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Management and Conservation

Translocation of Gunnison's Prairie Dogs From an Urban and Suburban Colony to Abandoned Wildland Colonies

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ABSTRACT Translocating prairie dogs from areas in or near human developments to wildlands can reduce conflicts with humans or supplement wild populations, but translocation methods differ in cost and fate of translocated individuals is often difficult to assess. We translocated 74 Gunnison's prairie dogs from 1 source colony in downtown Flagstaff, Arizona (urban) and 75 from 1 source colony in lower density housing outside the city (suburban) to 2 abandoned, recipient colonies on open grasslands 50 km north of the city (wildland). We released animals into uncaged, pre-existing burrow entrances (hard release) or into temporary cages over pre-existing burrow entrances (soft release). We captured 15 (10%) marked animals 1 year post-translocation at the 2 recipient colonies, 7 from soft release treatments and 8 from hard release treatments but visual surveys indicated a minimum of 57 adult prairie dogs and 76 pups present. Adult prairie dogs in all photographs taken by automated cameras placed at burrow entrances at each recipient colony had ear tags, suggesting that most animals at these colonies were survivors from translocation and that survival was likely higher than 10%. By 1 year post-release, recipient colonies occupied an area roughly 9–18 times that of source colonies. Urban Gunnison's prairie dogs can be successfully translocated to abandoned wildland colonies without using soft release methods, but animals may disperse widely. Given the cost and effort translocation requires, and the fact that all 6 confirmed mortalities were from human shooting, we recommend temporary restrictions on shooting at recipient colonies until populations have met management goals.

KEY WORDS Arizona, *Cynomys gunnisoni*, Gunnison's prairie dog, survival, translocation, urban.

The geographic range of Gunnison's prairie dog (*Cynomys gunnisoni*) spans high elevation short-grass prairie ecosystems in Arizona, New Mexico, Utah, and Colorado (Hollister 1916, Pizzimenti and Hoffmann 1973, Slobodchikoff et al. 2009). Like the black-tailed prairie dog (*Cynomys ludovicianus*), Gunnison's prairie dogs may be considered a keystone species in short-grass prairie communities (Kotliar et al. 1999, 2006; Kotliar 2000; Underwood 2007; but see Stapp 1998). Gunnison's prairie dog has declined as much as 96% across their range in the last century (U.S. Fish and Wildlife Service [USFWS] 2008) due to historical widespread poisoning campaigns, habitat loss to agriculture and urbanization, target shooting, and bubonic plague (Seglund et al. 2005, Wagner et al. 2006). The USFWS added Gunnison's prairie dog to the candidate list as warranted for protection in the montane portion of its range in Colorado and New Mexico (USFWS 2008) and it is considered a Species of Greatest Conservation Need by the state wildlife agencies in the 4 states that encompass its range (Utah Division of Wildlife Resources 2005, Arizona Game and Fish Department 2006, Colorado Division of Wildlife 2006, New Mexico Department of Game and Fish 2006).

Given the conservation concern for Gunnison's prairie dog, as well as its role as prey for reintroduced populations of the federally endangered black-footed ferret (*Mustela nigripes*) in Arizona (Jachowski et al. 2011), wildlife professionals can use translocation as a means of repopulating wildland colonies that have been extirpated by plague or other factors. Using Gunnison's prairie dogs from areas within or adjoining city limits as source populations for translocations can also offer a non-lethal solution for removal of Gunnison's prairie dogs from areas such as city parks, playgrounds, ball fields, and sites planned for intensive development where they are in conflict with human land uses. Although urbanization likely affects less than 1% of the species' current range (Seglund et al. 2005), conflict with human development can lead to the destruction of urban prairie dog colonies and public controversy. Managers often must choose between lethal removal methods or translocation, with the latter viewed as a more humane and socially acceptable option to the general public in urban areas, at least for black-tailed prairie dogs (Zinn and Andelt 1999).

