



Exotic Plant Monitoring in the Southern Plains Network

Project Report 2008

Natural Resource Report NPS/SOPN/NRR—2009/099



ON THE COVER

Canada Thistle (*Cirsium arvense*)

Jan Samanek, State Phytosanitary Administration, Bugwood.org

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Exotic Plant Monitoring

Tomye Folts-Zettner

2008 PROJECT REPORT

Introduction

Globalization of commerce, transportation, human migration, and recreation in recent history has introduced invasive exotic species to new areas at an unprecedented rate. Biogeographical barriers that once restricted the location and expansion of species have been circumvented, culminating in the homogenization of the Earth's biota. Although only 10% of introduced species become established and only 1% become problematic (Williamson 1993, Williamson and Fitter 1996) or invasive, nonnative species have profound impacts worldwide on the environment, economies, and human health.

Invasive species have been directly linked to the replacement of dominant native species (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure, alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), reduced agricultural productivity, and changes in water availability (D'Antonio and Mahall 1991). Often the damage caused by these species to natural resources is irreparable and our understanding of the consequences incomplete. Invasive species are second only to habitat destruction as a threat to wildland biodiversity (Wilcove et al. 1998). Consequently, the dynamic relationships among plants, animals, soil, and water established over many thousands of years are at risk of being destroyed in a relatively brief period.

For the National Park Service (NPS), the consequences of these invasions present a significant challenge to the management of the agency's natural resources "unimpaired for the enjoyment of future generations." National Parks, like other land management organizations, are deluged by new exotic species arriving through predictable (e.g., road, trail, and riparian corridors), sudden (e.g., long-distance dispersal through cargo containers and air freight), and unexpected anthropogenic pathways (e.g., weed seeds in restoration planting mixes). Nonnative plants claim an estimated 4,600 acres of public lands each year in the United States (Asher and Harmon 1995), significantly altering local flora. For example, exotic plants comprise an estimated 43% and 36% of the flora of the states of Hawaii and New York, respectively (Rejmanek and Randall 1994). Invasive plants infest an estimated 2.6 million acres of the 83 million acres managed by the NPS.



PHOTO CREDIT: JAN SAMANEK

Field Bindweed (*Convolvulus arvensis*), listed as a noxious weed in Colorado, Kansas, New Mexico, and Texas.

More NPS lands are infested daily despite diligent efforts to curtail the problem. Impacts from invasive species have been realized in most parks, resulting in an expressed need to control existing infestations and restore affected ecosystems. Additionally, there is a growing urgency to be proactive—to protect resources not yet impacted by current and future invasive species (Marler 1998). Invasive exotic species most certainly will continue to be a management priority for the National Parks well into the 21st Century. Invasive exotic plants have been consistently ranked as a top vital sign for long term monitoring as part of the NPS Inventory & Monitoring (I&M) Program. During the vital signs selection process in 2004-05, Southern Plains Network (SOPN) parks recognized the need for exotic plant monitoring (Perkins et al. 2006). All eleven parks (ALFL, BEOL, CAVO, CHIC, FOLS, FOUN, LAMR, LYJO, PECO, SAND and WABA) identified invasive exotic plants as among their most important management issues. During final selection of vital signs in 2006, invasive exotic plant monitoring was recognized across all network parks as the most important shared monitoring need.

Prevention and early detection are the principal strategies for successful invasive exotic plant management. While there is a need for long-term suppression programs to address very high-impact species, eradication efforts are most successful for infestations less than one hectare in size (Rejmanek and Pitcairn 2002). Eradication of infestations larger than 100 hectares is



Kochia (*Kochia scoparia*)

largely unsuccessful, costly, and unsustainable (Rejmanek and Pitcairn 2002). Costs, or impacts, to ecosystem components and processes resulting from invasion also increase dramatically over time, making ecosystem restoration improbable in the later stages of invasion. Further, in their detailed review of the nonnative species problem in the United States, the US Congress, Office of Technology Assessment (1993) stated that the environmental and economic benefits of supporting prevention and early detection initiatives significantly outweigh any incurred costs, with the median benefit-to-cost ratio being 17:1 in favor of being proactive. Although preventing the introduction of invasive exotic plants is the most successful and preferred strategy for resource managers, the realities of globalization, tight fiscal constraints, and limited staff time guarantee that invaders will get through park borders. Fortunately, invasive exotic plants quite often undergo a lag period between introduction and subsequent colonization of new areas. Managers, then, can take advantage of early detection monitoring to make certain invasive exotic species are found and successfully eradicated before populations become well established.

This strategy requires resource managers to: (1) detect invasive exotic species early (i.e., find a new species or an incipient population of an existing species while the infestation is small (less than 1 hectare), and (2) respond rapidly (i.e., implement appropriate management techniques to eliminate the

invasive plant and all of its associated regenerative material). As a compliment to this strategy, the SOPN has incorporated the following objectives into its monitoring plan for Exotic Plants: (1) to detect the initial occurrence for any of a subset of high priority species in areas of high and low invasion probability, (2) to determine changes in the status and trend (density, abundance or extent) of a subset of high priority species in areas of high and low invasion probability, and (3) to determine changes in species composition of a subset of high priority species in areas of high and low invasion probability, taking into account any management treatments that occurred between sampling intervals.

Methods

2008 was a pilot season for exotic plant monitoring to test the methods and results of the proposed protocol. Sampling was carried out at CAVO, CHIC, FOLS, FOUN and LAMR from June-September, in conjunction with the grassland monitoring pilot study. Due to time and budget constraints, two days of exotic monitoring was conducted at each park. Both paved and unpaved roads (vectors) were sampled at CHIC, FOUN and LAMR. Paved roads only were sampled at CAVO and FOLS due to the lack of unpaved vectors. At LAMR, an additional sample was conducted in the area between gas wells, as this will be a major issue for that park.

During the course of the pilot, it became apparent that the original methodology used, while resulting in highly detailed data, was not as productive in amount of area monitored as we had hoped. This methodology was altered at the final park sampled, FOUN, and proved to be much more efficient in amount of area sampled. One day's sampling effort using the old methodology resulted in 300 meters of vector sampled (150 meters on each side of the vector), while the new methodology resulted in 1000 meters sampled (500 meters per vector side) in a partial day of sampling. While a degree of detail is lost under the new method, we gain the benefit of amount of area sampled, concentrating on the area of highest probability of introduction.

Old Methodology (Based on Distance Sampling)

The abandoned methodology (implemented at CAVO, CHIC, FOLS and LAMR) was based on Distance Sampling, which was intended to estimate density, while accounting for differences in detection. For this approach, a 50 meter transect was laid perpendicular to the vector, on both sides of the vector, every 50 meters along the vector. The transect, running from the center of the vector out into the landscape, was then walked to determine every detectable occurrence of an exotic plant. In order to account for detection, the distance from the transect to the observed species (up to 25 meters either above

or below the transect) was recorded for each encounter. This approach provides estimates of actual density as well as a detailed “map” of exotics within the area sampled, but was excessively time-consuming in both layout and data-gathering, allowing for only a small area along the vector to be sampled in a work day. Based on this inefficiency, we decided that, while estimating actual density would certainly be a reliable means of evaluating change over time, the trade-off was too high given the amount of area we would realistically be able to afford to sample each year. Thus, we decided to try an alternative approach based on generalized linear modeling.

New Methodology (Based on Generalized Linear Modeling)

Using the new methodology, 50 meter sections (blocks) of both sides (right [R] and left [L]) of the vector were again sampled (Fig 1.). The transect ran parallel to the vector but set into the roadside along the interior edge of the mow strip.

Distance classes from the vector were set as follows:

D1 = distance between the roadside and the transect (mowed area) (approx 2 m)

D2 = from the transect to 12 meters

D3 = 12 – 22 meters into the landscape

D4 = 22 – 32 meters into the landscape

D5 = over 32 meters into the landscape

Within each 50 meter length, the occurrence of an exotic species was noted only once, but its detectable presence in each distance class (D#) and its density (distribution within a given block) was collected. This allowed for a more rapid assessment, thus more distance along the vector and greater sampling area was achieved. While a detailed location of a population is lacking, the presence of any given exotic within a 50 meter sample block, in conjunction with the distance class,

