

Exotic Plant Mapping at Homestead National Monument of America

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Summary

A survey of invasive and exotic plants was conducted in the prairie habitat at Homestead National Monument of America from 7/23 to 11/13/2003 and 8/9 to 11/07/2004 to document species composition and distributions. Plant locations were documented by walking throughout the prairie. Sixteen invasive taxa were found as isolated plants, localized populations, or to cover extensive areas. The most common taxa include smooth brome, dogwood, and native thistles.

In 2003, 40 acres were surveyed and less than 3 acres of invasive plants were mapped. This is equal to 7.2% of the 40 acres surveyed. Of these 3 acres only about a quarter of an acre was exotic invasive species or 0.6% of the area sampled. During 2004, 1.4049 acres of invasive plants were mapped. This is equal to 1.7% of the 80 acres that were surveyed. Of the 1.4049 acres of invasive plants only 0.9 of an acre were exotic species or 1.1% of the area surveyed.

This inventory has proven to be very useful, therefore it is recommended that invasive plant species are mapped on a regular basis and control measures are well documented. Reed canary grass, threatening the undisturbed Freeman School Prairie, is the most urgent issue documented in this report.

Acknowledgments

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Introduction

Homestead National Monument (NM) of America is a monument to the Homestead Act of 1862. In March 1936, Congress established the Homestead National Monument of America under the stewardship act of the National Park Service (NPS) to “*retain for posterity a proper memorial emblematical of the hardships and the pioneer life through which the early settlers passed in the settlement, cultivation and civilization of the Great West.*” (National Park Service 1999).

The monument commemorates the Homestead Act of 1862 and its effects upon the settlement of the West as well as advancements in agricultural technology. Homestead's purpose is to interpret the history of the country resulting in and from the Homestead Act and to commemorate the people whose lives were altered by the Homestead Act. This includes preserving literature, agricultural implements, and a museum to interpret settlement, cultivation, and development of the West.

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 NPS 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.

Invasive exotic plants are a resource management concern due to the impact each has on native ecosystems. Invasive species tend to encroach and compete with native plants, changing the ecosystem and thereby altering the interaction of both plants and animals. An initial list of invasive exotic species was developed by Homestead National Monument of America natural resource managers and from a list of previously treated invasive exotics (See Table 1). Musk thistle (*Carduus nutans*) is the only recorded species at Homestead National Monument of America that is on the Nebraska state noxious list (Nebraska Department of Agriculture 2005). An exotic grass, smooth brome (*Bromus inermis*), has been a persistent problem, and poses the greatest threat. Control of smooth brome is identified as a priority in the Homestead NM of America management plans including the 1993 Prairie Management Plan and again in the 2000 Fire Management Plan.

The objectives of this study were to:

1. Document the invasive exotic species distribution at the monument
2. Describe distributional aspects of invasive exotic plant species within the project area
3. Develop a baseline for an exotic species monitoring program, and
4. To identify areas where exotic control efforts should be targeted.

Study Area

Homestead NM of America is located in southeastern Nebraska (Gage County) just west of the City of Beatrice (Figure 1). The property consists of 78.9 ha (195 ac) including; 40.5 ha (100 ac) of restored tallgrass prairie, 24.3 ha (60 ac) of hardwood forest, and 1.2 ha (3 ac) of administrative areas (roads, structures, and trails). The restored prairie is considered the oldest restored tallgrass prairie in the National Park Service with the restoration process starting in 1939. The park is dissected by Cub Creek through the west end of the property.

The park lies within the glaciated Drift Hill Region of Southeast Nebraska. Underlying formations, bedded limestone and shale, indicate that this area was once at the bottom of the ocean. The gently rolling topography of the Monument has an extreme relief of 21.3 m (70 ft). The average elevation of this area is approximately 384.1 m (1,260 ft) above sea level with the highest point on the Monument rising to 402.3 m (1,320 ft).

Today, the vegetation of the Monument is roughly two-thirds reconstructed prairie and one-third woodland, the same general ratio of native prairie/woodland found by the original surveyors of the area. The Freeman School grounds (approximately 2.5 acres total size) contain a 0.75-acre remnant of untilled native prairie. The south and southeast upland slopes within the Monument contain the best examples of tallgrass prairie.

Dominant grasses include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and Indiangrass (*Sorghastum nutans*). Common forbs include goldenrods (*Solidago spp.*), sunflowers (*Helianthus spp.*), and leadplant (*Amorpha canescens*). The woodland and riparian vegetation consists primarily of bur oak (*Quercus macrocarpa*), ash (*Fraxinus pennsylvanicus*), silver maple (*Acer saccharinum*), hackberry (*Celtis occidentalis*), boxelder (*Acer negundo*), red elm (*Ulmus rubrum*), and cottonwood (*Populus deltoides*).

The monument is a "T" shape containing the original 64.8 ha (160 ac) homestead of Daniel Freeman and the Freeman School site. An estimated 35,000-40,000 people visit Homestead annually. Visitation is primarily during the summer months with dramatic increases during special programs; 27% of the visitors are from the local community; 4% have international origins; 66% of visitors identify the Monument as a day trip destination.

Environmental concerns at the monument stem mainly from agricultural land use which surrounds Homestead NM of America. Corn, wheat, and grain sorghum are the major crops. Other concerns are two anhydrous ammonia fertilizer plants, a gas fired power plant, State Highway 4, which dissects the monument, and a 27-home residential subdivision that borders the monument.