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Although translocations are an important conservation tool (Griffith et al. 1989), high mortality of translocated animals often results in failure of translocated populations to establish (Fischer and Lindenmayer 2000). Gunnison's prairie dogs have been translocated from urban to wildland areas around Flagstaff, Arizona for several years, but little is known about survival rate, causes of mortality or how successful those actions were in establishing new populations. Most prairie dog translocation literature investigates Utah (*Cynomys parvidens*) and black-tailed prairie dogs (Truett et al. 2001). These studies have documented that survival rates can vary widely and may be influenced by several factors, including translocation group size (Robinette et al. 1995), social relationships (Shier 2006), and whether animals are released into formerly occupied burrow systems or into areas without pre-existing burrow systems (Truett et al. 2001, Long et al. 2006).

We estimated 1-year survival of Gunnison's prairie dogs translocated from colonies in and around Flagstaff, Arizona to wildland colonies that were historically occupied and then presumably extirpated by plague. We tested 2 translocation techniques: soft release into temporary cages over pre-existing burrows supplemented with food and water versus hard release into uncaged, pre-existing burrows also supplemented with food. In addition, we assessed the relative efficacy of using metal ear tags versus subdermal Passive Integrated Transponder (PIT) tags for identifying animals in the field.

STUDY AREA

We captured prairie dogs at 2 source colonies in or near Flagstaff, Arizona, USA. One source colony (urban) was a long, narrow colony in landscaped and irrigated habitat adjacent to the Burlington Northern-Santa Fe Railway and U.S. Route 66 in downtown Flagstaff (elevation 2,094 m). The second source colony (suburban) was in a fenced, 14-ha horse pasture that was bounded by housing developments on 2 sides, approximately 21 km northeast of downtown Flagstaff (elevation 1,894 m). Both source colonies were scheduled to be destroyed, either through poisoning or development.

We selected 2 recipient colonies approximately 50 km north of Flagstaff separated by 6 km (elevation 1,740 m and 1,820 m). These colonies were among those surveyed for prairie dog presence by the Arizona Game and Fish Department in 1994 and 2001 (Wagner et al. 2006) and again in 2007 and had been designated as unoccupied based on lack of visual observation or signs of prairie dogs, including fresh digging or fresh feces. Before releasing prairie dogs at these colonies in 2008, we confirmed lack of occupancy by examining all burrow entrances for signs of digging and feces. One recipient colony was located on Arizona state trust lands and the other on a mix of both state trust and private lands, but both were open to public access. Both recipient colonies had a minimum of 100 burrow entrances that were still open (i.e., had not collapsed) that we deemed suitable as release locations. Major habitat type of both recipient colonies was Great Basin grassland (Brown 1994) with vegetation dominated by grasses (*Bouteloua gracilis*, *Pleuraphis jamesii*, *Achnatherum hymenoides*), forbs (*Sphaeralcea sp*., *Salsola kali*, *Helianthus* sp.), and scattered small shrubs (*Gutierrezia sarothrae*, *Ericameria nauseosus*). Both recipient colonies were grazed by cattle at similar stocking densities.

METHODS

We based our methods on published recommendations (Truett et al. 2001) modified in light of the most economical and commonly used procedures by public-citizens' groups conducting prairie dog translocations in Arizona (T. Bogan-Ozmun, Habitat Harmony, Inc., personal communication). Methods used in this project were approved by the Northern Arizona University Institutional Animal Care and Use Committee (Protocol 08-003). In June 2008, we dusted burrow entrances at source colonies with DeltaDust flea powder (Deltamethrin 0.05%; Bayer Environmental Science, Research Triangle Park, NC) prior to trapping in order to eliminate fleas that might potentially carry and introduce plague. We monitored source colonies for signs of illness or inactivity that might suggest plague was present for 2 weeks after dusting. Simultaneously, we mapped burrow entrances and noted when animals moved from one to another, thereby developing a network of burrows likely used by members of the same social group. Gunnison's prairie dogs live in territorial groups that vary in their social system from single male–single female to multiple male–multiple females (Travis and Slobodchikoff 1993, Slobodchikoff et al. 2009, Verdolin and Slobodchikoff 2009). Their territorial social groups are sometimes referred to as coteries (Rayor 1988) or clans (Fitzgerald and Lechleitner 1974, Hoogland 1999). By noting at which burrow entrance each animal was subsequently captured, we were able to increase the chance that clan members would be released either into the same burrow or to an adjacent burrow during translocation. Between 7 July and 5 August 2008 we trapped prairie dogs using Tomahawk livetraps (Tomahawk, WI) baited with a mixture of corn, oats, barley, and molasses. We moved traps holding captured prairie dogs to shade, covered traps with burlap, sprayed prairie dogs with flea spray (Pyrethrins 0.15%; Jeffers Flea & Tick Mist; Jeffers, Dothan, AL), and provided food and water until processing.

