 2007.

Date: June 24th, 2007
Weather: 85 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- Leafed out *Berberis* stems have grown to 6 inches. Cut stems left on boulders show no growth.
- *Berberis* population within the herbaceous layer has been temporarily reduced from 2-5% to 1-2%.
- *Euonymus* which was uprooted now appears to be dead.
- *Euonymus alata*, *Berberis thunbergii*, and *Rosa multiflora* seedlings are present.

Alton Jones; Plot 2

Management Log

Date: December 11, 2006
Description: Cut stem application
Weather: 45 degrees F.; overcast
Tools used: Machete, Felco hand held loppers, 18" Husquevarna chainsaw
Chemical Used: 50% Glyphosate solution (RoundUp Pro); Blue marking dye
Amount used: 32 oz herbicide; 45 ml marking dye
Time: 1½ hours
Number of people: 2 (H.L. & M.L.)
Notes: We started out using the machete to cut the stems of the Japanese barberry shrubs, but then decided the chainsaw would be much faster. Small, single stems were cut with the hand held loppers, as they proved more effective for the smaller diameter stems.

Plot 2 Cut stems treated with 50% Glyphosate.

Date: May 25, 2007
Description: Foliar spray with 3% Trichlopyr solution (Garlon 3A);
Weather: 80 degrees F.; sunny, light wind southwest
Tools used: 4 gallon Backpack sprayer with adjustable brass cone nozzle.
Chemical Used: 3% Trichlopyr solution (Garlon 3A)
Amount used: 11.5 oz. herbicide; 45 ml marking dye (Approx.24oz. solution remaining from Plot 3)
Time: 10 minutes
Number of people: 2 (M.L., H.L.)
Notes: Remaining foliar spray applied to all barberry plants which had been missed by the cut-stem application in the fall of 2006.

Monitoring Log

Date: July 26, 2006
Weather: 85 degrees F.; sunny
Time: 1.5 hours
Number of people: 2 (H.L. & T.R.)
Data sheets completed? Yes
Observations:

- The presence of species such as *Ostrya virginiana*, *Betula alleghaniensis*, *Arisaema triphyllum*, and *Anemone quinquefolia*, suggest relatively high groundwater table, or seepage.
- *Polystichum acrostichoides* appears to be all new growth, suggesting heavy deer browsing during the winter.

Date: March 30, 2007
Weather: 60 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? No
Observations:

- Rooted portion of *Berberis* stems within plot, which were cut and sprayed with RoundUp Pro, show no growth.
- Cut stems left on boulders show no growth.

Date: April 24th, 2007
Weather: 70 degrees F.; sunny
Time: 15 minutes
Number of people: 2 (H.L. & T.R.)
Data sheets completed? No
Observations:

- Rooted portions of Berberis stems within plot, which were cut and sprayed with RoundUp Pro, continue to show no growth.
- Cut stems left on boulders show no growth.
- A treated *Berberis* plant was uprooted to examine root structure. Roots were yellow and flexible (slightly more flacid than those examined in Plot 1).

Plot 2 Located to left of orange flags, April 2007.

Plot 2 Glyphosate treated stems show no growth.

Date: May 14, 2007
Weather: 75 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- Approximately 10% of the treated *Berberis* stems, which were cut show 2mm long leaf buds at the base of the stem.
- Plants which were only partially treated (portions were missed) show stunted re-growth in the untreated branches.
- Several plants were inadvertently left untreated in December; their growth appears normal.
- Cut stems left on boulders show no growth.
- *Acer saccharum* seedlings and *Anemone quinquefolia* are more numerous than in the 2006 mid-summer survey.
- *Panax triloba* observed in Plot.

Plot 2 Impartially treated stem show discolored re-growth.

Date: June 24th, 2007
Weather: 85 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- *Berberis* plants, whose growth was previously stunted on untreated branches, now appear dead.
- 100% of the treated *Berberis* stems appear dead.
- Several individuals that had not received the cut stem treatment were treated with a foliar spray on May 25, 2007, and now have yellow leaves.
- *Berberis* seedlings that were treated with the foliar spray seem unaffected.

