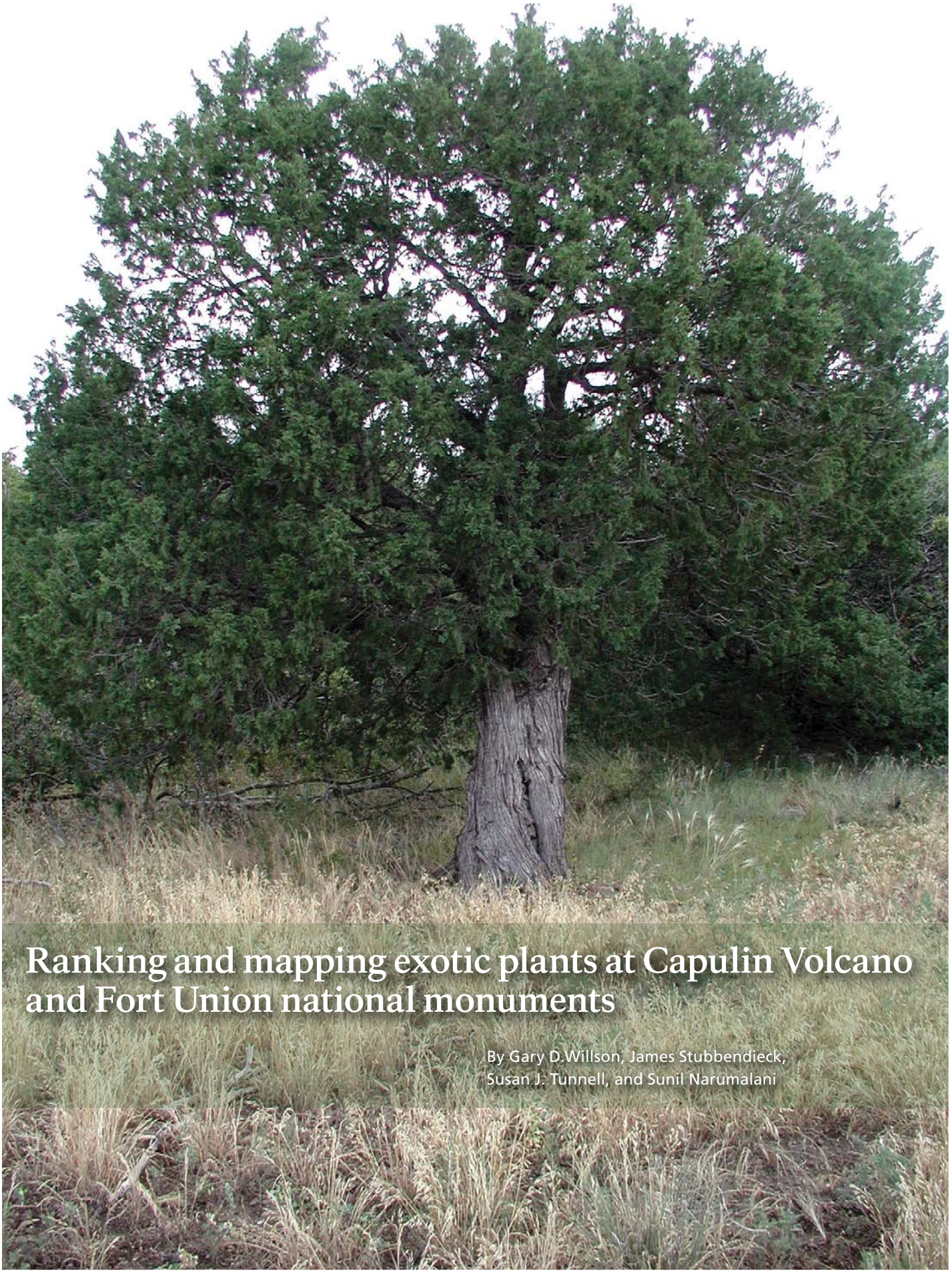

Ranking and mapping exotic plants at Capulin Volcano and Fort Union national monuments

By Gary D.Willson, James Stubbendieck, Susan J. Tunnell, and Sunil Narumalani

THROUGHOUT THE GREAT PLAINS AND ROCKY MOUN-tains, exotic plants are jeopardizing the integrity of natural ecosystems (U.S. Geological Survey's Invasive Species Working Group 2000). The National Park Service has identified management and control of invasive, exotic plants, especially state-listed noxious weeds, as a high-priority resource management issue. Noxious weeds are invasive plants that threaten agricultural crops and rangeland and whose control is mandated by state law. In the Intermountain Region, resource managers in 19 National Park System units have prioritized areas where exotic plants need to be inventoried and their population distribution mapped before effective and efficient management can be implemented (Intermountain Regional Office 2001).