We marked each prairie dog with a uniquely numbered metal ear tag in each ear (Monel Small Animal Ear Tag 1005-1; National Band and Tag Co., Newport, KY) and a unique number painted on each side using hair dye (Revlon® Colorsilk™ black permanent hair color; Revlon, Inc., New York, NY). In addition, in a subset of those captured (those captured on alternating processing days) we inserted a Passive Integrated Transponder (PIT; 134.2 kHz; Biomark, Inc., Boise, ID) subcutaneously on the back of the neck. We sexed, weighed, and aged prairie dogs as adult or juvenile based on body mass. After the prairie dogs were processed and tagged, they were transferred to dog kennels and housed with other prairie dogs that had been captured either at the same burrow entrance or at a burrow entrance that we had linked with another based on observations of prairie dogs moving between them. We provided food and hay bedding during transport to recipient colonies. We released most animals into recipient colonies on the day of capture or the day following capture. However, because we always released female and juvenile animals in groups of at least 2, and we required those animals to have been captured at the same burrow entrance or one behaviorally linked with it, we sometimes held animals for up to 3 days until an appropriate release-mate was available. We dusted abandoned burrow entrances at each recipient colony with DeltaDust flea powder and mapped burrows using a Garmin 60CSx Global Positioning System (GPS) unit prior to reintroduction. Because the area was grazed by cattle, we did not conduct vegetation manipulation or mowing at the recipient colonies. We cleared burrow entrances of vegetation and debris and verified a minimum burrow depth of 1 m.

Approximately half of the prairie dogs at each recipient colony were soft released into acclimation cages temporarily fitted over abandoned burrow entrances (72 of 149 prairie dogs translocated: 37 at recipient site 1 and 35 at recipient site 2) whereas the remaining prairie dogs were hard released directly into abandoned burrow entrances without acclimation cages. At each recipient colony, we released all animals within a treatment (hard vs. soft) into neighboring burrow entrances. We separated hard and soft release treatments from each other by at least 150 m. We constructed acclimation cages (46 cm × 91 cm × 91 cm) of 1.3 cm (0.5 in.) mesh hardwire cloth, with a double layer hardwire cloth bottom covered with grass hay. We staked cages to the ground using 4 pieces of 61 cm rebar woven through each corner. We lined the entrance to the abandoned burrow with a corrugated drainage pipe connected to the opening in the bottom of the acclimation cage (modified from Roe and Roe 2004, Long et al. 2006). We provided supplemental food and water on a daily basis to soft release animals and provided all translocated prairie dogs supplemental food, including fresh produce, for a minimum of 2 weeks post-release. We left acclimation cages in place for 1 week after we translocated the prairie dogs.

During 44 days between 10 June and 25 August 2009, we assessed 1-year survival by deploying 35–86 live traps per day at each site and a baited and camouflaged PIT tag reader (Biomark, Inc.; FS2001FR-ISO reader with racket antenna) near burrow entrances where we observed prairie dogs. We also estimated prairie dog abundance using visual surveys during which 2 independent observers hidden in blinds noted the number of adult and juvenile animals at each location. This observation period was limited to 15 min to reduce likelihood that animals moved from 1 location to another and were thereby double-counted. We repeated surveys 4–6 times per day and surveyed each site 5 times between 1 and 25 August. We used the largest number of animals recorded during any 1 observation period as the estimate of minimum number of animals alive at the site. Between observation periods and during trap deployment, 2 observers independently mapped locations of adults and pups to delineate clan locations. We opportunistically placed 14 motion- and infrared-triggered cameras (Audubon BirdCam; Wingscapes®, Alabaster, AL) at burrow entrances in locations where we had been unable to confirm adults with ear tags either visually, by trapping, or with the PIT tag reader. Although photographs did not allow us to determine individual identification, we could detect whether adult animals at that location had ear tags (translocated animals) or were lacking ear tags (animals that had colonized the site independently). To assess how far translocated prairie dogs spread post-release, we mapped all burrow entrances with recent digging sign at both recipient colonies in August 2009 and estimated colony area.

