

A RELOCATION TECHNIQUE FOR BLACK-TAILED PRAIRIE DOGS

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ABSTRACT.—Relocations of black-tailed prairie dogs have occurred both to save individual prairie dogs from urban development and to reestablish populations that have been extirpated. Unfortunately, however, many past relocation efforts rarely exceeded 40% retention. Many factors have contributed to very low retention rates in past relocation efforts including lack of (1) suitable habitat, (2) proper artificial burrow systems, (3) aboveground acclimation cages or pens, and (4) skilled people conducting the relocations. In an attempt to increase prairie dog relocation success, we developed techniques that are easy to implement, promote high retention, and effectively conserve labor, financial resources, and prairie dog populations. We conducted 3 relocations along the Front Range of Colorado in 2001 and 2002. Relocation techniques we developed resulted in at least 46%–92% retention. Our results suggest that a large percentage of prairie dogs can be retained by (1) ensuring that habitat is suitable, (2) using underground nest chambers modeled after natural nest chambers, (3) acclimating prairie dogs to the release site in large retention pens rather than in retention caps or other small acclimation cages (i.e., rabbit hutch), and (4) providing supplemental feed and water ad libitum to the prairie dogs.

Key words: prairie dog, relocation, translocation, black-tailed prairie dog, *Cynomys ludovicianus*, artificial release.

The black-tailed prairie dog (*Cynomys ludovicianus*) is 1 of 5 species of prairie dogs in the United States. Historically, the species existed from Canada to northern Mexico, from the foothills of the Rockies east to the mid-grass prairie (Fitzgerald et al. 1994). Black-tailed prairie dogs were the most numerous and widespread herbivore in the Great Plains (Barko 1997) and perhaps even North America (Wuerthner 1997). Various sources report that the prairie dog has declined 98% throughout its range during the past 100 years because of poisoning campaigns, land use conversion, plague, and other causes (Whicker and Detling 1988, Miller et al. 1994).

The U.S. Fish and Wildlife Service (USFWS), after receiving a petition from the National Wildlife Federation, determined in their 12-month finding that the prairie dog was “warranted but precluded” from listing as a threatened species (USFWS 2000). In addition, to meet minimum conservation standards set forth in the Conservation Assessment and Strategy (Van Pelt 1999) and the Multi-State Conservation Plan (Luce 2003), some of the 11 states within the range of the black-tailed prairie dog may need to conduct live relocations. Relocations may be utilized as a management technique to ensure no net loss of prairie dog acreage

in the face of development or agricultural activities, or to reestablish prairie dogs in areas where they were extirpated. Unfortunately, survival and retention of relocated prairie dogs during many past relocation efforts have rarely exceeded 40% (Jacquart et al. 1986, McDonald 1993, Robinette et al. 1995, Truett and Savage 1998, Truett et al. 2001, Meaney et al. 2002).

Many factors have contributed to very low retention rates from past relocation efforts. These include the lack of (1) suitable habitat, (2) proper artificial burrow systems, (3) aboveground acclimation cages or pens, and (4) skilled people conducting the relocations. One technique that resulted in as little as 0% retention involved simply releasing prairie dogs into augered holes rather than proper artificial burrow systems. Prairie dogs released into augered holes (with or without acclimation structures) seldom remain where they are released (Turner 1979, Jacquart et al. 1986, Truett and Savage 1998, Truett et al. 2001). Other techniques utilizing underground artificial nest chambers coupled with aboveground acclimation cages still, however, generally result in <50% retention (Truett et al. 2001, Meaney et al. 2002). Therefore, it is vitally important that relocation techniques be developed and utilized which

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TABLE 1. Habitat attributes including soil type, vegetation composition, slope, and size of the relocation area of DMOS relocation sites in 2001 and GWROS sites in 2002.

