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Distribution and Abundance of Nonnative Plant Species at Johnstown Flood National Memorial and Allegheny Portage Railroad National Historic Site

Technical Report NPS/NER/NRTR—2007/083

ON THE COVER
Giant knotweed (*Polygonatum sachalinense*) invading the understory of a black cherry dominated modified successional forest along the Little Conemaugh River, Allegheny Portage Railroad National Historic Site, Staple Bend Unit.
Photograph(s) by: Ephraim Zimmerman, PNHP, from Vegetation Classification and Mapping at ALPO.

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Executive Summary

Nonnative plant species were inventoried at Johnstown Flood National Memorial (JOFL) and Allegheny Portage Railroad National Historic Site (ALPO) during vegetation mapping and classification activities.

Fifty-four nonnative species were found among the 50 survey points at JOFL. The most widespread were Morrow's honeysuckle (*Lonicera morrowii*), purple crownvetch (*Coronilla varia*), and multiflora rose (*Rosa multiflora*); all were present at over 50 percent of the sampling points. Eight other species occurred at over 20 percent of the sample points, including species often associated with abandoned pasture land, including reed canarygrass (*Phalaris arundinacea*), lesser burdock (*Arctium minus*), ground ivy (*Glechoma hederacea*), sweet vernalgrass (*Anthoxanthum odoratum*), Canada thistle (*Cirsium arvense*), orchardgrass (*Dactylis glomerata*), Japanese or giant knotweed (*Polygonatum cuspidatum, P. sachalinense*), and Scot's pine (*Pinus sylvestris*). Red Maple - Black Cherry Successional Forest / Woodland patches contained between one and 12 nonnative plants. Points in the Eastern Hemlock - Northern Hardwood Forest contained between four and five species each. For the forest types, the number and percent cover of nonnative plants most likely falls along a disturbance gradient as more mature, closed canopy types exhibit a lower number and percent cover of nonnative plants. Points in the Conifer Plantations contained between six and 17 nonnative plant species. The two points in the Cattail Marsh contained two and five nonnative species, respectively. Points situated in the Riverine Scour patches contained between six and 13 nonnative species. Points in Old Field type, the most common association at JOFL, contained between two and 15 species of nonnative plants. There were a total of 42 nonnative plant species recorded in the Old Field patches at JOFL. The high number of nonnative species occurring across all vegetation patches at JOFL illustrate the disturbed and/or early successional nature of all associations at the park.

A total of 92 nonnative species were found at ALPO. Eighty-three were found among the 200 survey points and the additional nine were found only along road- and trail-sides or around abandoned settlements. Thirteen of 90 species were found at 10 percent of the points surveyed at ALPO. The most widespread nonnative plant was multiflora rose, which was present at just under 35 percent of the 200 survey points. No other nonnative plant species was present at over 20 percent of the points surveyed. Morrow's honeysuckle was present at just under 20 percent of all points; however, it was locally abundant and found with a much higher frequency in Successional Old Field and Modified Successional Forest types. Other species found in over ten percent of the sample points were orchardgrass, garlic mustard (*Alliaria petiolata*), sweet vernalgrass, Japanese barberry (*Berberis thunbergii*), oriental ladysthumb (*Polygonum caespitosum*), ground ivy, reed canarygrass, Japanese stiltgrass (*Microstegium vimineum*), colonial bentgrass (*Agrostis capillaris*), Kentucky bluegrass (*Poa pratensis*), common yarrow (*Achillea millefolium*), oxeye daisy (*Chrysanthemum leucanthemum*), meadow fescue (*Festuca elatior*), and Japanese or giant knotweed.

Sample points in hardwood and mixed hardwood-hemlock forest associations had fewer than eight nonnative plant species for any one point. Dry Eastern Hemlock - Oak Forest patches did not contain any nonnative plant species. Forest patches at the Staple Bend Tunnel Unit contained dense infestations of Japanese knotweed, giant knotweed, or the hybrid of those two

species (*Polygonum x bohemica*). In contrast to the high quality hardwood and mixed hardwood - conifer forest associations, the Modified Successional Forest, Successional Old Fields, and Conifer Plantation patches contained high numbers of nonnative plant species. Wet Meadow and Alder Riverine Shrubland associations contained a moderate number of nonnative plant species. Two vegetation associations were dominated by and named for nonnative species: the Reed Canarygrass Riverine Grassland and Japanese or Giant Knotweed Herbaceous Vegetation association.

In general, smaller roads and trails under moderate to closed canopies at ALPO had fewer nonnative plants than those occurring in wider canopy openings. Along the historic ALPO Trace, the composition of nonnative plants often reflects that of the Successional Old Field association. The Trace, which at times approaches 20 m (66 ft) in width, may facilitate the movement of invasive species into the adjacent hardwood and mixed hardwood -hemlock forest associations. Japanese stiltgrass and Japanese knotweed populations along the Trace may be the most severe threats to native species and intact forest communities, as they appear to be able to tolerate understory conditions and thrive in light gaps and openings in the canopy.

Objectives for invasive species management should be developed for each vegetation association and, in particular, for associations exhibiting large numbers of nonnative plant species. Control efforts for widespread species should focus on sites where aggressive nonnative species directly threaten natural populations of rare plant and animal species or threaten higher quality systems.

Control of nonnative plants in higher quality forest associations at ALPO should focus efforts on and near trails and roadsides and near forest edges. For any road building, forestry, or maintenance activities, equipment should be thoroughly cleaned prior to use and cleaned in the area following the activity. For example, tires of vehicles used in brush removal and salvage logging should be cleaned before they enter relatively invasive-free communities.

The JOFL and ALPO survey results demonstrate the difference in nonnative species composition of closed-canopy, undisturbed forests, like those seen at higher elevations and steep slopes at ALPO and open, successional fields and successional forests of JOFL and lower elevation abandoned agricultural areas at ALPO. The results of the inventory suggest that the invasive species composition is a symptom of human disturbance, both past and present, where more disturbed or successional vegetation associations exhibited a substantially higher number of nonnative plant species at JOFL and ALPO.

Keywords: nonnative species, vegetation mapping, Johnstown Flood National Memorial, Allegheny Portage Railroad National Historic Site

Introduction

The introduction and naturalization of nonnative invasive plant species into native plant communities has emerged as a problem of primary importance for natural areas management. Both deliberate and unintentional nonnative introductions have long been associated with human movement, but the rate of artificial introductions has increased dramatically in the wake of European colonization and the increased ease of transoceanic transport over the past two centuries (Mack et al. 2000). Nonnative invasive plants can spread quickly and aggressively in the absence of natural herbivores, pests, and parasites (Blossey and Notzold 1995). Plants which are far from dominant in their natural communities can overwhelm the competition in their new homes, altering community structure, changing nutrient cycling, slowing succession, and interfering with the fire regime in fire-adapted systems (Myster and Pickett 1995; Gordon 1998; Mack et al. 2000; Tu 2003).

Disturbed, successional, and fragmented habitats are significantly more vulnerable to invasion than intact later successional types (Robertson et al. 1994; Symstad 2000; Cadenasso and Pickett 2001); therefore, invasive plant control is of much greater importance in smaller areas, with high perimeter-to-area ratios, large areas of successional habitat, or highly heterogeneous vegetation associations. The National Parks Service (NPS) units in western Pennsylvania (Allegheny Portage Railroad National Historic Site [ALPO], Johnstown Flood National Memorial [JOFL], Fort Necessity National Battlefield [FONE], and Friendship Hill National Historic Site [FRHI]) are well described by these qualifications for invasion. All are roughly 500 ha (1,236 ac) or smaller, with varying degrees of habitat heterogeneity; many habitat patches are recovering from varying degrees of human disturbance, and all four units are surrounded by development. Control of invasive plant species should be a significant consideration in management of these four units.

Studies by Pennsylvania Natural Heritage Program in Western Pennsylvania NPS Units

From 2001–2002, the Pennsylvania Natural Heritage Program (PNHP), under the direction of the Western Pennsylvania Conservancy (WPC), conducted an inventory of special concern species and delineated plant communities in the four western Pennsylvania NPS units (WPC 2003). Plant communities were inventoried and mapped for each property through field assessment and aerial photointerpretation. WPC ecologists found that nonnative species were well established in many areas and comprised a significant proportion of the vegetative composition of many plant communities in the four NPS units; however, nonnative plant populations were not the focus of that study.

PNHP has been involved in quantitative, plot-based, plant community-mapping projects in the four NPS properties in western Pennsylvania as part of a national vegetation community classification and mapping program sponsored by NPS, United States Geological Survey (USGS), and NatureServe (Perles et al. 2006a, b, c, d). The goal of the mapping effort at the NPS units was to produce an up-to-date digital geospatial vegetation database for the park and to provide a plant species list, a dichotomous key for vegetation associations, and descriptions of the vegetation associations in the park. To ensure that vegetation mapping is standardized across the NPS, The Nature Conservancy (TNC), in conjunction with NatureServe, the Federal

Geographic Data Committee (FGDC), and the Ecological Society of America Vegetation Subcommittee, developed a protocol for creating vegetation maps in national parks. This protocol was adopted by the United States Geological Survey (USGS)/NPS Vegetation Mapping Program as the standard (TNC and ESRI 1994a, b, c) and has been implemented at the four NPS units in western Pennsylvania by PNHP.

Baseline information on plant community composition and rarity is critical to developing desired conditions and park management goals relating to native plant communities, nonnative plant and insect species, and effects of deer browse and other disturbances. Plot sampling for the vegetation-mapping project began in 2004 at FONE and continued in the other park units through 2006. This mapping effort provided the opportunity to evaluate the presence, absence, and/or abundance of nonnative plant species at points within each delineated community patch and to identify areas of high nonnative plant species abundance.

Previous Assessments of Nonnative Species at JOFL and ALPO

Assessments of nonnative species date to 1999 when natural resource manager Brain Eick began an inventory and mapping project to determine large infestations of the major nonnative species at JOFL and ALPO. At JOFL, workers mapped populations of multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), "bush" honeysuckle (*Lonicera* spp.), and Japanese and giant knotweed (*Polygonum cuspidatum, P. sachalinense*). At the Main Unit of ALPO (Staple Bend Tunnel was not mapped), workers mapped garlic mustard (*Alliaria petiolata*), Japanese honeysuckle (*Lonicera japonica*), and oriental bittersweet (*Celastrus orbiculatus*) in addition to those mapped at JOFL. Fuller's teasel (*Dipsacus fullonum*) was mapped for the Summit area of the Main Unit in 2003 by natural resource manager Kathy Penrod. The populations, recorded as non-geographically corrected maps, were digitized by PNHP as best as possible and made available to park resource managers as part of the deliverables for this project. ArcMap shapefiles were provided to NPS management (maps are found in Appendix A). However, because they were not originally geo-referenced, and due to the length of time that has elapsed since their creation, they were not utilized in this project.

Goals and Objectives

The goal of this study was to inventory the nonnative plant populations in each of the four NPS units between 2004 and 2006 at each of the NPS vegetation mapping plots and accuracy assessment points. This report details the results of the inventory for JOFL, which took place in 2004, and ALPO, which took place in 2005–2006. This inventory will contribute to a general understanding of the nonnative plant distributions, identify what species are most prevalent, and determine which vegetation associations are most impacted by nonnative plant species. This report draws attention to survey points and vegetative communities with particularly dense populations of nonnative plants and identifies them as targets for further study and management. NPS Natural Resources Technical Report NPS/NER/NRTR—2006/053 (Zimmerman and Yoder 2006) provides information on the distribution and abundance of nonnative invasive plant species at FONE and FRHI.

The specific objectives of this study were to:

1. Provide a list of nonnative plant species present in each NPS unit;
2. Provide a list of nonnative plant species to target in more detailed surveys and control efforts (species listed as posing a moderate to severe threat to native plants and habitats in Pennsylvania: http://www.dcnr.state.pa.us/forestry/wildplant/invasive.aspx);
3. Provide a general understanding of which vegetative communities are most/least impacted by nonnative plants;
4. Provide information to help develop management recommendations and prioritize areas for detailed monitoring and management; and
5. Digitize already existing maps of nonnative species occurrence.

Site Information

Johnstown Flood National Memorial

The 67 ha (164 ac) Johnstown Flood National Memorial (JOFL) is situated in Cambria County on a portion of the South Fork of the Little Conemaugh River. The park includes the former lakebed of Lake Conemaugh, a two-mile-long reservoir on the South Fork; its earthen dam failed in 1889 resulting in a catastrophic flood that impacted a number of communities downstream, including Johnstown, Pennsylvania. The former lakebed has remained dry ever since. Historically, this region was forested. The forests of the region are typically dominated by northern hardwood species such as sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*), and black cherry (*Prunus serotina*). Eastern hemlock (*Tsuga canadensis*) and eastern white pine (*Pinus strobus*) are common associated trees. Typical shrubs include striped maple (*Acer pensylvanicum*) and American witchhazel (*Hamamelis virginiana*). These forests can contain diverse wildflowers, herbaceous plants, and ferns in the understory (Cuff et al. 1989). Much of the forests in the JOFL region were harvested multiple times in the last two centuries and converted to agriculture or development. While the landscape has re-grown to be predominantly forested today, there exists substantial evidence of human activity throughout JOFL (Perles et al. 2006a).

PNHP Vegetation Classification and Mapping activities identified seven vegetation associations: Red Maple - Black Cherry Successional Forest / Woodland, Eastern Hemlock - Northern Hardwood Forest, Conifer Plantation, Silky Willow Shrub Swamp, Old Field, Cattail Marsh, and Riverine Scour Vegetation (Perles et al. 2006a). These vegetation types reflect the land use history, ongoing management, and varied environmental settings of the park. At the time of the flood, the area that is now designated as the park was used for agriculture and recreation, or was underwater. After the flood in 1889, management of the land ceased until 1964 with the creation of JOFL. Thus, all vegetation associations at JOFL have been markedly altered prior to and following establishment of the park in 1964 (Perles et al. 2006a).

In particular, the vegetation of the former lakebed has been intensely managed since the late 1980s. In 1986, 12 ha (30 ac) of the 28 ha (69 ac) lakebed supported planted stands of Scot's pine (*Pinus sylvestris*), eastern white pine, and red pine (*Pinus resinosa*) (Bowersox 1986). The majority of these trees were removed between 1988 and 1991 to simulate the extent of the former reservoir. Native and nonnative early successional trees and shrubs soon dominated the area following removal of the pines. An intensive management regime, which included the use of herbicide, was employed to remove these woody plants from 1995 through 2000 (Eick 1996). Shrubs species have been actively removed in this area since 2000.

Allegheny Portage Railroad National Historic Site

Situated in Blair and Cambria Counties, Allegheny Portage Railroad National Historic Site (ALPO) covers approximately 518 ha (1,280 ac) and consists of two units: the Main Unit and the Staple Bend Tunnel Unit. The Main Unit (approximately 525 ha [1,296 ac]) contains the Visitor Center, the historic Lemon House, Engine House #6 Exhibit Shelter, the Skew Arch Bridge, a picnic area, and hiking trails. The Staple Bend Tunnel Unit (approximately 88 ha [218 ac])

contains a hiking and biking trail on the historic railroad Trace that leads to the Staple Bend Tunnel (NPS 2006a). The predominant vegetation types of the region are the Appalachian Oak Forests and Northern Hardwood Forests. The Appalachian Oak Forest is typically dominated by white oak (*Quercus alba*) and northern red oak (*Quercus rubra*), with sugar maple, sweet birch (*Betula lenta*), bitternut hickory (*Carya cordiformis*), American beech, and tuliptree (*Liriodendron tulipifera*) as associates. The Northern Hardwood Forest is typically dominated by sugar maple, American beech, sweet birch, yellow birch, red maple, and black cherry (Cuff et al. 1989).

PNHP Vegetation Classification and Mapping activities identified 16 vegetation associations: Alder Riverine Shrubland, Allegheny Hardwood Forest, Conifer Plantation, Dry Eastern Hemlock - Oak Forest, Eastern Hemlock - Northern Hardwood Forest, Eastern Hemlock - Tuliptree - Birch Forest, Japanese or Giant Knotweed Herbaceous Vegetation, Modified Successional Forest, Northern Hardwood Forest, Northern Red Oak - Northern Hardwood Forest, Reed Canarygrass Riverine Grassland, Sparsely Vegetated Cliff, Successional Old Field, Sugar Maple Floodplain Forest, Tuliptree - Beech - Maple Forest, and Wet Meadow (Perles et al. 2006d). These vegetation associations are strongly influenced by the varied environmental setting, historic development, and agricultural activities. While much of the hardwood and mixed hardwood - hemlock forest types within the Main Unit are of high quality, Modified Successional Forest, Conifer Plantations, and Successional Old Field are fairly common associations in the park, especially in the southeastern corner of the Main Unit. These vegetation types are a direct result of previous disturbances. The forest types in the Staple Bend Tunnel Unit are generally of lower quality, compared with the forests at higher elevations in the Main Unit. Much of the Staple Bend Tunnel Unit contains dense infestations of Japanese knotweed, giant knotweed, or the hybrid of those two species (*Polygonum x bohemica*) (Perles et al. 2006d).

Methods

Field Methods

PNHP ecologists followed a rapid inventory (rapid assessment) methodology developed and used for Delaware Water Gap National Recreation Area (DEWA) to inventory nonnative plant populations in delineated plant community polygons. Rapid assessment took place in conjunction with the NPS/NatureServe vegetative community mapping and accuracy assessment activities for JOFL and ALPO. A 1,962-m^2 (25-m radius) circular plot was established at the center of each NPS/NatureServe community-mapping plot and at each accuracy assessment point (Figures 1–3). In addition, there were several more points randomly established within community patches to increase the number of sample points. At each location, we recorded the abundance of all identifiable nonnative species using a predetermined list created by PNHP with input from NPS resource managers (see Appendix B for sampling form). Additional nonnative species found during survey activities were added to the list. For each species present, an abundance code was assigned as follows:

A = abundant (very common, approximately >20% cover in a 25-m radius area)

O = occasional (scattered, approximately 1–20% cover in a 25-m radius area)

R = rare (one plant or very few widely scattered plants in a 25-m radius area)

At ALPO, presence and abundance of nonnative plant species were also assessed along 50 m (164 ft) long stretches of trails and other transportation corridors throughout the park unit (Figures 2–3). Sample sites consisted of 50 m (164 ft) linear stretches along three representative types of rights-of-way: dirt paths (hiking trails), gravel two-tracks (accessible by vehicles), and paved roads (accessed by park and visitor vehicles). The sites chosen represent the most common types of transportation rights-of-way. Abundance of nonnative species along these rights-of-way was recorded using the same scale as above. The type of trail was recorded along with its width, width of canopy opening caused by the linear feature, and estimated percent canopy cover above the trail. The latter was classified into three categories: Open (less than 40% canopy cover), Moderate (40–60 % canopy cover), and Closed (>70% canopy cover). Trails were not assessed at JOFL because of its small size.

The location of each plot was recorded with a Trimble GeoXM global positioning system (GPS) unit,with the datum set to North America 1983 (Conus) and the coordinate system set to Universal Trans-Mercator (UTM) zone 17. The X-Y coordinates for both NPS units were differentially corrected using Trimble GPS Pathfinder Office and Shape Correct software with base station data from the CORS National Geodetic Survey Pittsburgh, PA base station (http://www.ngs.noaa.gov/cgi-cors/corsage.prl?site=PIT1).

When completed, park-specific abundance, cultivation, and management codes were assigned to each nonnative species encountered according to guidelines presented in “NPSpecies Data Dictionary for Users: Field and Value Definitions, Version 2” (Wotawa 2004).

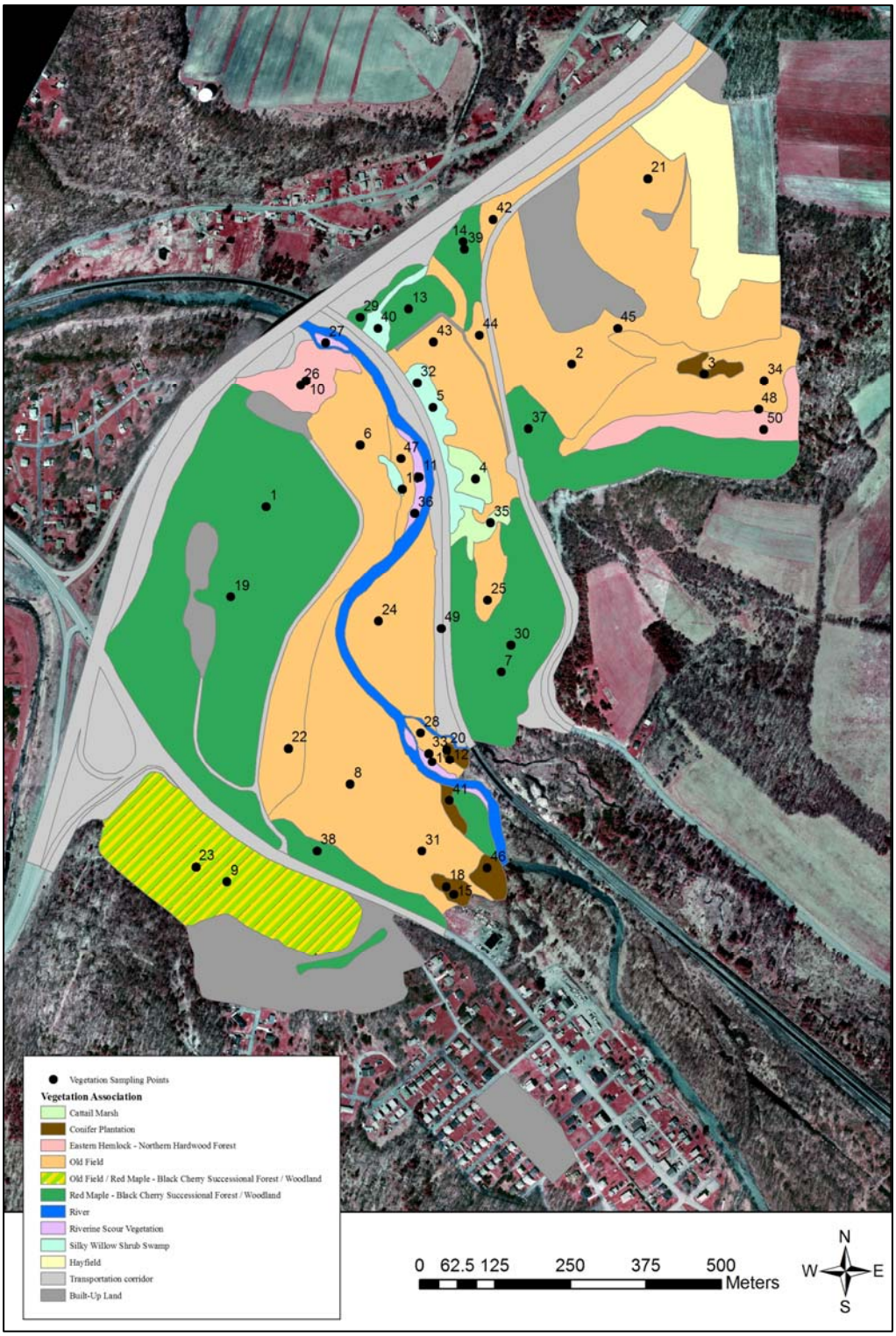

Figure 1. Locations of nonnative plant monitoring points within delineated vegetation associations, Johnstown Flood National Memorial.

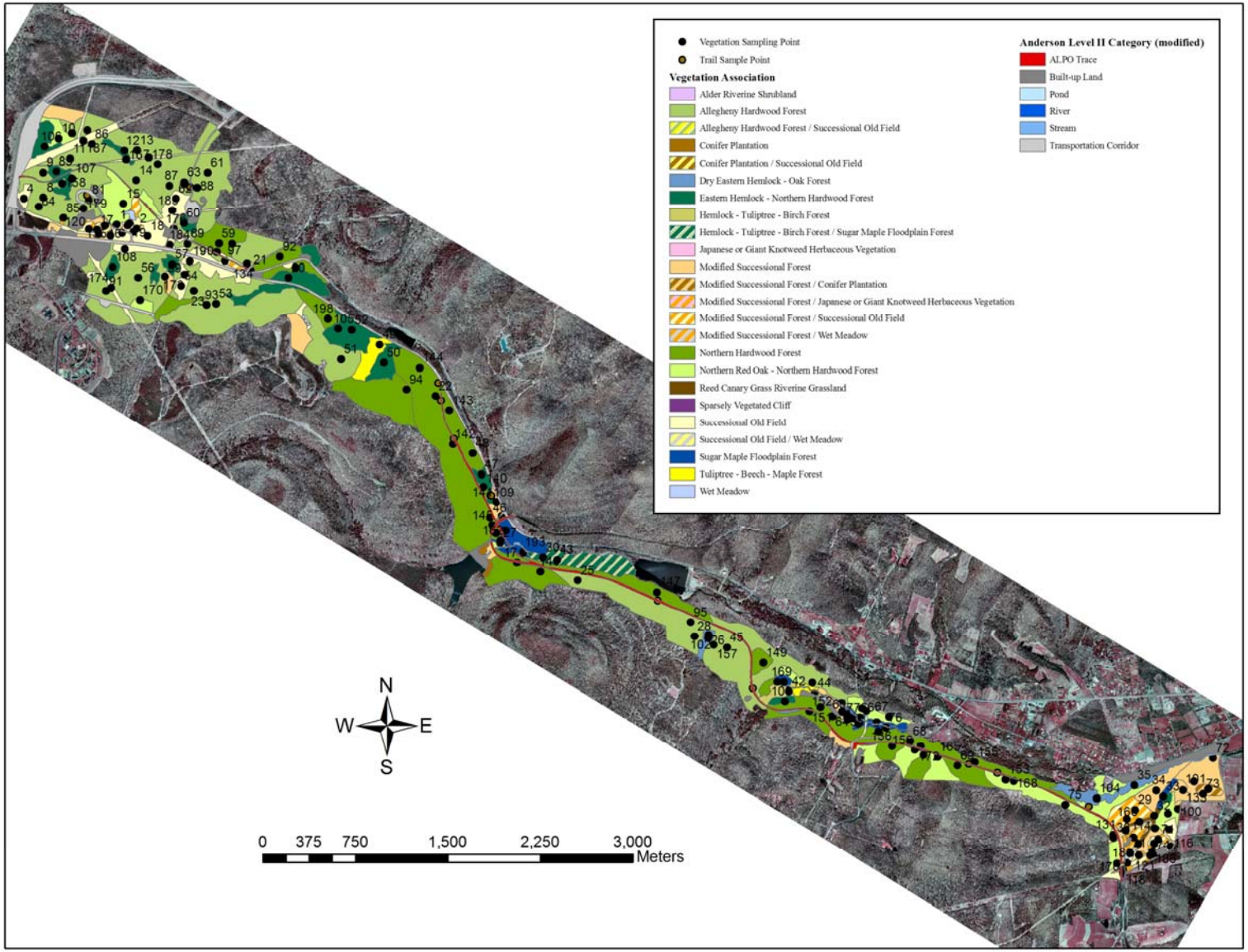

Figure 2. Locations of nonnative plant monitoring points and points along rights-of-way within delineated vegetation associations, Allegheny Portage Railroad National Historic Site, Main Unit.