RESULTS

We expended 9,300 trap-hours (no. traps × hrs open) using 40–200 traps per day to capture 149 prairie dogs (74 from the urban source colony: 40 M and 34 F; and 75 from the suburban source colony: 34 M and 41 F). We tagged all prairie dogs with uniquely numbered ear tags in each ear and inserted PIT tags in 110 (74%, 55 M and 55 F). We released all 74 animals captured at the urban source colony into recipient colony 1 with 37 released into caged burrow entrances (soft release) and 37 released into uncaged burrow entrances (hard release). Likewise, we released all 75 prairie dogs captured at the suburban source colony into recipient colony 2 with 35 of these placed in soft-release burrow entrances and 40 were hard released. The number of prairie dogs released into any 1 burrow entrance varied from 1 in the case of adult males, to as many as 8 in the case of females and juveniles. Because we attempted to release animals that were socially known to each other (based on having been captured at the same entrance burrow or one behaviorally linked with it), we sometimes released animals into the same burrow entrance on different days. For example, an adult female and a juvenile may have been released into the same burrow entrance on day 1 and 2 juveniles into that entrance on day 2, but all 4 animals would have been considered behaviorally linked based on capture location. Overall, we introduced a mean of 4 (±2.4 SD) prairie dogs per burrow entrance.

Re-capture of prairie dogs using live traps and a PIT tag reader was relatively ineffective in spite of using alternate baits, pre-baiting, and using multiple traps per hole. We expended 4,574 trap hours to re-capture 14 tagged survivors in 2009 (317 trap hours/prairie dog) and 85 hours of PIT tag reader deployment identified 4 individuals, 3 of which were also re-trapped. Thus, we were able to confirm survival of 15 individual prairie dogs (10% survival). Of these, 13 were in reproductive condition when re-trapped, exhibiting swollen mammae or black scrotum and descended testes (Hoogland 2003). Nine of the 15 re-captured individuals in 2009 were translocated as juveniles and were subsequently reproductive as yearlings at the recipient colonies. Likewise, an adult translocated female re-trapped several times in the summer of 2009 was confirmed tending 4 pups. Of the 14 trap re-captures with ear tags, 1 prairie dog had lost 1 ear tag. Ten of the re-captured individuals were originally marked with PIT tags and all retained working tags. Additionally, 20 pups were trapped in the recipient colonies in 2009. Based on equipment costs for each re-identification method, the PIT tag reader was the most expensive method per prairie dog detected and resulted in the least number of individual detections (Table 1). However, labor costs greatly increased the costs of re-trapping efforts and observations (Table 1).

The number of animals individually identified via trapping and PIT tag reader recordings was far less than the number present at each recipient colony. Based on our repeated, time-limited observations during August, the minimum number of adult prairie dogs present (visible above ground within a 15-min time period) was 57 across both sites with an additional minimum of 39 pups at recipient colony 1 and 37 pups at recipient colony 2. We obtained 2,681 photographs of prairie dogs at burrow entrances and in 678 (25%) we could see ears clearly enough to determine whether ear tags were present. In all cases, adults had ear tags, indicating that they had been translocated. Given that many of these photographs were taken in locations where we had not successfully re-trapped prairie dogs (Fig. 1), this suggested our estimates of survival were conservative. Nor did we document any untagged adult prairie dogs at either recipient colony by trapping or in photographs. If the minimum number of 57 adults estimated based on visual surveys were in fact ear-tagged, post-translocation survival could have been as high as 38%.

Although few animals could be individually identified because of low trap success, the number of individuals surviving in hard and soft release treatments was similar. At recipient colony 1, of 8 identified individuals, 4 were from the soft-release and 4 were from the hard-release groups. Likewise, at recipient colony 2, of 7 re-captures, 3 were from the soft-release and 4 were from the hard-release treatments. We observed soft-released prairie dogs burrow out of acclimation cages within 24 hours after release. Although we left the cages in place for 1 week with supplemental food and water, we saw no evidence that prairie dogs used them after they dug out.