Site/Soil type	Vegetation	Slope	Relocation area
DMOS			
Clay-loam ¹	bluegrass (<i>Poa</i> spp.) smooth brome (<i>Bromus inermis</i>) adjacent yellow sweet clover (<i>Melilotus officinalis</i>)	0–5%	Phase 1: 8 ha Phase 2: 4 ha adjacent to phase 1 site
GWROS			
Cobbly clay loam ²	blue grama (<i>Bouteloua gracilis</i>) Indian rice grass (<i>Achnatherum hymenoides</i>) red three awn (<i>Aristida purpurea</i>) prickly pear (<i>Opuntia polyacantha</i>) common mullein (<i>Verbascum thapsus</i>) field bindweed (<i>Convolvulus arvensis</i>) ragweed (<i>Ambrosia</i> spp.)	0–5%	8 ha

¹Moreland and Moreland 1975

²Price and Amen 1980

are relatively easy to implement, promote high retention and survival, and effectively conserve labor, financial resources, and prairie dog populations.

We describe 3 relocations we conducted on the Front Range of Colorado in 2001 and 2002. These relocations focused on successfully establishing prairie dogs rather than comparatively testing techniques. Relocation techniques described in this paper resulted in 46%–92% retention.

METHODS

Relocation Sites

We conducted 3 prairie dog relocations between 2001 and 2002. Two relocations were conducted in June–August 2001 to Davidson Mesa Open Space (DMOS) in Louisville, Colorado. A 3rd relocation was conducted in June 2002 to Great Western Reservoir Open Space (GWROS) in Broomfield, Colorado. Table 1 describes the soil type, vegetation, slope, and size of the relocation area for each site. Predators such as Red-tailed Hawks (*Buteo jamaicensis*) and coyotes (*Canis latrans*) were observed on each site before, during, and after relocations.

Site Preparation

Black-tailed prairie dogs prefer a visually unobstructed habitat, generally shorter than 20 cm (Clippinger 1989, McDonald 1993, Fitzgerald et al. 1994, Hoogland 1995). Because vegetation on the DMOS site was >20 cm tall, we mowed it to a height of approximately 10

cm 3 weeks before the phase 1 relocation and 1 week before the phase 2 relocation. The GWROS release site was not mowed because the vegetation was generally shorter than 20 cm.

We buried artificial burrow systems at all 3 sites. Underground nest chambers were constructed from 0.95-cm-thick plywood, and high-density cardboard tubes served as tunnels leading from the nest chambers to the soil surface (Fig. 1). We used biodegradable and modifiable tubes to ensure the relocation site remained free of synthetic materials and quickly resembled a natural prairie dog colony.

Using a mini-excavator to dig holes for the artificial burrow systems, we buried most chambers ≥ 1 m deep. Although most natural prairie dog nest chambers are 2–3 m deep (Hoogland 1995), burying artificial nest chambers at this depth could result in an extreme amount of soil and vegetation disturbance. Because prairie dog “listening” chambers are approximately 1 m deep (Hoogland 1995) and provide prairie dogs with adequate protection from predators, inclement weather, and summer temperature extremes, we determined that 1 m was appropriate to balance resource disturbance with prairie dog survival.

Aboveground retention caps and pens covered the entrances of artificial burrows during relocations. Retention caps and pens temporarily contained the released prairie dogs so they could acclimate to their new surroundings and would not immediately disperse. We used retention caps, which were enclosed cylinders 1 m² made from 0.635-cm hardware cloth (Fig. 2), during all 3 relocations. Retention pens, made

