

**A SURVEY OF INVASIVE PLANTS
PISGAH STATE PARK, CHESHIRE COUNTY, NEW HAMPSHIRE**

Prepared by

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Summary

In 2008 and 2009, Ashuelot Valley Environmental Observatory (AVEO) developed and completed a survey of invasive plants in Pisgah State Park, Cheshire County, NH. The survey covered all trails and roads, totaling 54.4 miles, within the park. Trained volunteer Citizen Scientists documented a total of 29 occurrences of five invasive species, including Japanese barberry, glossy buckthorn, multiflora rose, Oriental bittersweet, and purple loosestrife. While most (69%) trails were devoid of focal species, volunteers noted occurrences in several locations, including Jon Hill Road and trails near the Horseshoe Road trailhead/ Habitat Trail area. Volunteers also noted winged burning bush and non-native bush honeysuckles at locations outside of the formal survey routes. These findings parallel those of the New Hampshire Natural Heritage Bureau, which noted a minimal presence of invasive species in the park during a recent ecological inventory. AVEO recommends that this survey be repeated and expanded in the future in order to gauge and curtail the establishment of invasive plants throughout Pisgah.

Background and Introduction

In southern New England, “large areas of protected forestland are uncommon, conserved forests are largely disconnected, important natural and cultural resources (including many plant and animal species) are vulnerable to loss” (Foster et. al. 2005; pg. 2). As New Hampshire’s largest state park, Pisgah State Park’s (Pisgah) 13,421 acre mosaic of rugged topography, mature- and old-growth forests, wetlands, mid-succession habitat, and rich cultural history affords an unparalleled setting for conservation, recreation and education, while providing a vast array of ecosystem services. Considering myriad ecological, social, aesthetic, and economic benefits, large tracts of conserved land, such as Pisgah, require nothing less than best management practices (Foster et. al. 2005), including appropriate monitoring and management of all potential avenues which may compromise its ecological integrity.

Since its creation in 1960, natural resource management in Pisgah has been limited, with the exception of some open areas that have been maintained as early succession habitat. Over time, natural processes of forest succession have transformed old fields and early-succession habitat, the legacy of abandoned homesteads, to largely continuous forest throughout the majority of the park. Management of Pisgah came to the forefront in 2006, when NH Department of Resources and Economic Development’s (DRED) Division of Forests and Lands

proposed a timber sale on the park's eastern edge. Concern arose from the communities' citizens and environmental professionals about pursuing new management without a comprehensive management plan for the park. In response, DRED formed the Pisgah State Park Advisory Committee to create a management plan, and the Pisgah State Park Technical Team to help inform the planning process. Central to this task was establishing the current condition of all natural resources, including documenting the presence and distribution of invasive plants throughout the park.

Invasive plants are a potential threat to the ecological integrity of Pisgah's natural communities, especially given concerns about impacts of timber management, mowing to maintain early succession habitat, recreational off-road vehicle usage, and other land use. Equipped with the ability to outcompete native plants, these non-native species can overtake natural areas if not controlled, thus, it is crucial to determine where, and to what extent, invasive plant species occur. In response to NH Natural Heritage Bureau's (NHNHB) request for a comprehensive survey of invasive plants in Pisgah, AVEO launched a Citizen Science program designed to detect invasive plants throughout the park, expecting that presence of invasive species would be minimal and primarily correlated to areas that have experienced recent or ongoing anthropogenic disturbance. Objectives of the program included: (1) to promote local community involvement in a current conservation initiative, (2) to document focal species and establish a baseline status of invasive plants in the park, and (3) to provide a dataset to help inform the management plan currently being drafted by the Pisgah State Park Technical Team.