Translocated Gunnison's prairie dogs spread widely to occupy areas much larger than the area of the urban and suburban source colonies (Fig. 2). By mid-August of 2009, the number of burrow entrances increased 1.5 times from 338 abandoned burrow entrances (most partially or totally collapsed pre-release) to 545 at recipient colony 1 and 6-fold from 112 abandoned burrow entrances to 712 at recipient colony 2. Prairie dogs captured at the urban source colony originally occupied an area of 2.3 ha. Because not all of the prairie dogs living in that colony were translocated, the minimum density was 32 prairie dogs/ha based on the 74 prairie dogs translocated. By August 2009, these prairie dogs spread into an area of 41 ha, approximately 18 times that of their source colony, with density of 2 prairie dogs/ha. Likewise, the suburban source colony occupied an area of 4.1 ha with a minimum density of 18 prairie dogs/ha and spread into an area of 38 ha at recipient colony 2, a 9-fold increase in area with density of 2 prairie dogs/ha.

Based on 307 hours of observation, we documented both avian and terrestrial predators at both recipient colonies, including red-tailed hawk (*Buteo jamaicensis*, 10 times), northern harrier (*Circus cyaneus*, 9), golden eagle (*Aquila chrysaetos*, 2), Swainson's hawk (*Buteo swainsoni*, 1), and coyote (*Canis latrans*, 2), but observed no predation events. We also observed hunters, prairie dog target shooters, off-road vehicle tracks, and spent bullet casings at both recipient colonies. We located 6 dead prairie dogs (1 tagged adult and 5 pups); all were shot.

DISCUSSION

We considered both recipient colonies to be successful 1 year after release. A minimum of 10% of translocated animals survived and most of them were in reproductive condition, with some documented interacting with 4 or more pups. Moist weather in the spring of 2009 may have contributed to the reproductive success we documented, and success may be lower in drier years (Brown and Ernest 2002). Translocations are ultimately considered successful only if populations are self-sustaining over time (Griffith et al. 1989) and the reproduction documented in the first year after translocation at our sites indicated potential for population maintenance. Informal visits to the recipient colonies in 2010 confirmed that a minimum of 30 individuals were present at each colony 2 years after translocation.

Low trap success hampered our efforts to assess survival and prairie dogs' reluctance to enter traps may have been due to the previous trap experience during translocation, or to

Table 1. Effort and equipment cost comparison of 4 re-identification methods used to detect translocated Gunnison's prairie dogs based on a study near Flagstaff, Arizona, 2009.

	Re-trapping	PIT tag reader	Re-sighting ear tags	Remote camera
Estimated costs (without labor)	$7,000[a]	$3,700[b]	$1,500[c]	$3,150[d]
Total hours deployed	4,574	85	260	3,442
Total hours effort/person	173	17	100	34
Total no. of tag detections	14	4	10	13
Hours deployed/prairie dog	327	21	26	265
Hours effort/prairie dog	12.4	4.1	9.9	2.6
Equipment cost/prairie dog (without labor)	$500[e]	$925	$150[e]	$242

[a] $35/trap × 200 traps.
[b] $3,000 reader + $700 for 110 PIT tags.
[c] $500 binoculars × 2 + $250 spotting scopes × 2.
[d] $200/camera + $25/memory card × 14 cameras.
[e] These equipment costs would be negligible if traps, binoculars, and spotting scopes were already in hand.

Figure 1. Photograph from a remote a camera placed at a burrow entrance of a translocated Gunnison's prairie dog in July 2009 1 year after release into grassland north of Flagstaff, Arizona, USA. Note the visible ear tag and obvious signs of reproductive condition.

increased wariness due to negative interactions with human shooters at recipient colonies. Long et al. (2006) noted that black-tailed prairie dogs living in colonies that recently experienced shooting or harassment were more difficult to live trap. In contrast, we expected a PIT tag reader placed at the burrow entrance to be effective at passively reading tags as the prairie dogs repeatedly passed through a relatively narrow burrow entrance. Despite our efforts to partially bury the PIT tag reader and allow the prairie dogs to become accustomed to its presence, only 4 prairie dogs ever came close enough for their PIT tags to be detected. Prairie dogs would use different burrow entrances to avoid the PIT tag reader when placed at a frequently used entrance and some barked in the direction of the reader, apparently expressing discomfort at the object's presence. Photographs from infrared-triggered cameras were effective for verifying the presence of ear tags on individuals that were too shy to approach the traps and PIT tag reader although we could not read individual ear tag numbers. Marking prairie dogs with PIT tags alone would have prohibited this type of visual confirmation of tagged animals. In addition to the presence of ear tags, photographs allowed us to often identify sex and confirm interactions of translocated adults with pups. Remote cameras could be more useful in identifying individuals if used in conjunction with color-coded metal ear tags.

