



Invasive Exotic Plant Monitoring (Year 3) for Hopewell Culture National Historical Park

Natural Resource Report NPS/HTLN/NRR—2016/1117



ON THE COVER

Early Spring view of the Scioto River at Hopewell Culture National Historical Park.
Photo courtesy of National Park Service

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National Park Service
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Republic, Missouri 65738

January 2016

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Young, C. C., J. L. Haack-Gaynor, and J. C. Bell. 2016. Invasive plant monitoring (Year 3) for Hopewell Culture National Historical Park. Natural Resource Report NPS/HTLN/NRR—2016/1117. National Park Service, Fort Collins, Colorado.

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Abstract

During the three surveys that occurred during 2008, 2011, and 2015, Heartland Network staff identified 54 unique plant species judged to be invasive. Silktree, winter creeper, glossy buckthorn, and crownvetch were new finds in 2015. Invasive plants continue to occupy significant area within Hopewell Culture National Historical Park; 98 of 107 search units are occupied by at least 1 invasive plant species. This problem likely requires ongoing control efforts of well-established and early detection species.

Introduction

This study of invasive plants in Hopewell Culture National Historical Park completes the third round of monitoring for this vital sign. Beginning in 2010, the Heartland Exotic Plant Management Team began using these data to guide control of these problematic plants. This report explains the current status of invasive plants in the park and attempts to evaluate to the extent possible the effect of recent control efforts. These efforts, as more thoroughly outlined in the 2012 report (Young et al. 2012), serve to maintain and restore the park's cultural landscape.

Methods

Watch lists

Invasive exotic plant species on two watch lists were sought during monitoring (Table 1). Plants designated as high priority invasive species (Young et al. 2007) and not known to occur on the park per IRMA, NPSpecies Application (<https://irma.nps.gov/App/Portal/Home>) constituted the "early detection watch list" (n=66). Designated invasive exotic plants known to occur on the park per NPSpecies constitute the "park-established watch list" (n=40). Black locust (*Robinia pseudocacaia*) was also included on the park established list, but is native to the United States, Ohio, and possibly the area near Hopewell Culture National Historical Park. Nevertheless, the plant is still often invasive. While aquatic species are listed on the watch lists, terrestrial plants were the focus of this survey.

Field methods

Invasive exotic plant species on designated watch lists (Table 1) were sought in high priority areas in Hopewell Culture National Historical Park (Figure 1). These high priority areas consisted of areas with woods or restored prairies and measured 223.2 acres in area. Kristen Bates with Davey Resource Group conducted the first survey from June 17-18 and August 4-8, 2008. Dr. Steven Brewer with Copperhead Consulting and Ms. Kyla Hershey with Lawhon and Associates, Inc. used a Garmin 60CSx and Trimble Instruments model GeoXT handheld GPS units to conduct the second survey during July 7-16, 2011. Surveys were conducted in search units approximately 2 acres in size. Jordan Bell, Sonia Bingham, and Craig Young conducted the third survey during August 10-12, 2015. During this search, Andrew Molloy and Jacob Sisler, staff from Hopewell Culture National Historical Park, assisted with GPS navigation and additional searching during the overwhelming majority of the survey. Three equidistant passes through each search unit were made, though entire polygons were not fully searched. Observers recorded line transects to identify invasive exotic plants in an approximately 3- to 12-m belt. The widest belt possible was used, but varied depending on site conditions. Belt widths likely also varied to some degree among observers. Coarse cover values (0=0, 1=0.1-0.9 m², 2=1-9.9 m², 3=10-49.9 m², 4= 50-99.9 m², 5=100-499.9 m², 6= 500-999.9 m², 7= 1,000-4,999 m²) were attributed to each species per search unit. We searched 321 transects within 107 units. In 2015, however, we did not record data in units 78-82 and 84-87 due to conversion to agriculture.

Analytical methods

The estimates of plant cover for each invasive species on the park required calculation of the fraction of the area searched during the survey. Calculations of the observed reference frame fraction were made by multiplying transect length, the number of transects, and the belt width. The belt width was either 3 m (the minimum possible width) or 12 m (the maximum possible width). Transect length was calculated by summing the lengths of the 321 transects. The product was then divided by the reference frame area (Eq. 1).

$$\text{Eq.1. Fraction of area searched} = \frac{\text{transect length} * \text{number of transects} * \text{belt width}}{\text{reference frame area}}$$

The minimum fraction of area searched (belt width = 3 m) was 10%, and the maximum fraction of area searched (belt width = 12 m) was 40%.