Considering the large scale of such a project, a survey protocol designed specifically for trained volunteers allowed for collection of sound data in a timely and cost-effective manner. AVEO recruited and trained volunteers from local communities and schools to survey trail segments for presence/absence of a select group of invasive plants (presence of a focal species, regardless of abundance, is hereafter referred to as an occurrence). Focal species included Japanese barberry, autumn olive, non-native bush honeysuckles, common (European) buckthorn, glossy buckthorn, multiflora rose, Japanese knotweed, winged burning bush, Oriental bittersweet, and purple loosestrife (for scientific names, see Table 1). Although originally intended to be surveyed, garlic mustard (*Alliaria petiolata*) was removed from the focal species list due to difficulty of detection and identification during late summer and fall when the surveys were conducted (Rowe & Swearingen 2005). In the fall of 2008, AVEO's volunteer Citizen Scientists piloted the sampling

protocol and surveyed more than 12 miles of trail. The project resumed in late summer and fall of 2009, when volunteers completed surveys along all remaining trail segments and documented location and extent of invasive plant occurrences throughout the park.

Table 1. Focal species included in the invasive plant survey of Pisgah State Park, Cheshire County, NH in 2008-2009.

Scientific Name	Common Name	Abbreviation
Shrubs		
<i>Berberis thunbergii</i>	Japanese barberry	BETH
<i>Elaeagnus umbellata</i>	autumn olive	ELUM
<i>Euonymus alatus</i>	winged burning bush	EAUL
<i>Lonicera</i> spp.	non-native bush honeysuckles	LOSP
<i>Polygonum cuspidatum</i>	Japanese knotweed	POCU
<i>Rhamnus cathartica</i>	common (European) buckthorn	RHCA
<i>Rhamnus frangula</i>	glossy buckthorn	RHFR
<i>Rosa multiflora</i>	multiflora rose	ROMU
Vines		
<i>Celastrus orbiculatus</i>	Oriental bittersweet	CEOR
Herbaceous		
<i>Lythrum salicaria</i>	purple loosestrife	LYSA

Methods

Trained volunteers followed a sampling protocol adapted from the Rutgers University Invasive Plant Monitoring Project (Rutgers 2009). AVEO assigned pairs of observers a trail segment ranging from 0.3 to 3.2 miles in length; trail segments were defined by identifying reasonable sections of road or trail between trailheads or intersections to establish clear start and end points. This slightly contrasts the Rutgers protocol in which all survey routes had a standardized distance of two miles. Along each trail, observers visually searched for focal species at sampling points located every 0.1 mile, using a pedometer to gauge distance travelled. Upon arriving at each point, observers set out pre-measured ropes on both sides of the trail to facilitate search efforts within two plots each with an area of 120 ft². Centered on the point, observers ran a 20 ft rope parallel to the trail and a six foot rope perpendicular to the trail to form these rectangular plots. They sought out focal species within these trailside areas by looking at each layer of vegetation from the ground up. While remaining on the trail, they searched for distant occurrences beyond the plot boundary. Observers made note of any invasive species detected

between sampling points; in effect, the entire length of each trail or road throughout the park was sampled. At each point, observers additionally recorded findings of interest concerning both natural and cultural history (e.g. stone walls).

For each survey, observers recorded the following information on datasheets when applicable: (1) trail segment, (2) start point, (3) plot number, (4) latitude and longitude, (5) compass direction of trail sides, (6) distance of occurrence from trail, with trailside (T) being <6 ft from trail and distant (D) being >6 ft from trail, (7) four letter species code, and (8) abundance noted as Few (less than three stems), Some (greater than three stems, small patches), or Many (ground covered). Each occurrence of a focal species was further documented by photographs of both the entire plant and a close-up of the leaves, stem and buds; these were reviewed by AVEO staff to ensure proper identification of focal species. For occurrences of only a few stems, volunteers pulled the plant and hung it by the roots to dry in a nearby shrub. When encountering a significant occurrence, they marked the location with labeled biodegradable flagging to aid future eradication efforts.