At the request of the Intermountain Region, the Great Plains Cooperative Ecosystem Studies Unit organized a team of range ecologists and a remote sensing specialist at the University of Nebraska–Lincoln to inventory and map noxious weeds within two park units in New Mexico: Capulin Volcano National Monument and Fort Union National Monument. During the initial stages of this effort, we proposed to map all noxious weeds that are included on the New Mexico noxious weed list over the entire area of both national monuments. Review of the plants at these national monuments, however, led us to modify our original objective. Only one noxious weed—field bindweed (*Convolvulus arvensis*)—was known from Capulin Volcano. Field bindweed was also the only known noxious weed from Fort Union. Additional exotic plants not classified as noxious weeds were present at both national monuments, however. Without management, many of these exotics have the potential to become state-listed. Instead of mapping all the exotic plants in each unit, we used a ranking system to first determine which exotic plants were serious pests and then mapped only those species.

Exotic species ranking system

The exotic species ranking system (Hiebert and Stubbendieck 1993)—a decision-making tool in natural resource management—allows resource managers to rank exotic plants by numerical scores. The ranking system is divided into two main sections: (1) significance of impact and (2) feasibility of control or management. Significance of impact is further divided into current level of impact and innate ability of a species to become a pest. A score for current level of impact (–8 to 50 points) is based on the present degree and extent of impact caused by the species; a score for innate ability of the species to become a pest (4 to 50 points) is based on a plant's life history and traits that predispose it to become a problem. A score for feasibility of control (3 to 100 points) is based on the abundance of a species and the ease and side effects of control measures. The ranking system also provides for a qualitative assessment (low, medium, or high) of urgency of control by identifying the potential financial and ecological impacts of delayed action.

Figure 1 (previous page). Japanese and downy brome at Capulin Volcano National Monument, New Mexico.

NPS PHOTO/GARY WILLSON

We used this system because it had been extensively tested and applied in several park units in the Midwest (Stubbendieck et al. 1992; Stumpf et al. 1994) and was published and distributed as an NPS natural resource report (Hiebert and Stubbendieck 1993). The ranking system can assist resource managers in making sound decisions regarding exotic plant management by separating innocuous from disruptive species. An advantage of the system is that it allows resource managers to rank the exotic plants without prior extensive field visits, though field visits are necessary when making final decisions about the management of high-priority species.

Ranking and mapping strategy

To determine our strategy for mapping exotic plants, we first visited the two national monuments in March 2003. We used species lists compiled by park staffs and the New Mexico Natural Heritage Program as a starting point for determining the exotic plants present. We visited each national monument to become familiar with the plant communities and conferred with park staffs about their concerns.

We returned to the national monuments in August 2003 to rank the exotic plants, assess urgency of control, and determine which species to map. Following a thorough field inventory of the plant communities and additional review of the plant lists, a team composed of researchers from the University of Nebraska–Lincoln and the resource manager at Capulin Volcano ranked each exotic plant using the exotic plant ranking system. Based on what they learned from ranking exotics in 10 parks in the Midwest Region, Stubbendieck et al. (1992) consider all species with a significance of impact score of 50 or higher to be highly disruptive. We followed a similar approach and decided to map only exotics with a score of 50 or higher. In addition, we provided background information about species that rated medium or high in urgency of action in order to alert park staffs to the possibility of increased effort and cost to control these plants in the future. Using a global positioning system (GPS), we mapped the highly disruptive species and used the coordinates to delineate areas of exotic plant occurrence.

Results

At Capulin Volcano National Monument, we ranked 21 exotic plants and decided that Japanese brome (*Bromus japonicus*) and downy brome (*Bromus tectorum*) were the species of primary concern (i.e., highly disruptive) (fig. 1 and table 1). These two annual bromes are very similar in biology, ecology, and distribution and are suspected of interbreeding. We mapped Japanese brome and downy brome within the same GPS polygons because both species occurred together, and mapping the species separately at the selected scale was not feasible. The area occupied by annual brome totaled 44.8 acres (18.1 ha) (fig. 2). A biplot of the relationship between the significance of impact and the feasibility of control reveals that three species (Japanese brome, downy brome, and smooth brome [*Bromus inermis*]) are serious threats and difficult to control (fig. 3). Although smooth brome also shares these characteristics, it does not pose an eminent serious threat (i.e., low urgency) to the resources at Capulin Volcano because of the small number of populations that are located primarily along roadsides within the national monument. In addition to Japanese and downy brome, we found common horehound (*Marrubium vulgare*) to be a species of medium urgency because of its invasive potential; however, because the significance of impact score for the species was lower than 50 and only one very small population, which is already actively managed, occurs in the national monument, we did not map it.