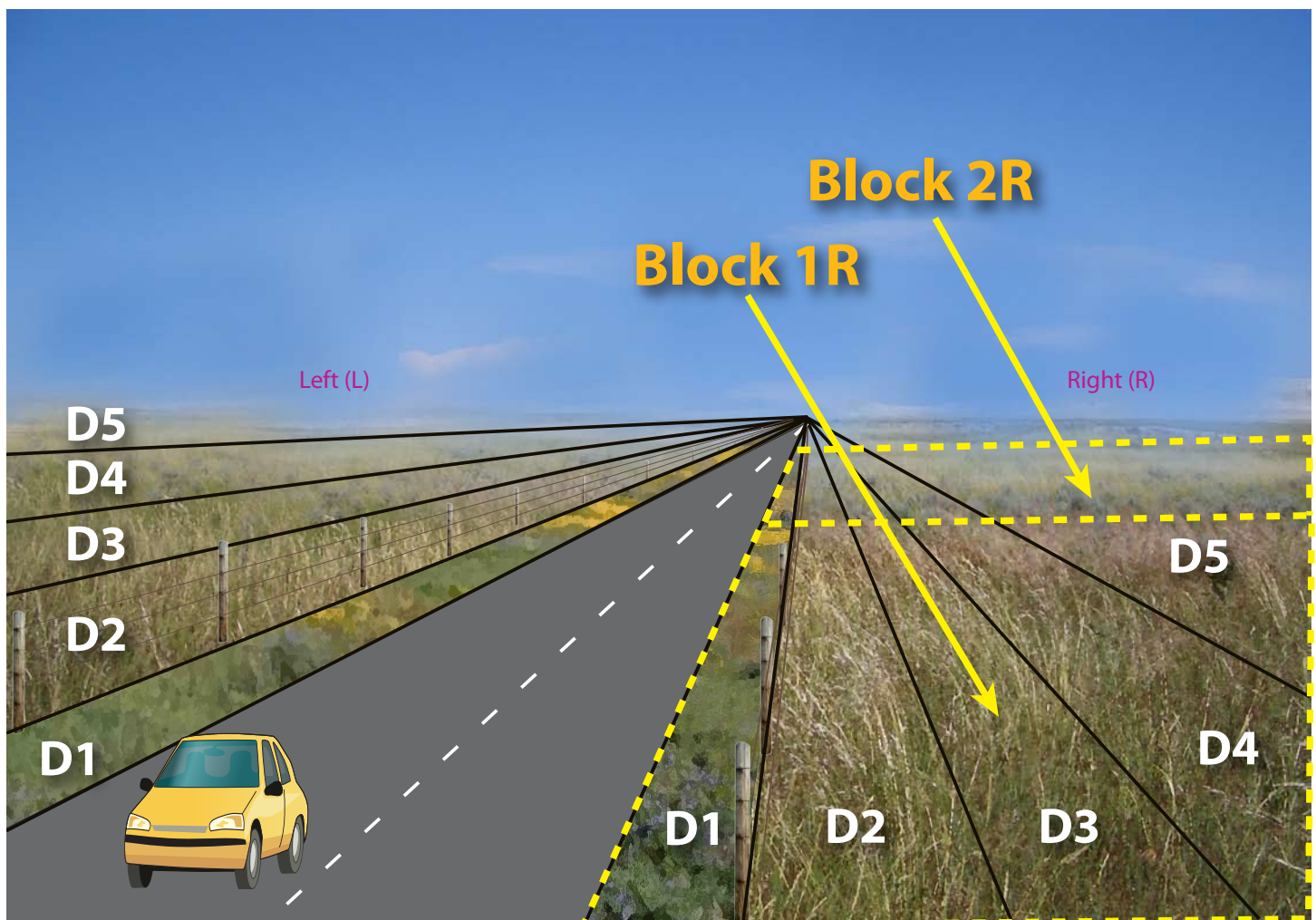


Figure 1. Fifty meter blocks are sampled on each side of a vector (e.g., roads and trails) in each of 5 distance classes from the vector.



Common Mullein (*Verbascum thapsus*)

can be reasonably relocated by management teams. Additionally, the presence of a major species of concern can trigger a more thorough search of the area for additional occurrences.

The density classes used to describe exotic species populations remained the same in both methodologies. A population is distributed within a block in one of four ways: less than five plants, scattered throughout the block in a patchy or clumped manner, scattered throughout in an even distribution, or forming a matrix. This distribution equates to an initial introduction, establishment, spread and complete invasion of the habitat. This will also allow for the future monitoring of gross changes to exotic populations.

Detection of some exotic species, particularly low-growing and rosette-stage species, decreases with distance, while other large-mass or tall growing species can easily be seen at great distance. This limitation should always be taken into consideration when management actions are planned. The presence of a species of concern in any given area should trigger a more thorough search prior to eradication efforts. At times, topographic features such as rises and depressions will screen the visual field. These disruptions are noted in each sample block in the appropriate distance class as “no data available” to distinguish from areas where no plants were detected.

Results & Discussion

The SOPN objectives found in the introduction mentions that all parks will be stratified into high and low probability areas for sampling, roughly corresponding to roads, trails, streams and boundaries (high probability) and interior areas (low probability). Exotic species present in the low probability areas will be measured in conjunction with grassland monitoring. It should be stressed that the scope of this report encompasses only the results from high probability areas sampled in 2008.

A crosswalk between data was achieved by converting data collected using the old methodology into 50 x 25 meter sampling blocks, with the presence and distribution of an exotic extrapolated from the detailed data. For the purpose of analysis, the distance classes between the methods were not comparable for the 2008 pilot season, but it is anticipated that in future years this data will be included in order to determine the spread potential of any exotic species. For the purpose of park management efforts, however, specific location information is available for the 2008 season.

Specific exotic species will differ among the parks as environmental conditions change along the north-south and east-west gradients. While Johnsongrass (*Sorghum halepense*) is a major problem at CHIC (eastern-most park) it becomes non-existent in the far western reach of the SOPN. Each state produces a Noxious Weed List but a particular species will not be considered noxious in every state in which it is found. Therefore, a noxious designation should be used as only part of the consideration of a species's threat. Of greater importance is the displacement of native species through the rate of spread and extent of an exotic. Both prickly Russian thistle (*Salsola tragus*) and mullein (*Verbascum thapsus*) are listed as noxious weeds only in Colorado, but they are major invasive components at CAVO, FOUN and LAMR, requiring management consideration.

Each park within the SOPN has its problematic exotic plants, with field bindweed (*Convolvulus arvensis*), Johnsongrass (*Sorghum halepense*), K.R. bluestem (*Bothriochloa ischaemum*), green bristlegrass (*Setaria viridis*) and prickly Russian thistle (*Salsola tragus*) found in several parks. Both the greatest variety of exotics and the most established populations occur most frequently within and adjacent to the mowstrips along paved vectors.

Introduction, distribution and spread of exotics will continue to be monitored in the parks, with a rapid communication of results developed to inform both parks and the appropriate Exotic Plant Management Teams. In return It will be important for the SOPN to receive information of management activities regarding specific exotic species to inform future monitoring results.

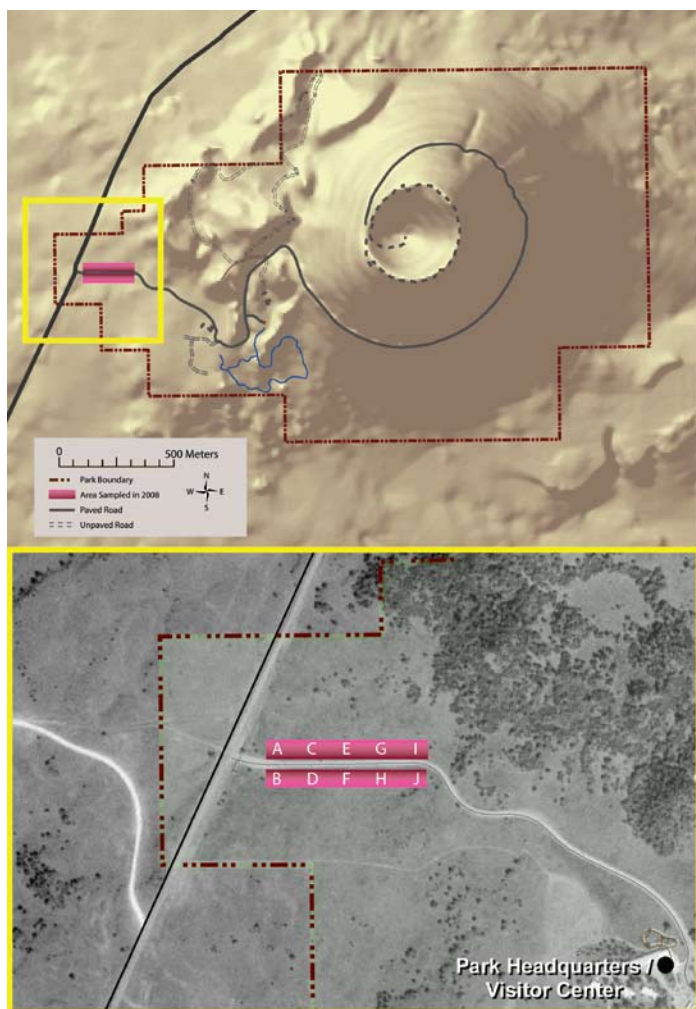


Figure 2. Area Sampled at Capulin Volcano National Monument for exotic plants during 2008.

Full monitoring for exotics is expected to take place during the 2009 field season at all parks in the SOPN. Results of the 2008 field season of the Exotic Plant Monitoring pilot study for each park sampled follows.

Capulin Volcano N.M. (CAVO)

Exotic sampling occurred along the entrance road (paved vector), starting at the entrance gate and running 175 meters into the park (Fig. 2). The general lack of unpaved roads precluded sampling of this vector type. Future efforts are expected to include hiking trails, but there were no vectors of this type sampled in 2008. Three weeks prior to our visit, CAVO experienced a dramatic and damaging hail storm that knocked down and/or shredded much of their vegetation. Due to the resilience and often low growth form of most exotic plants their detection was not deemed problematic.

Twelve vector blocks were sampled using the older perpendicular transect method. Mullein (*Verbascum thapsus*) was encountered in all but one block and continues to displace native plants while moving over 50 meters into the landscape (Table 1). Yellow sweetclover (*Melilotus officinalis*) was found in scattered patches primarily 10 meters into the landscape, but was demonstrating establishment up to 40 meters into the landscape in Vector Blocks B, G and E. Climbing buckwheat (*Polygonum convolvulus*) appears to be filling the field bindweed (not present) niche and has successfully moved deep into the landscape in scattered patches, with a presence in 10 of the 12 blocks sampled. Green bristlegrass (*Setaria viridis*), while also present in all but two blocks, was generally confined to the first 10 meters from the vector, possibly benefitting from man-

Table 1. The number and percentage of 50m-blocks sampled (N=12) along roads that exotic plant species were observed at Capulin Volcano National Monument. Also shown is whether a given species is listed by individual states or federally as a noxious weed.

Scientific Name	Common Name	No. Blocks*	% Blocks	Noxious
<i>Verbascum thapsus</i>	Mullein	11	92%	CO
<i>Melilotus officinalis</i>	Yellow sweetclover	10	83%	
<i>Polygonum convolvulus</i>	Climbing buckwheat	10	83%	CO,KS,NM,TX
<i>Setaria viridis</i>	Green bristlegrass	10	83%	
<i>Sonchus asper</i>	Spiny sowthistle	8	67%	CO
<i>Chenopodium album</i>	Lambsquarters	4	33%	
<i>Rumex spp</i>	Dock	4	33%	
<i>Melilotus alba</i>	White sweetclover	3	25%	
<i>Bromus spp</i>	Brome grass	2	17%	CO
<i>Euphorbia dentata</i>	Toothed spurge	2	17%	
<i>Tragopogon spp</i>	Salsify	2	17%	
<i>Marrubium vulgare</i>	Horehound	1	8%	CO

* The specific blocks where a given species was observed can be found in Appendix 1.



Climbing buckwheat (*Polygonum convolvulus*)

cern. Lambsquarters (*Chenopodium*, thought to be *album*), while present as less than five plants when encountered, was spread throughout and deep into the landscape.

White sweetclover (*Melilotus alba*) was found only in Blocks A and C, closest to the park entrance but scattered throughout and deep into the landscape. It should be noted that one small population of this exotic was found in Block B, but located 10-15 meters away from the vector. A patch of horehound (*Marrubium vulgare*), a species known to be highly invasive in climates similar to CAVO, was found deep into the landscape of Block K. Efforts to limit any further establishment of these two exotics would be prudent.

