



Invasive Exotic Plant Monitoring (Year 3) for Arkansas Post National Memorial

Natural Resource Report NPS/HTLN/NRR—2016/1116



ON THE COVER

Common periwinkle growing as an understory plant in the Memorial Unit forest, Arkansas Post National Memorial.
Photograph by Adam Throckmorton

Invasive Exotic Plant Monitoring (Year 3) for Arkansas Post National Memorial

Natural Resource Report NPS/HTLN/NRR—2016/1116

Craig C. Young, Jenifer L. Haack-Gaynor, Jordan C. Bell

National Park Service
Heartland Network
Republic, Missouri 65738

January 2016

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

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate comprehensive information and analysis about natural resources and related topics concerning lands managed by the National Park Service. The series supports the advancement of science, informed decision-making, and the achievement of the National Park Service mission. The series also provides a forum for presenting more lengthy results that may not be accepted by publications with page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available in digital format from the Heartland Network website (<http://science.nps.gov/im/units/htln/>), and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>). To receive this report in a format optimized for screen readers, please email irma@nps.gov.

Please cite this publication as:

Young, C. C., J. L. Haack-Gaynor, and J. C. Bell. 2016. Invasive plant monitoring (year 3) for Arkansas Post National Memorial. Natural Resource Report NPS/HTLN/NRR—2016/1116. National Park Service, Fort Collins, Colorado.

Contents

	Page
Figures.....	iv
Tables.....	iv
Abstract.....	v
Introduction.....	7
Methods.....	7
Results and Discussion	9
Literature Cited	16
Appendix A. Viewing GeoPdfs	17

Figures

	Page
Figure 1. Invasive exotic plant search units in Arkansas Post National Memorial – Main Unit.	10
Figure 2. Invasive exotic plant search units in Arkansas Post National Memorial – Osotouy Unit.....	11

Tables

	Page
Table 1. Invasive plant watch lists used to guide surveys in Arkansas Post National Memorial during 2006, 2011, and 2015.....	12
Table 2. Cover estimates and frequency of invasive plants found in Arkansas Post National Memorial during 2006, 2011, and 2015 surveys.....	15

Abstract

During the three surveys that occurred during 2006, 2011, and 2015 in Arkansas Post National Memorial, Heartland Network staff identified 28 unique plant species judged to be invasive. Parrot feather water milfoil was the single new find in 2015. Invasive plants continue to occupy significant area within Arkansas Post National Memorial. Efforts to control hardy orange (aka trifoliate orange) appear to have been very successful. Weaker evidence also points to reduction in Chinese privet. Apparent increases in Chinaberry and especially Nepalese browntop (aka Japanese stiltgrass) counterbalance these encouraging trends. Modest continued efforts and additional projects will be needed for the foreseeable future to maintain control of these invasive plants in the park.

Introduction

This study of invasive plants in Arkansas Post National Memorial 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 carefully 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 three watch lists were sought during monitoring (Table 1). Plants designated as high priority invasive species (Young et al. 2007a) and known to occur in the same state as the park, but not on the park per NPSpecies (NPS 2012) constituted the "early detection watch list" (n=98). Designated invasive exotic plants known to occur on the park per NPSpecies constituted the "park-established watch list" (n=18). Invasive exotic plants on the "park-based watch list" (n=4) included plants selected by park managers or network staff that were not designated as invasive in the protocol, but may not have been included due to incomplete information in NPSpecies (i.e., not documented) or inaccurate information in the USDA Plants database (i.e., state distribution information inaccurate) or simply due to differing opinions regarding Heartland Network's designation. While aquatic species were 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 throughout the Memorial and Osotouy Units of Arkansas Post National Memorial (Figure 2 and 3). Dan Tenaglia conducted field work during August 30-September 7, 2006 using a MobileMapper GPS Unit. Dr. Steven Brewer with Copperhead Consulting and Kyla Hershey with Lawhon and Associates, Inc. used Garmin 60CSx and Trimble Instruments model GeoXT handheld GPS units to conduct the second survey during August 8-14, 2011. Jordan Bell, Craig Young, and park natural resource manager Kirby McCallie repeated the survey on July 7-9, 2015. Surveys were conducted in search units, approximately 2 acres in size (Figures 1 and 2). 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. A total of 507 transects within 169 search units were searched.