Materials and Methods

Homestead NM of America was surveyed 7/23 to 11/13/2003 and 8/9 to 11/07/2004 for invasive/exotic plants. The area of concern includes approximately 40 ha (100 ac) of a natural zone consisting of prairie. The area of study was surveyed via methods modified from Eads (2001). An east-west baseline was established within the prairie. Surveyors then walked perpendicular to the baseline covering approximately a 20 meter belt searching for targeted invasive species (Table 1). A Garmin 12 GPS (Global Positioning System) receiver was used to delineate starting and stopping points throughout this process so that the possibility of missing an area or duplicating work was reduced. Starting and stopping points were also marked with a steel post with orange flagging.

When invasive or exotic plants were located, a Trimble GeoExplorer 3 GPS unit was utilized (NAD83 Conus) to map individual plants and the area of all grouped plants (i.e., the drip line of each group of invasive species). Individual plants were mapped as a point whereas plants that occupied more than one plant per square meter were mapped as a polygon. Plant groups were assigned density class values including 0-10 stems/meter, 11-50 stems/meter, 51-100 stems/meter or >100 stems/meter.

Data collected with the Trimble GeoExplorer 3 was then downloaded to the computer using GPS Pathfinder Office 2.8. Data was then differential corrected and then exported as an ArcView shape file.

During the 2003 season all invasive species were marked including thickets. During the 2004 season thickets were not mapped (to make the process go faster).

Results

Species mapped included dogwood (*Cornus spp.*), native thistles (*Cirsium spp.*), plum (*Prunus americana*), foxtail grasses (*Setaria spp.*), sumac (*Rhus glabra*), smooth brome, lamb's quarter (*Chenopodium album*), and reed canary grass (*Phalaris arundinacea*).

Marijuana (*Cannabis sativa*), musk thistles, field bind weed (*Convolvulus arvensis*), crabgrasses (*Digitaria spp.*), sweetclover (*Melilotus spp.*), bouncing bet (*Saponaria officinalis*), field pennycress (*Thlaspi arvense*), and common mullein (*Verbascum thapsus*) were also mapped, however, no specimens were found in the area surveyed. Refer to the treated areas maps (Figures 2 and 3) to gain a better understanding of where these species were found.

During 2003, 2.885 acres of invasive plants were mapped. This is equal to 7.2% of the 40 acres surveyed. Of the 2.885 acres of invasive species only 0.264046 of an acre were exotic invasive species or 0.6% of the area sampled (Figure 4). During 2004, 1.4049 acres of invasive plants were mapped. This is equal to 1.7% of the 80 acres that were surveyed. Of the 1.4049 acres of invasive plants only 0.9 of an acre were exotic species or 1.1% of the area surveyed (Figure 5).

Of the original list of 13 plants all but two of them were found to be in the monument. Canada thistle (*Cirsium arvense*) and bull thistle (*C. vulgare*) were the only two on the original list that were not found. Canada thistle has never been found within the monument and bull thistle is unconfirmed (NPSpecies 2004). Three native but invasive plants were added to the list: tall thistles (*Cirsium altissimum*), dogwood (*Cornus sp.*), and plum. Osage orange (*Maclura pomifera*) was found to be present only in the historic hedgerow. It does not appear to be expanding into the prairie. White mulberry (*Morus alba*) and honey locust (*Gleditsia triacanthos*) were the main tree species that were removed from the prairie, however, no specimens were marked - only general locations were documented.

Along the road ditches, fence rows and trails, there was a higher occurrence of exotic species. The historic Osage orange hedgerow has undergrowth that is composed completely of smooth brome. Along State Highway 4 in the early spring it was noted that there was a large amount of field bindweed.

Discussion

This survey provides information that will be used to determine the focus of invasive plant management into the future. The methods used for this survey are simple in nature and provide very useful data. Global positioning system units make the collection of data relatively easy and resulting maps identify areas where management actions need to occur. This technique also enhances the monuments ability to keep very accurate records of where management actions occur.

Efforts were made to survey the monument for exotic species in 2003 and 2004. During both of these sampling periods an inadequate amount of time was allocated to the project. During the 2003 survey the east forty was surveyed. During the 2004 survey the east and half of the middle and north forties were surveyed. Efforts were made to cover the area faster in 2004 and not as many of the woody species were mapped.

During the survey no new exotic species were noted. Reed canary grass was however found in an upland location and in the road ditch at the Freeman School. Plans are to treat these patches in 2005.

Using the method documented by Eads (2001) is an easy and effective means to identify areas of invasive species in quantifiable terms, however, for species that have a large distribution such as smooth brome and Kentucky bluegrass (*Poa pratensis*) it is ineffective. The IKONOS image from 2001 is a very accurate picture of where the exotic cool season grasses are located. The neighboring lawns in pioneer acres allow the viewer to compare areas of known composition (Kentucky bluegrass) to areas in the monument.

Data regarding invasive species, both exotic and native, is very important to the monuments managers when reporting on GPRA (Government Performance Results Act) goals. To report to GPRA goals it is necessary to have an accurate grasp of the number of acres impacted by exotic and invasive native species. The goals are ensuring that management actions are protecting the resource for future generations of monument visitors.

During the winter of 2004-05 it is planned to use Alien Plant Ranking System software that was developed from Hiebert and Stubbendiek's Handbook for Ranking Exotic Plants for Management and Control (1993) to rank the exotic vegetation of the Monument. After this is completed it is suggested that just those plants that pose the most risk to the ecosystem are mapped.