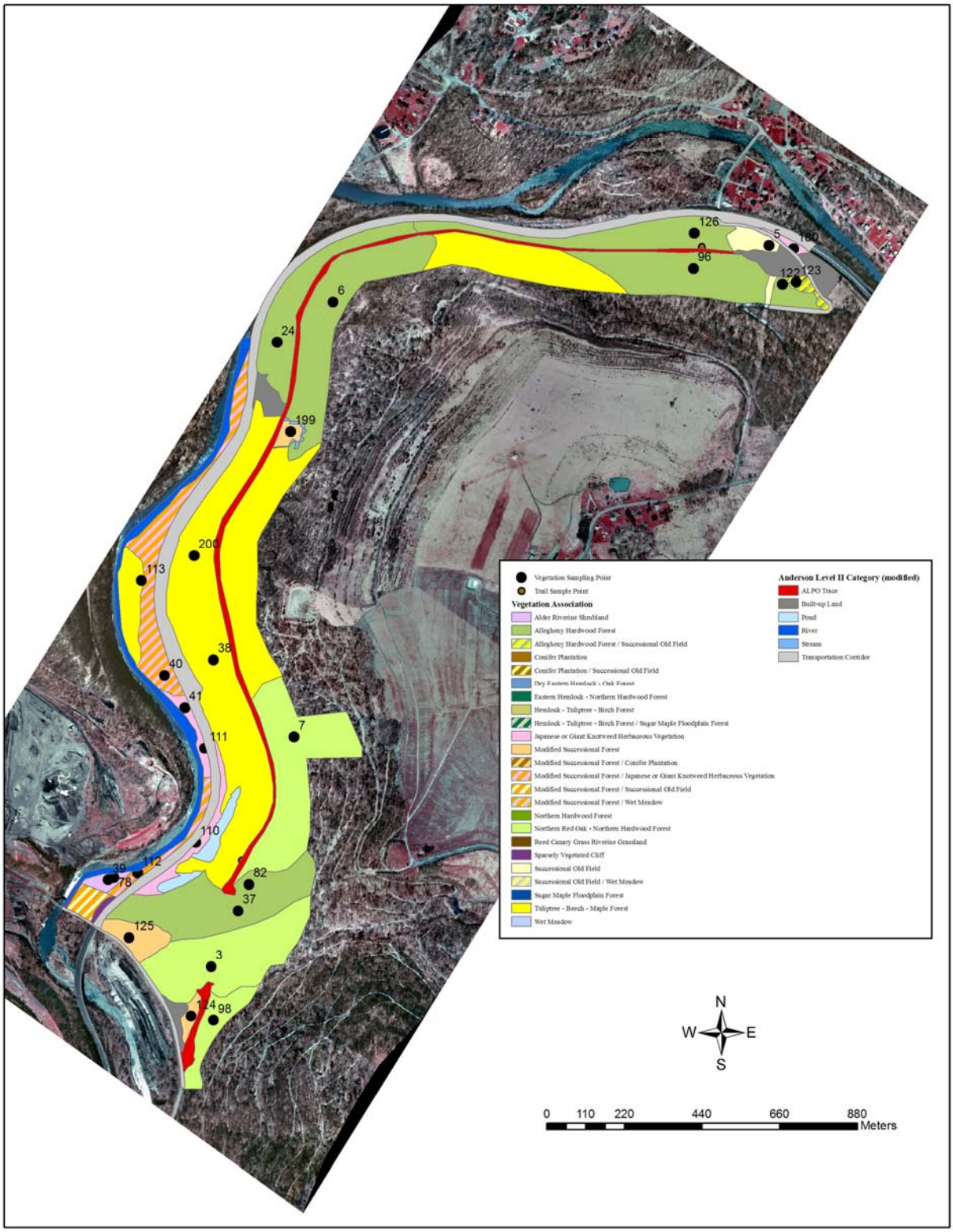

Figure 3. Locations of nonnative plant monitoring points and points along rights-of-way within delineated vegetation associations, Allegheny Portage Railroad National Historic Site, Staple Bend Tunnel Unit.

Data Analysis

Data were transcribed from field recording sheets, from points corresponding to vegetation survey plots and those along transportation rights-of-way, into a Microsoft Excel spreadsheet. To facilitate quantitative evaluation of the data, the abundance codes A, O, and R were translated to the values 60, 10, and 1, respectively, to represent the midpoint cover value. Data were then summarized by survey point, species, and vegetation association and presented below.

Not all nonnative species are considered to be "invasive," or possessing the ability to aggressively spread and displace native vegetation, by the Pennsylvania Department of Conservation and Natural Resources (PA DCNR). Two lists of invasive species are currently distributed by PA DCNR. The first (PA DCNR 2005a) is a list of noxious weeds developed by DCNR in 2000 as a brochure (http://www.dcnr.state.pa.us/forestry/wildplant/invasive.aspx) that identified noxious weeds and their threat to natural areas. The second (PA DCNR 2005b), "DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers," developed in 2005 by the Mid Atlantic Exotic Pest Plant Council (Mid-Atlantic EPPC) specifically as an educational tool for land managers (http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm), is much more comprehensive. However, the level of threat was not addressed in the Tutorial. Therefore, in the tables below, the nonnative plants were designated as "invasive" when identified as invasive in the Exotic Plant Tutorial (PA DCNR 2005b), and threat level was provided when information on threat was available through the DCNR Invasive Species in PA brochure (PA DCNR 2005a).

The presence and coverage for each nonnative species was reported at each survey point and totaled for all points within a vegetation association in order to determine nonnative species composition by specific vegetation association. Species presence/absence was reported along select roads and trails at ALPO.

Results and Discussion

Johnstown Flood National Memorial

A total of 54 nonnative plant species were recorded at JOFL. Norway maple (*Acer platanoides)*, a species listed on both DCNR lists, was not found among the sampling points, but was encountered at one location at JOFL, along the road leading to the South Abutment parking lot (Figure 4). In addition, Japanese knotweed and giant knotweed were lumped together for analysis due to the species' tendency to occur together in large mixed stands. Thus, 52 nonnative species were found among the 50 survey points (Figure 1; Table 1). Of the 52 nonnative species, 24 were found at over 10 percent of the points surveyed at JOFL. Twelve species are listed as posing a moderate to serious threat to native plants and habitats in Pennsylvania according to the PA DCNR Invasive Species in Pennsylvania (PA DCNR 2005a; http://www.dcnr.state.pa.us/forestry/wildplant/invasive.aspx). Five others, purple crownvetch (*Coronilla varia*), spotted knapweed (*Centaurea stoebe* ssp. *micranthos*), European alder (*Alnus glutinosa*), winged burning bush (*Euonymus alata*), and meadow fescue (*Festuca elatior*), were species considered invasive on the PA DCNR's Exotic Plant Tutorial for Natural Lands Managers (PA DCNR 2005b; http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm).

The most widespread species was Morrow's honeysuckle (*Lonicera morrowii*), which was present at 31 of the 50 survey points (62%) within the park (Table 1). Purple crownvetch and multiflora rose were also present at over 50 percent of the sampling points with frequencies of 58 and 52 percent, respectively (Table 1).

Eight other species occurred at over 20 percent of the sample points including species often associated with Old Fields, the most prominent vegetation association at JOFL (Table 1). This list includes reed canarygrass (*Phalaris arundinacea*), lesser burdock (*Arctium minus*), ground ivy (*Glechoma hederacea*), sweet vernalgrass (*Anthoxanthum odoratum*), Canada thistle (*Cirsium arvense*), orchardgrass (*Dactylis glomerata*), Japanese or giant knotweed, and Scot's pine.

Relation of Nonnative Species to Vegetation Association

Vegetation classification and mapping activities at JOFL identified seven vegetation associations. This study of Johnstown Flood National Memorial identified seven vegetation associations: Red Maple - Black Cherry Successional Forest / Woodland, Eastern Hemlock - Northern Hardwood Forest, Conifer Plantation, Silky Willow Shrub Swamp, Old Field, Cattail Marsh, and Riverine Scour Vegetation. In addition, three subtypes of the Old Field vegetation type were identified: Herbaceous subtype, Wet Meadow subtype, and Hawthorn subtype (Perles et al. 2006a).

Red Maple - Black Cherry Successional Forest / Woodland patches (n= 10; Table 2) contained between one and 12 nonnative plants (Table 3). In all, a total of 23 different nonnative species were found in this type throughout the park (Table 4). Morrow's honeysuckle, purple crownvetch, multiflora rose, and ground ivy, were found at over 40% of the sample points within this type (Table 4). The Red Maple - Black Cherry Successional Forest / Woodland patches at

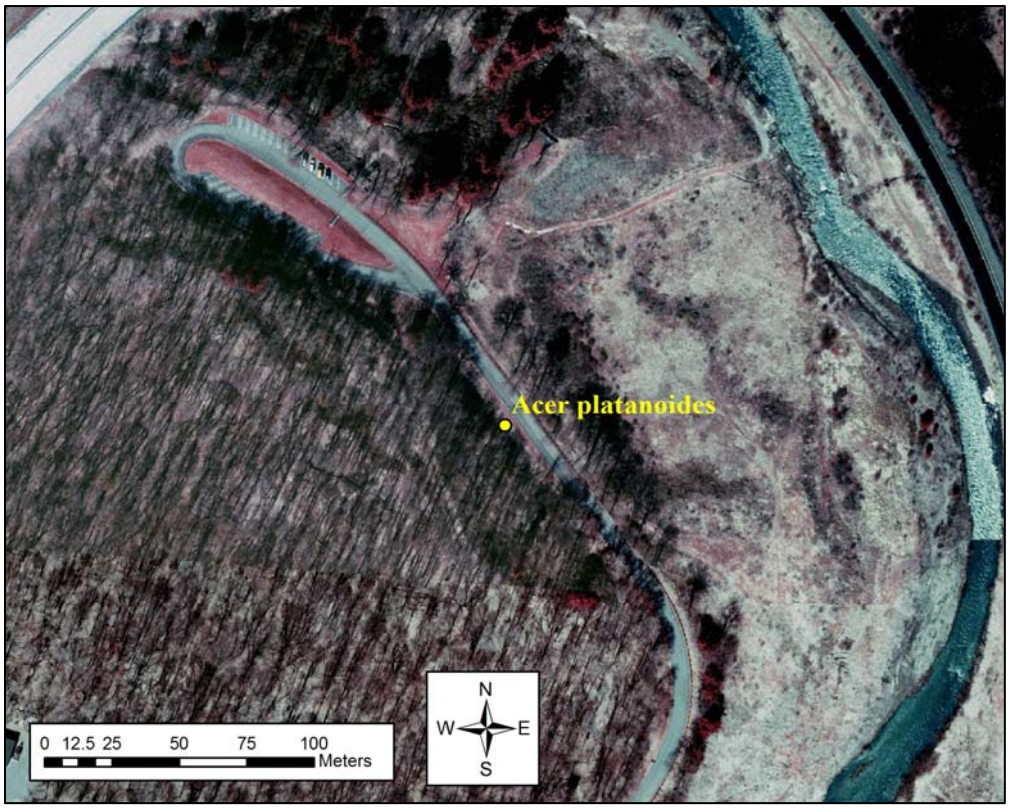

Figure 4. Location of Norway maple (*Acer platanoides*), Johnstown Flood National Memorial.

Table 1. List of nonnative plant species present at Johnstown Flood National Memorial with abundance and cultivation codes and invasive status as stated by PA Department of Conservation and Natural Resources (PA DCNR).

Scientific Name	Common Name	Points where present	% of points present	Abundance[a]	Cultivation[b]	Invasive[c]	Threat (PA DCNR)[d]
Lonicera morrowii	Morrow's honeysuckle	31	62	Abundant	Not cultivated	Yes	Serious
Coronilla varia	purple crownvetch	29	58	Abundant	Not cultivated	Yes	No
Rosa multiflora	multiflora rose	26	52	Abundant	Not cultivated	Yes	Serious
Phalaris arundinacea	reed canarygrass	14	28	Common	Not cultivated	Yes	Moderate
Arctium minus	lesser burdock	12	24	Unknown	Not cultivated	No	No
Glechoma hederacea	ground ivy	12	24	Common	Not cultivated	No	No
Anthoxanthum odoratum	sweet vernalgrass	11	22	Common	Not cultivated	Yes	No
Cirsium arvense	Canada thistle	11	22	Common	Not cultivated	Yes	Serious
Dactylis glomerata	orchardgrass	11	22	Common	Not cultivated	No	No
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	11	22	Common	Not cultivated	Yes	Serious
Pinus sylvestris	Scot’s pine	10	20	Common	Persistent	No	No
Daucus carota	Queen Anne's lace	9	18	Common	Not cultivated	No	No
Hesperis matronalis	dames rocket	9	18	Common	Not cultivated	Yes	Moderate
Chrysanthemum leucanthemum	Oxeye daisy	8	16	Common	Not cultivated	No	No
Alliaria petiolata	garlic mustard	7	14	Unknown	Not cultivated	Yes	Serious
Dipsacus fullonum	Fuller's teasel	7	14	Common	Not cultivated	No	No
Rumex obtusifolius	bitter dock	7	14	Unknown	Not cultivated	No	No
Berberis thunbergii	Japanese barberry	6	12	Common	Not cultivated	Yes	Moderate
Centaurea stoebe ssp. *micranthos*	spotted knapweed	6	12	Unknown	Not cultivated	Yes	No
Phleum pratense	timothy	6	12	Common	Not cultivated	No	No
Plantago lanceolata	narrowleaf plantain	6	12	Common	Not cultivated	No	No
Verbascum thapsus	common mullein	6	12	Unknown	Not cultivated	No	No
Veronica officinalis	common gypsyweed	6	12	Unknown	Not cultivated	No	No
Taraxacum officinale	common dandelion	5	10	Common	Not cultivated	No	No
Agrostis capillaris	colonial bentgrass	4	8	Unknown	Not cultivated	No	No
Clinopodium vulgare	wild basil	4	8	Uncommon	Not cultivated	No	No
Poa pratensis	Kentucky bluegrass	4	8	Uncommon	Not cultivated	No	No
Tussilago farfara	coltsfoot	4	8	Unknown	Not cultivated	No	No
Agrostis gigantea	redtop	3	6	Unknown	Not cultivated	No	No
Elaeagnus umbellata	autumn olive	3	6	Common	Not cultivated	Yes	Serious
Holcus lanatus	common velvetgrass	3	6	Unknown	Not cultivated	No	No
Malus sp.	crab apple	3	6	Unknown	Persistent	No	No

Table 1. List of nonnative plant species present at Johnstown Flood National Memorial with abundance and cultivation codes and invasive status as stated by PA Department of Conservation and Natural Resources (PA DCNR) (continued).

Scientific Name	Common Name	Points where present	% of points present	Abundance[a]	Cultivation[b]	Invasive[c]	Threat (PA DCNR)[d]
Solanum dulcamara	climbing nightshade	3	6	Unknown	Not cultivated	No	No
Festuca elatior	meadow fescue	2	4	Unknown	Not cultivated	Yes	No
Lolium perenne	perennial ryegrass	2	4	Unknown	Not cultivated	No	No
Prunella vulgaris	common selfheal	2	4	Uncommon	Not cultivated	No	No
Ranunculus acris	tall buttercup	2	4	Uncommon	Not cultivated	No	No
Rumex acetosella	common sheep sorrel	2	4	Unknown	Not cultivated	No	No
Alnus glutinosa	European alder	1	2	Unknown	Not cultivated	Yes	No
Bromus inermis	smooth brome	1	2	Unknown	Not cultivated	No	No
Dianthus armeria	Deptford pink	1	2	Common	Not cultivated	No	No
Epipactis helleborine	broadleaf helleborine	1	2	Rare	Not cultivated	No	No
Hieracium caespitosum	meadow hawkweed	1	2	Unknown	Not cultivated	No	No
Ligustrum obtusifolium	obtuse-leaved border privet	1	2	Unknown	Not cultivated	Yes	Moderate
Malus pumila	apple	1	2	Unknown	Persistent	No	No
Melilotus officinalis	yellow sweetclover	1	2	Unknown	Not cultivated	No	No
Nasturtium officinale	watercress	1	2	Unknown	Not cultivated	No	No
Pastinaca sativa	wild parsnip	1	2	Unknown	Not cultivated	Yes	Moderate
Polygonum caespitosum	oriental ladysthumb	1	2	Unknown	Not cultivated	No	No
Rumex crispus	curly dock	1	2	Unknown	Not cultivated	No	No
Trifolium pratense	red clover	1	2	Unknown	Not cultivated	No	No
Euonymus alata	winged burning bush	1	2	Unknown	Not cultivated	Yes	No
*Acer platanoides**	Norway maple	0	0	Rare	Persistent	Yes	Serious

*Species present, but occurred outside vegetation sample points

[a]Abundance Codes: Abundant designation for species present at >50% of sample locations, or observed covering a large portion of the park, Common = occurring at 10 to 50 percent of sample locations, Uncommon = species present between 4 and 10% of sample locations, Rare = species present at 2% or fewer sample locations; If insufficient data to determine population, Abundance was listed as "Unknown."

[b]Cultivation codes: Designated as "cultivated" if species was purposely planted and maintained (e.g. agricultural crops), "not cultivated" if species was not planted, or "persistent" of plant species was once planted, but now not maintained (e.g. nonnative pines in plantations) (NPS 1996).

[c]Invasive: plant species listed as "invasive" by Pennsylvania Department of Conservation and Natural Resources (PA DCNR) Invasive Exotic Plant Management Tutorial for Natural Lands Managers (PA DCNR 2005b; http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm).

[d]Threat (PA DCNR): designation or threat posed by a species given by PA DCNR Invasive Species in Pennsylvania (PA DCNR 2005a; http://www.dcnr.state.pa.us/forestry/wildplant/invasive.aspx).

Table 2. Number of sample plots in each vegetation association, Johnstown Flood National Memorial.

Vegetation Association	Number of Vegetation Sample Points (VSP)
Cattail marsh	2
Conifer plantation	7
Eastern hemlock - northern hardwood forest	3
Old field	19
Red maple - black cherry successional forest/woodland	10
Riverine scour vegetation	4
Transportation corridor	1
Silky willow shrub swamp	4
Total Number of Sample Plots	50

Table 3. Location (UTM X and Y coordinates), composition, and abundance of nonnative plant species at vegetation survey plots (VSP), Johnstown Flood National Memorial.

VSP	Community	UTM X	UTM Y	Number of nonnatives	Total nonnative cover	% nonnative cover
4	Cattail marsh	689131.3	4468635.3	5.0	100.0	20.0
35	Cattail marsh	689155.9	4468562.8	2.0	11.0	5.5
3	Conifer plantation	689509.9	4468810.2	17.0	144.0	8.5
18	Conifer plantation	689082.4	4467958.1	11.0	101.0	9.2
12	Conifer plantation	689088.2	4468168.8	9.0	172.0	19.1
41	Conifer plantation	689087.5	4468101.0	9.0	190.0	21.1
46	Conifer plantation	689150.5	4467989.1	7.0	120.0	17.1
15	Conifer plantation	689095.0	4467945.2	6.0	24.0	4.0
20	Conifer plantation	689083.4	4468185.8	5.0	50.0	10.0
26	Eastern hemlock - northern hardwood forest	688841.7	4468791.4	5.0	50.0	10.0
10	Eastern hemlock - northern hardwood forest	688850.0	4468799.0	4.0	90.0	22.5
50	Eastern hemlock - northern hardwood forest	689609.3	4468717.3	4.0	90.0	22.5
42	Old field	689160.6	4469066.8	15.0	282.0	18.8
2	Old field	689290.9	4468826.2	13.0	230.0	17.7
28	Old field	689039.8	4468213.4	10.0	191.0	19.1
24	Old field	688970.6	4468399.0	9.0	54.0	6.0
33	Old field	689053.6	4468179.5	9.0	181.0	20.1
31	Old field	689041.9	4468017.0	8.0	94.0	11.8
47	Old field	689007.0	4468669.0	8.0	85.0	10.6
21	Old field	689416.8	4469135.2	7.0	161.0	23.0
8	Old field	688923.5	4468127.8	5.0	133.0	26.6
45	Old field	689366.6	4468885.8	6.0	210.0	35.0
6	Old field	688939.8	4468691.7	5.0	141.0	28.2
25	Old field	689150.9	4468433.6	5.0	41.0	8.2
22	Old field	688820.5	4468188.1	4.0	240.0	60.0
34	Old field	689610.0	4468799.0	4.0	40.0	10.0
44	Old field	689137.7	4468874.5	3.0	71.0	23.7
48	Old field	689600.1	4468751.0	3.0	30.0	10.0
43	Old field	689061.7	4468863.2	2.0	11.0	5.5

Table 3. Location (UTM X and Y coordinates), composition, and abundance of nonnative plant species at vegetation survey plots (VSP), Johnstown Flood National Memorial (continued).

VSP	Community	UTM X	UTM Y	Number of nonnatives	Total nonnative cover	% nonnative cover
23	Old field	688667.3	4467990.8	7.0	70.0	10.0
9	Old field	688718.9	4467966.4	5.0	50.0	10.0
19	Red maple - black cherry successional forest/woodland	688725.5	4468438.8	1.0	0.0	0.0
37	Red maple - black cherry successional forest/woodland	689219.1	4468719.0	1.0	10.0	10.0
14	Red maple - black cherry successional forest/woodland	689110.6	4469029.2	12.0	220.0	18.3
29	Red maple - black cherry successional forest/woodland	688939.8	4468904.1	9.0	281.0	31.2
30	Red maple - black cherry successional forest/woodland	689189.8	4468359.2	9.0	122.0	13.6
13	Red maple - black cherry successional forest/woodland	689019.9	4468918.1	6.0	60.0	10.0
39	Red maple - black cherry successional forest/woodland	689112.9	4469017.1	6.0	160.0	26.7
7	Red maple - black cherry successional forest/woodland	689173.7	4468314.6	4.0	4.0	1.0
1	Red maple - black cherry successional forest/woodland	688783.7	4468589.7	2.0	2.0	1.0
38	Red maple - black cherry successional forest/woodland	688868.3	4468017.1	1.0	1.0	1.0
11	Riverine scour vegetation	689038.1	4468638.7	13.0	44.0	3.4
17	Riverine scour vegetation	689059.3	4468165.0	11.0	192.0	17.5
27	Riverine scour vegetation	688882.6	4468862.0	8.0	71.0	8.9
36	Riverine scour vegetation	689030.3	4468578.5	6.0	15.0	2.5
40	Silky willow shrub swamp	688969.2	4468885.9	12.0	261.0	21.8
5	Silky willow shrub swamp	689060.4	4468754.2	5.0	42.0	8.4
16	Silky willow shrub swamp	689009.5	4468618.3	2.0	20.0	10.0
32	Silky willow shrub swamp	689034.3	4468795.4	1.0	1.0	1.0
49	Transportation corridor	689074.0	4468386.6	8.0	194.0	24.3

Table 4. Nonnative species summarized by vegetation association, Johnstown Flood National Memorial.

Scientific Name	Common Name	Plots Invaded	%	Cattail Marsh				Conifer Plantation			
				Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Lonicera morrowii	Morrow's honeysuckle	31	62	2	2.0	100.0	30.5	5	7	71.4	10.0
Coronilla varia	purple crownvetch	29	58	---	2.0	---	---	6	7	85.7	18.3
Rosa multiflora	multiflora rose	26	52	---	2.0	---	---	6	7	85.7	8.5
Phalaris arundinacea	reed canarygrass	14	28	---	2.0	---	---	4	7	57.1	35.0
Arctium minus	lesser burdock	12	24	---	2.0	---	---	1	7	14.3	10.0
Glechoma hederacea	ground ivy	12	24	---	2.0	---	---	2	7	28.6	1.0
Anthoxanthum odoratum	sweet vernalgrass	11	22	---	2.0	---	---	3	7	42.9	7.0
Cirsium arvense	Canada thistle	11	22	1	2.0	50.0	10	2	7	28.6	10.0
Dactylis glomerata	orchardgrass	11	22	---	2.0	---	---	3	7	42.9	10.0
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	11	22	---	2.0	---	---	3	7	42.9	43.3
Pinus sylvestris	Scot’s pine	10	20	---	2.0	---	---	1	7	14.3	10.0
Daucus carota	Queen Anne's lace	9	18	---	2.0	---	---	1	7	14.3	10.0
Hesperis matronalis	dames rocket	9	18	---	2.0	---	---	1	7	14.3	1.0
Chrysanthemum leucanthemum	oxeye daisy	8	16	---	2.0	---	---	2	7	28.6	10.0
Alliaria petiolata	garlic mustard	7	14	---	2.0	---	---	2	7	28.6	5.5
Dipsacus fullonum	Fuller's teasel	7	14	2	2.0	100.0	10	---	7	---	---
Rumex obtusifolius	bitter dock	7	14	---	2.0	---	---	---	7	---	---
Berberis thunbergii	Japanese barberry	6	12	---	2.0	---	---	3	7	42.9	10.0
Centaurea stoebe ssp. *micranthos*	spotted knapweed	6	12	---	2.0	---	---	---	7	---	---
Phleum pratense	timothy	6	12	---	2.0	---	---	1	7	14.3	10.0
Plantago lanceolata	narrowleaf plantain	6	12	---	2.0	---	---	1	7	14.3	10.0
Verbascum thapsus	common mullein	6	12	---	2.0	---	---	---	7	---	---
Veronica officinalis	common gypsyweed	6	12	---	2.0	---	---	2	7	28.6	10.0
Taraxacum officinale	common dandelion	5	10	---	2.0	---	---	2	7	28.6	5.5
Agrostis capillaris	colonial bentgrass	4	8	---	2.0	---	---	1	7	14.3	10.0
Clinopodium vulgare	wild basil	4	8	1	2.0	50.0	10	1	7	14.3	10.0
Poa pratensis	Kentucky bluegrass	4	8	---	2.0	---	---	1	7	14.3	1.0
Tussilago farfara	coltsfoot	4	8	---	2.0	---	---	1	7	14.3	10.0
Agrostis gigantea	redtop	3	6	---	2.0	---	---	2	7	28.6	10.0
Elaeagnus umbellata	autumn olive	3	6	---	2.0	---	---	---	7	---	---
Holcus lanatus	common velvetgrass	3	6	---	2.0	---	---	1	7	14.3	10.0
Malus sp.	crab apple	3	6	---	2.0	---	---	1	7	14.3	1.0
Solanum dulcamara	climbing nightshade	3	6	---	2.0	---	---	---	7	---	---
Festuca elatior	meadow fescue	2	4	---	2.0	---	---	---	7	---	---

Table 4. Nonnative species summarized by vegetation association, Johnstown Flood National Memorial (continued).

Scientific Name	Common Name	Plots Invaded	%	Cattail Marsh				Conifer Plantation			
				Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Lolium perenne	perennial ryegrass	2	4	---	2.0	---	---	---	7	---	---
Prunella vulgaris	common selfheal	2	4	---	2.0	---	---	1	7	14.3	10.0
Ranunculus acris	tall buttercup	2	4	---	2.0	---	---	---	7	---	---
Rumex acetosella	common sheep sorrel	2	4	---	2.0	---	---	---	7	---	---
Alnus glutinosa	European alder	1	2	---	2.0	---	---	---	7	---	---
Bromus inermis	smooth brome	1	2	---	2.0	---	---	---	7	---	---
Dianthus armeria	Deptford pink	1	2	---	2.0	---	---	---	7	---	---
Epipactis helleborine	broadleaf helleborine	1	2	---	2.0	---	---	1	7	143	1.0
Hieracium caespitosum	meadow hawkweed	1	2	---	2.0	---	---	1	7	143	1.0
Ligustrum obtusifolium	obtuse-leaved border privet	1	2	---	2.0	---	---	---	7	---	---
Malus pumila	apple	1	2	---	2.0	--	--	1	7	14.3	10.0
Melilotus officinalis	yellow sweetclover	1	2	---	2.0	---	---	---	7	---	---
Nasturtium officinale	watercress	1	2	1	2.0	50.	10	---	7	---	---
Pastinaca sativa	wild parsnip	1	2	---	2.0	---	---	1	7	14.3	10.0
Polygonum caespitosum	oriental ladysthumb	1	2	---	2.0	---	---	---	7	---	---
Rumex crispus	curly dock	1	2	---	2.0	---	---	---	7	---	---
Trifolium pratense	red clover	1	2	---	2.0	---	---	---	7	---	---
Euonymus alata	winged burning bush	1	2	---	2.0	---	---	---	7	---	---
Total number of nonnatives present in plant vegetation association						5.0				32.0	

*Japanese knotweed and giant knotweed were combined for field survey and analysis.

Table 4. Nonnative species summarized by vegetation association, Johnstown Flood National Memorial (continued).

		Eastern Hemlock - Northern Hardwood Forest				Old Field			
Scientific Name	Common Name	Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Lonicera morrowii	Morrow's honeysuckle	3	3	100.0	10.0	11	19	57.9	13.7
Coronilla varia	purple crownvetch	1	3	33.3	10.0	13	19	68.4	48.5
Rosa multiflora	multiflora rose	3	3	100.0	10.0	9	19	47.4	12.6
Phalaris arundinacea	reed canarygrass	---	3	---	---	8	19	42.1	33.9
Arctium minus	lesser burdock	1	3	33.3	10.0	3	19	15.8	7.0
Glechoma hederacea	ground ivy	1	3	33.3	60.0	5	19	26.3	30.0
Anthoxanthum odoratum	sweet vernalgrass	---	3	---	---	6	19	31.6	35.0
Cirsium arvense	Canada thistle	---	3	---	---	4	19	21.1	20.3
Dactylis glomerata	orchardgrass	---	3	---	---	4	19	21.1	22.5
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	1	3	33.3	60.0	2	19	10.5	35.0
Pinus sylvestris	Scot's pine	---	3	---	---	7	19	36.8	6.1
Daucus carota	Queen Anne's lace	---	3	---	---	4	19	21.1	10.0
Hesperis matronalis	dames rocket	2	3	66.7	10.0	2	19	10.5	5.5
Chrysanthemum leucanthemum	oxeye daisy	---	3	---	---	3	19	15.8	7.0
Alliaria petiolata	garlic mustard	---	3	---	---	1	19	5.3	10.0
Dipsacus fullonum	Fuller's teasel	---	3	---	---	2	19	10.5	10.0
Rumex obtusifolius	bitter dock	---	3	---	---	3	19	15.8	7.0
Berberis thunbergii	Japanese barberry	---	3	---	---	2	19	10.5	10.0
Centaurea stoebe ssp. micranthos	spotted knapweed	---	3	---	---	3	19	15.8	10.0
Phleum pratense	timothy	---	3	---	---	3	19	15.8	26.7
Plantago lanceolata	narrowleaf plantain	---	3	---	---	3	19	15.8	10.0
Verbascum thapsus	common mullein	---	3	---	---	5	19	26.3	1.0
Veronica officinalis	common gypsyweed	---	3	---	---	1	19	5.3	10.0
Taraxacum officinale	common dandelion	---	3	---	---	2	19	10.5	5.5
Agrostis capillaris	colonial bentgrass	---	3	---	---	1	19	5.3	10.0
Clinopodium vulgare	wild basil	---	3	---	---	1	19	5.3	10.0
Poa pratensis	Kentucky bluegrass	---	3	---	---	2	19	10.5	5.5
Tussilago farfara	coltsfoot	1	3	33.3	10.0	1	19	5.3	10.0
Agrostis gigantea	redtop	---	3	---	---	1	19	5.3	10.0
Elaeagnus umbellata	autumn olive	---	3	---	---	2	19	10.5	10.0
Holcus lanatus	common velvetgrass	---	3	---	---	2	19	10.5	5.5
Malus sp.	crab apple	---	3	---	---	---	19	---	---
Solanum dulcamara	climbing nightshade	---	3	---	---	---	19	---	---

Table 4. Nonnative species summarized by vegetation association, Johnstown Flood National Memorial (continued).