Analytical methods

A park-wide cover range was estimated for each invasive plant species encountered. First, 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 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 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, summing 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 represented the strongest evidence for differences in abundance.

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

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

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.

Results and Discussion

We identified a cumulative total of 28 out of 120 (23%) invasive plant species sought during the three surveys (Table 2). Of these, 21 species (75%) were identified during the most recent survey; 15 species (54%) were identified during all three surveys; and 8 species (29%) were identified during a single survey. Five of the species in this study are largely aquatic and are not likely to require park treatments.

We believe that we identified *Myriophyllum aquaticum* (parrot feather watermilfoil) as the single new identification for 2015. Because aquatic species were not specifically targeted in this survey, however, we will confirm that identification in the near future.

Nine species showed strong evidence for changes in abundance during the three surveys. Three of those – *Cynodon dactylon* (Bermudagrass), *Eichornia crassipes* (common water hyacinth), and *Murdannia keisak* (wart-removing herb) – likely reflect measurement error associated with the survey. Five of these species had been actively managed with increasing abundance observed for *Melia azederach* (Chinaberry) and *Microstegium vimineum* (Nepalese browntop, aka Japanese stiltgrass) and decreasing abundance observed for *Poncirus trifoliata* (hardy orange, aka trifoliolate orange), *Sorghum halepense* (Johnsongrass), and *Vinca major* (bigleaf periwinkle). Of the other four species under management, we interpret the data, although weaker in the respect that population size intervals overlap, to point to no change in *Albizia julibrissin* (silktree), *Robinia pseudoacacia* (black locust), or *Wisteria sinensis* (Chinese wisteria) and decreasing abundance in *Ligustrum sinense* (Chinese privet).

Treatments to reduce the cover of hardy orange and, with weaker evidence, Chinese privet appear to have been successful. The increase in Chinaberry and especially Nepalese browntop (aka Japanese stiltgrass) bears watching and long-term annual control. Continuing efforts to reduce the vining common periwinkle and Chinese wisteria are also important and highly feasible projects.

We acknowledge that identification mistakes may beset the *Bromus* species (*B. arvensis* and *B. racemosus*). 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 Arkansas Post National Memorial, but control efforts have apparently been successful for two widespread woody plants. Modest continued efforts and additional projects will be needed for the foreseeable future to maintain control of these invasive plants.

Arkansas Post National Memorial - Main Unit Exotic Plant Search Units



Figure 1. Invasive exotic plant search units in Arkansas Post National Memorial – Main Unit. The search units indicate the search locations for invasive exotic plants in 2006, 2011, and 2015.

Arkansas Post National Memorial - Osotouy Unit Exotic Plant Search Units



Figure 2. Invasive exotic plant search units in Arkansas Post National Memorial – Osotouy Unit. The search units indicate the search locations for invasive exotic plants in 2006 and 2011, 2015.

Table 1. Invasive plant watch lists used to guide surveys in Arkansas Post National Memorial during 2006, 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>Ailanthus altissima</i>	Tree of heaven
<i>Alliaria petiolata</i>	Garlic mustard
<i>Alternanthera sessilis</i>	Sessile joyweed
<i>Ampelopsis brevipedunculata</i>	Amur peppervine
<i>Arctium minus</i>	Lesser burdock
<i>Arundo donax</i>	Giant reed
<i>Bothriochloa bladhii</i>	Caucasian bluestem
<i>Bromus inermis</i>	Smooth brome
<i>Bromus racemosus</i>	Bald brome
<i>Bromus sterilis</i>	Poverty brome
<i>Bromus tectorum</i>	Cheatgrass
<i>Carduus nutans</i>	Nodding plumeless thistle
<i>Celastrus orbiculatus</i>	Oriental bittersweet
<i>Centaurea stoebe ssp. micranthos</i>	Spotted knapweed
<i>Cirsium arvense</i>	Canada thistle
<i>Cirsium vulgare</i>	Bull thistle
<i>Coronilla varia</i>	Crownvetch
<i>Daucus carota</i>	Queen Anne's lace
<i>Dioscorea oppositifolia</i>	Chinese yam
<i>Dipsacus fullonum</i>	Fuller's tassel
<i>Egeria densa</i>	Brazilian waterweed
<i>Eichhornia crassipes</i>	Common water hyacinth
<i>Elaeagnus pungens</i>	Thorny olive
<i>Elaeagnus umbellata</i>	Autumn olive
<i>Elaeagnus umbellata/angustifolia</i>	Russian olive
<i>Elymus repens</i>	Quackgrass
<i>Eragrostis curvula</i>	Weeping lovegrass
<i>Euonymus fortunei</i>	Winter creeper
<i>Euphorbia cyparissias</i>	Cypress spurge
<i>Glechoma hederacea</i>	Ground ivy
<i>Hedera helix</i>	English ivy
<i>Hemerocallis fulva</i>	Orange daylily
<i>Hesperis matronalis</i>	Dames rocket
<i>Holcus lanatus</i>	Common velvetgrass
<i>Humulus japonicus</i>	Japanese hop
<i>Hydrilla verticillata</i>	Waterthyme
<i>Hypericum perforatum</i>	Common St. Johnswort
<i>Hesperis matronalis</i>	Dames rocket
<i>Holcus lanatus</i>	Common velvetgrass
<i>Humulus japonicus</i>	Japanese hop