The following plants pose the greatest risk to the integrity of the prairie.

Smooth Brome (*Bromus inermis*)

Smooth brome is pervasive throughout the monument. It is the species that poses the greatest risk to the restored tallgrass prairie. The main goal of the park's fire regimes (1993-2003) was to combat smooth brome by burning late in the spring. Mapping all of the smooth brome would be a very daunting task. The infrared IKONIS Image which was taken in April 2001 (Figure 6) is

an excellent tool for determining the areas with the highest concentration of cool season grasses. The red pigments indicate areas which are actively growing. Smooth brome is the main cool season grass present at the monument. For a reference of how the cool season grass appearance compare it to the lawns in the adjacent housing division.

Reed Canary Grass (*Phalaris arundinacea*)

Reed Canary Grass is the plant that may have the highest potential to degrade the vegetation communities at Homestead National Monument of America. Currently it is found on the streambanks of Cub Creek, southeast of ash thicket in the lowland prairie and in a small patch in the road ditch at the Freeman School.

In researching the control of reed canary grass the best option (most effective and least expensive) appears to be using glyphosphate herbicides in areas where it needs to be controlled; followed with native plant restoration. Upstream of the monument reed canary grass is abundant ensuring a constant seed source for the stream banks. Therefore, it is suggested that the reed canary grass on the stream banks is monitored to ensure that it is not expanding its range. If it is not expanding its range control is not recommended.

Musk Thistle (*Carduus nutans*)

Musk thistle is the only species within the park that is listed as a noxious species by the state of Nebraska. Control of this biennial is best achieved by manual removal, either cutting below the ground surface or pulling with the weed wrench. This species has the potential to have major impacts on the plant community if individual plants are not removed on an annual basis. Plants have been found throughout the monument but they seem to be concentrated in the road ditches and along the trails and where runoff enters from adjoining landowners.

Tall Thistle (*Cirsium altissimum*)

Tall thistle is a native thistle that is very important to many insect and bird species. It is locally abundant in many of the wetter areas of the monument living up to its other common name, roadside thistle. Control of tall thistles has occurred throughout the last ten years as documented in unpublished Prairie Management Action forms 1993-2004. The form is completed by staff and volunteer when ever management actions occur in the prairie.

Without some measure of control it is feared that the tall thistle would continue to expand its range, decreasing the plant diversity of the prairie. Therefore it is suggest that limited manual removal of the thistles continue. The weed wrench proved to be a very effective tool when pulling the thistle.

Woody species American Plum (*Prunus americana*) and Dogwood (*Cornus* spp.)

Plum and dogwood species are both very important edge species. Weaver (1954) states that “shrubs migrate up the slopes and over the hilltops and often form a shrub border a few rods to a mile or more in width between prairie and oak woodland.” With this being said it is realized by

the managers that if these woody species are given the opportunity they will shade out the tallgrass species and the monument would become wooded. Therefore, current goals for the monument state that not more than 5% of the prairie, as measured by mean relative cover, is composed of woody species. In order to achieve this goal it will be necessary to accurately map thickets on a regular basis and remove the unwanted vegetation.

The other exotic species noted in this survey for the most part are occurring on sites which were recently disturbed in relatively small numbers.

Conclusion

Homestead National Monument of America has 50 different nonnative species listed in NPSpecies. NPSpecies is the National Park Service's database to store, manage and disseminate scientific information on the biodiversity of all organisms in all National Park units throughout the United States and its territories (see Table 2). Most of these species do little or no harm to the restored tallgrass prairie. As managers of the monument it is necessary to prioritize which species have the greatest potential to degrade the site and develop actions that will help to manage those species. Smooth brome has in the past been the greatest threat to the Monument. The current fire regime of burning early in the spring seems to be effective at keeping the smooth brome in check. The species that is causing the greatest concern to current managers is reed canary grass. Currently reed canary grass is only located in three different areas; in the ditch along the Freeman School prairie, in the creek bottom near where the trail was washed out in 2001 and in the northwest corner of the middle forty.

Recommendations from the survey are:

- Develop a concise list of invasive plant species of management concern (i.e. those that pose the greatest risk).
- Use chemicals to control reed canary grass in the road ditch by the Freeman prairie.
- Work with maintenance personnel to document when chemicals are applied within the monument.
- In order to report to the GPRA goals continue surveying on an annual basis. It may be most effective and beneficial to map them only once as they are removed.

