

An Invasive Exotic Plant Inventory of Pea Ridge National Military Park

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September 2003

Technical report NPS/HTLN/P6370010724

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Summary

No information on current invasive exotic species composition, distribution, and abundance existed for the Pea Ridge NMP prior the inventory. Information is needed for park managers to make appropriate decisions to ensure the long-term sustainability of species and abide by the National Park Service (NPS) mission statement. Surveys were conducted in the fall of 2001, continued through the spring/summer of 2002, and ended in November 2002. Plots were revisited as part of another general plant inventory in the spring of 2003. Invasive exotic plant species presence/absence was assessed within 496-100 meter square plots randomly allocated throughout the park. Percent cover was assessed in a subset of these. Invasive exotic plants located adjacent and en route to plots were also noted. Forty-one invasive/exotic species were documented. Among these, four species were most common: Carolina buckthorn (*Rhamnus caroliniana*), Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), and sericea lespedeza (*Lespedeza cuneata*). Five species not on the targeted list included crown vetch (*Coronilla varia*), yucca (*Yucca smalliana*), Kentucky blue grass (*Poa pratensis*), bedstraw (*Galium pedemontanum*), and tree of heaven (*Ailanthus altissima*). Management implications and recommendations identify possible steps to ensure the long-term sustainability of invasive exotic plants Pea Ridge NMP.

Acknowledgments

The author wishes to thank the staff at Pea Ridge NMP for their kindness and willing support of the project. Thanks also go to the National Park Service Heartland Network Inventory and Monitoring Program and Regional Offices who funded the project and to staff who assisted with project logistics.

Introduction

In 1998 Congress passed the National Parks Omnibus Management Act in response to concerns about the condition of natural resources within the national parks. The act requires each park to gather baseline inventory data on pertinent natural resources, data that will provide a pivotal step toward establishing an effective monitoring program furthering the ability to effectively manage and protect park resources. The National Park Service responded with the Natural Resource Challenge program, including the establishment of biome-based inventory and monitoring networks. The Heartland Network, as part of the NPS Inventory and Monitoring (I&M) program, has undertaken inventories of vascular plants and vertebrates within fifteen parks in eight Midwestern states.

Stemming from this challenge and a widespread concern regarding the status of invasive exotic plant species at Pea Ridge NMP, an inventory was deemed necessary to determine species present, distribution, and abundance.

Exotic and invasive plant species are recognized as being potentially threatening to native plant populations. They have not originated within a particular ecosystem but have been introduced by humans for potential benefits, often as is the case with multiflora rose and sericea lespedeza. Years later, the full impact of these introduced species on the ecosystem results in vigorous efforts to eradicate the introduced species. In other cases, a native species such as Carolina buckthorn becomes a superior competitor for the same resources needed by other native species.

Prior to 1956, much of the park had been used for agriculture and homesteads. Several remains of decaying house foundations, yards with exotic flower, shrub and tree species, and former pastures are still in evidence throughout the park. Many of the introduced plants are considered invasive and, as they are propagated by birds and small mammals, are possibly endangering native species habitat. Sericea lespedeza is known to occur at the park and other limited information had previously been documented (Dale 1983) but a complete inventory had not been done.

Natural disturbances create openings within the ecosystem and these invasive species are the first to colonize newly opened areas. Such is the case at Pea Ridge NMP-such species as multiflora rose and sericea lespedeza were introduced for wildlife habitat or food. While there are native roses (*Rosa* spp.) and lespedezas (*Lespedeza* spp.), these species were recommended for their ability to become established quickly. In the case of sericea lespedeza, it was expected to provide quail forage; later, it was found that quail could not digest the hard seeds. Native annual lespedezas, on the other hand, provide good nutrition for small birds such as quail. Multiflora rose does provide great cover; unfortunately, it spreads so quickly that impenetrable thickets often develop and encroach on open areas.

Throughout northwest Arkansas, these species are spread throughout the woods wherever there are old home sites and pastures. Japanese honeysuckle also propagated by birds is very aggressive in spreading into native habitats, wherever there is a human-made or natural opening

and may take up habitat that native species would otherwise occupy. Carolina buckthorn is encountered in a variety of habitats located throughout the park.

We conducted a thorough, one-year invasive exotic plant survey in 2001-2002. The inventory had three objectives: 1) identify the presence/absence of targeted invasive exotic plants expected to occur at Pea Ridge NMP; 2) document the distribution of these targeted species; and 3) estimation of relative abundance of these targeted species.

Study Area

Pea Ridge National Military Park is located in Benton County in the extreme northwest corner of Arkansas 16 km (10 mi) northeast of Rogers (Figure 1). The park encompasses approximately 1,740.9 ha (4,300 ac) comprised of 1457.5 ha (3,600 ac) mixed upland forest, 161.9 ha (400 ac) abandoned or hayed fescue fields and one restored tallgrass prairie, and 121.5 ha (300 ac) of developed land.

According to the National Park Service, the park is one of the most well preserved battlefields in the United States (NPS 2003) and is a class II air quality area. Air quality around the park is generally perceived to be good, however no formal air quality monitoring equipment is located in or around the park. A nearby highway contributes to emissions in the park. The entire park is burned in sections, which rotate at 3-year intervals, and contribute to emissions in and around the park.