Spiny sowthistle (*Sonchus asper*), dock (*Rumex spp*), brome (*Bromus spp*), and salsify (*Tragopogon spp*) were detected primarily in the area closest to the roadside and likely benefit from management activities (mowing) and frequent disturbance. This is especially true of the brome, which while only located in one patch comprising parts of Blocks A and C, was present as a matrix within the first 10 meters from the vector. The species of brome present is unknown, as it was not in active growth, but this determination should be made during active growth to avoid the spread of an undesirable population. One small patch of relatively benign toothed spurge (*Euphorbia dentata*) was observed and should be monitored for spread.

Chickasaw N.R.A. (CHIC)

Exotic sampling occurred along the Veteran Lake access (paved vector), starting at the junction of the dam road and the access road and running 175 meters along the north side of the lake (Fig. 3). A total of twelve blocks were sampled along this vector. Blocks A, C, E, G, I, and K, along the right side of the vector were truncated in depth due to close proximity of the lake. Vector Blocks B, D, F, H, J, and L on the left side include a second paved road running from Rock Creek campground to an eastern entrance to the park. The area between these two roads had been treated with a prescribed burn at least two years prior to sampling.

agement activities (mowing). However, in Block H, patches of this exotic had moved approximately 20 meters into the landscape, which may be a cause of concern.

The unpaved vector chosen for sampling was located in the Guy Sandy unit, west of Guy Sandy Creek. The main access road was sampled from the junction of the main road with the eastern branch-off to Guy Sandy Creek, running 175 meters back up the main road to the North. This area had been treated with a prescribed burn at least six months prior to sampling, and had been burned at least twice in the past. A total of twelve blocks were sampled on this vector.

Johnsongrass (*Sorghum halepense*) was observed in all but one block and continues to be a major exotic invasive in the park (Table 2). Johnsongrass was found in scattered patches both along roadsides and deep into the landscape on both vectors sampled. The unpaved vector supported several populations exhibiting an even distribution both along the roadside and in the landscape, with two areas on the roadside that had become a matrix. The paved vector had a limited number of even distributions of Johnsongrass along the roadside, but none that had reached a matrix proportion. It is unknown how Johnsongrass in both areas is responding to prescribed fire.

Bermuda grass (*Cynodon dactylon*) was detected in only one block along the roadside on the unpaved vector, but had an

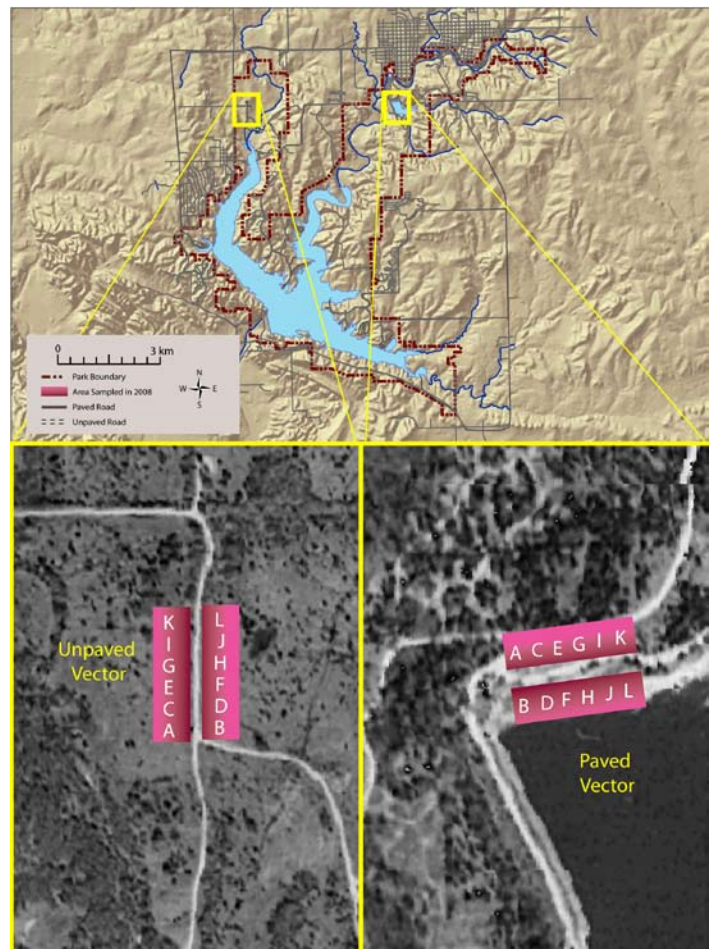


Figure 3. Area Sampled at Chickasaw National Recreation Area for exotic plants during 2008.

Table 2. The number and percentage of 50m-blocks sampled (N=24) along roads that exotic plant species were observed at Chickasaw National Recreation Area. Also shown is whether a given species is listed by individual states or federally as a noxious weed.

Scientific Name	Common Name	No. Blocks*	% Blocks	Noxious
<i>Sorghum halepense</i>	Johnsongrass	23	96%	CO,KS
<i>Cynodon dactylon</i>	Bermuda grass	13	54%	**
<i>Toxicodendron radicans</i>	Poison ivy	12	50%	
<i>Bothriochloa ischaemum</i>	K.R. bluestem	9	38%	**
<i>Paspalum dilatatum</i>	Dallasgrass	5	21%	
<i>Echinochloa crus-galli</i>	Barnyard grass	1	4%	
<i>Lespedeza cuneata</i>	Sericea lespedeza	1	4%	CO,KS
<i>Lonicera japonica</i>	Japanese honeysuckle	1	4%	**
<i>Phragmites australis</i>	Common reed	1	4%	

* The specific blocks where a given species was observed can be found in Appendix 2.

** indicates species not listed as noxious but of invasive concern to the SOPN.

even distribution where found. The remainder of this exotic was found in the mowstrips along the paved vector, forming a matrix. This type of distribution for Bermuda grass is directly linked to management activity (mowing). This exotic has not spread into the landscape but should be monitored to ensure that this does not occur. Treatment of the single block (J) along the unpaved vector should be considered to prevent further establishment in this area.

K.R. bluestem (*Bothriochloa ischaemum*) is an exotic of major concern. Once established, it will rapidly form a sod matrix displacing native grasses and is quite difficult to eradicate. It responds very favorably to mowing. Only Block A along the paved vector contained this exotic in small clumps along the roadside. It is highly advised that immediate eradication efforts take place in this area to discourage further establishment. The unpaved vector has well established colonies of K.R. bluestem along the roadside with primarily an even

to matrix-forming distribution, but no evidence of this grass moving into the landscape. Future monitoring efforts should watch carefully for further spread of this exotic.

A colony of common reed grass (*Phragmites australis*) has been established in Block G of the unpaved vector and has formed a 20m² patch approximately 20 meters into the landscape. There are both native and non-native populations of this plant, with identification only possible through genetic analysis. Changes in this population should be monitored before control efforts are undertaken. One clump of Japanese honeysuckle (*Lonicera japonica*) was found along the paved vector in Block E. Eradication of this small population should be undertaken to prevent further establishment. Dallisgrass (*Paspalum dilatatum*) is found only along the mowstrips of the paved vector and responds favorably to mowing. It does not normally spread into the landscape. A suspected introduction of barnyard grass (*Echinochloa crus-galli*) was observed in Block G along the unpaved vector roadside and should be monitored for persistence. A suspected introduction of Sericea lespedeza (*Lespedeza cuneata*) was observed on the unpaved vector in Block D approximately 30 meters into the landscape and also requires monitoring for persistence. It is questionable if poison ivy (*Toxicodendron radicans*) should be considered an exotic, although its invasiveness is confirmed. It is found in scattered patches in areas that receive at least partial shade within the landscape, but does not persist in areas that are mowed.

Lake Meredith N.R.A. (LAMR)

Exotic sampling took place in three vector types at LAMR in July 2008 (Fig. 4). The paved vector (12 blocks sampled) chosen was on the north side of Lake Meredith in the Blue West sector near the boat ramp. The sampling began at the



Johnsongrass (*Sorghum halepense*)

junction of the Blue West main road and the road to the parking area above the boat ramp, and ran 175 meters up the main road away from the ramp. The unpaved vector (10 blocks sampled) was on the uplands of the south side of the lake in the Sanford-Yake area in an active gas well region receiving fairly constant disturbance. This vector began below the water tower and ran 175 meters east toward the dam. A third vector (2 blocks sampled) was chosen in a bottomland work zone between two active gas wells north of the lake and west of Mullinaw Crossing.

Prickly Russian thistle (*Salsola tragus*) is a major exotic problem at LAMR exacerbated by widespread disturbance and spread from natural gas development activities throughout the park (Table 3). It forms primarily an even to matrix distribution from the roadside throughout the landscape on both the paved and bottomland gas well vectors, and a scattered patchy to even distribution on the unpaved vector from the roadside throughout the landscape.

Field bindweed (*Convolvulus arvensis*) is considered a noxious weed in Texas. It was found in small quantities along the mowed roadside of Blocks A and B on the paved vector. Eradication efforts should be rapidly implemented to contain any future establishment in this or other areas. Of particular concern is the easy spread of this exotic due to management activities (mowing) by dispersal of bits of vegetation and seed on mower blades and tires. It is recommended that mowing of this plant be avoided when possible and that mowing equipment be cleaned prior to relocation into bindweed-free areas.

Green bristlegrass (*Setaria viridis*) is present on the gas well vector in only one small clump, possibly limited by ponding of runoff. Its control is achievable at this site. On the paved vector, it is also limited to two populations: Block C contains a 10m² evenly distributed population 10 meters into the landscape, while Block I has a small clump 40 meters into the landscape. The unpaved vector contains the greatest amount



Figure 4. Area Sampled at Lake Meredith National Recreation Area for exotic plants during 2008.

of bristlegrass, with a scattered patchy to even distribution from the roadside throughout the landscape.

K.R. bluestem (*Bothriochloa ischaemum*) poses a major exotic threat to LAMR because it responds favorably to management activities (mowing) and is difficult to control. Fortunately, K.R. bluestem was found only on the mowed roadsides of the paved vector but is spreading from a patchy distribution to

Table 3. The number and percentage of 50m-blocks sampled (N=24) along roads that exotic plant species were observed at Lake Meredith National Recreation Area. Also shown is whether a given species is listed by individual states or federally as a noxious weed.

Scientific Name	Common Name	No. Blocks*	% Blocks	Noxious
<i>Salsola tragus</i>	Prickly Russian thistle	24	100%	CO
<i>Setaria viridis</i>	Green bristlegrass	13	54%	CO
<i>Kochia scoparia</i>	Kochia	12	50%	CO
<i>Cirsium spp</i>	Thistle	10	42%	
<i>Bothriochloa ischaemum</i>	K.R. bluestem	6	25%	**
<i>Eragrostis cilianensis</i>	Stinkgrass	3	13%	
<i>Convolvulus arvensis</i>	Bindweed	2	8%	CO,KS,NM,TX

* The specific blocks where a given species was observed can be found in Appendix 3.