To calculate the minimum end of the estimated cover range for each species, the lower endpoints associated with the assigned cover class values for that species were summed and then divided by the reference frame fraction observed assuming the widest possible survey belt (i.e., maximum fraction observed) (Eq. 2).

$$\text{Eq.2. Minimum cover estimate} = \frac{\sum \text{low end of cover value range for species}}{\text{fraction of area searched assuming 12-m belt width}}$$

Maximum cover for each species was calculated similarly, using the upper endpoints of the cover values in each occupied search unit and assuming that a 3 m belt was surveyed (i.e., minimum fraction of area observed) (Eq. 3).

$$\text{Eq. 3. Maximum cover estimate} = \frac{\sum \text{high end of cover value range for species}}{\text{fraction of area searched assuming 3-m belt width}}$$

Taken together, the minimum and maximum cover estimates provide an estimated range of cover that accounts for the uncertainty arising from the sampling method. Non-overlapping ranges represent the strongest evidence for differences in abundance.

The park-wide frequency of invasive exotic plants was calculated as the percentage of occupied search units (Eq. 4).

$$\text{Eq. 4. Frequency of an invasive plant species} = \frac{\sum \text{units occupied by species}}{\sum \text{units sampled}} * 100$$

Taken together, the minimum and maximum cover estimates provide an estimated range of cover that accounts for the uncertainty arising from the sampling method. Non-overlapping ranges represent the strongest evidence for differences in abundance.

Finally, maps were created for each target invasive plant species (see attached GeoPdf). The maps indicated which search unit was occupied and the estimated cover class value for that search unit during each survey period.