Previous floral and faunal inventories described the species assemblages (plants, Dale 1983; mammals, Johnsey & Malinen 1971; birds, Powell & Lichtenburg 2000) and a preliminary herpetological inventory (Briggler & Pilgrim 2001) further serve to document these communities. No known federally threatened or endangered plant or animal species occur in the park but several populations of state special concern Ozark chinquapin (*Castanea pumila ozarkensis*) exist. An inventory is currently being conducted for rare or endangered bat species.

Historic maps indicate that the park was more open and contained tallgrass prairie in 1862. In order to accurately represent battlefield conditions and restore the resources to a natural setting, park natural resource managers will restore 24.3 ha (60 ac) of native tallgrass to an area currently maintained as a hayfield.

Soils in the park consist primarily of toloca silt-loam, peridge silt-loam, captina silt loam and jay silt loam (NRCS 1977) with typical slopes of 1-3%. The fertile topsoils are somewhat poorly drained as the park does not contain any wetlands; two perennially flowing springs do exist and are currently being sampled by the USGS as part of a level I water quality monitoring initiative.

Materials and Methods

Four hundred and ninety six 100 m² (20m x 5 m) plots were stratified across the park and sampled from October 2001-November 2002 for presence/absence of invasive exotic plants. Two hundred and eighty of the plots were also assessed percent cover of the invasive exotic species. Additionally, invasive exotic plants located adjacent and en route to plots were also noted. Prior to the survey a list of 36 targeted invasive exotic species was developed (Table 1); five additional species were added as inventory work commenced.

Plot origins (located at the northwest corner of plots) were located in the field with a Trimble GeoExplorer 3 Global Positioning System (GPS) portable hand-held unit at the highest accuracy possible given the conditions at the time. Plots were longitudinally 200 m apart whereas latitudinal distances were randomly chosen (Figure 2). Plastic red flagging was attached to a small diameter tree or bush at or near the northwest corner of plots to reduce observer error.

Results

A total of 41 species (Table 1) in 22 families were documented; three families, the Asteraceae, Fabaceae, and Poaceae, were represented with five species. Two hundred and forty six of the 496 plots (48.8%) contained an invasive exotic plant. Twenty one of the 36 targeted species were found in plots. Overall, four invasive exotic species were most prevalent and were distributed throughout the park (Figures 3-6).

Carolina buckthorn, an invasive, yet native shrub species, was found in 155 plots (31.3%) yet had an average cover <5%. Shrubs encountered were individual saplings less than 1.8 m (4 ft) tall, or in some cases clumped and up to 2 m (8 ft) tall and spreading. Multiflora rose was found in 85 plots (17.1%) and had an average cover of 5.5%. Japanese honeysuckle was found in 71 plots (14.3%) yet had a higher average cover (11%) than the prior two. Sericea lespedeza was found in 60 plots (12.1%) and had an average cover of 7.9%.

Five species not originally on the target list were encountered: crown vetch (*Coronilla varia*), yucca (*Yucca smalliana*), Kentucky blue grass (*Poa pratensis*), bedstraw (*Galium pedemontanum*), and tree of heaven (*Ailanthus altissima*).

Discussion

In those regions that are characterized as forest with older, taller trees with greater basal area and a dense canopy (over 60% cover), very few exotics are located; the presence of open, disturbed area increases the probability of exotic occurrence significantly. Weeds by description are those plants that are opportunists, either producing many seed or asexually propagating via rhizomes, suckers, or runners. By the time that hardwood trees become the dominant vegetation and the canopy is enclosed, the number of invasive and/or exotic species is reduced.

Within the old pastures growing up in saplings and shrubs, Kentucky fescue (*Festuca arundinacea*), annual and Kentucky bluegrass (*Poa annua* and *P. pratensis*), Johnson grass (*Sorghum halepense*), downy brome (*Bromus tectorum*), and common bermudagrass (*Cynodon dactylon*) have been found. These do not appear to be moving into the older or less disturbed areas, but are common on the sides of the roads and in more disturbed sites. These areas are regularly mowed during the growing season. English plantain (*Plantago lanceolata*) and dandelion (*Taraxacum officinale*) are found in mowed areas and scattered in the restored prairie. These do not appear to be invading less disturbed areas and will probably die out as succession continues and trees and shrubs dominate. In the prairie, prescribed fire is expected to eliminate these exotics.

Exotic species were abundant along the edges of forests, roadsides, in ditches, and in areas that had either been cleared for savanna restoration, opened up through natural processes such as wind storms, or at old home sites that had originally been cleared for farming and homesteads. Considering the prolific new seedlings and saplings of Carolina buckthorn and multiflora rose, birds are probably the primary vectors of distribution. The planting of exotic species by humans cannot be overlooked as most of the old home sites had flower gardens that still bloom today. Species such as jonquil (*Narcissus jonquilla*), blackberry lily (*Belamcanda chinensis*), and multiflora rose are commonly found at old home sites. Today, these are discouraged because of their invasive and persistent characteristics.

Ticks were more plentiful in grassy, open areas than in the deeper woods. Deer require the open areas for grazing and probably spend more stationary time in these sections of the woods. An interesting observation and impression was the low frequency of poison ivy in the wooded areas. In speculating on why this area is so different from analogous woods along the Buffalo River, I considered the relative abundance of deer. Several resource managers and naturalists have reported that deer do browse poison ivy and, perhaps, this alone explains the absence of poison ivy in certain sections of the park. Another possibility might lie in the practice of deer rubbing against tree trunks and perhaps keeping the poison ivy from growing up the trunks of trees to more sunlight.