Alton Jones; Plot 3

Management Log

Description: Mechanical treatment followed by Foliar spray with 3% Trichlopyr solution (Garlon 3A);
Date: December 11, 2006
Weather: 45 degrees F.; overcast
Tools used: 18" Husquevarna chainsaw
Chemical Used: none
Amount used: n/a
Time: 1 hour

Number of people: 1 (M.L.)
Notes: Plot 3 has been initially treated mechanically to minimize overspray during the foliar spray process in the spring. Foliar spray will take place at the time of leaf-out for Japanese barberry. All stems were roughly cut and left to dry where they fell within the plot.

Description: Foliar spray with 3% Trichlopyr solution (Garlon 3A);
Date: May 25, 2007
Weather: 80 degrees F.; sunny, light wind southwest
Tools used: 4 gallon Backpack sprayer with adjustable brass cone nozzle.
Chemical Used: 3% Trichlopyr solution (Garlon 3A)
Amount used: 11.5 oz. herbicide; 45 ml marking dye
Time: 1 hr, 30 minutes
Number of people: 2 (M.L., H.L.)
Notes: Foliar spray applied to all barberry plants within plot. White plastic buckets placed over individual plants of *Actaea pachypoda*. Plastic sheeting covered a population of *Diplazium acrostichoides* located adjacent to the stream.

Monitoring Log

Date: August 8, 2006
Weather: 90 degrees F.; sunny
Time: 1.5 hours
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- Much of the herbaceous groundcover is comprised of fern species.
- Though the plot lies adjacent to the stream, fewer plants of *Arisaema* are present than in the uphill plots.

Date: March 30, 2007
Weather: 60 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? No
Observations:

- Remaining portion of Berberis stems, which were chain-sawed within plot show variable growth. Stems which were not cut, or only partially cut are beginning to leaf out. Rooted stems, cut within 10 inches of the ground surface show no re-growth at this point.
- Cut stems left on ground show no growth.

Date: April 24th, 2007
Weather: 70 degrees F.; sunny
Time: 15 minutes
Number of people: 2 (H.L. & T.R.)
Data sheets completed? No
Observations:

- Portions of stems, that were not cut and those that were partially cut, have leaves c. 1 cm. in length. Rooted Berberis stems, which were cut to within 10 inches of the ground show variable leaf growth (5mm. – 1cm.).
- Cut stems left on ground show no growth.

Date: May 8, 2007
Weather: 65 degrees F.; sunny
Time: .5 hours
Number of people: 1 (H.L.)
Data sheets completed? Yes (herbaceous layer)
Observations:

- Portions of stems, that were not cut and those that were partially cut, are fully leafed out. Un-cut stems are in flower.
- *Berberis* cover within Plot 3 is equal to that of August 2006.
- Cut stems left on ground show no growth.
- Herbaceous layer re-surveyed. A population of *Diplazium acrostichoides* (silvery spleenwort) was located along the stream bank, and several *Actaea pachypoda* were beginning to emerge. Plastic buckets will be used to cover these two species during the application of foliar spray. *Acer saccharum* seedlings numerous.

Plot 3*Actaea pachypoda* beneath *Berberis thunbergii.*

***Acer saccharum* seedlings, May 2007.**

Date: June 24th, 2007
Weather: 85 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- 75% of the *Berberis* plants treated with the foliar spray appear dead.
- Of the remaining 25%, 20% have yellowed leaves and 5% appear unaffected (these possibly did not receive the foliar spray).
- Native plants negatively affected by the foliar spray include: *Acer saccharum* seedlings, *Prenanthes altissima*, and *Anemone quinquefolia*.
- *Actaea pachypoda* plants survived, as did the *Diplazium acrostichoides*. The fern population however, did receive some herbicide as it dripped off the adjacent *Berberis* leaves after the plastic was removed.

Plot 3 Foliar spray 3% solution Trichlopyr.

Alton Jones; Plot 4

Management Log

Description: Control
Date: December 11, 2006
Weather: 45 degrees F.; overcast
Tools used: None
Chemical Used: none
Amount used: n/a
Time: 15 minutes
Number of people: 1 (H.L.)
Notes:

- Plot 4 was set up as a control plot. Berberis appeared dormant. Leaf buds formed; bud scales closed.
- The plot is located alongside the stream, within the wetter portion of the site. The density and height of the Japanese barberry is equivalent to that found within Plots 5, 6, and portions of 3.

