*Human–Wildlife Conflicts* 2(2):206–211, Fall 2008

# Evaluation of physical barriers to prevent prairie dog colony expansion

**Gary Witmer**, USDA/APHIS Wildlife Services' National Wildlife Research Center, 4101 LaPorte Avenue, Fort Collins, CO 80521-2154, USA *Gary.W.Witmer@aphis.usda.gov*

**James Gionfriddo**, USDA/APHIS Wildlife Services' National Wildlife Research Center, 4101 LaPorte Avenue, Fort Collins, CO 80521-2154, USA

**Michael Pipas**, USDA/APHIS Wildlife Services' National Wildlife Research Center, 4101 LaPorte Avenue, Fort Collins, CO 80521-2154, USA

***Abstract*:** Expansion of black-tailed prairie dog (*Cynomys ludovicianus*) colonies on public and private lands can result in damage to property. Physical barriers to prairie dogs can be used to minimize human–wildlife conflicts. We evaluated 17 existing barriers in the Fort Collins and Boulder, Colorado, areas. Most barriers were made of a single row of vinyl material; these barriers sustained high levels of damage, primarily from wind, and were frequently breached by prairie dogs digging underneath them. Barriers that included a vegetation and a vinyl barrier or a double-vinyl barrier were wind damaged and breached less frequently than the single-vinyl barriers. Sturdy panels of corrugated metal or fiberglass, extending about 76 cm above and 76 cm below the ground surface, were not damaged by wind and were rarely breached by prairie dogs. These barriers were about twice the cost of the single-vinyl barriers, but were much more durable and more effective in preventing prairie dog colony expansion.

***Key words:*** barriers, black-tailed prairie dog, *Cynomys ludovicianus*, human–wildlife conflicts, wildlife damage management

**Black-tailed prairie dogs** (*Cynomys ludovicianus*) pose many challenges to resource managers in suburban areas where conflicts exist with prairie dogs (Reading et al. 2002; Witmer et al. 2000, 2003). Prairie dog colonies have the potential to expand rapidly in size (Crosby and Graham 1986, Fagerstone et al. 2005), which can lead to increased conflicts with humans, including damage to crops and ornamental plants, irrigation piping, and underground cables. Each individual prairie dog population often must be managed very differently. Hence, municipalities have designed management plans with public input to reduce conflicts with prairie dogs. Such plans include zoned management areas and a variety of other management techniques and tools (Zinn and Andelt 1999, Reading et al. 2002, Witmer et al. 2003).

The prairie dog management plans of Boulder, Colorado (City of Boulder 1996), Fort Collins, Colorado (City of Fort Collins 1998), and Boulder County, Colorado (Boulder County 2002) use an integrated approach to manage conflicts that incorporate prairie dog habitat and population management and people management (Witmer et al. 2000, 2003). It should be noted, however, that the possible techniques can vary greatly in their effectiveness, cost, and public acceptability. For example, to restrict the expansion of colonies, land managers can relocate prairie dogs (Truett et al. 2001), use artificial barriers (Franklin and Garrett 1989, Hygnstrom 1996), use toxicants (Witmer and Fagerstone 2003), or trap and euthanize the animals and use the carcasses for injured raptor and black-footed ferret programs (M. Brennan, biologist, Boulder County, personal communication). However, resource managers are often limited in their management options by budgetary, legal, and sociopolitical constraints.

In this study, we evaluated the effectiveness and durability of existing artificial barriers placed to restrict the expansion of prairie dog colonies. Seventeen existing barriers were examined for their physical characteristics (length, height, material, method of placement), amount and types of damage that occurred to each, and frequency and type of breaching by prairie dogs. To be effective, barriers must hold up under harsh (particularly windy) weather conditions and must prevent prairie dogs from gaining access to the other side of the barrier (i.e., prevent colony expansion).