Park personnel have been cutting Eastern red cedar (*Juniperus virginiana*) in selected cedar glade areas of the forest, creating savanna-like openings. Once the savannas are established in native grasses, it is expected that the exotics will be set back. Until then, these areas seem particularly vulnerable to exotic plant invasions. Prescribed burns should help eliminate the exotics species and allow for native plant re-establishment.

Notable species found scattered throughout the park that were much more isolated and in fewer numbers were wintercreeper (*Euonymus fortunei*), American holly (*Ilex opaca*), periwinkle (*Vinca minor*), and daffodils or jonquils (*Narcissus* spp.). Blackberry lily was encountered almost as commonly as jonquils, usually the most common planting at old home sites.

The frequency of the plots and their relative closeness to each other give a good picture of the extent of invasive species in the park. As might be expected, the greater number of exotic and/or invasive species occurred in the more disturbed parts of the park: old home sites, mowed right of ways and shoulders along the paved drive around the park, old pastures, woods adjacent to horse trails and hiking trails (especially when near open areas and edges), cedar woodlands-especially those newly cut for savanna openings, and along Old Wire and Leetown Roads. Exotic, invasive species were noticeably absent in the older woods northeast of the Elkhorn Tavern, and in the shadier, older woods with deeper ravines; however, this may not remain so. The sheer numbers and vigor of exotic species in plots adjacent to the forest provide an ongoing steady supply of reproductive fruits with seed for wildlife to disseminate, trailing vines, or rhizomes that recognize no boundaries.

Considering that 84% of the total area is recognized as upland forest, much of this woodland is in earlier stages of succession, and most of the plots were forest/woodland as well, the threat of exotic invasion seems to be a very present and growing concern with such a large reservoir of exotics present in adjacent areas. With this baseline data, exotic species can be monitored in the future and a more complete picture of this threat will emerge.

At the end of summer and continuing into fall, field work concentrated on the woods and pastures between Elk Horn tavern and Highway 62. Extensive stands of multiflora rose and Japanese honeysuckle were more densely concentrated in this area than in the other areas studied. Birds disseminate these seed randomly in all types of openings and seeds appear to do best in openings within woodlands and shrub lands, although a very few have been found in older forests (those with large, older trees present and little under story) only where there was a natural or man-made opening.

Conclusion

Two-hundred and forty six plots showed the presence of one or more exotic species. While this is just less than fifty percent of the total number of plots, exotic species appear to be proliferating, spreading into open areas, and generally thriving. The plan to create savannas within the park in order to restore the park to its Civil War era ecological patterns and to encourage animal species to return to these savannas will open up areas of the park which are now enclosed by over story canopy. This will encourage the spread of many of these exotic species and will have to be carefully managed. A regular monitoring regime is recommended for the Park in order to determine the extent to which these species are spreading into areas of the park that as of yet do not show establishment of exotic species populations. The use of fire as a management tool in the establishment of savannas and in the eradication of various exotic and invasive populations of plants that will come in during these changes will play a key role in this undertaking. In the northeast corner of the park where there is almost 100% canopy cover during the late spring/summer months, exotic plants will not be a threat unless natural events such as tornadoes and windstorms, or pest species such as the red oak borer, create natural openings. Although Chestnut blight is apparent in the remnant populations of Ozark chinquapin, these trees are found in the sub-canopy and their demise will not result in less canopy cover. Monitoring all areas within the park will help to ensure that exotic species do not become a greater problem in the future.

The impact of exotic and invasive species on the native plant populations at Pea Ridge NMP is of concern to resource managers who plan to restore the park to its 19th Century, pre-settlement conditions. One disappearing habitat, the savanna barrens, was once significant in the park and provided a natural transition between forests and prairies. These support prairie grasses and wildflowers that require an open canopy for sunlight. Schoolcraft described this 19th century landscape as natural openings within forests, with widely spaced trees and herbaceous ground cover (Schoolcraft 1853). These openings will encourage species such as northern bobwhite (*Colinus virginianus*), rufous-sided towhee (*Pipilo erythrophthalmus*), and mourning dove (*Zenaidura macroura*) plus other songbirds (Shugart and James 1973) and small mammals such as the white-footed mouse (*Peromyscus leucopus*), golden mouse (*Ochrotomys nuttalli*), and the fulvous harvest mouse (*Reithrodontomys fulvescens*) (Masters, Lochmiller, McMurry, Bukenhofer 1998) that utilize edges and openings in the forest. In cutting trees in the glade-like woodlands to open up savanna areas, exotic species are expected to colonize. Controlling these species will be paramount in efforts to establish the savanna barrens.