** indicates species not listed as noxious but of invasive concern to the SOPN.



Prickly Russian thistle [tumbleweed] (*Salsola tragus*)

more even stands. Future exotic monitoring should be diligent in its detection and rapid eradication should be implemented whenever K.R. is found, particularly within the landscape.

Kochia (*Kochia scoparia*) was not detected along the paved vector, but was another dominant component of the vegetation found at both the gas well and unpaved vectors, exhibiting primarily a scattered patchy distribution from the roadside deep into the landscape.

Species of thistle (*Cirsium spp*) were found on all vectors. Native vs. non-native identification was not possible during the sampling period due to lack of bloom and aids to field identification. Few if any of the thistles observed are thought to be non-native, but this will be verified during the 2009 field season. On the paved vector, a patchy distribution was seen along the mowed roadside, but Block D exhibited an expansion of a few thistles up to 30 meters into the landscape. Thistles in the unpaved vector were primarily found 35-50 meters into the landscape, in scattered patches and as individuals. No thistles were observed on the gas well vector. Stinkgrass (*Eragrostis cilianensis*) was only present in scattered patches along the mowed roadside of the paved vector in Blocks E, G and K.

Fort Larned N.H.S. (FOLS)

The pilot study for exotics took place during July 2008 at FOLS. Only a paved vector was examined due to the limitation of unpaved roads in the park, starting at the junction of Hwy 156 and County Road 242, and proceeding south on the County Road for 175 meters. This paved vector also serves as a park boundary, resulting in only one side (6 blocks) of the vector being examined. Vegetation within this section of landscape represents agricultural pasture undergoing up to 35 years of restoration effort.

Field bindweed (*Convolvulus arvensis*) is listed as a Noxious Weed in Kansas. Scattered patches of this exotic were found in Blocks E and F, 15-45 meters into the landscape. Eradication options should be explored to contain this population.

Smooth brome (*Bromus inermis*), a residual of past agricultural activities, forms the matrix for this restored prairie. It appears that native bunchgrasses are beginning to overtake this exotic, but additional control efforts should be explored.

Yellow sweetclover (*Melilotus officinalis*) is present in two-thirds of the blocks surveyed. It is found in Blocks A and B in scattered patches along the mowed roadside and again in patches 20-45 meters into the landscape. Blocks E and F contain a limited patch at 40 meters into the field and this population should be considered for rapid eradication.

Green bristlegrass (*Setaria viridis*), while present in 50% of the blocks sampled, is found only in the mowstrip in scattered patches. Prickly lettuce (*Lactuca serriola*) is also limited to



Figure 5. Area Sampled at Fort Larned National Historic Site for exotic plants during 2008.

Table 4. The number and percentage of 50m-blocks sampled (N=6) along roads that exotic plant species were observed at Fort Larned National Historic Site. Also shown is whether a given species is listed by individual states or federally as a noxious weed.

Scientific Name	Common Name	No. Blocks*	% Blocks	Noxious
<i>Bromus inermis</i>	Smooth brome	6	100%	**
<i>Melilotus officinalis</i>	Yellow sweetclover	4	67%	**
<i>Setaria viridis</i>	Green bristlegrass	3	50%	CO
<i>Convolvulus arvensis</i>	Bindweed	2	33%	CO,KS,NM,TX
<i>Lactuca serriola</i>	Prickly lettuce	2	33%	

* The specific blocks where a given species was observed can be found in Appendix 4.
 ** indicates species not listed as noxious but of invasive concern to the SOPN.

the mowstrip in Blocks E and F in very limited numbers. Both of these exotics are good candidates for eradication due to their limited numbers, but this activity may be constrained by county maintenance.

Fort Union N.M. (FOUN)

New methodology was used in exotic sampling at FOUN in early September 2008, resulting in a record 40 Vector Blocks being examined. Both paved and unpaved vectors were sampled. The paved vector started at the entrance gate to the park and ran for 500 meters toward the Visitor Center on both sides of the vector (1000 m total), for a total of 20 blocks. The unpaved vector began at the rear (north side) of the maintenance yard and ran for 500 meters toward the Visitor Center on both sides of the vector (1000 m total), for a total of 20 blocks. Initially, this vector hugged the fence boundary of Fort Union Ranch, enabling documentation of the spread of exotics from the park side into the private ranchland.

Field bindweed (*Convolvulus arvensis*) is listed as a Noxious Weed in New Mexico and has spread widely at FOUN, primarily through management activities (mowing). Efforts at control are underway at the park and should be expanded. Extreme care should be taken to limit the spread of this exotic by contaminated equipment. Along the paved vector, bindweed was primarily limited to the 2m mowstrip, frequently moving into the 2-12 meter Distance Class (D2). Distribution of bindweed in the mowstrip (D1) and D2 was patchy near the entrance gate, but became more evenly spread as one moved toward the Visitor Center. Bindweed was observed over 12 meters (D3) into the landscape on the left (Visitor Center) side of the vector in Blocks E and H. Bindweed is also prevalent on the unpaved vector, primarily in scattered patches along the mowstrip and often beginning to move into the D2 area on both sides of the vector. Of particular concern was the observation of beginning establishment in Block C into private ranchland. This establishment is limited and should be controlled.

Prickly Russian thistle (*Salsola tragus*) is a major invasive problem at FOUN present in every block sampled on both paved and unpaved vectors and is becoming established up to 30 meters into the landscape. Management activities (mowing) along the paved roadside may provide limited control, but *Salsola* is present consistently as scattered patches mov-

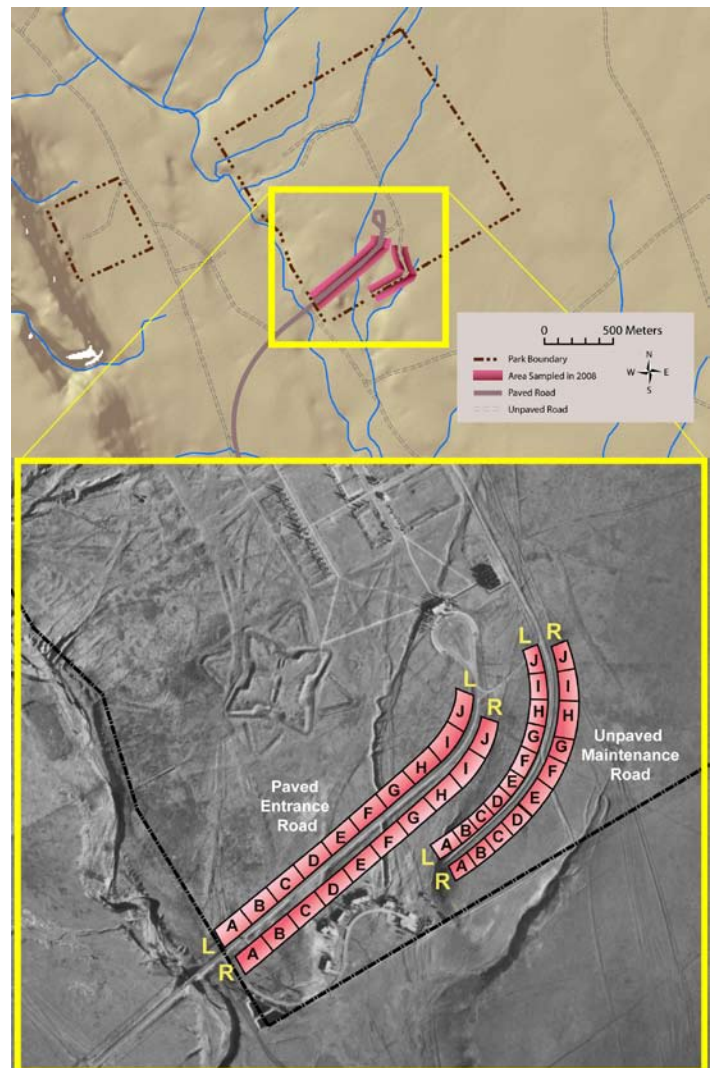


Figure 6. Area Sampled at Fort Union National Monument for exotic plants during 2008.

Table 5. The number and percentage of 50m-blocks sampled (N=40) along roads that exotic plant species were observed at Fort Union National Monument. Also shown is whether a given species is listed by individual states or federally as a noxious weed.

Scientific Name	Common Name	No. Blocks*	% Blocks	Noxious
<i>Salsola tragus</i>	Prickly Russian thistle	40	100%	CO
<i>Euphorbia dentata</i>	Toothed spurge	38	95%	
<i>Convolvulus arvensis</i>	Field Bindweed	37	93%	CO,KS,NM,TX
<i>Melilotus alba</i>	White sweetclover	24	60%	**
<i>Setaria viridis</i>	Green bristlegrass	21	53%	CO
<i>Erodium cicutarium</i>	Stork's-bill	19	48%	
<i>Panicum capillare</i>	Fall witchgrass	19	48%	
<i>Sonchus asper</i>	Spiny sowthistle	17	43%	
<i>Kochia scoparia</i>	Kochia	14	35%	CO
<i>Amaranth spp</i>	Pigweed	8	20%	
<i>Cirsium spp</i>	Thistle	7	18%	
<i>Verbascum thapsus</i>	Mullein	6	15%	CO
<i>Melilotus officinalis</i>	Yellow sweetclover	5	13%	**
<i>Lactuca serriola</i>	Prickly lettuce	4	10%	
<i>Setaria pumila</i>	Yellow bristlegrass	4	10%	FED
<i>Bromus spp</i>	Brome	3	8%	**
<i>Eragrostis cilianensis</i>	Stinkgrass	3	8%	
<i>Cynodon dactylon</i>	Bermuda grass	1	3%	
<i>Malva neglecta</i>	Common mallow	1	3%	
<i>Rumex spp</i>	Dock	1	3%	
<i>Tragopogon spp</i>	Salisify	1	3%	**

* The specific blocks where a given species was observed can be found in Appendix 5.