		Eastern Hemlock - Northern Hardwood Forest				Old Field			
Scientific Name	Common Name	Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Festuca elatior	meadow fescue	---	3	---	---	1	19	5.3	10.0
Lolium perenne	perennial ryegrass	---	3	---	---	2	19	10.5	5.5
Prunella vulgaris	common selfheal	---	3	---	---	1	19	5.3	10.0
Ranunculus acris	tall buttercup	---	3	---	---	1	19	5.3	10.0
Rumex acetosella	common sheep sorrel	---	3	---	---	1	19	5.3	1.0
Alnus glutinosa	European alder	---	3	---	---	1	19	5.3	10.0
Bromus inermis	smooth brome	---	3	---	---	1	19	5.3	10.0
Dianthus armeria	Deptford pink	---	3	---	---	1	19	5.3	10.0
Epipactis helleborine	False hellebore	---	3	---	---	---	19	---	---
Hieracium caespitosum	meadow hawkweed	---	3	---	---	---	19	---	---
Ligustrum obtusifolium	obtuse-leaved border privet	---	3	---	---	1	19	5.3	1.0
Malus pumila	apple	---	3	---	---	---	19	---	---
Melilotus officinalis	yellow sweetclover	---	3	---	---	---	19	---	---
Nasturtium officinale	watercress	---	3	---	---	---	19	---	---
Pastinaca sativa	wild parsnip	---	3	---	---	---	19	---	---
Polygonum caespitosum	oriental ladysthumb	---	3	---	---	---	19	---	---
Rumex crispus	curly dock	---	3	---	---	1	19	5.3	10.0
Trifolium pratense	red clover	---	3	---	---	1	19	5.3	1.0
Euonymus alata	winged burning bush	---	3	---	---	---	19	---	---
				8.0				42.0	

*Japanese knotweed and giant knotweed were combined for field survey and analysis

Table 4. Nonnative species summarized by vegetation association, Johnstown Flood National Memorial (continued).

Scientific Name	Common Name	Red Maple - Black Cherry Successional Forest/Woodland				Riverine Scour Vegetation			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Lonicera morrowii	Morrow's honeysuckle	4	10	40.0	5.5	3	4	75.0	10.0
Coronilla varia	purple crownvetch	5	10	50.0	30.0	1	4	25.0	10.0
Rosa multiflora	multiflora rose	5	10	50.0	14.6	2	4	50.0	5.5
Phalaris arundinacea	reed canarygrass	---	10	---	---	---	4	---	---
Arctium minus	lesser burdock	3	10	30.0	10.0	2	4	50.0	5.5
Glechoma hederacea	ground ivy	4	10	40.0	20.3	---	4	---	---
Anthoxanthum odoratum	sweet vernalgrass	---	10	---	---	2	4	50.0	10.0
Cirsium arvense	Canada thistle	2	10	20.0	35.0	1	4	25.0	1.0
Dactylis glomerata	orchardgrass	3	10	30.0	10.0	---	4	---	---
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	2	10	20.0	30.5	2	4	50.0	35.0
Pinus sylvestris	Scot's pine	1	10	10.0	10.0	1	4	25.0	10.0
Daucus carota	Queen Anne's lace	3	10	30.0	10.0	---	4	---	---
Hesperis matronalis	dames rocket	2	10	20.0	35.0	1	4	25.0	10.0
Chrysanthemum leucanthemum	Oxeye daisy	---	10	---	---	3	4	75.0	1.0
Alliaria petiolata	garlic mustard	3	10	30.0	26.7	---	4	---	---
Dipsacus fullonum	Fuller's teasel	---	10	---	---	---	4	---	---
Rumex obtusifolius	bitter dock	2	10	20.0	10.0	---	4	---	---
Berberis thunbergii	Japanese barberry	1	10	10.0	10.0	---	4	---	---
Centaurea stoebe ssp. micranthos	spotted knapweed	---	10	---	---	3	4	75.0	23.7
Phleum pratense	timothy	1	10	10.0	1.0	---	4	---	---
Plantago lanceolata	narrowleaf plantain	---	10	---	---	2	4	50.0	5.5
Verbascum thapsus	common mullein	1	10	10.0	1.0	---	4	---	---
Veronica officinalis	common gypsyweed	2	10	20.0	10.0	1	4	25.0	1.0
Taraxacum officinale	common dandelion	---	10	---	---	1	4	25.0	1.0
Agrostis capillaris	colonial bentgrass	1	10	10.0	1.0	1	4	25.0	10.0
Clinopodium vulgare	wild basil	---	10	---	---	1	4	25.0	1.0
Poa pratensis	Kentucky bluegrass	1	10	10.0	10.0	---	4	---	---
Tussilago farfara	coltsfoot	---	10	---	---	1	4	25.0	10.0
Agrostis gigantea	redtop	---	10	---	---	---	4	---	---
Elaeagnus umbellata	autumn olive	---	10	---	---	1	4	25.0	10.0
Holcus lanatus	common velvetgrass	---	10	---	---	---	4	---	---
Malus sp.	crab apple	1	10	10.0	1.0	1	4	25.0	10.0

Table 4. Nonnative species summarized by vegetation association, Johnstown Flood National Memorial (continued).

Scientific Name	Common Name	Red Maple - Black Cherry Successional Forest/Woodland				Riverine Scour Vegetation			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Solanum dulcamara	climbing nightshade	1	10	10.0	10.0	---	4	---	---
Festuca elatior	meadow fescue	1	10	10.0	60.0	---	4	---	---
Lolium perenne	perennial ryegrass	---	10	---	---	---	4	---	---
Prunella vulgaris	common selfheal	---	10	---	---	---	4	---	---
Ranunculus acris	tall buttercup	---	10	---	---	---	4	---	---
Rumex acetosella	common sheep sorrel	---	10	---	---	1	4	25.0	1.0
Alnus glutinosa	European alder	---	10	---	---	---	4	---	---
Bromus inermis	smooth brome	---	10	---	---	---	4	---	---
Dianthus armeria	Deptford pink	---	10	---	---	---	4	---	---
Epipactis helleborine	false hellebore	---	10	---	---	---	4	---	---
Hieracium caespitosum	meadow hawkweed	---	10	---	---	---	4	---	---
Ligustrum obtusifolium	obtuse-leaved border privet	---	10	---	---	---	4	---	---
Malus pumila	apple	---	10	---	---	---	4	---	---
Melilotus officinalis	yellow sweetclover	1	10	10.0	10.0	---	4	---	---
Nasturtium officinale	watercress	---	10	---	---	---	4	---	---
Pastinaca sativa	wild parsnip	---	10	---	---	---	4	---	---
Polygonum caespitosum	oriental ladysthumb	---	10	---	---	1	4	25.0	10.0
Rumex crispus	curly dock	---	10	---	---	---	4	---	---
Trifolium pratense	red clover	---	10	---	---	---	4	---	---
Euonymus alata	winged burning bush	---	10	---	---	---	4	---	---
				23.0				21.0	

*Japanese knotweed and giant knotweed were combined for field survey and analysis

Table 4. Nonnative species summarized by plant vegetation association, Johnstown Flood National Memorial (continued).

Scientific Name	Common Name	Transportation Corridor				Silky Willow Shrub Swamp			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Lonicera morrowii	Morrow's honeysuckle	1	1	100.0	1.0	2	4	50.0	10.0
Coronilla varia	purple crownvetch	1	1	100.0	60.0	2	4	50.0	35.0
Rosa multiflora	multiflora rose	---	1	---	---	1	4	25.0	1.0
Phalaris arundinacea	reed canarygrass	1	1	100.0	1.0	1	4	25.0	10.0
Arctium minus	lesser burdock	---	1	---	---	2	4	50.0	10.0
Glechoma hederacea	ground ivy	---	1	---	---	---	4	---	---
Anthoxanthum odoratum	sweet vernalgrass	---	1	---	---	---	4	---	---
Cirsium arvense	Canada thistle	---	1	---	---	1	4	25.0	10.0
Dactylis glomerata	orchardgrass	1	1	100.0	60.0	---	4	---	---
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	---	1	---	---	1	4	25.0	60.0
Pinus sylvestris	Scot’s pine	---	1	---	---	---	4	---	---
Daucus carota	Queen Anne's lace	1	1	100.0	1.0	---	4	---	---
Hesperis matronalis	dames rocket	---	1	---	---	1	4	25.0	10.0
Chrysanthemum leucanthemum	Oxeye daisy	---	1	---	---	---	4	---	---
Alliaria petiolata	garlic mustard	---	1	---	---	1	4	25.0	60.0
Dipsacus fullonum	Fuller's teasel	1	1	100.0	1.0	2	4	50.0	5.5
Rumex obtusifolius	bitter dock	---	1	---	---	2	4	50.0	5.5
Berberis thunbergii	Japanese barberry	---	1	---	---	---	4	---	---
Centaurea stoebe ssp. micranthos	spotted knapweed	---	1	---	---	---	4	---	---
Phleum pratense	timothy	1	1	100.0	10.0	---	4	---	---
Plantago lanceolata	narrowleaf plantain	---	1	---	---	---	4	---	---
Verbascum thapsus	common mullein	---	1	---	---	---	4	---	---
Veronica officinalis	common gypsyweed	---	1	---	---	---	4	---	---
Taraxacum officinale	common dandelion	---	1	---	---	---	4	---	---
Agrostis capillaris	colonial bentgrass	---	1	---	---	---	4	---	---
Clinopodium vulgare	wild basil	---	1	---	---	---	4	---	---
Poa pratensis	Kentucky bluegrass	---	1	---	---	---	4	---	---
Tussilago farfara	coltsfoot	---	1	---	---	---	4	---	---
Agrostis gigantea	redtop	---	1	---	---	---	4	---	---
Elaeagnus umbellata	autumn olive	---	1	---	---	---	4	---	---
Holcus lanatus	common velvetgrass	---	1	---	---	---	4	---	---
Malus sp.	crab apple	---	1	---	---	---	4	---	---

Table 4. Nonnative species summarized by plant vegetation association, Johnstown Flood National Memorial (continued).

Scientific Name	Common Name	Transportation Corridor				Silky Willow Shrub Swamp			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Solanum dulcamara	climbing nightshade	---	1	---	---	2	4	50.0	10.0
Festuca elatior	meadow fescue	---	1	---	---	---	4	---	---
Lolium perenne	perennial ryegrass	---	1	---	---	---	4	---	---
Prunella vulgaris	common selfheal	---	1	---	---	---	4	---	---
Ranunculus acris	tall buttercup	---	1	---	---	---	4	---	10.0
Rumex acetosella	common sheep sorrel	---	1	---	---	---	4	---	---
Alnus glutinosa	European alder	---	1	---	---	---	4	---	---
Bromus inermis	smooth brome	---	1	---	---	---	4	---	---
Dianthus armeria	Deptford pink	---	1	---	---	1	4	25.0	---
Epipactis helleborine	false hellebore	---	1	---	---	---	4	---	---
Hieracium caespitosum	meadow hawkweed	---	1	---	---	---	4	---	---
Ligustrum obtusifolium	obtuse-leaved border privet	---	1	---	---	---	4	---	---
Malus pumila	apple	---	1	---	---	---	4	---	---
Melilotus officinalis	yellow sweetclover	---	1	---	---	---	4	---	---
Nasturtium officinale	watercress	---	1	---	---	---	4	---	---
Pastinaca sativa	wild parsnip	---	1	---	---	---	4	---	---
Polygonum caespitosum	oriental ladysthumb	---	1	---	---	---	4	---	---
Rumex crispus	curly dock	---	1	---	---	---	4	---	---
Trifolium pratense	red clover	---	1	---	---	---	4	---	---
Euonymus alata	winged burning bush	1	1	100.0	60.0	---	4	---	---
				8.0				13.0	

*Japanese knotweed and giant knotweed were combined for field survey and analysis

JOFL range from patches of higher quality forest to patches of open woodland that developed on the former agriculture land abandoned after the flood. In general, these forests are essentially young or degraded versions of the northern hardwood forest type or Black Cherry - Northern Hardwood Forest type described by Fike (1999) that are typical of this region of Pennsylvania (Perles et al. 2006a). Field work during vegetation mapping activities detailed in Perles et al. (2006a) revealed a relatively large stand of older, fair quality Red Maple - Black Cherry Successional Forest on the western border of the park, with relatively large trees and only a few nonnative plants at a low percent cover (VSP 1; Table 3). This forest patch is known to provide habitat for rare plants such as Appalachian blue violet (*Viola appalachiensis*) (WPC 2003).

The three points in the two patches of Eastern Hemlock - Northern Hardwood Forest contained between four and five species each (Table 3), and included Morrow's honeysuckle and multiflora rose. All together, there were eight nonnative plant species recorded for this type at JOFL (Table 4). Although the Eastern Hemlock - Northern Hardwood Forest patches that occur in the park are most likely remnants of the northern hardwood forest types that are typical of this region of Pennsylvania (Perles et al. 2006a), the findings are consistent with the notion that fragmented habitats are significantly more vulnerable to invasion than larger intact later successional types (Robertson et al. 1994; Symstad 2000; Cadenasso and Pickett 2001). Purple crownvetch was present at one point (10% cover; Table 4). Its presence, along with the Morrow's honeysuckle and multiflora rose, suggests that these patches have experienced some disturbance or are simply so small that edge effects (i.e., high light availability) are present throughout the patch.

For the forest types, the number and percent cover of nonnative plants most likely falls along a disturbance gradient as more mature, closed canopy types, such as the remnant Eastern Hemlock - Northern Hardwoods Forest, exhibit a lower number and percent cover of nonnative plants than successional types. This was also observed within Red Maple - Black Cherry Successional Forest / Woodland patches. Those with a more developed overstory and a history that included fewer recent disturbances (i.e., conversion from forest to active agriculture) supported fewer nonnative species than patches with a more open canopy and recent conversion from active agriculture (*personal observation*). However, information on site history was not collected for each point, and forest canopy characteristics and site conditions needed for further analysis were not a part of this study.

Points situated in the Riverine Scour patches (n = 4) contained between six and 13 nonnative species each. This type, located on bars, islands, and spits in and adjacent to the South Fork of the Little Conemaugh River, is highly variable in vegetation structure and species composition overall due to the frequent scour that these sites experience (Perles et al. 2006a). The frequent flooding and scour events facilitate establishnent of nonnative and opportunistic native species. A total of 21 nonnative species (Table 4) were observed in this vegetation association frequently disturbed by annual flooding events. Species able to establish rapidly following scour and which can tolerate the sandy, rocky soil conditions thrive. Morrow's honeysuckle, multiflora rose, spotted knapweed, sweet vernalgrass, oxeye daisy (*Chrysanthemum leucanthemum*), and narrowleaf plantain (*Plantago lanceolata*) are regularly found in this type.

The two points in the Cattail Marsh (n=2) contained two and five nonnative species (Table 4). Morrow's honeysuckle and Fuller's teasel were present at both points. There were only five nonnative species recorded for this type (Table 4). The nonnative plant composition of the Silky

Willow Shrub Swamp patches (n= 4) ranged between one and 12 species (Table 4). Morrow's honeysuckle and Fuller's teasel were also prominent species. Both the Cattail Marsh and Silky Willow Shrub Swamp are maintained by the berm that supports the railroad and influences the hydrology in the immediate area by preventing water from draining to the South Fork of the Little Conemaugh River (Perles et al. 2006a).

Points in Old Field type (n=19, Table 2) contained between two and 15 species of nonnative plants (Table 3). There were a total of 42 nonnative plant species recorded in the Old Field patches at JOFL (Table 4). Abandoned agricultural fields and pastures are thought to be highly susceptible to nonnative species invasion (Robertson et al. 1994; Pyle 1995; Stover and Marks 1998; Goldblum and Beatty 1999). However, Old Field patches did not have consistently high numbers of nonnative species, as one might expect. The differences in vegetation reflect the land use history, ongoing management, and varied environmental settings of the park. Three subtypes of the Old Field vegetation type were identified at JOFL during vegetation mapping activities (Perles et al. 2006a): the Herbaceous subtype, the Wet Meadow subtype, and the Hawthorn subtype. This further suggests possible reasons for the differences observed in the composition of nonnative species. As these subtypes were not delineated in mapping activities (Perles et al. 2006a), it was not possible to make further distinctions among old fields. The differences in hydrology most likely affect composition as only species able to tolerate saturated soils can survive in Wet Meadow subtype patches. Similar statements may be made for management (mowing, planting, and use of herbicide) as the Hawthorn subtype most likely represents old fields with a substantial shrub component. Resource managers at JOFL maintain Old Field patches in the area of the former Lake Conemaugh lakebed to improve the view of the landscape from the visitor's center and to represent the extent of the reservoir prior to the flood. As part of the Lakebed Vegetation Management Plan, a series of management activities were conducted between 1988 and 1991 to remove pine trees and to plant grasses and forbs in the treated areas. Several of the nonnatives present in the Old Fields, like purple crownvetch, may have been deliberately planted as part of the re-vegetation activities. An intensive management regime of woody plant removal and herbicide application was employed from 1995 through 2000 (Eick 1996). In 2003, a crew of Student Conservation Association volunteers performed nonnative invasive woody shrub control in the lakebed. These sites have continued to have tree and shrub species removed (K. Penrod, pers. comm., 2005).

Points in the Conifer Plantations (n = 7; Table 3) contained between six and 17 nonnative plant species. There were 32 nonnative species recorded in all. The remnant pine plantations are all of what is left of the planted stands of Scot's pine, eastern white pine, and red pine (Bowersox 1986). The variability is probably due to the relative openness of the canopy. While some Conifer Plantations are closed-canopy forest stands, others are more open in nature and contain a similar composition of nonnative species as Old Fields. This is not unexpected, as much of the land had been once cleared for grazing prior to establishment of the Conifer Plantations.

The findings illustrate the disturbed, early successional nature of all plant communities at JOFL. The range in the number of nonnative plant species in each type at JOFL indicates that vegetation association alone is not the sole determiner of invasive species composition. One problem of analyzing nonnative composition by vegetation association is that the definitions of all vegetation associations were very broad and included different successional states (Perles et al. 2006a). For example, the Red Maple - Black Cherry Successional Forest / Woodland types

range from patches of forest to patches of open woodland that developed on the former agriculture land abandoned after the flood. While these forests are either young versions of the northern hardwood forest type or black cherry - northern hardwood forest type described by Fike (1999) that are typical of this region of Pennsylvania, or degraded versions (Perles et al. 2006a), the impacts of historic land management is significant to the current plant composition.

Prominent Nonnative Species in Detail

Morrow's honeysuckle was present at 31 out of the 50 vegetation sampling points and was represented in every plant vegetation association at JOFL (Table 4). While primarily found in open, successional habitats, it can tolerate shade with reduced flowering and seed production (Rhoads and Block 2002f) and invade thinned edges and fragmented closed-canopy systems (Brothers and Spingarn 1992; Cadenasso and Pickett 2001). The species also appears to be able to tolerate somewhat saturated soils, as it was present in the Cattail Marsh and Silky Willow Shrub Swamp. However, it was more than likely present on mounds raised above the water line and on the edges of this type. Its occurrence among all vegetation associations at JOFL suggests a high level of historic disturbance. The average percent cover (a figure calculated by averaging the cover values of a species at all points by number of points sampled) of the Morrow's honeysuckle in each type was often at or near 10%, indicating that it was common in most areas but not dominant (Table 4). Since 2001, the park has removed and continues to remove nonnative Morrow's and Amur honeysuckles (*Lonicera maackii*) at the former lakebed and along the South Abutment and Picnic Area roads (K. Penrod, pers. comm., 2007).

Multiflora rose was present at 29 of the 50 points (Table 1) and present in all but the Cattail Marsh community and at the one point along a dirt road through the former lakebed (Transportation Corridor; Table 4). It was present at only one point in the Silky Willow Shrub Swamp, where it was found to be rare (Table 4). Its low abundance in the Silky Willow Shrub Swamp and absence in the Cattail Marsh types is expected, given its intolerance to very wet conditions (Smith 1993). Multiflora rose, while often associated with disturbed and semi-open habitats (Smith 1993; Robertson et al. 1994; Stover and Marks 1998), is also able to spread into closed-canopy systems, albeit at a lower density (Rhoads and Block 2002g). Like Morrow's honeysuckle, its high occurrence in the forest types suggests a high degree of disturbance at JOFL. Past removal or cutting of Morrow's honeysuckle may have limited its establishment at VSP 49 situated along the dirt road through the lakebed. In 2003, the park removed some patches of multiflora rose at the former lakebed; however, not all patches could be treated at that time due to seasonal flooding of some areas (K. Penrod, pers. comm., 2007).

Unlike the two shrubby species, purple crownvetch is limited to open, brightly lit spaces (Gleason and Cronquist 1991; Tu 2003). It was found at 29 of the 50 points at JOFL and at a high frequency (71%) and average cover (52% cover) in Old Field types, including built-up areas and along roadsides (classified as Old Field at JOFL). Because it has been widely used as a cover species along roadsides and as an erosion control agent on steep slopes, its presence here is expected. Its moderate coverage value in hemlock - northern hardwood forest (10% cover) is most likely an artifact of low sample size: its presence at 33 percent of the points (three points total) in this community (Table 4) indicates that there was only one occurrence. However, even at a single point, its presence was surprising in this forest type, which usually only supports species able to tolerate low-light conditions. The occurrence of purple crownvetch at this one

point may be a symptom of the high variation of land use and disturbance history of the JOFL landscape. Additionally, it may have established following a natural opening of the canopy if it was located near enough to the forest edge for invasion to occur (Goldblum and Beatty 1999). The relatively small patch size of the intact forest patches and associated characteristics of smaller patches (i.e., greater edge, greater amount of light, etc.), in addition to the land use and landscape history, facilitate nonnative species establishment.

Other prominent species that, while not abundant at JOFL, should be a concern of managers are: dame's rocket (*Hesperis matronalis*), found at nine sampling points; garlic mustard, found at seven points; Japanese barberry, found at six points; and autumn olive (*Elaeagnus umbellata*), which was present at three points. Norway maple, as mentioned before, was not found among the sampling points, but is present at one location at JOFL along the road leading to the South Abutment parking lot (Figure 4).

Other commonly encountered nonnative plants included species associated with old fields, like sweet vernalgrass, Canada thistle, and orchardgrass. These species do not appear to be able to survive beneath the forest canopy. Reed canarygrass was also found in all open vegetation associations, including many of the Old Field patches sampled. Its absence in the Red Maple - Black Cherry Forest/Woodland types suggests that the species survivorship is also reduced beneath a more intact canopy.

Japanese knotweed and giant knotweed were treated as one species due to the difficulty of estimating species cover in large mixed stands. These two species were found throughout the park, ranging from small populations of a single species to what appear to be larger swarms of both species and a hybrid between the two. Japanese/giant knotweed was most prevalent in Old Field patches and occurred with equal frequency elsewhere except for Cattail Marsh and Eastern Hemlock - Northern Hardwood Forest types (Table 4). Because of the general disturbance of all types at JOFL, and low number of sample sites, it was not possible to elucidate patterns of invasion. Since 2000, the park has removed and continues to spot treat Japanese and giant knotweed patches at park roads and at the former lakebed, including the largest and most dense patches formerly located near the river (Penrod, pers. comm., 2007).

Allegheny Portage Railroad National Historic Site

A total of 92 nonnative plant species were recorded at vegetation sampling points (VSPs) and points along roads and trails at ALPO (Table 5). The list included both Japanese and giant knotweed species, and like JOFL, these two species were treated as one, due to the difficulty of assessing cover of each species within large mixed stands. Thus, 91 species were used in analyses. Eighty-two nonnative species were found among the 200 VSPs in the 16 described vegetation associations (Figure 2; Table 5). Of the 82 nonnative species recorded at the sampling points, 16 were found at over 10 percent of the points surveyed. In addition to the species recorded during vegetation mapping activities at ALPO, eight species were found only occurring on or along roads and trails. Norway maple, was not found among the sampling points or along the trails and roadsides, but is present at one location in the Main Unit ALPO (Figure 5).

Table 5. List of nonnative plant species present at Allegheny Portage Railroad National Historic Site with abundance and cultivation codes and invasive status as stated by PA Department of Conservation and Natural Resources.

Scientific Name	Common Name	Points Where Present	%of Points Present	Abundance[a]	Cultivation[b]	Invasive[c]	Threat (PA DCNR)[d]
Rosa multiflora	multiflora rose	69	34.5	Common	Not cultivated	Yes	Serious
Lonicera morrowii	Morrow's honeysuckle	39	19.5	Common	Not cultivated	Yes	Serious
Dactylis glomerata	orchardgrass	38	19.0	Common	Not cultivated	No	No
Alliaria petiolata	garlic mustard	35	17.5	Common	Not cultivated	Yes	Serious
Anthoxanthum odoratum	sweet vernalgrass	33	16.5	Common	Not cultivated	No	No
Berberis thunbergii	Japanese barberry	32	16.0	Common	Not cultivated	Yes	Moderate
Polygonum caespitosum	oriental ladysthumb	30	15.0	Unknown	Not cultivated	No	No
Glechoma hederacea	ground ivy	26	13.0	Common	Not cultivated	No	No
Phalaris arundinacea	reed canarygrass	26	13.0	Common	Not cultivated	Yes	Moderate
Agrostis capillaris	colonial bentgrass	24	12.0	Common	Not cultivated	No	No
Microstegium vimineum	Japanese stiltgrass	24	12.0	Common	Not cultivated	Yes	Serious
Poa pratensis	Kentucky bluegrass	23	11.5	Unknown	Persistent	No	No
Achillea millefolium	common yarrow	22	11.0	Common	Not cultivated	No	No
Chrysanthemum leucanthemum	oxeye daisy	21	10.5	Common	Not cultivated	No	No
Festuca elatior	meadow fescue	21	10.5	Common	Not cultivated	Yes	No
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	20	10.0	Common	Not cultivated	Yes	Serious
Clinopodium vulgare	wild basil	19	9.5	Unknown	Not cultivated	No	No
Poa compressa	Canada bluegrass	18	9.0	Unknown	Not cultivated	No	No
Daucus carota	Queen Anne's lace	17	8.5	Unknown	Not cultivated	No	No
Phleum pratense	timothy	17	8.5	Unknown	Not cultivated	No	No
Taraxacum officinale	common dandelion	17	8.5	Unknown	Not cultivated	No	No
Hesperis matronalis	dames rocket	16	8.0	Unknown	Not cultivated	Yes	Moderate
Veronica officinalis	common gypsyweed	15	7.5	Unknown	Not cultivated	No	No
Cirsium arvense	Canada thistle	14	7.0	Unknown	Not cultivated	Yes	Serious
Rumex obtusifolius	bitter dock	14	7.0	Unknown	Not cultivated	No	No
Bromus inermis	smooth brome	13	6.5	Unknown	Not cultivated	No	No
Elaeagnus umbellata	autumn olive	13	6.5	Uncommon	Not cultivated	Yes	Serious
Coronilla varia	purple crownvetch	12	6.0	Unknown	Not cultivated	Yes	No
Ligustrum obtusifolium	obtuse-leaved border privet	12	6.0	Unknown	Not cultivated	Yes	Moderate
Lotus corniculatus	bird’s-foot trefoil	12	6.0	Unknown	Not cultivated	No	No
Hieracium caespitosum	meadow hawkweed	11	5.5	Common	Not cultivated	No	No
Arctium minus	lesser burdock	10	5.0	Uncommon	Not cultivated	No	No
Barbarea vulgaris	common wintercress	10	5.0	Uncommon	Not cultivated	No	No
Cirsium vulgare	bull thistle	10	5.0	Uncommon	Not cultivated	No	Serious
Plantago lanceolata	narrowleaf plantain	10	5.0	Uncommon	Not cultivated	No	No
Centaurea stoebe ssp. *micranthos*	spotted knapweed	9	4.5	Uncommon	Not cultivated	Yes	No

Table 5. List of nonnative plant species present at Allegheny Portage Railroad National Historic Site with abundance and cultivation codes and invasive status as stated by PA Department of Conservation and Natural Resources (continued).