By first ranking species to determine the most disruptive, we were able to identify species of concern and focus our efforts on mapping those species.

We ranked 22 exotic species at Fort Union National Monument (table 2). The only species that ranked high enough to map (scoring 50 or higher for significance of impact) was field bindweed (fig. 4). This was also the only species we identified as of medium or high urgency. Field bindweed occupied 3.3 acres (1.3 ha) and was restricted to the residence area and the roadside near the front gate (fig. 5). These highly disturbed areas are ideal for field bindweed to establish and persist over time. Many of the other exotic plants present were restricted to a low, wet area adjacent to Coyote Creek. These plants are of little threat because of their reliance on water and the lack of permanent streams and wet areas in the national monument.

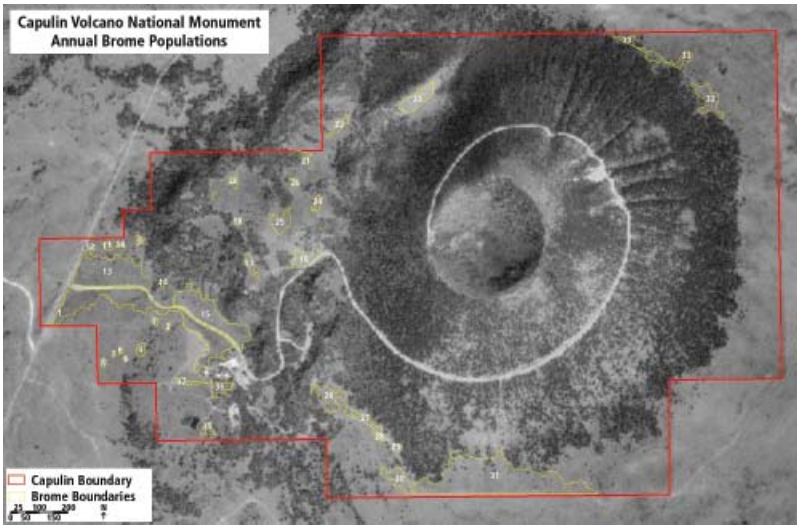

Figure 2. Investigators mapped populations of annual brome (*Bromus japonicus* and *Bromus tectorum* [shown in yellow]) at Capulin Volcano National Monument. These species are highly disruptive and of primary concern for resource management at the national monument.

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Discussion

The exotic species ranking system was a useful decision-making tool at Capulin Volcano and Fort Union national monuments. By first ranking species to determine the most disruptive, we were able to identify species of concern and focus our efforts on mapping those species. At both national monuments, we found far fewer exotic plant species than are present in parks in the Midwest, where the ranking system has been extensively applied, and possibly in other parks in the Intermountain Region (table 3). For example, of the 92 exotic plants found at Pipestone National Monument in Minnesota, 11 were highly disruptive. By comparison, Capulin Volcano had 3 and Fort Union had 1 (table 3).

At Capulin Volcano, we mapped widespread infestations of two highly disruptive species, Japanese and downy brome. We recommend that exotic plant management at Capulin Volcano focus on these species. Smooth brome and common horehound need monitoring so it can be determined whether populations are increasing and require proactive management. Other exotic plants in the national monument, such as Russian thistle (*Salsola tragus*) and kochia (*Kochia scoparia*), are annuals that can exploit a newly disturbed area with a rapid increase in individual plants. High population numbers may occur one year and low population numbers the next. Although these species do not pose long-term problems, disturbed areas in the national monument that are undergoing native plant restoration may require management to reduce competition from annual exotics.

Table 1. Ranking of exotic plant species at Capulin Volcano National Monument

Species	Significance of impact			Feasibility of control[3]	Urgency
	Level of impact[1]	Innate ability to become a pest[2]	Total		
Agropyron cristatum	3	27	30	41	Low
Bromus inermis	23	36	59	36	Low
Bromus japonicus	26	25	51	44	Medium
Bromus tectorum	26	27	53	44	Medium
Chenopodium album	–6	26	20	56	Low
Cichorium intybus	–8	32	24	65	Low
Convolvulus arvensis	4	43	47	31	Low
Cynoglossum officinale	7	23	30	50	Low
Descurainia sophia	3	26	29	41	Low
Echinochloa crus-galli	–8	26	18	60	Low
Euphorbia davidii	–8	30	22	40	Low
Kochia scoparia	10	34	44	70	Low
Marrubium vulgare	13	32	45	37	Medium
Melilotus officinalis	11	27	38	36	Low
Polygonum convolvulus	–8	21	13	50	Low
Salsola tragus	4	23	27	61	Low
Setaria pumila	10	24	34	44	Low
Setaria viridis	10	24	34	44	Low
Tragopogon dubius	5	32	37	40	Low
Tragopogon pratensis	5	25	30	65	Low
Verbascum thapsus	17	16	33	26	Low