** indicates species not listed as noxious but of invasive concern to the SOPN.

ing toward even patches over 10 meters into the landscape. On the paved vector, there are scattered patches of *Salsola* over 20 meters into the landscape in Blocks C, F and G, and over 30 meters in Block D, all between the entrance road and staff housing. It is moving toward a matrix in Block J on the housing (right) side of the roadway. On the unpaved vector, *Salsola* is moving towards evenness within the first 2 meters of the roadway, consistently patchy 2-12 meters in, and beginning to establish in patches over 12 meters into the landscape. In Block B on the park (left) side of the road, *Salsola* was observed in patches over 20 meters distant from the roadway, corresponding to the invasion seen in this area from the paved vector. Of particular concern are the patches in Blocks A, B, C and D that are becoming well established on private ranchland. This population should be rapidly eradicated. Overall, there appears to be less movement into the landscape along the unpaved vector, but this should be closely monitored. It is recommended that control methods be sought and implemented for *Salsola* to prevent any further spread of this well-established exotic.

Green bristlegrass (*Setaria viridis*) is well established as scat-

tered patches on both sides of the mowstrips of the paved vector and is present in smaller quantities over 2 meters off the roadway. Bristlegrass responds favorably to management activities (mowing). On the unpaved vector, it is only present in small quantities in the right sides of Blocks G and H. A similar species, yellow bristlegrass (*Setaria pumila*) was potentially identified along the right side of the paved vector in Blocks C, D, I and J. This species is on the Federal Noxious Weed list and would be of critical concern if present at FOUN. However, species identification is questionable at this time and needs to be verified.

Common mullein (*Verbascum thapsus*) is present only along the paved vector. On the left side of the roadway, a few plants were observed in the mowstrip of Block B, and up to 30 meters along the fence line of Block A. Mullein is more prevalent on the right (housing) side of the vector, present in scattered patches over 30 meters into the landscape in Block A and only a few present within 10 meters of the roadway in Blocks B, D and F. It should be noted that first-year rosettes of mullein are difficult to detect at a distance, so areas deeper into the landscape should be searched for additional plants. This ex-

otic will continue to spread if not controlled, as it produces copious quantities of seed, but is easily eradicated within a few years.

Yellow sweetclover (*Melilotus officinalis*) is present only along the paved vector in limited to patchy quantities within the first 10 meters of both sides of the roadway. This small population can be eradicated to prevent spread into other areas. Yellow sweetclover is found on the right (housing) side of the vector in Blocks A, B and E, and on the left side in Blocks B and J.

Bermuda grass (*Cynodon dactylon*) was found in a small patch on the right (boundary) side of Block D on the unpaved vector. This grass will spread to form a monoculture, choking out native plants and can be easily eradicated at this point.

An unidentified species of brome grass (*Bromus spp*) was observed along the paved vector only, in the mowstrip on both sides of Block A and similarly on the right side of Block D. There was no evidence of spread outside of the mowstrip. Efforts will be made to provide identification to the species level in order to determine threat and monitoring of this small population is warranted.

Limited numbers of two species of thistle (*Cirsium spp*) were observed on both sides of the paved vector in the mowstrip and first four meters from the roadside. At this time it is suspected that these are native thistle species as none exhibited features of noxious non-natives. It is important to monitor these populations and verify species identification.

Kochia (*Kochia scoparia*) is found only on the paved vector, but exhibits spread deep into the landscape, especially in the area between the entrance road and staff housing. The management activity of mowing seems to have a limiting effect on population size, with the largest populations present 2-12 meters from the roadway. These populations are scattered patches to evenly distributed, with a matrix forming on the right (housing) side of Block D. This block contains an even population over 30 meters into the landscape. Neighboring Block C contains scattered populations at similar distances. Patches also exist on the right side of Block G over 12 meters into the landscape. This exotic is said to “disappear” as grassland health improves, but large quantities may inhibit a shift toward health. Kochia was not detected along the unpaved vector.

Fall witchgrass (*Panicum capillare*) is an exotic that responds favorably to management activities (mowing). It is found primarily in scattered patches along the mowstrips of the primary vector and in smaller quantities over 2 meters from the roadway. On the unpaved vector, a few plants were observed in the first 2 meters of the right side of Blocks I and J. This small population can be easily eradicated at this stage.

White sweetclover (*Melilotus alba*) is present in all blocks along the paved vector, but in limited quantities on the unpaved vector. It is primarily in scattered patches within the first 10 meters of the paved roadway, with some of these patches moving toward evenness. In Blocks A, B, G and H to the right (housing) side of the vector evenly distributed populations of white sweetclover in the D2 class have moved further into the landscape as scattered patches. This has also occurred on the left (fort) side of Blocks A and B, with scattered patches occurring up to 20 meters into the landscape.

Toothed spurge (*Euphorbia dentata*), while very prevalent along the roadsides, is considered a relatively benign exotic at this time. Its population appears to be limited somewhat by mowing, but occurs in scattered patches up to 5 meters from the roadside.

Several relatively benign exotic species were observed at FOUN. These exotics exist primarily in the mowstrip and respond favorably to management activities (mowing). While these may not be expected to cause major invasions, their control and eradication early in their establishment is recommended to improve grassland health. Stork's-bill (*Erodium cicutarium*) and spiny sowthistle (*Sonchus asper*) are found in the mowstrip and first 3 meters all along and on both sides of the paved vector in scattered patches. Limited to patchy populations of prickly lettuce (*Lactuca serriola*), salsify (*Tragopogon spp*), stinkgrass (*Eragrostis cilianensis*), dock (*Rumex spp*), common mallow (*Malva neglecta*) and pigweed (*Amaranth spp*) are similarly found on the right side only of the paved vector. It is not yet determined if the pigweed and dock are non-native species.

The Relationships Among Density, Distance from the Vector, and Vector Type

Exotic Plant Density

The five density classes we recorded represent a range from a small number of individual plants of a give species to a continuous matrix within the block for that species. Most species observed were found as either a small number of individual plants or in scattered patches (Fig. 7). Only three species were observed in a continuous matrix: Prickly Russian thistle (*Salsola tragus*), field bindweed (*Convolvulus arvensis*), and kochia (*Kochia scoparia*). All three of these species were observed in such density on some blocks along paved roads; whereas only *Salsola* was also found in such density (1 block) along the unpaved road. Several species were more frequently observed as scattered patches than few individual plants, indicating the beginning of local establishment of these species along the vector.

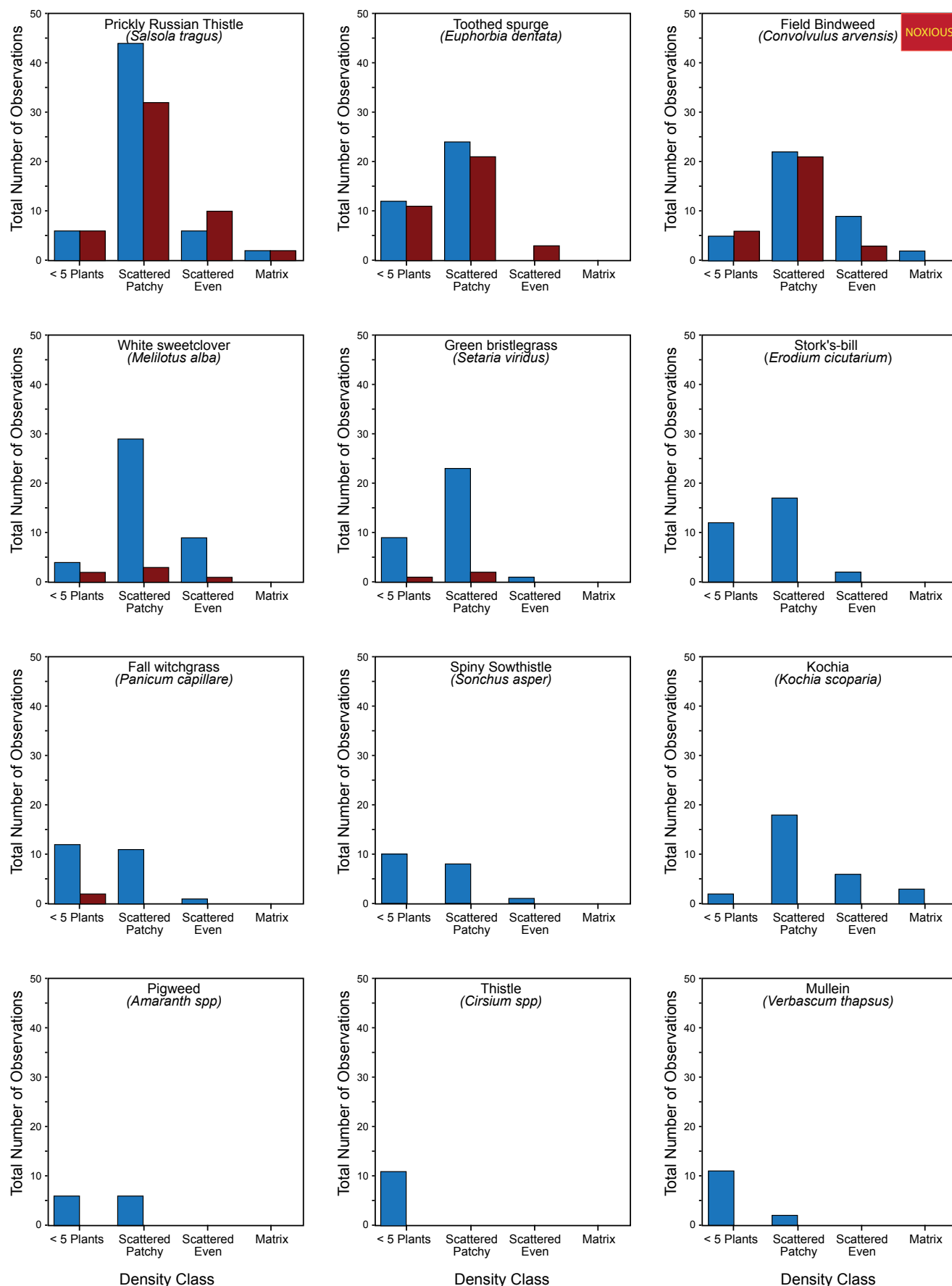


Figure 7 – The number of observations of each species during 2008 in each of four density (abundance) classes along paved (blue bars) and unpaved (Red bars) vectors at Fort Union National Monument.