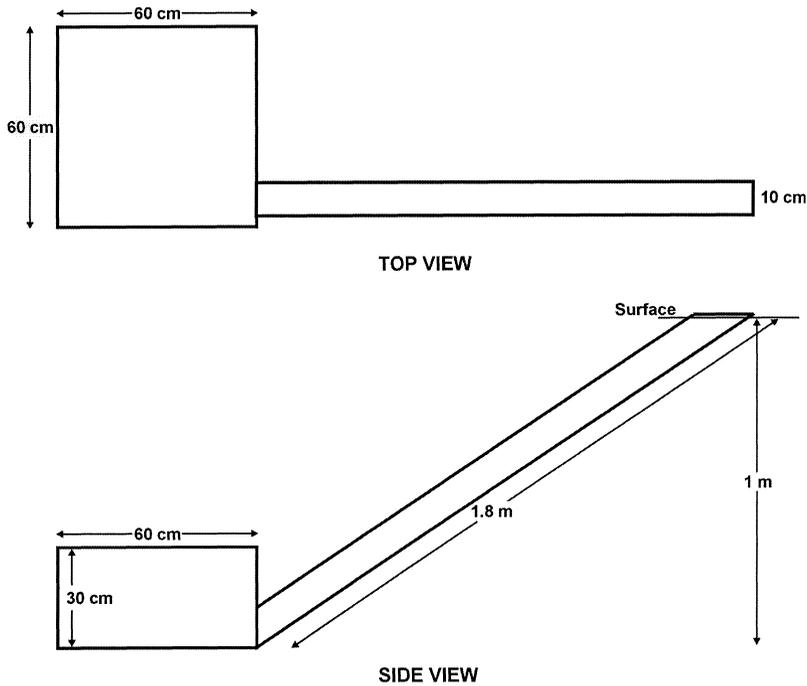


Fig. 1. Diagram of the artificial burrow system for prairie dogs designed by Roe Ecological Services and installed on DMOS in 2001 and GWROS in 2002.

from 2.5-cm chicken wire (Fig. 3), were much larger than retention caps, being 14.5 m^2 (3.81 m long per side). The chicken wire was purchased in $1.8 \times 45.72\text{-m}$ rolls, which were then cut into three $1.8 \times 15.24\text{-m}$ lengths. To allow each length to be folded into a square pen with a bottom, side, and top, we made two 60-cm slits (cutting from the outer edge inward) at 3.81-m intervals. The bottom was staked to the ground with lawn staples, the top was held together with plastic zip ties, and the sides were kept vertical with metal posts zip-tied to the chicken wire.

Trap Site Coterie Identification

Based on the assumption that prairie dogs' natural social groupings are important and should be maintained, we relocated prairie dogs in coterie (family groups) as much as possible. We determined coterie association by observing social interactions and daily movement patterns of individual prairie dogs on the trap site. Prairie dogs that interacted amicably and without obvious territorial display and remained within a similar area were

determined to be of the same coterie. We made a map of the trap site and corresponding coterie associations, labeling each trap with a piece of electrical tape showing the unique coterie identifier of the area within which the trap was placed.

Relocation Process

During all relocation efforts we used only cage-type live-traps for prairie dog capture. Trapped prairie dogs were collected at approximately 2-hour intervals throughout the day and moved to a shaded area for processing to reduce likelihood of heat stress. Processing included dusting with insecticide to remove fleas, recording the sex, age class (adult, yearling, or juvenile), and coterie identifier, and assigning each individual an artificial burrow at the release site. Prairie dogs captured during the GWROS relocation were marked with Nyanzol-D hair dye with individual patterns. After processing them, we immediately transported all individuals to the relocation site in a pickup truck equipped with a ventilated bed topper in the live-traps within which they were trapped to minimize stress and to preserve