The survival of translocated prairie dogs after 1 year in our study was minimally 10%, and may have been as high as 38%, within the range (0–40%) typically reported for translocations of other prairie dog species (Truett et al. 2001). Higher translocation estimates published elsewhere were based on short-term survival over the first few weeks or months after release (Davidson et al. 1999, Bly-Honness et al. 2004, Roe and Roe 2004). Annual survival estimates for wild populations of Gunnison's prairie dogs typically range from 17–35% for juveniles and from 30–50% for adults (Rayor 1985, Cully 1997, Hoogland 2001). We followed several procedures for translocating prairie dogs that were recommended for increased survival. We released animals with others trapped at the same burrow entrance or nearby burrow entrances at the capture sites (Shier 2006). We also released a minimum group of 60 prairie dogs at each recipient colony (Robinette et al. 1995). Additionally, we took precautions against plague and provided supplemental food to all the translocated prairie dogs after release (Truett et al. 2001, Long et al. 2006).

Dispersal away from recipient colonies, social and environmental disorientation, and predation are the primary causes for reduction in numbers of prairie dogs after translocation (Truett et al. 2001). These factors may be of greater concern for prairie dogs from urban and suburban source colonies because they may be unfamiliar with predators or food sources at wildland recipient colonies. Acclimation cages are frequently recommended to reduce both dispersal and predation after release (Lewis et al. 1979, Coffeen and Pederson 1989, Truett et al. 2001, Roe and Roe 2004). Prairie dogs in our study rapidly dug out of acclimation cages, as has been reported in other translocation studies (Player and Urness 1982, Truett and Savage 1998). Given the time and expense required to construct acclimation cages we feel soft release is not necessary for translocation of Gunnison's prairie dogs into pre-existing burrows, consistent with similar recommendations for black-tailed prairie dogs (Long et al. 2006).

A variety of potential animal predators were observed at both recipient colonies, but no predation events were observed. Hunters and prairie dog target shooters located the newly translocated colonies within the first 2 months after release. We found carcasses of 6 prairie dogs shot by humans but anecdotal information gained through discussions with the hunters and shooters we interviewed at recipient colonies indicated many more prairie dogs had been shot at our sites than we documented. Both the dirt roads that ran through our recipient colonies, facilitating human access, and the potential for urban prairie dogs to be less wary of humans and vehicles may have contributed to mortality.

Prairie dogs quickly increased the number of burrow entrances and expanded the colony size at both recipient colonies. Translocated black-tailed prairie dog colonies also gradually increased in size (Dullum et al. 2005) but the rate documented for those colonies would have required 4 years or more to approach the magnitude of colony growth we documented in 1 year. Spread of prairie dogs away from release burrow entrances after translocation could bias survival estimates after translocation, especially if infrequent site visits limit the observers' ability to detect movement away from release burrows.

MANAGEMENT IMPLICATIONS

Translocation of Gunnison's prairie dogs from urban and suburban source colonies can be an effective alternative management technique for removing prairie dogs in conflict