Control Plot 4; stream boundary.

Monitoring Log

Date: August 7, 2006
Weather: 80 degrees F.; sunny
Time: 2 hours
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- Much of the herbaceous groundcover is interspersed between *Berberis* plants.

Date: March 30, 2007
Weather: 60 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? No
Observations:

- *Berberis* leaf buds exposed to c.1 - 2mm.

Plot 4 *Berberis thunbergii* breaking dormancy, March 30, 2007.

Date: April 24th, 2007
Weather: 70 degrees F.; sunny
Time: 15 minutes
Number of people: 2 (H.L. & T.R.)
Data sheets completed? No
Observations:

- Berberis leaf length c.1cm. Flower buds are beginning to form (c. 2mm. in length).
- Herbaceous growth of native species between the *Berberis* plants is greater than previously observed in 2006.

Plot 4 *Berberis thunbergii* flower buds, April 24, 2007.

Plot 4 Contrasting view toward Plot 5 (to the right of T. Rawinski).

Date: May 14, 2007
Weather: 75 degrees F.; sunny
Time: .5 hours
Number of people: 1 (H.L.)
Data sheets completed? Yes (herbaceous layer)
Observations:

- Native herbaceous cover appears denser without the heavy cover of *Berberis* (not fully leafed out).
- Increases in native herbaceous groundcover now evident include: *Arisaema triphyllum*, *Dennstaedtia punctilobula*, *Smilacena racemosa*, *Acer saccharum*, and *Anemone quinquefolia*.

Date: June 24th, 2007
Weather: 85 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- *Berberis* is now fully leafed out.

Alton Jones; Plot 5

Management Log

Description: Basal bark treatment
Date: December 11, 2006
Weather: 45 degrees F.; overcast
Tools used: 4 gallon Backpack sprayer with adjustable brass cone nozzle.
Chemical Used: 20% Trichlopyr solution, pre-mixed as Pathfinder II; Blue marking dye
Amount used: 192 oz herbicide; 45ml marking dye
Time: 3 hours
Number of people: 1 (M.L.)
Notes: Of all the plots, the highest density of Japanese barberry was found in Plot 5.

Plot 5 Basal spray application

***Berberis* stems treated with 20% Trichlopyr solution.**

Monitoring Log

Date: July 26, 2006
Weather: 85 degrees F.; sunny
Time: 1.5 hours
Number of people: 2 (H.L. & T.R.)
Data sheets completed? Yes
Observations:

- Of native note were a number of *Botrychium* and *Viola pubescens.*
- Non-native note: 1 small vine of *Ampelopsis brevipedunculata.*

Date: March 30, 2007
Weather: 60 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? No
Observations:

- The majority of Berberis leaf buds, show exposed leaf tips c.1mm. in length. Some buds appear to still be dormant.

Plot 5 Leaf buds begin to break dormancy.

Date: April 24th, 2007
Weather: 70 degrees F.; sunny
Time: 15 minutes
Number of people: 2 (H.L. & T.R.)
Data sheets completed? No
Observations:

- Where portions of *Berberis* stems are breaking dormancy, the leaves appear smaller than those in the control plot. *Berberis* leaf length c. 5mm. - 1cm. Flower buds beginning to form (c. 1mm. in length). Most stems have not advanced beyond the initial bud break, or appear dormant.
- Leaf buds on the Euonymus shrubs that were treated with the basal herbicide application have broken dormancy.

Plot 5 Plot located to left of orange flags.

Plot 5 Stunted leaves persist on some branches.

Date: May 14, 2007
Weather: 75 degrees F.; sunny
Time: .5 hours
Number of people: 1 (H.L.)
Data sheets completed? Yes (herbaceous layer)
Observations:

- *Berberis* stems continue to show growth activity, although the leaves are stunted and many have become desiccated.
- Stems that did not advance beyond the initial bud break now appear dead.
- The *Euonymus alata* shrubs now also appear dead.
- Negative impacts to native species include: *Arisaema triphyllum* which has leafed out, with some individuals flowering. However, the leaves on this species throughout the plot are yellow and curled under, as if desiccated. *Smilacena racemosa*, which has emerged at the same time, appears unaffected.