Table 1 (cont.). Invasive plant watch lists used to guide surveys in Arkansas Post National Memorial during 2006, 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>Hydrilla verticillata</i>	Waterthyme
<i>Hypericum perforatum</i>	Common St. Johnswort
<i>Imperata cylindrica</i>	Cogongrass
<i>Iris pseudacorus</i>	Paleyellow iris
<i>Leonurus cardiaca</i>	Common motherwort
<i>Lespedeza bicolor</i>	Shrub lespedeza
<i>Lespedeza cuneata</i>	Sericea lespedeza
<i>Ligustrum lucidum</i>	Glossy privet
<i>Linaria vulgaris</i>	Butter and eggs
<i>Lolium arundinaceum</i>	Tall fescue
<i>Lolium pratense</i>	Meadow fescue
<i>Lolium spp</i>	Fescue
<i>Lonicera maackii</i>	Amur honeysuckle
<i>Lonicera morrowii</i>	Morrow's honeysuckle
<i>Lotus corniculatus</i>	Bird's-foot trefoil
<i>Lygodium japonicum</i>	Japanese climbing fern
<i>Lysimachia nummularia</i>	Creeping jenny
<i>Lythrum salicaria</i>	Purple loosestrife
<i>Melia azedarach</i>	Chinaberrytree
<i>Melilotus officinalis</i>	Sweetclover
<i>Microstegium vimineum</i>	Nepalese browntop
<i>Morus alba</i>	White mulberry
<i>Murdannia keisak</i>	Wartremoving herb
<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>Nandina domestica</i>	Sacred bamboo
<i>Pastinaca sativa</i>	Wild parsnip
<i>Paulownia tomentosa</i>	Princesstree
<i>Phalaris arundinacea</i>	Reed's canarygrass
<i>Photinia serratifolia</i>	Taiwanese photinia
<i>Phragmites australis</i>	Common reed
<i>Phyllostachys spp</i>	
<i>Poa compressa</i>	Canada bluegrass
<i>Poa pratensis</i>	Kentucky bluegrass
<i>Polygonum cuspidatum</i>	Japanese knotweed
<i>Potamogeton crispus</i>	Curly pondweed
<i>Potentilla recta</i>	Sulphur cinquefoil
<i>Prunus mahaleb</i>	Mahaleb's cherry
<i>Pueraria montana var. lobata</i>	Kudzu