Results

In 2008 and 2009, 24 volunteers and AVEO staff surveyed 32 trail segments (54.4 miles) and documented 29 occurrences of one or more of the focal species. Focal species were not detected on the majority (69%) of trail segments (Table 2). Ten trails, however, did yield one or more of the focal species (for a complete account of focal species presence/absence by trail, see Table A-1). Five of the focal species, Japanese barberry, glossy buckthorn, multiflora rose, Oriental bittersweet, and purple loosestrife, were documented on at least one occasion. Three of the focal species, Japanese knotweed, autumn olive, and common (European) buckthorn, were not detected. With 18 occurrences (62.0%), glossy buckthorn was most frequently encountered, followed by Oriental bittersweet with five occurrences (17%), and Japanese barberry with four occurrences (14%). The remaining species each were observed at only one location among all trail segments and accounted for 3.5% each of all focal species detected.

With only a few exceptions, most occurrences were observed 0.5 miles or less from the park's boundary. Invasive plants were not found in much of the park's interior, including the Pisgah Ridge area, the Kilburn Loop trail, Broad Brook Road, and backcountry trails such as the Dogwood Swamp Trail. The majority of invasives were noted in two areas: Jon Hill Road and

unnamed trails near the Habitat Trail/Horseshoe Road trailhead (Figure 1). The greatest number of invasives was noted along trails in the latter area; volunteers documented ten occurrences of glossy buckthorn and two of Japanese barberry. The second largest number of occurrences was noted in the old orchard on Jon Hill Road, with species including Oriental bittersweet, multiflora rose, and glossy buckthorn. Other observations throughout Pisgah generally consisted of a single occurrence of one focal species.

Table 2. Occurrences of focal invasive plant species along trails in Pisgah State Park, NH in 2008 and 2009.

Trail Segment	Species^a	# Occurrences^b	Date Surveyed
Beal's Road	RHFR	2	08/18/2009
Davis Hill	CEOR	1	05/21/2009
Jon Hill Road	CEOR	3	10/10/2008
	RHFR	1	
	ROMU	1	
Lily Pond Trail	RHFR	2	10/02/2009
Nash Trail	RHFR	1	08/18/2009
Reservoir Road	BETH	1	07/22/2009
	CEOR	1	
Reservoir Trail - South	LYSA	1	06/09/2009
Snowbrook Trail	RHFR	1	10/02/2009
South Woods Trail	BETH	1	10/24/2009
	RHFR	1	
Unnamed trails	BETH	2	10/19/2008
off Horseshoe Road & Habitat Trail	RHFR	10	

^a Species abbreviations given in Table 1.

^b Occurrences listed as the number of times a species was encountered, rather than the number of stems found.