Plot 5 Wilted *Arisaema triphyllum*.

Date: June 24th, 2007
Weather: 85 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- A greater proportion of *Berberis* plants are now dead; cover estimate has dropped from 50-75% in 2006 to 1-2%.
- Negative impacts to native species now also include: *Actaea pachypoda* and *Acer saccharum* saplings.
- *Arisaema triphyllum* cover has dropped from 1-2% to <1%.

Plot 5 Wilted leaves of *Acer saccharum* sapling.

Alton Jones; Plot 6

Management Log

Description: Foliar spray 3% aquatic Glyphosate solution, sold as Rodeo. Mechanically treated to date
Date: December 11, 2006
Weather: 45 degrees F.; overcast
Tools used: Machete, Felco hand loppers
Chemical Used: none
Amount used: n/a
Time: 2 hours
Number of people: 2 (H.L. & M.P.)
Notes:

- Plot 6 has been initially treated mechanically to minimize overspray during the foliar spray process in the spring. Foliar spray treatment will take place in the fall, before the Japanese barberry drops its leaves. All stems were cut to the ground, and piled within the plot to dry.
- Due to the proximity of groundwater to the soil surface and the presence of a seep within the plot, an aquatic herbicide will be utilized.
- The machete worked very well to cut at the numerous stems contained within one shrub. The loppers were a bit slower, but with gloves, just as successful.

Plot 6 Mechanical treatment prior to chemical.

Monitoring Log

Date: August 8, 2006
Weather: 90 degrees F.; sunny
Time: 1.5 hours
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- The northern half of the plot is covered by large boulders. Very few plants of any species grow within this portion of the plot.
- A seepage area is located in the northeast corner of the plot, and flow continues near the surface within the eastern half of the plot.
- Of native note: *Viola pubescens* and *Uvularia perfoliata*.

Date: March 30, 2007
Weather: 60 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? No
Observations:

- Rooted portions of Berberis stems which were cut with a machete or clippers with, show no growth.
- Cut stems left on boulders show no growth.

Date: April 24th, 2007
Weather: 70 degrees F.; sunny
Time: 15 minutes
Number of people: 2 (H.L. & T.R.)
Data sheets completed? No
Observations:

- Rooted portions of Berberis stems, which were cut with a machete or clippers show variable leaf growth (2mm. – 5mm.).
- Where cut stems were in contact with moist soil (eastern portion of plot, near seep), the stems have leafed out. No roots have formed to date.
- Cut stems left on boulders show no growth.

Plot 6 Re-sprouting cut stems.

Plot 6 Cut stems re-sprouting in wet soil.

Date: May 14, 2007
Weather: 75 degrees F.; sunny
Time: .5 hours
Number of people: 1 (H.L.)
Data sheets completed? Yes (herbaceous layer)
Observations:

- Rooted portions of Berberis stems, which were cut with a machete or clippers show variable leaf growth (2mm. – 5mm.).
- The *Berberis vulgaris* shrub that was pulled out has not re-sprouted.
- *Berberis thunbergii* cover is still below 1 meter.
- *Panax triloba* observed in Plot.

Date: June 24th, 2007
Weather: 85 degrees F.; sunny
Time: 15 minutes
Number of people: 1 (H.L.)
Data sheets completed? Yes
Observations:

- *Berberis thunbergii* cover is still below 1 meter.
- Leaf growth on *B. thunbergii* appears normal.

Observations at Alton Jones Forest Service Project
Notes on conversations with Josef Gorres; December, 2006

Shallow leaf litter, and a lack of a duff layer has been a source of concern relative to anecdotal observations of decline in spring ephemerals and fern species, notably broad beech fern *(Phegopteris hexagonoptera),* at the Nettie Marie Jones Nature Preserve. During mid December of 2006, while conducting treatments on the invasive shrub species present within the sugar maple grove, it was noted that the leaf litter consisted only of the recent leaf drop; no duff layer was present. Earthworms, worm casts, and areas where worms had pulled decaying leaves down into the soil were evident on the soil surface. In pulling up the lateral stems of apparently dormant *Berberis thunbergii*, earthworms were found entwined within the root masses. Earthworms were collected to determine species identity, however due to their immature state, identification was not possible. Superficially, there appeared to be at least three different species present. A quick survey of the depth of leaf litter outside of the plots showed that the depth gradually increased as the distance from the *Berberis* population increased.