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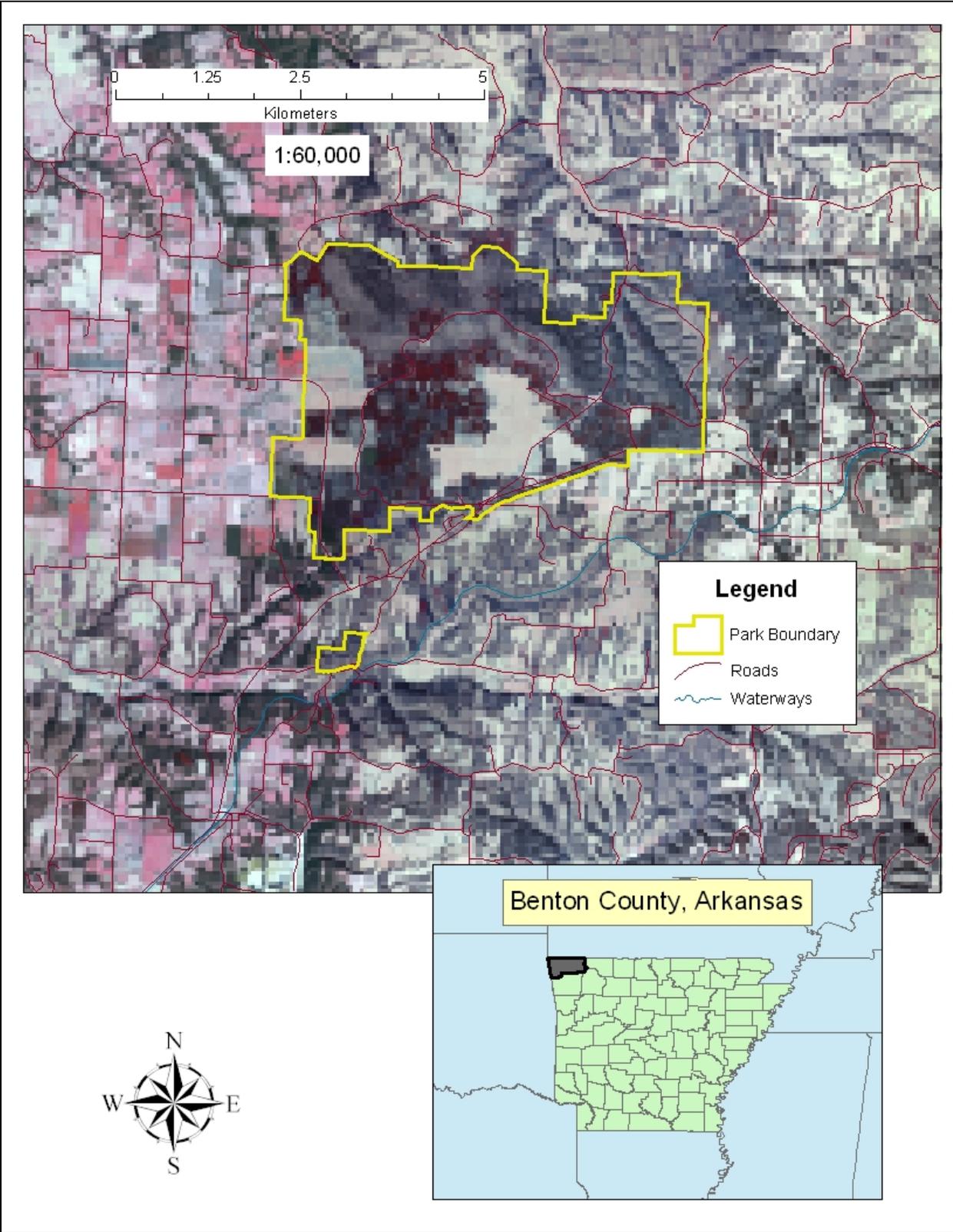


Figure 1 Location of Pea Ridge NMP.

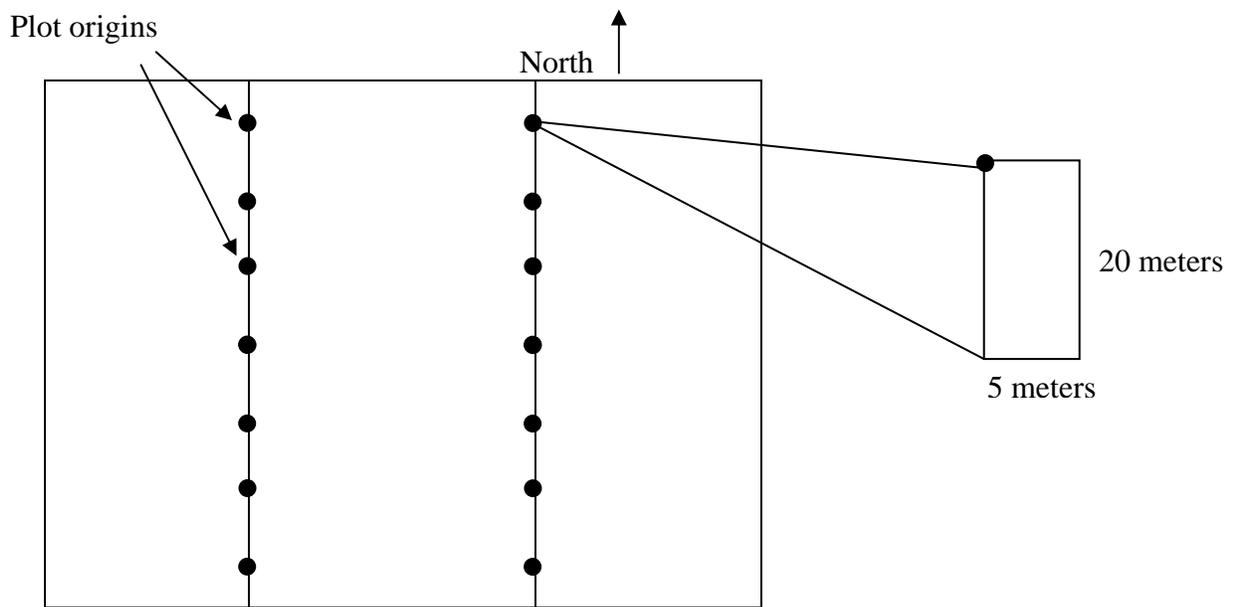


Figure 2. Diagram of plot orientation and layout.