Hopewell Culture National Historic Park Exotic Plant Search Units

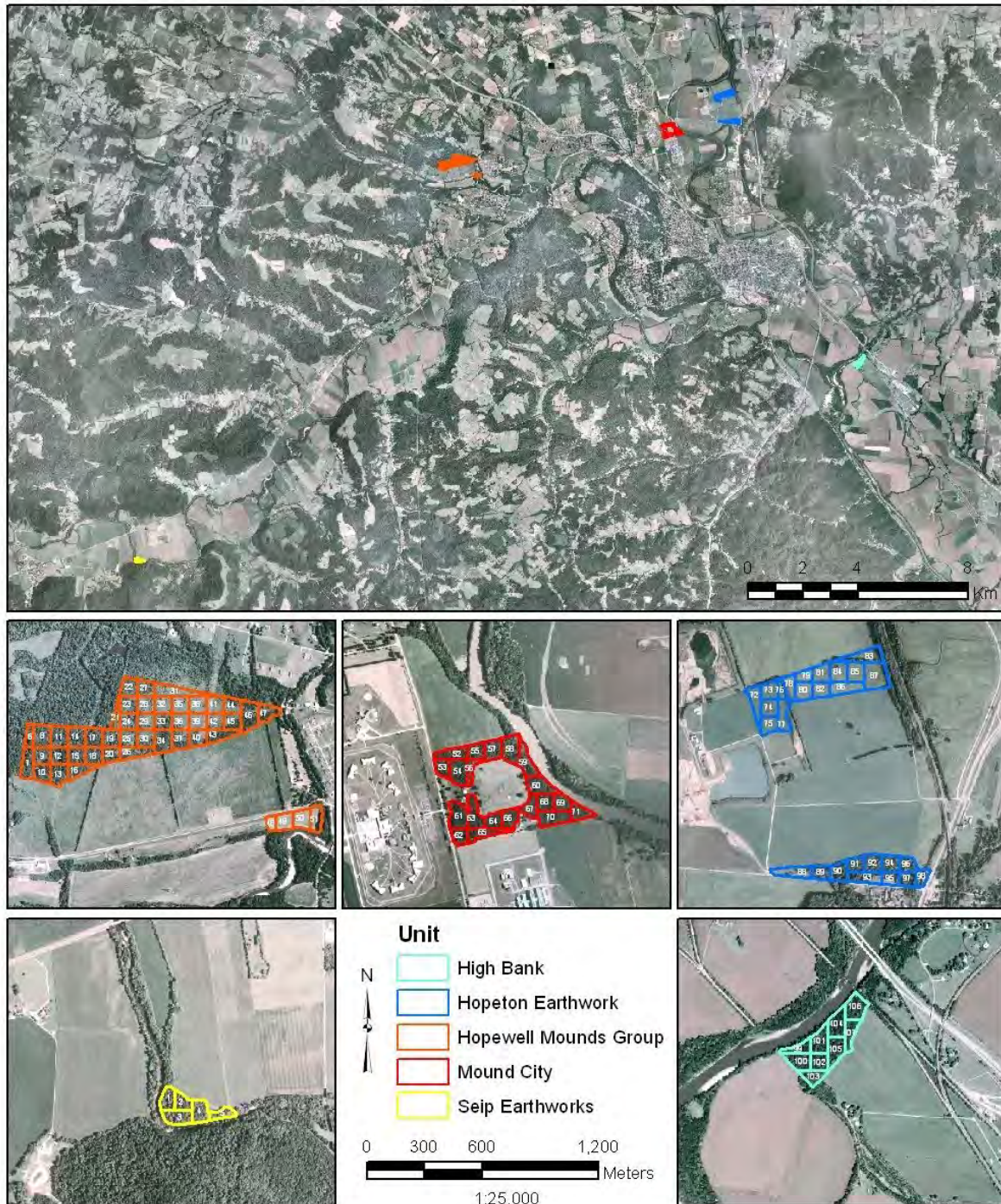


Figure 1. Invasive plant search units (n=107) on Hopewell Culture National Historical Park. Search units focused on restored prairies and intact forests on the park. The search units indicate the search locations for invasive exotic plants in 2008, 2011, and 2015.

Table 1. Invasive plant watch lists used to guide surveys in Hopewell Culture National Historical Park during 2008, 2011, and 2015. These watch lists include an early detection watch list, a park-established watch list, and a park-based watch list.

Early Detection Watch List	
Scientific name	Common name
<i>Acer ginnala</i>	Amur maple
<i>Acer platanoides</i>	Norway maple
<i>Alnus glutinosa</i>	European alder
<i>Ampelopsis brevipedunculata</i>	Amur peppervine
<i>Bromus racemosus</i>	Bald brome
<i>Bromus sterilis</i>	Poverty brome
<i>Butomus umbellatus</i>	Flowering rush
<i>Celastrus orbiculatus</i>	Oriental bittersweet
<i>Centaurea solstitialis</i>	Yellow star-thistle
<i>Centaurea stoebe ssp. micranthos</i>	Spotted knapweed
<i>Cynanchum louiseae</i>	Louise's swallow-wort
<i>Dioscorea oppositifolia</i>	Chinese yam
<i>Dipsacus laciniatus</i>	Cutleaf teasel
<i>Egeria densa</i>	Brazilian waterweed
<i>Elaeagnus umbellata</i>	Autumn olive
<i>Elaeagnus umbellata/ angustifolia</i>	Russian olive
<i>Elymus repens</i>	Quackgrass
<i>Euonymus alata</i>	Burningbush
<i>Euonymus fortunei</i>	Winter creeper
<i>Euphorbia cyparissias</i>	Cypress spurge
<i>Euphorbia esula</i>	Leafy spurge
<i>Frangula alnus</i>	Glossy buckthorn
<i>Hedera helix</i>	English ivy
<i>Holcus lanatus</i>	Common velvetgrass
<i>Humulus japonicus</i>	Japanese hop
<i>Iris pseudacorus</i>	Paleyellow iris
<i>Lespedeza bicolor</i>	Shrub lespedeza
<i>Lespedeza cuneata</i>	Sericea lespedeza
<i>Ligustrum obtusifolium</i>	Border privet
<i>Linaria vulgaris</i>	Butter and eggs
<i>Lolium arundinaceum</i>	Tall fescue
<i>Lolium pratense</i>	Meadow fescue
<i>Lolium spp</i>	Ryegrass
<i>Lonicera morrowii</i>	Morrow's honeysuckle
<i>Lonicera X bella</i>	Showy fly honeysuckle
<i>Lotus corniculatus</i>	Bird's-foot trefoil
<i>Lotus tenuis</i>	Narrow-leaf bird's-foot trefoil
<i>Lythrum salicaria</i>	Purple loosestrife
<i>Microstegium vimineum</i>	Nepalese browntop
<i>Miscanthus sinensis</i>	Chinese silvergrass

Table 1 (cont.). Invasive plant watch lists used to guide surveys in Hopewell Culture National Historical Park during 2008, 2011, and 2015. These watch lists include an early detection watch list, a park-established watch list, and a park-based watch list.