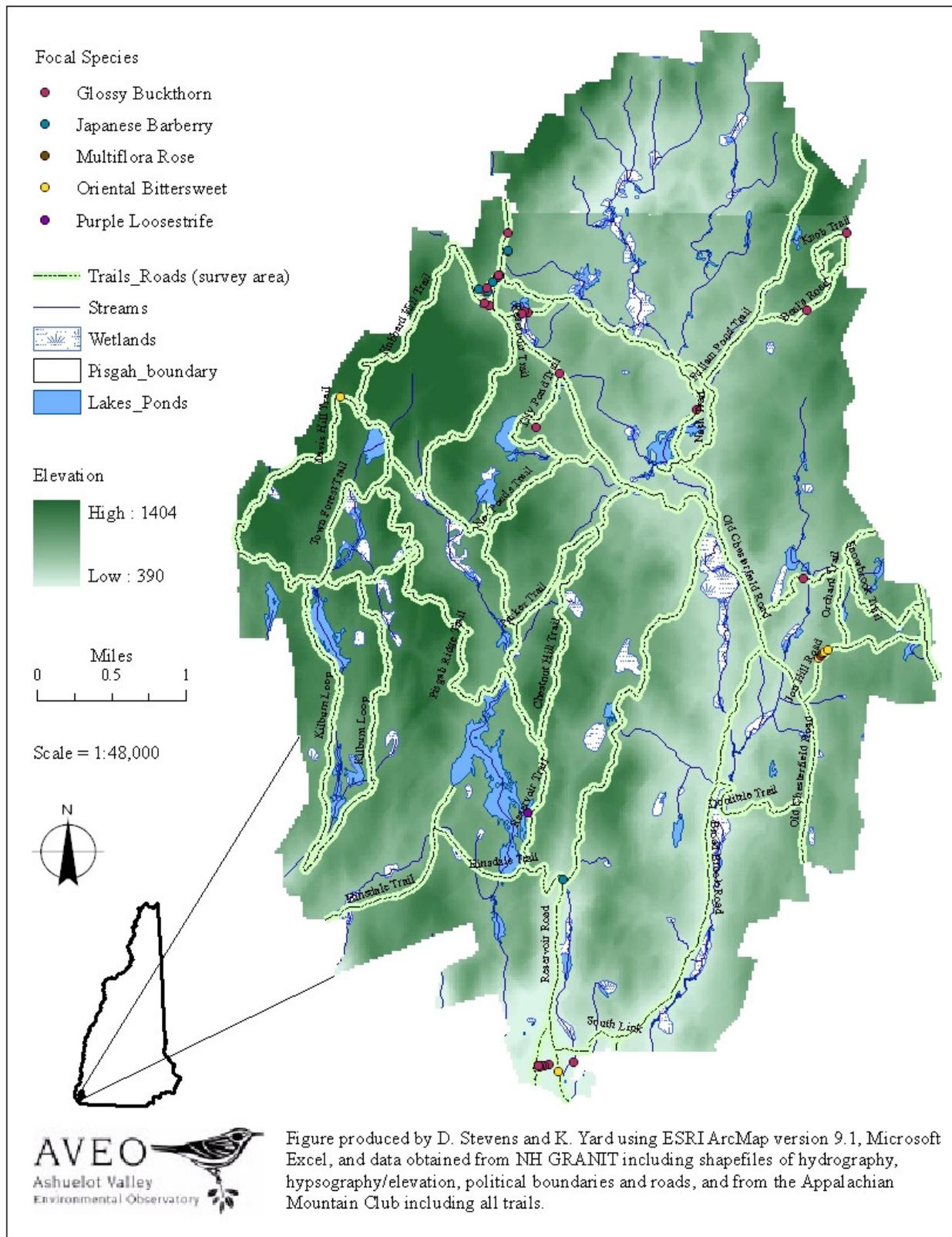


Figure 1. Occurrences of focal invasive plant species in Pisgah State Park, NH as documented in 2008-2009, including those along the powerline right-of-way at the south edge of the Park.

In addition to the number of occurrences of invasive plants, volunteers also noted the relative extent of the occurrence. Abundance was determined as Few (less than three stems), Some (greater than 3 stems), Many (ground covered), or Unspecified, in which abundance was not noted. Most occurrences were minor; the majority (41%) of occurrences were less than three stems, while only 13% of occurrences were substantial enough that the ground was covered (Figure 2).