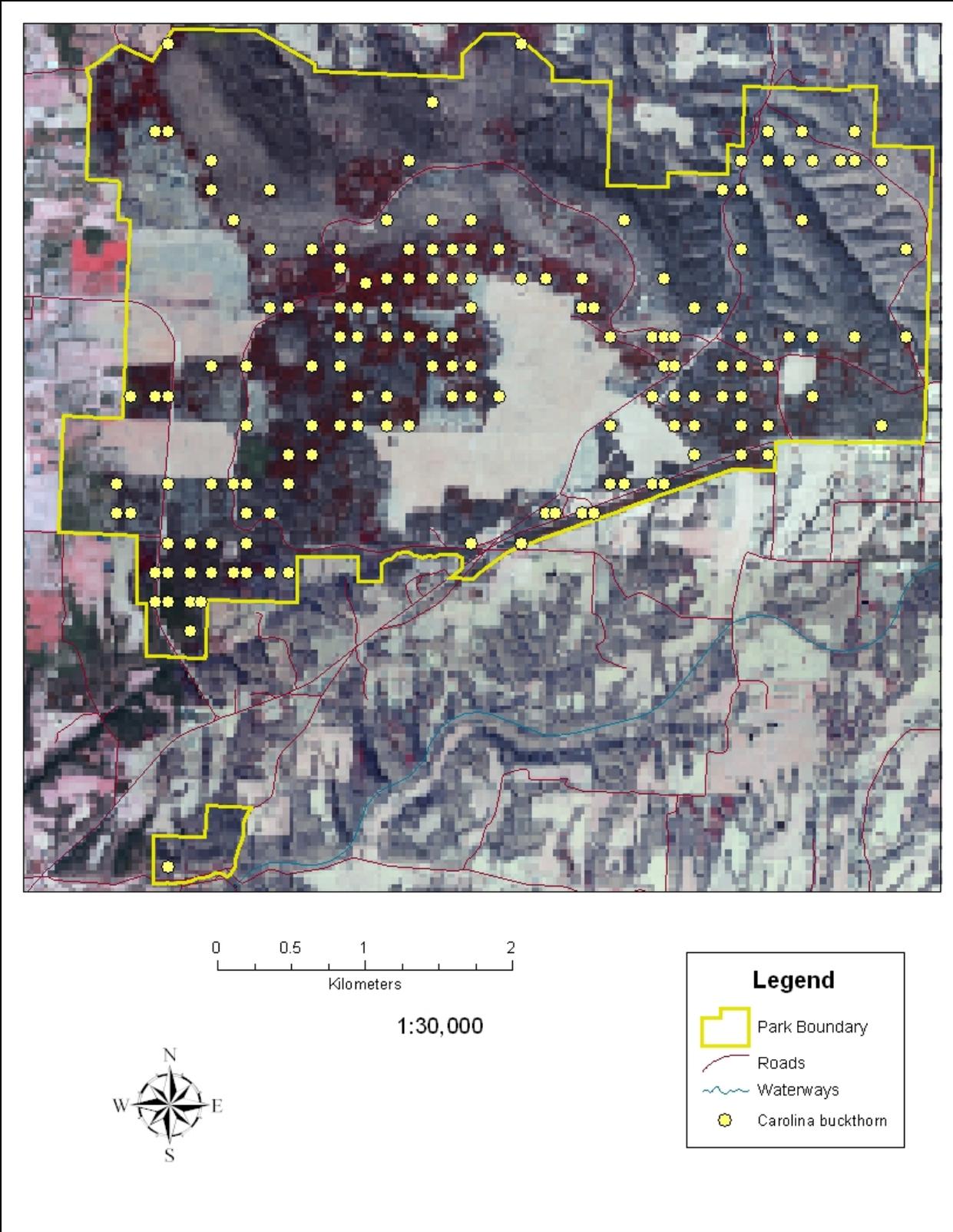


Figure 3. Location of Carolina buckthorn at Pea Ridge NMP.