## Study area and methods

During 2002–2003, 17 prairie dog barriers were evaluated through examination of the

physical condition of the barriers, the extent of prairie dog activity on each side of the barriers, and signs of prairie dog movements across, over, under, or through the barriers. We did not examine any barriers in a native prairie setting. Rather, all barriers were within Boulder and Larimer counties, Colorado, and all were at the interface between public and private property. All were erected to prevent the expansion of an existing colony. Most barriers (8) were constructed of reinforced vinyl (Figure 1): three were reinforced vinyl with chicken wire and three with chicken wire alone; one was a tightly woven nylon; one was comprised of corrugated fiberglass panels; and one was comprised of corrugated metal panels (Figure 2). The latter 2 barriers were made with sturdy panels 152 cm tall, extending 76 cm above and 76 cm below the ground surface. Most vinyl barriers were constructed with about 7 cm of the vinyl barrier buried beneath the ground surface in an effort to discourage prairie dogs from easily passing underneath. Two of the reinforced barriers were double barriers with distances of 0.45 and 1.8 m between the parallel barriers. The rationale for this type of barrier is that if an animal breaches the first barrier, it will immediately encounter the second barrier and be less inclined to attempt to breach that second barrier. With 4 of the barriers, there had been an attempt to establish a row of vegetation in conjunction with the physical barrier, presumably to increase the amount of visual obstruction. All barriers were installed between 1998 and 2002, so, they varied in age from 1 to 5 years when we evaluated them.

Barriers were evaluated only once. Our criteria of success for an effective barrier was that it must hold up under harsh (particularly windy) weather conditions and must prevent prairie dogs from gaining access to the other side of the barrier. Each barrier was characterized on the basis of its construction materials, height, length, how the barrier was attached to the support structure, and the numbers of active and inactive prairie dog burrows within 10 m of each side of the barrier. We refer to the inside of the barrier as the side with the prairie dog colony, whereas the outside was devoid of prairie dogs when the barrier was constructed. All damaged parts of each barrier were counted and measured, and the suspected or known cause (e.g., wind, erosion, equipment, animal, material failure) of each damaged area was recorded. The number of breaches by prairie dogs and how those breaches occurred (e.g., by prairie dogs digging under, climbing over, or chewing through the barrier) were determined for each barrier. We determined if animals were climbing over barriers by observing claw markings or muddy paw prints going up to the top of the barrier, and, in some cases, by directly observing animals going over the barriers while we were taking measurements. Any problems related to the design, construction, installation, placement, or maintenance of the barriers, or to the breakdown of materials were noted. The condition of the barriers and animal activity were recorded for each 10-m segment. Most barriers (Reef Industries, Inc., Houston, Tex.) were constructed as suggested in the guidelines provided by the City of Fort Collins (City of Fort Collins, no date).



Figure 1. An intact vinyl barrier.

For reinforced vinyl barriers, we used linear regression to examine for relationships between (1) barrier age and number of breaches, (2) barrier age and number of damaged areas, (3) barrier height and number of breaches, (4) barrier height and number of damaged areas, (5) barrier length and number of breaches, and (6) barrier length and number of damaged areas. To interpret the regressions, we used a significance level of $P = 0.05$.

## Results

### Barrier condition

There was large variation in both the length and height of the barriers. The average length



Figure 2. A corregated steel barrier, partially installed.

was 490 m (SD = 312 m, range = 138–1161 m). The average height was 73 cm (SD = 16 cm, range = 40–95 cm).

Most of the barriers had damaged areas caused by a variety of factors, including, in descending order, wind (1,126 cases), animal digging (88), animal chewing (78), unknown and other (35), attachment or support failure (18), equipment (9), and soil erosion (8). We noted that it often was difficult to distinguish animal digging and scratching from chewing, and both may have occurred often, so there is overlap in the numbers for those 2 categories. Among the 14 damaged barriers, the number of damaged areas per 10-m segment varied greatly, averaging 1.4 areas of damage (SD = 2.8, range = 2–995). This large average and standard deviation were greatly influenced by 1 barrier that had excessive wind damaged areas. The 4 physical barriers that included a vegetation barrier averaged only 0.2 (SD = 0.1) damaged segments. This pattern also was consistent with that of the 2 double barriers, which averaged only 0.4 (SD = 0.1) damaged segments. There was no relationship between the number of damaged areas and the barrier's age ($P = 0.61$), height ($P = 0.12$), or length ($P = 0.24$). Damage was equally likely to occur (1 damaged area/segment) near the ends of the barrier as near its middle.