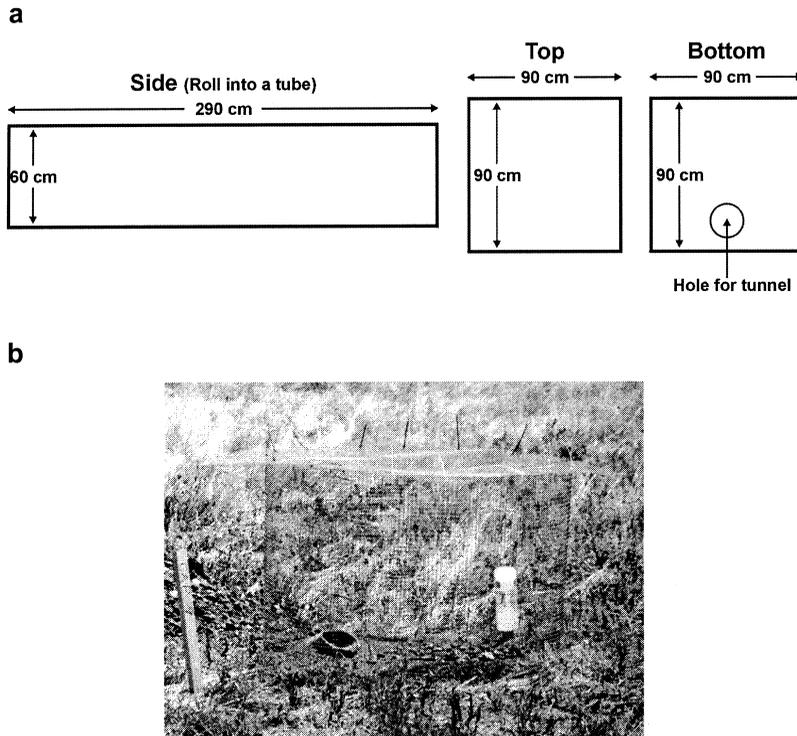


Fig. 2. Prairie dog retention cap designed by Roe Ecological Services and installed on DMOS in 2001 and GWROS in 2002: a, diagram; b, photo.

each individual's sex classification, coterie identifier, and artificial burrow assignment.

When possible, we released prairie dogs with their original coterie members into the same or adjacent artificial burrows at the release site. We released only 1 adult male or 2 yearling males with females and juveniles from the same coterie. Lone males or additional males of a coterie were released with males of the same coterie or adjacent coterie as often as possible. We released an average of 7.8 prairie dogs per artificial burrow system, with a maximum of 11.

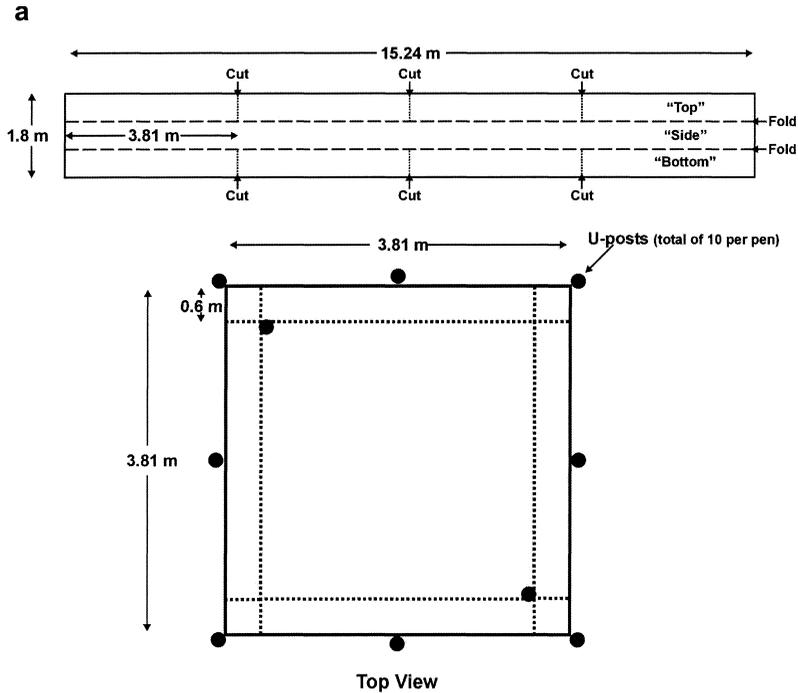
Supplemental Feeding and Watering

We attached a water bottle to the side of the retention cap or pen and placed a high-quality grain and mineral mix inside. This provided access to food and water *ad libitum* while the prairie dogs became acclimated to the new site. We checked levels of food and water and cap or pen integrity daily.

After we removed a cap or pen, we attached the water bottle to a post and placed grain and mineral mix at least every 3rd day on top of the mound or soil adjacent to the burrow entrance. This provided an additional food source, offered an incentive to remain at the original release burrow, and facilitated monitoring of relocated prairie dogs. Newly constructed natural burrows that showed prairie dog activity also received deposits of grain and mineral mix. We continued providing food and water for approximately 3 weeks post-release for all relocation efforts.