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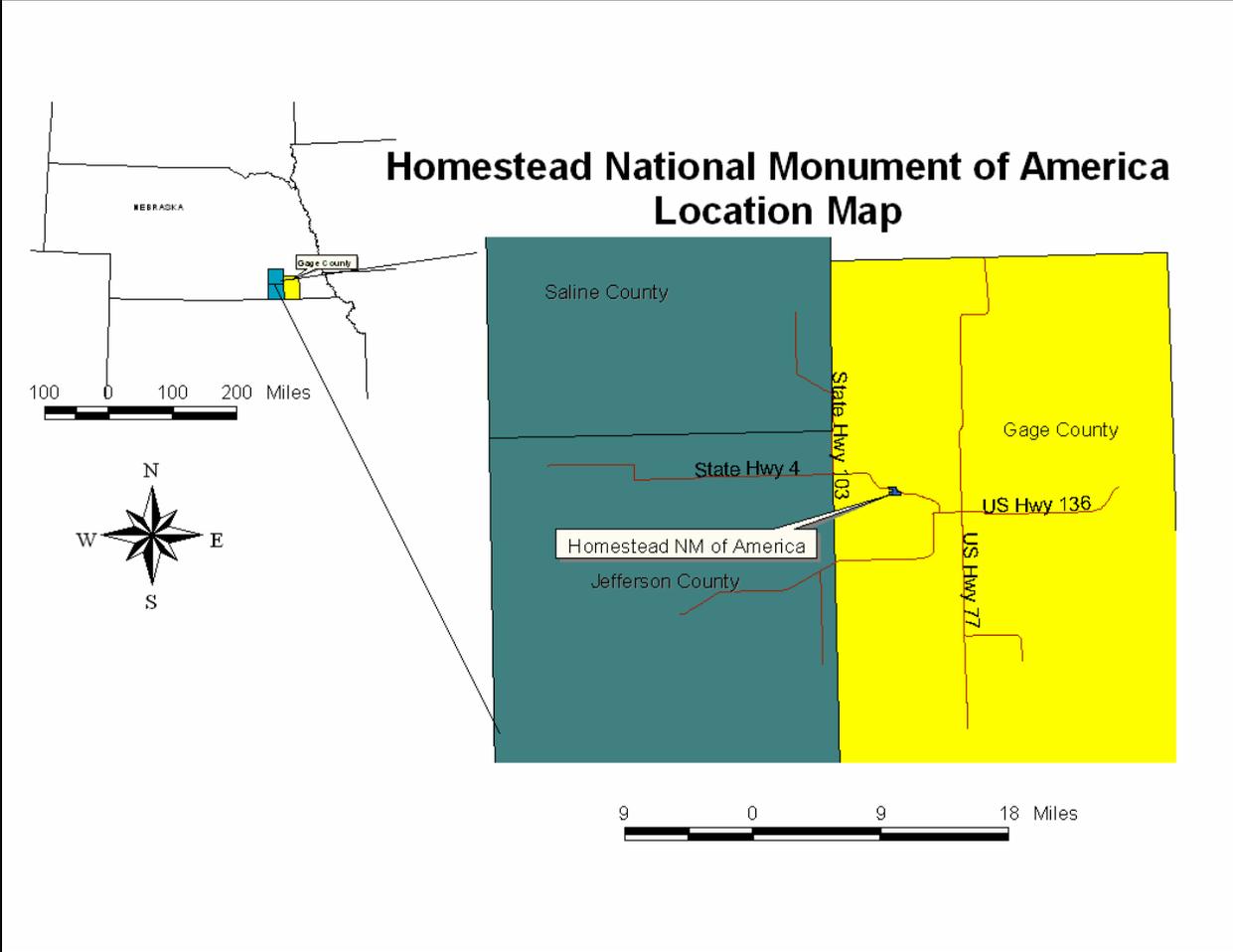


Figure 1. Location of Homestead NM of America, Gage County, Nebraska.