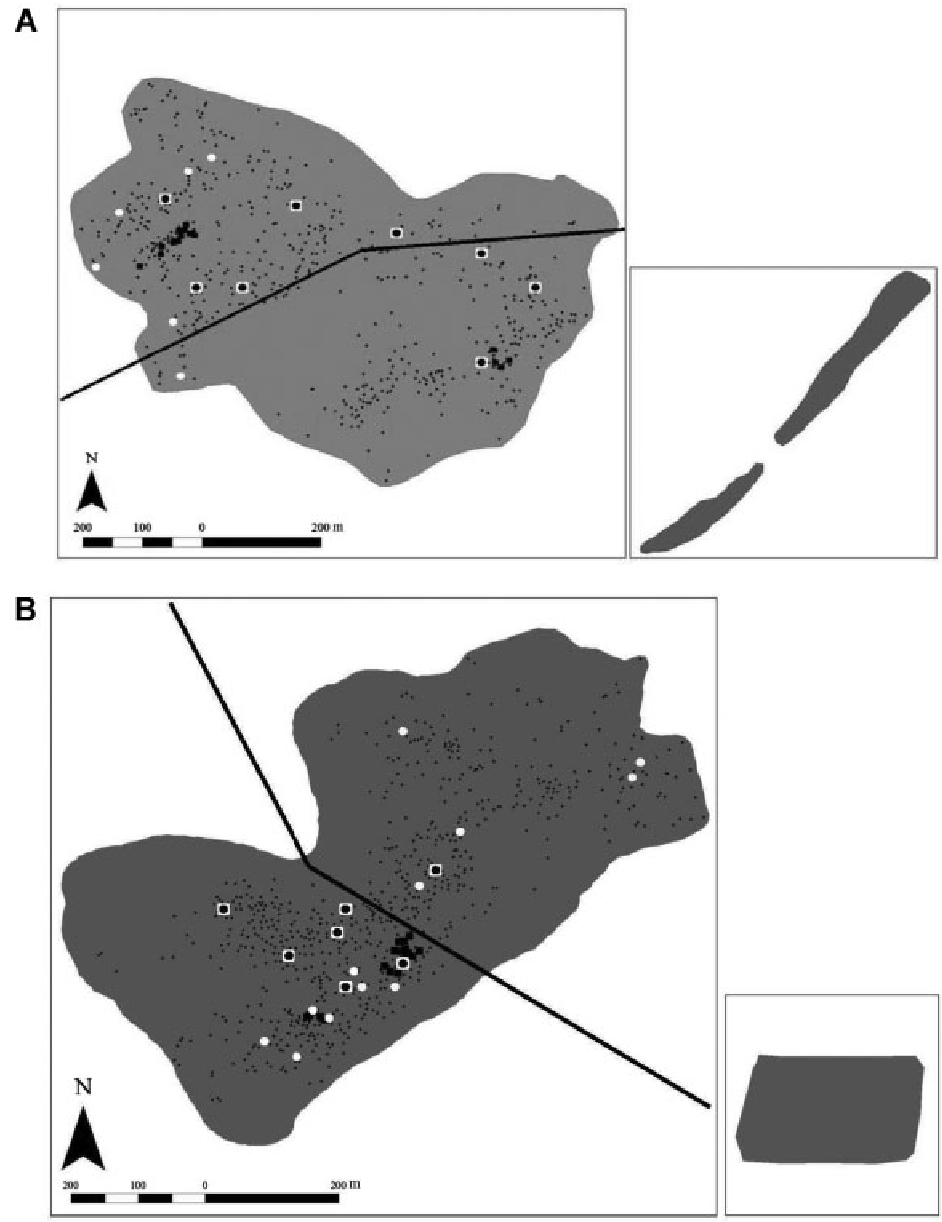

Figure 2. Location of 16 burrow entrances at which translocated Gunnison's prairie dogs were released in 2008 (black squares) and subsequent 545 burrow entrances mapped in 2009 (black circles) at recipient colony 1 north of Flagstaff, Arizona, USA (A) and the 20 burrows at which translocated prairie dogs were released in 2008 (black squares) and subsequent 712 active burrows mapped in 2009 (black circles) at recipient colony 2 (B). Shaded area represents the extent of observed prairie dog activity at each recipient colony relative to the area in which prairie dogs were initially trapped (inset) drawn to the same scale. Locations of individuals identified using re-trapping and/or PIT tag reader are indicated by white squares with black dots, locations where adults with ear tags were confirmed based on visual observation or photographs are indicated by white circles. Black lines indicate public access dirt roads.

with humans and re-establishing animals where colonies have been abandoned in wildland areas. Our results indicate that translocations may be successful without soft-release efforts when animals are released into areas that prairie dogs occupied previously that retain some pre-existing burrows. Estimating translocation success based on re-trapping of translocated animals may not be possible, so marking animals with ear tags and confirming survival visually or with automatic cameras should be considered as an alternative or supplemental approach. Translocation requires substantial investment in time and money; therefore, shooting restrictions or closures for newly translocated colonies are recommended at least until translocated populations have met management goals.

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