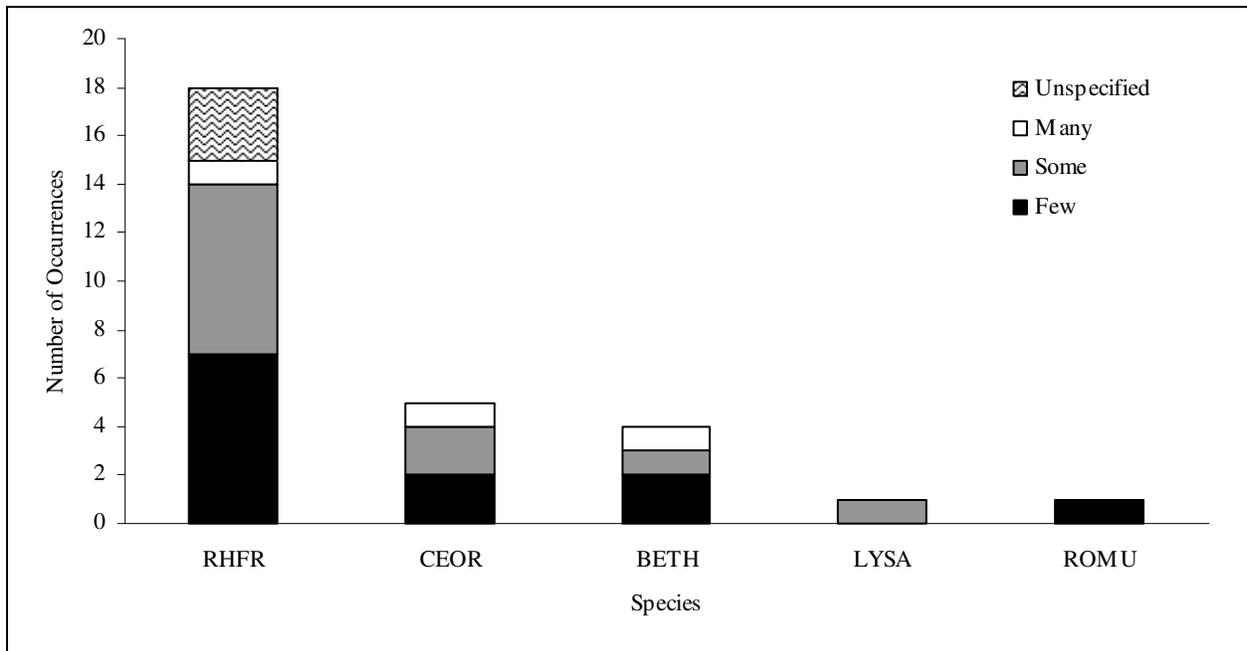


Figure 2. Abundance of invasive plants in Pisgah State Park in 2008 and 2009. Please refer to Table 1 for species codes.

Discussion and Recommendations

Supporting the original hypothesis, AVEO’s Citizen Science project found invasive plants to be sparsely distributed throughout the majority of the park. With the exception of two primary areas, Jon Hill Road and trails south of the Horseshoe Road trailhead/Habitat Trail area, AVEO volunteers largely noted the absence of focal species on trails and roads throughout Pisgah, particularly in the park’s interior. The highest concentrations of invasive plants were correlated with human land use, such as old orchards, fields or other disturbed areas. These findings correspond to the ecological inventory conducted by NHNHB, which noted that “Pisgah State Park has relatively few invasive plant species for a property of its size” (Bowman 2009; pg. 21). NHNHB field staff determined that the greatest number of invasives occurred along Old

Chesterfield Road and Jon Hill Road, and observed species including Japanese barberry, Oriental bittersweet, shrub honeysuckles, glossy buckthorn, and purple loosestrife, as well as garlic mustard, common reed (*Phragmites australis*) and wall-lettuce (*Lactuca muralis*), which were not included as AVEO focal species.

In addition to the trail segments that were formally surveyed, AVEO volunteers explored two areas suspected to support large numbers of invasive species, the fields near the Horseshoe Road trailhead area and the power line right-of-way (ROW) in the south end of the Park. South of Horseshoe Road trailhead, many of the focal species were repeatedly noted, including winged burning bush, Japanese barberry, bittersweet, non-native honeysuckles, and glossy buckthorn (Figure B-1). Along the approximately 0.5 mile stretch of ROW at Pisgah's southwestern boundary, volunteers documented six occurrences of glossy buckthorn. The majority of these occurrences were of moderate abundance (greater than 3 individuals per occurrence). Both of these areas receive comparably greater human disturbance than elsewhere in the park, by mowing for maintenance of early succession habitat in the former and off-road-vehicles use and periodic vegetation management in the latter, and may warrant further monitoring in the future.