Scientific Name	Common Name	Points Where Present	%of Points Present	Abundance[a]	Cultivation[b]	Invasive[c]	Threat (PA DCNR)[d]
Holcus lanatus	common velvetgrass	9	4.5	Uncommon	Not cultivated	No	No
Lepidium campestre	field pepperweed	9	4.5	Uncommon	Not cultivated	No	No
Dipsacus fullonum	Fuller's teasel	8	4.0	Uncommon	Not cultivated	No	No
Prunella vulgaris	common selfheal	8	4.0	Uncommon	Not cultivated	No	No
Ranunculus acris	tall buttercup	8	4.0	Uncommon	Not cultivated	No	No
Saponaria officinalis	bouncingbet	8	4.0	Uncommon	Not cultivated	No	No
Agrostis gigantea	redtop	6	3.0	Uncommon	Not cultivated	No	No
Lonicera maackii	Amur honeysuckle	6	3.0	Uncommon	Not cultivated	Yes	Serious
Hieracium aurantiacum	orange hawkweed	5	2.5	Uncommon	Not cultivated	No	No
Malus pumila	apple	5	2.5	Uncommon	Persistent	No	No
Rumex acetosella	common sheep sorrel	5	2.5	Uncommon	Not cultivated	No	No
Rumex crispus	curly dock	5	2.5	Uncommon	Not cultivated	No	No
Tragopogon dubius	yellow salsify	5	2.5	Uncommon	Not cultivated	No	No
Celastrus orbiculatus	oriental bittersweet	4	2.0	Common	Not cultivated	Yes	Serious
Linaria vulgaris	butter and eggs	4	2.0	Common	Not cultivated	No	No
Rhamnus cathartica	common buckthorn	4	2.0	Unknown	Not cultivated	Yes	Moderate
Trifolium repens	white clover	4	2.0	Common	Not cultivated	No	No
Ailanthus altissima	tree-of-heaven	3	1.5	Common	Not cultivated	Yes	Serious
Cerastium fontanum	common mouse-ear chickweed	3	1.5	Unknown	Not cultivated	No	No
Medicago lupulina	black medick	3	1.5	Unknown	Not cultivated	No	No
Trifolium pratense	red clover	3	1.5	Unknown	Not cultivated	No	No
Artemisia vulgaris	common wormwood	2	1.0	Unknown	Not cultivated	No	No
Hemerocallis fulva	orange daylily	2	1.0	Unknown	Not cultivated	Yes	No
Melilotus officinalis	yellow sweetclover	2	1.0	Unknown	Not cultivated	No	No
Rosa canina	dog rose	2	1.0	Rare	Persistent	No	No
Solanum dulcamara	climbing nightshade	2	1.0	Rare	Not cultivated	No	No
Stellaria media	common chickweed	2	1.0	Unknown	Not cultivated	No	No
Trifolium aureum	large yellow hop-clover	2	1.0	Unknown	Not cultivated	No	No
Tussilago farfara	coltsfoot	2	1.0	Unknown	Not cultivated	No	No
Anagallis arvensis	scarlet pimpernel	1	0.5	Unknown	Not cultivated	No	No
Anaphalis margaritacea	pearly everlasting	1	0.5	Unknown	Not cultivated	No	No
Brassica nigra	black mustard	1	0.5	Unknown	Not cultivated	No	No
Convallaria majalis	European lily of the valley	1	0.5	Rare	Not cultivated	No	No
Dianthus armeria	Deptford pink	1	0.5	Unknown	Not cultivated	No	No
Epipactis helleborine	false hellebore	1	0.5	Rare	Not cultivated	No	No
Forsythia sp.	forsythia	1	0.5	Rare	Not cultivated	No	No

Table 5. List of nonnative plant species present at Allegheny Portage Railroad National Historic Site with abundance and cultivation codes and invasive status as stated by PA Department of Conservation and Natural Resources (continued).

Scientific Name	Common Name	Points Where Present	%of Points Present	Abundance[a]	Cultivation[b]	Invasive[c]	Threat (PA DCNR)[d]
Humulus japonicus	Japanese hop	1	0.5	Rare	Not cultivated	Watch list	No
Hypochaeris radicata	hairy catsear	1	0.5	Unknown	Not cultivated	No	No
Iris pseudacorus	yellow iris	1	0.5	Rare	Not cultivated	No	No
Lathyrus latifolius	perennial pea	1	0.5	Unknown	Not cultivated	No	No
Lysimachia nummularia	moneywort	1	0.5	Unknown	Not cultivated	No	No
Picea abies	Norway spruce	1	0.5	Rare	Not cultivated	No	No
Pinus sylvestris	Scot's pine	1	0.5	Rare	Not cultivated	No	No
Syringa vulgaris	common lilac	1	0.5	Rare	Not cultivated	No	No
Verbascum thapsus	common mullein	1	0.5	Unknown	Not cultivated	No	No
Vinca minor	common periwinkle	1	0.5	Rare	Not cultivated	Yes	No
*Acer platanoides**	Norway maple	0	0.0	Uncommon	Not cultivated	Yes	Serious
*Chelidonium majus**	celandine	0	0.0	Rare	Not cultivated	Yes	No
*Echium vulgare**	common vipersbugloss	0	0.0	Rare	Not cultivated	No	No
*Euphorbia cyparissias **	cypress spurge	0	0.0	Rare	Not cultivated	No	No
*Galinsoga quadriradiata**	shaggy-soldier	0	0.0	Unknown	Not cultivated	No	No
*Pastinaca sativa**	wild parsnip	0	0.0	Unknown	Not cultivated	Yes	Moderate
*Rubus phoenicolasius**	wine raspberry	0	0.0	Rare	Not cultivated	Yes	Moderate
*Sedum telephium**	witch's moneybags	0	0.0	Rare	Persistent	No	No
*Senecio vulgaris**	old-man-in-the-spring	0	0.0	Rare	Not cultivated	No	No

*Species present at ALPO, but was found outside vegetation sample points or along trail points

[a]Abundance Codes: Abundant designation for species present at >50% of sample locations, or observed covering a large portion of the park, Common = occurring at 10 to 50 percent of sample locations, Uncommon = species present between 4 and 10% of sample locations, Rare = species present at 2% or fewer sample locations; If insufficient data to determine population, Abundance was listed as "Unknown."

[b]Cultivation codes: Designated as "cultivated" if species was purposely planted and maintained (e.g. agricultural crops), "not cultivated" if species was not planted, or "persistent" of plant species was once planted, but now not maintained (e.g. nonnative pines in plantations) (NPS 1996).

[c]Invasive: plant species listed as "invasive" by Pennsylvania Department of Conservation and Natural Resources (PA DCNR) Invasive Exotic Plant Management Tutorial for Natural Lands Managers (PA DCNR 2005b; http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm).

[d]Threat (PA DCNR): designation or threat posed by a species given by PA DCNR Invasive Species in Pennsylvania (PA DCNR 2005a; http://www.dcnr.state.pa.us/forestry/wildplant/invasive.aspx).

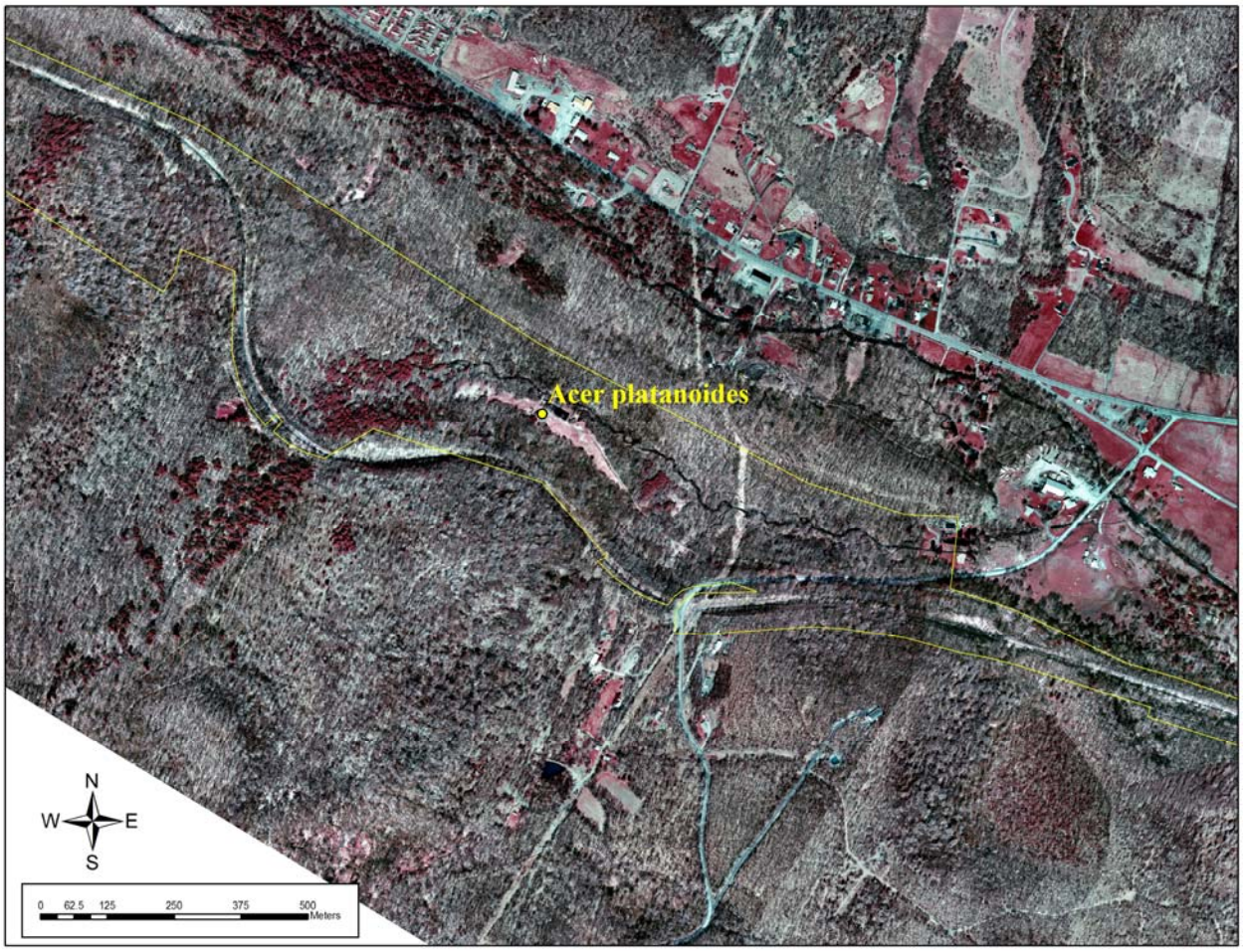

Figure 5. Location of Norway maple (*Acer platanoides*), Allegheny Portage Railroad National Historic Site, Main Unit.

In all, 19 species out of the 92, including Norway maple and those found along roads and trails at the park, are listed as posing a moderate to serious threat to native plants and habitats in Pennsylvania according to the PA DCNR Invasive Species in Pennsylvania (http://www.dcnr.state.pa.us/forestry/wildplant/invasive.aspx). Five others, common periwinkle (*Vinca minor*), purple crownvetch, orange daylily (*Hemerocallis fulva*), spotted knapweed, and meadow fescue were species considered invasive on the PA DCNR's Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm. Invasive plant mapping activities in 1999 identified one location where Japanese honeysuckle was present (Appendix A2). However, this species was not found among vegetation sample points during 2005 or 2006.

The most widespread nonnative plant species was multiflora rose, which was present at just under 35 percent of the 200 survey points (69 points; Table 5) and in every vegetation association except for Eastern Hemlock - Northern Hardwood Forest, Hemlock - Tuliptree - Birch Forest, Dry Eastern Hemlock - Oak Forest, and Sparsely Vegetated Cliff types (Table 6). No other nonnative plant species was present at more than 20 percent of the points surveyed. Morrow's honeysuckle was present at just under 20% of all points (19.5%; Table 5). However, it was locally abundant and found with a much higher frequency in Old Field, Disturbed and Modified Successional Forest types (Table 7; see community results and discussion below). Other species found in over ten percent of the sample points were orchardgrass, garlic mustard, sweet vernalgrass, Japanese barberry, oriental ladysthumb (*Polygonum caespitosum*), ground ivy, reed canarygrass, Japanese stiltgrass (*Microstegium vimineum*), colonial bentgrass (*Agrostis capillaris*), Kentucky bluegrass (*Poa pratensis*), common yarrow (*Achillea millefolium*), oxeye daisy, meadow fescue, and Japanese or giant knotweed (Table 5).

Relation of Nonnative Species to Vegetation Association

Vegetation classification and mapping activities identified 16 vegetation associations: Alder Riverine Shrubland, Allegheny Hardwood Forest, Conifer Plantation, Dry Eastern Hemlock - Oak Forest, Eastern Hemlock - Northern Hardwood Forest, Eastern Hemlock - Tuliptree - Birch Forest, Japanese or Giant Knotweed Herbaceous Vegetation, Modified Successional Forest, Northern Hardwood Forest, Northern Red Oak - Northern Hardwood Forest, Reed Canarygrass Riverine Grassland, Sparsely Vegetated Cliff, Successional Old Field, Sugar Maple Floodplain Forest, Tuliptree - Beech - Maple Forest, and Wet Meadow (Perles et al. 2006d). The Sparsely Vegetated Cliff Plant Community on the vertical rock features were created during the construction of the portage railroad; although, some small natural cliffs may occur away from the Trace (Perles et al. 2006d). These vegetation associations are strongly influenced by the varied environmental setting, historic development, and agricultural activities.

Sample points in hardwood and mixed hardwood - hemlock forest (Red Oak - Northern Hardwood Forest [n=17; Table 6], Allegheny Hardwoods Forest [n=37; Table 6], Northern Hardwoods Forest [n=28; Table 6], Eastern Hemlock - Northern Hardwood Forests [n=14; Table 6], Hemlock Tuliptree - Birch Forest [n=3; Table 6], Sugar Maple Floodplain Forest [n=9; Table 6], and Tuliptree - Beech - Maple Forest [n=5; Table 6]) types all contained fewer than eight nonnative plant species for any one point (Table 8). A number of points within these patches had no nonnative plants (Table 8). The points surveyed in Dry Eastern Hemlock - Oak Forest patches (n=4; Table 6) did not contain any nonnative plants at all (Table 8).

Table 6. Number of sample plots in each vegetation association, Allegheny Portage Railroad National Historic Site.

Vegetation Association	Number of Vegetation Sample Points (VSP)
Northern Red Oak - Northern Hardwood Forest	17
Allegheny Hardwood Forest	37
Modified Successional Forest	25
Successional Old Field	35
Conifer Plantation	7
Northern Hardwood Forest	28
Eastern Hemlock - Northern Hardwood Forest	14
Sugar Maple Floodplain Forest	9
Sparsely Vegetated Cliff	3
Hemlock - Tuliptree - Birch Forest	3
Dry Eastern Hemlock - Oak Forest	4
Wet Meadow	4
Japanese or Giant Knotweed Herbaceous Vegetation	5
Tuliptree - Beech - Maple Forest	5
Alder Riverine Shrubland	2
Reed Canarygrass Riverine Grassland	2
Total Number of Sample Plots	200

Table 7. Nonnative species summarized by vegetation association, Allegheny Portage Railroad National Historic Site.

Scientific Name	Common Name	Plots Invaded	%	Northern Red Oak - Northern Hardwood Forest				Allegheny Hardwood Forest			
				Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Rosa multiflora	multiflora rose	69	34.5	6	17	35.3	16.8	6	37	16.2	5.5
Lonicera morrowii	Morrow's honeysuckle	39	19.5	2	17	5.9	5.5	---	37	---	---
Dactylis glomerata	orchardgrass	38	19.0	1	17	5.9	1.0	1	37	2.7	10.0
Alliaria petiolata	garlic mustard	35	17.5	2	17	11.8	5.5	1	37	2.7	10.0
Anthoxanthum odoratum	sweet vernalgrass	33	16.5	1	17	5.9	10.0	1	37	2.7	10.0
Berberis thunbergii	Japanese barberry	32	16.0	1	17	5.9	10.0	4	37	10.8	5.3
Polygonum caespitosum	oriental ladysthumb	30	15.0	3	17	17.6	7.0	3	37	8.1	7.0
Glechoma hederacea	ground ivy	26	13.0	1	17	5.9	10.0	---	37	---	---
Phalaris arundinacea	reed canarygrass	26	13.0	---	17	---	---	---	37	---	---
Agrostis capillaris	colonial bentgrass	24	12.0	2	17	11.8	30.5	3	37	8.1	7.0
Microstegium vimineum	Japanese stiltgrass	24	12.0	1	17	5.9	10.0	2	37	5.4	5.0
Poa pratensis	Kentucky bluegrass	23	11.5	1	17	5.9	10.0	---	37	---	---
Achillea millefolium	common yarrow	22	11.0	---	17	---	---	---	37	---	---
Chrysanthemum leucanthemum	oxeye daisy	21	10.5	---	17	---	---	---	37	---	---
Festuca elatior	meadow fescue	21	10.5	---	17	---	---	---	37	---	---
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	19	9.5	---	17	---	---	---	37	---	35.0
Clinopodium vulgare	wild basil	20	10.0	---	17	---	---	8	37	21.6	---
Poa compressa	Canada bluegrass	18	9.0	---	17	---	10.0	---	37	---	---
Daucus carota	Queen Anne's lace	17	8.5	---	17	---	---	---	37	---	---
Phleum pratense	timothy	17	8.5	---	17	---	---	---	37	---	---
Taraxacum officinale	common dandelion	17	8.5	---	17	---	---	---	37	---	---
Hesperis matronalis	dames rocket	16	8.0	1	17	5.9	1.0	1	37	2.7	10.0
Veronica officinalis	common gypsyweed	15	7.5	---	17	---	---	---	37	---	---
Cirsium arvense	Canada thistle	14	7.0	---	17	---	---	---	37	---	---
Rumex obtusifolius	bitter dock	14	7.0	---	17	---	---	---	37	---	---
Bromus inermis	smooth brome	13	6.5	---	17	---	---	---	37	---	---
Elaeagnus umbellata	autumn olive	13	6.5	---	17	---	---	---	37	---	---
Coronilla varia	purple crownvetch	12	6.0	---	17	---	---	---	37	---	---
Lotus corniculatus	bird’s-foot trefoil	12	6.0	---	17	---	10.0	---	37	---	---
Ligustrum obtusifolium	obtuse-leaved border privet	12	6.0	1	17	5.9	1.0	---	37	---	---
Hieracium caespitosum	meadow hawkweed	11	5.5	---	17	---	1.0	---	37	---	---
Arctium minus	lesser burdock	10	5.0	---	17	---	---	---	37	---	---
Barbarea vulgaris	common wintercress	10	5.0	---	17	---	---	---	37	---	---
Cirsium vulgare	bull thistle	10	5.0	---	17	---	---	---	37	---	---
Plantago lanceolata	narrowleaf plantain	10	5.0	2	17	11.8	4.0	---	37	---	---
Centaurea stoebe ssp. *micranthos*	spotted knapweed	9	4.5	---	17	---	---	1	37	2.7	60.0
Holcus lanatus	common velvetgrass	9	4.5	---	17	---	---	---	37	---	---
Lepidium campestre	field pepperweed	9	4.5	---	17	---	---	---	37	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO Site (continued).

Scientific Name	Common Name	Plots Invaded	%	Northern Red Oak - Northern Hardwood Forest				Allegheny Hardwood Forest			
				Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Dipsacus fullonum	Fuller's teasel	8	4.0	---	17	---	---	---	37	---	---
Prunella vulgaris	common selfheal	8	4.0	---	17	---	---	1	37	2.7	10.0
Ranunculus acris	tall buttercup	8	4.0	---	17	---	---	---	37	---	---
Saponaria officinalis	bouncingbet	8	4.0	---	17	---	---	---	37	---	---
Agrostis gigantea	redtop	6	3.0	---	17	---	---	---	37	---	---
Lonicera maackii	Amur honeysuckle	6	3.0	---	17	---	---	---	37	---	---
Hieracium aurantiacum	orange hawkweed	5	2.5	---	17	---	---	---	37	---	---
Malus pumila	apple	5	2.5	1	17	5.9	10.0	---	37	---	---
Rumex acetosella	common sheep sorrel	5	2.5	---	17	---	---	---	37	---	---
Rumex crispus	curly dock	5	2.5	---	17	---	---	---	37	---	---
Tragopogon dubius	yellow salsify	5	2.5	---	17	---	---	---	37	---	---
Celastrus orbiculatus	oriental bittersweet	4	2.0	---	17	---	---	---	37	---	---
Linaria vulgaris	butter and eggs	4	2.0	---	17	---	---	---	37	---	---
Rhamnus cathartica	common buckthorn	4	2.0	---	17	---	---	---	37	---	---
Trifolium hybridum	alsike clover	4	2.0	---	17	---	---	---	37	---	---
Ailanthus altissima	tree-of-heaven	3	1.5	---	17	---	---	---	37	---	---
Cerastium fontanum	common mouse-ear chickweed	3	1.5	---	17	---	---	---	37	---	---
Medicago lupulina	black medick	3	1.5	---	17	---	---	---	37	---	---
Trifolium pratense	red clover	3	1.5	---	17	---	---	---	37	---	---
Artemisia vulgaris	common wormwood	2	1.0	---	17	---	---	---	37	---	---
Hemerocallis fulva	orange daylily	2	1.0	---	17	---	---	1	37	2.7	10.0
Melilotus officinalis	yellow sweetclover	2	1.0	---	17	---	---	---	37	---	---
Rosa setigera	climbing rose	2	1.0	---	17	---	---	---	37	---	---
Solanum dulcamara	climbing nightshade	2	1.0	---	17	---	---	---	37	---	---
Stellaria media	common chickweed	2	1.0	---	17	---	---	---	37	---	---
Trifolium aureum	large yellow hop-clover	2	1.0	---	17	---	---	---	37	---	---
Tussilago farfara	coltsfoot	2	1.0	---	17	---	---	---	37	---	---
Anagallis arvensis	scarlet pimpernel	1	0.5	---	17	---	---	---	37	---	---
Anaphalis margaritacea	pearly everlasting	1	0.5	---	17	---	---	---	37	---	---
Brassica nigra	black mustard	1	0.5	---	17	---	---	---	37	---	---
Convallaria majalis	European lily of the valley	1	0.5	---	17	---	---	---	37	---	---
Dianthus armeria	Deptford pink	1	0.5	---	17	---	---	---	37	---	---
Epipactis helleborine	false hellebore	1	0.5	1	17	5.9	1.0	---	37	---	---
Euphorbia cyparissias	cypress spurge	1	0.5	---	17	---	---	---	37	---	---
Forsythia sp.	Forsythia	1	0.5	---	17	---	---	---	37	---	---
Humulus japonicus	Japanese hop	1	0.5	---	17	---	---	---	37	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Plots Invaded	%	Northern Red Oak - Northern Hardwood Forest				Allegheny Hardwood Forest			
				Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Hypochaeris radicata	hairy catsear	1	0.5	---	17	---	---	---	37	---	---
Iris pseudacorus	yellow iris	1	0.5	---	17	---	---	---	37	---	---
Lathyrus latifolius	perennial pea	1	0.5	---	17	---	---	---	37	---	---
Lysimachia nummularia	moneywort	1	0.5	---	17	---	---	---	37	---	---
Picea abies	Norway spruce	1	0.5	---	17	---	---	---	37	---	---
Pinus sylvestris	Scot's pine	1	0.5	---	17	---	---	---	37	---	---
Syringa vulgaris	common lilac	1	0.5	---	17	---	---	---	37	---	---
Verbascum thapsus	common mullein	1	0.5	---	17	---	---	---	37	---	---
Vinca minor	common periwinkle	1	0.5	---	17	---	---	---	37	---	---
Chelidonium majus	celandine	1	0.5	---	17	---	---	---	37	---	---
Total number of nonnative species recorded in community type						16.0				13.0	

*Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*P. sachalinense*) were combined for field survey and analysis

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Modified Successional Forest				Successional Old Field			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Rosa multiflora	multiflora rose	21	25	84.0	37.3	16	35	45.7	22.5
Lonicera morrowii	Morrow's honeysuckle	14	25	56.0	17.1	13	35	37.1	13.2
Dactylis glomerata	orchardgrass	9	25	36.0	14.6	20	35	57.1	17.1
Alliaria petiolata	garlic mustard	13	25	52.0	40.1	7	35	20.0	24.3
Anthoxanthum odoratum	sweet vernalgrass	5	25	20.0	40.0	19	35	54.3	38.9
Berberis thunbergii	Japanese barberry	8	25	32.0	14.0	6	35	17.1	15.3
Polygonum caespitosum	oriental ladysthumb	8	25	32.0	27.6	1	35	2.9	10.0
Glechoma hederacea	ground ivy	6	25	24.0	18.3	9	35	25.7	14.6
Phalaris arundinacea	reed canarygrass	6	25	24.0	23.7	14	35	40.0	33.1
Agrostis capillaris	colonial bentgrass	5	25	20.0	20.0	1	35	2.9	10.0
Microstegium vimineum	Japanese stiltgrass	5	25	20.0	20.0	2	35	5.7	35.0
Poa pratensis	Kentucky bluegrass	4	25	16.0	22.5	13	35	37.1	24.7
Achillea millefolium	common yarrow	2	25	8.0	1.0	17	35	48.6	10.8
Chrysanthemum leucanthemum	oxeye daisy	4	25	16.0	7.8	14	35	40.0	7.4
Festuca elatior	meadow fescue	2	25	8.0	35.0	17	35	48.6	33.5
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	3	25	12.0	43.3	11	35	31.4	0.1
Clinopodium vulgare	wild basil	3	25	12.0	10.0	1	35	2.9	192.0
Poa compressa	Canada bluegrass	7	25	28.0	14.6	6	35	17.1	18.3
Daucus carota	Queen Anne's lace	3	25	12.0	10.0	13	35	37.1	7.9
Phleum pratense	timothy	2	25	8.0	10.0	13	35	37.1	15.6
Taraxacum officinale	common dandelion	4	25	16.0	5.5	9	35	25.7	9.0
Hesperis matronalis	dames rocket	5	25	20.0	16.4	5	35	14.3	20.0
Veronica officinalis	common gypsyweed	4	25	16.0	3.3	7	35	20.0	6.1
Cirsium arvense	Canada thistle	---	25	---	---	12	35	34.3	21.8
Rumex obtusifolius	bitter dock	1	25	4.0	10.0	9	35	25.7	7.0
Bromus inermis	smooth brome	1	25	4.0	60.0	9	35	25.7	37.8
Elaeagnus umbellata	autumn olive	3	25	12.0	10.0	7	35	20.0	6.1
Coronilla varia	purple crownvetch	---	25	---	---	8	35	22.9	22.5
Lotus corniculatus	bird’s-foot trefoil	3	25	12.0	10.0	7	35	20.0	15.9
Ligustrum obtusifolium	obtuse-leaved border privet	8	25	32.0	8.9	2	35	5.7	5.5
Hieracium caespitosum	meadow hawkweed	---	25	---	---	9	35	25.7	13.6
Arctium minus	lesser burdock	4	25	16.0	3.3	3	35	8.6	23.7
Barbarea vulgaris	common wintercress	1	25	4.0	1.0	6	35	17.1	7.0
Cirsium vulgare	bull thistle	3	25	12.0	7.0	6	35	17.1	7.0
Plantago lanceolata	narrowleaf plantain	---	25	---	---	5	35	14.3	10.0
Centaurea stoebe ssp. *micranthos*	spotted knapweed	1	25	4.0	10.0	6	35	17.1	15.3
Holcus lanatus	common velvetgrass	1	25	4.0	10.0	6	35	17.1	10.0
Lepidium campestre	field pepperweed	1	25	4.0	1.0	6	35	17.1	4.0