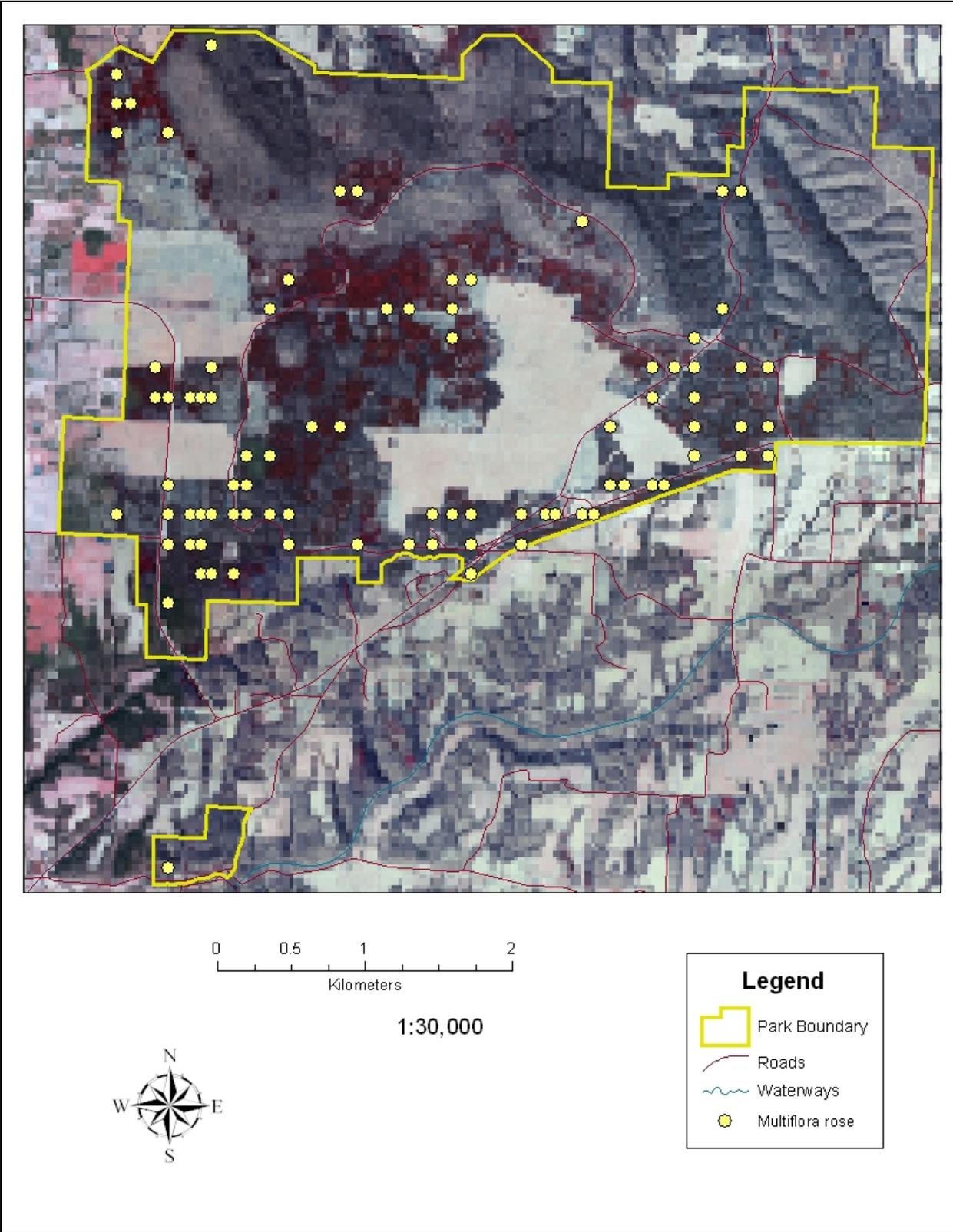


Figure 4. Location of multiflora rose at Pea Ridge NMP.