[1]–8 to 50 points possible
[2]4 to 50 points possible
[3]3 to 100 points possible

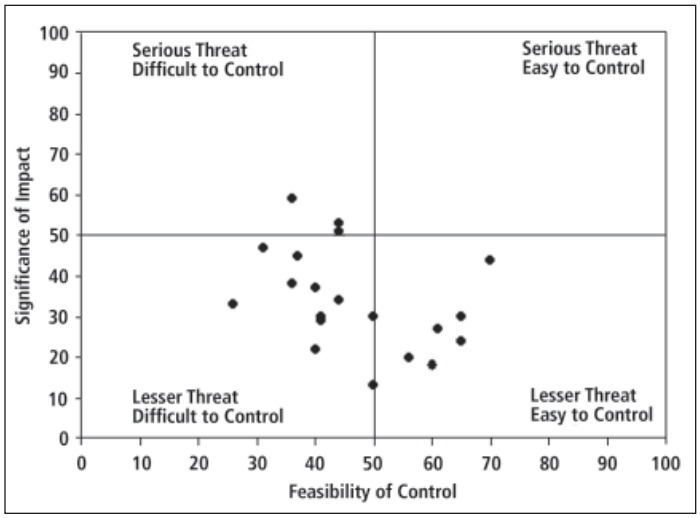

Figure 3. Capulin Volcano National Monument contains 21 species of exotic plants. Two species (*Setaria pumila* and *Setaria viridis*) scored the same, so the plot shows only one dot for both plants. The species that are serious threats and difficult to control are smooth brome (*Bromus inermis*), Japanese brome (*Bromus japonicus*), and downy brome (*Bromus tectorum*). The plot illustrates that few exotics are in the category of serious threat and difficult to control, which is the primary finding of the project.

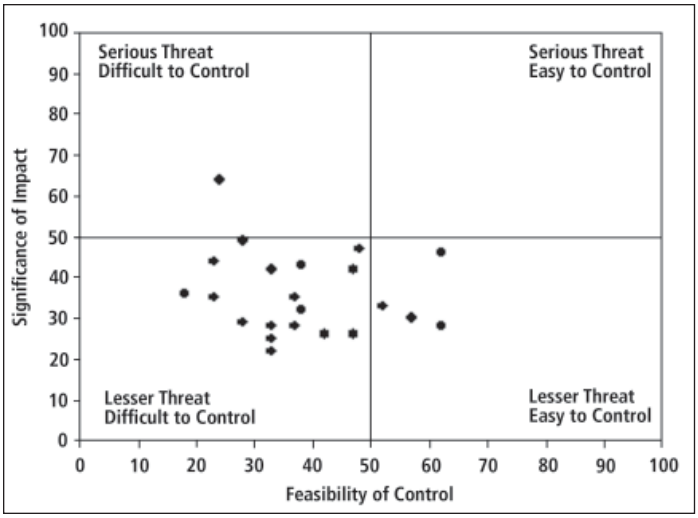

Figure 4. Fort Union National Monument contains 22 species of exotic plants. Field bindweed (*Convolvulus arvensis*), shown in the upper left quadrant, is a serious threat and difficult to control.

Table 2. Ranking of exotic plant species at Fort Union National Monument

Species	Significance of impact			Feasibility of control[3]	Urgency
	Level of impact[1]	Innate ability to become a pest[2]	Total		
Agrostis gigantean	3	32	35	23	Low
Bromus cartharticus	3	27	30	57	Low
Bromus japonicus	18	25	43	38	Low
Bromus tectorum	22	27	49	28	Low
Convolvulus arvensis	21	43	64	24	Medium
Cynodon dactylon	21	26	47	48	Low
Erodium cicutarium	3	25	28	33	Low
Kochia scoparia	12	34	46	62	Low
Lactuca serriola	5	21	26	42	Low
Marrubium vulgare	10	32	42	33	Low
Melilotus lupulina	3	29	32	38	Low
Medicago officinalis	17	27	44	23	Low
Medicago sativa	3	22	25	33	Low
Plantago lanceolata	3	25	28	37	Low
Plantago major	3	26	29	28	Low
Salsola tragus	10	23	33	52	Low
Sonchus asper	3	23	26	47	Low
Taraxacum officinale	4	32	36	18	Low
Tragopogon dubius	3	32	35	37	Low
Tragopogon pratensis	3	25	28	62	Low
Ulmus pumila	6	36	42	47	Low
Verbascum thapsus	6	16	22	33	Low