Scientific name	Common name
<i>Myosotis scorpioides</i>	True forget-me-not
<i>Myriophyllum aquaticum</i>	Parrot feather watermilfoil
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil
<i>Najas minor</i>	Brittle waternymph
<i>Onopordum acanthium</i>	Scotch cottonthistle
<i>Phalaris arundinacea</i>	Reed canarygrass
<i>Phragmites australis</i>	Common reed
<i>Poa compressa</i>	Canada bluegrass
<i>Polygonum cuspidatum</i>	Japanese knotweed
<i>Polygonum perfoliatum</i>	Asiatic tearthumb
<i>Polygonum sachalinense</i>	Giant knotweed
<i>Populus alba</i>	White poplar
<i>Potamogeton crispus</i>	Curly pondweed
<i>Pueraria montana</i> var. <i>lobata</i>	Kudzu
<i>Pyrus calleryana</i>	Callery pear
<i>Rhamnus cathartica</i>	Common buckthorn
<i>Rorippa nasturtium-aquaticum</i>	
<i>Coronilla varia</i>	Crownvetch
<i>Sonchus arvensis</i>	Field sowthistle
<i>Spiraea japonica</i>	Japanese meadowsweet
<i>Tanacetum vulgare</i>	Common tansy
<i>Torilis japonica</i>	Erect hedgeparsley
<i>Typha angustifolia</i>	Narrowleaf cattail
<i>Typha X glauca</i>	
<i>Viburnum opulus</i>	European cranberrybush
<i>Wisteria floribunda</i>	Japanese wisteria
Park-established Watch List	
<i>Ailanthus altissima</i>	Tree of heaven
<i>Albizia julibrissin</i>	Silktree
<i>Alliaria petiolata</i>	Garlic mustard
<i>Arctium minus</i>	Lesser burdock
<i>Berberis thunbergii</i>	Japanese barberry
<i>Bromus inermis</i>	Smooth Brome
<i>Bromus tectorum</i>	Cheatgrass
<i>Carduus nutans</i>	Nodding plumeless thistle
<i>Cirsium arvense</i>	Canada thistle
<i>Cirsium vulgare</i>	Bull thistle
<i>Daucus carota</i>	Queen Anne's lace
<i>Dipsacus fullonum</i>	Fuller's teasel
<i>Elaeagnus angustifolia</i>	Russian olive

Table 1 (cont.). Invasive plant watch lists used to guide surveys in Hopewell Culture National Historical Park during 2008, 2011, and 2015. These watch lists include an early detection watch list, a park-established watch list, and a park-based watch list.

Scientific name	Common name
Park-established Watch List (cont.)	
<i>Glechoma hederacea</i>	Ground ivy
<i>Hemerocallis fulva</i>	Orange daylily
<i>Hesperis matronalis</i>	Dames rocket
<i>Hypericum perforatum</i>	Common St. Johnswort
<i>Leonurus cardiac</i>	Common motherwort
<i>Ligustrum vulgare</i>	European privet
<i>Lonicera japonica</i>	Japanese honeysuckle
<i>Lonicera maackii</i>	Amur honeysuckle
<i>Lonicera tatarica</i>	Tatarian honeysuckle
<i>Lysimachia nummularia</i>	Creeping jenny
<i>Melilotus officinalis</i>	Sweetclover
<i>Morus alba</i>	White mulberry
<i>Pastinaca sativa</i>	Wild parsnip
<i>Paulownia tomentosa</i>	Princesstree
<i>Poa pratensis</i>	Kentucky bluegrass
<i>Potentilla recta</i>	Sulphur cinquefoil
<i>Prunus mahaleb</i>	Mahaleb cherry
<i>Robinia pseudoacacia</i>	Black locust (NATIVE)
<i>Rosa multiflora</i>	Multiflora rose
<i>Rumex acetosella</i>	Common sheep sorrel
<i>Rumex crispus</i>	Rumex crispus
<i>Saponaria officinalis</i>	Bouncingbet
<i>Sorghum halepense</i>	Johnsongrass
<i>Torilis arvensis</i>	Spreading hedgeparsley
<i>Ulmus pumila</i>	Siberian elm
<i>Verbascum thapsus</i>	Common mullein
<i>Vinca minor</i>	Common periwinkle

Results and Discussion

We identified a cumulative total of 54 (does not include *Poa* spp. or *Lonicera* spp. as unique taxa) out of 106 (51%) invasive plant species sought during the three surveys (Table 2). Of these, 44 (81%) were identified during the most recent survey; 27 (50%) were identified during all three surveys; and 16 (30%) were identified during a single survey.