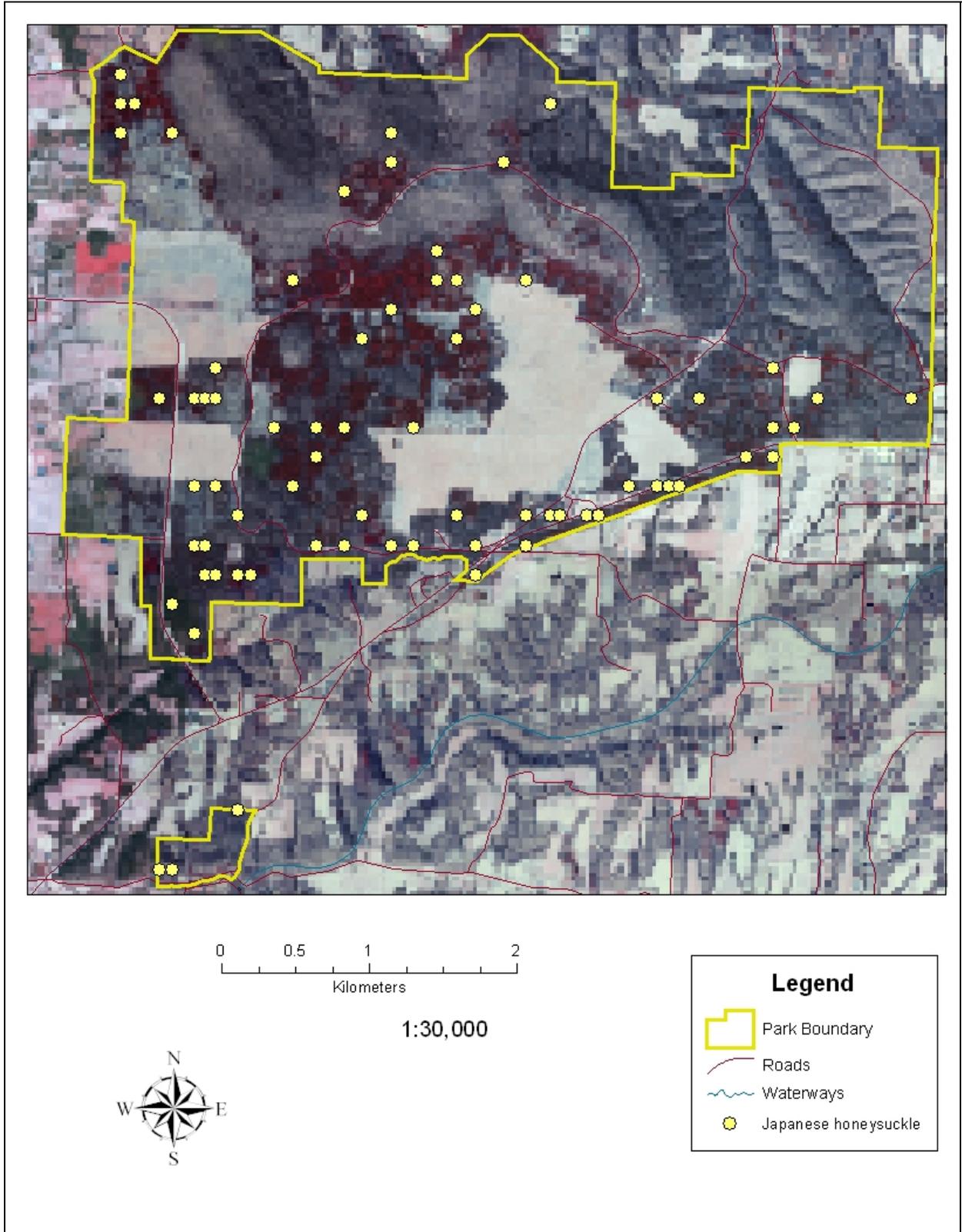


Figure 5. Location of Japanese honeysuckle at Pea Ridge NMP.

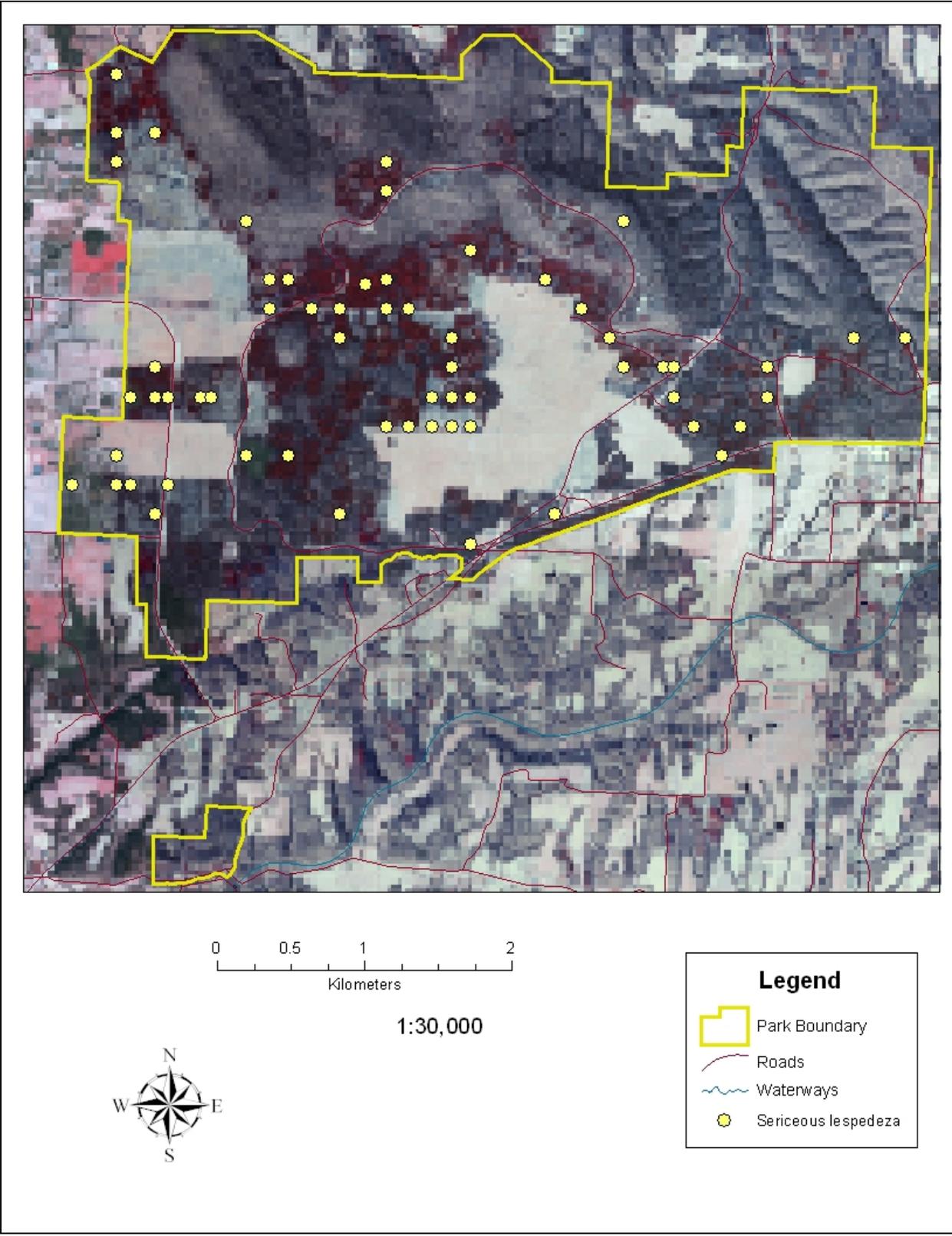


Figure 6. Location of sericeous lespedeza at Pea Ridge NMP.