Homestead NM of America 2003 treated areas

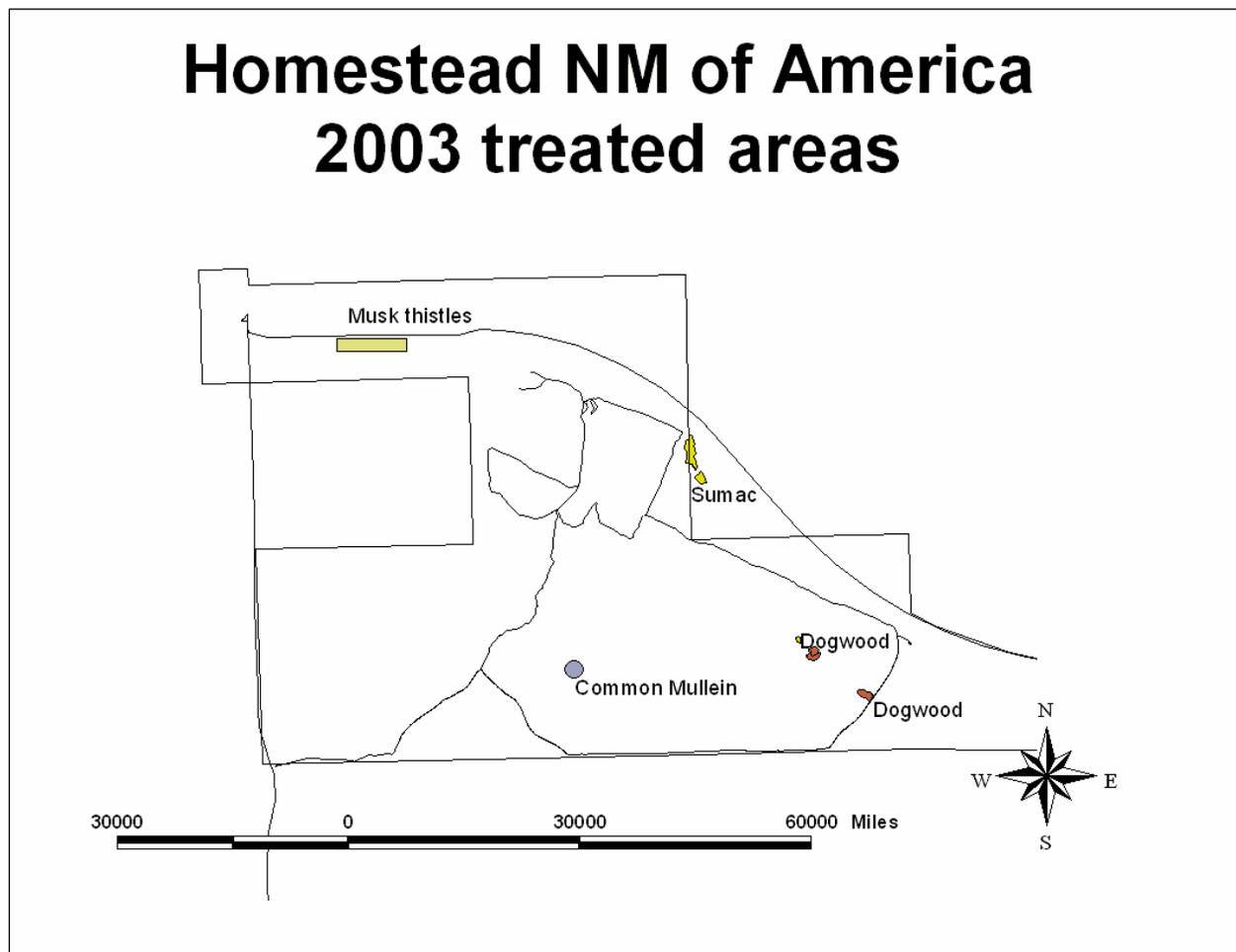


Figure 2. Treated areas in 2003 for Homestead NM of America.

Homestead NM of America 2004 treated areas

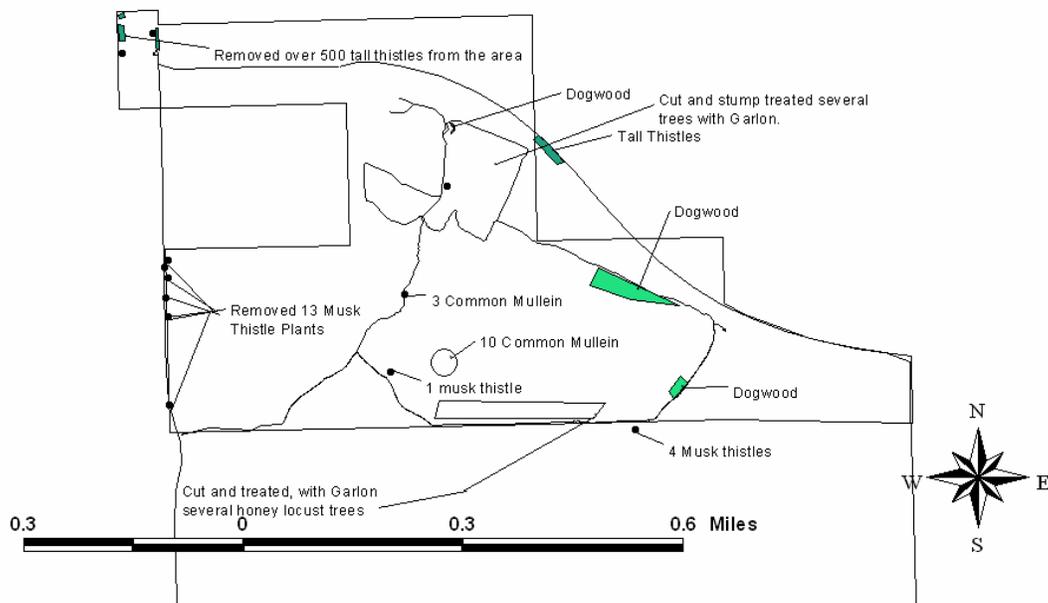


Figure 3. Treated areas in 2004 for Homestead NM of America.