Earthworms entwined in *Berberis* root mass.

Lack of accumulated leaf litter, presence of worm casts.

Josef Gorres from the University of Rhode Island was contacted for insight into what might be occurring within the ecosystem. Josef is currently doing research on the presence of non-native earthworms in forested habitats in Rhode Island, specifically where *Berberis thunbergii* is present. His research has shown that in early spring, the timing of soil activity for earthworms corresponds to leaf-out for *Berberis*. In late fall, when soil moisture increases, earthworms again become active, corresponding with the period of time when *Berberis* begins to go dormant and leaf-drop has occurred for native species. Gorres explained that the reason earthworms were observed entwined among the root mass of *Berberis*, is that excess nitrogen is exuded at the rhizosphere, and fed on by the worms. Gorres has concluded that as a result of the increase in the leaf litter decomposition rate, brought about by worm activity, ecosystem nitrogen becomes more accessible to the non-native plant species which tend to have growing seasons that correspond to the earthworm activity. He suggested that non-native plant species were sequestering the nitrogen contained in the leaves of the native canopy species. As a result, the nitrogen is stored within the non-native component of the ecosystem. Gorres noted that because of the change in the ecosystem's nitrogen cycle, complete removal of the non-native invasive plant species, without also removing the earthworms, would ultimately result in nitrogen being flushed out of the system. Soil acidity would gradually increase, and community diversity would subsequently decrease. In forested situations, where earthworms are

present, a decrease in the duff layer results in a decrease in shallow rooted, spring ephemerals such as *Maianthemum canadense*. Vegetative surveys conducted in July and August of 2006, and in May and June of 2007 in 6 treatment plots, indicated that *Maianthemum* was present in all plots in densities of 1, and less than 1 percent. Research of others, namely John Maerz, of the Warnell School of Forestry and Natural Resources at the University of Georgia, has indicated that earthworm activity in the soil breaks down mycorrhizal associations between plant species, resulting in a decrease over time in species that require those associations, and an increase in species that are not dependent on mycorrhizal associations in order to obtain soil nutrients.

In an effort to determine the species of earthworms present, and the timing of their activity within the forested habitat at Alton Jones, Josef Gorres suggested I use a monitoring protocol developed by an organization called Worm Watch Canada. I followed the organization's Modified Hand Sorting sampling method. The method utilizes a 25 x 50 centimeter search plot, wherein the soil is examined for earthworms at the surface, at 10 centimeters and at 20 centimeters. Soil temperature is recorded at each layer, using a digital temperature probe.

Limited sampling was conducted in 2007. Samples were taken in March, as the *Berberis* was breaking dormancy, and again in April and in May. As it was not possible to sample all plots, or to continue sampling into the growing season, the results were inconclusive. Following is an account of the observations made and data gathered.

Earthworm sampling plot

Examinations made at surface, 10cm & 20cm

Soil was sifted and earthworms collected.

Plot 1Worm Log

Date: December 11 and 18, 2006
Weather: 45 degrees F.; overcast
Time: 15 minutes
Number of people: 1 (H.L.)
Technique employed: Observation
Observations:

- The leaf litter consisted of this year's leaf drop, and no duff layer. Earthworms, worm casts, and areas where worms had pulled leaves down into the soil were evident on the surface of the soil.
- Earthworms were entwined in the root masses of *Berberis thunbergii.* Worms were collected to determine species identity. Most were immature, making positive ID not possible. One worm was identified as *Lumbricus terrestris.*

Date: March 30, 2007
Weather: 60 degrees F.; sunny
Time: 30 minutes
Number of people: 1 (H.L.)
Technique employed: A 25 x 10 cm. plot was dug. Soil was investigated at the surface, and at 10 and 20 cm. for the presence of earthworms, evidence of worm activity, and soil temperature. Plot was dug adjacent to a cut *Berberis thunbergii.*
Observations:

- At surface: Worm casts were present, possibly remaining from activity in December. No worms, or current earthworm activity were observed at any depth.