Considering the number of focal species found in these two areas, AVEO recognizes both the limitations of the survey protocol and the need for further study in specific areas. This methodology allowed for a park-wide survey to be conducted by volunteers along the very areas - roads and trails - that NHB has identified as one of several features most sensitive to establishment of invasive plants, but did not provide for focused surveys in specific areas with known past or present human land use. An additional limitation of the survey method was failure to adequately sample wetlands; future survey efforts ideally should incorporate visual search effort in these areas. Although the survey protocol was ideal for use on trails, other methods, such as transect based surveys or timed meanders (Huebner 2007), may be better suited to survey both wetlands and areas with past or present anthropogenic disturbance.

In short, AVEO supports NHB recommendations including “development of a plan to control existing invasive plants and prevent establishment of new populations of invasive plants” (Bowman 2009; pg. 23). We recommend monitoring invasive plants by repeating trailside surveys in the future, controlling known invasive plant occurrences, establishing a protocol to monitor areas of the park with changing or increasing land use (eg. recreation, mowing regimes

to maintain early succession habitat management, timber management). Further, we acknowledge the role of citizen science in implementing and maintaining such an endeavor.

Acknowledgements

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Appendix A: Supporting data

Table A-1. Occurrences of invasive plant species by trail segment throughout Pisgah State Park, NH as observed in 2008-2009.

Trail	Species	Number of Occurrences	Date
Baker Pond Trail	None	0	8/31/2009
Beal's Road/Knob Trail	RHFR	2	8/18/2009
Broad Brook Road	None	0	7/23/2009
Chestnut Hill	None	0	8/13/2009
Davis Hill	CEOR	1	5/21/2009
Dogwood Swamp Trail	None	0	10/18/2008
Dolittle Trail	None	0	10/10/2008
Fullam Pond Trail	None	0	8/18/2009
Hinsdale Trail	None	0	8/20/2009
Hubbard Hill	None	0	5/21/2009
Jon Hill Road	CEOR	3	10/10/2008
Jon Hill Road	RHFR	1	10/10/2008
Jon Hill Road	ROMU	1	10/10/2008
Kilburn Loop - East	None	0	8/6/2009
Kilburn Loop - West	None	0	8/6/2009
Kilburn Road	None	0	10/20/2008
Lily Pond Trail	RHFR	2	10/2/2009
Nash Trail (West)	RHFR	1	8/18/2009
North Ponds Trail	None	0	9/18/2009
Old Chesterfield Road - Mid	None	0	7/24/2009
Old Chesterfield Road - North	None	0	10/5/2008
Old Chesterfield Road - South	None	0	7/23/2009
Orchard Trail	None	0	10/2/2009
Parker Trail	None	0	8/13/2009
Pisgah Ridge Trail	None	0	10/2/2008
Reservoir Road	BETH	1	7/22/2009
Reservoir Road	CEOR	1	7/22/2009
Reservoir Trail - North	None	0	7/12/2009
Reservoir Trail - South	LYSA	1	6/9/2009
Snowbrook Trail	RHFR	1	10/2/2009
South Link	None	0	10/14/2008
South Woods Trail	BETH	1	10/24/2009
South Woods Trail	RFHR	1	10/24/2009
Unnamed trail between Jon Hill Rd. & Snowbrook Trail	None	0	10/19/2008
Unnamed trail from 119 Parking to Reservoir Rd.	None	0	10/12/2008
Unnamed Trails off Horseshoe Rd. & Habitat/Wildlife Trail	BETH	2	10/19/2008
Unnamed Trails off Horseshoe Rd. & Habitat/Wildlife Trail	RHFR	10	10/19/2008

Appendix B: Additional observations of invasive plant species in Pisgah State Park