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Modified Successional Forest				Successional Old Field			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Dipsacus fullonum	Fuller's teasel	1	25	4.0	1.0	6	35	17.1	25.2
Prunella vulgaris	common selfheal	2	25	8.0	10.0	3	35	8.6	10.0
Ranunculus acris	tall buttercup	---	25	---	---	7	35	20.0	7.4
Saponaria officinalis	bouncingbet	---	25	---	---	6	35	17.1	13.8
Agrostis gigantea	redtop	1	25	4.0	10.0	4	35	11.4	10.0
Lonicera maackii	Amur honeysuckle	5	25	20.0	6.4	---	35	---	---
Hieracium aurantiacum	orange hawkweed	---	25	---	---	5	35	14.3	6.4
Malus pumila	apple	---	25	---	---	3	35	8.6	26.7
Rumex acetosella	common sheep sorrel	---	25	---	---	5	35	14.3	10.0
Rumex crispus	curly dock	---	25	---	---	4	35	11.4	5.5
Tragopogon dubius	yellow salsify	---	25	---	---	5	35	14.3	2.8
Celastrus orbiculatus	oriental bittersweet	1	25	4.0	10.0	1	35	2.9	10.0
Linaria vulgaris	butter and eggs	---	25	---	---	2	35	5.7	10.0
Rhamnus cathartica	common buckthorn	1	25	4.0	10.0	3	35	8.6	4.0
Trifolium hybridum	alsike clover	---	25	---	---	3	35	8.6	10.0
Ailanthus altissima	tree-of-heaven	1	25	4.0	60.0	1	35	2.9	10.0
Cerastium fontanum	common mouse-ear chickweed	---	25	---	---	3	35	8.6	10.0
Medicago lupulina	black medick	1	25	4.0	60.0	1	35	2.9	10.0
Trifolium pratense	red clover	2	25	8.0	1.0	1	35	2.9	1.0
Artemisia vulgaris	common wormwood	---	25	---	---	2	35	5.7	1.0
Hemerocallis fulva	orange daylily	---	25	---	---	1	35	2.9	1.0
Melilotus officinalis	yellow sweetclover	---	25	---	---	1	35	2.9	1.0
Rosa setigera	climbing rose	---	25	---	---	2	35	5.7	1.0
Solanum dulcamara	climbing nightshade	---	25	---	---	---	35	---	---
Stellaria media	common chickweed	---	25	---	---	1	35	2.9	10.0
Trifolium aureum	large yellow hop-clover	---	25	---	---	1	35	2.9	10.0
Tussilago farfara	coltsfoot	---	25	---	---	1	35	2.9	60.0
Anagallis arvensis	scarlet pimpernel	1	25	4.0	1.0	---	35	---	---
Anaphalis margaritacea	pearly everlasting	---	25	---	---	---	35	---	---
Brassica nigra	black mustard	---	25	---	---	---	35	---	---
Convallaria majalis	European lily of the valley	1	25	4.0	60.0	---	35	---	---
Dianthus armeria	Deptford pink	---	25	---	---	1	35	2.9	1.0
Epipactis helleborine	false hellebore	---	25	---	---	---	35	---	---
Euphorbia cyparissias	cypress spurge					1	35	2.9	1.0
Forsythia sp.	forsythia	1	25	4.0	10.0	---	35	---	---
Humulus japonicus	Japanese hop	---	25	---	---	---	35	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Modified Successional Forest				Successional Old Field			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Hypochaeris radicata	hairy catsear	---	25	---	---	---	35	---	---
Iris pseudacorus	yellow iris	1	25	4.0	1.0	---	35	---	---
Lathyrus latifolius	perennial pea	1	25	4.0	60.0	---	35	---	---
Lysimachia nummularia	moneywort	1	25	4.0	10.0	---	35	---	---
Picea abies	Norway spruce	1	25	4.0	1.0	---	35	---	---
Pinus sylvestris	Scot's pine	---	25	---	---	1	35	2.9	10.0
Syringa vulgaris	common lilac	1	25	4.0	10.0	---	35	---	---
Verbascum thapsus	common mullein	---	25	---	---	---	35	---	---
Vinca minor	common periwinkle	1	25	4.0	60.0	---	35	---	---
Chelidonium majus	celandine	---	25	---	---	---	35	---	---
				52.0				66.0	

*Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*P. sachalinense*) were combined for field survey and analysis

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Conifer Plantation				Northern Hardwood Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Rosa multiflora	multiflora rose	3	7	42.9	10.0	5	28	17.9	4.6
Lonicera morrowii	Morrow's honeysuckle	4	7	57.1	10.0	---	28	---	---
Dactylis glomerata	orchardgrass	4	7	57.1	22.5	---	28	---	---
Alliaria petiolata	garlic mustard	3	7	42.9	26.7	2	28	7.1	10.0
Anthoxanthum odoratum	sweet vernalgrass	4	7	57.1	47.5	---	28	---	---
Berberis thunbergii	Japanese barberry	1	7	14.3	10.0	6	28	21.4	1.0
Polygonum caespitosum	oriental ladysthumb	1	7	14.3	60.0	7	28	25.0	7.4
Glechoma hederacea	ground ivy	2	7	28.6	10.0	2	28	7.1	35.0
Phalaris arundinacea	reed canarygrass	1	7	14.3	10.0	---	28	---	---
Agrostis capillaris	colonial bentgrass	4	7	57.1	22.5	1	28	3.6	10.0
Microstegium vimineum	Japanese stiltgrass	1	7	14.3	10.0	5	28	17.9	16.4
Poa pratensis	Kentucky bluegrass	2	7	28.6	10.0	---	28	---	---
Achillea millefolium	common yarrow	2	7	28.6	10.0	---	28	---	---
Chrysanthemum leucanthemum	oxeye daisy	2	7	28.6	10.0	---	28	---	---
Festuca elatior	meadow fescue	2	7	28.6	35.0	---	28	---	---
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	2	7	28.6	---	---	28	---	---
Clinopodium vulgare	wild basil	---	7	---	---	---	28	---	---
Poa compressa	Canada bluegrass	---	7	---	---	---	28	---	---
Daucus carota	Queen Anne's lace	1	7	14.3	10.0	---	28	---	---
Phleum pratense	timothy	1	7	14.3	10.0	---	28	---	---
Taraxacum officinale	common dandelion	3	7	42.9	10.0	---	28	---	---
Hesperis matronalis	dames rocket	2	7	28.6	35.0	---	28	---	---
Veronica officinalis	common gypsyweed	2	7	28.6	10.0	---	28	---	---
Cirsium arvense	Canada thistle	---	7	---	---	---	28	---	---
Rumex obtusifolius	bitter dock	1	7	14.3	1.0	---	28	---	---
Bromus inermis	smooth brome	2	7	28.6	35.0	---	28	---	---
Elaeagnus umbellata	autumn olive	3	7	42.9	26.7	---	28	---	---
Coronilla varia	purple crownvetch	2	7	28.6	10.0	---	28	---	---
Lotus corniculatus	bird’s-foot trefoil	1	7	14.3	10.0	---	28	---	---
Ligustrum obtusifolium	obtuse-leaved border privet	---	7	---	---	---	28	---	---
Hieracium caespitosum	meadow hawkweed	1	7	14.3	10.0	---	28	---	---
Arctium minus	lesser burdock	1	7	14.3	10.0	1	28	3.6	1.0
Barbarea vulgaris	common wintercress	2	7	28.6	10.0	---	28	---	---
Cirsium vulgare	bull thistle	1	7	14.3	10.0	---	28	---	---
Plantago lanceolata	narrowleaf plantain	1	7	14.3	10.0	---	28	---	---
Centaurea stoebe ssp. *micranthos*	spotted knapweed	---	7	---	---	---	28	---	---
Holcus lanatus	common velvetgrass	1	7	14.3	10.0	---	28	---	---
Lepidium campestre	field pepperweed	2	7	28.6	10.0	---	28	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Conifer Plantation				Northern Hardwood Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Dipsacus fullonum	Fuller's teasel	---	7	---	---	---	28	---	---
Prunella vulgaris	common selfheal	1	7	14.3	10.0	---	28	---	---
Ranunculus acris	tall buttercup	1	7	14.3	10.0	---	28	---	---
Saponaria officinalis	bouncingbet	---	7	---	---	---	28	---	---
Agrostis gigantea	redtop	---	7	---	---	---	28	---	---
Lonicera maackii	Amur honeysuckle	1	7	14.3	10.0	---	28	---	---
Hieracium aurantiacum	orange hawkweed	---	7	---	---	---	28	---	---
Malus pumila	apple	---	7	---	---	---	28	---	---
Rumex acetosella	common sheep sorrel	---	7	---	---	---	28	---	---
Rumex crispus	curly dock	1	7	14.3	10.0	---	28	---	---
Tragopogon dubius	yellow salsify	---	7	---	---	---	28	---	---
Celastrus orbiculatus	oriental bittersweet	---	7	---	---	1	28	3.6	10.0
Linaria vulgaris	butter and eggs	1	7	14.3	10.0	---	28	---	---
Rhamnus cathartica	common buckthorn	---	7	---	---	---	28	---	---
Trifolium hybridum	alsike clover	1	7	14.3	10.0	---	28	---	---
Ailanthus altissima	tree-of-heaven	---	7	---	---	---	28	---	---
Cerastium fontanum	common mouse-ear chickweed	---	7	---	---	---	28	---	---
Medicago lupulina	black medick	---	7	---	---	---	28	---	---
Trifolium pratense	red clover	---	7	---	---	---	28	---	---
Artemisia vulgaris	common wormwood	---	7	---	---	---	28	---	---
Hemerocallis fulva	orange daylily	---	7	---	---	---	28	---	---
Melilotus officinalis	yellow sweetclover	---	7	---	---	---	28	---	---
Rosa setigera	climbing rose	---	7	---	---	---	28	---	---
Solanum dulcamara	climbing nightshade	---	7	---	---	1	28	3.6	1.0
Stellaria media	common chickweed	---	7	---	---	---	28	---	---
Trifolium aureum	large yellow hop-clover	1	7	14.3	10.0	---	28	---	---
Tussilago farfara	coltsfoot	---	7	---	---	---	28	---	---
Anagallis arvensis	scarlet pimpernel	---	7	---	---	---	28	---	---
Anaphalis margaritacea	pearly everlasting	1	7	14.3	10.0	---	28	---	---
Brassica nigra	black mustard	---	7	---	---	---	28	---	---
Convallaria majalis	European lily of the valley	---	7	---	---	---	28	---	---
Dianthus armeria	Deptford pink	---	7	---	---	---	28	---	---
Epipactis helleborine	false hellebore	---	7	---	---	---	28	---	---
Euphorbia cyparissias	cypress spurge	---	7	---	---	---	28	---	---
Forsythia sp.	forsythia	---	7	---	---	---	28	---	---
Humulus japonicus	Japanese hop	---	7	---	---	---	28	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Conifer Plantation				Northern Hardwood Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Hypochaeris radicata	hairy catsear	---	7	---	---	---	28	---	---
Iris pseudacorus	yellow iris	---	7	---	---	---	28	---	---
Lathyrus latifolius	perennial pea	---	7	---	---	---	28	---	---
Lysimachia nummularia	moneywort	---	7	---	---	---	28	---	---
Picea abies	Norway spruce	---	7	---	---	---	28	---	---
Pinus sylvestris	Scot's pine	---	7	---	---	---	28	---	---
Syringa vulgaris	common lilac	---	7	---	---	---	28	---	---
Verbascum thapsus	common mullein	---	7	---	---	---	28	---	---
Vinca minor	common periwinkle	---	7	---	---	---	28	---	---
Chelidonium majus	celandine	---	7	---	---	---	28	---	---
				41.0	1.0			10.0	1.0

*Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*P. sachalinense*) were combined for field survey and analysis

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Eastern Hemlock - Northern Hardwood Forest				Sugar Maple Floodplain Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Rosa multiflora	multiflora rose	---	14	---	---	2	9	22.2	5.5
Lonicera morrowii	Morrow's honeysuckle	---	14	---	---	---	9	---	---
Dactylis glomerata	orchardgrass	---	14	---	---	---	9	---	---
Alliaria petiolata	garlic mustard	1	14	7.1	10.0	2	9	22.2	10.0
Anthoxanthum odoratum	sweet vernalgrass	---	14	---	---	---	9	---	---
Berberis thunbergii	Japanese barberry	1	14	7.1	1.0	2	9	22.2	10.0
Polygonum caespitosum	oriental ladysthumb	1	14	7.1	1.0	3	9	33.3	23.3
Glechoma hederacea	ground ivy	---	14	---	---	2	9	22.2	5.0
Phalaris arundinacea	reed canarygrass	---	14	---	---	---	9	---	---
Agrostis capillaris	colonial bentgrass	---	14	---	---	2	9	22.2	10.0
Microstegium vimineum	Japanese stiltgrass	1	14	7.1	1.0	2	9	22.2	30.0
Poa pratensis	Kentucky bluegrass	---	14	---	---	---	9	---	---
Achillea millefolium	common yarrow	---	14	---	---	---	9	---	---
Chrysanthemum leucanthemum	oxeye daisy	---	14	---	---	---	9	---	---
Festuca elatior	meadow fescue	---	14	---	---	---	9	---	---
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	---	14	---	---	---	9	---	---
Clinopodium vulgare	wild basil	---	14	---	---	---	9	---	---
Poa compressa	Canada bluegrass	---	14	---	---	---	9	---	---
Daucus carota	Queen Anne's lace	---	14	---	---	---	9	---	---
Phleum pratense	timothy	---	14	---	---	---	9	---	---
Taraxacum officinale	common dandelion	---	14	---	---	---	9	---	---
Hesperis matronalis	dames rocket	---	14	---	---	1	9	11.1	1.0
Veronica officinalis	common gypsyweed	---	14	---	---	---	9	---	---
Cirsium arvense	Canada thistle	---	14	---	---	---	9	---	---
Rumex obtusifolius	bitter dock	---	14	---	---	1	9	11.1	1.0
Bromus inermis	smooth brome	---	14	---	---	---	9	---	---
Elaeagnus umbellata	autumn olive	---	14	---	---	---	9	---	---
Coronilla varia	purple crownvetch	---	14	---	---	---	9	---	---
Lotus corniculatus	bird’s-foot trefoil	---	14	---	---	---	9	---	---
Ligustrum obtusifolium	obtuse-leaved border privet	---	14	---	---	---	9	---	---
Hieracium caespitosum	meadow hawkweed	---	14	---	---	---	9	---	---
Arctium minus	lesser burdock	---	14	---	---	1	9	11.1	1.0
Barbarea vulgaris	common wintercress	---	14	---	---	---	9	---	---
Cirsium vulgare	bull thistle	---	14	---	---	---	9	---	---
Plantago lanceolata	narrowleaf plantain	---	14	---	---	---	9	---	---
Centaurea stoebe ssp. *micranthos*	spotted knapweed	---	14	---	---	---	9	---	---
Holcus lanatus	common velvetgrass	---	14	---	---	---	9	---	---
Lepidium campestre	field pepperweed	---	14	---	---	---	9	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Eastern Hemlock - Northern Hardwood Forest				Sugar Maple Floodplain Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Dipsacus fullonum	Fuller's teasel	---	14	---	---	---	9	---	---
Prunella vulgaris	common selfheal	---	14	---	---	---	9	---	---
Ranunculus acris	tall buttercup	---	14	---	---	---	9	---	---
Saponaria officinalis	bouncingbet	---	14	---	---	---	9	---	---
Agrostis gigantea	redtop	---	14	---	---	---	9	---	---
Lonicera maackii	Amur honeysuckle	---	14	---	---	---	9	---	---
Hieracium aurantiacum	orange hawkweed	---	14	---	---	---	9	---	---
Malus pumila	apple	---	14	---	---	---	9	---	---
Rumex acetosella	common sheep sorrel	---	14	---	---	---	9	---	---
Rumex crispus	curly dock	---	14	---	---	---	9	---	---
Tragopogon dubius	yellow salsify	---	14	---	---	---	9	---	---
Celastrus orbiculatus	oriental bittersweet	---	14	---	---	---	9	---	---
Linaria vulgaris	butter and eggs	---	14	---	---	---	9	---	---
Rhamnus cathartica	common buckthorn	---	14	---	---	---	9	---	---
Trifolium hybridum	alsike clover	---	14	---	---	---	9	---	---
Ailanthus altissima	tree-of-heaven	---	14	---	---	---	9	---	---
Cerastium fontanum	common mouse-ear chickweed	---	14	---	---	---	9	---	---
Medicago lupulina	black medick	---	14	---	---	---	9	---	---
Trifolium pratense	red clover	---	14	---	---	---	9	---	---
Artemisia vulgaris	common wormwood	---	14	---	---	---	9	---	---
Hemerocallis fulva	orange daylily	---	14	---	---	---	9	---	---
Melilotus officinalis	yellow sweetclover	---	14	---	---	---	9	---	---
Rosa setigera	climbing rose	---	14	---	---	---	9	---	---
Solanum dulcamara	climbing nightshade	---	14	---	---	---	9	---	---
Stellaria media	common chickweed	---	14	---	---	---	9	---	---
Trifolium aureum	large yellow hop-clover	---	14	---	---	---	9	---	---
Tussilago farfara	coltsfoot	---	14	---	---	---	9	---	---
Anagallis arvensis	scarlet pimpernel	---	14	---	---	---	9	---	---
Anaphalis margaritacea	pearly everlasting	---	14	---	---	---	9	---	---
Brassica nigra	black mustard	---	14	---	---	---	9	---	---
Convallaria majalis	European lily of the valley	---	14	---	---	---	9	---	---
Dianthus armeria	Deptford pink	---	14	---	---	---	9	---	---
Epipactis helleborine	false hellebore	---	14	---	---	---	9	---	---
Euphorbia cyparissias	cypress spurge	---	14	---	---	---	9	---	---
Forsythia sp.	forsythia	---	14	---	---	---	9	---	---
Humulus japonicus	Japanese hop	---	14	---	---	---	9	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Eastern Hemlock - Northern Hardwood Forest				Sugar Maple Floodplain Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Hypochaeris radicata	hairy catsear	---	14	---	---	---	9	---	---
Iris pseudacorus	yellow iris	---	14	---	---	---	9	---	---
Lathyrus latifolius	perennial pea	---	14	---	---	---	9	---	---
Lysimachia nummularia	moneywort	---	14	---	---	---	9	---	---
Picea abies	Norway spruce	---	14	---	---	---	9	---	---
Pinus sylvestris	Scot's pine	---	14	---	---	---	9	---	---
Syringa vulgaris	common lilac	---	14	---	---	---	9	---	---
Verbascum thapsus	common mullein	---	14	---	---	---	9	---	---
Vinca minor	common periwinkle	---	14	---	---	---	9	---	---
Chelidonium majus	celandine	---	14	---	---	---	9	---	---
				4.0	1.0			10.0	1.0

*Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*P. sachalinense*) were combined for field survey and analysis

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Sparsely Vegetated Cliff				Hemlock - Tuliptree - Birch Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Rosa multiflora	multiflora rose	---	3	---	---	---	3	---	---
Lonicera morrowii	Morrow's honeysuckle	---	3	---	---	---	3	---	---
Dactylis glomerata	orchardgrass	1	3	33.3	10.0	---	3	---	---
Alliaria petiolata	garlic mustard	2	3	66.7	10.0	---	3	---	---
Anthoxanthum odoratum	sweet vernalgrass	---	3	---	---	---	3	---	---
Berberis thunbergii	Japanese barberry	---	3	---	---	---	3	---	---
Polygonum caespitosum	oriental ladysthumb	1	3	33.3	10.0	1	3	33.3	10.0
Glechoma hederacea	ground ivy	1	3	33.3	10.0	1	3	33.3	10.0
Phalaris arundinacea	reed canarygrass	---	3	---	---	---	3	---	---
Agrostis capillaris	colonial bentgrass	---	3	---	---	---	3	---	---
Microstegium vimineum	Japanese stiltgrass	1	3	33.3	60.0	---	3	---	---
Poa pratensis	Kentucky bluegrass	1	3	33.3	10.0	1	3	33.3	10.0
Achillea millefolium	common yarrow	1	3	33.3	10.0	---	3	---	---
Chrysanthemum leucanthemum	oxeye daisy	---	3	---	---	---	3	---	---
Festuca elatior	meadow fescue	---	3	---	---	---	3	---	---
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	1	3	33.3	---	---	3	---	---
Clinopodium vulgare	wild basil	---	3	---	---	---	3	---	---
Poa compressa	Canada bluegrass	1	3	33.3	10.0	---	3	---	---
Daucus carota	Queen Anne's lace	---	3	---	---	---	3	---	---
Phleum pratense	timothy	---	3	---	---	---	3	---	---
Taraxacum officinale	common dandelion	1	3	33.3	10.0	---	3	---	---
Hesperis matronalis	dames rocket	1	3	33.3	10.0	---	3	---	---
Veronica officinalis	common gypsyweed	1	3	33.3	10.0	---	3	---	---
Cirsium arvense	Canada thistle	---	3	---	---	---	3	---	---
Rumex obtusifolius	bitter dock	1	3	33.3	10.0	---	3	---	---
Bromus inermis	smooth brome	---	3	---	---	---	3	---	---
Elaeagnus umbellata	autumn olive	---	3	---	---	---	3	---	---
Coronilla varia	purple crownvetch	1	3	33.3	10.0	---	3	---	---
Lotus corniculatus	bird’s-foot trefoil	---	3	---	---	---	3	---	---
Ligustrum obtusifolium	obtuse-leaved border privet	---	3	---	---	---	3	---	---
Hieracium caespitosum	meadow hawkweed	---	3	---	---	---	3	---	---
Arctium minus	lesser burdock	---	3	---	---	---	3	---	---
Barbarea vulgaris	common wintercress	1	3	33.3	1.0	---	3	---	---
Cirsium vulgare	bull thistle	---	3	---	---	---	3	---	---
Plantago lanceolata	narrowleaf plantain	---	3	---	---	---	3	---	---
Centaurea stoebe ssp. *micranthos*	spotted knapweed	---	3	---	---	---	3	---	---
Holcus lanatus	common velvetgrass	---	3	---	---	---	3	---	---
Lepidium campestre	field pepperweed	---	3	---	---	---	3	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Sparsely Vegetated Cliff				Hemlock - Tuliptree - Birch Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Dipsacus fullonum	Fuller's teasel	---	3	---	---	---	3	---	---
Prunella vulgaris	common selfheal	---	3	---	---	---	3	---	---
Ranunculus acris	tall buttercup	---	3	---	---	---	3	---	---
Saponaria officinalis	bouncingbet	---	3	---	---	---	3	---	---
Agrostis gigantea	redtop	---	3	---	---	---	3	---	---
Lonicera maackii	Amur honeysuckle	---	3	---	---	---	3	---	---
Hieracium aurantiacum	orange hawkweed	---	3	---	---	---	3	---	---
Malus pumila	apple	---	3	---	---	---	3	---	---
Rumex acetosella	common sheep sorrel	---	3	---	---	---	3	---	---
Rumex crispus	curly dock	---	3	---	---	---	3	---	---
Tragopogon dubius	yellow salsify	---	3	---	---	---	3	---	---
Celastrus orbiculatus	oriental bittersweet	1	3	33.3	10.0	---	3	---	---
Linaria vulgaris	butter and eggs	---	3	---	---	---	3	---	---
Rhamnus cathartica	common buckthorn	---	3	---	---	---	3	---	---
Trifolium hybridum	alsike clover	---	3	---	---	---	3	---	---
Ailanthus altissima	tree-of-heaven	---	3	---	---	---	3	---	---
Cerastium fontanum	common mouse-ear chickweed	---	3	---	---	---	3	---	---
Medicago lupulina	black medick	---	3	---	---	---	3	---	---
Trifolium pratense	red clover	---	3	---	---	---	3	---	---
Artemisia vulgaris	common wormwood	---	3	---	---	---	3	---	---
Hemerocallis fulva	orange daylily	---	3	---	---	---	3	---	---
Melilotus officinalis	yellow sweetclover	---	3	---	---	---	3	---	---
Rosa setigera	climbing rose	---	3	---	---	---	3	---	---
Solanum dulcamara	climbing nightshade	---	3	---	---	---	3	---	---
Stellaria media	common chickweed	1	3	33.3	60.0	---	3	---	---
Trifolium aureum	large yellow hop-clover	---	3	---	---	---	3	---	---
Tussilago farfara	coltsfoot	1	3	33.3	10.0	---	3	---	---
Anagallis arvensis	scarlet pimpernel	---	3	---	---	---	3	---	---
Anaphalis margaritacea	pearly everlasting	---	3	---	---	---	3	---	---
Brassica nigra	black mustard	---	3	---	---	---	3	---	---
Convallaria majalis	European lily of the valley	---	3	---	---	---	3	---	---
Dianthus armeria	Deptford pink	---	3	---	---	---	3	---	---
Epipactis helleborine	false hellebore	---	3	---	---	---	3	---	---
Euphorbia cyparissias	cypress spurge	---	3	---	---	---	3	---	---
Forsythia sp.	forsythia	---	3	---	---	---	3	---	---
Humulus japonicus	Japanese hop	---	3	---	---	---	3	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

		Sparsely Vegetated Cliff				Hemlock - Tuliptree - Birch Forest			
Scientific Name	Common Name	Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Hypochaeris radicata	hairy catsear	---	3	---	---	---	3	---	---
Iris pseudacorus	yellow iris	---	3	---	---	---	3	---	---
Lathyrus latifolius	perennial pea	---	3	---	---	---	3	---	---
Lysimachia nummularia	moneywort	---	3	---	---	---	3	---	---
Picea abies	Norway spruce	---	3	---	---	---	3	---	---
Pinus sylvestris	Scot's pine	---	3	---	---	---	3	---	---
Syringa vulgaris	common lilac	---	3	---	---	---	3	---	---
Verbascum thapsus	common mullein	---	3	---	---	---	3	---	---
Vinca minor	common periwinkle	---	3	---	---	---	3	---	---
Chelidonium majus	celandine	---	3	---	---	---	3	---	---
				18.0	1.0			3.0	1.0

*Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*P. sachalinense*) were combined for field survey and analysis

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Dry Eastern Hemlock - Oak Forest				Wet Meadow			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Rosa multiflora	multiflora rose	---	4	---	---	1	4	25.0	60.0
Lonicera morrowii	Morrow's honeysuckle	---	4	---	---	1	4	25.0	10.0
Dactylis glomerata	orchardgrass	---	4	---	---	1	4	25.0	10.0
Alliaria petiolata	garlic mustard	---	4	---	---	1	4	25.0	10.0
Anthoxanthum odoratum	sweet vernalgrass	---	4	---	---	2	4	50.0	35.0
Berberis thunbergii	Japanese barberry	---	4	---	---	---	4	---	---
Polygonum caespitosum	oriental ladysthumb	---	4	---	---	---	4	---	---
Glechoma hederacea	ground ivy	---	4	---	---	---	4	---	---
Phalaris arundinacea	reed canarygrass	---	4	---	---	1	4	25.0	60.0
Agrostis capillaris	colonial bentgrass	---	4	---	---	1	4	25.0	10.0
Microstegium vimineum	Japanese stiltgrass	---	4	---	---	1	4	25.0	10.0
Poa pratensis	Kentucky bluegrass	---	4	---	---	---	4	---	---
Achillea millefolium	common yarrow	---	4	---	---	---	4	---	---
Chrysanthemum leucanthemum	oxeye daisy	---	4	---	---	---	4	---	---
Festuca elatior	meadow fescue	---	4	---	---	---	4	---	---
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	---	4	---	---	1	4	25.0	---
Clinopodium vulgare	wild basil	---	4	---	---	---	4	---	---
Poa compressa	Canada bluegrass	---	4	---	---	1	4	25.0	10.0
Daucus carota	Queen Anne's lace	---	4	---	---	---	4	---	---
Phleum pratense	timothy	---	4	---	---	---	4	---	---
Taraxacum officinale	common dandelion	---	4	---	---	---	4	---	---
Hesperis matronalis	dames rocket	---	4	---	---	---	4	---	---
Veronica officinalis	common gypsyweed	---	4	---	---	---	4	---	---
Cirsium arvense	Canada thistle	---	4	---	---	---	4	---	---
Rumex obtusifolius	bitter dock	---	4	---	---	---	4	---	---
Bromus inermis	smooth brome	---	4	---	---	---	4	---	---
Elaeagnus umbellata	autumn olive	---	4	---	---	---	4	---	---
Coronilla varia	purple crownvetch	---	4	---	---	1	4	25.0	60.0
Lotus corniculatus	bird’s-foot trefoil	---	4	---	---	---	4	---	---
Ligustrum obtusifolium	obtuse-leaved border privet	---	4	---	---	---	4	---	---
Hieracium caespitosum	meadow hawkweed	---	4	---	---	---	4	---	---
Arctium minus	lesser burdock	---	4	---	---	---	4	---	---
Barbarea vulgaris	common wintercress	---	4	---	---	---	4	---	---
Cirsium vulgare	bull thistle	---	4	---	---	---	4	---	---
Plantago lanceolata	narrowleaf plantain	---	4	---	---	---	4	---	---
Centaurea stoebe ssp. *micranthos*	spotted knapweed	---	4	---	---	---	4	---	---
Holcus lanatus	common velvetgrass	---	4	---	---	1	4	25.0	10.0
Lepidium campestre	field pepperweed	---	4	---	---	---	4	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Dry Eastern Hemlock - Oak Forest				Wet Meadow			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Dipsacus fullonum	Fuller's teasel	---	4	---	---	---	4	---	---
Prunella vulgaris	common selfheal	---	4	---	---	1	4	25.0	10.0
Ranunculus acris	tall buttercup	---	4	---	---	---	4	---	---
Saponaria officinalis	bouncingbet	---	4	---	---	---	4	---	---
Agrostis gigantea	redtop	---	4	---	---	1	4	25.0	10.0
Lonicera maackii	Amur honeysuckle	---	4	---	---	---	4	---	---
Hieracium aurantiacum	orange hawkweed	---	4	---	---	---	4	---	---
Malus pumila	apple	---	4	---	---	---	4	---	---
Rumex acetosella	common sheep sorrel	---	4	---	---	---	4	---	---
Rumex crispus	curly dock	---	4	---	---	---	4	---	---
Tragopogon dubius	yellow salsify	---	4	---	---	---	4	---	---
Celastrus orbiculatus	oriental bittersweet	---	4	---	---	---	4	---	---
Linaria vulgaris	butter and eggs	---	4	---	---	---	4	---	---
Rhamnus cathartica	common buckthorn	---	4	---	---	---	4	---	---
Trifolium hybridum	alsike clover	---	4	---	---	---	4	---	---
Ailanthus altissima	tree-of-heaven	---	4	---	---	---	4	---	---
Cerastium fontanum	common mouse-ear chickweed	---	4	---	---	---	4	---	---
Medicago lupulina	black medick	---	4	---	---	---	4	---	---
Trifolium pratense	red clover	---	4	---	---	---	4	---	---
Artemisia vulgaris	common wormwood	---	4	---	---	---	4	---	---
Hemerocallis fulva	orange daylily	---	4	---	---	---	4	---	---
Melilotus officinalis	yellow sweetclover	---	4	---	---	---	4	---	---
Rosa setigera	climbing rose	---	4	---	---	---	4	---	---
Solanum dulcamara	climbing nightshade	---	4	---	---	---	4	---	---
Stellaria media	common chickweed	---	4	---	---	---	4	---	---
Trifolium aureum	large yellow hop-clover	---	4	---	---	---	4	---	---
Tussilago farfara	coltsfoot	---	4	---	---	---	4	---	---
Anagallis arvensis	scarlet pimpernel	---	4	---	---	---	4	---	---
Anaphalis margaritacea	pearly everlasting	---	4	---	---	---	4	---	---
Brassica nigra	black mustard	---	4	---	---	---	4	---	---
Convallaria majalis	European lily of the valley	---	4	---	---	---	4	---	---
Dianthus armeria	Deptford pink	---	4	---	---	---	4	---	---
Epipactis helleborine	false hellebore	---	4	---	---	---	4	---	---
Euphorbia cyparissias	cypress spurge	---	4	---	---	---	4	---	---
Forsythia sp.	forsythia	---	4	---	---	---	4	---	---
Humulus japonicus	Japanese hop	---	4	---	---	---	4	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Dry Eastern Hemlock - Oak Forest				Wet Meadow			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Hypochaeris radicata	hairy catsear	---	4	---	---	---	4	---	---
Iris pseudacorus	yellow iris	---	4	---	---	---	4	---	---
Lathyrus latifolius	perennial pea	---	4	---	---	---	4	---	---
Lysimachia nummularia	moneywort	---	4	---	---	---	4	---	---
Picea abies	Norway spruce	---	4	---	---	---	4	---	---
Pinus sylvestris	Scot's pine	---	4	---	---	---	4	---	---
Syringa vulgaris	common lilac	---	4	---	---	---	4	---	---
Verbascum thapsus	common mullein	---	4	---	---	---	4	---	---
Vinca minor	common periwinkle	---	4	---	---	---	4	---	---
Chelidonium majus	celandine	---	4	---	---	---	4	---	---
				0.0				14.0	

*Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*P. sachalinense*) were combined for field survey and analysis

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Japanese or Giant Knotweed Herbaceous Vegetation				Tuliptree - Beech - Maple Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Rosa multiflora	multiflora rose	1	5	20.0	1.0	4	5	80.0	7.8
Lonicera morrowii	Morrow's honeysuckle	4	5	80.0	30.5	---	5	---	---
Dactylis glomerata	orchardgrass	1	5	20.0	10.0	---	5	---	---
Alliaria petiolata	garlic mustard	---	5	---	---	1	5	20.0	10.0
Anthoxanthum odoratum	sweet vernalgrass	---	5	---	---	---	5	---	---
Berberis thunbergii	Japanese barberry	---	5	---	---	3	5	60.0	10.0
Polygonum caespitosum	oriental ladysthumb	---	5	---	---	1	5	20.0	10.0
Glechoma hederacea	ground ivy	---	5	---	---	1	5	20.0	10.0
Phalaris arundinacea	reed canarygrass	---	5	---	---	---	5	---	---
Agrostis capillaris	colonial bentgrass	1	5	20.0	10.0	3	5	60.0	10.0
Microstegium vimineum	Japanese stiltgrass	1	5	20.0	10.0	1	5	20.0	10.0
Poa pratensis	Kentucky bluegrass	---	5	---	---	1	5	20.0	60.0
Achillea millefolium	common yarrow	---	5	---	---	---	5	---	---
Chrysanthemum leucanthemum	oxeye daisy	1	5	20.0	10.0	---	5	---	---
Festuca elatior	meadow fescue	---	5	---	---	---	5	---	---
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	---	5	100.0	60.0	---	5	---	---
Clinopodium vulgare	wild basil	5	5	---	---	1	5	20.0	---
Poa compressa	Canada bluegrass	1	5	20.0	10.0	---	5	---	---
Daucus carota	Queen Anne's lace	---	5	---	---	---	5	---	---
Phleum pratense	timothy	---	5	---	---	1	5	20.0	10.0
Taraxacum officinale	common dandelion	---	5	---	---	---	5	---	---
Hesperis matronalis	dames rocket	---	5	---	---	---	5	---	---
Veronica officinalis	common gypsyweed	1	5	20.0	1.0	---	5	---	---
Cirsium arvense	Canada thistle	1	5	20.0	60.0	---	5	---	---
Rumex obtusifolius	bitter dock	---	5	---	---	1	5	20.0	10.0
Bromus inermis	smooth brome	---	5	---	---	---	5	---	---
Elaeagnus umbellata	autumn olive	---	5	---	---	---	5	---	---
Coronilla varia	purple crownvetch	---	5	---	---	---	5	---	---
Lotus corniculatus	bird’s-foot trefoil	---	5	---	---	---	5	---	---
Ligustrum obtusifolium	obtuse-leaved border privet	---	5	---	---	---	5	---	---
Hieracium caespitosum	meadow hawkweed	---	5	---	---	---	5	---	---
Arctium minus	lesser burdock	---	5	---	---	---	5	---	---
Barbarea vulgaris	common wintercress	---	5	---	---	---	5	---	---
Cirsium vulgare	bull thistle	---	5	---	---	---	5	---	---
Plantago lanceolata	narrowleaf plantain	1	5	20.0	10.0	---	5	---	---
Centaurea stoebe ssp. *micranthos*	spotted knapweed	---	5	---	---	---	5	---	---
Holcus lanatus	common velvetgrass	---	5	---	---	---	5	---	---
Lepidium campestre	field pepperweed	---	5	---	---	---	5	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Japanese or Giant Knotweed Herbaceous Vegetation				Tuliptree - Beech - Maple Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Dipsacus fullonum	Fuller's teasel	1	5	20.0	10.0	---	5	---	---
Prunella vulgaris	common selfheal	---	5	---	---	---	5	---	---
Ranunculus acris	tall buttercup	---	5	---	---	---	5	---	---
Saponaria officinalis	bouncingbet	1	5	20.0	10.0	1	5	20.0	10.0
Agrostis gigantea	redtop	---	5	---	---	---	5	---	---
Lonicera maackii	Amur honeysuckle	---	5	---	---	---	5	---	---
Hieracium aurantiacum	orange hawkweed	---	5	---	---	---	5	---	---
Malus pumila	apple	---	5	---	---	1	5	20.0	10.0
Rumex acetosella	common sheep sorrel	---	5	---	---	---	5	---	---
Rumex crispus	curly dock	---	5	---	---	---	5	---	---
Tragopogon dubius	yellow salsify	---	5	---	---	---	5	---	---
Celastrus orbiculatus	oriental bittersweet	---	5	---	---	---	5	---	---
Linaria vulgaris	butter and eggs	1	5	20.0	10.0	---	5	---	---
Rhamnus cathartica	common buckthorn	---	5	---	---	---	5	---	---
Trifolium hybridum	alsike clover	---	5	---	---	---	5	---	---
Ailanthus altissima	tree-of-heaven	1	5	20.0	1.0	---	5	---	---
Cerastium fontanum	common mouse-ear chickweed	---	5	---	---	---	5	---	---
Medicago lupulina	black medick	1	5	20.0	1.0	---	5	---	---
Trifolium pratense	red clover	---	5	---	---	---	5	---	---
Artemisia vulgaris	common wormwood	---	5	---	---	---	5	---	---
Hemerocallis fulva	orange daylily	---	5	---	---	---	5	---	---
Melilotus officinalis	yellow sweetclover	---	5	---	---	---	5	---	---
Rosa setigera	climbing rose	---	5	---	---	---	5	---	---
Solanum dulcamara	climbing nightshade	---	5	---	---	---	5	---	---
Stellaria media	common chickweed	---	5	---	---	---	5	---	---
Trifolium aureum	large yellow hop-clover	---	5	---	---	---	5	---	---
Tussilago farfara	coltsfoot	---	5	---	---	---	5	---	---
Anagallis arvensis	scarlet pimpernel	---	5	---	---	---	5	---	---
Anaphalis margaritacea	pearly everlasting	---	5	---	---	---	5	---	---
Brassica nigra	black mustard	1	5	20.0	1.0	---	5	---	---
Convallaria majalis	European lily of the valley	---	5	---	---	---	5	---	---
Dianthus armeria	Deptford pink	---	5	---	---	---	5	---	---
Epipactis helleborine	false hellebore	---	5	---	---	---	5	---	---
Euphorbia cyparissias	cypress spurge	---	5	---	---	---	5	---	---
Forsythia sp.	Forsythia	---	5	---	---	---	5	---	---
Humulus japonicus	Japanese hop	1	5	20.0	1.0	---	5	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Japanese or Giant Knotweed Herbaceous Vegetation				Tuliptree - Beech - Maple Forest			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Hypochaeris radicata	hairy catsear	1	5	20.0	1.0	---	5	---	---
Iris pseudacorus	yellow iris	---	5	---	---	---	5	---	---
Lathyrus latifolius	perennial pea	---	5	---	---	---	5	---	---
Lysimachia nummularia	moneywort	---	5	---	---	---	5	---	---
Picea abies	Norway spruce	---	5	---	---	---	5	---	---
Pinus sylvestris	Scot's pine	---	5	---	---	---	5	---	---
Syringa vulgaris	common lilac	---	5	---	---	---	5	---	---
Verbascum thapsus	common mullein	1	5	20.0	10.0	---	5	---	---
Vinca minor	common periwinkle	---	5	---	---	---	5	---	---
Chelidonium majus	celandine	---	5	---	---	---	5	---	---
				20.0				13.0	1.0

*Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*P. sachalinense*) were combined for field survey and analysis

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Alder Riverine Shrubland				Reed Canarygrass Riverine Grassland			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Rosa multiflora	multiflora rose	2	2	100.0	5.5	2	2	100.0	35.0
Lonicera morrowii	Morrow's honeysuckle	---	2	---	---	1	2	50.0	10.0
Dactylis glomerata	orchardgrass	---	2	---	---	---	2	---	---
Alliaria petiolata	garlic mustard	---	2	---	---	---	2	---	---
Anthoxanthum odoratum	sweet vernalgrass	1	2	50.0	10.0	---	2	---	---
Berberis thunbergii	Japanese barberry	---	2	---	---	---	2	---	---
Polygonum caespitosum	oriental ladysthumb	---	2	---	---	---	2	---	---
Glechoma hederacea	ground ivy	1	2	50.0	10.0	---	2	---	---
Phalaris arundinacea	reed canarygrass	2	2	100.0	35.0	2	2	100.0	60.0
Agrostis capillaris	colonial bentgrass	1	2	50.0	60.0	---	2	---	---
Microstegium vimineum	Japanese stiltgrass	1	2	50.0	60.0	---	2	---	---
Poa pratensis	Kentucky bluegrass	---	2	---	---	---	2	---	---
Achillea millefolium	common yarrow	---	2	---	---	---	2	---	---
Chrysanthemum leucanthemum	oxeye daisy	---	2	---	---	---	2	---	---
Festuca elatior	meadow fescue	---	2	---	---	---	2	---	---
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	---	2	---	---	1	2	50.0	---
Clinopodium vulgare	wild basil	2	2	100.0	---	---	2	---	---
Poa compressa	Canada bluegrass	1	2	50.0	10.0	---	2	---	---
Daucus carota	Queen Anne's lace	---	2	---	---	---	2	---	---
Phleum pratense	timothy	---	2	---	---	---	2	---	---
Taraxacum officinale	common dandelion	---	2	---	---	---	2	---	---
Hesperis matronalis	dames rocket	---	2	---	---	---	2	---	---
Veronica officinalis	common gypsyweed	---	2	---	---	---	2	---	---
Cirsium arvense	Canada thistle	---	2	---	---	1	2	50.0	10.0
Rumex obtusifolius	bitter dock	---	2	---	---	---	2	---	---
Bromus inermis	smooth brome	---	2	---	---	1	2	50.0	10.0
Elaeagnus umbellata	autumn olive	---	2	---	---	---	2	---	---
Coronilla varia	purple crownvetch	---	2	---	---	---	2	---	---
Lotus corniculatus	bird’s-foot trefoil	---	2	---	---	---	2	---	---
Ligustrum obtusifolium	obtuse-leaved border privet	---	2	---	---	1	2	50.0	10.0
Hieracium caespitosum	meadow hawkweed	---	2	---	---	---	2	---	---
Arctium minus	lesser burdock	---	2	---	---	---	2	---	---
Barbarea vulgaris	common wintercress	---	2	---	---	---	2	---	---
Cirsium vulgare	bull thistle	---	2	---	---	---	2	---	---
Plantago lanceolata	narrowleaf plantain	---	2	---	---	---	2	---	---
Centaurea stoebe ssp. *micranthos*	spotted knapweed	1	2	50.0	60.0	---	2	---	---
Holcus lanatus	common velvetgrass	---	2	---	---	---	2	---	---
Lepidium campestre	field pepperweed	---	2	---	---	---	2	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

Scientific Name	Common Name	Alder Riverine Shrubland				Reed Canarygrass Riverine Grassland			
		Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Dipsacus fullonum	Fuller's teasel	---	2	---	---	---	2	---	---
Prunella vulgaris	common selfheal	---	2	---	---	---	2	---	---
Ranunculus acris	tall buttercup	---	2	---	---	---	2	---	---
Saponaria officinalis	bouncingbet	---	2	---	---	---	2	---	---
Agrostis gigantea	redtop	---	2	---	---	---	2	---	---
Lonicera maackii	Amur honeysuckle	---	2	---	---	---	2	---	---
Hieracium aurantiacum	orange hawkweed	---	2	---	---	---	2	---	---
Malus pumila	apple	---	2	---	---	---	2	---	---
Rumex acetosella	common sheep sorrel	---	2	---	---	---	2	---	---
Rumex crispus	curly dock	---	2	---	---	---	2	---	---
Tragopogon dubius	yellow salsify	---	2	---	---	---	2	---	---
Celastrus orbiculatus	oriental bittersweet	---	2	---	---	---	2	---	---
Linaria vulgaris	butter and eggs	---	2	---	---	---	2	---	---
Rhamnus cathartica	common buckthorn	---	2	---	---	---	2	---	---
Trifolium hybridum	alsike clover	---	2	---	---	---	2	---	---
Ailanthus altissima	tree-of-heaven	---	2	---	---	---	2	---	---
Cerastium fontanum	common mouse-ear chickweed	---	2	---	---	---	2	---	---
Medicago lupulina	black medick	---	2	---	---	---	2	---	---
Trifolium pratense	red clover	---	2	---	---	---	2	---	---
Artemisia vulgaris	common wormwood	---	2	---	---	---	2	---	---
Hemerocallis fulva	orange daylily	---	2	---	---	---	2	---	---
Melilotus officinalis	yellow sweetclover	1	2	50.0	1.0	---	2	---	---
Rosa setigera	climbing rose	---	2	---	---	---	2	---	---
Solanum dulcamara	climbing nightshade	1	2	50.0	1.0	---	2	---	---
Stellaria media	common chickweed	---	2	---	---	---	2	---	---
Trifolium aureum	large yellow hop-clover	---	2	---	---	---	2	---	---
Tussilago farfara	coltsfoot	---	2	---	---	---	2	---	---
Anagallis arvensis	scarlet pimpernel	---	2	---	---	---	2	---	---
Anaphalis margaritacea	pearly everlasting	---	2	---	---	---	2	---	---
Brassica nigra	black mustard	---	2	---	---	---	2	---	---
Convallaria majalis	European lily of the valley	---	2	---	---	---	2	---	---
Dianthus armeria	Deptford pink	---	2	---	---	---	2	---	---
Epipactis helleborine	false hellebore	---	2	---	---	---	2	---	---
Euphorbia cyparissias	cypress spurge	---	2	---	---	---	2	---	---
Forsythia sp.	forsythia	---	2	---	---	---	2	---	---
Humulus japonicus	Japanese hop	---	2	---	---	---	2	---	---

Table 7. Nonnative species summarized by vegetation association, ALPO (continued).

		Alder Riverine Shrubland				Reed Canarygrass Riverine Grassland			
Scientific Name	Common Name	Pres.	Points (n)	% Occur	Avg. Cover	Pres.	Points (n)	% Occur	Avg. Cover
Hypochaeris radicata	hairy catsear	---	2	---	---	---	2	---	---
Iris pseudacorus	yellow iris	---	2	---	---	---	2	---	---
Lathyrus latifolius	perennial pea	---	2	---	---	---	2	---	---
Lysimachia nummularia	moneywort	---	2	---	---	---	2	---	---
Picea abies	Norway spruce	---	2	---	---	---	2	---	---
Pinus sylvestris	Scot's pine	---	2	---	---	---	2	---	---
Syringa vulgaris	common lilac	---	2	---	---	---	2	---	---
Verbascum thapsus	common mullein	---	2	---	---	---	2	---	---
Vinca minor	common periwinkle	---	2	---	---	---	2	---	---
Chelidonium majus	celandine	---	2	---	---	---	2	---	---
				11.0				7.0	

*Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*P. sachalinense*) were combined for field survey and analysis

Table 8. Location (UTM X and Y coordinates), composition, and abundance of nonnative plant species at vegetation survey plots (VSP), Allegheny Portage Railroad National Historic Site.

VSP	Community	UTM X	UTM Y	Number of nonnatives	Total nonnative cover	% nonnative cover
39	Alder Riverine Shrubland	681825.0	4470023.0	7	320	47.5
78	Alder Riverine Shrubland	681840.4	4470029.5	7	43	6.1
6	Allegheny Hardwood Forest	682462.9	4471665.5	5	150	26.7
8	Allegheny Hardwood Forest	706603.8	4481582.7	0	0	---
9	Allegheny Hardwood Forest	706603.5	4481786.0	0	0	---
11	Allegheny Hardwood Forest	706818.7	4481895.6	0	0	---
13	Allegheny Hardwood Forest	707362.2	4481961.9	0	0	---
14	Allegheny Hardwood Forest	707356.3	4481723.6	0	0	---
23	Allegheny Hardwood Forest	707822.3	4480818.6	3	30	10.0
24	Allegheny Hardwood Forest	682303.4	4471551.2	0	0	---
25	Allegheny Hardwood Forest	710937.7	4478462.6	0	0	---
28	Allegheny Hardwood Forest	711882.8	4478007.1	3	80	26.7
37	Allegheny Hardwood Forest	682193.6	4469935.4	5	41	8.5
45	Allegheny Hardwood Forest	712146.8	4477915.1	0	0	---
51	Allegheny Hardwood Forest	709017.4	4480262.3	0	0	---
53	Allegheny Hardwood Forest	708002.9	4480716.4	0	0	---
56	Allegheny Hardwood Forest	707371.4	4480926.8	0	0	---
61	Allegheny Hardwood Forest	707936.5	4481784.5	0	0	---
81	Allegheny Hardwood Forest	706974.6	4481563.1	0	0	---
82	Allegheny Hardwood Forest	682224.5	4470010.4	4	13	3.3
84	Allegheny Hardwood Forest	706565.4	4481505.0	0	0	---
86	Allegheny Hardwood Forest	706997.9	4482012.3	0	0	---
87	Allegheny Hardwood Forest	707624.9	4481679.6	0	0	---
88	Allegheny Hardwood Forest	707849.5	4481662.1	0	0	---
89	Allegheny Hardwood Forest	707772.4	4481204.3	3	30	10.0
91	Allegheny Hardwood Forest	707111.6	4480818.5	0	0	---
93	Allegheny Hardwood Forest	707927.8	4480705.2	0	0	---
95	Allegheny Hardwood Forest	711853.8	4478121.5	0	0	---
96	Allegheny Hardwood Forest	683484.6	4471761.6	1	10	10.0
122	Allegheny Hardwood Forest	683737.3	4471715.6	1	60	60.0
123	Allegheny Hardwood Forest	683775.6	4471722.4	2	61	30.5
126	Allegheny Hardwood Forest	683486.6	4471861.9	1	10	10.0
150	Allegheny Hardwood Forest	712839.2	4477630.5	3	21	7.0
157	Allegheny Hardwood Forest	712040.9	4477936.4	0	0	---
158	Allegheny Hardwood Forest	706755.9	4481697.9	0	0	---
159	Allegheny Hardwood Forest	706835.4	4482101.0	0	0	---
160	Allegheny Hardwood Forest	706960.7	4482126.1	0	0	---
161	Allegheny Hardwood Forest	707529.7	4481851.9	0	0	---
199	Allegheny Hardwood Forest	682341.8	4471297.8	2	70	35.0
2	Conifer Plantation	707360.5	4481326.3	10	191	22.8
16	Conifer Plantation	707101.4	4481351.4	5	150	30.0
65	Conifer Plantation	713118.0	4477375.1	9	190	25.0
73	Conifer Plantation	716010.2	4476725.0	7	120	17.1
99	Conifer Plantation	707589.0	4480936.3	0	0	---
127	Conifer Plantation	707334.2	4481302.2	24	290	12.1
135	Conifer Plantation	707146.6	4481269.3	18	380	21.1
26	Dry Eastern Hemlock - Oak Forest	711994.8	4477990.2	0	0	---
35	Dry Eastern Hemlock - Oak Forest	715451.3	4476794.1	0	0	---
102	Dry Eastern Hemlock - Oak Forest	711996.5	4478019.2	0	0	---
104	Dry Eastern Hemlock - Oak Forest	715144.5	4476687.8	0	0	---
12	Eastern Hemlock - Northern Hardwood Forest	707260.8	4481960.6	2	2	1.0
20	Eastern Hemlock - Northern Hardwood Forest	708592.8	4480926.8	1	1	1.0

Table 8. Location (UTM X and Y coordinates), composition, and abundance of nonnative plant species at vegetation survey plots (VSP), Allegheny Portage Railroad National Historic Site (continued).

VSP	Community	UTM X	UTM Y	Number of nonnatives	Total nonnative cover	% nonnative cover
47	Eastern Hemlock - Northern Hardwood Forest	710159.4	4479323.5	1	10	10.0
50	Eastern Hemlock - Northern Hardwood Forest	709363.5	4480234.8	0	0	---
52	Eastern Hemlock - Northern Hardwood Forest	709102.8	4480497.6	0	0	---
57	Eastern Hemlock - Northern Hardwood Forest	707648.3	4481035.7	0	0	---
60	Eastern Hemlock - Northern Hardwood Forest	707741.4	4481372.9	0	0	---
83	Eastern Hemlock - Northern Hardwood Forest	706709.0	4481794.7	0	0	---
103	Eastern Hemlock - Northern Hardwood Forest	712615.6	4477479.4	0	0	---
105	Eastern Hemlock - Northern Hardwood Forest	708994.7	4480506.5	0	0	---
106	Eastern Hemlock - Northern Hardwood Forest	706613.4	4481993.6	0	0	---
107	Eastern Hemlock - Northern Hardwood Forest	706836.9	4481737.1	0	0	---
108	Eastern Hemlock - Northern Hardwood Forest	707167.2	4481013.1	0	0	---
109	Eastern Hemlock - Northern Hardwood Forest	710227.2	4479154.0	0	0	---
30	Hemlock - Tuliptree - Birch Forest	710653.9	4478649.1	0	0	---
42	Hemlock - Tuliptree - Birch Forest	712650.1	4477557.1	3	30	10.0
43	Hemlock - Tuliptree - Birch Forest	710769.7	4478629.2	0	0	---
40	Japanese or Giant Knotweed Herbaceous Vegetation	681984.5	4470605.1	4	140	40.0
41	Japanese or Giant Knotweed Herbaceous Vegetation	682041.8	4470513.3	3	121	40.3
110	Japanese or Giant Knotweed Herbaceous Vegetation	682072.3	4470129.5	1	60	60.0
111	Japanese or Giant Knotweed Herbaceous Vegetation	682098.4	4470397.5	4	63	15.8
180	Japanese or Giant Knotweed Herbaceous Vegetation	683768.2	4471817.5	15	205	13.7
1	Modified Successional Forest	707197.7	4481359.7	13	230	17.1
17	Modified Successional Forest	707037.7	4481316.4	9	140	15.0
29	Modified Successional Forest	715456.9	4476593.7	7	220	10.0
34	Modified Successional Forest	715629.8	4476753.1	10	200	20.0
36	Modified Successional Forest	715282.4	4476366.9	6	260	43.3
55	Modified Successional Forest	713125.1	4477334.2	6	151	25.2
58	Modified Successional Forest	715485.9	4476316.9	8	121	15.1
72	Modified Successional Forest	716089.8	4477014.6	11	360	35.0
85	Modified Successional Forest	706764.2	4481413.9	1	10	10.0
100	Modified Successional Forest	715804.7	4476603.0	25	605	24.2
101	Modified Successional Forest	716050.5	4476764.8	12	175	14.6
112	Modified Successional Forest	681907.9	4470042.5	3	121	40.3
114	Modified Successional Forest	715616.6	4476441.5	7	111	15.9
116	Modified Successional Forest	715746.8	4476297.1	10	205	20.5
119	Modified Successional Forest	715391.2	4476519.5	12	143	11.9
120	Modified Successional Forest	706972.5	4481324.1	4	90	22.5
124	Modified Successional Forest	682060.0	4469635.9	3	121	40.3
125	Modified Successional Forest	681883.7	4469860.0	5	50	10.0
129	Modified Successional Forest	715381.0	4476425.4	7	143	20.4
130	Modified Successional Forest	715937.4	4476826.9	9	95	10.6
131	Modified Successional Forest	715280.4	4476392.2	4	81	20.3
133	Modified Successional Forest	715846.6	4476755.7	6	51	8.5
141	Modified Successional Forest	710277.1	4479100.8	8	171	21.4
195	Modified Successional Forest	713075.6	4477465.6	6	92	15.3
197	Modified Successional Forest	713078.9	4477396.6	3	21	7.0
22	Northern Hardwood Forest	709784.9	4479963.5	0	0	---
46	Northern Hardwood Forest	710225.8	4478971.2	0	0	---
48	Northern Hardwood Forest	710085.8	4479494.8	0	0	---
59	Northern Hardwood Forest	708026.5	4481205.6	4	90	22.5
64	Northern Hardwood Forest	713001.5	4477359.2	4	31	8.2
68	Northern Hardwood Forest	713631.7	4477156.2	1	10	10.0

Table 8. Location (UTM X and Y coordinates), composition, and abundance of nonnative plant species at vegetation survey plots (VSP), Allegheny Portage Railroad National Historic Site (continued).