Table 1 (cont.). Invasive plant watch lists used to guide surveys in Arkansas Post National Memorial during 2006, 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>Pyrus calleryana</i>	Callery's pear
<i>Rhamnus cathartica</i>	Common buckthorn
<i>Rorippa nasturtium-aquaticum</i>	Watercress
<i>Rosa multiflora</i>	Multiflora rose
<i>Salvinia molesta</i>	Kariba-weed
<i>Saponaria officinalis</i>	Bouncingbet
<i>Solanum viarum</i>	Tropical soda apple
<i>Sphenoclea zeylanica</i>	Chickenspike
<i>Tamarix ramosissima</i>	Saltcedar
<i>Tanacetum vulgare</i>	Common tansy
<i>Torilis arvensis</i>	Spreading hedgeparsley
<i>Triadica sebifera</i>	Chinese tallow
<i>Typha angustifolia</i>	Narrowleaf cattail
<i>Typha X glauca</i>	
<i>Ulmus pumila</i>	Siberian elm
<i>Vinca minor</i>	Common periwinkle
<i>Wisteria floribunda</i>	Japanese wisteria
Park-established Watch List	
<i>Albizia julibrissin</i>	Silktree
<i>Alternanthera philoxeroides</i>	Alligatorweed
<i>Baccharis halimifolia</i>	Eastern baccharis (NATIVE)
<i>Cynodon dactylon</i>	Bermudagrass
<i>Echinochloa crus-galli</i>	Barnyardgrass
<i>Ligustrum sinense</i>	Chinese privet
<i>Ligustrum vulgare</i>	European privet
<i>Lonicera japonica</i>	Japanese honeysuckle
<i>Poncirus trifoliata</i>	Hardy orange
<i>Populus alba</i>	White poplar
<i>Robinia pseudoacacia</i>	Black locust
<i>Rumex acetosella</i>	Common sheep sorrel
<i>Rumex crispus</i>	Curly dock
<i>Sorghum halepense</i>	Johnsongrass
<i>Torilis arvensis</i>	Spreading hedgeparsley
<i>Verbascum thapsus</i>	Common mullein
<i>Vinca major</i>	Bigleaf periwinkle
<i>Wisteria sinensis</i>	Chinese wisteria
Park-based Watch List	
<i>Bromus japonica</i>	Japanese brome
<i>Lolium perenne</i>	Perennial ryegrass
<i>Paspalum urvillei</i>	Vasey's grass
<i>Torilis japonica</i>	Japanese hedgeparsley

Table 2. Cover estimates and frequency of invasive plants found in Arkansas Post National Memorial during 2006, 2011, and 2015 surveys. ^ Indicates plant species to which control measures have been applied in the park. 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>Albizia julibrissin</i> [^]	silk tree	2006	0.0015	0.0578	3.6
		2011	0.0062	0.1233	0.6
		2015	0.0062	0.1255	1.2
<i>Alternanthera philoxeroides</i>	alligatorweed	2006	0.0075	0.2958	7.7
		2011	0.1223	2.1711	8.3
		2015	0.1956	2.8758	13.0
<i>Arundo donax</i>	giant reed	2011	0.0062	0.1233	0.6
<i>Baccharis halimifolia</i>	eastern baccharis	2006	0.0835	1.3601	9.5
		2011	0.1124	2.2707	6.5
		2015	0.0620	0.9914	10.7
<i>Bromus arvensis</i>	field brome	2011	0.0315	0.2713	1.2
<i>Bromus racemosus</i>	bald brome	2006	0.0007	0.0267	1.2
<i>Cynodon dactylon</i>	Bermudagrass	2006 a	0.0309	0.2469	0.6
		2011 b	0.8760	11.3085	21.3
		2015 a	0.0087	0.2212	8.9
<i>Echinochloa crus-galli</i>	barnyardgrass	2011	0.0006	0.0245	0.6
<i>Eichhornia crassipes</i>	common water hyacinth	2006 a	0.4880	5.6814	4.7
		2011 a	0.9341	10.9184	8.9
		2015 b	0.0088	0.2256	4.1
<i>Lespedeza cuneata</i>	sericea lespedeza	2006	0.0007	0.0267	1.2
		2015	0.0001	0.0022	0.6
<i>Ligustrum sinense</i> [^]	Chinese privet	2006	0.5089	7.8617	38.5
		2011	0.1248	3.0004	34.3
		2015	0.0135	0.5204	43.8
<i>Lolium perenne</i>	perennial ryegrass	2011	0.0006	0.0245	0.6
<i>Lonicera japonica</i>	Japanese honeysuckle	2006 a	1.1102	18.6841	58.0
		2011	0.3201	6.4831	43.8
		2015 b	0.0329	0.9215	53.8
<i>Maclura pomifera</i>	osage orange	2006	0.1124	1.5291	7.1
<i>Melia azedarach</i> [^]	Chinaberry tree	2006	0.0069	0.1500	1.8
		2011 a	0.0006	0.0245	0.6
		2015 b	0.0646	0.6027	6.5
<i>Microstegium vimineum</i> [^]	Nepalese browntop	2006 a	0.0137	0.2978	3.0
		2011	0.0253	0.5177	3.0
		2015 b	0.3543	6.3825	12.4
<i>Murdannia keisak</i>	wartremoving herb	2006 a	0.0086	0.2212	3.0
		2015 b	0.0001	0.0022	0.6
<i>Myriophyllum aquaticum</i>	parrot feather watermilfoil	2015	0.0001	0.0022	0.6
<i>Paspalum urvillei</i>	Vasey's grass	2006	0.0001	0.0022	0.6