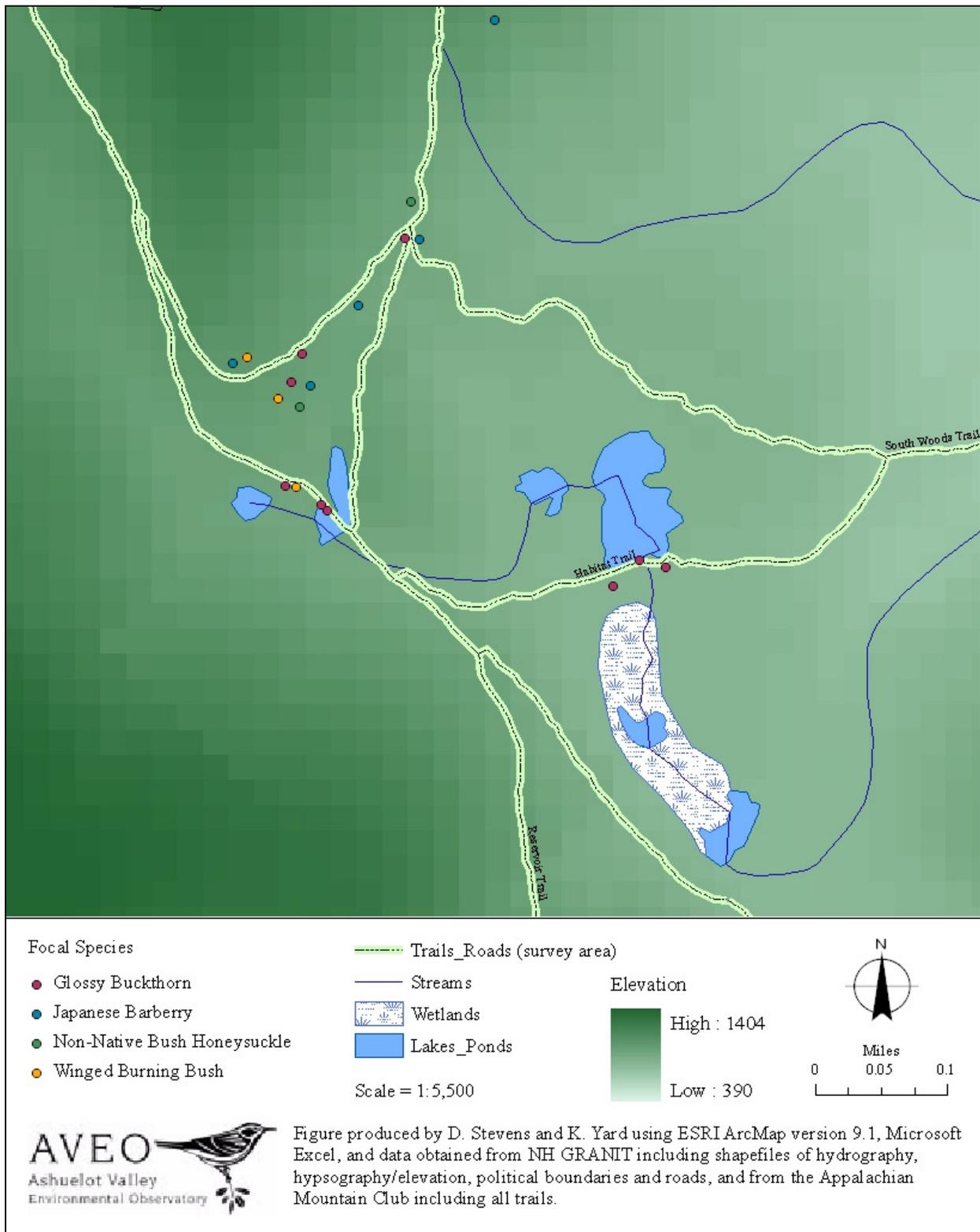


Figure B-1. Location of invasive plant species south of the Horseshoe Road trailhead of Pisgah State Park, NH, as documented in fall 2008, including off-trail observations.