Albizia julibrissin (silktree), *Euonymus fortunei* (winter creeper), *Frangula alnus* (glossy buckthorn), and *Securigera varia* (crownvetch) were the new finds in 2015. Of these only *Albizia julibrissin* was on the park-established list, while the other species were early detections.

Nine species showed non-overlapping abundance ranges with five showing declines in abundance, although of these only *Lonicera maackii* (Amur honeysuckle) and *Pyrus calleryana* (Callery pear) were subjected to any treatment.

Based on the relatively high abundance of the woody plant species *Elaeagnus umbellata* (autumn olive) and bush *Lonicera* spp. (*L. maackii*, *L. morrowii*, *L. tatarica*) and the relative effectiveness of controls, management of these plants in high priority areas will lead to wide-scale changes in the park's vegetation. Two species which should be considered for control due to possible recent increases are *Ailanthus altissima* (tree-of-heaven) and *Microstegium vimineum* (Japanese stiltgrass). Both species, although already widespread and abundant, may be controlled in high priority areas. Finally, the relatively early stage of colonization by *Phalaris arundinacea* (reed canarygrass), *Polygonum cuspidatum* (Japanese knotweed), *Pyrus calleryana* (Callery pear), and *Securigera varia* (crownvetch) suggests these species for continued rapid response efforts.

We acknowledge that identification mistakes may beset the *Bromus* species (*B. arvensis*, *B. racemosus*, *B. sterilis*, *B. tectorum*), bush *Lonicera* (bush honeysuckle), and *Poa* spp. (bluegrass) observations. The numbers associated with these species may be best interpreted at the genus- rather than the species-level.

In conclusion, invasive plants continue to occupy significant area within Hopewell Culture National Historical Park. Monitoring efforts in more targeted areas may be required to demonstrate the effectiveness of control in specific treatment sites.

Table 2. Cover estimates and frequency of invasive plants found in Hopewell Culture National Historical Park during 2008, 2011, and 2015 surveys. Non-overlapping cover ranges are identified using letters (a, b, etc.).

Scientific Name	Common Name	Year	Low Cover Estimate (ac)	High Cover Estimate (ac)	Frequency (%)
<i>Ailanthus altissima</i>	tree of heaven	2011	0.0192	0.3944	3.7
		2015	0.0460	0.6002	10.3
<i>Albizia julibrissin</i>	silktree	2015	0.0006	0.0245	0.9
<i>Alliaria petiolata</i>	garlic mustard	2008	0.4555	8.8152	53.3
		2011	1.0082	14.4871	69.2
		2015	0.0954	1.9485	60.7
<i>Arctium minus</i>	lesser burdock	2008	0.0007	0.0267	1.9
		2011	0.0038	0.1490	6.5
<i>Berberis thunbergii</i>	Japanese barberry	2008	0.0025	0.1001	4.7
		2011	0.0217	0.4945	8.4
		2015	0.0015	0.0578	5.6
<i>Bromus arvensis</i>	field brome	2011	0.0006	0.0245	0.9
<i>Bromus inermis</i>	smooth brome	2008	0.0192	0.5157	12.1
		2011	0.0939	1.9008	7.5
<i>Bromus racemosus</i>	bald brome	2011	0.0866	1.1105	15.0
		2015	0.1861	2.9955	7.5
<i>Bromus sterilis</i>	poverty brome	2011	0.0006	0.0245	0.9
<i>Bromus tectorum</i>	cheatgrass	2008	0.0324	0.7957	18.7
		2011	0.5456	6.1254	20.6
<i>Celastrus orbiculatus</i>	Oriental bittersweet	2011 a	0.0068	0.1478	1.9
		2015 b	0.000124	0.004448	1.9
<i>Cirsium arvense</i>	Canada thistle	2008 a	0.0347	0.8869	19.6
		2011 b	0.9786	14.4250	23.4
		2015 a,b	0.1065	1.7866	9.3
<i>Cirsium vulgare</i>	bull thistle	2008	0.0008	0.0311	3.7
		2011	0.0013	0.0512	2.8
		2015	0.0062	0.1233	0.9
<i>Daucus carota</i>	Queen Anne's lace	2008	0.0363	1.1940	44.9
		2011	0.3182	5.5491	50.5
		2015	0.1106	1.6939	42.1
<i>Dipsacus fullonum</i>	Fuller's teasel	2008	0.0019	0.0756	3.7
		2011	0.0074	0.1722	2.8
		2015	0.0003	0.0111	4.7
<i>Echinochloa crus-galli</i>	barnyardgrass	2011	0.0080	0.1967	3.7
<i>Elaeagnus umbellata</i>	autumn olive	2008	0.1996	3.0338	30.8
		2011	2.1258	42.5202	28.0
		2015	0.9603	17.4000	33.6
<i>Euonymus alatus</i>	burningbush	2008	0.0027	0.1068	7.5