Monitoring

Three methods commonly are used to estimate prairie dog population size and density. Mark-recapture is a reliable but labor-intensive method (Otis et al. 1978, Fagerstone and Biggins 1986, Menkens et al. 1990). Counts of plugged and reopened burrows provide an index of prairie dog activity (Knowles 1982, Tietjen and Matschke 1982). Visual counts can



b



Fig. 3. Prairie dog retention pen designed by Roe Ecological Services and installed on GWROS in June 2002; a, diagram; b, photo.

provide a quick estimate of prairie dog population density (Fagerstone and Biggins 1986, Knowles 1986). We did not have the financial means or the desire to disturb the newly relocated populations to conduct a mark-recapture study. Population estimation by counts of plugged and reopened burrows was not practical because the number of prairie dogs per burrow was initially unnaturally high. Furthermore, Lewis et al. (1979) confirmed that the number of burrows is not necessarily correlated

with prairie dog density. Therefore, we conducted visual counts for estimation of post-release retention.

We observed prairie dogs on the DMOS site from the cab or top of a pick-up truck with 10×50 binoculars because the site had relatively flat terrain and was recently mowed. Prairie dogs from the GWROS site also were observed and identified with the use of 10×50 binoculars from a hill approximately 30 m above and 100 m away from the release site.

TABLE 2. Relocation methods, number of prairie dogs relocated, and percent retention for DMOS phase 1 and phase 2 relocations conducted in 2001 and GWROS relocation conducted in 2002.

Site	Methods used	Number relocated	Percent retention
DMOS phase 1	50 artificial burrow systems 44 nest chambers were 5-sided without bottoms 6 nest chambers were 6-sided with plywood bottoms Retention caps without bottoms 2- to 3-day acclimation period	399	45% (182 retained)
DMOS phase 2	24 artificial burrow systems All 24 nest chambers were 6-sided with plywood bottoms Retention caps with bottoms 5-day acclimation period	196	62% (121 retained)
GWROS	16 artificial burrow systems 3 nest chambers were 5-sided with no bottoms 13 nest chambers were 6-sided with cardboard bottoms 12 retention caps with bottoms 6 retention pens 8-day acclimation period	104	89% (96 retained)

We mapped the location of individual prairie dogs on the GWROS site during observations conducted from dawn until dusk for 2 consecutive days until we could not identify any additional unique prairie dogs. Because prairie dogs were not marked for the phase 1 and 2 DMOS relocations, we mapped the location of every burrow and identified the number and approximate age class of prairie dogs using each burrow. We also conducted these observations from dawn until dusk for 2 consecutive days. For all 3 sites we conducted monitoring activities approximately 2 weeks post-release.

RESULTS

Table 2 describes methods used, number of prairie dogs relocated, and percent retention for all 3 relocations. It is possible that more prairie dogs survived from the DMOS phase 2 release and dispersed into the adjacent phase 1 area. However, because individuals were not marked, we can base our conclusions only on the number of prairie dogs observed in the area where they were released. Prairie dogs that no longer remained on the relocation sites may have (1) been killed by coyotes or raptors, (2) died of stress or other unknown factors, or (3) dispersed away from the designated release area (i.e., DMOS prairie dogs may have moved to 1 of 3 existing prairie dog towns in close

proximity to the relocation site). Coyote predation and dispersal rates for all relocations were highest for the first 3 or 4 days post-release and decreased thereafter.

Retention caps and pens kept most prairie dogs from immediately dispersing. We left retention caps and pens in place for 2–3 days post-release for phase 1 at DMOS and for 5–8 days for phase 2 on the DMOS and GWROS releases. We originally planned to acclimate phase 1 prairie dogs for 5 days. However, we did not put bottoms on the retention caps, and within 2–3 days the prairie dogs had dug out. After digging out, most prairie dogs were observed returning to the shelter of the cap when seeking safety and at night. Some prairie dogs, however, dispersed and did not return to the artificial burrow. Therefore, we put bottoms on the retention caps made of the same hardware cloth with a 10-cm cutout for the tube, and we extended the acclimation period to 5 days for the phase 2 effort.