VSP	Community	UTM X	UTM Y	Number of nonnatives	Total nonnative cover	% nonnative cover
69	Northern Hardwood Forest	714017.0	4476955.2	3	21	7.0
79	Northern Hardwood Forest	708649.6	4481005.6	4	22	5.5
90	Northern Hardwood Forest	708135.4	4481201.9	0	0	---
92	Northern Hardwood Forest	708521.7	4481097.8	0	0	---
94	Northern Hardwood Forest	709547.8	4480015.8	0	0	---
136	Northern Hardwood Forest	713485.3	4477115.5	4	4	1.0
137	Northern Hardwood Forest	713375.1	4477236.1	0	0	---
138	Northern Hardwood Forest	710320.8	4478986.2	2	11	5.5
140	Northern Hardwood Forest	710171.1	4479222.2	0	0	---
142	Northern Hardwood Forest	709925.9	4479570.3	0	0	---
143	Northern Hardwood Forest	709895.8	4479847.9	0	0	---
144	Northern Hardwood Forest	709654.6	4480192.4	0	0	---
145	Northern Hardwood Forest	710244.4	4478909.6	0	0	---
146	Northern Hardwood Forest	710275.1	4478849.3	0	0	---
147	Northern Hardwood Forest	711580.3	4478368.9	0	0	---
148	Northern Hardwood Forest	710633.6	4478534.7	0	0	---
149	Northern Hardwood Forest	712441.8	4477791.6	3	71	23.7
151	Northern Hardwood Forest	712903.7	4477432.3	1	1	1.0
152	Northern Hardwood Forest	712815.7	4477398.7	0	0	---
154	Northern Hardwood Forest	713741.3	4477041.5	3	12	4.0
155	Northern Hardwood Forest	714155.5	4476982.6	2	2	1.0
198	Northern Hardwood Forest	708909.9	4480590.7	0	0	---
3	Northern Red Oak - Northern Hardwood Forest	682116.9	4469777.5	2	120	43.3
7	Northern Red Oak - Northern Hardwood Forest	682351.6	4470429.6	3	21	7.0
10	Northern Red Oak - Northern Hardwood Forest	706728.5	4482059.2	0	0	---
15	Northern Red Oak - Northern Hardwood Forest	707252.1	4481530.6	1	1	1.0
27	Northern Red Oak - Northern Hardwood Forest	710309.6	4478768.6	3	30	10.0
67	Northern Red Oak - Northern Hardwood Forest	713463.7	4477355.1	0	0	---
75	Northern Red Oak - Northern Hardwood Forest	714890.7	4476636.0	1	1	1.0
98	Northern Red Oak - Northern Hardwood Forest	682123.3	4469624.4	0	0	---
118	Northern Red Oak - Northern Hardwood Forest	715360.3	4476105.4	6	24	4.0
132	Northern Red Oak - Northern Hardwood Forest	715312.1	4476156.3	3	30	10.0
139	Northern Red Oak - Northern Hardwood Forest	715725.8	4476563.0	0	0	---
153	Northern Red Oak - Northern Hardwood Forest	714407.8	4476841.4	0	0	---
156	Northern Red Oak - Northern Hardwood Forest	713671.0	4477083.5	0	0	---
164	Northern Red Oak - Northern Hardwood Forest	713240.6	4477424.5	1	10	10.0
165	Northern Red Oak - Northern Hardwood Forest	713856.3	4477025.8	0	0	---
170	Northern Red Oak - Northern Hardwood Forest	707385.8	4480746.0	0	0	---
196	Northern Red Oak - Northern Hardwood Forest	713211.3	4477300.7	3	3	1.0
32	Reed Canarygrass Riverine Grassland	715611.1	4476547.4	4	140	35.0
166	Reed Canarygrass Riverine Grassland	715492.9	4476497.0	5	100	20.0
168	Sparsely Vegetated Cliff	714473.0	4476829.0	1	10	10.0
170	Sparsely Vegetated Cliff	715359.3	4476081.8	7	52	7.4
171	Sparsely Vegetated Cliff	710442.5	4478606.1	18	321	17.8
4	Successional Old Field	706444.8	4481572.6	15	300	20.0
5	Successional Old Field	683699.3	4471827.1	12	111	9.3
18	Successional Old Field	707448.3	4481266.1	11	201	21.8
21	Successional Old Field	708282.5	4480989.3	5	300	60.0
54	Successional Old Field	707720.2	4480860.5	10	350	35.0
62	Successional Old Field	707676.9	4481572.9	4	40	10.0
63	Successional Old Field	707746.4	4481707.1	2	20	10.0

Table 8. Location (UTM X and Y coordinates), composition, and abundance of nonnative plant species at vegetation survey plots (VSP), Allegheny Portage Railroad National Historic Site (continued).

VSP	Community	UTM X	UTM Y	Number of nonnatives	Total nonnative cover	% nonnative cover
71	Successional Old Field	715645.0	4476352.9	9	240	26.7
74	Successional Old Field	715609.7	4476224.9	10	200	20.0
80	Successional Old Field	713277.4	4477401.4	1	10	10.0
97	Successional Old Field	708075.5	4481065.9	10	132	14.6
115	Successional Old Field	715611.0	4476319.1	15	169	11.3
117	Successional Old Field	715487.4	4476224.6	15	237	15.8
121	Successional Old Field	715579.6	4476221.0	14	154	11.0
128	Successional Old Field	715443.6	4476368.0	16	206	12.9
134	Successional Old Field	708255.2	4481041.8	5	100	20.0
167	Successional Old Field	707273.4	4481889.6	1	60	60.0
172	Successional Old Field	713716.2	4477113.1	35	569	16.3
173	Successional Old Field	707748.3	4480950.8	18	253	14.1
174	Successional Old Field	707153.7	4480843.9	2	20	10.0
175	Successional Old Field	707263.8	4481160.0	16	242	15.1
176	Successional Old Field	707660.1	4481325.8	23	571	24.8
177	Successional Old Field	707749.1	4481693.3	14	163	11.6
178	Successional Old Field	707457.0	4481905.0	0	0	---
179	Successional Old Field	706925.9	4481489.9	13	144	11.1
181	Successional Old Field	708009.2	4481136.7	15	150	10.0
182	Successional Old Field	707241.8	4481291.1	15	250	16.7
183	Successional Old Field	707648.2	4481475.3	19	245	12.9
184	Successional Old Field	707630.5	4481193.0	15	300	20.0
185	Successional Old Field	715392.4	4476160.0	18	244	13.6
186	Successional Old Field	715598.8	4476255.7	18	358	19.9
187	Successional Old Field	706927.0	4482039.0	3	30	10.0
188	Successional Old Field	707052.9	4481283.2	14	181	12.9
190	Successional Old Field	707791.2	4481060.7	14	313	22.4
191	Successional Old Field	715732.9	4476434.7	8	144	18.0
33	Sugar Maple Floodplain Forest	715685.1	4476703.9	4	40	10.0
66	Sugar Maple Floodplain Forest	713226.5	4477350.1	1	10	10.0
76	Sugar Maple Floodplain Forest	713434.5	4477267.4	1	10	10.0
162	Sugar Maple Floodplain Forest	710312.1	4478787.2	0	0	---
163	Sugar Maple Floodplain Forest	712606.9	4477635.3	3	130	43.3
169	Sugar Maple Floodplain Forest	712556.4	4477633.9	3	130	43.3
192	Sugar Maple Floodplain Forest	713360.3	4477309.6	8	26	3.3
193	Sugar Maple Floodplain Forest	710494.3	4478690.7	0	0	---
194	Sugar Maple Floodplain Forest	710350.9	4478867.9	0	0	---
38	Tuliptree - Beech - Maple Forest	682124.0	4470649.6	6	110	18.3
44	Tuliptree - Beech - Maple Forest	712858.7	4477544.0	7	70	10.0
49	Tuliptree - Beech - Maple Forest	709329.6	4480379.2	2	20	10.0
113	Tuliptree - Beech - Maple Forest	681918.9	4470873.9	1	1	1.0
200	Tuliptree - Beech - Maple Forest	682068.1	4470944.5	4	40	10.0
19	Wet Meadow	707301.4	4481367.3	6	110	24.3
31	Wet Meadow	715415.8	4476241.0	6	210	35.0
77	Wet Meadow	713162.1	4477345.3	1	10	10.0
189	Wet Meadow	707284.5	4481349.5	2	20	10.0

Multiflora rose was the most prevalent nonnative plant species within the hardwood forest associations at ALPO (Table 7). It was absent from all types containing hemlock as well as the Sparsely Vegetated Cliff type. The Northern Red Oak - Northern Hardwood Forest type contained the greatest nonnative species diversity, containing 16 out of the 88 possible nonnative species occurring at ALPO (Table 7). The dense canopy of the hemlock forest types (Eastern Hemlock - Northern Hardwood Forests, Hemlock Tuliptree - Birch Forest, Dry Eastern Hemlock - Oak Forest) most likely limits opportunistic species and only species able to tolerate dark understories are able to survive. In addition, the steep slopes on which these types often occur most likely limited logging, clearing, and other disturbances; thus, limiting opportunities for nonnative species establishment in these types.

While forest patches in the Main Unit were virtually free of nonnative plants, forest patches at the Staple Bend Tunnel Unit contained dense infestations of Japanese knotweed, giant knotweed, or the hybrid of those two species. This was best observed in VSPs 122 and 123 (Table 5). Located at Staple Bend Tunnel, these two Allegheny Hardwoods Forest patches contained dense understories of these species beneath the forest canopy (Table 6).

In contrast to the high quality hardwood and mixed hardwood - conifer forest communities northwest of the Hollidaysburg Reservoir, the Modified Successional Forest (n=25; Table 6), Successional Old Fields (n=35; Table 6), and Conifer Plantation patches (n=7; Table 6) contained considerably greater numbers of nonnative plants. In all, 52 nonnative species were found within the Modified Successional Forest patches (Table 7). Vegetation survey points in this type contained between one and 25 nonnative species (Table 8). Multiflora rose was present at 21 out of 25 points surveyed in this vegetation type (84%; Table 7). Morrow's honeysuckle, garlic mustard, and obtuse-leaved border privet (*Ligustrum obtusifolium*) were also frequently encountered at sampling points within this type (56%, 52%, and 32%, respectively; Table 7). These associations are fairly common in the park, due to historic land clearing, agriculture, and silviculture, especially in the southeastern corner of the Main Unit near the village of Foot of Ten (Perles et al. 2006d).

Likewise, Successional Old Field patches (n=35; Table 6) contained high numbers of nonnative plants, ranging from points with one nonnative plant to 35 species (Table 8). Together, 66 species of nonnative plants occurred in this type (Table 7). Orchardgrass, sweet vernalgrass, oxeye daisy, ground ivy, reed canarygrass, Kentucky bluegrass, common selfheal (*Prunella vulgaris*), common yarrow, meadow fescue, timothy (*Phleum pratense*), Canada thistle, bitter dock (*Rumex obtusifolius*), Queen Ann's lace (*Daucus carota*), common dandelion (*Taraxacum officinale*), purple crownvetch, smooth brome (*Bromus inermis*), Japanese/giant knotweed, and meadow hawkweed (*Hieracium caespitosum*) all occurred at over one-quarter of the sample points (Table 7). Other species included velvetgrass (*Holcus lanatus*), lesser burdock, Canada bluegrass (*Poa compressa*), wild basil (*Clinopodium vulgare*), bird's-foot trefoil (*Lotus corniculatus*), curly dock (*Rumex crispus*), narrowleaf plantain, clovers (*Trifolium pratense, T. aureum, T. arvense, T. repens*), Fuller's teasel, hairy catsear (*Hypochaeris radicata*), colonial bentgrass, common gypsyweed (*Veronica officinalis*), orange hawkweed (*Hieracium aurantiacum*), and common sheep sorrel (*Rumex acetosella*), in addition to those previously listed. Many of these species are common to abandoned old fields and pastures throughout the region and few are considered invasive (see Table 5).

The wide range in the number of nonnative plants present within the Old Field vegetation associations is most likely the result of current and historic management and environmental factors. Further analysis of the Successional Old Fields would most likely reveal differences due to site hydrology and management regime. Transmission rights-of-way were classified as Successional Old Field patches in Perles et al. vegetation map for ALPO (2006d). These areas are periodically mowed to remove unwanted tree and shrub species that might interfere with the overhead power lines. Herbicide may also be employed to control unwanted vegetation in these areas. A majority of Successional Old Fields points with fewer than five nonnative plants occurred in Utility Rights-of-Way (Table 8; see Figure 3). Likewise, management of Successional Old Field patches around the Lemon House are frequently mowed as part of the cultural landscape (VSPs 62, 183, 18, 182, 184; Table 8). None of these points have more than 20 nonnative species (Table 8).

Conifer Plantations contained a total of 42 nonnative plant species (Table 7), with frequencies ranging from zero nonnative plants to 24 (Table 8). The Conifer Plantations at ALPO are currently transitioning into woodland and forest associations that resemble Modified Successional Forest patches in their composition of nonnative plant species (Table 7).

Wet Meadow patches contained between one and seven nonnative species at points surveyed but exhibited high species diversity. Fifteen different nonnative species were found at the four points sampled within patches of this type and few occurred more than once (Table 7). More sample points are needed, in addition to better site history and hydrology information, to determine the patterns of nonnative species composition within this type.

Alder Riverine Shrubland patches (n=2; Table 6) occur only at the Staple Bend Tunnel Unit along the banks of the Little Conemaugh River (Perles et al. 2006d). A total of 11 nonnative species were found in this type (Table 7). Of note here were spotted knapweed and Japanese stiltgrass, which dominated the herbaceous vegetation layer.

A type, dominated almost exclusively by a single nonnative species was the Japanese or Giant Knotweed Herbaceous Vegetation (n=5; Table 6) association, occurred also along the Little Conemaugh River at Staple Bend Tunnel (Perles et al. 2006d). A total of 20 nonnative plant species occurred within this type (Table 7). However, this type is significant for its predominance of Japanese knotweed, giant knotweed, or the hybrid between the two (60% cover, Table 7). Japanese or giant knotweed dominated patches contained up to 14 other nonnative species at each point.

Another plant vegetation association described by Perles et al. (2006d) defined by a nonnative plant species is the Reed Canarygrass Riverine Grassland (n=2; Table 6), which occurred along small drainages in the southeast corner of the Main Unit. The sample points in this area contained four and five nonnative species (Table 8). However, reed canarygrass, which defines the type, composed nearly 100 percent of vegetative cover (Table 7). The type contained only seven nonnative plants due to the predominance of reed canarygrass.

Prominent Nonnative Species in Detail

As previously mentioned, multiflora rose was present at just under 35 percent of the 200 survey points (69 points; Table 5) and in every vegetation association except for Eastern Hemlock - Northern Hardwood Forest, Hemlock - Tuliptree - Birch Forest, Dry Eastern Hemlock - Oak Forest, and Sparsely Vegetated Cliff types (Table 6). Although it can tolerate shade with reduced flowering and seed production (Rhoads and Block 2002g), it was not surprising that it was absent from the hemlock forest types, as these tended to be the least disturbed at ALPO and were forests with the densest canopies (pers. obs.). It occurred with greatest frequency in Modified Successional Forest, Successional Old field, and Conifer Plantation associations (84%, 45.7%, 42.9%, respectively; Table 7). Its distribution across most vegetation associations at ALPO suggests that this species may be difficult to eradicate. Management activities should focus on control where populations directly threaten rare plant populations and animal habitats. As it was present in most vegetation associations at ALPO, it may serve as an indicator of forest quality among the forest vegetation associations.

The average percent cover (a figure calculated by averaging the cover values of a species at all points by number of points sampled) of the multiflora rose populations in each type appeared to be related to successional state and canopy cover where the species occurred at more than one point within a vegetation association. In general, populations occurring in forested associations averaged less than 10% average cover; an exception was the Northern Red Oak - Northern Hardwood Forest (17%; Table 7). The openness of the Northern Red Oak - Northern Hardwood Forest canopy may facilitate establishment of multiflora rose and, therefore, a higher percent cover among the points than in other forest associations due to the increased light beneath the canopy. Further analysis may reveal other important relationships, including patch size and fragmentation, historic disturbance, and surrounding community/cover type. Compared to the 17 percent average cover of multiflora rose in the Northern Red Oak - Northern Hardwood Forest patches, average percent cover was substantially greater among the Modified Successional Forest and Successional Old Field patches (37.3%, 22.5%, respectively; Table 7). Mowing of some Successional Old Fields may have reduced the size of populations in this type from that of the Modified Successional Forest. The moderate average coverage values and ubiquity of multiflora rose in these two communities indicate significant and well-established invasion. This species thrives in early successional habitats, where it may inhibit the growth of later-successional woody species (Myster and Pickett 1990, 1992).

Morrow's honeysuckle was present at 39 of the 200 survey points (Table 5) and was most prevalent in Modified Successional Forest and Successional Old Field patches throughout the park. Morrow's honeysuckle was present at 56 percent of the points in Modified Successional Forest patches and 37.1 percent of the Successional Old Field patches. However, the average percent cover was only 17.1 and 13.2 percent, respectively (Table 7), indicating that populations were small where it was found. It was absent from most closed canopy forest types with the exception, again, being the Northern Red Oak - Northern Hardwoods Forest association, where it occurred at only just under six percent of the points (5.9%, 6% average cover; Table 7). A similar species, Amur honeysuckle, occurred only in the Modified Successional Forest patches (20% occurrence; Table 7) of the southeastern portion of the Main Unit.

Garlic mustard was present at 35 of the 200 points (Table 5) and present in every forest vegetation association except the Hemlock - Tuliptree - Birch Forest and Dry Eastern Hemlock - Oak Forest (Table 7). It was also absent from the Alder Riverine Shrubland, Reed Canarygrass Riverine Grassland, and Japanese or Giant Knotweed Herbaceous Vegetation (Table 7) associations. Its absence from the Hemlock - Tuliptree - Birch Forest and Dry Eastern Hemlock - Oak Forest may be due to the remoteness of these forest patches, dense canopy and dark understory conditions, and the already mentioned lack of disturbance of these types. The species' absence from the three open, heavily invaded Alder Riverine Shrubland, Reed Canarygrass Riverine Grassland, and Japanese or Giant Knotweed Herbaceous Vegetation associations is not understood, given its ubiquity in disturbed successional habitats throughout its ever-expanding range. It is possible that this plant may have been overlooked in these types already heavily dominated by nonnative species. The park has been attempting to control garlic mustard at the Summit area of the Main Unit since 2001; however, it has continued to persist in most treatment plots and new patches have been detected each year (K. Penrod, pers. comm., 2007).

Japanese barberry was present at 32 of the 200 survey points at ALPO, with a distribution similar to that of garlic mustard, occurring in all but the Hemlock - Tuliptree - Birch Forest, Dry Eastern Hemlock - Oak Forest types, and Alder Riverine Shrubland, Reed Canarygrass Riverine Grassland, and Japanese or Giant Knotweed Herbaceous Vegetation associations (Table 7). This species is able to tolerate closed-canopy conditions and, unlike multiflora rose, populations beneath these closed canopy forest patches were robust. This invasion of closed-canopy systems is not unusual for Japanese barberry, which has been documented in established forests in eastern Pennsylvania, New York, and New Jersey (Ehrenfeld 1997). Since 2001, the park has controlled Japanese barberry at some old field and forest sites at the Summit area of the Main Unit, and at the Incline 9 area (K. Penrod, pers. comm., 2007).

Reed canarygrass was present at 26 of the 200 points at ALPO (Table 5) and most common along small drainages in the southeast corner of the Main Unit (see Reed Canarygrass Riverine Grassland above). However, it was not limited to this type and has established in wet Successional Old Fields. The species was found at 40 percent of the points in Successional Old Fields and at 24 percent of the points in Modified Successional Forest patches; it was also a component of the Alder Riverine Shrubland (Table 7).

Japanese stiltgrass was present at 24 of the 200 survey points and in all vegetation associations except Hemlock - Tuliptree - Birch, Dry Eastern Hemlock - Oak Forest, and Reed Canarygrass Riverine Grasslands. Its prevalence among most of the vegetation associations across ALPO indicates its high ecological amplitude. However, it occurred at very low densities at most points. Its frequency among points in types where it occurred more than once never occurred at greater than 20 percent cover (Modified Successional Forest, 20%; Table 7). While occurring in most types, it was abundant along trails and the historic ALPO Trace and should be a concern there, especially with its demonstrated ability to survive in a variety of habitats.

Japanese knotweed, giant knotweed, or the hybrid between the two occurred at 20 of the 200 plots. Patches where these species dominate all other vegetation occur primarily along the railroad corridor adjacent to the Little Conemaugh River. The species are a major management concern where present, often dominating the understories of full-canopied forests as they do in

the Allegheny Hardwoods Forest patches at Staple Bend Tunnel. Since 2000, the park has controlled knotweed along the historic Trace and Tunnel at Staple Bend. Because of the prevalence of these species on adjacent properties and along the railroad, the park has not attempted to eradicate it, but rather to control it at visitor access areas. The park has also controlled knotweed along the historic Trace at the Main Unit since 2004 (K. Penrod, pers. comm., 2007).

The following species, while not widely distributed at ALPO, are considered to be threats to native flora. Autumn-olive was found in 13 of the 200 points; obtuse-leaved border privet found at 12 points, and common buckthorn (*Rhamnus cathartica*) found at four out of 200 points (Table 5). These species were predominantly found in Successional Old Fields and Modified Successional Forests (Table 7). Tree-of-heaven (*Ailanthus altissima*), was found at three of the 200 sample points at ALPO, all within successional or exotic types (Modified Successional Forest, Successional Old Field, Japanese or Giant Knotweed Herbaceous Vegetation). Tree-of-heaven may become more of a problem if not controlled, as it may spread rapidly from the locations where it was found. Japanese hops (*Humulus japonicus*), a "watch list" species according to the Mid Atlantic EPPC, was found along the Trace at Staple Bend Tunnel. Oriental bittersweet should be controlled, as it has the ability to rapidly out-compete native plant species (Rhoads and Block 2002b). More intense inventory of the area surrounding locations should be conducted to assess the threat posed to the surrounding landscape by these five species. Further surveys for Japanese honeysuckle should take place to assess its impact on vegetation associations at ALPO. Of these species, the park has removed autumn olive at old fields near the Lemon House and controlled oriental bittersweet along the highway corridor at the Summit area of the Main Unit. The park also treats tree-of-heaven annually at the Staple Bend Tunnel Unit (K. Penrod, pers. comm., 2007).

Roads and Trails

Sixty-one nonnative plant species were found along roads and trails at ALPO, including the historic Trace (Table 9). The 14 points along the roads, trails, and the Trace contained between zero and 31 species of nonnative plants (Table 9). These features, which range in size from 1.5–20 m (5–66 ft) in width, fragment the community patches and often serve as corridors of invasion for nonnative and native opportunistic species.

In general, smaller rights-of-way beneath moderate to closed canopies have fewer nonnative plants than those occurring in wider canopy openings (Table 9). Except at the recently disturbed trail leading to the restroom facility at the Summit Picnic Area (T3, Table 9), trails between moderate to closed canopies contained between zero and nine nonnative plants.

The composition of the Trace is often considerably different than that of adjacent vegetation associations. The species composition of trails and roadsides and most of the ALPO Trace often reflects that of the successional old field with several of the nonnative "old field" grass species present (Table 10). The Trace, which at times approaches 20 m (66 ft) in width (ROW point T6; Table 9), may facilitate the movement of invasive species into the relatively high quality hardwood and mixed hardwood - hemlock forest communities at ALPO. Japanese stiltgrass and Japanese knotweed may be the most severe threats to native species and intact forest

Table 9. Location (UTM X and Y coordinates), number of nonnative species, and physical variables and canopy cover class along transportation rights-of-way (ROW), Allegheny Portage Railroad National Historic Site.

ROW Point	Adjacent Community Type	Trail / Road Type	Location	UTM X	UTM Y	No. of Nonnative Species	Canopy cover Class*	% Canopy Cover
T1	Allegheny Hardwood Forest	Paved road	Main Unit, Summit Section, Entrance Road	707796.2	4481669.0	13	Open	0%
T2	Built-up Land	Paved road	Main Unit, Summit Section, Picnic Loop	707043.8	4481561.8	9	Moderate	40-60%
T3	Allegheny Hardwood Forest	Gravel path**	Main Unit, Summit Section, Picnic Loop	706957.8	4481602.3	20	Moderate	40-60%
T4	Northern Hardwood Forest	ALPO Trace	Main unit	709828.1	4479928.8	8	Moderate	40-60%
T5	Northern Hardwood Forest	ALPO Trace	Main unit	709805.3	4480070.3	0	Closed	>70%
T6	Northern Hardwood Forest	ALPO Trace	Main unit	709931.4	4479614.0	15	Open	0%
T7	Eastern Hemlock - Northern Hardwood Forest	Dirt two-track	Main unit	710236.3	4479152.2	6	Moderate	40-60%
T8	Allegheny Hardwood Forest	ALPO Trace	Main unit	711585.3	4478299.0	17	Open	0%
T9	Allegheny Hardwood Forest	ALPO Trace	Main unit	712354.9	4477581.6	31	Open	0%
T10	Northern Hardwood Forest	ALPO Trace	Main unit, East of Valley Forge Road	714110.4	4476967.7	19	Open	0%
T11	Northern Red Oak - North	ALPO Trace	Main unit, East of Valley Forge Road	714339.2	4476896.6	21	Open	0%
T12	Northern Red Oak - North	Dirt path	Main unit, East of Valley Forge Road	715079.9	4476619.5	1	Closed	>70%
T13	Allegheny Hardwood Forest	ALPO Trace	Staple Bend Tunnel Unit	683508.6	4471823.1	24	Open	0%
T14	Tuliptree-Beech-Maple For	ALPO Trace	Staple Bend Tunnel Unit	682203.7	4470078.6	21	Open	0%

*Canopy cover classes: Open (less than 40% canopy cover), Moderate (40-60 % canopy cover), and Closed (>70% canopy cover).
**Trail was not 50 m in length, nonnative species were assessed from the length of the trail

Table 10. Nonnative plant species occurring along roads and trails at Allegheny Portage Railroad National Historic Site.

Sci Name	Common Name	Plots invaded	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14
Taraxacum officinale	common dandelion	9	60	60	10	---	---	---	---	1	10	1	10	---	60	1
Arctium minus	lesser burdock	8	10	---	10	1	---	10	10	---	1	---	---	---	10	10
Cerastium fontanum	common mouse-ear chickweed	8	---	10	10	10	---	10	---	1	---	---	10	---	1	10
Alliaria petiolata	garlic mustard	7	---	---	1	10	---	10	60	10	---	10	10	---	---	---
Dactylis glomerata	orchardgrass	7	10	10	10	---	---	10	---	---	10	---	10	---	10	---
Daucus carota	Queen Anne's lace	7	---	---	1	---	---	---	---	1	10	10	1	---	1	10
Glechoma hederacea	ground ivy	7	---	10	10	60	---	60	10	10	10	---	---	---	---	---
Hesperis matronalis	dames rocket	7	10	---	10	---	---	---	10	1	10	10	10	---	---	---
Microstegium vimineum	Japanese stiltgrass	7	---	---	---	60	---	60	60	60	60	60	60	---	---	---
Poa pratensis	Kentucky bluegrass	7	60	60	60	---	---	60	---	---	---	60	10	---	10	---
Clinopodium vulgare	wild basil	6	---	---	---	60	---	60	10	10	10	---	1	---	---	---
Chrysanthemum leucanthemum	oxeye daisy	6	---	1	1	---	---	---	---	---	10	1	1	---	10	---
Rumex obtusifolius	bitter dock	6	1	10	10	10	---	1	---	---	10	---	---	---	---	---
Artemisia vulgaris	common wormwood	5	---	---	---	---	---	---	---	10	10	60	60	---	---	10
Medicago lupulina	black medick	5	---	---	60	---	---	---	---	---	10	1	10	---	10	---
Poa compressa	Canada bluegrass	5	---	---	---	---	---	---	---	1	60	60	60	---	---	10
Prunella vulgaris	common selfheal	5	---	1	1	---	---	---	---	---	---	10	10	---	1	---
Rosa multiflora	multiflora rose	5	---	---	---	---	---	---	---	---	10	10	1	1	---	10
Rumex crispus	curly dock	5	---	---	1	---	---	---	---	---	1	---	10	---	10	1
Coronilla varia	purple crownvetch	5	60	---	10	---	---	---	---	10	60	---	---	---	---	10
Achillea millefolium	common yarrow	4	---	1	---	---	---	---	---	10	10	10	---	---	---	---
Bromus inermis	smooth brome	4	10	---	---	---	---	1	---	---	1	---	---	---	10	---
Lepidium campestre	field pepperweed	4	---	---	1	---	---	---	---	1	1	---	---	---	---	1
Polygonum caespitosum	oriental ladysthumb	4	---	---	---	60	---	60	---	---	---	---	---	---	60	10
Trifolium repens	white clover	4	---	---	---	---	---	---	---	---	---	1	10	---	10	10
Anthoxanthum odoratum	sweet vernalgrass	3	10	---	---	---	---	60	---	---	10	---	---	---	---	---
Hieracium caespitosum	meadow hawkweed	3	10	---	10	---	---	---	---	---	1	---	---	---	---	---
Stellaria media	common chickweed	3	---	---	---	---	---	10	---	---	---	---	10	---	---	10
Tussilago farfara	coltsfoot	3	---	---	---	---	---	---	---	10	---	---	---	---	10	10
Berberis thunbergii	Japanese barberry	2	---	---	---	---	---	10	---	---	10	---	---	---	---	---
Centaurea stoebe ssp. *micranthos*	spotted knapweed	2	---	---	---	---	---	---	---	10	10	---	---	---	---	---
Chelidonium majus	celandine	2	---	---	---	---	---	---	---	---	10	---	10	---	---	---
Cirsium arvense	Canada thistle	2	---	---	60	---	---	---	---	---	---	---	---	---	---	60
Cirsium vulgare	bull thistle	2	10	---	---	---	---	---	---	---	---	---	---	---	1	---
Galinsoga quadriradiata	shaggy-soldier	2	---	---	---	---	---	---	---	---	---	1	1	---	---	---
Humulus japonicus	Japanese hop	2	---	---	---	---	---	---	---	---	---	---	---	---	1	1
Melilotus officinalis	yellow sweetclover	2	---	---	---	---	---	---	---	---	1	1	---	---	---	---
Pastinaca sativa	wild parsnip	2	---	---	---	---	---	---	---	---	1	---	---	---	10	---

Table 10. Nonnative plant species occurring along roads and trails at Allegheny Portage Railroad National Historic Site.