[1]–8 to 50 points possible
[2]4 to 50 points possible
[3]3 to 100 points possible

Table 3. Number of exotic plant species from selected National Park System units

Unit	State	Exotics	Highly disruptive exotics
Capulin Volcano National Monument	New Mexico	21	3
Effigy Mounds National Monument	Iowa	65	8
Fort Union National Monument	New Mexico	22	1
Pipestone National Monument	Minnesota	92	11
Scotts Bluff National Monument	Nebraska	44	9
Wilson's Creek National Battlefield	Missouri	48	18

The only highly disruptive species we mapped at Fort Union National Monument was field bindweed. This plant was restricted to disturbed areas near residences and along the roadside. We consider the plant community at Fort Union a stable shortgrass prairie without serious threats from exotic plants at present. Places of potential concern at Fort Union are the wet areas near Coyote Creek and areas of disturbance around the residential buildings and roads. As exotic plants become established, management should be directed toward control in these areas to avoid spreading. However, the dry climate of Fort Union will most likely limit exotic plant occurrence to areas with supplemental water.

The remaining exotic plants at Capulin Volcano and Fort Union occur in small, scattered populations, which do not now threaten the national monuments' native plant communities. Biplots of the relationship between the significance of impact and feasibility of control for Capulin Volcano (fig. 3) and Fort Union (fig. 4) show that these species fall within the lesser-threat quadrants. A majority of these plants are found in anthropogenic and naturally occurring disturbed areas. However, some of these species have the capacity to become problematic if they find an invasion pathway, but the dry climate of both national monuments is most likely limiting their expansion.

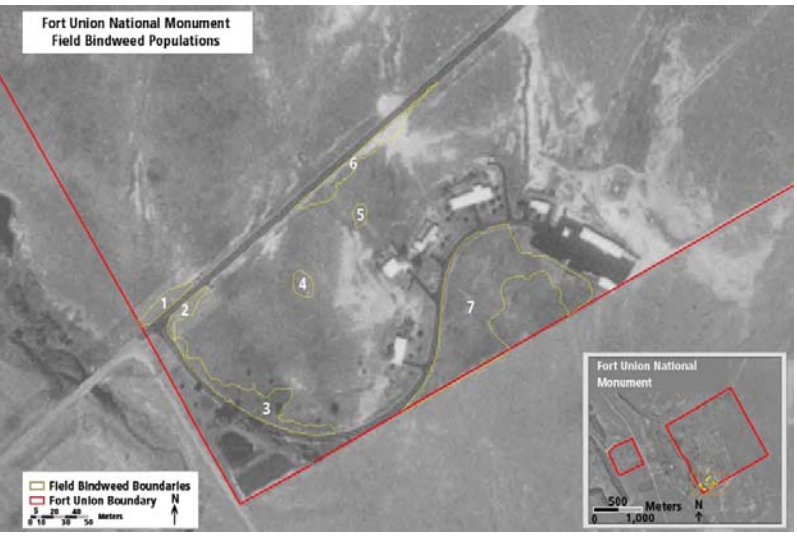

Figure 5. Investigators mapped populations of field bindweed (*Convolvulus arvensis* [shown in yellow]) at Fort Union National Monument. This species is highly disruptive and a species of concern for resource management at the national monument.

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Conclusion

Capulin Volcano and Fort Union national monuments were established as units of the National Park System for their geologic and historical resources, respectively. Both of these national monuments contain native plant communities. National Park Service management policies require that natural resources, including native plant communities, be protected from threats such as invasive, exotic plants. Because of their small size and primary management mission, neither national monument employs a full-time natural resource manager. Fortunately, we found that very few highly disruptive exotic plants had invaded the national monuments, possibly because of the dry climate. Managers at both national monuments can draw on the resources of the Chihuahuan Desert Southern Shortgrass Prairie Exotic Plant Management Team to control the disruptive exotics that do occur. The distribution maps of disruptive exotic plants that we provided should facilitate their effort. Finally, both national monuments are included in the Southern Plains Network, which proposes to monitor the response of exotic plants to management in each unit in the network.

We found that very few highly disruptive exotic plants had invaded the national monuments.

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