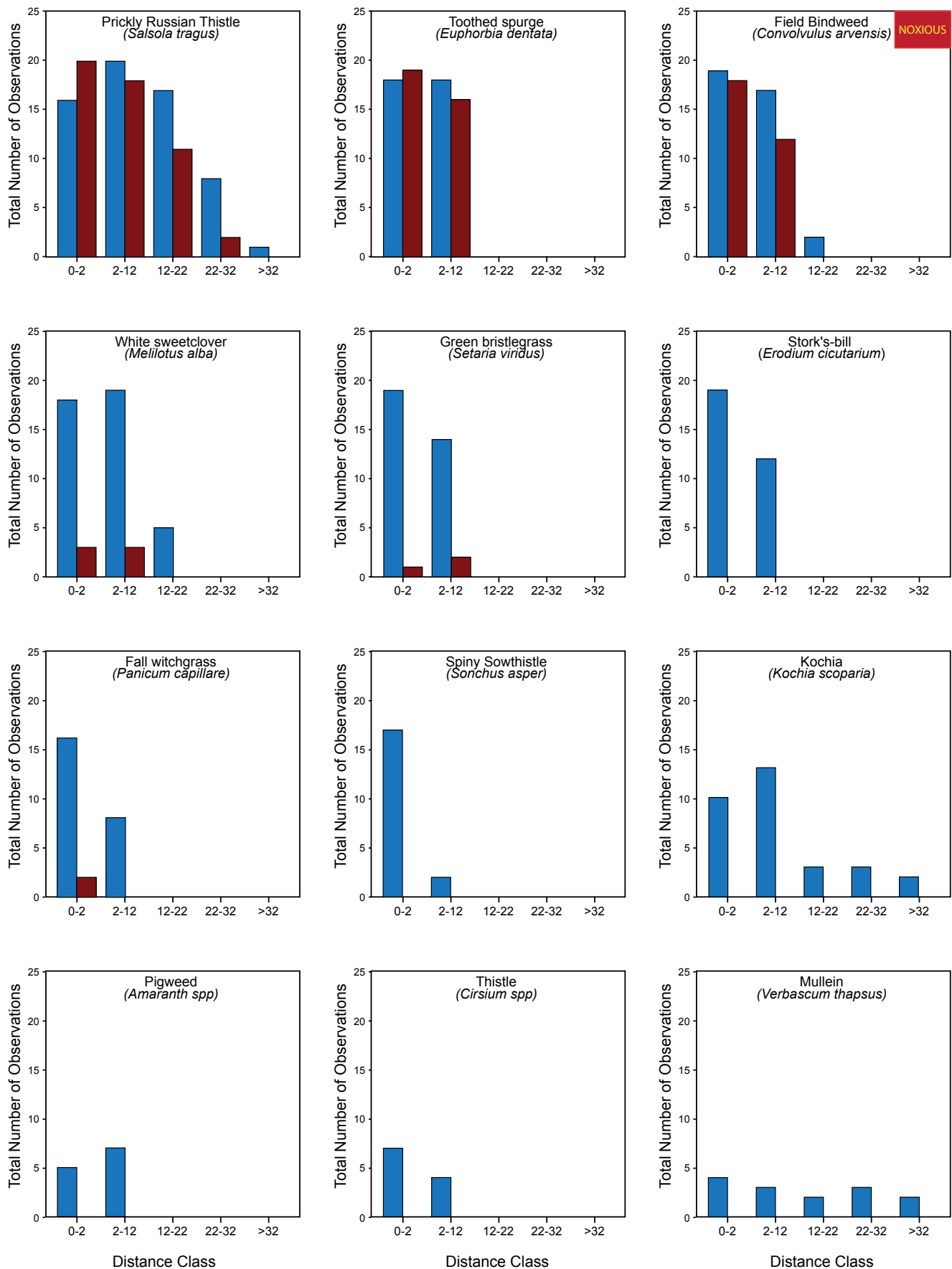


Figure 8 – The number of observations of each species during 2008 in each of five distance classes (from the vector) along paved (blue bars) and unpaved (Red bars) vectors at Fort Union National Monument.

Distance from the Vector

Distance from the vector provides an indication of whether a given species has a tendency to invade the interior habitats or whether they tend to remain localized near the source from which they likely invaded. Some species, such as Mullein (*Verbascum thapsus*) appear to be equally likely found in all distance classes, indicating that it is not restricted to localized invasion near the vectors (Fig. 8). However, it was only observed along the paved vectors. Virtually all of the most common exotic species tended to be observed within the first few distance classes from the vector, although for some life forms, especially low stature plants in low densities, this may be at least partially explained by a decrease in the ability to detect them at greater distances. Other species, such as Spiny sowthistle (*Sonchus asper*) was present only along paved vector and is most often present in the D1 (0-2 meter mowed strip) class.

Effect of Vector Type

As can be seen in both Figures 7 and 8, exotic species tended to occur much more frequently along paved roads than dirt roads. This is likely due to the number of vehicles using those vector types, as well as the nature of the travel. For example, vehicles coming from far and varied distances are much more likely to use the paved roads; whereas the dirt roads are likely used by park staff in vehicles used locally. In addition, the action of mowing, usually along paved roads, provides frequent disturbance which is ideal for establishment of invading species. The area along roadsides (although compacted) also seems to benefit from increased moisture runoff, which also provides a more suitable habitat for establishment.

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Appendix 1. The location (Blocks) where each species of exotic plant was observed at Capulin Volcano National Monument.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Bromus spp</i>	Brome	Entrance Road	L	A
<i>Bromus spp</i>	Brome	Entrance Road	L	C
<i>Chenopodium album</i>	Common lambsquarters	Entrance Road	L	G
<i>Chenopodium album</i>	Common lambsquarters	Entrance Road	L	I
<i>Chenopodium album</i>	Common lambsquarters	Entrance Road	L	K
<i>Chenopodium album</i>	Common lambsquarters	Entrance Road	R	B
<i>Euphorbia dentata</i>	Toothed spurge	Entrance Road	L	I
<i>Euphorbia dentata</i>	Toothed spurge	Entrance Road	R	J
<i>Marrubium vulgare</i>	Horehound	Entrance Road	L	K
<i>Melilotus alba</i>	White sweetclover	Entrance Road	L	A
<i>Melilotus alba</i>	White sweetclover	Entrance Road	L	C
<i>Melilotus alba</i>	White sweetclover	Entrance Road	R	B
<i>Melilotus officinalis</i>	Yellow sweetclover	Entrance Road	L	E
<i>Melilotus officinalis</i>	Yellow sweetclover	Entrance Road	L	G
<i>Melilotus officinalis</i>	Yellow sweetclover	Entrance Road	L	I
<i>Melilotus officinalis</i>	Yellow sweetclover	Entrance Road	L	K
<i>Melilotus officinalis</i>	Yellow sweetclover	Entrance Road	R	B
<i>Melilotus officinalis</i>	Yellow sweetclover	Entrance Road	R	D
<i>Melilotus officinalis</i>	Yellow sweetclover	Entrance Road	R	F
<i>Melilotus officinalis</i>	Yellow sweetclover	Entrance Road	R	H
<i>Melilotus officinalis</i>	Yellow sweetclover	Entrance Road	R	J
<i>Melilotus officinalis</i>	Yellow sweetclover	Entrance Road	R	L
<i>Polygonum convolvulus</i>	Climbing buckwheat	Entrance Road	L	E
<i>Polygonum convolvulus</i>	Climbing buckwheat	Entrance Road	L	G
<i>Polygonum convolvulus</i>	Climbing buckwheat	Entrance Road	L	I
<i>Polygonum convolvulus</i>	Climbing buckwheat	Entrance Road	L	K
<i>Polygonum convolvulus</i>	Climbing buckwheat	Entrance Road	R	B
<i>Polygonum convolvulus</i>	Climbing buckwheat	Entrance Road	R	D
<i>Polygonum convolvulus</i>	Climbing buckwheat	Entrance Road	R	F
<i>Polygonum convolvulus</i>	Climbing buckwheat	Entrance Road	R	H
<i>Polygonum convolvulus</i>	Climbing buckwheat	Entrance Road	R	J
<i>Polygonum convolvulus</i>	Climbing buckwheat	Entrance Road	R	L
<i>Rumex spp</i>	Dock	Entrance Road	L	G
<i>Rumex spp</i>	Dock	Entrance Road	R	B
<i>Rumex spp</i>	Dock	Entrance Road	R	H
<i>Rumex spp</i>	Dock	Entrance Road	R	J

Appendix 1. Capulin Volcano National Monument - Cont.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Setaria viridis</i>	Green bristlegrass	Entrance Road	L	E
<i>Setaria viridis</i>	Green bristlegrass	Entrance Road	L	G
<i>Setaria viridis</i>	Green bristlegrass	Entrance Road	L	I
<i>Setaria viridis</i>	Green bristlegrass	Entrance Road	L	K
<i>Setaria viridis</i>	Green bristlegrass	Entrance Road	R	B
<i>Setaria viridis</i>	Green bristlegrass	Entrance Road	R	D
<i>Setaria viridis</i>	Green bristlegrass	Entrance Road	R	F
<i>Setaria viridis</i>	Green bristlegrass	Entrance Road	R	H
<i>Setaria viridis</i>	Green bristlegrass	Entrance Road	R	J
<i>Setaria viridis</i>	Green bristlegrass	Entrance Road	R	L
<i>Sonchus asper</i>	Spiny sowthistle	Entrance Road	L	E
<i>Sonchus asper</i>	Spiny sowthistle	Entrance Road	L	G
<i>Sonchus asper</i>	Spiny sowthistle	Entrance Road	L	I
<i>Sonchus asper</i>	Spiny sowthistle	Entrance Road	L	K
<i>Sonchus asper</i>	Spiny sowthistle	Entrance Road	R	B
<i>Sonchus asper</i>	Spiny sowthistle	Entrance Road	R	D
<i>Sonchus asper</i>	Spiny sowthistle	Entrance Road	R	F
<i>Sonchus asper</i>	Spiny sowthistle	Entrance Road	R	H
<i>Tragopogon spp</i>	Salisify	Entrance Road	R	B
<i>Tragopogon spp</i>	Salisify	Entrance Road	R	J
<i>Verbascum thapsus</i>	Mullein	Entrance Road	L	C
<i>Verbascum thapsus</i>	Mullein	Entrance Road	L	E
<i>Verbascum thapsus</i>	Mullein	Entrance Road	L	G
<i>Verbascum thapsus</i>	Mullein	Entrance Road	L	I
<i>Verbascum thapsus</i>	Mullein	Entrance Road	L	K
<i>Verbascum thapsus</i>	Mullein	Entrance Road	R	B
<i>Verbascum thapsus</i>	Mullein	Entrance Road	R	D
<i>Verbascum thapsus</i>	Mullein	Entrance Road	R	F
<i>Verbascum thapsus</i>	Mullein	Entrance Road	R	H
<i>Verbascum thapsus</i>	Mullein	Entrance Road	R	J
<i>Verbascum thapsus</i>	Mullein	Entrance Road	R	L