We acclimated prairie dogs in the caps and pens for 8 days for the GWROS relocation. By the end of the 7th day, the prairie dogs had caused damage to the vegetation and root layer through clipping and digging even though they had sufficient supplemental food. Therefore, we removed the caps and pens on the 8th day post-release to minimize resource damage.

DISCUSSION

One limitation of DMOS phase 1 and 2 relocations was that release sites were in the middle of a recreational open space. Two trails heavily used by hikers, joggers, dog walkers, and cyclists bisected the relocation sites. Farrar et al. (1998) reported that relocated prairie dogs are nearly twice as sensitive to human activity as native prairie dogs. The activity on the trails may have affected release site fidelity and subsequent survival through frequent interruptions in foraging and social interactions (Farrar et al. 1998). Thus, many prairie dogs may have left the relocation area before they had enough time to become established.

A 2nd potential limitation was that the vegetation composition of DMOS was not suitable for prairie dog survival and persistence because the primary species were not grazing tolerant and grew 30 cm in height (Roe and Roe 2003). Similarly, most of GWROS had a large proportion of annual and noxious weeds, which are not generally considered suitable for prairie dog habitation (Roe and Roe 2003). A small portion of GWROS, upon which the relocation was conducted, supported more species that were considered grazing tolerate and maintain a shorter height. This vegetation composition also may have contributed to the higher level of prairie dog retention at GWROS.

High levels of coyote activity also were considered a limitation for all 3 relocations. On several occasions we observed coyotes hunting at the release sites. Observations of the release sites 1 and 2 weeks post-release showed evidence of coyote use, including scat and digging on and around artificial burrows. This high level of predator activity also could have caused prairie dogs to disperse away from the release site.

Alternatively, the strengths as expressed by the increasing retention of our relocations, especially the relocation on GWROS, included (1) size of our artificial nest chambers, (2) development of new techniques including the use of retention pens, and (3) supplemental feeding and watering during the relocation and post-release. Natural prairie dog nest chambers are roughly 30 cm high and 50 cm in diameter (Hoogland 1995), or 58,904 cm³ in volume. Our artificial underground nest chambers are 108,000 cm³. Consequently, we observed 5 to 15 prairie dogs freely choosing to

remain and use the chambers once we removed retention caps or pens.

Many other relocation efforts past and present use smaller structures not modeled after natural nest chambers, which may have lead to lower retention levels. For example, efforts conducted along the Front Range of Colorado commonly used 2 different styles of underground nest chambers. One style is a 6-sided plywood box approximately 23.5 cm high, 18.4 cm wide, and 61 cm long (26,376.4 cm³). The 2nd style is a 20.32-cm-diameter and 122-cm-long (39,518 cm³) pressed cardboard caisson tube wired to plywood end caps. The use of larger, more natural-sized nest chambers may reduce crowding and ensure that ample oxygen is available within these chambers to allow multiple individuals to spend the night in a single box without asphyxiating.

The combined cost of construction and installation of the larger plywood boxes is generally \$10 more per box than the small plywood boxes or small caisson tubes (Table 3). Typically, however, twice as many prairie dogs can be relocated and retained in larger plywood boxes. This translates into fewer boxes, less labor and equipment rental fees per box, and less soil and surface disturbance. Therefore, the total cost of artificial burrow systems using small plywood or small caisson tubes may be up to twice as much as large plywood boxes.

Another improvement on the GWROS project was the creation and use of retention pens instead of traditional retention caps on 6 of the 16 artificial burrows. Retention caps, because of their small size, appear to restrict prairie dog behavior and interaction with their natural environment. In contrast, retention pens allow prairie dogs to interact in a less crowded containment area and to investigate a greater portion of their natural environment while being adequately retained. Within the retention pens prairie dogs are able to consume natural vegetation, develop dusting sites, initiate new burrow systems, and interact socially with their coterie and pen mates. The retention pens are generally over 4 times as expensive as retention caps (Table 3); however, materials used to construct the pens are reusable and their use may have resulted in increased retention of relocated prairie dogs.