Homestead NM of America Invasive Plant Survey 2003

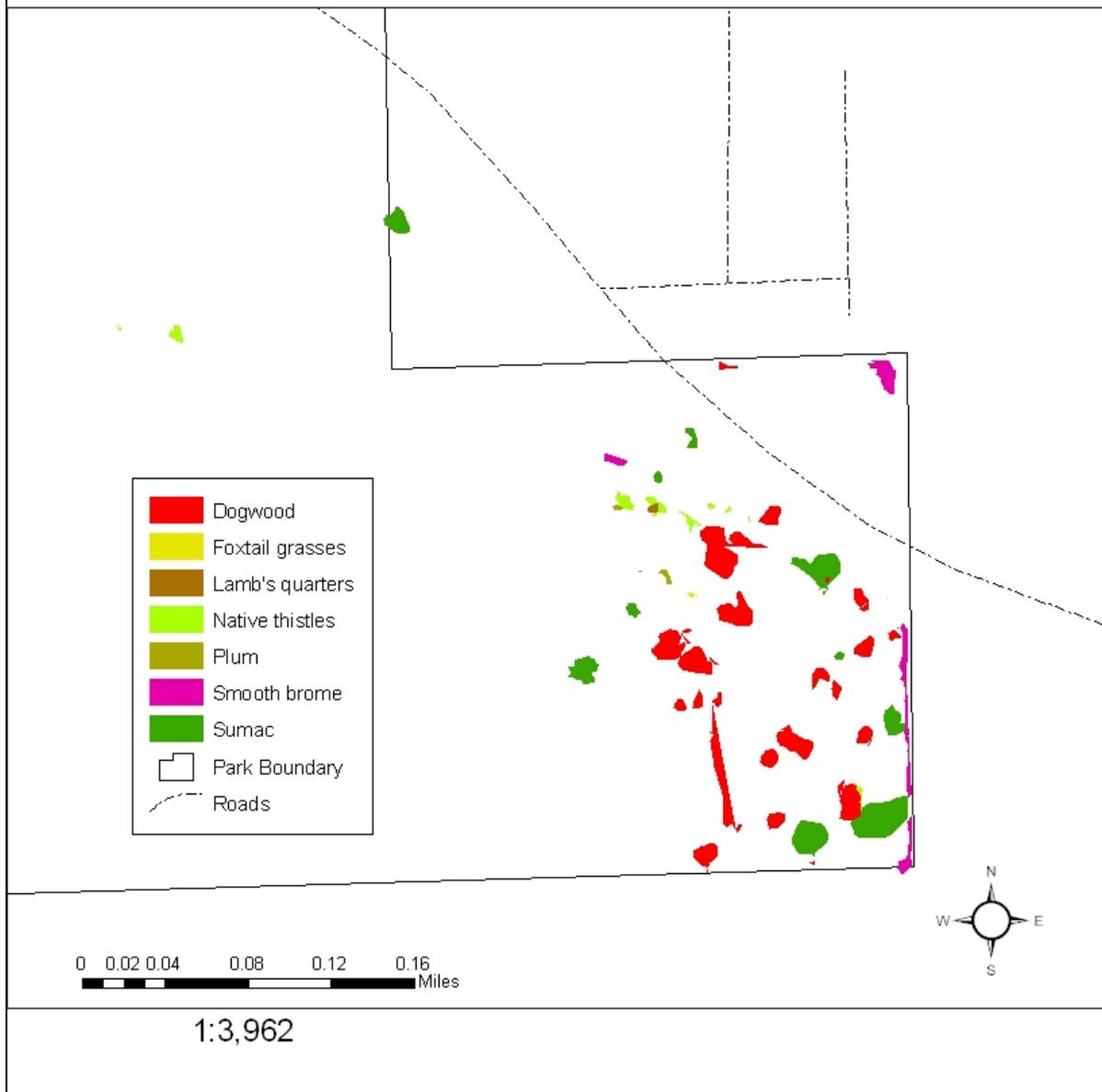


Figure 4. Areas of plant survey during 2003 for Homestead NM of America.

Homestead NM of America Invasive Plant Survey 2004

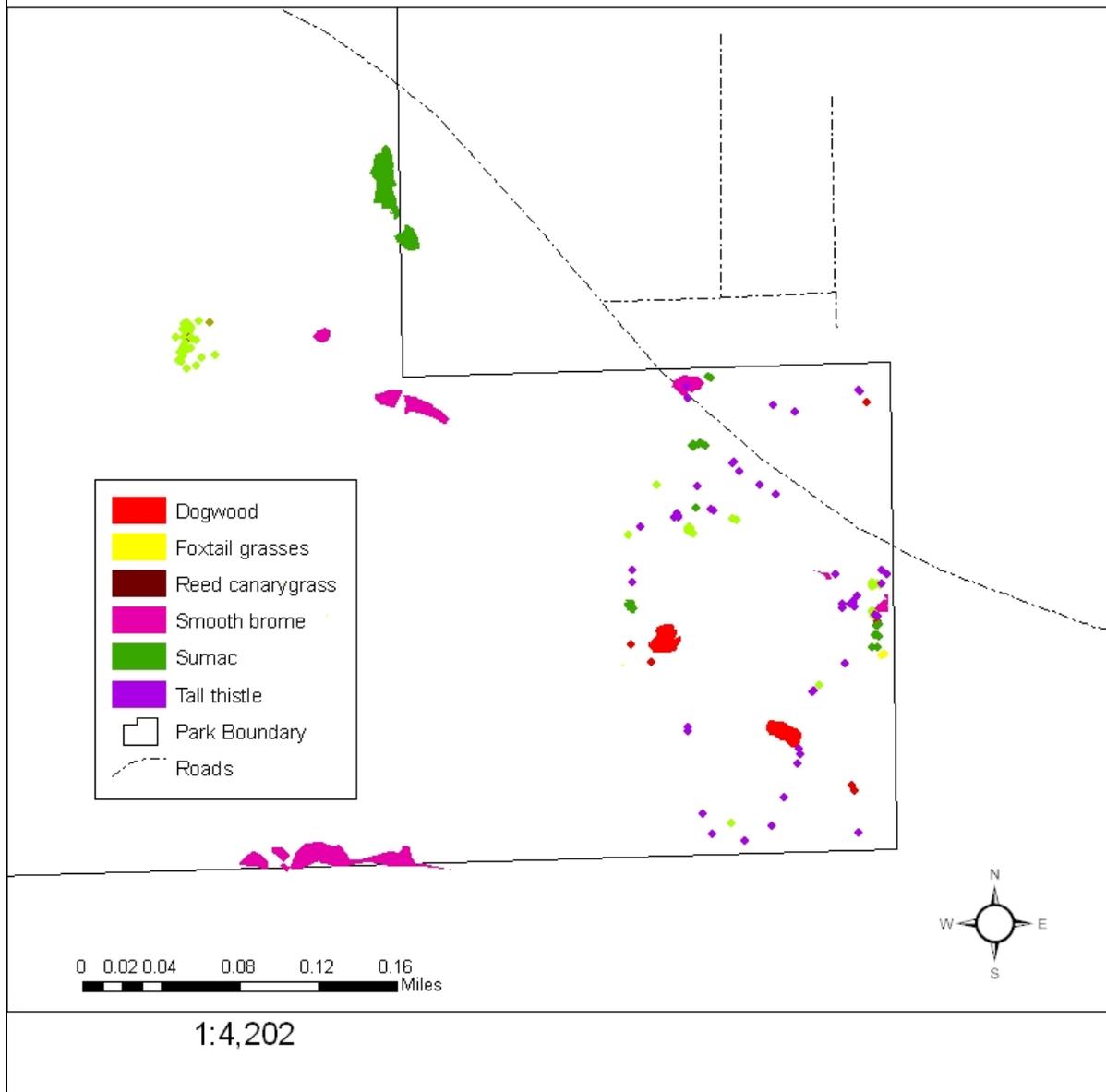
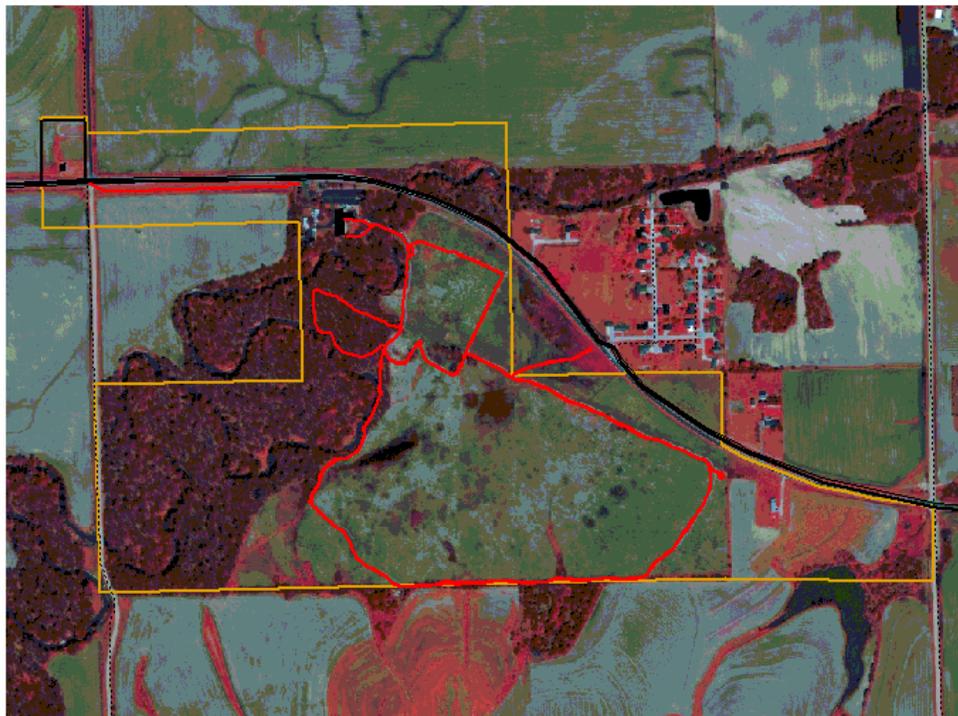