One of our criteria of barrier success was that it must hold up under harsh (particularly windy) weather conditions. Only 3 of the 17 barriers met this criterion. Two barriers that were not damaged were comprised of very heavy-duty, well-entrenched materials: corrugated fiberglass or metal panels. The third undamaged barrier was made of chicken wire alone.

## Barrier breaching by prairie dogs and prairie dog burrows near barriers

All barriers had been breached, as indicated by recent prairie dog activity outside the barrier (Figure 3). Hence, none of the barriers met our second criterion of barrier success: that it must prevent prairie dogs from gaining access to the other side of the barrier. The number of breaches per 10-m segment varied greatly, averaging 0.3 breaches (SD = 0.31, range = 0.02–1.2). Often, we could not determine how a barrier was breached. When we could, breaching resulted, in descending order, from prairie dogs digging under (208), chewing or clawing through (28), moving through a gap under the barrier (22), going over a collapsed barrier (6), climbing over the barrier (1), going through a culvert (1), going through a slit in the barrier (1), or going through an open gate in the barrier (1). The 4 physical barriers with a vegetation barrier nearby averaged 0.09 (SD = 0.05) breaches per segment, and the 2 double barriers averaged 0.13 (SD = 0.0) breaches per segment. There was no relationship between the number of breaches and barrier age ($P = 0.78$), its height ($P = 0.09$) or its length ($P = 0.14$). Barriers were somewhat more likely to be breached in their middle (67% of segments breached) versus near their ends (44% of segments breached).

All barriers had some burrows within 10 m of the inside and the outside of the barrier. Many 10-m segments, however, had no burrow

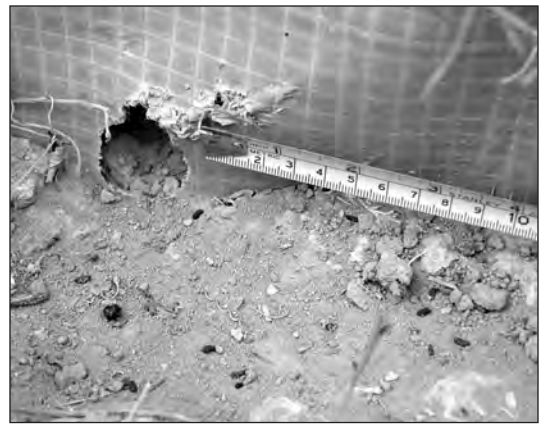


Figure 3: A vinyl barrier that has been damaged by animals.

openings within 10 m of them. Hence, when the number of burrow openings within 10 m of the inside of the barrier is averaged over all 10-m segments of the barrier, there were 1.64 (SD = 1.29, range = 0–10) burrows within 10 m of each segment of the barrier. The same was true outside the barriers, where the average was 1.11 (SD = 1.12, range = 0–8) burrows within 10 m of each segment of the barrier. Three of the 17 barriers evaluated had a large number of burrow openings both inside and outside the barrier. Across barriers, the closest burrow opening within 10 m of the barrier on the inside averaged 3.3 m (SD = 1.6 m). Similarly, on the outside of the barriers, the average distance of the nearest burrow opening was 3.1 m (SD = 2.0 m).