Soil Temperature: Soil temperature was recorded at each of the observation depths, using a digital thermometer and temperature probe. .

- At Surface – 69.6 degrees F.
- At 3 cm. – 38.7 degrees F.
- At 10 cm. – 36.0 degrees F.
- At 20 cm. – 37.3 degrees F

Date: April 24th, 2007
Weather: 70 degrees F.; sunny
Time: 15 minutes
Number of people: 2 (H.L. & T.R.)
Technique employed: Observation
Observations:

- A cut Berberis plant was uprooted to examine root structure. No earthworms were observed entwined within the root mass. A sample was not dug, however soil temperature was recorded.

Soil Temperature: Soil temperature was recorded at various depths, using a digital thermometer and temperature probe.

- At Surface – 61.7 degrees F.
- At 10 cm. – 53.0 degrees F.
- At 20 cm. – 52.0 degrees F.

Plot 2 Worm Log

Date: December 11, 2006
Weather: 45 degrees F.; overcast
Time: 15 minutes
Number of people: 1 (H.L.)
Technique employed: Observation

- Earthworms present in roots and on soil surface. Worm activity and a lack of duff layer evident within Plot 2

Date: April 24th, 2007
Weather: 70 degrees F.; sunny
Time: 15 minutes

Number of people: 2 (H.L. & T.R.)
Technique employed: Observation

- A cut Berberis plant was uprooted to examine root structure. No earthworms were observed entwined within the root mass.

Date: May 8th, 2007
Weather: 71.6 degrees F.; sunny
Time: 1 hour
Number of people: 1 (H.L.)
Technique employed: A 25 x 10 cm. plot was dug. Soil was investigated at the surface, and at 10 and 20 cm. for the presence of earthworms, evidence of worm activity, and soil temperature. The worm plot was dug in the location of a *Berberis* plant, no earthworms were observed entwined within the root mass.
Observations:

- At surface: No worms observed. Worm casts, holes and leaf matter pulled into soil were evident. Small black ants were noted just beneath the leaf litter.
- At 3 cm: 4 small or partial worms collected for identification. 1 large white grub; 1 small grub; 2 brown segmented worms were collected for identification.
- At 10 cm: No worms observed.
- At 20 cm. 1 small or partial worm collected for identification. 1 small grub observed.

Soil Temperature: Soil temperature was recorded at each of the observation depths, using a digital thermometer and temperature probe. .

- At surface – 60.5degrees F.
- At 3 cm. – 54.6 degrees F.
- At 10 cm. – 52.2 degrees F.
- At 20 cm. – 51.1 degrees F.

Plot 3 Worm Log

Date: December 11, 2006
Weather: 45 degrees F.; overcast
Time: 15 minutes
Number of people: 1 (H.L.)
Technique employed: Observation

- Earthworms present in roots and soil surface. Worm activity and lack of duff layer were evident within Plot 3.

Date: May 8th, 2007
Weather: 66.4 degrees F.; sunny
Time: 1 hour
Number of people: 1 (H.L.)
Technique employed: A 25 x 10 cm. plot was dug. Soil was investigated at the surface, and at 10 and 20 cm. for the presence of earthworms, evidence of worm activity, and soil temperature. The worm plot was dug adjacent to a large boulder.
Observations:

- At surface: 1 small or partial worm collected for identification. Worm casts, holes and leaf matter pulled into soil were evident. Small black ants were noted just beneath the leaf litter.
- At 3 cm: 4 small or partial worms collected for identification. 1 white segmented worm was collected for identification.
- At 10 cm: 1 mature worm collected: identified as *Lumbricus terrestris.*
- At 20 cm. 1 small brown grub observed.

Soil Temperature: Soil temperature was recorded at each of the observation depths, using a digital thermometer and temperature probe. .

- At surface – 53.1degrees F.
- At 3 cm. – 53.0 degrees F.
- At 10 cm. – 49.2 degrees F.
- At 20 cm. – 49.9 degrees F.