Supplemental feeding and watering was also important to prairie dog health and site

TABLE 3. Estimated cost comparison of equipment and materials needed for 10 augered holes, 10 artificial burrow systems, and 10 acclimation cages/pens. Costs are based on a unit of 10 because equipment is often rented on a daily basis and typically at least 10 holes can be augered or 10 artificial burrow systems installed in a day.

Method	Equipment and materials used	Estimated cost (per 10)	
AUGERED HOLES	• 1-day rental of a 2-man, hand-held auger ¹	\$58	
	OR		
	• 1-day rental of a bobcat with an auger bit (including delivery) ¹	\$320	
	TOTAL		\$58–320
ARTIFICIAL BURROW SYSTEMS ²	Small plywood (26,376 cm ³)		
	• 1-day rental of a trencher walk-behind unit (including delivery) ²	\$250	
	• 6-sided plywood nest chamber (including plywood, corner blocks, screws, and glue) ³	\$66	
	• Black Corex plastic tubing (3.1 m length) ³	\$40	
	TOTAL		\$356
Small caisson tube (39,518 cm ³)	• 1-day rental of a trencher walk-behind unit (including delivery) ¹	\$250	
	OR		
	• 1-day rental of a full-sized backhoe (including delivery) ¹	\$360	
	• Caisson nest chamber (including caisson tube, wire, and plywood end caps) ³	\$50	
	• Black Corex plastic tubing (3.1 m length) ³	\$40	
	TOTAL		\$340–450
Large plywood (108,000 cm ³)	• 1-day rental of a mini-excavator (including delivery) ¹	\$310	
	• 5-sided plywood nest chamber (including plywood, corner blocks, 3.5 × 32-mm screws, glue, and cardboard bottom) ³	\$70	
	• Cardboard tube (1.8 m length) ⁴	\$50	
	TOTAL		\$430
ACCLIMATION CAGES/PENS ⁵			
Retention cap	• Includes 0.635-cm hardware cloth (circumference, top, and bottom), zip ties or wire to hold the cap together, and lawn staples to hold the cap securely to the ground ³		
	TOTAL		\$175
Retention pen	• Includes 2.5-cm chicken wire, U-posts, zip ties to hold the sides together and to the U-posts, and lawn staples to hold the pen securely to the ground ³		
	TOTAL		\$740

¹Based on estimates obtained in December 2003 from NationsRent in Boulder, CO. These estimates do not include fuel, tax, or damage waiver.

²None are reusable and are a recurring cost for each relocation.

³Based on estimates obtained in December 2003 at Home Depot in Louisville, CO.

⁴Contact Roe Ecological Services to obtain.

⁵All are reusable and with care should be a 1-time cost.

retention. For all 3 projects, extremely hot and dry conditions at the trap and release sites made the prairie dogs highly susceptible to malnutrition and dehydration. Even though prairie dogs naturally acquire most of their water from forage, we frequently observed prairie dogs drinking from water bottles. Providing relocated prairie dogs with a high level of nutritional supplementation and free water

during post-release may help to ensure prairie dog health. Ample, easily obtained food may allow prairie dogs to spend more time digging new burrows, or modifying artificial burrows, and may improve overwinter survival. These relocation techniques demonstrate increased post-release retention and will likely contribute to long-term success of future prairie dog relocations.

ACKNOWLEDGMENTS

We thank the editors and reviewers for their comments during the review process for this manuscript, which helped us ensure its clarity and quality. We also thank the City of Louisville, Colorado, and the City and County of Broomfield, Colorado, for funding relocation efforts. Finally, we thank Ray Sterner, Kathleen Fagerstone, Gary Witmer, Mark Brennan, and Dave Seery for providing equipment, information, and advice during our early years.

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Received 19 May 2003
Accepted 20 April 2004