## Discussion

Expansion of prairie dog colonies from public properties to private properties often results in property damage or conflicts that need to be resolved. Barriers have been, and continue to be, an attractive, nonlethal management strategy to resolve the problems, but the effectiveness of these barriers to contain colonies has often been questioned (Franklin and Garrett 1989, Hygnstrom 1996). Additionally, the cost of barrier installation and maintenance is a concern. The materials and installation for a vinyl barrier cost approximately $30 per m, with an additional $140–$160 for each corner or end post arrangement (J. Jukkolo, Wyco Fence and Supply, personal communication). The materials used for these barriers are considered to have a life span of about 5 years (City of Fort Collins 1998). Corrugated metal or fiberglass barriers are more durable and require less maintenance than vinyl barriers, but are twice as expensive at approximately $60 per m (B. Pritchett, biologist, City of Boulder, personal communication). The cost of corners for both metal and fiberglass barriers also is $60, which is much less expensive than the cost for corners of vinyl barriers. However, there are generally only 1 or 2 corners per entire barrier, and, in many cases, there are no corners. These costs must be weighed against the cost of other prairie dog management options. Fumigation costs about $4 per burrow opening, and relocation costs about $15 per animal (City of Fort Collins 1998). It should be noted that survival rates for relocation can be low unless considerable effort is made to reduce losses (Truett et al. 2001).

Our survey of existing barriers confirms our concern about their effectiveness and durability. Most (82%) of the barriers evaluated had damage, usually in numerous places and often covering a substantial area. Barriers were damaged in a variety of ways, but high winds were the most frequent cause. Days with high winds (≥ 80 km/hr) occur relatively frequently along the Colorado Front Range during the fall and spring. Of course, several variables, including orientation of the barrier and the prevailing wind speed and direction in a specific area, can affect barrier durability. All barriers had burrow openings near them, and all barriers had been breached by prairie dogs. This was evident by burrow openings outside the barriers. The amount of effort prairie dogs expend to get outside barriers is probably related to the density of the colony and to the normal dispersal tendencies of maturing animals. Prairie dogs gained access to areas outside the barriers in several different ways, but animals digging under them was most prevalent. To prevent digging under, barriers would need to extend a considerable depth under the ground surface, as burrows for black-tailed prairie dogs commonly extend to depths of 2 to 3 m (Sheets et al. 1971). Additionally, to be effective, barriers must be well-made and regularly-maintained. Vinyl (even reinforced vinyl) was particularly subject to damage. Fiberglass and metal panels are much more durable, and, if extended well below the surface, are rarely breached. The cost of these materials and extensive trenching and labor required to install them, however, make the barriers quite expensive. Presumably, the barriers evaluated in this study had varying amounts of maintenance, but maintenance records had either not been kept or were not available for examination. Prairie dogs commonly breached the 2 barriers comprised of chicken wire alone, perhaps because chicken wire provides minimal visual obstruction.

Efforts to use vegetation as a visual barrier in addition to a nearby physical barrier did not prevent breaching by prairie dogs, but it may have reduced it. Unfortunately, in the hot, dry climate of the plains of Colorado, dense

vegetation is difficult to establish and maintain without irrigation and routine care. It is possible that increased effort put into the vegetation barriers would result in more frequent and better maintenance of the physical barriers. This may explain why vegetation barriers had fewer damaged areas and breaches on average. Terrall et al. (2005) noted the difficulty in establishing thick vegetation barriers in arid climates and, consequently, that all barriers were breached to some extent, regardless of width. Franklin and Garrett (1989), on the other hand, reported that vegetation barriers comprised of 3 parallel rows of young pine trees reduced, but did not eliminate, prairie dog movements. The results of their study and of ours suggest that vegetation barriers should be further investigated for their ability to slow colony expansion, especially because vegetation barriers are more aesthetically pleasing to many people than are artificial physical barriers. Similarly, the 2 double barriers had less damage and fewer breaches than the average for other barriers. Perhaps this type of barrier should also be further investigated, but higher costs must be considered.

The results of this study suggest that barriers constructed to prevent or slow prairie dog colony expansion will probably be only partially effective unless considerable effort and cost is invested in barrier construction and maintenance. As a result, in almost all cases, some removal of prairie dogs that breach the barrier will be needed. Also, it is necessary to prevent easy reopening of new burrows by other prairie dogs. This can be accomplished by filling the burrows with pea gravel or by using chicken wire over burrow openings. It is likely that only when these measures are followed will barriers be effective in prevention of colony expansion and damage to private property and vegetation outside the barrier.

## Acknowledgments

We thank D. Dees, Fort Collins Natural Areas Department, and M. Brennan, Boulder County Open Space and Parks Department, for providing access to public properties with prairie dog colony barriers. We also thank T. Linder and S. Gaddis for assistance with fieldwork and data entry. We appreciate the comments of 3 anonymous reviewers.