Table 2 (cont.). Cover estimates and frequency of invasive plants found in Hopewell Culture National Historical Park during 2008, 2011, and 2015 surveys. Non-overlapping cover ranges are identified using letters (a, b, etc.).

Scientific Name	Common Name	Year	Low Cover Estimate (ac)	High Cover Estimate (ac)	Frequency (%)
<i>Euonymus alatus</i>		2011	0.0074	0.1722	2.8
		2015	0.0030	0.1179	12.1
<i>Euonymus fortunei</i>	winter creeper	2015	0.0015	0.0578	5.6
<i>Frangula alnus</i>	glossy buckthorn	2015	0.0007	0.0267	1.9
<i>Glechoma hederacea</i>	ground ivy	2008	0.3034	4.8372	32.7
		2011	2.0232	32.4836	43.0
		2015	0.2430	4.2777	27.1
<i>Hemerocallis fulva</i>	orange daylily	2008	0.0037	0.1468	5.6
		2011	0.0006	0.0245	0.9
		2015	0.0038	0.1490	6.5
<i>Hesperis matronalis</i>	dames rocket	2008 a	0.0031	0.1223	4.7
		2015 b	0.0001	0.0022	0.9
<i>Leonurus cardiaca</i>	common motherwort	2008	0.0001	0.0022	0.9
<i>Ligustrum vulgare</i>	European privet	2008	0.0039	0.1535	8.4
		2011	0.0502	1.1389	19.6
		2015	0.0065	0.2535	22.4
		2015	0.0062	0.1233	0.9
<i>Lolium perenne</i>	perennial ryegrass	2011	0.1156	2.0256	12.1
<i>Lonicera spp.</i>	honeysuckle	2011	0.0006	0.0245	0.9
<i>Lonicera japonica</i>	Japanese honeysuckle	2008	0.7377	10.2195	59.8
		2011	6.0889	101.1980	78.5
		2015	1.3901	25.0651	72.0
<i>Lonicera maackii</i>	Amur honeysuckle	2008 a	0.3696	5.9954	63.6
		2011 b	6.9982	117.0605	76.6
		2015	4.2860	54.0439	71.0
<i>Lonicera morrowii</i>	Morrow's honeysuckle	2011 a	0.8667	12.9182	21.5
		2015 b	0.0225	0.5256	12.1
<i>Lonicera tatarica</i>	Tatarian honeysuckle	2008	0.0272	0.8360	25.2
<i>Lysimachia nummularia</i>	creeping jenny	2008	0.0142	0.5627	21.5
		2011	0.4189	6.6134	34.6
		2015	0.0233	0.5567	15.9
<i>Melilotus officinalis</i>	sweetclover	2008 a	0.0078	0.3069	16.8
		2011 a	0.0186	0.4935	12.1
		2015 b	0.0001	0.0022	0.9
<i>Microstegium vimineum</i>	Nepalese browntop	2011	0.0371	0.3702	1.9
		2015	0.0657	0.6472	10.3
<i>Morus alba</i>	white mulberry	2008	0.0383	0.9101	15.9

Table 2 (cont.). Cover estimates and frequency of invasive plants found in Hopewell Culture National Historical Park during 2008, 2011, and 2015 surveys. Non-overlapping cover ranges are identified using letters (a, b, etc.).