Table 2 (cont.). Cover estimates and frequency of invasive plants found in Arkansas Post National Memorial during 2006, 2011, and 2015 surveys. ^ Indicates plant species to which control measures have been applied in the park. 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>Paspalum urvillei</i>		2015	0.0006	0.0245	0.6
<i>Poncirus trifoliata</i> [^]	hardy orange	2006 a	18.0434	144.4808	39.6
		2011 b	0.1934	3.5205	31.4
		2015 b	0.1167	2.0554	42.6
<i>Robinia pseudoacacia</i> [^]	black locust	2006	0.0335	0.7188	6.5
		2011	0.0735	0.8372	7.1
		2015	0.0860	1.0860	14.8
<i>Rosa multiflora</i>	multiflora rose	2006	0.0007	0.0289	1.8
		2015	0.0006	0.0245	0.6
<i>Sorghum halepense</i> [^]	Johnsongrass	2006	0.1329	1.9768	5.9
		2011 a	0.7055	14.1325	4.7
		2015 b	0.0454	0.5780	6.5
<i>Torilis japonica</i>	erect hedgeparsley	2006	0.0007	0.0267	1.2
<i>Typha angustifolia</i>	narrowleaf cattail	2006	0.5628	6.8181	4.7
		2011	0.1501	3.0372	5.3
		2015	0.2669	3.1353	7.1
<i>Verbascum thapsus</i>	common mullein	2006	0.0001	0.0022	0.6
		2011	0.0006	0.0245	0.6
		2015	0.0001	0.0022	0.6
<i>Vinca major</i> [^]	bigleaf periwinkle	2006	0.0988	1.6054	1.8
		2011 a	0.3521	2.9643	2.4
		2015 b	0.0124	0.2488	1.8
<i>Wisteria sinensis</i> [^]	Chinese wisteria	2011	0.0130	0.2711	1.8
		2015	0.0062	0.1255	1.2

Literature Cited

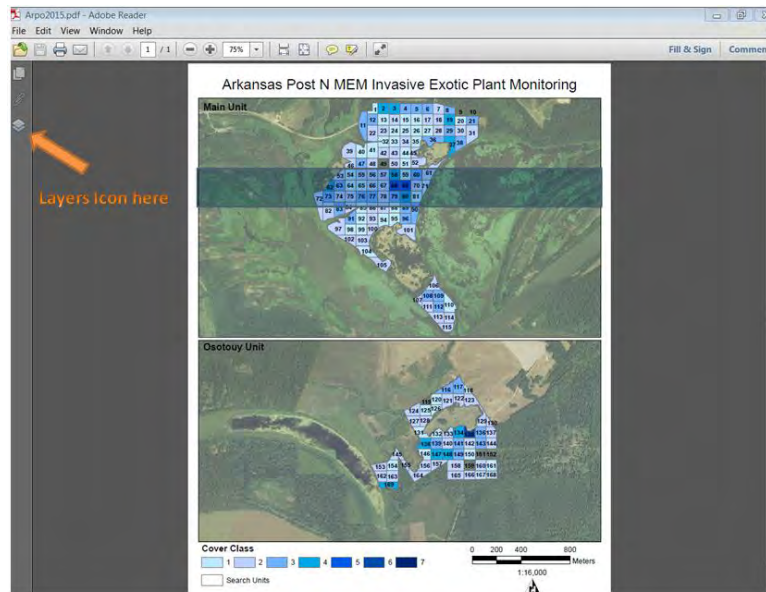
NPSpecies - The National Park Service Biodiversity Database. IRMA version.
<https://irma.nps.gov/Species.mvc/Welcome> (accessed 16 February 2012).