Sci Name	Common Name	Plots invaded	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14
*Polygonum cuspidatum/sachalinense**	Japanese/giant knotweed	2	---	---	---	---	---	---	---	---	---	---	---	---	1	10
Ranunculus acris	tall buttercup	2	---	---	1	---	---	---	---	---	---	---	---	---	10	---
Saponaria officinalis	bouncingbet	2	---	---	---	---	---	---	---	---	10	1	---	---	---	---
Trifolium pratense	red clover	2	---	---	10	---	---	---	---	---	---	---	---	---	10	---
Veronica officinalis	common gypsyweed	2	---	---	---	---	---	10	---	---	10	---	---	---	---	---
Barbarea vulgaris	common wintercress	1	---	---	---	---	---	---	---	---	---	---	---	---	---	10
Dianthus armeria	Deptford pink	1	---	---	---	---	---	---	---	---	---	---	---	---	10	---
Dipsacus fullonum	Fuller's teasel	1	---	---	---	---	---	---	---	---	1	---	---	---	---	---
Echium vulgare	common vipersbugloss	1	---	---	---	---	---	---	---	---	---	1	---	---	---	---
Lathyrus latifolius	perennial pea	1	---	---	---	---	---	---	---	---	10	---	---	---	---	---
Linaria vulgaris	butter and eggs	1	---	---	---	---	---	---	---	10	---	---	---	---	---	---
Lonicera morrowii	Morrow's honeysuckle	1	---	---	---	---	---	---	---	---	---	1	---	---	---	---
Phalaris arundinacea	reed canarygrass	1	---	---	---	---	---	---	---	---	---	---	---	---	---	1
Phleum pratense	timothy	1	---	---	---	---	---	---	---	---	---	---	---	---	10	---
Plantago lanceolata	narrowleaf plantain	1	---	---	---	---	---	---	---	---	---	---	---	---	10	---
Rubus phoenicolasius	wine raspberry	1	---	---	---	---	---	---	---	---	---	---	10	---	---	---
Festuca elatior	meadow fescue	1	---	---	---	---	---	---	---	---	---	---	---	---	---	10
Sedum telephium	witch's moneybags	1	1	---	---	---	---	---	---	---	---	---	---	---	---	---
Senecio vulgaris	old-man-in-the-spring	1	10	---	---	---	---	---	---	---	---	---	---	---	---	---
Solanum dulcamara	climbing nightshade	1	---	---	---	---	---	---	---	---	---	---	---	---	1	---
Tragopogon dubius	yellow salsify	1	---	---	---	---	---	---	---	---	1	---	---	---	---	---
Trifolium aureum	large yellow hop-clover	1	---	---	---	---	---	---	---	---	---	---	---	---	---	1
Verbascum thapsus	common mullein	1	---	---	---	---	---	---	---	1	---	---	---	---	---	---
Total		61	13	9	20	8	0	15	6	17	31	19	21	1	24	21

*Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*P. sachalinense*) were combined for field survey and analysis

communities, as they appear to be able to tolerate understory conditions and thrive in light gaps. Park managers have focused removal efforts on Japanese and giant knotweed and Morrow's honeysuckle since 1999 (K. Penrod, pers. comm., 2005). However, based on observations and consultation with PNHP botanists, Japanese stiltgrass appears to have increased in abundance in the time since the 2001 PNHP survey (WPC 2003; S. Grund, pers. comm., November 20, 2006). Currently, Japanese stiltgrass is one of the most abundant nonnative species along the ALPO Trace between the Main Unit and Foot of Ten. Control efforts for Japanese knotweed and giant knotweed patches along the Trace occurred in 2005 and 2006. Treated sites are monitored annually and spot treated when necessary (K. Penrod, pers. comm., 2006).

Management Recommendations

General Management and Planning

The JOFL and ALPO survey results demonstrate the difference in nonnative species composition of closed-canopy, undisturbed forests, like those northwest of the Hollidaysburg Reservoir and on steep slopes at ALPO, compared to patches of open, disturbed fields and successional forests of JOFL, and abandoned agricultural lands at both parks. As previously mentioned, the nonnative species composition and percent cover was reported for each survey point and totaled for all points within a vegetation association in order to determine what nonnative species were found in specific vegetation associations. This information should provide a list of species to "be on the lookout for" within each vegetation association. Percent cover, or the area occupied by each nonnative species, is a measure of how robust the population is at each survey point. While this information was recorded at each point and summarized by vegetation association in this report, it was difficult to compare the coverage values between associations because of the variation in composition among points within each type. Values appeared to be more of a function of canopy openness, soil disturbance, soil moisture, and other ecosystem factors (such as soil texture, slope, aspect, etc.) than vegetation association alone, although certain factors that influence native species undoubtedly influence nonnative species. The vegetation associations mapped may contain a wide range of these factors (e.g., see discussion of Successional Old Fields at JOFL) and thus exhibited a wide range of nonnative species. Therefore vegetation association alone is not the sole determining factor of "invadedness."

The aim of our recommendations is to reduce disturbance of existing, relatively invasive-free communities and to control targeted invasive plant species populations. These recommendations should be tied together as part of the park resource management plan in which the overall goals and desired conditions for various sites within the parks are addressed.

In general, control efforts should focus on species identified by the PA DCNR as posing a moderate to severe threat to native plants, animals, and natural associations in PA (Tables 1, 5). While some may be easier to control than others, an invasive species management plan focusing on these species should be developed for the two park units.

For abundant nonnative species such as multiflora rose, purple crownvetch, Japanese and giant knotweed, and Morrow's and Amur honeysuckle, respectively, management should focus on sites where large populations directly threaten rare plant populations and animal habitats. At both NPS units, purple crownvetch is difficult to address in terms of management, for while it is considered an invasive species in Pennsylvania (Exotic Plant Tutorial for Natural Lands Managers), it was planted heavily as a cover species and for erosion control along roadsides throughout and around JOFL and throughout the former lakebed. While it may be limited to open areas, managers should seek to remove this species when possible and explore an alternative native cover species along roadsides and for erosion control. Mixtures of native warm (e.g., *Schizachyrium scoparium*, and others) and cool season grasses (e.g., *Agrostis perennans, Festuca rubra*, and others) are available for such projects.

Objectives for invasive species management should be developed for each vegetation association and, in particular, for Red Maple - Black Cherry Successional Forest / Woodland patches, Old Fields, and Pine Plantations at JOFL, and Modified Successional Forest, Successional Old Field, and Conifer Plantation types at ALPO. For Successional Old Fields at both NPS units, management should either: 1) maintain areas as open pasture as part of the cultural landscape or utility rights-of-way, or 2) conduct activities to promote succession toward native forest vegetation associations in uplands areas. For Conifer Plantations, nonnative pines should be removed and these areas should be replanted with native tree species. For both types, data collected in the NPS 6 Parks Mapping Project (Perles et al. 2006a, 2006d) can be used to create model-types for restoration activities. For example, the local and global vegetation association descriptions, as well as species lists, and information collected in the plots (i.e., percent cover, dominance, etc.) can be used to provide references for restoration.

Control of nonnative invasive plants is more problematic in the successional forest types (Red Maple - Black Cherry Successional Forest / Woodlands at JOFL and Modified Successional Forests at ALPO) where nonnative plants often dominate the plant cover and where nonnatives define the vegetation association (Reed Canarygrass Riverine Grassland, Japanese or Giant Knotweed Herbaceous Vegetation). In these communities, management activities should concentrate on controlling the most aggressive invasive species where they threaten native plants or may spread into adjacent, less disturbed vegetation associations.

Control efforts in higher quality forest types at ALPO (Northern Red Oak - Northern Hardwood Forest, Allegheny Hardwoods Forest, Northern Hardwoods Forest, Eastern Hemlock - Northern Hardwood Forests, Hemlock Tuliptree - Birch Forest, Sugar Maple Floodplain Forest, and Tuliptree - Beech - Maple Forest) should focus on and near trails, roadsides, and near forest edges. Small populations should be removed whenever they are observed. For any road building, forestry, or maintenance activities, equipment should be thoroughly cleaned prior to use and cleaned in the area following the activity. For example, tires of vehicles used in brush removal and salvage logging should be cleaned before they enter relatively invasive-free communities.

Long term monitoring points should be established to assess effectiveness of treatments and restoration activities in all vegetation associations.

Construction, expansion, and upgrading of roads should be limited in mature, closed-canopy forests. Road construction creates corridors of disturbance into the interior of invasion-resistant habitats, opening them to invasion (Parendes and Jones 2000). Widening and upgrading of existing one-lane gravel roads and hiking trails can create or widen openings in the canopy, admitting the direct sunlight preferred by many invasive understory species. When new road construction is unavoidable, it should be routed through already-invaded habitat such as successional fields. Clauses can be added into contracts requiring contractors to use weed-free fill and/or straw, to clean equipment, etc. Contract language should require the contractor to monitor their sites and come back to control any invasive plants that come in as a result of their work.

Roads and trails fragment community patches and often serve as corridors of invasion for nonnative and native opportunistic species (Benninger-Truax et al. 1992). Data from this study

suggested that several nonnative species that were abundant along trails were not found at survey points (Table 5) and others were found primarily in the Successional Old Field and Modified Successional Forest associations. Trails through hardwood and mixed hardwood conifer forests, for example, often contain multiflora rose, Japanese stiltgrass, and other species requiring more light than in the forest interior, thus the presence and percent cover of these species was much lower at assessment points than along the trails. This was especially true for the historic ALPO Trace. These fragmenting features that support nonnative plants may threaten higher quality patches when natural disturbances, such as loss of canopy cover due to ice damage or wind-throw, may result in openings in the canopy, enabling nonnative expansion from trail and roadsides. A concentrated effort to remove problem species within a buffer of 10 m (33 ft) from the edge of the trail or road should, therefore, provide a substantial defense against the spread of these species in closed canopy forests in the event of a canopy-opening disturbance. In all forest types, control of multiflora rose, Japanese barberry, and Japanese stiltgrass should be focused along roads and trails through higher quality oak-dominated community patches at both park units. Special attention should be paid to culverts and waterbars that provide suitable habitat for some nonnative plant species. Following construction of any new structure such as those previously mentioned, the plant composition of the disturbed area should be monitored and these areas should be targets for species control.

Management of Specific Invasive Species

Again, control efforts should focus on species identified by the PA DCNR as posing a moderate to severe threat to native plants, animals, and natural communities in PA (Tables 1, 5). Control options for all species listed as invasive in these tables should be assessed. While some may be easier to control than others, an invasive species management plan focusing on these species should be developed for the two park units.

General management recommendations for the most widespread invasives at JOFL and ALPO are provided below. These short summaries do not attempt to include all of the management options for all species or all site conditions.

Morrow's honeysuckle are able to re-sprout from roots or remaining vegetation left behind after cutting or pulling; while these measures can be effective for small infestations, sites should be monitored afterwards to prevent reestablishment. The selective application of herbicides as foliar sprays or to cut stumps may be necessary to prevent resprouting. Glyphosate and triclopyr are effective applied to the leaves in 2% solution or cut stems in 20–25% solution (Batcher and Stiles 2001; Rhoads and Block 2002f).

Multiflora rose seedlings can be pulled by hand, but larger plants may require chains or cables and a tractor, and dense thickets will need heavy machinery; the roots must be removed to prevent resprouting. Regular mowing of populations in old fields can also be effective (Eckardt 1987). Herbicide treatment of cut stems (with glyphosate or triclopyr) is recommended as the most effective treatment by Rhoads and Block (2002g).

Japanese barberry can be pulled, using gloves, and mowing will reduce proliferation but not prevent regrowth. Leaf application of 2% glyphosate or triclopyr, or application of a 25% solution of the same herbicides to cut stems is also recommended (Rhoads and Block 2002d).

Complete removal of the root system renders herbicide application unnecessary (Brunelle and Lapin 1996).

Japanese knotweed/giant knotweed spreads vegetatively as well as by wind and water dispersal of its small, buoyant seeds. Persistent cutting may be enough to control small infestations, but mechanical attempts at removal will not work in the long term because of the regenerative ability of knotweed rhizomes. NPS research at Penn State showed good results for foliar application of glyphosate plus sticker-spreader in early June followed by a second application in late August (Rhoads and Block 2002e).

Garlic mustard may be controlled by hand pulling or cutting; however, this is labor-intensive and less effective against large infestations. All plant materials should be removed from the site after cutting or pulling because flowering plants can still produce seeds after being uprooted; mechanical removal must continue for several years until the seed bank is emptied. Annual mowing or prescribed burning are effective for larger populations (Rhoads and Block 2002c).

Obtuse-leaved border privet seedlings can be pulled by hand or a weed wrench can be used to remove larger plants. Mowing or cutting is effective, although it will resprout. Herbicides can be used effectively to control privet; glyphosate and triclopyr are recommended. Either can be used in water as a foliar application or to treat cut stumps. Treatment of the basal 12–15 inches of woody stems with 25% triclopyr in oil is another alternative (Rhoads and Block 2002h).

Autumn olive seedlings and sprouts can be pulled by hand and the roots should be removed completely. Because cutting or fire alone results in thicker, denser growth upon resprouting, use of chemical herbicides are required to remove larger individuals. Glyphosate can be used to control larger plants. Foliar application of glyphosate is effective. In areas where other species are present, the herbicide should be applied to freshly cut stumps to minimize damage to other plants (Rhoads and Block 2002a).

Tree-of-heaven can be best controlled by manual removal of young seedlings. However, the entire root must be removed or it may resprout. It may take several trimmings and cuttings to remove larger saplings. Girdling (manually cutting away bark and cambium tissues around the trunks) or basal bark treatment are an effective and relatively inexpensive method for killing larger stems. Use of glyphosate, either sprayed onto the leaves or painted onto a freshly cut stump will kill the plant (NPS 2006b).

Japanese stiltgrass can be pulled by hand throughout the growing season or mowed in late summer (i.e., August–September) when the plants are flowering, preferably before seed is produced. For extensive stiltgrass infestations, application of a 2% solution of glyphosate (e.g., Roundup) or the formulation labeled for wetland areas (e.g., Rodeo), mixed with water (8 oz. per 3 gals. mix) and a surfactant in late summer is a more practical and effective method (Tu 2000; NPS 2006d).

Oriental bittersweet vines can be pulled out by the roots and removed from the site, preferably before fruiting. If fruits are present, vines should be bagged and disposed of in a landfill, or left in the bags and allowed to bake in the sun long enough to kill the seeds. Certain systemic herbicides, such as glyphosate or triclopyr that are taken into the roots and kill the entire plant,

have been used successfully in bittersweet management. This method is most effective if the stems are first cut by hand or mowed and herbicide is applied immediately to cut stem tissue (Rhodes and Block 2002b; NPS 2006c).

Norway maple seedlings can be pulled when the soil is moist. Larger plants should be dug out including the root systems. Larger trees should be cut down and the stumps ground out. Trees can be girdled by cutting through the bark and cambium layer all around the trunk. Girdling is most effective in spring. Glyphosate treatment, applied to the cut stumps and root collar sprouts, is recommended (USDA Forest Service).

Reed canarygrass can be hand-pulled in small areas that are newly infested. As fragments of rhizome inevitably remain and grow, follow-up hand-pulling over the next four or five years is recommended. Periodic mowing (five times) in a season has been found to be effective as has discing or plowing. This may be impossible in wetter areas. Flooding kills the seeds, which cannot survive prolonged inundation, but established rhizomes are unaffected. Only glyphosate formulas approved for use in aquatic systems may be used (Rhoads and Block 2002i).

Common buckthorn control is most effective using a combination of cutting and herbicide application. Application a triclopyr herbicide at the rate of 1:4 herbicide:water on cut stumps during the growing season, from late May to October of herbicides has been found to effectively control buckthorn. This has also been affective during the winter (NPS 2006e).

Conclusions

Invasive exotic plant species represent one of the greatest threats to the native vegetation at JOFL and ALPO. The results of the inventory suggest that the invasive species composition is a symptom of human disturbance, both past and present, as more disturbed or successional vegetation associations exhibited a substantially higher number of nonnative plant species. Successional Old Fields and Modified Successional Forests at both NPS units represent highly disturbed areas where invasive nonnative plants are abundant and where management is required to limit their spread into higher quality forest types.

Differences between JOFL and ALPO – in the invasive species present, their density, and their distribution among the plant communities – are likely due to differences in community fragmentation and disturbance history at the two sites.

JOFL and ALPO, although close in proximity, represent the results of very different land management strategies and each possesses unique challenges to management of nonnative plant species. Abandoned fields (Successional Old Fields at ALPO, and Old Fields at JOFL) were similar in composition due to their similarity in history and environmental factors. Multiflora rose and Morrow's honeysuckle occurred with great frequency in these and the Modified Successional Forest types. The low number of nonnative plants in the hardwood and mixed hardwood-coniferous forests indicated a higher degree of forest quality at ALPO than at JOFL. However, species like multiflora rose were still present at a number of points within the closed canopy forest types. This species is primarily dispersed by birds (Rhoads and Block 2002g) and, therefore, more likely to spread into forests (McDonnell 1986). Its shade tolerance allows it to persist with reduced vigor as a successional area develops a closed canopy, or even to invade mature forest (Stover and Marks 1998; Rhoads and Block 2002g).

At both JOFL and ALPO, points located in mature forest types had fewer invasive species than points located in Old Fields and Modified Successional Forest types. Since JOFL is small and forests generally fragmented, it is not surprising that the vegetation associations were more impacted by nonnative plants. The low number of invasives in hemlock-dominated types at ALPO suggests that these patches are less disturbed than other types at the two NPS units. These forest patches at ALPO are large and are more isolated from pedestrian traffic than the smaller Eastern Hemlock - Northern Hardwood Forest and Red Maple - Black Cherry Successional Forest/Woodland patches at JOFL. Control of nonnatives in forest patches may be more difficult at JOFL and the southeastern portion of the Main Unit at ALPO, given their smaller size, higher degree of fragmentation, and established populations of aggressive nonnative species.

Because the Successional Old Field and Modified Successional Forest (Red Maple - Black Cherry Successional Forest/Woodland at JOFL) associations contain particularly high abundances of invasive shrub species that may threaten and impede the succession to a native forest type without proper management, the management of these former agricultural fields should be a priority for park resource managers. Natural resource managers should develop management plans specifically tailored to these areas in the park that address the control of invasive species, designate desired future conditions (vegetation structure and composition), and outline management actions to achieve the desired target conditions. The development and

implementation of a management plan specifically for abandoned pastures and successional forest types associations would facilitate the control of these invasive species and the restoration of natural vegetation associations.

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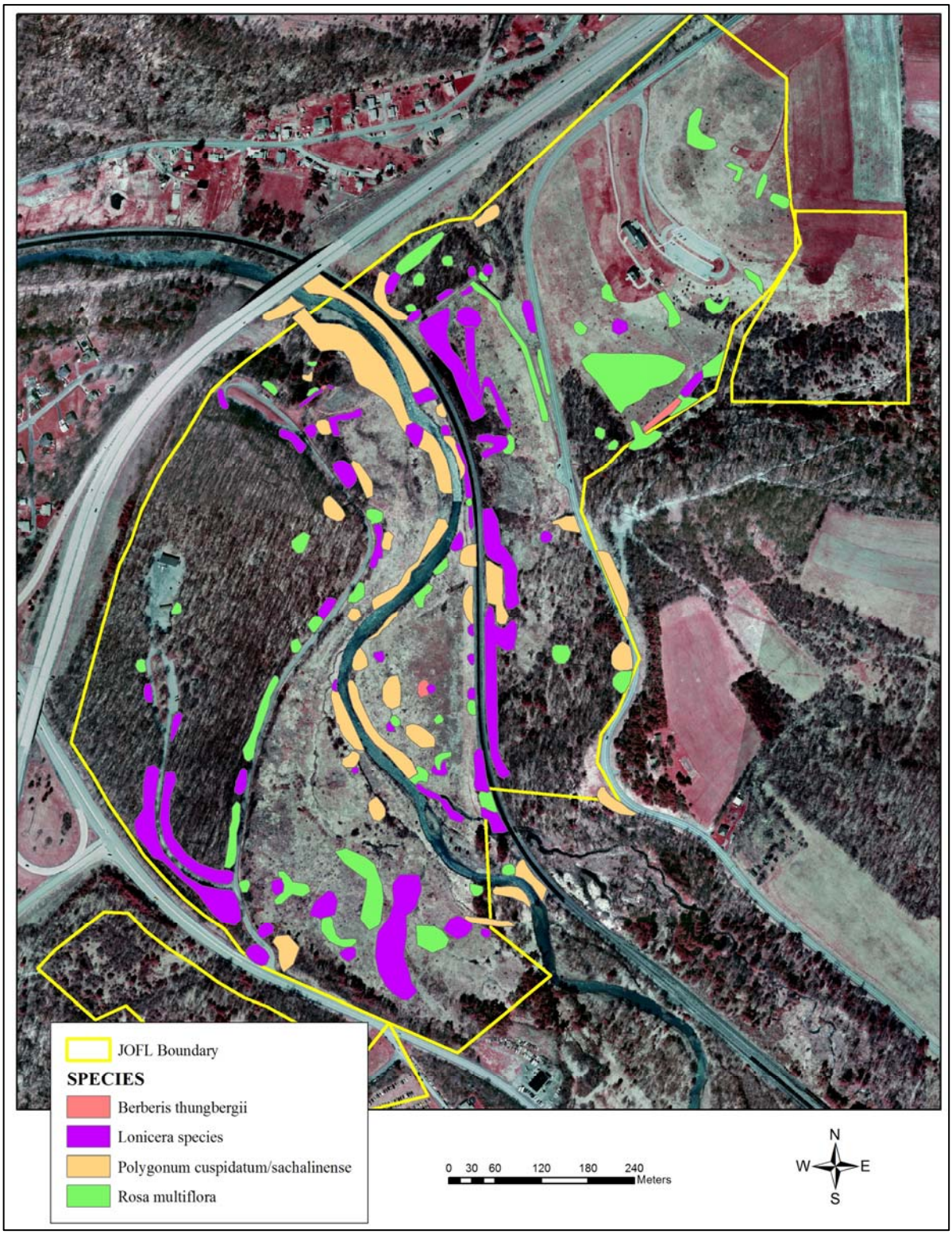
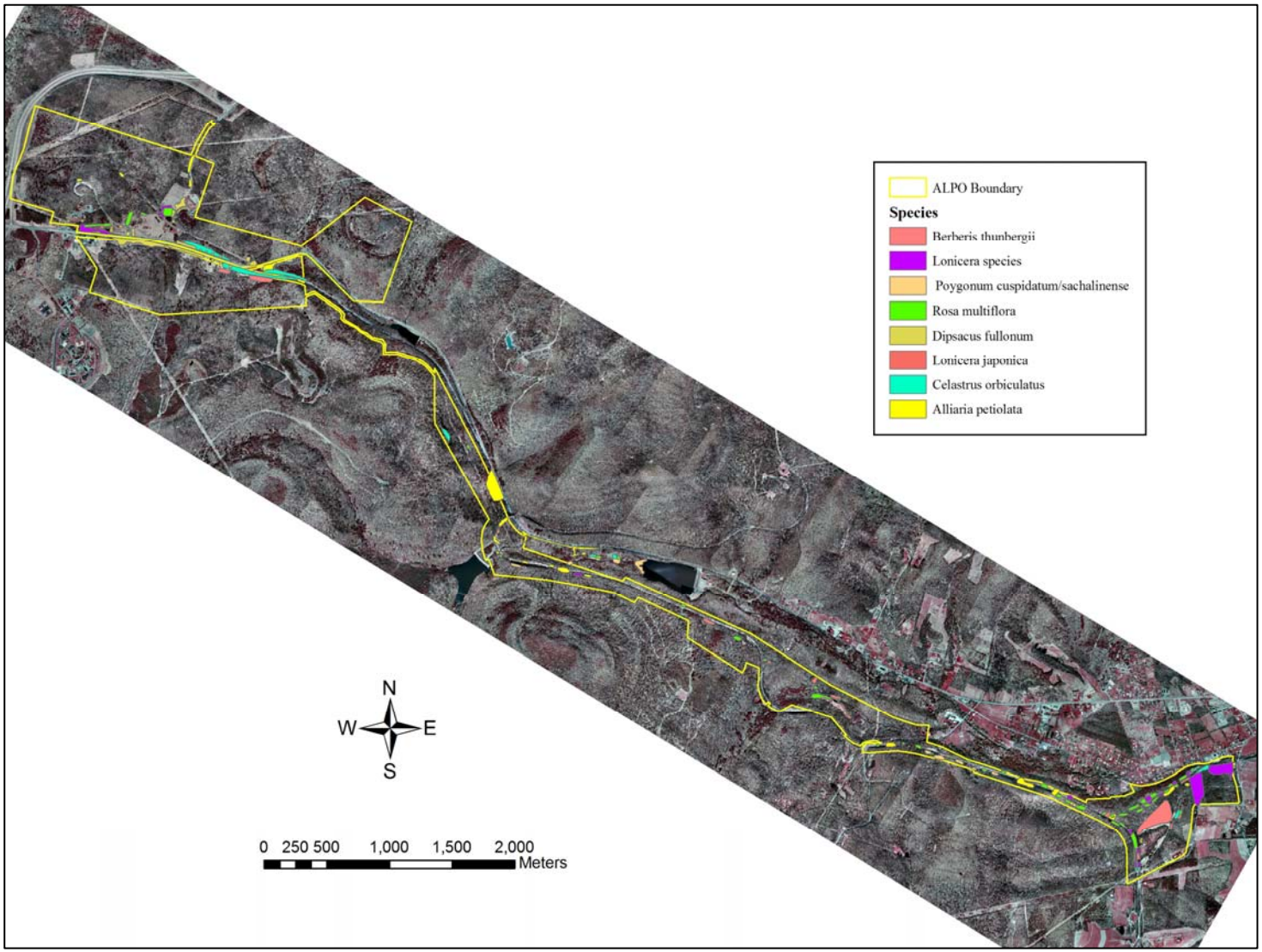
Appendix A. Mapped populations of select nonnative plant species at Johnstown Flood National Memorial and Allegheny Portage Railroad National Historic Site, 1999 (digitized in 2005).

Appendix A1. Mapped populations of select nonnative plant species at Johnstown Flood National Memorial, 1999 (digitized in 2005).



Appendix A2. Mapped populations of select nonnative plant species at Allegheny Portage Railroad National Historic Site, 1999 (digitized in 2005).



Appendix B. Field form used for rapid assessment of nonnative plant species at Johnstown Flood National Memorial and Allegheny Portage Railroad National Historic Site.

WPC NPS Invasive Species Rapid Assessment									Date: _____			
Plants within 50 m of point: **A = abundant, O = occasional, R = rare**									Observers:			
spp	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot
Acer platanoides												
Agrostis capillaris												
Agrostis gigantea												
Agrostis stolonifera												
Ailanthus altissima												
Alliaria petiolata												
Anthoxanthum odoratum												
Arctium minus												
Berberis thunbergii												
Bromus inermis												
Celastrus orbiculatus												
Centaurea maculosa												
Chrysanthemum leucanthemum												
Cirsium arvense												
Cirsium vulgare												
Coronilla varia												
Dactylis glomerata												
Daucus carota												
Dipsacus fullonum												
Elaeagnus angustifolia												
Elaeagnus umbellata												
Euonymus alata												
Festuca arundinacea												
Glechoma hederacea												
Hedera helix												
Hieracium caespitosum												
Hieracium venosum												
Heracleum mantegazzianum												
Holcus lanatus												
Hypochoeris radicata												
Larix japonica												
Lathyrus latifolius												
Ligustrum obtusifolius												
Lonicera japonica												
Lonicera maackii												
Lonicera morrowii												
Lonicera tatarica												
Lotus corniculatus												
Lythrum salicaria												
Malus pumila												
Microstegium vimineum												
Myriophyllum spicatum												
Pastinaca sativa												
Paulownia tomentosa												
Phalaris arundinacea												
Phleum pratense												
Phragmites australis												

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Picea abies												
Pinus sylvestris												
Plantago lanceolata												
Poa compressa												
Poa pratensis												
Polygonum caespitosa												
Polygonum cuspidatum												
Polygonum perfoliata												
Polygonum persicaria												
Polygonum. sachalinense												
Prunella vulgaris												
Ranunculus acris												
Ranunculus ficaria												
Rhamnus cathartica												
Rhamnus divaricata												
Rhamnus frangula												
Rosa multiflora												
Rumex acetosella												
Rumex crispus												
Rumex obtusifolius												
Taraxacum officinale												
Trapa natans												
Trifolium aureum												
Trifolium pratense												
Tussilago farfara												
Vinca minor												
others												

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

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National Park Service
U.S. Department of the Interior

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