Scientific Name	Common Name	Year	Low Cover Estimate (ac)	High Cover Estimate (ac)	Frequency (%)
		2011	0.3849	6.6206	16.8
		2015	0.6095	7.8171	24.3
<i>Pastinaca sativa</i>	wild parsnip	2008	0.0023	0.0912	10.3
		2011	0.0408	0.5192	8.4
		2015	0.0150	0.3511	8.4
<i>Phalaris arundinacea</i>	reed canarygrass	2008	0.0026	0.1023	5.6
<i>Phalaris arundinacea</i>		2011	0.0080	0.1967	3.7
		2015	0.0006	0.0245	0.9
<i>Poa spp.</i>	bluegrass	2011	0.0840	1.8711	26.2
		2015	0.0657	1.3865	17.8
<i>Poa pratensis</i>	Kentucky bluegrass	2008	0.0194	0.6459	24.3
<i>Polygonum cuspidatum</i>	Japanese knotweed	2011	0.0062	0.1233	0.9
		2015	0.0006	0.0245	0.9
<i>Potentilla recta</i>	sulphur cinquefoil	2008	0.0023	0.0890	9.3
		2011	0.0019	0.0756	3.7
<i>Prunus mahaleb</i>	Mahaleb cherry	2008	0.0006	0.0245	0.9
<i>Pyrus calleryana</i>	Callery pear	2011 a	0.0062	0.1233	0.9
		2015 b	0.0001	0.0022	0.9
<i>Robinia pseudoacacia</i>	black locust	2008	0.1180	2.1190	23.4
		2011	0.9317	12.0533	30.8
		2015	0.7681	10.2081	18.7
<i>Rosa multiflora</i>	multiflora rose	2008	0.3499	4.8372	60.7
		2011	1.7600	29.1165	67.3
		2015	0.4890	8.1756	60.7
<i>Rumex crispus</i>	curly dock	2008	0.0057	0.2224	18.7
		2011	0.0292	0.9116	29.0
		2015	0.0027	0.1045	6.5
<i>Saponaria officinalis</i>	bouncingbet	2011	0.0136	0.2955	3.7
		2015	0.0006	0.0245	0.9
<i>Schedonorus phoenix</i>	tall fescue	2011	4.2151	77.0351	61.7
	tall fescue	2015	0.9380	13.2945	28.0
<i>Securigera varia</i>	crownvetch	2015	0.0006	0.0245	0.9
<i>Sorghum halepense</i>	Johnsongrass	2008 a	0.0064	0.2513	12.1
		2011 b	0.4497	8.7175	20.6
		2015	0.1785	3.6750	26.2
<i>Torilis arvensis</i>	spreading hedgeparsley	2008	0.0118	0.4670	18.7
		2011	0.0402	0.9857	19.6
		2015	0.0014	0.0556	4.7

Table 2 (cont.). Cover estimates and frequency of invasive plants found in Hopewell Culture National Historical Park during 2008, 2011, and 2015 surveys. Non-overlapping cover ranges are identified using letters (a, b, etc.).

Scientific Name	Common Name	Year	Low Cover Estimate (ac)	High Cover Estimate (ac)	Frequency (%)
Ulmus pumila	Siberian elm	2011	0.0001	0.0022	0.9
		2015	0.0003	0.0111	4.7
Verbascum thapsus	common mullein	2008	0.0001	0.0044	1.9
		2011	0.0025	0.0979	3.7
		2015	0.0015	0.0600	6.5
Vinca minor	common periwinkle	2008 a	0.0513	0.6902	6.5
		2011 b	1.9250	38.5712	10.3
		2015 a,b	0.5381	6.6947	7.5