Young, C.C., J.L. Haack, L.W. Morrison, and M.D. DeBacker. 2007. Invasive exotic plant monitoring protocol for the Heartland Inventory and Monitoring Program. Natural Resource Report NPS/HTLN/NRR-2007/018. National Park Service, Fort Collins, Colorado.

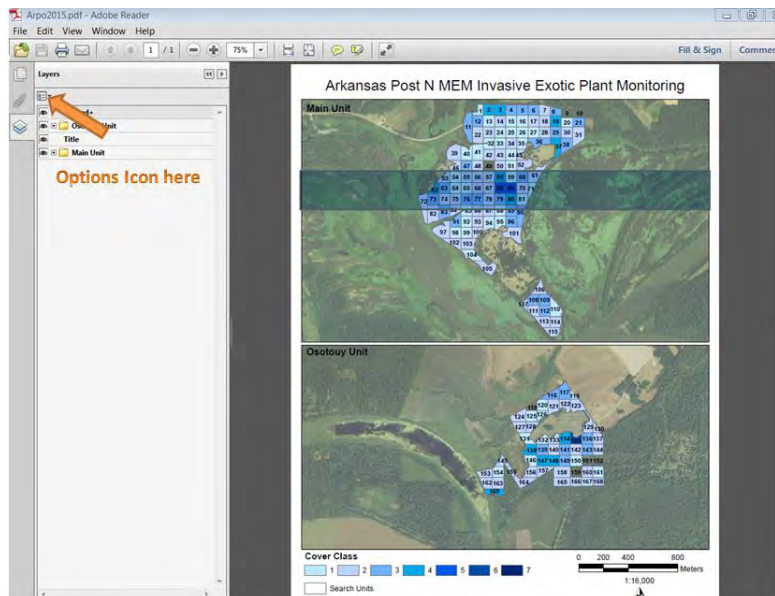
Young, C. C., J. C. Bell, C. S. Gross, and A. D. Dunkle. 2012. Invasive exotic plant monitoring (year 2) and treatment recommendation for Arkansas Post National Memorial. Natural Resource Technical Report NPS/HTLN/NRTR—2012/609. National Park Service, Fort Collins, Colorado.

Appendix A. Viewing GeoPdfs

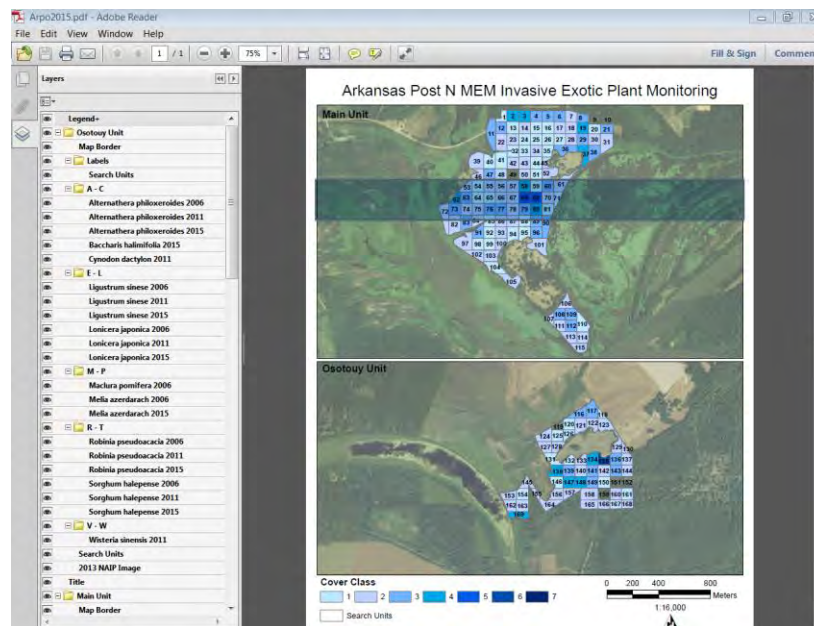
Open a report in Adobe Reader 9.0 or other Adobe software product. When the report first opens, a map will appear highlighting the search units in the Memorial and Osotouy Units separately. To interpret the map, first click the layers icon (double overlapping diamonds).