Appendix 2. The location (Blocks) where each species of exotic plant was observed at Chickasaw National Recreation Area.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Bothriochloa ischaemum</i>	K.R. bluestem	GUYSAND	L	A
<i>Bothriochloa ischaemum</i>	K.R. bluestem	GUYSAND	L	A
<i>Bothriochloa ischaemum</i>	K.R. bluestem	GUYSAND	L	A
<i>Bothriochloa ischaemum</i>	K.R. bluestem	GUYSAND	L	A
<i>Bothriochloa ischaemum</i>	K.R. bluestem	GUYSAND	L	A
<i>Bothriochloa ischaemum</i>	K.R. bluestem	GUYSAND	L	A
<i>Bothriochloa ischaemum</i>	K.R. bluestem	GUYSAND	L	A
<i>Bothriochloa ischaemum</i>	K.R. bluestem	GUYSAND	L	A
<i>Bothriochloa ischaemum</i>	K.R. bluestem	GUYSAND	L	A
<i>Cynodon dactylon</i>	Bermuda grass	GUYSAND	R	J
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	L	A
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	L	C
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	L	E
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	L	G
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	L	I
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	L	K
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	R	B
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	R	D
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	R	F
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	R	H
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	R	J
<i>Cynodon dactylon</i>	Bermuda grass	VETLAKE	R	L
<i>Echinochloa crus-galli</i>	Barnyard grass	GUYSAND	L	G
<i>Lespedeza cuneata</i>	Sericea lespedeza	GUYSAND	R	D
<i>Lonicera japonica</i>	Japanese honeysuckle	VETLAKE	L	E
<i>Paspalum dilatatum</i>	Dallasgrass	VETLAKE	L	C
<i>Paspalum dilatatum</i>	Dallasgrass	VETLAKE	L	E
<i>Paspalum dilatatum</i>	Dallasgrass	VETLAKE	L	G
<i>Paspalum dilatatum</i>	Dallasgrass	VETLAKE	L	I
<i>Paspalum dilatatum</i>	Dallasgrass	VETLAKE	L	K
<i>Phragmites australis</i>	Common reed	GUYSAND	L	G
<i>Sorghum halepense</i>	Johnsongrass	GUYSAND	L	A
<i>Sorghum halepense</i>	Johnsongrass	GUYSAND	L	C
<i>Sorghum halepense</i>	Johnsongrass	GUYSAND	L	E
<i>Sorghum halepense</i>	Johnsongrass	GUYSAND	L	G

Appendix 2. Chickasaw National Recreation Area - Cont.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Sorghum halepense</i>	Johnsongrass	GUY SAND	L	I
<i>Sorghum halepense</i>	Johnsongrass	GUY SAND	L	K
<i>Sorghum halepense</i>	Johnsongrass	GUY SAND	R	B
<i>Sorghum halepense</i>	Johnsongrass	GUY SAND	R	D
<i>Sorghum halepense</i>	Johnsongrass	GUY SAND	R	F
<i>Sorghum halepense</i>	Johnsongrass	GUY SAND	R	H
<i>Sorghum halepense</i>	Johnsongrass	GUY SAND	R	J
<i>Sorghum halepense</i>	Johnsongrass	GUY SAND	R	L
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	L	A
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	L	C
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	L	E
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	L	G
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	L	I
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	R	B
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	R	D
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	R	F
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	R	H
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	R	J
<i>Sorghum halepense</i>	Johnsongrass	VET LAKE	R	L
<i>Toxicodendron radicans</i>	Poison ivy	GUY SAND	L	C
<i>Toxicodendron radicans</i>	Poison ivy	GUY SAND	L	E
<i>Toxicodendron radicans</i>	Poison ivy	GUY SAND	L	G
<i>Toxicodendron radicans</i>	Poison ivy	GUY SAND	L	I
<i>Toxicodendron radicans</i>	Poison ivy	GUY SAND	L	K
<i>Toxicodendron radicans</i>	Poison ivy	GUY SAND	R	B
<i>Toxicodendron radicans</i>	Poison ivy	VET LAKE	L	E
<i>Toxicodendron radicans</i>	Poison ivy	VET LAKE	L	G
<i>Toxicodendron radicans</i>	Poison ivy	VET LAKE	L	K
<i>Toxicodendron radicans</i>	Poison ivy	VET LAKE	R	B
<i>Toxicodendron radicans</i>	Poison ivy	VET LAKE	R	D
<i>Toxicodendron radicans</i>	Poison ivy	VET LAKE	R	J

Appendix 3. The location (Blocks) where each species of exotic plant was observed at Lake Meredith National Recreation Area.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Bothriochloa ischaemum</i>	K.R. bluestem	BLUEW	L	A
<i>Bothriochloa ischaemum</i>	K.R. bluestem	BLUEW	L	C
<i>Bothriochloa ischaemum</i>	K.R. bluestem	BLUEW	R	B
<i>Bothriochloa ischaemum</i>	K.R. bluestem	BLUEW	R	D
<i>Bothriochloa ischaemum</i>	K.R. bluestem	BLUEW	R	F
<i>Bothriochloa ischaemum</i>	K.R. bluestem	BLUEW	R	H
<i>Cirsium spp</i>	Thistle	BLUEW	L	A
<i>Cirsium spp</i>	Thistle	BLUEW	L	C
<i>Cirsium spp</i>	Thistle	BLUEW	R	B
<i>Cirsium spp</i>	Thistle	BLUEW	R	D
<i>Cirsium spp</i>	Thistle	BLUEW	R	F
<i>Cirsium spp</i>	Thistle	BLUEW	R	H
<i>Cirsium spp</i>	Thistle	BLUEW	R	L
<i>Cirsium spp</i>	Thistle	PUMPRD	L	A
<i>Cirsium spp</i>	Thistle	PUMPRD	R	F
<i>Cirsium spp</i>	Thistle	PUMPRD	R	I
<i>Cirsium spp</i>	Thistle	PUMPRD	R	J
<i>Convolvulus arvensis</i>	Field Bindweed	BLUEW	L	A
<i>Convolvulus arvensis</i>	Field Bindweed	BLUEW	R	B
<i>Eragrostis cilianensis</i>	Stinkgrass	BLUEW	L	E
<i>Eragrostis cilianensis</i>	Stinkgrass	BLUEW	L	G
<i>Eragrostis cilianensis</i>	Stinkgrass	BLUEW	L	K
<i>Kochia scoparia</i>	Kochia	GASWELL	L	A
<i>Kochia scoparia</i>	Kochia	GASWELL	R	B
<i>Kochia scoparia</i>	Kochia	PUMPRD	L	A
<i>Kochia scoparia</i>	Kochia	PUMPRD	L	C
<i>Kochia scoparia</i>	Kochia	PUMPRD	L	E
<i>Kochia scoparia</i>	Kochia	PUMPRD	L	G
<i>Kochia scoparia</i>	Kochia	PUMPRD	R	B
<i>Kochia scoparia</i>	Kochia	PUMPRD	R	D
<i>Kochia scoparia</i>	Kochia	PUMPRD	R	F
<i>Kochia scoparia</i>	Kochia	PUMPRD	R	H
<i>Kochia scoparia</i>	Kochia	PUMPRD	R	I
<i>Kochia scoparia</i>	Kochia	PUMPRD	R	J
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	L	A
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	L	C

Appendix 3. Lake Meredith National Recreation Area - Cont.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	L	E
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	L	G
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	L	I
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	L	K
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	R	B
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	R	D
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	R	F
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	R	H
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	R	J
<i>Salsola tragus</i>	Prickly Russian thistle	BLUEW	R	L
<i>Salsola tragus</i>	Prickly Russian thistle	GASWELL	L	A
<i>Salsola tragus</i>	Prickly Russian thistle	GASWELL	R	B
<i>Salsola tragus</i>	Prickly Russian thistle	PUMPRD	L	A
<i>Salsola tragus</i>	Prickly Russian thistle	PUMPRD	L	C
<i>Salsola tragus</i>	Prickly Russian thistle	PUMPRD	L	E
<i>Salsola tragus</i>	Prickly Russian thistle	PUMPRD	L	G
<i>Salsola tragus</i>	Prickly Russian thistle	PUMPRD	R	B
<i>Salsola tragus</i>	Prickly Russian thistle	PUMPRD	R	D
<i>Salsola tragus</i>	Prickly Russian thistle	PUMPRD	R	F
<i>Salsola tragus</i>	Prickly Russian thistle	PUMPRD	R	H
<i>Salsola tragus</i>	Prickly Russian thistle	PUMPRD	R	I
<i>Salsola tragus</i>	Prickly Russian thistle	PUMPRD	R	J
<i>Setaria viridis</i>	Green bristlegrass	BLUEW	L	C
<i>Setaria viridis</i>	Green bristlegrass	BLUEW	L	I
<i>Setaria viridis</i>	Green bristlegrass	GASWELL	L	A
<i>Setaria viridis</i>	Green bristlegrass	PUMPRD	L	A
<i>Setaria viridis</i>	Green bristlegrass	PUMPRD	L	C
<i>Setaria viridis</i>	Green bristlegrass	PUMPRD	L	E
<i>Setaria viridis</i>	Green bristlegrass	PUMPRD	L	G
<i>Setaria viridis</i>	Green bristlegrass	PUMPRD	R	B
<i>Setaria viridis</i>	Green bristlegrass	PUMPRD	R	D
<i>Setaria viridis</i>	Green bristlegrass	PUMPRD	R	F
<i>Setaria viridis</i>	Green bristlegrass	PUMPRD	R	H
<i>Setaria viridis</i>	Green bristlegrass	PUMPRD	R	I
<i>Setaria viridis</i>	Green bristlegrass	PUMPRD	R	J

Appendix 4. The location (Blocks) where each species of exotic plant was observed at Fort Larned National Historic Site.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Bromus inermis</i>	Smooth brome	WestBdy	L	A
<i>Bromus inermis</i>	Smooth brome	WestBdy	L	B
<i>Bromus inermis</i>	Smooth brome	WestBdy	L	C
<i>Bromus inermis</i>	Smooth brome	WestBdy	L	D
<i>Bromus inermis</i>	Smooth brome	WestBdy	L	E
<i>Bromus inermis</i>	Smooth brome	WestBdy	L	F
<i>Convolvulus arvensis</i>	Field Bindweed	WestBdy	L	E
<i>Convolvulus arvensis</i>	Field Bindweed	WestBdy	L	F
<i>Lactuca serriola</i>	Prickly lettuce	WestBdy	L	E
<i>Lactuca serriola</i>	Prickly lettuce	WestBdy	L	F
<i>Melilotus officinalis</i>	Yellow sweetclover	WestBdy	L	A
<i>Melilotus officinalis</i>	Yellow sweetclover	WestBdy	L	B
<i>Melilotus officinalis</i>	Yellow sweetclover	WestBdy	L	E
<i>Melilotus officinalis</i>	Yellow sweetclover	WestBdy	L	F
<i>Setaria viridis</i>	Green bristlegrass	WestBdy	L	D
<i>Setaria viridis</i>	Green bristlegrass	WestBdy	L	E
<i>Setaria viridis</i>	Green bristlegrass	WestBdy	L	F