## Literature cited

Boulder County. 2002. Grassland management plan: prairie dog habitat element. Boulder County Parks and Open Space Department, Boulder, Colorado, USA.

City of Boulder. 1996. Black-tailed prairie dog habitat conservation plan. City of Boulder Open Space/Real Estate Department, Boulder, Colorado, USA.

City of Fort Collins. 1998. Prairie dog policy for city natural areas. Department of Natural Resources, Fort Collins, Colorado, USA.

City of Fort Collins. n. d. Prairie dog visual barrier setup guidelines. Department of Natural Resources, Fort Collins, Colorado, USA.

Crosby, L., and R. Graham. 1986. Population dynamics and expansion rates of black-tailed prairie dogs. Proceedings of the Vertebrate Pest Conference 12:112–115.

Fagerstone, K., H. Tietjen, J. Glahn, G. Schenbeck, and J. Bourassa. 2005. Black-tailed prairie dog colony dynamics in South Dakota over a 10-year period. Proceedings of the Wildlife Damage Management Conference 11:323–336.

Franklin, W., and M. Garrett. 1989. Nonlethal control of prairie dog colony expansion with visual barriers. Wildlife Society Bulletin 17:426–430.

Hygnstrom, S. 1996. Plastic visual barriers were ineffective at reducing recolonization rates of prairie dogs. Proceedings of the Great Plains Wildlife Damage Control Workshop 12:74–76.

Reading, R., T. Clark, L. McCain, and B. Miller. 2002. Black-tailed prairie dog conservation: a new approach for a 21st century challenge. Endangered Species Update 19:162–170.

Sheets, R., R. Linder, and R. Dahlgren. 1971. Burrow systems of prairie dogs in South Dakota. Journal of Mammalogy 52:451–453.

Terrall, D., J. Jenks, and A. Smith. 2005. Use of natural vegetative barriers to limit expansion of black-tailed prairie dog towns. Proceedings of the Wildlife Damage Management Conference 11:387–392.

Truett, J., J. Dullman, M. Matchett, E. Owens, and D. Seery. 2001. Translocating prairie dogs: a review. Wildlife Society Bulletin 29:863–872.

Witmer, G., M. Brennan, D. Dees, B. Hoffman, F.

Pusateri, C. Richardson, and D. Seery. 2003. Black-tailed prairie dog management in urban-suburban settings: opportunities and challenges. Transactions of the North American Wildlife and Natural Resources Conference 68:209–221.

Witmer, G., and K. Fagerstone. 2003. The use of toxicants in black-tailed prairie dog management: an overview. Proceedings of the Wildlife Damage Management Conference 10:359–369.

Witmer, G., K. VerCauteren, K. Manci, and D. Dees. 2000. Urban-suburban prairie dog management: opportunities and challenges. Proceedings of the Vertebrate Pest Conference 19:439–444.

Zinn, H., and W. Andelt. 1999. Attitudes of Fort Collins, Colorado, residents towards prairie dogs. Wildlife Society Bulletin 27:1098–1106.



**Gary Witmer** (photo) is a research wildlife biologist for the USDA/APHIS/Wildlife Services' National Wildlife Research Center in Fort Collins, Colorado. He received his Ph.D. degree from Oregon State University (1981). His research focuses on reducing damage by both native species and invasive species of rodents.

**James Gionfriddo** (photo unavailable) is a research wildlife biologist for the USDA/APHIS/Wildlife Services' National Wildlife Research Center in Fort Collins, Colorado. He received his Ph.D. degree from Iowa State University (1994). His research focuses on fertility control in wildlife.

**Michael Pipas** (photo unavailable) is a wildlife disease biologist for the USDA/Wildlife Services and is based in Casper, Wyoming. At the time of this research study, he was a biological science technician for the USDA/APHIS/Wildlife Services' National Wildlife Research Center in Fort Collins, Colorado. He received his M.S. degree from Washington State University (1992).