Table 1. List of species inventoried at Pea Ridge NMP.

Common Name	Scientific Name	Family
American holly	<i>Ilex opaca</i>	Aquifoliaceae
Annual bluegrass	<i>Poa annua</i>	Poaceae
*Bedstraw	<i>Galium pedemontanum</i>	Rubaceae
Bermudagrass	<i>Cynodon dactylon</i>	Poaceae
Blackberry lily	<i>Belamcanda chinensis</i>	Liliaceae
Bouncing bet	<i>Saponaria officinalis</i>	Caryophyllaceae
Bull thistle	<i>Cirsium vulgare</i>	Asteraceae
Carolina buckthorn	<i>Rhamnus caroliniana</i>	Rhamnaceae
Carpet weed	<i>Mollugo verticillata</i>	Molluginaceae
Chicory	<i>Cichorium intybus</i>	Asteraceae
Common periwinkle	<i>Vinca minor</i>	Apocynaceae
*Crown vetch	<i>Coronilla varia</i>	Fabaceae
Cut-leaf primrose	<i>Oenothera laciniata</i>	Onagraceae
Dandelion	<i>Taraxacum officinale</i>	Asteraceae
Deptford pink	<i>Dianthus armeria</i>	Caryophyllaceae
English ivy	<i>Hedera helix</i>	Araliaceae
English plantain	<i>Plantago lanceolata</i>	Plantaginaceae
Field madder	<i>Sherardia arvensis</i>	Rubiaceae
Ground ivy	<i>Glechoma hederacea</i>	Lamiaceae
Hedge bindweed	<i>Calystegia sepium</i>	Convolvulaceae
Japanese honeysuckle	<i>Lonicera japonica</i>	Caprifoliaceae
Johnson grass	<i>Sorghum halpense</i>	Poaceae
*Kentucky bluegrass	<i>Poa pratensis</i>	Poaceae
Mimosa tree	<i>Albizia julibrissin</i>	Fabaceae
Multiflora rose	<i>Rosa multiflora</i>	Rosaceae
Orchard grass	<i>Dactylis glomerata</i>	Poaceae
Ox eye daisy	<i>Chrysanthemum leucanthemum</i>	Asteraceae
Peach	<i>Prunus persica</i>	Rosaceae
Perilla mint	<i>Perilla frutescens</i>	Lamiaceae
Queen Anne's Lace	<i>Daucus carota</i>	Apiaceae
Roughfruit cinquefoil	<i>Potentilla recta</i>	Rosaceae
Sericea lespedeza	<i>Lespedeza cuneata</i>	Fabaceae
Sheep sorrel	<i>Rumex acetosella</i>	Polygonaceae
Silver poplar	<i>Populus alba</i>	Salicaceae
Tall fescue	<i>Festuca arundinacea</i>	Poaceae
*Tree of heaven	<i>Ailanthus altissima</i>	Simaroubaceae

Table 1. List of species inventoried at Pea Ridge NMP (cont.).

White sweet clover	Melilotus albus	Fabaceae
Winter creeper	Euonymus fortunei	Celastraceae
Winter vetch	Vicia villosa	Fabaceae
Yarrow	Achillea millefolium	Asteraceae
*Yucca	Yucca smalliana	Liliaceae

*denotes a species not on the original target species list

Table 2. Summary of invasive exotic species within the herbaceous layer.

Common name	Scientific Name	Number/Percent of plots species present	Average percent cover at plots surveyed
Carolina buckthorn	Rhamnus caroliniana	155/31.3	<5
Multiflora rose	Rosa multiflora	85/17.1	5.5
Japanese honeysuckle	Lonicera japonica	71/14.3	11.0
Sericea lespedeza	Lespedeza cuneata	60/12.1	7.9
Yarrow	Achillea millefolium	23/4.6	6.0
Johnson grass	Sorghum halpense	14/2.8	6.1
Tall fescue	Festuca arundinacea	13/2.6	8.5
Ox eye daisy	Chrysanthemum leucanthemum	12/2.4	<5
Orchard grass	Dactylis glomerata	11/2.2	<5
Annual bluegrass	Poa annua	7/1.4	5.0
Blackberry lily	Belamcanda chinensis	7/1.4	5.3
American holly	Ilex opaca	7/1.4	<5
Queen Anne's Lace	Daucus carota	6/1.2	6.3
Bull thistle	Cirsium vulgare	5/<1	<5
Winter creeper	Euonymus fortunei	4/<1	<5
Dandelion	Taraxacum officinale	3/<1	<5
Deptford pink	Dianthus armeria	3/<1	<5
Bermudagrass	Cynodon dactylon	1/<1	5.0
Common periwinkle	Vinca minor	1/<1	<5
Perilla mint	Perilla frutescens	1/<1	<5
Winter vetch	Vicia villosa	1/<1	5.0
Yucca	Yucca smalliana	1/<1	<5