Plot 4 Worm Log

Date: December 11, 2006
Weather: 45 degrees F.; overcast
Time: 15 minutes
Number of people: 1 (H.L.)
Technique employed: Observation

- Earthworm activity and a lack of duff layer, was evident on the soil surface within Plot 4.

Plot 5 Worm Log

Date: December 11, 2006
Weather: 45 degrees F.; overcast
Time: 15 minutes
Number of people: 1 (H.L.)
Technique employed: Observation

- Earthworms present in roots and on soil surface. Worm activity and a lack of duff layer were evident within Plot 5.

Plot 6 Worm Log

Date: December 11, 2006
Weather: 45 degrees F.; overcast
Time: 15 minutes
Number of people: 2 (H.L. & M.P.)
Technique employed: Observation

- Earthworms were observed densely entwined within root masses that were inadvertently pulled up, where they lay over shallow rock surfaces.
- Worm activity was also evident on soil surface, and there was a lack of duff layer within Plot 6.

Date: March 30, 2007
Weather: 60 degrees F.; sunny
Time: 30 minutes
Number of people: 1 (H.L.)
Technique employed: A 25 x 10 cm. plot was dug. Soil was investigated at the surface, and at 10 and 20 cm. for the presence of earthworms, evidence of worm activity, and soil temperature. The plot was dug adjacent to the seep. Water was present at 20 cm.
Observations:

- At surface: Worm casts were present beneath a shallow layer of leaf litter, possibly remaining from activity in December. No worms or current earthworm activity was observed.
- At 3 cm: No worms observed.
- At 10 cm: No worms observed. An unidentified insect species (larval stage – 7 individual grubs) was observed.
- At 20 cm: No worms observed, or any insect activity – groundwater present.

Soil Temperature: Soil temperature was recorded at each of the observation depths, using a digital thermometer and temperature probe.

- Surface – 62.9 degrees F.
- 3 cm. – 44.9 degrees F.
- 10 cm. – 38.7 degrees F.
- 20 cm. – 36.9 degrees F.

Public Outreach and Invasive Species Treatment Workshops

Pojac Point Invasive Species Management Demonstration Site
North Kingstown, Rhode Island

In November of 2006, David Gregg presented information on the invasive species management project being conducted at the Pojac Point site at the annual Pojac Point Community - Nature Conservancy trail clean-up for the Nature Conservancy's Pine Barrens Preserve, , Executive Director of the Rhode Island Natural History Survey,. The Nature Conservancy owns land adjacent to the project area, which also supports a population of *Phellodendron amurense*. The event was attended by 25 people; primarily community volunteers and TNC stewardship staff.

RHODE ISLAND NATURAL HISTORY SURVEY
Providing Ecosystem Science and Information

Follow this project and get the dates for the field tours at the RI Invasive Species Portal:
www.rinhs.org/invasives

Forest Invasives Control Demonstration Project

Funded by U.S. Forest Service, RI Ag. Experiment Station/URI-CELS, and the Rhode Island Foundation; fieldwork and research by Hope Leeson.

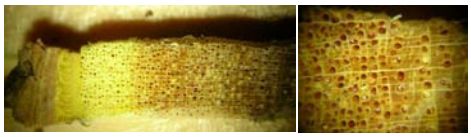
Amur cork-tree, *Phellodendron amurense* Rupr.

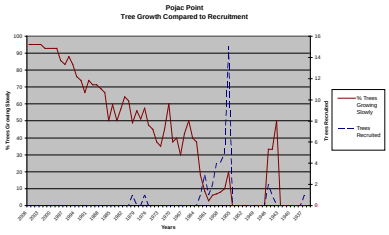
Background and Identification: *Phellodendron amurense* Rupr. and similar congeners were introduced into the US from eastern Asia prior to 1874. It is a popular landscape ornamental. It has dark green, compound leaves that turn yellow in autumn. Male and female flowers occur on separate plants, with females bearing clusters of fleshy purple berries in August and September. The bark is tannish-gray, deeply crevassed and "corky" (hence the name). Except for the berries, the tree can be mistaken for an ash tree. Although described in the literature as hardy and versatile, this species likes moderate winters and rich, moist soils.