Figure 5. Areas of plant survey during 2004 for Homestead NM of America.

Homestead National Monument of America IKONOS IMAGE April 2001



0.3 0 0.3 0.6 Miles

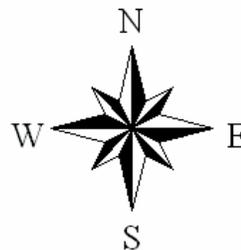


Figure 6. IKONOS image for Homestead NM of America (April 2001).

Table 1. Original list of invasive exotic plants of management concern.

Scientific Name	Common Name	Stage of Invasion	Habitat
<i>Bromus inermis</i>	Smooth brome	Retreat	Every where
<i>Cannabis sativa</i>	Marijuana	Search and Destroy	Forest
<i>Carduus spp.</i>	Thistles	Retreat	Prairie
<i>Chenopodium album</i>	Lamb's quarters	Search and Destroy	Upland prairie
<i>Cirsium arvense</i>	Canada thistle	Eternal vigilance	
<i>Cirsium vulgare</i>	Bull thistle	Search and destroy	prairie
<i>Convolvulus arvensis</i>	Field bindweed	Man in trenches	upland prairie
<i>Digitaria spp.</i>	Crabgrasses	Retreat	prairie
<i>Melilotus officinalis</i>	Yellow sweetclover	search and destroy	prairie?
<i>Maclura pomifera</i>	Osage orange		
<i>Morus alba</i>	White mulberry		
<i>Phalaris arundinacea</i>	Reed canary grass	Man in trenches	riparian zone near water
<i>Poa pratensis</i>	Kentucky bluegrass	Retreat	Prairie
<i>Rosa multiflora</i>	Multiflora rose		
<i>Saponaria officinalis</i>	Bouncing bet	search and destroy	?
<i>Setaria spp.</i>	Foxtail grasses	Retreat	disturbed areas
<i>Thlaspi arvense</i>	Field pennycress	search and destroy	?
<i>Verbascum thapsus</i>	Common mullein	search and destroy	prairie

Table 2. Non-native plant list for Homestead NM of America.