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 411/131179, January 2016

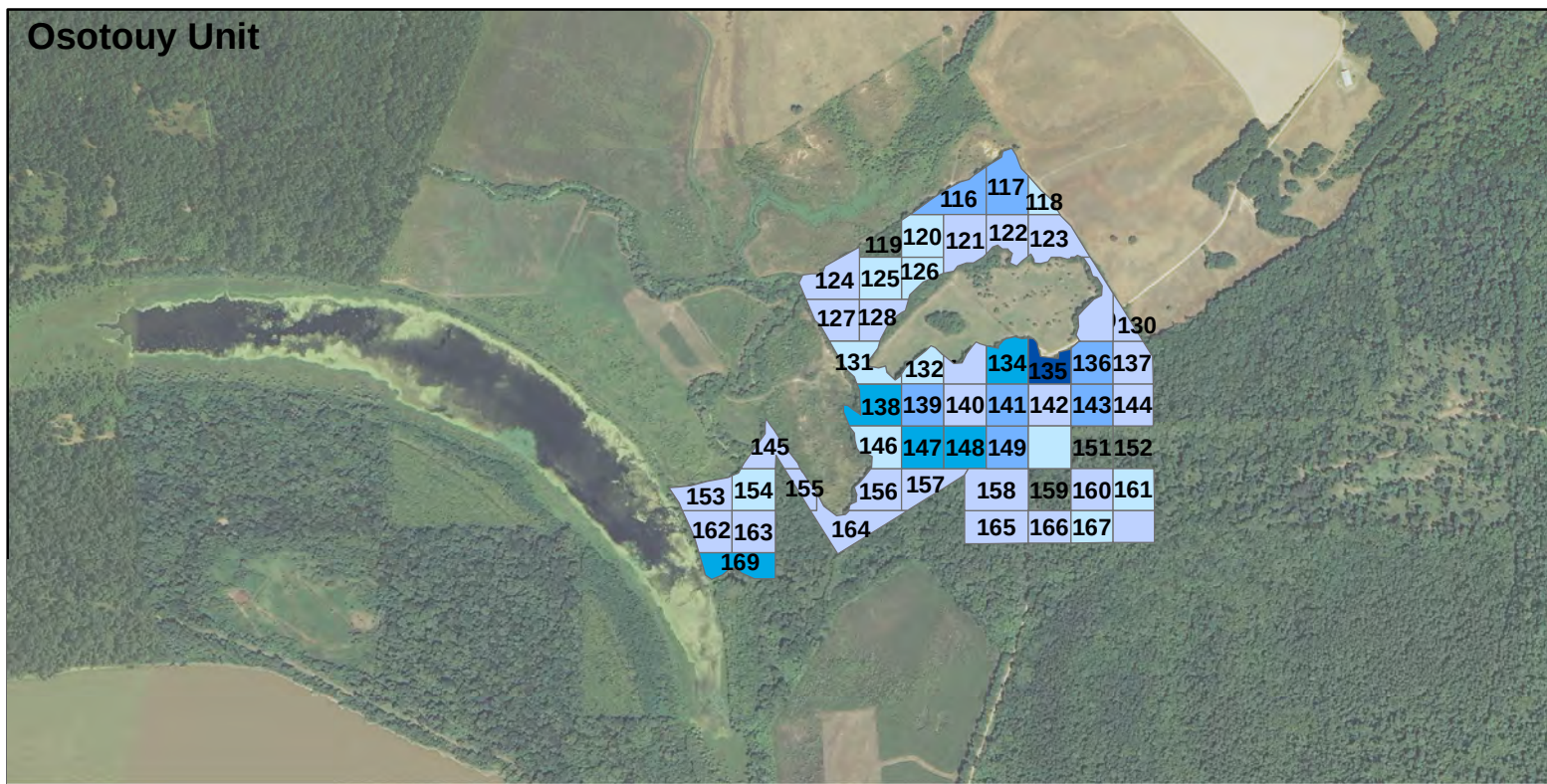
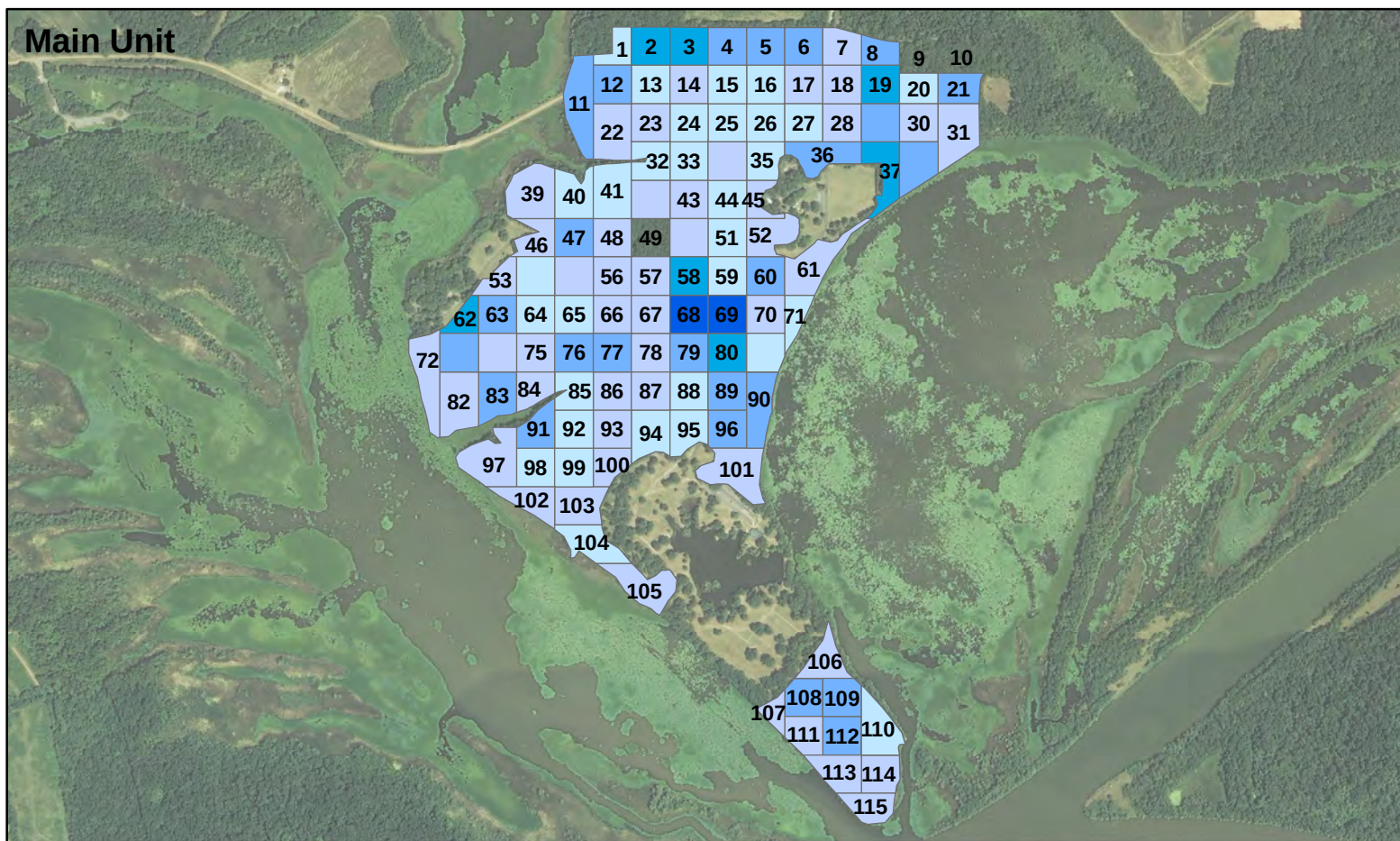
National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov

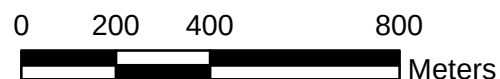
Arkansas Post N MEM Invasive Exotic Plant Monitoring



Cover Class



Search Units



1:16,000