According to The Nature Conservancy and others, this tree is demonstrating invasive characteristics in suburban and urban fringe forests in the northeast. The **Rhode Island Invasive Species Council** lists *Phellodendron* as a likely invasive but in need of further research. There are apparently no studies of invasion parameters or systematic studies of control methods for this species in the maritime-moderated New England climate and glacially derived soils. RINHS has found P. amurense throughout Rhode Island.

Prevention and control methods have not been developed for this relatively new invader. This species does sucker, but the response of the tree to mechanical or chemical control has not been characterized. An invasion on Pojac Point, in North Kingstown, offers an opportunity to investigate *P. amurense*.

To learn more about the invasion biology of *Phellodendron* and the history of this invasion in particular, RINHS is analyzing tree ring samples. Preliminary analysis links recruitment and growth to plentiful sunlight. However, under very low light conditions this plant can remain viable and individuals less than 10 feet tall and just 2" in diameter are almost 50 years old. Individuals as small as three feet tall and 3/4" in diameter have been found to set fruit.





RINHS is testing physical and chemical control methods including girdling, cutting, pulling, grinding, and cut-stump and basal application of selected herbicides. Results will be assessed in 2007, with follow-up applications as indicated. Site tours for forest professionals and land managers are planned throughout 2007. Results will be presented at appropriate conferences and in publication.

Other unusual forest invaders noted at Pojac Point include black jetbead *Rhodotypos scandens* and linden viburnum *Viburnum dilatatum.*

Outreach poster for the Pojac Point Tree Ring Study

A poster illustrating the investigation into the age of the Pojac Point *Phellodendron* population was presented, along with an explanation of what treatment methods had been applied within the three research plots. The TNC board members were then given a tour of the research site.

In November 2006, the same poster was presented at the annual meeting of the Rhode Island Forest Conservator's Organization (RIFCO). Approximately 80 people attended, largely landowners of working forests or tree farms, consulting foresters, and state agency personnel.

A demonstration workshop will be held in November 2007 at the Project Point Project Area, to specifically discuss the treatments applied, the application techniques and results.

Alton Jones Invasive Species Management Demonstration Site
West Greenwich, Rhode Island

On April 28, 2007, The RINHS held a demonstration workshop at the Alton Jones site. Six people attended. Participants included professional land managers, private large land owners, and individuals interested in invasive species management and monitoring. A summery of the treatments applied within each plot, and the methods used, was presented, along with a tour of the plots and examination and discussion of the preliminary results. All information presented during the workshop has been posted on the RINHS web site.

A second demonstration workshop will be held October 13, 2007, to further discuss techniques employed and results of the treatment methods.

Rhode Island Natural History Survey Annual Conference Poster Display

In March of 2007, posters detailing the management techniques applied within the three Pojac Point Plots and the six Alton Jones plots were presented at the annual conference of the Rhode Island Natural History Survey. An abstract, outlining the work done at both sites was published in the conference program.

DEMONSTRATION OF MANAGEMENT TECHNIQUES FOR INVASIVE PLANTS OF FORESTED ECOSYSTEMS IN RHODE ISLAND

Hope Leeson, David Gregg, Erik Endrulat[1], and Matt Largess[2]

To gain understanding of the management and ecology of two invasive plant species identified as emerging and potential threats by the RI Invasive Species Council, we established two management plots in forested habitats in southern Rhode Island. One site is within a mixed hardwood forest dominated by sugar maple (*Acer saccharum*). The site contains a dense understory of Japanese barberry (*Berberis thunbergii*). Japanese barberry is becoming a disruptive component of forest understories throughout Rhode Island, and is a concern for many land managers in the state. The second site, is within a mixed hardwood forest surrounded by residential land, contains areas dominated by amur corktree (*Phellodendron amurense*). Identified as a forest invader in the mid-Atlantic region, *Phellodendron* is an emerging species of concern in New England, as its biology and response to control are not well understood. We will use the two management sites as demonstration areas to highlight the successes and failures of the various invasive plant management strategies employed on these two species. Demonstration site workshops will be held for natural resource professionals, landowners and the general public. The first demonstration workshop is scheduled for 28 April, 2007.

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