Appendix 5. The location (Blocks) where each species of exotic plant was observed at Fort Union National Monument.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Amaranth species</i>	Pigweed	Ent_Rd	R	A
<i>Amaranth species</i>	Pigweed	Ent_Rd	R	B
<i>Amaranth species</i>	Pigweed	Ent_Rd	R	C
<i>Amaranth species</i>	Pigweed	Ent_Rd	R	E
<i>Amaranth species</i>	Pigweed	Ent_Rd	R	F
<i>Amaranth species</i>	Pigweed	Ent_Rd	R	G
<i>Amaranth species</i>	Pigweed	Ent_Rd	R	H
<i>Amaranth species</i>	Pigweed	Ent_Rd	R	J
<i>Bromus spp</i>	Brome	Ent_Rd	L	A
<i>Bromus spp</i>	Brome	Ent_Rd	R	A
<i>Bromus spp</i>	Brome	Ent_Rd	R	D
<i>Cirsium spp</i>	Thistle	Ent_Rd	L	F
<i>Cirsium spp</i>	Thistle	Ent_Rd	L	I
<i>Cirsium spp</i>	Thistle	Ent_Rd	R	B
<i>Cirsium spp</i>	Thistle	Ent_Rd	R	C
<i>Cirsium spp</i>	Thistle	Ent_Rd	R	F
<i>Cirsium spp</i>	Thistle	Ent_Rd	R	G
<i>Cirsium spp</i>	Thistle	Ent_Rd	R	H
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	L	A
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	L	B
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	L	C
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	L	D
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	L	E
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	L	F
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	L	G
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	L	H
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	L	J
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	R	A
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	R	B
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	R	C
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	R	D
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	R	E
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	R	F
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	R	G
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	R	H
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	R	I

Appendix 5. Fort Union National Monument - Cont.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Convolvulus arvensis</i>	Field Bindweed	Ent_Rd	R	J
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	L	A
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	L	C
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	L	D
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	L	E
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	L	F
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	L	G
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	L	H
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	L	I
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	L	J
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	R	A
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	R	C
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	R	D
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	R	E
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	R	F
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	R	G
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	R	H
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	R	I
<i>Convolvulus arvensis</i>	Field Bindweed	Maint_Rd	R	J
<i>Cynodon dactylon</i>	Bermuda grass	Maint_Rd	R	D
<i>Eragrostis cilianensis</i>	Stinkgrass	Ent_Rd	R	D
<i>Eragrostis cilianensis</i>	Stinkgrass	Ent_Rd	R	E
<i>Eragrostis cilianensis</i>	Stinkgrass	Ent_Rd	R	J
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	L	A
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	L	B
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	L	C
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	L	D
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	L	E
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	L	F
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	L	G
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	L	H
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	L	I
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	L	J
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	R	A
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	R	B
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	R	C

Appendix 5. Fort Union National Monument - Cont.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	R	D
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	R	E
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	R	F
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	R	G
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	R	H
<i>Erodium cicutarium</i>	Stork's-bill	Ent_Rd	R	I
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	L	A
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	L	C
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	L	D
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	L	E
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	L	F
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	L	G
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	L	H
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	L	I
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	L	J
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	R	A
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	R	B
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	R	C
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	R	D
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	R	E
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	R	F
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	R	G
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	R	H
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	R	I
<i>Euphorbia dentata</i>	Toothed spurge	Ent_Rd	R	J
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	L	A
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	L	C
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	L	D
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	L	E
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	L	F
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	L	G
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	L	H
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	L	I
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	L	J
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	R	A
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	R	B

Appendix 5. Fort Union National Monument - Cont.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	R	C
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	R	D
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	R	E
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	R	F
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	R	G
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	R	H
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	R	I
<i>Euphorbia dentata</i>	Toothed spurge	Maint_Rd	R	J
<i>Kochia scoparia</i>	Kochia	Ent_Rd	L	B
<i>Kochia scoparia</i>	Kochia	Ent_Rd	L	C
<i>Kochia scoparia</i>	Kochia	Ent_Rd	L	D
<i>Kochia scoparia</i>	Kochia	Ent_Rd	L	E
<i>Kochia scoparia</i>	Kochia	Ent_Rd	L	F
<i>Kochia scoparia</i>	Kochia	Ent_Rd	R	B
<i>Kochia scoparia</i>	Kochia	Ent_Rd	R	C
<i>Kochia scoparia</i>	Kochia	Ent_Rd	R	D
<i>Kochia scoparia</i>	Kochia	Ent_Rd	R	E
<i>Kochia scoparia</i>	Kochia	Ent_Rd	R	F
<i>Kochia scoparia</i>	Kochia	Ent_Rd	R	G
<i>Kochia scoparia</i>	Kochia	Ent_Rd	R	H
<i>Kochia scoparia</i>	Kochia	Ent_Rd	R	I
<i>Kochia scoparia</i>	Kochia	Ent_Rd	R	J
<i>Lactuca serriola</i>	Prickly lettuce	Ent_Rd	R	C
<i>Lactuca serriola</i>	Prickly lettuce	Ent_Rd	R	D
<i>Lactuca serriola</i>	Prickly lettuce	Ent_Rd	R	G
<i>Lactuca serriola</i>	Prickly lettuce	Ent_Rd	R	H
<i>Malva neglecta</i>	Common mallow	Ent_Rd	R	J
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	L	A
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	L	B
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	L	C
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	L	D
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	L	E
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	L	F
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	L	G
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	L	H
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	L	I

Appendix 5. Fort Union National Monument - Cont.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	L	J
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	R	A
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	R	B
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	R	C
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	R	D
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	R	E
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	R	F
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	R	G
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	R	H
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	R	I
<i>Melilotus alba</i>	White sweetclover	Ent_Rd	R	J
<i>Melilotus alba</i>	White sweetclover	Maint_Rd	R	A
<i>Melilotus alba</i>	White sweetclover	Maint_Rd	R	B
<i>Melilotus alba</i>	White sweetclover	Maint_Rd	R	G
<i>Melilotus alba</i>	White sweetclover	Maint_Rd	R	H
<i>Melilotus officinalis</i>	Yellow sweetclover	Ent_Rd	L	B
<i>Melilotus officinalis</i>	Yellow sweetclover	Ent_Rd	L	J
<i>Melilotus officinalis</i>	Yellow sweetclover	Ent_Rd	R	A
<i>Melilotus officinalis</i>	Yellow sweetclover	Ent_Rd	R	B
<i>Melilotus officinalis</i>	Yellow sweetclover	Ent_Rd	R	E
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	L	A
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	L	B
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	L	C
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	L	D
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	L	E
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	L	F
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	L	G
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	L	H
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	L	J
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	R	A
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	R	B
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	R	C
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	R	D
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	R	E
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	R	F
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	R	H

Appendix 5. Fort Union National Monument - Cont.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Panicum capillare</i>	Fall witchgrass	Ent_Rd	R	I
<i>Panicum capillare</i>	Fall witchgrass	Maint_Rd	R	I
<i>Panicum capillare</i>	Fall witchgrass	Maint_Rd	R	J
<i>Rumex spp</i>	Dock	Ent_Rd	R	H
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	L	A
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	L	B
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	L	C
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	L	D
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	L	E
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	L	F
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	L	G
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	L	H
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	L	I
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	L	J
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	R	A
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	R	B
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	R	C
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	R	D
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	R	E
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	R	F
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	R	G
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	R	H
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	R	I
<i>Salsola tragus</i>	Prickly Russian thistle	Ent_Rd	R	J
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	L	A
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	L	B
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	L	C
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	L	D
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	L	E
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	L	F
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	L	G
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	L	H
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	L	I
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	L	J
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	R	A
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	R	B

Appendix 5. Fort Union National Monument - Cont.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	R	C
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	R	D
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	R	E
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	R	F
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	R	G
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	R	H
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	R	I
<i>Salsola tragus</i>	Prickly Russian thistle	Maint_Rd	R	J
<i>Setaria pumila</i>	Yellow bristlegrass	Ent_Rd	R	C
<i>Setaria pumila</i>	Yellow bristlegrass	Ent_Rd	R	D
<i>Setaria pumila</i>	Yellow bristlegrass	Ent_Rd	R	I
<i>Setaria pumila</i>	Yellow bristlegrass	Ent_Rd	R	J
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	L	A
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	L	C
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	L	D
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	L	E
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	L	F
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	L	G
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	L	H
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	L	I
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	L	J
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	R	A
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	R	B
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	R	C
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	R	D
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	R	E
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	R	F
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	R	G
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	R	H
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	R	I
<i>Setaria viridis</i>	Green bristlegrass	Ent_Rd	R	J
<i>Setaria viridis</i>	Green bristlegrass	Maint_Rd	R	G
<i>Setaria viridis</i>	Green bristlegrass	Maint_Rd	R	H
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	L	A
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	L	B
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	L	C

Appendix 5. Fort Union National Monument - Cont.

Scientific Name	Common Name	Vector	Vector Side	Block
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	L	D
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	L	E
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	L	F
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	L	G
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	L	H
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	L	I
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	L	J
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	R	A
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	R	B
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	R	C
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	R	D
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	R	E
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	R	F
<i>Sonchus asper</i>	Spiny sowthistle	Ent_Rd	R	G
<i>Tragopogon spp</i>	Salisify	Ent_Rd	R	D
<i>Verbascum thapsus</i>	Mullein	Ent_Rd	L	A
<i>Verbascum thapsus</i>	Mullein	Ent_Rd	L	B
<i>Verbascum thapsus</i>	Mullein	Ent_Rd	R	A
<i>Verbascum thapsus</i>	Mullein	Ent_Rd	R	B
<i>Verbascum thapsus</i>	Mullein	Ent_Rd	R	D
<i>Verbascum thapsus</i>	Mullein	Ent_Rd	R	F

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.

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National Park Service
U.S. Department of the Interior



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