Scientific Name	Common Name	Flowering dates*	Lifespan*	Habit*	Management	
					Current	Suggested
<i>Abutilon theophrasti</i>	Velvetleaf	July-Oct	Annual	Forb	None	
<i>Amaranthus retroflexus</i>	Redroot, rough pigweed	July-Oct	Annual	Forb	None	Chemical
<i>Asparagus officinalis</i>	Asparagus		Perennial	Forb	None	
<i>Berberis thunbergii</i>	Japanese barberry	April-May	Perennial	Shrub	None	Mechanical removal or Glyphosate Chem
<i>Bromus commutatus</i>	Hairy chess	Cool Season	Winter Annual	Grass	Rx Burn is time to impact	
<i>Bromus inermis</i>	Smooth brome	Cool Season	Perennial	Grass	Rx Burn is time to impact	Rx Burn timed to tiller elongation (May)
<i>Bromus japonicus</i>	Japanese chess	Cool Season	Winter Annual	Grass	Rx Burn is time to impact	Chemical
<i>Cannabis sativa</i>	Marijuana	July-Oct	Annual	Forb	Hand pulled and removed	
<i>Capesella bursapastoris</i>	Shepherd's purse	Mar-Nov	Annual (or winter annual, rarely biennial)	Forb	None	
<i>Carduus nutans</i>	Musk-thistle	May-Aug	Biennial (Rarely annual)	Forb	Cut below ground, seed heads removed	
<i>Cichorium intybus</i>	Chickory	June-Oct	Perennial	Forb	None	
<i>Cirsium vulgare</i>	Bull thistle	July-Sep	Biennial	Forb	Hand pulled and removed	
<i>Commelina communis</i>	Asiatic dayflower	May-Oct	Perennial	Forb	None	

<i>Convolvulus arvensis</i>	Field-bindweed	June-Sep	Perennial	Forb	Chemical applied to road ditches	
<i>Echinochloa muricata</i>	Rough barnyardgrass	Warm Season	Annual	Grass	None	
<i>Eleusine indica</i>	Yard-grass	Cool Season	Winter Annual	Grass	None	
<i>Euphorbia davidii</i>	David's Spurge				None	
<i>Fagopyrum esculentum</i>	Buckwheat	June-Sep	Annual	Forb	None	
<i>Fagopyrum vulgare</i>	Buckwheat			Forb	None	
<i>Hesperis matronalis</i>	Dame's rocket	May-Aug	Biennial (Short-lived perennial)	Forb	None	
<i>Hibiscus trionum</i>	Flower of an hour	June-Sep	Annual	Forb	None	
<i>Kochia spp.</i>		July-Oct	Annual	Forb	None	
<i>Lactuca serriola</i>	Prickly lettuce	July-Sep	Annual	Forb	None	
<i>Lamium amplexicaule</i>	Henbit deadnettle	March-May	Annual (Biennial)	Forb	None	
<i>Leonurus cardiaca</i>	Common motherwort	May-Sep	Perennial	Forb	None	
<i>Maclura pomifera</i>	Osage Orange	April-June	Perennial	Tree	In Prairie cut and sprayed	
<i>Malva neglecta</i>	Common mallow, cheeses	April-Oct	Annual (or Biennial)	Forb	None	
<i>Medicago lupulina</i>	Black medic	April-Nov	Annual	Forb	None	
<i>Melilotus albus</i>	White sweet clover	May-Oct	Biennial (Rarely annual)	Forb	None	
<i>Melilotus officinalis</i>	Yellow sweetclover	May-Oct	Biennial (Rarely annual)	Forb	None	
<i>Morus alba</i>	White mulberry	Early May	Perennial	Tree	In Prairie cut and sprayed	
<i>Nepeta cataria</i>	Catnip	June-Oct	Perennial	Forb	None	
<i>Parthenocissus tricuspidata</i>	Boston-ivy	Spring	Perennial	Vine	None	

<i>Pennisetum glaucum</i>	Pearl Millet		Annual	Grass	None	
<i>Phalaris arundinacea</i>	Reed canary grass	Cool Season	Perennial	Grass	None	
<i>Poa pratensis</i>	Kentucky bluegrass	Cool Season	Perennial	Grass	Rx Burn is time to impact	Rx burn
<i>Polygonum arenastrum</i>	Dooryard knotweed	June-Oct	Annual	Forb	None	
<i>Rumex crispus</i>	Curly dock	April-July	Perennial	Forb	None	
<i>Salix X rubens</i>	Hybrid crack willow		Perennial	Tree	None	
<i>Saponaria officinalis</i>	Soapwort, bouncing Bet.	June-Sep	Perennial	Forb	None	
<i>Setaria faberi</i>	Nodding or giant foxtail-grass	Warm Season	Annual	Grass	None	
<i>Setaria viridis</i>	Green bristlegrass	Warm Season	Annual	Grass	None	
<i>Stellaria media</i>	Common Chickweed	March-Oct	Annual	Forb	None	
<i>Taraxacum officinale</i>	Common dandelion	April-Oct	Perennial	Forb	Sprayed in housing area	
<i>Thlaspi arvense</i>	Field penny-cress	April-June	Annual (or winter annual)	Forb	None	
<i>Tragopogon dubius</i>	Fistulous goat's beard	May-July	Biennial (or short-lived perennial)	Forb	None	
<i>Trifolium repens</i>	White clover	May-Oct	Perennial	Forb	None	
<i>Ulmus pumila</i>	Siberian elm	March-April	Perennial	Tree	In Prairie cut and sprayed	
<i>Verbascum thapsus</i>	Common mullein	June-July	Biennial	Forb	Cut below ground	
<i>Veronica arvensis</i>	Corn speedwell	May-June	Annual or winter annual	Forb	None	

*Downloaded from NPSpecies (<http://science.nature.nps.gov/im/apps/npspp/index.htm>) July 13, 2004. Information on flowering dates, habit, and lifespan from Stubbendieck et al. 1995. Information on suggested management taken from various NPS and Nature Conservancy websites.