Literature Cited

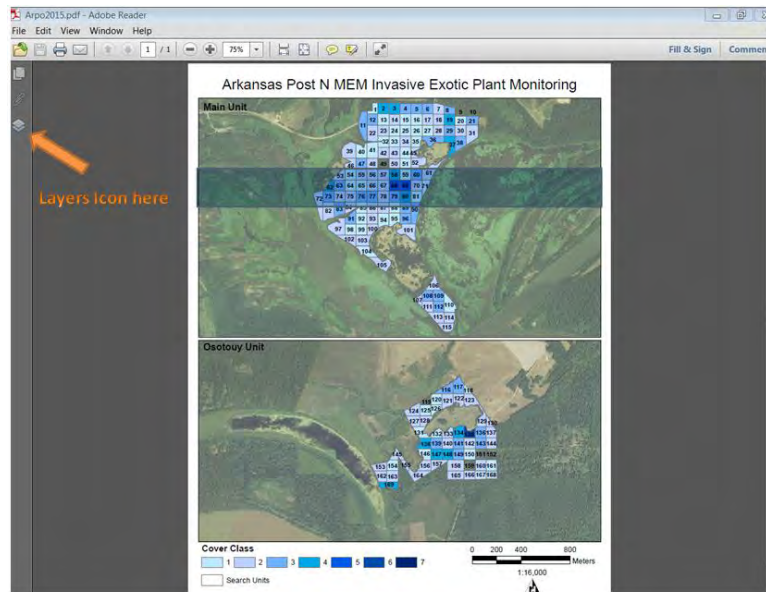
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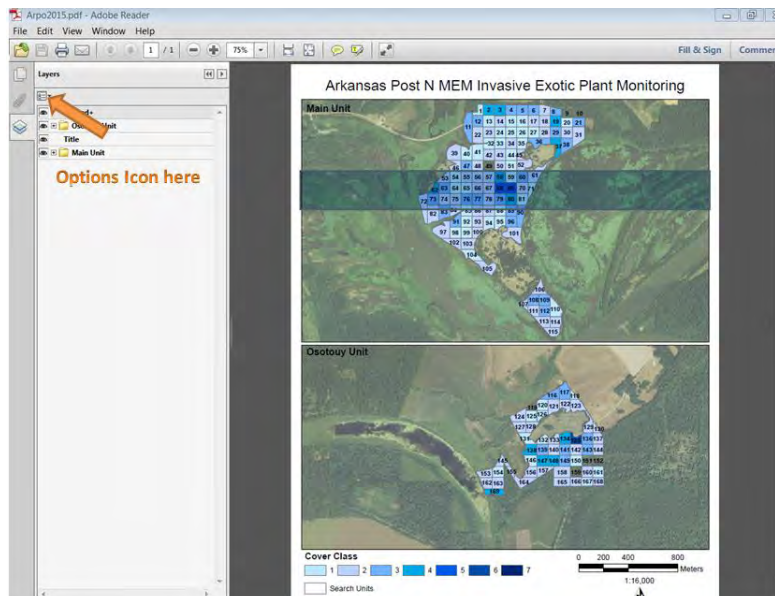
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Appendix A. Viewing GeoPdfs

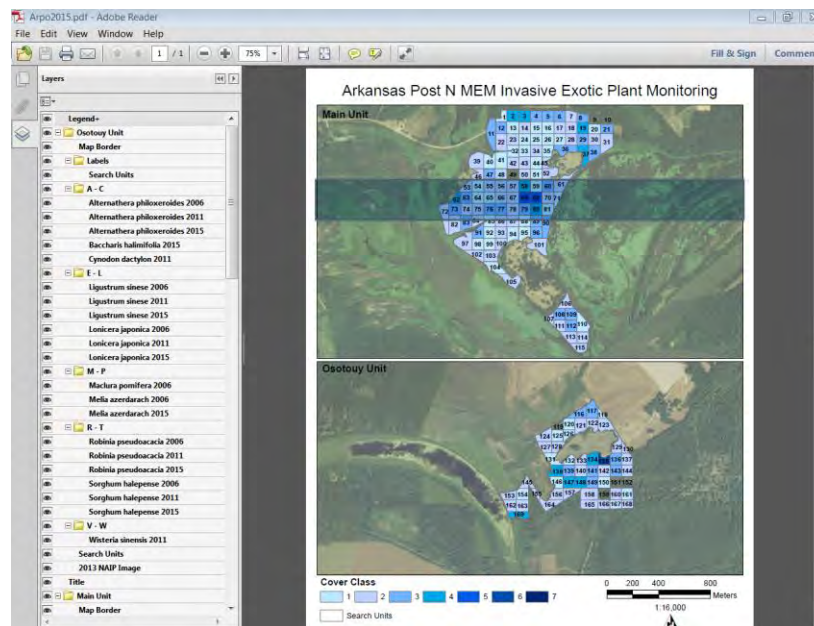
Open a report in Adobe Reader 9.0 or other Adobe software product. When the report first opens, a map will appear highlighting the search units. To interpret the map, first click the layers icon (double overlapping diamonds).



Next, click on the options icon to “Expand All”.



Click on the “eye” icons to turn the associated information on and off on the map.



In most cases, the viewer will turn off all layers except for a single species-year combination. In order to visualize changes in abundance and distribution of a species among years, the layers of interest can be turned on and off in sequence. Multiple versions of the report and geopdf map may be opened at once if simultaneous, side-by-side comparisons are needed.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 353/131184, January 2016

National Park Service
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